PO Box 13960, Armagh Street
ANZ Centre 267 High Street, Christchurch 8141, New Zealand
T: +64 3 366 3521 // **F:** +64 3 366 3188
E: info@beca.com // **www.beca.com**

Otago Regional Council
70 Stafford Street
Private Bag 1954
Dunedin 9054

5 April 2019

Attention: Peter Christophers – Principal Consents Officer

Dear Peter

Resource consent application for Queenstown Lakes District Wastewater Network Consent

Please find enclosed an application for resource consent made on behalf of Queenstown Lakes District Council (QLDC). The application relates to the discharge of wastewater overflows from the QLDC network to freshwater receiving environments, or onto land in circumstances where it may enter fresh water.

Under the Otago Regional Plan: Water the proposal is a Discretionary activity pursuant to the following rules:

- 12.A Discharge of human sewage – 12.A.2.1;
- 12.B Discharge of hazardous wastes – 12.B.4.2; and
- 12.C Other discharges – 12.C.3.2

Notification

Pursuant to Section 95A(3)(a) of the Resource Management Act 1991 the applicant, Queenstown Lakes District Council, requests that the application be publicly notified.

Yours sincerely,

Alisha Robinson
Senior Planner

on behalf of

Beca Limited

Direct Dial: 03 968 4377
Email: alisha.robinson@beca.com

1 Resource Consent Application

Otago Regional Council

This application is made under Section 88 of the Resource Management Act 1991.

(For Office Use Only)
Deposit Paid: $

Charges / Deposits

A deposit **must** accompany the application (see page **8** for amounts). The applicant will be invoiced for all costs incurred in processing this application that exceed the deposit.

Council can accept electronic lodgement of applications if sent to public.enquiries@orc.govt.nz. Include "consent application" in the subject line.

Please complete the application in pen. For questions marked with an * you will find notes on page 4

1.* Applicant(s) Details

Applicant(s) name(s) in full: Queenstown Lakes District Council

OR Company Name (in full) _____

OR Names of Trustees (in full) if Applicant is a Trust _____

or Name of Incorporation _____

Postal Address: Queenstown Lakes District Council
Private Bag 50072
Queenstown Post Code 9348

Street Address (not a P O box number): 74 Shotover Street
Queenstown Post Code 9300

Phone Number: Business 03 441 0499 Private _____
Mobile _____ Fax _____

Email Address: mark.baker@qldc.govt.nz.

(Please provide a valid and clear email address. The Council's default contact method for correspondence is via electronic means)

If you do not prefer contact by electronic means, please tick ☐

1(a). Key Contact for Applicant Details

If the applicant consists of multiple parties (e.g. multiple consent holders, Trust etc) please outline who the key contact for the consent will be, if granted.

Key contact name(s) in full: Mark Baker

Postal Address: as. above. Post Code _____

Street Address _____
(not a P O box number) _____
_____ Post Code _____

Phone Number Business _____ Private _____
Mobile _____ Fax _____

Email Address Mark.Baker@qldc.govt.nz

(Please provide a valid and clear email address. The Council's default contact method for correspondence is via electronic means)

If you do not prefer contact by electronic means, please tick ☐

2.* Consultant/Contact Details (if not applicant)

Name of Consultant/ Contact Person: Beca Ltd. - Alisha Robinson

Postal Address PO Box 13960 Armagh Street
Christchurch
_____ Post Code 8011

Phone Number Business 03 968 4377 Private _____
Mobile _____ Fax _____

Email Address alisha.Robinson@beca.com

(Please provide a valid and clear email address. The Council's default contact method for correspondence is via electronic means)

If you do not prefer contact by electronic means, please tick ☐

3. On Site Supervisor/Manager Contact Details (if applicable)

Name of On Site Supervisor/Manager Person:

Postal Address _____
_____
_____ Post Code _____

Phone Number Business _____ Private _____
Mobile _____ Fax _____

Email Address _____

(Please provide a valid and clear email address. The Council's default contact method for correspondence is via electronic means)

If you do not prefer contact by electronic means, please tick ☐

4.* a) Are there any current or expired resource consents relating to this proposal?

☐ Yes ☑ No

If yes, give Consent Number(s) and Description: _____
_____
_____

✳ **b) Do you agree to your current consent automatically being surrendered should a replacement consent be issued.**

☐ Yes ☐ No

c) Has there been a previous application for this activity that was returned as incomplete?

☐ Yes ☑ No

If yes, give Consent Number(s) and Description: _____

_____

_____

d) Have you a pre-application lodged with Council for this activity?

☑ Yes ☐ No

If yes, give pre-application Number(s) and Description: Attendence at project meeting by peter christophers.

_____

e) Have you spoken to a Council staff member about this application prior to lodging this application?

☑ Yes ☐ No If yes, please state name of staff member Peter christophers.

5. The applicant is (tick one): ☐ owner ☐ leasee ☐ prospective purchaser **of the land on which the activity occurs.**

6*. Who is the owner of the land on which the activity occurs/is to occur? (only complete if applicant is not the landowner)

Name of landowner: _____

Postal Address _____

_____

_____ Post Code _____

Phone Number Business _____ Private _____

Mobile _____ Fax _____

Email Address _____

7*. Who is the occupier of the land on which the activity occurs/is to occur? (only complete if the applicant is not the land occupier)

Name of land occupier _____

Postal Address _____

_____

_____ Post Code _____

Phone Number Business _____ Private _____

Mobile _____ Fax _____

Email Address _____

8*. Who leases the land on which the activity occurs/is to occur? (only complete if land is leased and it is not leased to the applicant)

Name of land leasee _____

Postal Address _____

_____

_____ Post Code _____

Phone Number Business _____ Private _____

Mobile _____ Fax _____

Email Address _____

9. Tick the consents required in relation to this proposal:

Water

☐ Take Surface Water ☐ Divert

☐ Take Groundwater ☐ Dam

Discharge onto or into:

☐ Land ☑ Water ☐ Air

Land Use:

☐ Bore construction ☐ Bore alteration

☐ Activities in or on beds of lakes or rivers or floodbanks

☐ Disturbance of contaminated land

Coastal: ☐ Activities in the coastal marine area (i.e., below mean high water spring tide)?

Where you have indicated the type of consent that is required, you must complete the appropriate Application Form before your application can be processed. Application Forms can be found on the Council's website: www.orc.govt.nz.

10. What is the maximum term of consent you are seeking? 35 years

11.Territorial Local Authority in which activity is situated?

☐ Dunedin City Council ☑ Queenstown Lakes District Council

☐ Clutha District Council ☐ Waitaki District Council

☐ Central Otago District Council

12*. Do you require any other resource consent from any local authority for this activity?

☐ Yes ☑ No

If Yes, please list: _____

Have these consents been applied for/issued? ☐ Yes ☐ No If Yes

If Yes, please give the date applied for or issued: _____

Notes on Application Form Details

1. **Applicant(s) Details**

A resource consent can only be held by a legal organisation or fully named individual(s). A legal organisation includes a limited company, incorporated group or registered trust. If the application is for a trust the full names of all trustees are required. If the application is not for a limited company, incorporated group or trust, then you must use fully named individual(s).

2. **Consultant/Contact Details**

If you are using a consultant/agent for this application put their details here. If you are not, leave question 2 blank.

4 **Previous Consent**

Do you currently have a resource consent to do the activity that you are applying to renew with this application? If so, please enter the permit number if known and a brief description including the date of issue and the expiry date.

6-8 **Landowner, occupier and leasee**

If you are not the landowner, land occupier or leasee of the land where the activity will be undertaken, you may be required to obtain their unconditional written approval to your application. On pg 6 there is a form that can be used.

12. **Additional Consents**

If you are carrying out earthworks or building work you may need other consents from either the ORC or your Territorial Local Authority.

Declaration

Before signing the declaration below, in order to provide a complete application have you remembered to:

Fully completed this Form 1 and the necessary Application Forms ☑

Attached the required deposit.(or pay on line) (see page 8 for deposit that is payable) ☑
Cheques payable to Otago Regional Council $5,000.00.

Please note: your deposit may not cover the entire cost of processing your application. At the end of the application process you will be invoiced for any costs that exceed the deposit. Interim invoices may be sent out for applications, where appropriate.
If the required deposit does not accompany your application, staff will contact you on the phone number provided on this form to request payment, and after 3 working days your application will returned if no payment is made for the required deposit.

I/we hereby certify that to the best of my/our knowledge and belief, the information given in this application is true and correct.

I/we undertake to pay all actual and reasonable application processing costs incurred by the Otago Regional Council.

* Name/s PETER JONATHAN HANSBY
(BLOCK CAPITALS)

Signature/s _____
(or person authorised to sign on behalf of applicant)

Designation GM PROPERTY & INFRASTRUCTURE Date 1/4/2019
(e.g., owner, manager, consultant)

Otago Regional Council Postal Address: 70 Stafford St, Private Bag 1954, Dunedin 9054

Consultation

– (consultation is not compulsory, but it can make a process easier and reduce costs).

Under Section 95E of the Resource Management Act 1991 (the Act) the Council will identify affected parties to an application and if the application is to be processed on a non-notified basis the unconditional written approval of affected parties will be required. Consultation with potentially affected parties and interested parties can be commenced prior to lodging the application.

Consultation may be required with the appropriate Tangata Whenua for the area. The address of the local Iwi office is: Aukaha, 258 Stuart Street, P O Box 446, Dunedin, Fax (03)477-0072, Phone (03) 477-0071, email: info@aukaha.co.nz. If you require further advice please contact the Otago Regional Council.

Good consultation practices include:

- Giving people sufficient information to understand your proposal and the likely effects it may have on them
- Allowing sufficient time for them to assess and respond to the information
- Considering and taking into account their responses

Written approval forms are appended to this form on Page 9.

Information Requirements

In order for any consent application to be processed efficiently in the minimum time and at minimum cost, it is critical that as much relevant information as possible is included with the application. **Where an application is significantly incomplete, the Consent Authority may decide not to accept the application for processing.**

Resource Management Act 1991
FOURTH SCHEDULE—ASSESSMENT OF EFFECTS ON THE ENVIRONMENT

(Below are the provisions of the 4th schedule of the Act, which describes what must be in an application for resource consent, as amended in 2015.)

1 Information must be specified in sufficient detail

Any information required by this schedule, including an assessment under clause 2(1)(f) or (g), must be specified in sufficient detail to satisfy the purpose for which it is required.

2 Information required in all applications

(1) An application for a resource consent for an activity (the **activity**) must include the following:
- (a) a description of the activity:
- (b) a description of the site at which the activity is to occur:
- (c) the full name and address of each owner or occupier of the site:
- (d) a description of any other activities that are part of the proposal to which the application relates:
- (e) a description of any other resource consents required for the proposal to which the application relates:
- (f) an assessment of the activity against the matters set out in Part 2:
- (g) an assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b). *("document" includes regional & district plans, regulations, national policy statements, iwi plans)*

(2) The assessment under subclause (1)(g) must include an assessment of the activity against—
- (a) any relevant objectives, policies, or rules in a document; and
- (b) any relevant requirements, conditions, or permissions in any rules in a document; and
- (c) any other relevant requirements in a document (for example, in a national environmental standard or other regulations).

(3) An application must also include an assessment of the activity's effects on the environment that—
- (a) includes the information required by clause 6; and
- (b) addresses the matters specified in clause 7; and
- (c) includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

3 Additional information required in some applications

An application must also include any of the following that apply:

(a) if any permitted activity is part of the proposal to which the application relates, a description of the permitted activity that demonstrates that it complies with the requirements, conditions, and permissions for the permitted activity (so that a resource consent is not required for that activity under section 87A(1)):
(b) if the application is affected by section 124 or 165ZH(1)(c) (which relate to existing resource consents), an assessment of the value of the investment of the existing consent holder (for the purposes of section 104(2A)):"(c) if the activity is to occur in an area within the scope of a planning document prepared by a customary marine title group under section 85 of the Marine and Coastal Area (Takutai Moana) Act 2011, an assessment of the activity against any resource management matters set out in that planning document (for the purposes of section 104(2B)

4 (relates to subdivisions- *not included here as subdivisions not ORC jurisdiction.)*

5 Additional information required in application for reclamation

An application for a resource consent for reclamation must also include information to show the area to be reclaimed, including the following:

(a) the location of the area:
(b) if practicable, the position of all new boundaries:
(c) any part of the area to be set aside as an esplanade reserve or esplanade strip.

Assessment of environmental effects

6 Information required in assessment of environmental effects

(1) An assessment of the activity's effects on the environment must include the following information:
(a) if it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:
(b) an assessment of the actual or potential effect on the environment of the activity:
(c) if the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use:
(d) if the activity includes the discharge of any contaminant, a description of—
(i) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
(ii) any possible alternative methods of discharge, including discharge into any other receiving environment:
(e) a description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect:
(f) identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted:
(g) if the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved:
(h) if the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).
(2) A requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan.
(3) To avoid doubt, subclause (1)(f) obliges an applicant to report as to the persons identified as being affected by the proposal, but does not—
(a) oblige the applicant to consult any person; or
(b) create any ground for expecting that the applicant will consult any person.

7 Matters that must be addressed by assessment of environmental effects

(1) An assessment of the activity's effects on the environment must address the following matters:
(a) any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects:
(b) any physical effect on the locality, including any landscape and visual effects:
(c) any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:
(d) any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations:
(e) any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants:
(f) any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.
(2) The requirement to address a matter in the assessment of environmental effects is subject to the provisions of any policy statement or plan.

Set out below are details of the amounts payable for those activities to be funded by fees and charges, as authorised by s36(1) of the Resource Management Act 1991.

Resource Consent Application Fees (from 1 July 2018)

Note that the fees shown below are a **deposit** to be paid on lodgement of a consent application and applications for exemptions in respect of water metering devices. This deposit will not usually cover the full cost of processing the application, and further costs are incurred at the rate shown in the scale of charges. GST is included in all fees and charges.

If you wish to make a payment via internet banking, or on line, the details are below. Please note the applicants name and "consent application" should be used as reference when paying the deposit -

BNZ George Street, Dunedin - 02 0900 0532547 00. For on line go to ORC.govt. nz and follow prompts

Publicly Notified Applications: [3]	$
First application	5,000.00
Concurrent applications	225.00

Non Notified Applications and Limited Notified Applications: [3]	$
First application (except those below)	1,000.00
Concurrent applications [1]	50.00
Variation to conditions – s127	1,000.00
Administrative variation – s127	500.00
Exemptions from water measuring Regulations	200.00
Bores	500.00
Gravel	500.00

Hearings	
Payment for Commissioner request – s100A	Per Note 2 below Per Note 4 below
Objections	
Payment for Commissioner request – s357AB	Per Note 4 below

Transfers and Certificates Deposits:	$
Transfer of permits and consents	100.00
Priority Table	100.00
Section 417 Certificate	200.00
Certificate of Compliance	200.00
Section 125 – Extension of lapse date	100.00
All Other Costs	As per Scale of Charges

Scale of Charges:	**From 1 July 2018** $
Staff time per hour:	
* Executive staff	235.00
* Senior Technical/Scientist	170.00
* Technical/Scientist	125.00
* Field Staff	100.00
* Administration	85.00
Disbursements	Actual
Additional site notice	Actual
Advertisements	Actual
Vehicle use per kilometre	0.70
Travel and accommodation	Actual
Testing charges	Actual
Consultants	Actual
Commissioners	Actual
Photocopying and printing	Actual
Councillor hearing fees per hour	
*Chairperson	100
*Member	80
*Expenses	Actual

Notes

1. For additional permits in respect of the same site, activity, applicant, time of application, and closely related effect as the first application.

2. The deposit payable shall be 90% of the cost of a hearing as calculated by Council in accordance with information contained in the application file and using the scale of charges. The amount payable will be due at least 10 working days before the commencement of the hearing. If the amount is not paid by the due date, then the Otago Regional Council reserves the right under S36 (7) of the Resource Management Act to stop processing the application. This may include cancellation of the hearing.

Should a hearing be cancelled or postponed due to the non payment of the charge, the applicant will be invoiced for any costs that arise from that cancellation or postponement.

Following completion of the hearing process, any shortfall in the recovery of hearing costs will be invoiced, or any over recovery will be refunded to the applicant.

Under Section 100A of the RMA, one or more submitters may make a request to have a resource consent application heard by one or more hearing commissioners who are not members of Council. In this case the applicant will pay the amount that Council estimates it would cost for the application to be heard had the request not been made, and the submitter(s) who made the request will pay, in equal shares, the cost of the application being heard that exceeds that amount payable by the applicant.

Further, the applicant may request to have a resource consent application heard by one or more hearing commissioners who are not members of Council. In this case, the applicant will pay the full costs.

3. Where actual and reasonable costs are less than the deposit paid, a refund will be given.

4. Where an applicant requests under s100A (for a consent hearing) or under s357AB (for the hearing of an objection) an independent commissioner(s); the applicant will be required to pay any increase in cost of having the commissioner(s).

Where a submitter(s) requests under s100A an independent commissioner(s) any increase in costs that is in addition to what the applicant would have paid shall be paid by the submitter. If there is more than one submitter who has made such request the costs shall be evenly shared.

Administrative Charges
The following one-off administration charges shall apply to all resource consent applications received:

Publicly Notified and Limited Notified Applications	**$**
First application	100.00
Concurrent applications	50.00
Non-Notified Applications	**$**
First application	50.00
Concurrent applications	25.00
Other	**$**
Certificate of Compliance	25.00
Section 417 Certificate	25.00
Exemptions from water metering regulations	25.00

Review of Consent Conditions
Following the granting of a consent, a subsequent review of consent conditions may be carried out at either request of the consent holder, or, as authorised under Section 128, as a requirement of Council. Costs incurred in undertaking such reviews will be payable by the consent holder at the rates shown in the Scale of Charges above.

Reviews initiated by Council will not be charged to consent holders.

Compliance Monitoring Charges (from 1 July 2017)

1. Performance Monitoring
The following charges will apply to the review of performance monitoring reports for all consent holders, except those listed in section 1.6 below. The charges shown are annual fixed fees per performance monitoring report or plan, and are inclusive of GST.

		From 1 July 2017
1.1 Discharge to Air Consent		*$*
Measurement of contaminants from a Stack report		86.00
Ambient air quality measurement of contaminants report		100.00
Management plans and maintenance records		33.50
Annual Assessment report		66.50
1.2 Discharge to Water, Land and Coast		*$*
• Effluent Systems	Environmental Quality report	46.50
	Installation producer statements	60.00
	Return of flow/discharge records	60.00
• Active Landfills	Environmental Quality report	58.00
	Management Plans	130.00
• Industrial Discharges	Effluent quality report	42.00
	Environmental report	92.50
	Return of flow/discharge records	60.00
Annual Assessment report		50.00
Management Plans – minor environmental effects		130.00
Management Plans – major environmental effects		260.00

Maintenance records	30.00

1.3 Water Takes

Verification reports	60.00
Annual assessment report	50.00
Manual return of data per take	80.00
Datalogger return of data per take sent to the ORC	50.00
Telemetry data per consent	35.00
Administration fee – water regulations	100.00
Low flow monitoring charge*	
- Kakanui at McCones	327.00
- Unnamed Stream at Gemmels	1,431.00

*Charge for monitoring sites established by the ORC specifically to monitor consented activities in relation to river flows.

1.4 Structures

Inspection reports for small dams	130.00
Inspection reports for large dams	260.00
Structure integrity reports	80.00

1.5 Photographs

Provision of photos	60.00

1.6 Set Fees for Specific Consent Holders

Performance monitoring fees will be charges as 75% of actual costs for the following consent holders

Dunedin City Council
Central Otago District Council
Clutha District Council
Queenstown Lakes District Council
Waitaki District Council
Ravensdown
Contact Energy
Trustpower
Pioneer Generation

Additional charges may be incurred for new consents granted during the year.

2. Audit

Audit work will be charged at half of the actual cost incurred, with the actual costs being calculated using the Scale of Charges.

3. Non-Compliance, Incidents and Complaints

Enforcement work on consent conditions, and remedying negative effects from permitted activities – Scale of Charges.

Gravel Inspection and Management

Gravel extraction fee – $0.66 per cubic metre (incl. GST). Where more than 10,000 cubic metres of gravel is extracted within a prior notified continuous two month period, the actual inspection and management costs will be charged, as approved by the Director Corporate Services.

Written Approvals of Persons Likely to be Adversely Affected

I/We (Please print full name/s)_____ _____

of (Address) _____

I /we have read the full application for the proposal by (Applicant)

_____

for a Resource Consent (Number) _____ to _____

_____

and give my/our written approval to the proposed activity/activities.

In signing this written approval I/we understand that:

- The consent authority must decide that I/we am/are no longer an affected person, and disregard adverse effects on me/us
- That /we I may withdraw my/our written approval in writing before the hearing, or if no hearing before a decision is made on the application.

Signature/s_____ Date _____
(or person authorised to sign on behalf of affected party/parties)

Phone _____ Fax _____ Email _____

Please note: If this application is subsequently notified the above approval does not constitute a submission as required under Section 96 of the Resource Management Act 1991.

Written Approvals of Persons Likely to be Adversely Affected

I/We (Please print full name/s)_____ _____

of (Address) _____

I /we have read the full application for the proposal by (Applicant)

_____

for a Resource Consent (Number) _____ to _____

_____

and give my/our written approval to the proposed activity/activities.

In signing this written approval I/we understand that:

- The consent authority must decide that I/we am/are no longer an affected person, and disregard adverse effects on me/us
- That /we I may withdraw my/our written approval in writing before the hearing, or if no hearing before a decision is made on the application.

Signature/s_____ Date _____
(or person authorised to sign on behalf of affected party/parties)

Phone _____ Fax _____ Email _____

Please note: If this application is subsequently notified the above approval does not constitute a submission as required under Section 96 of the Resource Management Act 1991.

7 Application To Discharge Water or Contaminants to Water

Otago Regional Council

(For Office Use Only)
Consent No.: _____

This application form should be used for all discharges to water, e.g. to rivers, lakes, ocean, harbours, etc.

Show the location of the discharge on your map on Form 1. Include design plans and details with this application.

Part A: General

1. What is the discharge: Water ☐ or contaminant ☑

   (A contaminant is any substance or water which is likely to change the natural state of the water into which it is discharged in any way.)

2. What is the source of the water or contaminant (eg. Sewage treatment, industry, sewage pumping station, water treatment, rural activity)?

   Sewage.

3. Describe the contaminant: Wastewater / sewage from public system.

   including, where appropriate:
   Temperature: _____ °C pH: _____ Suspended solids: _____ g/m^3
   BOD_5: _____ g/m^3 Faecal coliforms: _____ cfu/100mls

   The chemical content, including heavy metals or toxic substances, nitrates, ammonia and dissolved reactive phosphorous and their toxicity to the receiving water / environment.

4. Is the contaminant treated in any way before being discharged? Yes ☐ No ☑

   If yes, describe treatment _____

5. What is the name of the water body into which the discharge is made (e.g. name of river, lake, bay, harbour, ocean, etc) and what is the map reference in NZTM 2000 at the discharge point?

   Fresh water bodies in QLDC district refer to application.

   NZTM 2000: E_____ N_____

Part A: General (contd.)

6. **Discharge Rate Information:**

Maximum flow rate: _____ litres per second

Maximum flow: _____ cubic metres per day

or _____ cubic metres per week

For sewage discharges:

Average dry weather flow: _____ litres per second

Peak flow: _____ litres per second

Daily peak flow: _____ cubic metres per day

Peak wet weather flow: _____ litres per second

Is the discharge: continuous ☐ or intermittent ☑

What will be the maximum discharging period? _____ hours per day

_____ days per week

_____ weeks per month

_____ months per year

* 7. Does the discharge also involve:

Outlet structure?	Yes ☐	No ☑
Diversion?	Yes ☐	No ☑
Discharge to air?	Yes ☐	No ☑

If you answered "Yes" to any of 7. above, another schedule to this consent application may be required.

Part B: Assessment of Effects on the Environment

1. Comment on the possible effects the discharge may have on the quality of the receiving water and any downstream users:

Refer to A.E.E application document & supporting Appendices.

2. In the vicinity of the discharge or within a reasonable distance downstream are there any:

		Yes	No	Not Known
(i)	Obvious signs of fish, eels, insect life, aquatic plants, etc?	☑	☐	☐
(ii)	Wetlands (e.g., swamp areas)?	☐	☐	☐
(iii)	Waste discharges (e.g., rural, industrial sewage, etc)?	☐	☐	☐
(iv)	Recreational activities carried out (e.g., swimming, fishing, canoeing?)	☑	☐	☐
(v)	Areas of particular aesthetic or scientific value (e.g., scenic waterfall, rapids, archaeological sites)?	☐	☐	☐
(vi)	Areas or aspects of significance to Iwi?	☐	☐	☐

Part B: Assessment of Effects on the Environment (Contd.)

If you have answered yes to any of 2. above, describe what effects your discharge may have and the steps you propose to take to mitigate these.

Refer to consent Application document attached.

(Continue on a separate page if necessary)

3. What alternative methods of disposal or discharge locations have you considered?

"

4. Why did you choose the proposed method of disposal and location point?

"

5. How will the equipment controlling the discharge be operated and maintained to prevent equipment failure, and what measures will be implemented to ensure that the effects of any malfunction are remedied?

"

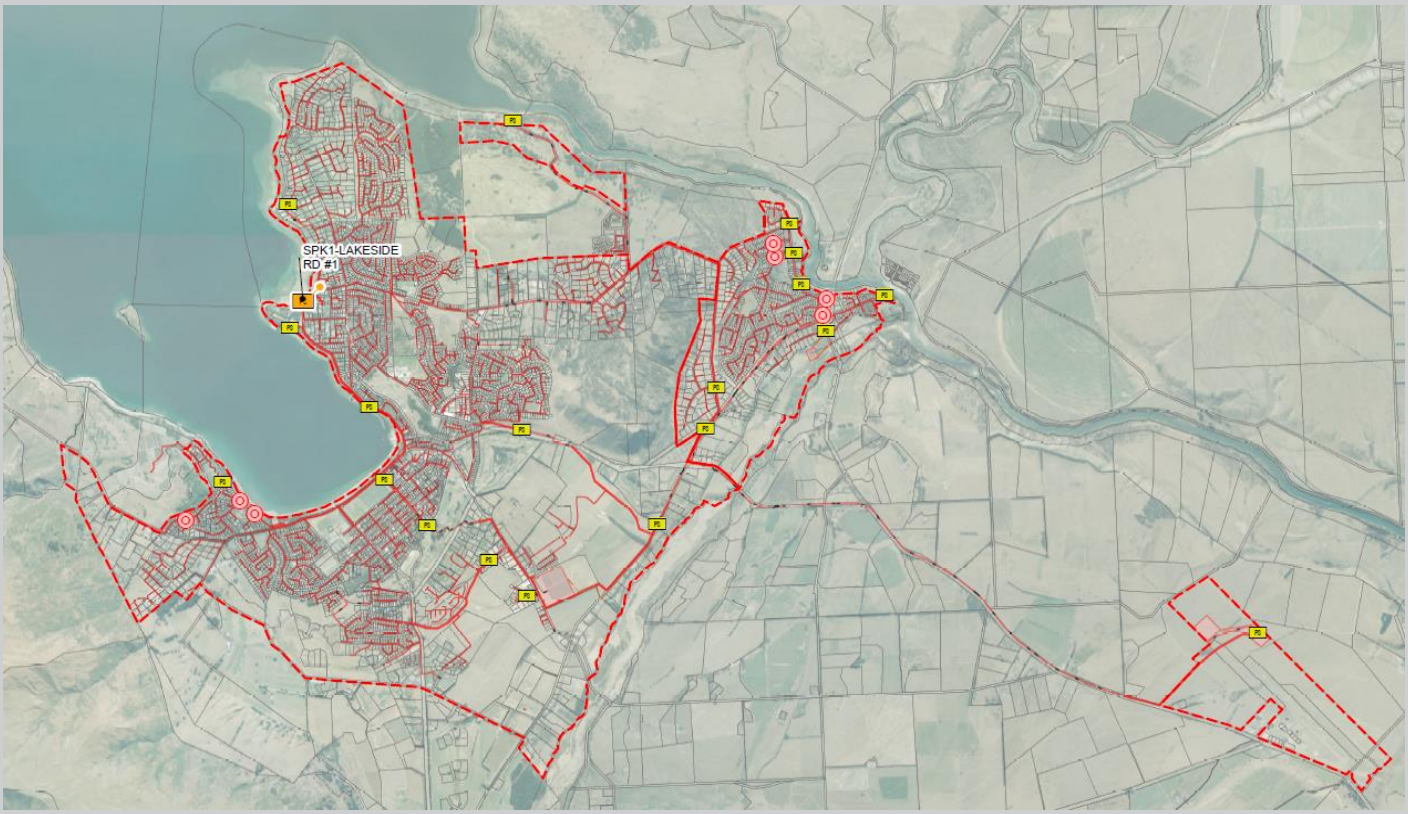
6. What, if any, monitoring do you propose to carry out to ensure that the discharge does not have any adverse effect?

"

Queenstown Lakes District Council Wastewater Network Consent

Prepared for Queenstown Lakes District Council
Prepared by Beca Limited

5 April 2019



make
everyday
better.

Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
1	Alice Burnett / Alisha Robinson	1st working draft	10/10/2018
2	Adam Mercieca / Alisha Robinson	2nd working draft	19/11/2018
3	Adam Mercieca / Alisha Robinson	3rd working draft	12/03/2019
4	Adam Mercieca / Alisha Robinson	Final for Lodgement	05/04/2019

Document Acceptance

Action	Name	Signed	Date
Prepared by	**Adam Mercieca** **Alisha Robinson**		05/04/2019
Reviewed by	**Fiona Blight**		05/04/2019
Approved by	**Fiona Blight**		05/04/2019
on behalf of	Beca Limited		

1 Introduction

1.1 Overview

Queenstown Lakes District Council (QLDC) is applying for resource consent from Otago Regional Council (ORC) to discharge wastewater overflows from its network to freshwater receiving environments, or onto land in circumstances where it may enter freshwater, as a result of blockages, breakages, system failures, extreme storm events, and capacity exceedance in the network.

Wastewater networks are critical for protecting communities from unnecessary exposure to wastewater. Exposure can result in an adverse impact to human health. Wastewater flows easily through the wastewater network pipes when only human waste and toilet paper is flushed, and when only soapy water is put down drains. Blockages and breakages occur in the wastewater pipes when foreign objects such as fats, sanitary items, wet wipes, construction offcuts, debris and dust are put into the network at pipe openings (in houses, businesses or at manholes). External influences such as tree roots invading pipes are also another cause of pipe damage. Storm events can also cause overflows from the network through capacity exceedance, but this is an uncommon occurrence in the Queenstown Lakes District.

Blockages and breakages in the wastewater network restrict wastewater from flowing freely through pipes and can result in a build-up of pressure in the system. In some instances, this pressure can cause wastewater to build up and overflow into the environment, typically out of manholes or at pump stations. If these overflows can't happen at these locations there is a risk that, instead, the build-up of wastewater can cause the wastewater to blow back into private property through toilets, showers, and sinks. This type of overflow has the potential to result in greater direct adverse impacts to human health than if a release occurs at a manhole or pump station. Having occasional overflows in these locations (i.e. manholes or pump stations) also protects the structural integrity of the public network. The public network enables the protection of public health of the wider community and environment.

The wastewater overflows described above currently occur from the QLDC wastewater network. They are not a new or proposed occurrence. These overflows can occur anywhere within the entire QLDC network and they are currently not authorised under the Resource Management Act 1991 (the Act). To address this, a District wide resource consent is being sought to authorise these overflows. In this Assessment of Environment Effects (AEE) and supporting documents, this District wide resource consent is referred to as the 'Network Consent'.

1.2 Philosophy for the Network Consent

The philosophy for the Network Consent was developed in the start-up phase of the project to focus on the management of actual and potential adverse effects on public health and the environment. While the likelihood of wastewater overflows can be managed to a certain degree, overflows can also be unpredictable and not completely avoidable.

As it is not possible to prevent the occurrence of overflows entirely, the Network Consent is sought with a key focus on how the actual and potential adverse effects from an overflow could be managed (avoided, remedied, or mitigated). The management of adverse effects has been categorised into the following:

- Physical response – how is an overflow physically responded to and what action is undertaken to minimise temporary and permanent adverse effects on public health, the environment, and cultural values; and
- Operational and maintenance improvements to the network – to reduce, over time, the likelihood of overflows occurring and therefore reducing the likelihood of adverse effects occurring.

The above two categorisations have driven the formulation and content of the proposed draft conditions of consent, which are included in section 7 of this AEE.

It was also recognised early on from a review of the Regional Plan: Water for Otago (RPW) that the objectives and policies related to wastewater discharges overall seek that adverse effects be avoided (as opposed to remedied or mitigated). As overflows cannot be completely prevented from occurring, the adverse effects resulting from overflows cannot necessarily be entirely avoided either. If an overflow that discharges to land is contained before reaching a waterbody, the impacts on that waterbody can be avoided. However, if an overflow to land is not able to be contained, or the overflow is directly to water, the adverse effects cannot always be avoided. On this basis, the proposed draft conditions of consent have been developed to avoid where possible, or otherwise manage, the adverse effects so that any temporary or resultant effect is minimised as much as practical and towards the avoid end of the effects scale.

1.3 Structure of report

This application for a discharge resource consent is made pursuant to Section 88 of the Resource Management Act 1991 (RMA). This document is a supporting AEE prepared by Beca Limited (Beca) in accordance with the Fourth Schedule of the RMA and comprises the following:

- An explanation of the resource consents and duration sought;
- A description of the proposed activity;
- A description of the existing environment;
- A summary of the consultation and engagement that has been undertaken prior to lodgement;
- An assessment of the actual and potential effects on the environment as a result of the proposed activity;
- An assessment of the proposed activity against the relevant statutory and non-statutory documents; and
- Draft proposed consent conditions.

Supporting ecological and public health assessments form part of and are appended to this AEE.

As part of early engagement with Ngāi Tahu, it confirmed that it would undertake a Cultural Impact Statement (CIS) for the application. At date of lodgement the CIS has not yet been received but is understood to be in progress.

1.4 Reasons for resource consent

The following resource consents are sought from ORC:

Table 1 – Reasons for Consent

Rule	Rule summary	Activity Assessment and Status
	Regional Water Plan	
12.A Discharge of human sewage 12.A.2.1	Except as provided for by Rule 12.A.1.1 to 12.A.1.4, the discharge of human sewage to water, or onto or into land in circumstances where it may enter water.	Discretionary
12.B Discharge of hazardous wastes 12.B.4.2	The discharge of any hazardous substance to water or onto or into land in circumstances which may result in that substance entering water is a discretionary activity, unless it is: (a)	Discretionary

	Permitted by a rule in 12.B.1; or (b) Provided for by a rule in 12.B.2 or 12.B.3.	
12.C Other discharges 12.C.3.2	The discharge of water or any contaminant: (i) to water; or (ii) Onto or into land in circumstances which may result in a contaminant entering water	Discretionary

Adopting a bundling approach, resource consent is required overall for a **discretionary activity**. No other resource consents are required. A full assessment against the relevant rules and permitted activities is contained in Section 6.3 and Appendix F of this AEE.

1.4.1 Demonstration of overall compliance with standards

Schedule 4 of the RMA requires a description of the permitted activities proposed and a demonstration that these activities comply with the requirements, conditions and permissions for the permitted activity. The Regional Plan: Water does not have any permitted activities for wastewater discharges to water (via the wastewater system, overland, or transported by the stormwater system). As such no further assessment has been undertaken or included in this AEE.

1.4.2 Overall status for the resource consent

The overall status for the resource consent for the Network Consent is a **Discretionary activity** under sections 104 and 104B of the RMA.

1.5 Consent duration sought

The Network Consent is being sought for a consent duration of 35 years.

The adverse effects of a wastewater overflow discharge and the receiving environments are known entities that have been assessed for this application. These two entities are unlikely to change substantially over time. The proposed conditions of consent will avoid, where possible, and manage the adverse effects through a physical response and operational and maintenance improvements over time, so that any temporary or resultant effect is minimised as much as practical and towards the avoid end of the effects scale. Additionally, a review condition in accordance with section 128 of the RMA is proposed providing for the ability to review the conditions of consent should circumstances change.

QLDC has invested and set aside significant resources in future asset growth, management and maintenance. These resources are laid out throughout the QLDC 30 Year Infrastructure Strategy and the Long Term Plan, discussed below in section 2.3.

Consequently, QLDC seeks a consent duration of 35 years to reflect the nature of the discharges and the receiving environments, and to ensure consistency and security in future asset and financial planning including the compliance monitoring of the Network Consent by QLDC and ORC.

2 Description of Project

2.1 Scope of resource consent

As set out in section 1 of this report, this AEE is to support a resource consent to discharge wastewater overflows that occur from the QLDC network. The occurrence of wastewater overflows from the QLDC network across the District is an existing situation. Additionally, the Network Consent does not include discharges of wastewater from the existing QLDC treatment plants as these discharges are already consented under the RMA through ORC. Further, the Network Consent does not include discharges of wastewater from future wastewater treatment plants that QLDC may build.

The Network Consent includes the following QLDC owned and managed wastewater collection networks in the following locations (grouped by locations which connect to the same treatment plant):

- Queenstown, Arthurs Point, Frankton, Shotover Country and Lakes Hayes Estate, Lake Hayes, Arrowtown;
- Wanaka and Albert Town;
- Cardrona (part)
- Lake Hāwea; and
- Luggate (part)

The following wastewater network areas are not currently owned or managed by QLDC but have been included in the assessment of actual and potential adverse effects. This is because it is anticipated that in the future QLDC will either develop a wastewater network in these areas or take over the ownership and / or management of existing private wastewater networks in these areas:

- Kingston
- Glenorchy
- Cardrona
- Hāwea Flat
- Glendhu Bay
- Luggate
- Jacks Point and Village
- Hanley Farms
- Coneburn (industrial zoned area)
- Millbrook Resort area

The Network Consent will apply to the above areas either when they are constructed and become operational (if the infrastructure is developed by QLDC), or following RMA, section 224(c) approval as part of the subdivision process, when the infrastructure vests in QLDC (if the infrastructure is developed privately).

For clarity, the scope of the resource consent does not include wastewater overflows from the following areas in the District unless the existing QLDC wastewater infrastructure in these locations:

- Rural areas of the District, including where there are some small clusters of urban development such as Speargrass Flat, Makarora, Kinloch, Johns Creek, Wilson Bay, Drift Bay, Wye Creek and Bobs Cove.

Appendix A to this AEE contains a set of maps that show the existing QLDC wastewater network and indicatively the network boundaries including those future areas. These maps are provided for information purposes only to assist in understanding the network using a spatial tool.

QLDC has separate wastewater and stormwater networks and pipes. As overflows can occur from manholes in the wastewater network that are typically located in an urban street, there is the potential for the overflow to flow into the QLDC stormwater network via kerb channels and catch pits before it can be stopped and contained. Although containment and clean up include measures to "catch" the overflow within the pipe system, there is still the potential that some wastewater overflows could reach freshwater bodies through the stormwater network.

Accordingly, and as set out under section 1.4 and 7 of this AEE, resource consent is sought to authorise discharge wastewater overflows that have the potential to reach freshwater:

- Directly from the wastewater network;
- From the wastewater network via over land flow; and / or
- From the wastewater network via over land flow into the QLDC stormwater network.

2.2 The QLDC wastewater network

Reticulated wastewater networks are a key requirement of any urban area for the protection of human health. QLDC provides public wastewater services to protect the health of its communities and the environment and is enabled to do this by the Local Government Act 2002. The wastewater network conveys toilet wastes, grey water (e.g. household wastewater from kitchens, bathrooms and laundries) and trade wastes from commercial and industrial premises to wastewater treatment plants.

The QLDC wastewater network contains 421km of wastewater pipes and 65 pump stations[1] (illustrated on the indicative network boundary maps contained in Appendix A). The network carries 4,650,042m^3 of wastewater per annum[2] and this number will continue to grow with a growing population and an annual increase in visitors to the district. Section 2.3 below provides further explanation on improvements to the wastewater network proposed by QLDC including in relation to increasing capacity to accommodate this anticipated growth.

Currently, Council wholly maintains seven public wastewater schemes throughout the Queenstown Lakes District which cover wastewater from Queenstown including Sunshine Bay and Fernhill, Arthurs Point, Frankton Road, Frankton, Lower Shotover including Quail Rise, Shotover Country, Lake Hayes Estate and area, Arrowtown, Wanaka, Albert Town, and Lake Hāwea. Council also maintains, in part, schemes in Luggate and Cardrona with the possibility that the remaining parts of these schemes could be transferred to QLDC ownership and management in the future. This will decrease septic tank use in these areas reducing the adverse effects from these on both public health and the environment.

[1] Reported in QLDC Asset Management Plan 2018.

[2] Reported in QLDC Asset Management Plan 2018.

This network uses a combination of gravity and pumped systems to carry wastewater to treatment plants. Typically, this conveyance is gravitational, carrying wastewater to natural low points (lakes, rivers). From here pumping stations lift the wastewater to higher points to continue under gravity to treatment plants.

The main Queenstown wastewater network pipes traverse the waters edge along Frankton Arm to Frankton beach where wastewater is then pumped over to the Shotover Treatment Plant. Similarly, the main wastewater line from Wanaka runs along State Highway 6 to the treatment plant located near Wanaka airport.

As outlined in Sections 1.1 and 1.2, overflows can occur anywhere in the QLDC network due to blockages and breakages occurring restricting the flow of wastewater. This can result in the build-up of wastewater in the pipes and can cause it to back up and overflow into the environment. Blockages and breakages are typically caused from anything that is not water, human waste, toilet paper, or soaps being put down pipes into the network and from third party damage from tree roots and construction in the vicinity of pipes.

Overflows typically occur at manholes (most common) and pump stations, and can flow overland directly into waterbodies, or overland into catch pits and into the stormwater network to the final point of discharge, being a waterbody. This is reflective of all wastewater networks and illustrates that overflows cannot be entirely prevented, or their locations known prior to their occurrence.

To help manage overflows across the wider system engineered overflow points also exist within the network. However, overflows from these points are uncommon because the points are designed to contain the overflow before it were to reach land or water and are network alarmed. The location and type of currently existing engineered overflows are identified in Table 2 below.

Table 2 – Engineered Overflows

Scheme	Location	Receiving Environment	Unit Type	Overflow Type
Wanaka	Aubrey Road, Wanaka	Lake Wanaka	Pump Station	Pipe
Arthurs Point	Oxenbridge, Tunnel Road	Shotover River	Pump Station	Pipe
Queenstown	Allan Crescent, Frankton	Lake Wakatipu	Wastewater Main	Weir
Queenstown	40 Remarkables Crescent, Frankton	Kawarau River	Wastewater Manhole	Pipe
Queenstown	Kawarau Place, Frankton	Kawarau River	Pump Station	Pipe
Queenstown	Jubilee Park, Park Street	Lake Wakatipu	Pump Station	Pipe
Queenstown	Bayview, Kelvin Heights	Lake Wakatipu	Pump Station	Pipe
Wanaka	68 Alison Ave, Albert Town	Clutha River, via stormwater flow path	Pump Station	Pipe

2.3 Operation, maintenance, and planned improvements of the wastewater Network

QLDC owns and operates the vast majority of wastewater networks throughout the District with some private networks, such as Millbrook, connecting for bulk conveyance treatment and disposal to wastewater treatment plants, and other communities with wholly privately contained wastewater networks and treatment systems. As of 2018, QLDC contracts the maintenance and operation of its wastewater network out to Veolia and Fulton Hogan.

The current 10 Year Plan states that the Queenstown Lakes District is identified as being the fastest growing district in New Zealand and as such has ambitious infrastructure projects moving forward. In the 2017/18 Annual Plan, 9% of Council's operating expenditure was on wastewater.

The Infrastructure Assets Management Strategy 2018 – 2048 has an increased focus on infrastructure planning and signals increased capital investment for the three waters. Specifically, the document identifies the need to: "reduce the likelihood of polluting high contact recreation areas: Seek and operate within resource consents. Actively monitor and invest in the wastewater networks to reduce the adverse effects of wastewater contamination at these key sites (i.e. do not have large wastewater facilities that could pollute the beaches and areas where people are most likely to have contact/recreational activities)"[3] .

The strategic objectives for three waters management in the QLDC 10 Year Plan are:

- to ensure no contamination of public water supply attributed to three waters infrastructure;
- adverse effects on the environment from three waters infrastructure are managed/mitigated; and
- ensure compliance with resource consents.

In addressing the issues identified by the 10 Year Plan, QLDC expects to spend around $816M on service improvements, increased capacity and extensions. Specifically, QLDC plan to spend $105M between 2018 and 2028 on to the wastewater network including pump stations, pipes and treatment plants[4].

The indicated investment of capital into the wastewater systems is long term, i.e. in excess of 30 years. This is because the QLDC wastewater network is in fact relatively young. The average age of the infrastructure that makes up the network is 21 years. Wastewater pipes have an expected lifespan of 60-80 years. The investment of capital is therefore aligned with when certain parts of the system will need upgrading or replacing.

The predominant cause of wastewater overflows is foreign objects in the systems, rather than age-related failures of the infrastructure. This means that it is important to educate the community that the wastewater network is made to transport human waste, toilet paper, soaps, and grey water only, and that anything else contributes to blockages and breakages that cause overflows and may affect the integrity of the system.

2.4 Physical response to wastewater overflows

All wastewater pump stations within the QLDC network include level alarms, which are used to advise the network operator if there is an issue with the pump station, causing the water level to rise above normal levels. The alarm notifications are sent via text message to the duty operator(s) to allow action to be taken before an overflow occurs. Each of the wastewater pump stations in the network are visited regularly to

[3] QLDC 10 YEAR PLAN 2018–2028 [VOLUME 2], June 2018

[4] QLDC 10 YEAR PLAN 2018–2028 [VOLUME 1], June 2018

ensure the required preventative maintenance is undertaken, and to allow any potential problems to be identified and corrected as early as possible.

If an overflow occurs that is not able to be prevented or picked up through the alarm systems, it is typically called in by a member of the public. Appendix B to this AEE contains a flow chart which sets out QLDC's physical response process for responding to wastewater overflow events. This response process is implemented by its operation and maintenance contractors regardless of if the overflow is discovered by them, Council, or a member of the public. The response process flow chart has been consolidated specifically for the purpose of this consent.

As the flow chart explains, as soon as QLDC knows from a Council officer or a member of the public that an overflow has occurred it contacts its operations and maintenance contractor who aims to reach the location within 60 minutes of notification. People and equipment are available in both Wanaka and Queenstown 24 hours a day, 7 days a week to respond to an overflow. The 2017/2018 median response times were 22 minutes with a key performance indictor of 60 mins[5].

Once the response team arrives at the overflow location they, as a priority, stop and contain the overflow, and take steps to keep the public safe from unnecessary exposure to the wastewater. This may include closing off recreational areas such as beaches and waterways along with access to these areas.

In particular, in the event that wastewater has reached a lake or river, signage is erected to warn the public of the biological hazard. Where the overflow has led to visible floating debris, a boom is used to contain and remove the floating material.

The relevant authorities (Otago Regional Council and Ministry of Health) are notified as soon as practical, and the affected waterbody is tested until the water quality is back to acceptable swimming guideline levels in the 'Microbiological water quality guidelines for recreational water quality' (Ministry for the Environment Guidelines for Recreational Water Quality).

Following the site being made safe, the crew work to restore the service. Typically, this involves jetting the pipes to dislodge the blockage, allowing the wastewater to flow freely again. Screen devices are used to capture the debris dislodged during jetting to avoid causing issues elsewhere in the network. The 2017/2018 median resolution time was 151 minutes with a key performance indicator of 240 minutes[6].

On occasion the team responding to the event may determine that further work is required to prevent the risk of the issue reoccurring. The repair work is either carried out onsite immediately, or if this is not possible, it is scheduled to be done as soon as possible.

[5] QLDC Annual Report 2017-2018

[6] QLDC Annual Report 2017-2018

3 Description of the Existing Environment

3.1 Queenstown Lakes District

The Queenstown Lakes District measures some 8,500m^2 on the eastern side of the Main Divide of the Southern Alps. It reaches from Makarora and Lakes Wanaka and Hāwea in the north to Lake Wakatipu, Queenstown and Kingston in the south.

The District is notable for its natural features and dramatic scenery consisting of the high alpine peaks of the Southern Alps, bright blue alpine lakes and river valleys. These features attract large numbers of international and domestic tourists year-round providing for a range of activities. The district is well known for adventure tourism, including jetboating, skydiving, bungy jumping, skiing, mountaineering and other activities such as sightseeing, shopping, historic townships and wineries and its generally high water quality. The extensive range of activities, sights and locations provided throughout the district has ensured the development of markets from high value, luxury tourism to backpackers, hostels and freedom camping.

The District is the fastest growing District in New Zealand and is subsequently recognised by central government as a high growth district. The majority of this growth is centred around Queenstown and Wanaka, the two largest urban areas in the District contributing to a growing local economy. As well as domestic growth steadily increasing in these areas, they are also hugely popular with tourists. ..

3.2 Surrounding Land use

The wastewater network traverses residential, commercial, industrial, town centres, townships, special and open space areas and as such the potential receiving environment in the event of a wastewater overflow can be varied.

Subsequently, the type of waste in the wastewater pipes may be varied depending on the land use activity. For example, wastewater from commercial and industrial zones may have both domestic wastewater and trade waste, whereas residential and open space zones will primarily have domestic wastewater due to the activities occurring in these zones.

3.2.1 Areas where large groups will congregate

As a consequence of the random nature of the wastewater overflows there is always a potential that a wastewater overflow could occur in an area where groups of people congregate for example, a park, waterfront, school etc. There are a number of these types of sites located around the Queenstown District such as Ben Lomond Scenic Reserve, Historic Arrowtown Chinese Settlement, Lake Hayes, Lake Wanaka and Lake Wakatipu waterfronts and the Wanaka Recreational Reserve. Some of these areas are close to waterbodies, some are not. In any case, QLDC has an investment matrix assessment which identifies the high comparable benefit for increased infrastructure investment in these public areas. Greater investment is accordingly made in infrastructure (including wastewater infrastructure) near these areas.

3.3 Waterbodies and their receiving environments

In an overflow event there is potential for wastewater to discharge to a surface waterbody. An Ecology Report prepared by Ryder Environmental Limited (Appendix C) categorises similar waterbodies within the Queenstown Lakes District into the following:

- Large Lakes;
- Medium Lakes;
- Streams;
- Small – moderate Rivers;

- Moderate – large Rivers; and
- Very Large Rivers.

These waterbodies are summarised below, with in depth analyses on characteristics, values and ecological make-up analysed within the Ecology Report.

3.3.1 Large Lakes

Lake Hāwea, Wakatipu and Wanaka are large, deep glacial lakes fed by large alpine rivers that drain from the Southern Alps and foothill ranges. These large lakes are known for the high water quality with clear waters. These clear waters are in part due to the low nutrient availability which results in a low biomass of phytoplankton. High water clarity allows high penetration of ultra-violet radiation into the water which kills bacteria and results in a very low *E.coli* concentration.

Lake Wakatipu, its high water clarity and its scenic characteristics are recognised in the Kawarau Water Conservation Order (Kawarau WCO). Similarly, the Lake Wanaka Preservation Act 1973 (LWPA) recognises the value the community places on the water quality of Lake Wanaka.

3.3.2 Medium Lakes

Lake Hayes is a medium sized lake which is commonly photographed due to the highly scenic surrounding landscape being reflected in its waters. Additionally, this lake is commonly used for swimming and boating activities. Lake Hayes is a nutrient rich lake which is due to historic catchment development and land use intensification as well as contemporary activities in the catchment which can result in a periodic algal bloom.

Lake Hayes does not meet the water quality targets Schedule 15 of the Otago Regional Plan: Water due to the combined effects of contemporary nitrogen discharges in combination with the internal load of phosphorus from historic land use practices.

3.3.3 Streams

A number of small streams flow through the urban areas of Wanaka and Queenstown including Bullock and Horne Creeks which are identified in Schedule 1A of the Regional Plan; Water as having a significant habitat for trout spawning and juvenile rearing. Additionally, Horne Creek is also identified as having unimpeded access through to Lake Wakatipu and being weed free.

The Ecology report identifies a lack of detailed information on the water quality and ecology of these smaller streams. There are potentially native fish present in these streams such as longfin eel, kōara and upland bully, all are classified as ‘at risk – declining’ species.

Given their small size, streams are most likely to be of less significance to contact recreation, however any wastewater discharges to these smaller streams may carry contaminants to larger water bodies.

3.3.4 Small – medium Rivers

Three small – moderate sized rivers flow through or adjacent to urban areas within the Queenstown Lakes District; Arrow River, Cardrona and Luggate Creek. Both the Arrow and Cardrona Rivers have a high degree of naturalness.

3.3.5 Medium – large Rivers

The Hāwea and Shotover Rivers are identified as having outstanding characteristics from Schedule 1A of the Regional Plan: Water and the Kawarau WCO. These rivers are heavily used for rafting, kayaking and jetboating.

3.3.6 Very Large Rivers

The natural values of the Clutha / Mata-Au and Kawarau Rivers from Schedule 1A of the Regional Plan; Water and Kawarau WCO include wild scenic characteristics, scientific values, and for recreational purposes.

3.4 Drinking water take locations

The supply of drinking water in New Zealand is governed by the relevant provisions of the Health Act 1956 and the *Drinking-water Standards for New Zealand 2005 (revised 2018)* (DWSNZ). While that regime is the primary means of ensuring the safe and wholesome supply of drinking water, particularly through the requirements for testing and treatment of water drawn from ground and surface sources, maintaining the underlying quality of those sources is an essential part of the process. In the event of an overflow, there is the possibility for wastewater to reach groundwater via seepage or flows from surface water identified in section 3.3.

In the Queenstown Lakes District, community water supply is secured for the two largest urban areas of Queenstown and Wanaka via surface intakes from Lakes Wakatipu and Wanaka. Community water takes outside Queenstown and Wanaka, which are comparatively much less than for the two large urban areas, generally draw water from aquifers.

The Queenstown Lakes District aquifers are found to have scattered areas of glacial-gravel deposits, separated by schist ridges and major bedrock hills. The various aquifers in the Wakatipu basin are mainly of value for providing domestic water to public, communal and individual water supplies, with a very high volume abstraction being used for irrigation or industry. The aquifers are replenished by rainfall, rivers, creeks, feed springs and out-flowing seepage into the basin[7].

Table 3 below outlines the existing primary community water takes, their location and treatment.

Table 3 – Queenstown Lakes District community water takes

Urban Area	Take Type	Take Location	Treatment
Arrowtown	Bore(s)	Adjacent to Bush Creek, Arrowtown	UV and Chlorine
Arthurs Point	Bore(s)	Adjacent to the Shotover River, Arthurs Point	UV and Chlorine
Glenorchy	Bore(s)	Glenorchy/Queenstown Road	Chlorine
Hāwea	Bore(s)	Scotts Beach, Lake Hawea	UV and Chlorine
Lake Hayes	Bore(s)	Northern end of Lake Hayes	UV, Chlorine, Lime (pH)

[7] Queenstown Lakes District Council Three Waters Asset Management Plan 2018

[7] Investigation into the Wakatipu Basin Aquifers, Jens Rekker (July 2014)

Queenstown	Lake Intakes	Kelvin Heights + Two Mile (Fernhill)	Chlorine at both intakes and UV at Kelvin Heights only.
Wanaka	Lake Intakes	Beacon Point + Western	Chlorine
Shotover Country	Bore(s)	Adjacent to the Shotover River and Shotover Country housing development	Filtration, UV and Chlorine

3.5 Cultural and Heritage Sites

The Queenstown Lakes District Plan does not specifically identify sites of significance to mana whenua. However, it is acknowledged that the District and its waterways are of much importance to mana whenua. Accordingly, engagement has occurred with Ngāi Tahu via its appointed representatives Aukaha and Te Ao Mārama to ascertain any physical and metaphysical sites of significance that the project should be aware of and consider.

Through this engagement Ngāi Tahu confirmed it would undertake a Cultural Impact Statement (CIS) to provide understanding of the values and actual and potential cultural effects. At the time of lodgement this CIS had not been received but is understood to be in progress.

4 Consultation and Engagement

QLDC have consulted and engaged with a number of parties during the preparation of the consent application and the assessment of the environmental effects. This is described below. Appendix E contains further supporting information.

4.1 Otago Regional Council

While not consultation, the project team has met with the Resource Consent officers of Otago Regional Council to discuss the Network Consent, the philosophy for the consent being adopted and implemented by QLDC, the structure for the proposed draft conditions of consent (i.e. physical response and improvements over time to the network), and the parties with whom QLDC has consulted with pre lodgement of the application.

A further discussion was held with ORC over the telephone[8] to provide an update on progress in preparing the resource consent application including technical assessments and engagement with Stakeholders. The public engagement undertaken in mid-November (see below) was also mentioned. ORC relayed it was agreeable to the process being undertaken and that it could not, at that point, think of anything fundamental missing in the assessment or with the engagement being undertaken.

4.2 Ngai Tahu: Aukaha and Te Ao Marama

Aukaha manage engagement on behalf of Ngai Tahu with four rūnanga who have an interest in the Queenstown Lakes District on the north side of the Clutha River. Te Ao Mārama manage engagement on behalf of Ngāi Tahu with three rūnanga who have an interest in the Queenstown Lakes District on the south side of the Clutha River.

The project team, Aukaha and Te Ao Mārama have met three times to discuss the purpose of the resource consent being sought in relation to wastewater overflows within the Queenstown Lakes District. The first was an individual meeting with each by the project team, who travelled to Dunedin and Invercargill respectfully, to provide an introduction to the project and relay the desire by QLDC to work collaboratively with Ngāi Tahu on the project. The second and third meetings are described below. Aukaha and Te Ao Mārama has liaised the rūnanga in regards to the preparation of a CIS.

4.3 Fish and Game

A meeting with Nigel Paragreen from Fish and Game discussed sensitive areas such as spawning sites, and disruptions to the ecological function. A follow up round table hui with the QLDC project team, Ngāi Tahu, Department of Conservation and Ministry of Health was also held.

4.4 Department of Conservation

A meeting with Nardia Yozen from Department of Conservation (DOC) outlined that water quality is a key interest area followed by recreational impacts and the cultural sensitivity relationship / connection to Ngāi Tahu values and interests. Additionally, Suzie Geh attended the first stakeholder hui, Trudy Anderson and Lisa Nilsen attended the second hui. DOC also provided written information on its values which has been taken into account in undertaken this assessment.

[8] On 1 November 2018.

4.5 Ministry of Health

The project team met with Susan Moore of the District Health Board / Ministry of Health. At this meeting, MoH confirmed that NIWA was suitably qualified and experienced to undertake a public health assessment.

4.6 Combined Stakeholder Engagement

4.6.1 Stakeholder Hui – 27 September 2018

Collaborative engagement was undertaken with Te Ao Mārama, Aukaha, Department of Conservation, Fish and Game, and Ministry of Health, at a round table Hui held on the 27th of September 2018 in Queenstown. The project team, including Ryders and NIWA, presented and discussed technical assessment methodology, how QLDC responds to any overflow event, and provided a high level run through of the proposed draft conditions. The stakeholders all expressed appreciation with the update on project progress and raised no major concerns regarding the proposed methodology for the ecological and public health assessments. MoH agreed in principle with the public health assessment methodology proposed. The project team found it useful to have all of the key stakeholders together to discuss the project and to raise aspects of the project that were particularly important to them.

4.6.2 Stakeholder Hui – 14 March 2019

A second stakeholder hui was held on 14 March 2019 in Queenstown and was attended by Te Ao Mārama, Aukaha, Department of Conservation, Fish and Game, and Ministry of Health. The hui provided an update of work undertaken since the last hui and provided an open table discussion on any queries and / or concerns. Information regarding notification and the consent duration that QLDC is seeking was provided and discussed. Additionally, Otago Regional Council in its regulatory role (processing and deciding on the application) attended to receive a project update and listen to feedback provided by the stakeholders.

4.7 Community (Public) Consultation

Appendix E contains Community Consultation material related to the below engagement that was specifically undertaken for the project. As part of its communications and engagement programme for the year QLDC has via media (including social), Scuttlebutt, and at community forums, provided educational information to the community about how to use the wastewater network and around trade waste disposal.

4.7.1 Scuttlebutt Article – 19 October 2018

An article prepared and issued in the November Scuttlebutt Newsletter to inform the public of the resource consent application to ORC and to provide education around what causes overflows. The article educates the public on what can and cannot go into the wastewater network pipes and how they can play their part to reduce the likelihood of blockages and breakages in the future. QLDC intends to continue with regular similar articles for educational purposes in future.

4.7.2 Media Release – 29 October 2018

A media release was prepared and issued by QLDC to promote attendance at the drop-in sessions for the public. The media release advised the times and locations for the sessions.

4.7.3 Facebook – 2 November 2018

The drop in sessions were advertised via the QLDC Facebook page to notify and inform the community.

4.7.4 Community Drop in Sessions – 8 November 2018 and 12 November 2018

A community drop in session was held on 8 November 2018 at the Queenstown Events Centre. Poster material (contained in Appendix E) was available at the session. As well as publicly advertising this session the relevant Community Associations were also specifically invited along. Only two members of the public from the Lakes Hayes Estate Community Association attended the drop in. No direct concerns were raised regarding the overflows.

A second drop in session was held on 12 November 2018 at the Wanaka Centre to cater for Wanaka and Hāwea and the surrounding areas. The posters in Appendix E were also available at this session. Similar to the Queenstown drop in session the relevant Community Associations were specifically invited along to the event. QLDC also made direct contact with the Guardians of Lake Wanaka Trust and the Upper Clutha Trust Board to offer individual meetings, but both groups were happy to send along representatives to the drop in session.

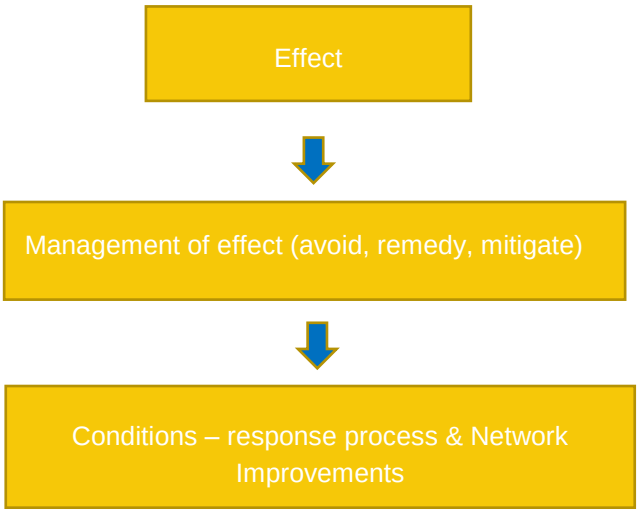
Ten people attended the Wanaka drop in session. A good discussion was held regarding the overflows, why they occur, what QLDC is proposing to do through the annual and long term plans re improvements to the network, and this resource consent and proposed conditions. No direct concerns were raised with regard to the overflows or the resource consent.

5 Assessment of Environmental Effects

5.1 Philosophy for Assessment of Effects

The philosophy for the following assessment of environmental effects has been formulated to articulate that the management (i.e. avoid, remedy, or mitigate) of adverse effects is achieved through the implementation of the conditions of consent.

Subsequently, the following formulation was adopted for this assessment:



The assessment below provides an assessment of the following effects as a result from overflows from the wastewater network to land and fresh waterbodies:

- Positive Effects;
- Ecological Effects;
- Public Health and Recreation Effects;
- Amenity Effects; and
- Cumulative Effects

5.2 Positive effects

Through this consent process, QLDC's intention is to build on its current plans and practices and to implement a strategy to best manage the actual and potential adverse effects on public health and the environment from wastewater overflows to water bodies.

Positive effects identified from this process include that QLDC will follow a detailed, transparent response process to overflows when they occur to protect human health and will make improvements to the network through annual monitoring and long term planning. The consent will also support improved reporting of overflows and increased communication and visibility between QLDC, the ORC, stakeholders and the community.

Network improvements through annual plans, wastewater strategies and capital works projects, will improve the network and reduce the frequency of overflows over time which is considered to be a positive effect for the community and the receiving environments. Ongoing community education on the operation of the wastewater network will additionally contribute to a reduction in the frequency of overflows.

5.3 Ecological effects

As outlined in section 3, the Queenstown Lakes District is host to a number of receiving freshwater environments. Ecologically, the majority of these waterways have good to excellent water quality and support high valued aquatic ecosystems[9].In particular, Lakes Wakatipu, Wanaka and Hāwea are microtrophic, characterised by high water clarity and low nutrients and algal biomass. A large volume of this water then forms the Clutha and Kawarau rivers. In comparison, the Shotover river has high sediment loads and Lake Hayes has poor water quality resulting from historical land use practices.

Wastewater overflows have the potential to discharge nutrients, namely nitrogen and phosphorus, and contaminants including metals and chemicals to the environment. Due to the high water quality within the District, these freshwater environments are potentially sensitive to these inputs.

The impacts of a wastewater overflow reaching a freshwater receiving environment has been identified within the Ecology Report (Appendix C). These impacts include a high biochemical oxygen demand as organic matter aerobically breaks down, loss of water clarity from suspended solids, increased phytoplankton biomass and nitrogen toxicity.

The adverse ecological effects arising from the aforementioned impacts include, but are not limited to, increased fungal growth, changes in macroinvertebrate communities, reduced visibility effecting trout and salmon feeding ranges and water toxicity. These adverse effects and their prevalence or severity can be attributed to the specific freshwater receiving environment and nature (volume, duration) of the overflow event.

Lakes

In the case of the large lakes, Wakatipu, Wanaka and Hāwea, the low levels of nutrients mean they are anticipated to be sensitive to wastewater discharges. However, these effects are not expected to adversely affect the overall health of the lakes and will be largely restricted to localised effects in the vicinity of the discharge. Following the notification of an overflow, the response process kicks in to remediate the breakage in the network, stop flow of discharge to the receiving environment, and to contain the area. The 2017/2018 median response times were 22 minutes with a key performance indictor of 60 mins and a median resolution time of 151 minutes with a key performance indicator of 240 minutes. Thus reducing the areas of the lakes subject to the overflow discharge and adverse effects.

Lake Hayes is expected to be less sensitive to an event due to existing high levels of nutrients. However, Lake Hayes has been identified as having limited potential for the dispersion of a wastewater plume compared to the larger lakes.

Streams, small rivers and small-medium rivers

The Ecological Assessment identifies streams, small rivers and small-medium rivers are generally highly sensitive to wastewater discharges during periods of low flows. However, in the case of small-medium rivers such as the Arrow River, Cardrona and Luggate Creek, higher flow periods will result in greater dilution. The adverse effects associated with a wastewater overflow reaching these environments is associated with the potential to feed into downstream tributaries and interrupt trout and kōaro spawning and rearing habitats.

However, given the infrequent discharge events, the values associated with these environments are not expected to be significantly affected.

[9] Queenstown Lakes District Council Wastewater Network Consent: Assessment of Ecological Effects 16/11/2018 – Ryder Environmental Limited

Large Rivers

The Ecological Assessment states the Hāwea, Shotover, Kawarau and Clutha Rivers contain generally low nutrients although the Shotover can carry high loads of suspended sediment. In addition, these rivers have large flows and thus a greater capacity for dilution meaning they are relatively insensitive to wastewater discharges ecologically. Given the infrequent nature of overflow events, short term discharge and dilution capacity resulting from large river flows, it is considered that the adverse effects on these larger rivers will be less than minor.

Conclusion

The above ecological assessments on the freshwater bodies of the Queenstown Lakes District identifies a range of freshwater receiving environments. The characteristics of these receiving environments assist in evaluating the level potential adverse effects may occur and a need to remedy and mitigate these potential adverse effects. An example of this is localised adverse effects compared to high dilution potential in differing environments. As a result of this, QLDC proposes a raft of consent conditions designed to mitigate the adverse effects. These proposed conditions include physical responses to overflow events in regards to clean up efforts, network improvements designed to reduce frequency over time and ongoing community education. These conditions are outlined in section 7 below.

Consequently, with the implementation of proposed consent conditions, the adverse ecological effects of infrequent, short term wastewater overflows to freshwater environments are considered to be more than minor in localised environments but overall no more than minor.

5.4 Public Health effects

The freshwater environments of the Queenstown Lakes District provide numerous water based and related recreation opportunities. These opportunities encourage the public to interact closely with the district's lakes and rivers resulting in a high probability of primary contact recreation including activities such as swimming and paddling where full immersion is anticipated, and canoeing and paddle boarding where ingestion is unlikely unless the individual capsizes and falls into the water.

In order to understand the relationship between these activities and potential overflow events, NIWA has been engaged to assess the potential adverse public health effects in the event a wastewater discharge reaches these freshwater environments. Its report is attached in Appendix D.

It is important to note that the NIWA assessment has been based on modelling the health risks arising from contact recreation based on several assumptions. These include (but are not restricted to): the nature of contact recreation (swimming, or activities likely to lead to full immersion), the duration of swimming, a typical concentration range of the selected model pathogen based on New Zealand and overseas measurements of untreated wastewater, and use of norovirus as the model pathogens. Currently no data or modelling of dilution, dispersion or advection of discharges exist for freshwater lakes and rivers in the Queenstown Lakes District.

Consequently, a 'reverse' Quantitative Microbial Risk Assessment (QMRA) has been used for this assessment. A reverse QMRA approach was considered appropriate in view of the absence of key data and information required in a conventional QMRA approach.

Using the assumptions listed earlier, the QMRA modelling estimates can only be presented in terms of the Individual Infection or Illness Risks likely to exist, assuming various degrees of dilution of the discharge. As noted earlier, where these risks will prevail (i.e. downstream extent of risk), or the period over which these risks are likely to exist cannot be estimated without access to the output from a calibrated hydrodynamic model (lakes), or estimates of mixing and dilution (streams and rivers). Attempts to overcome the limitations impose by absence of this information is likely to make the risk assessment overly conservative and alarmist.

In this case, assumptions within the QMRA were considered adequate for the purposes of this consent. Assumptions made in place of absent data was incorporated into a model allowing for 'Monte-Carlo' random sampling.

These assessments summarised the following:

- Risk of illness is always lower than risk of infection – illness requires infection, whereas infection does not necessarily lead to illness;
- Aggregation of pathogens considerably decreases infectivity and risk of illness, especially at low doses;
- Risk of illness or infection decreases as dilution increases

The assessment concluded very infrequent wastewater overflows should be anticipated. The QMRA process indicates a potential for serious health risks arising from discharges. As a result, response plans are recommended to ensure public health is protected and risk to the district's communities are minimised.

In response to the identified potential adverse effects of infection and illness upon contact with an overflow event, QLDC has proposed both physical responses and long term network improvements as conditions of consent.

Physical Responses

QLDC has proposed a framework of physical responses to an overflow event – the flow chart is explained above and contained in Appendix B.

Dr. Neale Hudson also confirmed that a review of the response plan included in this application was undertaken and he concluded that it provides a suitable high-level indication of what would be done in response to an overflow event.

Network Improvements

In addition to immediate physical responses, network improvements over time will assist in minimising the risk of overflowing and resulting primary contact.

These network improvements include increased capital investment, ongoing monitoring and production of annual monitoring reports and the development of a specific wastewater network strategy.

The implementation of the above response plans and longer term network improvements will assist in reducing the likelihood of future overflow events. As a result, in the future the overall public health risk to local communities is considered to be very low[10].

Conclusion

With the implementation of the proposed consent conditions including physical response processes, the public health assessment finds the risk to human health from occasional discharge of wastewater to be low to very low. Consequently, the adverse public health effects are considered to be no more than minor.

5.4.1 Drinking water quality effects

Freshwater resources across the Queenstown Lakes District are generally of alpine origin and thus of high quality. QLDC takes advantage of this resource and has a variety of drinking water takes across the district. As explained above, these takes are both from aquifer groundwater via bores and surface water via intakes from the large lakes Wakatipu and Wanaka. While drinking water takes are treated with chlorine, and some with UV light wastewater overflow events have the potential to introduce adverse effects via infiltration and

[10] Hudson, N. (2019) Aberrant discharges for Queenstown Lakes Council Wastewater Networks, 23

recharge from surface water. Table 3 in section 3.4 outlines the existing community water takes within the district and their general location. As drinking water takes are managed for human consumption per the DWSNZ and constantly monitored, the overall adverse effects are considered to be less than minor. These potential adverse effects on the two forms of water takes are discussed below.

Groundwater takes

The majority of community drinking water takes owned and managed by QLDC are groundwater takes via bores. Takes from bores located near surface waterbodies may also include a contribution of surface water. These takes supply most of the urban areas of the District with the exception of Queenstown and Wanaka. In the event of a wastewater overflow, seepage or recharge from surface water may result in wastewater traces entering aquifers where groundwater takes are located. However, due to the infrequent nature, generally small volumes of discharge and dilution, this is considered to be highly unlikely. Additionally, QLDC is required to take (and has taken) steps to ensure surface water cannot infiltrate these groundwater take locations through physical barriers such as backflow prevention devices, watertight doors and implementation of a new standard to be followed when constructing new community supply bores.

Subsequently, the adverse effects on community groundwater drinking takes are considered to be less than minor.

Surface water takes

The two largest urban areas of the Queenstown Lakes District are Queenstown and Wanaka. Both of these urban areas are supplied drinking water from surface intakes on Lakes Wakatipu and Wanaka respectively. It is noted the surface take locations for both these urban areas are located either adjacent or not far from residential populations. Given these takes are from surface water, their proximity to urban areas and that wastewater overflows can discharge to surface water, there is the potential for adverse effects to be introduced.

Surface takes are treated with chlorine, and in the case of the Kelvin Heights intake also UV disinfection. In the event that an overflow enters the lake in close proximity to a drinking water intake, the intake can be shut down as part of the overflow response.

Consequently, the adverse effects on surface drinking water take are considered to be less than minor.

5.5 Amenity effects

5.5.1 Recreational

The freshwater environments of the Queenstown Lakes District provide numerous recreational opportunities, particularly during the warmer summer months. These opportunities include, but are not limited to, swimming, boating, fishing and paddle boarding and occur across the district's lakes and rivers.

Wastewater overflow events have been identified as primarily occurring from manholes which are generally located at low points in the network such as lake-fronts and rivers. As a result, in the event of an overflow there is the potential for discharge to reach the freshwater environments and adversely effect those recreational values associated with the rivers and lakes of the district.

Given QLDC provides access for many recreational opportunities along freshwater margins in the form of reserves and boat ramps, it is inherent that Council seeks to protect and maintain these areas. This is proposed though the implementation of proposed consent conditions that seek to mitigate of adverse effects associated with a wastewater overflow event. These conditions include a set of physical response protocols articulating remediation efforts during and after an overflow event. These physical responses include collection of solids, vacuuming of affected areas, water quality sampling and public notification.

Consequently, the adverse effects on recreation values of infrequent and short term wastewater discharges to both land and water are considered to be transient and no more than minor.

5.5.2 Odour

In the event of a wastewater overflow to either land or freshwater, the potential for adverse odour effects exist. The greatest risk of adverse odour effects is considered to be those small overflows typically occurring from a manhole. This is due to the fact that pump stations are actively alarmed and monitored and larger overflows will be rapidly identified and remediated. A smaller overflow has the potential to exist for a longer period of time and thus have a greater odour effect.

However, given the remediation protocols proposed within the conditions of consent; when an overflow is identified QLDC contractors are required to clean up all traces of the event. Through this remediation, and use of specialist equipment any adverse odour effects are considered to be short term, localised, infrequent and will not last beyond remediation.

Consequently, the proposed physical response consent conditions will allow for sufficient remediation of the environment and thus the adverse odour effects of an overflow event is considered to be no more than minor.

5.5.3 Visual

Public perception of raw wastewater directly entering a freshwater environment from an overflow is not anticipated to be favourable or acceptable to those that live, work and play in the Queenstown Lakes District. As such, a wastewater overflow event, regardless of location, has the potential to introduce adverse visual effects.

As overflow events cannot be fully avoided, adverse effects must be mitigated and remedied. QLDC has acted upon this through the alarming of pump stations and the implementation of proposed consent conditions. The alarming of pump stations allows QLDC and its contractor, Veolia, to have fore warning of potential overflow events and provides the opportunity to mitigate and remedy a potential event. This is particularly crucial as pump stations are generally located at low points in the network such as lakes and rivers where the public are afforded recreational opportunities and thus without the existing controls there would be a greater chance of seeing an overflow.

Additionally, proposed response protocols call on QLDC's contractor to be onsite as soon as possible following an overflow notification and to take remediation steps to clean up all traces of the overflow, whether that be on land or in freshwater. It is noted this response seeks to keep any discharge as short term as possible and thus keep adverse effects localised. Once the discharge has been remediated there will be no long lasting visual effects.

Consequently, while it is acknowledged the adverse effects cannot be entirely avoided, they are mitigated and remedied to a degree that the effects can be considered more than minor but less than significant.

5.6 Cultural effects

The Queenstown Lakes District Plan does not directly identify sites of significance to mana whenua. However, it is acknowledged that the District, and in particular its waterways, are of much importance to mana whenua. Accordingly, engagement with Ngāi Tahu through Aukaha and Te Ao Mārama representing their associated rūnanga was established early on in the preparation of this application.

This engagement sought to quantify the sites of significance and associated values to mana whenua. Ngāi Tahu are the appropriate people to provide the actual and potential cultural effects. Arising from this engagement and the production of a CIS, cultural effects can be assessed, and potential adverse effects could be avoided, mitigated or remedied.

At point of lodgement, a formal CIS has not been received and thus there is the limited the ability for assessment of cultural effects.

Notwithstanding the above, it is acknowledged that throughout engagement mana whenua indicated their appreciation of the work undertaken thus far and were generally supportive of the management of overflows given they already occur and cannot be fully avoided in the future.

5.7 Cumulative Effects

Ecological and human health assessments have identified the ability to sufficiently mitigate and remedy the adverse effects given overflow events are infrequent, short term and generally small in volume. However, the potential for cumulative adverse effects exists if overflow events increase in frequency and severity or a number of them occur in simultaneous or quick succession. The data that QLDC holds on historic overflows does not reflect these types of events occurring. However, the Network Consent is forward looking and intended to be in place for 35 years.

With existing and planning procedures in place the likelihood of these events occurring transient, very infrequent and the effects very acute and not cumulative. Notwithstanding this, their occurrence cannot be entirely ruled out as a possibility.

As explained above, QLDC has actively identified network improvements to reduce the likelihood of such events occurring in it's 10 Year Plan and expects to spend $$816M on service improvements, increased capacity and extensions. Specifically, QLDC plan to spend $105M between 2018 and 2028 on to the wastewater network including pump stations, pipes and treatment plants.

Additionally, quick intervention and clean up of overflows will assist in reducing the potential for cumulative effects. As part of the response process (Appendix B) an analysis and investigation into each event is required. Similarly, the QLDC under the proposed conditions of consent is required to record each event and therefore repeat overflows in the same part of the network will be investigated further to identify and resolve any underlying issue.

It is anticipated that the 10 Year Plan investment in addition to a large part of the current network being under 21 years old will result in overflows not increasing in frequency or severity. One of the key factors is ongoing community education.

As such, it is anticipated that while the potential for cumulative effects exists, these are not considered to be significant.

6 Statutory and Non Statutory Assessment (Summary)

This section provides a summary of the statutory context under which the Network Consent will be assessed, and a summary of the statutory and non statutory assessment that has been undertaken to support this resource consent application. The full statutory and non statutory assessment is contained in Appendix F.

6.1 Statutory Context Summary

In accordance with Section 15 of the RMA, the QLDC is seeking resource consent to discharge wastewater to freshwater receiving environments and to land in circumstances when it many enter freshwater.

In considering an application authorising a discharge; the consent authority is required to make assessment pursuant to Sections 104 and 105 of the RMA.

6.2 Statutory and Non Statutory Assessment

There are a number of objectives and policies relevant to this discharge application in the national and regional planning documents. A full and comprehensive assessment against these documents is enclosed within Appendix G. A succinct summary of the main conclusions can be found below.

6.3 Statutory Assessment Summary

6.3.1 Resource Management Act 1991 (RMA)

Section 104 and 105 of the RMA sets out the matters a territorial authority must have regard for when considering a discharge application. These matters are subject to Part 2 of the RMA which sets out the purpose (Section 5) and principles (Section 6-8) of the Act.

Part 2 – Purpose and Principles

Section 5 - Purpose

Section 5(1) of the RMA states the purpose of the RMA is *to 'promote the sustainable management of natural and physical resources*.

With regard to sustainable management as defined in section 5(2); the effects caused by the overflow events on the environment and to human health can be remedied and mitigated through response and infrastructure planning actions proposed by QLDC.

Section 6 – Matters of National Importance

Section 6 of the RMA addresses the requirement to '*recognise and provide for'* matters of national importance in achieving the purpose of the Act.

In regards to the specific matters identified in Appendix G; this proposal will be consistent with Section 6. Waterbodies and their associated habitats within the district will be preserved and protected and Māori's relationship with the land addressed through engagement.

Section 7 – Other Matters

Section 7 requires decision makers to have *'particular regard'* to the stated matters in achieving the purpose of the Act. The matters relevant to this proposal are outlined within section 7.2.1, Appendix F.

It is considered that the proposal will be consistent with these matters. Proposed conditions of consent will seek to ensure the maintenance and enhancement of landscape values and Kaitiakitanga is provided for through engagement and the production of a Cultural Impact Statement.

Section 8 – Treaty of Waitangi

Section 8 of the RMA requires those persons exercising functions under the Act to *'take into account'* the principles of Te Tiriti o Waitangi.

Engagement with local iwi has been established with QLDC and the project team relaying its intent to work in collaborative way with Ngāi Tahu. This is reflected in the engagement that has been undertaken pre lodgement of the application. Additionally, a CIS is being prepared. Having taken into account the principles of Te Tiriti o Waitangi, the proposal is considered to be in accordance with Section 8.

Section 104

Section 104(1)(a) – Actual and Potential Effects

Pursuant to Section 104(1)(a) when considering an application for a resource consent, a consent authority must have regard to the actual and potential effects on the environment.

The actual and potential effects identified on the environment as a result of this proposal have been discussed in detail in the above Section 5 – Assessment of Environmental Effects. It is considered that any adverse effects arising from the proposal can be sufficiently mitigated through proposed suite of consent conditions outlined within Section 7. Additionally, the proposal will result in positive effects over time being the more efficient and effective operation of the QLDC wastewater system reducing the likelihood of wastewater overflows occurring.

Section 104(1)(b) – Actual and Potential Effects

National Policy Statement for Freshwater Management

The NPSFM sets out the objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits.

The NPSFM contains 4 objectives and 7 policies on water quality. The objectives are high level, with a focus on outstanding freshwater bodies, significant values of wetlands and water bodies degraded to the point of over-allocation.

The NPSFM contains 5 objectives and 8 policies on water quantity. The objectives relate to safeguarding life supporting capacity; avoiding further, and phasing out existing, over-allocation; improving and maximising efficient allocation and efficient use of water; and protecting significant values of wetlands.

The NPSFM contains 1 objective and 2 policies aimed at improving integrated management of fresh water and land development across whole catchments.

The NPSFM also contains 1 objective and 1 policy to ensure tangata whenua values and interests are identified and reflected in freshwater management.

Appendix F assesses the objectives relevant to this proposal. This assessment concludes the proposal will be consistent with the NPSFM through management of effects to the receiving environment. This is

accomplished through the proposed suite of consent conditions and through involvement and engagement with iwi and hapū.

National Policy Statement for Urban Development Capacity

Queenstown Lakes District has been identified by central government as a high growth district. As such, the Council is currently developing a Future Development Strategy (FDS) to guide urban development.

While this proposal is to authorise existing and future overflows, the National Policy Statement for Urban Development Capacity (NPSUDC) is not considered to be of relevance to this application. This is because the outcomes of the FDS are not yet certain and thus any further future wastewater networks not yet identified are uncertain.

Otago Regional Policy Statement

The Regional Policy Statement (RPS) was made operative on 1 October 1998 and is a framework for the sustainable and integrated management of resources across the Otago Region. It identifies regionally significant issues and sets out objectives and policies that direct how natural and physical resources are to be managed. Being a high level policy framework; the Otago Regional Plan is required to give effect to this RPS.

Otago Regional Council is currently reviewing its RPS. Council notified its proposed RPS on 23 May 2015 and released its decisions on 1 October 2016. Given the majority of this proposed RPS is operative, a dual assessment has been conducted for fullness and clarity within Appendix F.

In summary, it is found that the proposal is generally consistent with, and not contrary to the operative and proposed RPS's.

Otago Regional Plan: Water

The Otago Regional Plan was notified on 28 February 1998 and made operative on 1 January 2004 with various amendments since this date. The purpose of the Otago Regional Plan: Water (ORPW) is to promote the sustainable management of Otago's water resources. This is achieved by giving effect to the RPS though objectives and policies to address use, development and protection of Otago's freshwater resources.

Appendix G sets out a full assessment of the relevant objectives and policies within the plan in regards to the proposal. This assessment finds the proposal is generally consistent with and not contrary to, the ORPW.

Lake Wanaka Preservation Act 1973

The Lake Wanaka Preservation Act 1973 was made operative on 23 November 1973 in recognition of concern over hydro-electric development effects on Lake Wanaka. The purpose of this Act is to preserve the water levels of and maintain and improve the water quality of Lake Wanaka in addition to restricting artificial water movement. This is partially achieved through the establishment of the Guardians of Lake Wanaka which reports to the Minister of Conservation on matters affecting the purpose of the Act.

Through public engagement and proposed conditions, it is considered that the proposal is consistent with the purpose of the Act.

Water Conservation (Kawarau) Order 1997

Pursuant to s214 of the RMA, the purpose of Water Conservation Orders is to provide protection of the characteristics of, and preservation of the natural state of water bodies. The Kawarau Water Conservation Order was publicly notified on 27 June 1991 and made operative on 17 March 1997.

The Kawarau Water Conservation Order specifically preserves water bodies located in Schedule 1 and protects the characteristics of those water bodies in Schedule 2 with the exception of maintenance or protection of network utility operations.

Overall, the way in which wastewater overflows are responded to, as proposed in the suite of consent conditions will provide for both the preservation and protection of the identified water bodies. For this reason it is considered that the application will not be contrary to the purpose of this Order.

Section 105 Summary

In accordance with Section 105(1)(c) of the RMA, alternative methods for the proposed discharges have been assessed.

The only possible "alternative" option would be for QLDC to rebuild the entire wastewater network to the most up to date technology standards. However, this would come at a significant cost to ratepayers and would not eliminate overflows altogether. Any system will be designed and constructed to a certain 'event' standard or probability. Additionally, there is no certainty any system can fully account for factors such as blockages and breakages caused through foreign objects. Wastewater overflows in the Queenstown Lakes District unlike other Council areas are not predominantly from wet weather events but from foreign objects entering the system from the public / community.

For the reasons outlined above and explored in further detail in Appendix F; the incremental upgrade of the QLDC network and a suite of consent conditions as proposed is the preferred outcome.

6.4 Non Statutory Assessment

In accordance with Section 104(1)(c), the consent authority may consider any other relevant matters in order to make a determination on the application. Other matters that are considered to be relevant are explored in detail in Appendix F and summarised below.

Iwi Management Plans

Two Iwi Management Plans (IMP) have been identified as relevant to this application, there are;

- Kāi Tahu Ki Otago – Natural Resources Management Plan 2005 and;
- Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan 2008.

As no CIS has yet been received, a full and detailed assessment against these plans has not yet been undertaken.

7 Proposed Draft Conditions

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
Administrative conditions		
1	**In General Accordance** Except as modified by the conditions below, the Wastewater Network Overflow Discharge Consent shall be undertaken in general accordance with the information provided by the Consent Holder, Queenstown Lakes District Council (QLDC), being: a) The Assessment of Environmental Effects prepared by Beca Ltd dated 5 April 2019 b) The Physical Response Flow Chart (attached to these conditions as Attachment 1) c) The ecological assessment prepared by Ryder Consultants Ltd d) The public health assessment prepared by NIWA	It is expected that ORC will have a standard "in general accordance with the application material" condition. However, this resource consent is slightly different to typical consents because something that already occurs is being consented, and the conditions are key to the ongoing management of adverse effects. Therefore an "except as modified by the condition below" is requested to be included in this condition as this stipulates that the conditions, where different or advancing something beyond the application documentation, take precedent.
2	**Physical Scope of Network Consent** This Network Consent authorises wastewater overflow discharges from the following: a) QLDC owned and managed wastewater collection networks (including existing and new manholes, pump stations, engineered overflow points, and pipes): – Queenstown including Arthurs Point, Frankton, Shotover Country and Lakes Hayes Estate, Lake Hayes, and Arrowtown; – Wanaka and Albert Town; – Lake Hāwea; – Luggate (part); and – Cardrona township (part).	Describes what is authorised by the resource consent so that the application material does not need to be referred back to and is clear for compliance monitoring purposes for both ORC and QLDC. The assessment of environmental effects undertaken for this application has assessed the receiving environment for all the areas listed, including those areas that are not currently under the ownership and / or management of QLDC. The proposed conditions set out below seek to manage the adverse effects of overflows through physical response procedures that apply no matter the location / waterbody, and through improvements to the wastewater network over time. Ongoing improvements to wastewater systems technology is envisaged to assist in

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
	b) Wastewater collection network areas which are not currently owned or managed by QLDC, but have the potential to be in the future (including existing and new manholes, pump stations, engineered overflow points, and pipes): – Kingston; – Glenorchy; – Cardrona; – Hāwea Flat; – Glendhu Bay; – Luggate; – Jacks Point and Village; – Hanley Farms; – Coneburn (industrial zoned area); and – Millbrook Resort area. Refer to Condition 10 for the timing of when these future areas will be subject to the conditions of this consent. For clarity this Network Consent does not authorise wastewater discharges from wastewater treatment plants.	reducing the likelihood that overflows will occur from new manholes and pump stations.
3	**Access** QLDC shall enable that access to relevant parts of the wastewater network is available at all reasonable times to the Otago Regional Council or its agents for the purpose of carrying out inspections, surveys, investigations, tests, measurements and to take samples.	A general condition to allow monitoring and inspections of the network by the consenting authority.
4	**Maintain Records on Overflows** QLDC shall maintain a record of wastewater overflows that reach water or have the potential to reach water. This record shall include: a) The specific location the overflow occurred b) The approximate start time and end time of the overflow if this is known	To ensure that a robust record of overflows (and relevant information relating to them) is kept by QLDC going forward. This will assist it to meet its reporting obligations to ORC under this consent and will built up a history of overflow data allowing easy identification of where repeat overflows are occurring in the same area of the network.

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
	c) The day and time the overflow was notified to QLDC (and then its operations and maintenance contractors if relevant) d) The time it took from being notified about the overflow to reaching the overflow location e) The approximate flow rate and the total volume of the wastewater discharged if this can be ascertained f) Whether the overflow reached a waterbody or had the potential to reach a waterbody g) What actions were taken to physically clean up the overflow h) Why the overflow occurred if this can be determined i) What actions were taken, if necessary, in terms of maintenance, remedial works or renewal to fix the reason why the overflow occurred j) Whether Otago Regional Council and the Ministry of Health were notified of the overflow and the date that this occurred This record shall be available, on request, to the *Regulatory / Consenting Manager,* Otago Regional Council.	So that a record of overflows is kept. This will build up a robust history of overflows and will allow for easy identification of where repeat overflows are occurring in the same area of the network.
5	**Lapsing of Consent** In accordance with section 125(1) and (1A)(a) of the Resource Management Act this consent shall have no lapsing date as it has been given effect to immediately upon the consent being granted.	This wording proposed within this condition is considered necessary to reflect that the consent is authorising an activity that is already occurring, as opposed to a fully new activity which may not start immediately. Therefore, this condition provides confirmation that the consent has been given effect to at the time it was approved. Theoretically the consent would otherwise not be given effect to until an overflow discharge occurred (which is unknown when this might occur).
6	**Duration of Consent** The duration of this consent in accordance with section 123 of the Resource Management Act 1991 shall be 35 years.	See the reasons for this duration set out in section 1.5 of the AEE.

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
7	**Review of Consent Conditions** The Otago Regional Council, under section 128 of the Resource Management Act, may within 3 months of the Annual Monitoring Report being provided in accordance with condition 10 serve notice on QLDC of its intention to review the conditions of this consent for the purpose of reviewing the effectiveness of these conditions in avoiding, remedying or mitigating any adverse effects on the environment resulting from the wastewater overflows authorised by this consent. The review of conditions shall allow for: a) Deletion or amendment to any condition(s) of this consent to ensure that any adverse effects are appropriately avoided, remedied or mitigated; and / or Addition of new condition(s) as necessary to avoid, remedy or mitigate any unforeseen adverse effects on the environment	QLDC is accepting of a review condition being imposed on this consent, particularly given the given the 35-year consent duration being sought. The timing for review suggested is to line up with the Annual Monitoring Report process.
Physical Response Conditions		
8	**Responding to a Wastewater Overflow covered under this Consent** Once QLDC is notified of a wastewater overflow authorised under this consent, it shall respond to the overflow in general accordance with the process set out in the flow chart in Attachment 1 to these conditions.	The flow chart included in Appendix B to the AEE sets out how the overflows are physically responded to in order to manage (avoid, remedy or mitigate) any adverse effects on public health and the environment. This condition ties that response process to this consent, however it is preferred if the words in general accordance are included in the condition wording to reflect that this is a collated summary of the process undertaken. Condition 4 above requires the more detailed recording of what process was undertaken in responding to an overflow and provides that it can be monitored by ORC. Condition 4 requires that the record keeping be available upon request to ORC. Condition 10 also requires that this information be included in

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
		the Annual Monitoring Report to be provided to ORC. It is recommended that the flow chart in Appendix B of the AEE be attached to these conditions as Attachment 1 to remove the need to refer back to the consent application documentation.
Ongoing Community Awareness		
9	QLDC shall continue to educate and raise awareness to the community, including visitors to the District, on how the wastewater system should be used. The methods (e.g. media, social media, newsletters, print material, meetings) QLDC may use to educate the community is not restricted under this consent, but the following shall be covered in education content (in no particular order and not all to be covered in every education initiative): a) What should go down wastewater pipes – i.e. only water, human waste, toilet paper, and soaps b) The implications of putting other things down the wastewater pipes for domestic and commercial connections (i.e. breakages and blockages potentially resulting in a wastewater overflow into the community environment) c) How construction material/debris should be properly disposed of d) The correct process for obtaining approved connections to the QLDC stormwater and wastewater networks and the importance of engaging appropriately qualified trades people e) What sort of trees to avoid planting in the vicinity of wastewater pipes The education initiatives that QLDC has undertaken each year shall be included in the Annual Monitoring Report provided to ORC in accordance with Condition 10 of this consent.	As the predominant reason for overflows occurring relates to foreign objects being put down the wastewater network, QLDC recognises the importance of continuing its education and raising awareness to the community and visitors to the District. Ongoing and regular education via a number of methods (media including social, Scuttlebutt, targeted meetings/communication with key parts of the community such as eating establishments, hotels, industrial premises, and local construction industry) will assist in reducing the likelihood of overflows occurring over time. That the education is occurring can be monitored by ORC as the condition requires that the Annual Monitoring Report (Condition 10) includes the education initiatives that QLDC has undertaken throughout the previous year.

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
Network Improvements		
10	**Annual Monitoring Report** QLDC shall prepare and submit an Annual Monitoring Report to the *Regulatory / Consenting Manager*, Otago Regional Council by 1 September each year. The report shall cover the previous financial year (1 July to 30 June) and provide, where required below, information for the current financial year. The Annual Monitoring Report shall include the following information (in no particular order): a) The data collected under Condition 4 of this consent b) A summary (including evidence) of the education initiatives undertaken by QLDC in accordance with Condition 10 of this consent, and what education initiatives are planned for the current financial year c) What work QLDC has undertaken in the previous financial year to reduce the likelihood of blockages to the wastewater pipes from tree root ingress, and what work it intends to undertake in regard to this matter in the current financial year d) Confirmation of what wastewater networks are owned and / or managed by QLDC, including whether any of the future networks listed in Condition 2 of this consent are now owned and / or managed by QLDC and therefore are subject to the conditions of this consent for the current financial year e) Confirmation including evidence that QLDC has implemented a wastewater preventative inspection programme by CCTV or other technology, and how this was implemented in the previous financial year f) A summary of any wastewater maintenance or remedial works beyond	This condition is intended to provide ORC on an annual basis with the evidence that QLDC is: • Physically responding to any wastewater overflow in accordance with required procedures • Identifying through data collection any areas of the network that have had repeat overflows occurring in the same area of the network and the measures undertaken to fix these problems • Carrying out ongoing education and raising awareness with the community including visitors to the District • Making investments to improve the wastewater network to reduce the likelihood of overflows occurring over time The 1 September timing for providing the Annual Monitoring Report to Council is to line up with Councils financial year, being 1 July to 30 June, allowing the months of July and August to prepare the report for the previous financial year as well as capturing investment information for the coming financial year. Why 1 September is proposed as opposed to one month later (i.e. 1 August) is that this date lines up with QLDCs financial allocation systems for the coming financial year, whereby it will be confirmed what investments are being made to the wastewater network in the coming year.

QLDC condition number	QLDC proposed condition	Reasons why condition proposed / purpose of the condition
	"business as usual operating and maintaining the network" implemented in the previous financial year g) A summary of what wastewater capital investment works were implemented in the previous financial year h) Subsequent to the first Annual Monitoring Report a summary of what wastewater capital investment works were programmed for the previous financial year did not get implemented, the reasons why, and what was implemented instead i) What wastewater capital investment works are programmed to be implemented in the current financial year For clarity the Annual Monitoring Report does not need to include information relating to wastewater treatment plants in the Queenstown Lakes District, unless in relation to capital works investment where it would be helpful as supporting evidence to network improvements.	

8 Conclusion

QLDC is applying for resource consent from ORC to discharge wastewater overflows from its network to freshwater receiving environments and to land in circumstances when it may enter water. These overflows occur as a result of blockages, breakages, system failures, extreme storm events, and capacity exceedance in the network.

The occurrence of wastewater overflows from the QLDC network across the District is an existing situation.

Subsequently, consent is sought for a **Discretionary activity** pursuant to Rules 12.A Discharge of human sewage, 12.B Discharge of hazardous wastes, and 12.C Other discharges of the Otago Regional Plan: Water.

An assessment against the relevant statutory and non-statutory documents has been undertaken and has found that the proposed management of overflows are not entirely contrary to the objectives and policies of these documents.

The supporting technical assessments identify potential adverse ecological and public health effects. Consequently, an effects philosophy has been developed to manage these potential adverse effects through the implementation of conditions. These conditions require an immediate physical response process and ongoing network improvements including annual reporting to reduce the frequency of overflows occurring.

Therefore, the above assessment of effects has identified that the overall effects are more than minor but less than significant.

Appendix A – Indicative Network Location Maps

0 0.5 1 Km

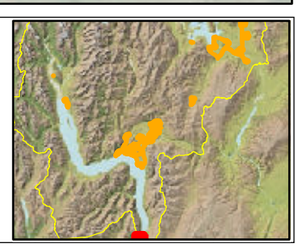
N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Kingston

Area of Assessment

Sewer Network



SPAP-OXNBRDGE TUN RD

SM53422

SM16083

SPKP-KAWARAU PLACE

SPPS-PARK STREET

SPBV-BAYVIEW RD

0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Area of Assessment

Unittype

Sewer Main with Overflow

Sewer Pump Station with Overflow

Sewer Network

sPumpstation

Existing and Future Wastewater Network Areas – Queenstown / Jacks Point

PS

SPAP-OXNBRDGE
TUN RD

PS

0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Arthurs Point

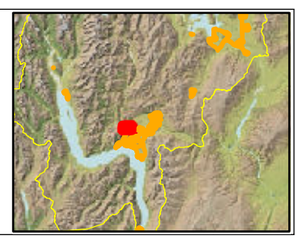
Area of Assessment

Unittype

PS Sewer Pump Station with Overflow

Sewer Network

PS sPumpstation



QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Lake Hayes (Sth) / Shotover Country

Area of Assessment
Sewer Network
sPumpstation
sTreatmentPlant

0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Lake hayes (Nth) / Arrowtown / Millbrook

Area of Assessment
Sewer Network
PS sPumpstation

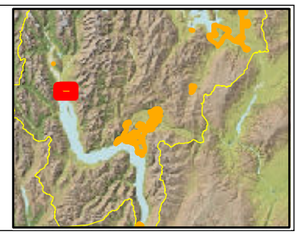
0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Glenorchy

Area of Assessment
Sewer Network
PS sPumpstation
sTreatmentPlant



QUEENSTOWN LAKES DISTRICT COUNCIL

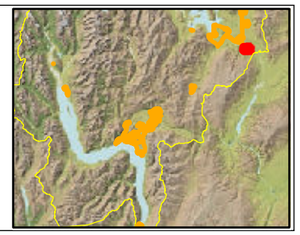
Existing and Future Wastewater Network Areas – Luggate

PS

0 0.5 1 Km

N

Area of Assessment
Sewer Network
PS sPumpstation
sTreatmentPlant



PS

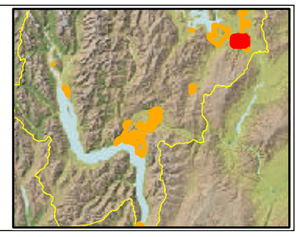
0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Wanaka Airport

Area of Assessment
Sewer Network
PS sPumpstation
sTreatmentPlant



QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Wanaka / Albert Town

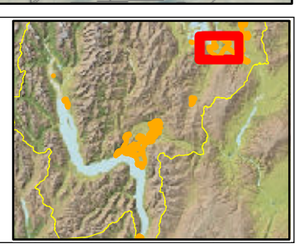
Area of Assessment

Unittype

Sewer Network

PS sPumpstation

PS Sewer Pump Station with Overflow



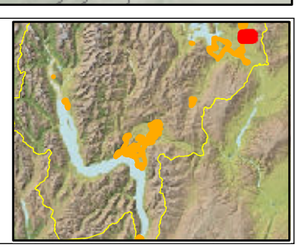
0 0.5 1 Km

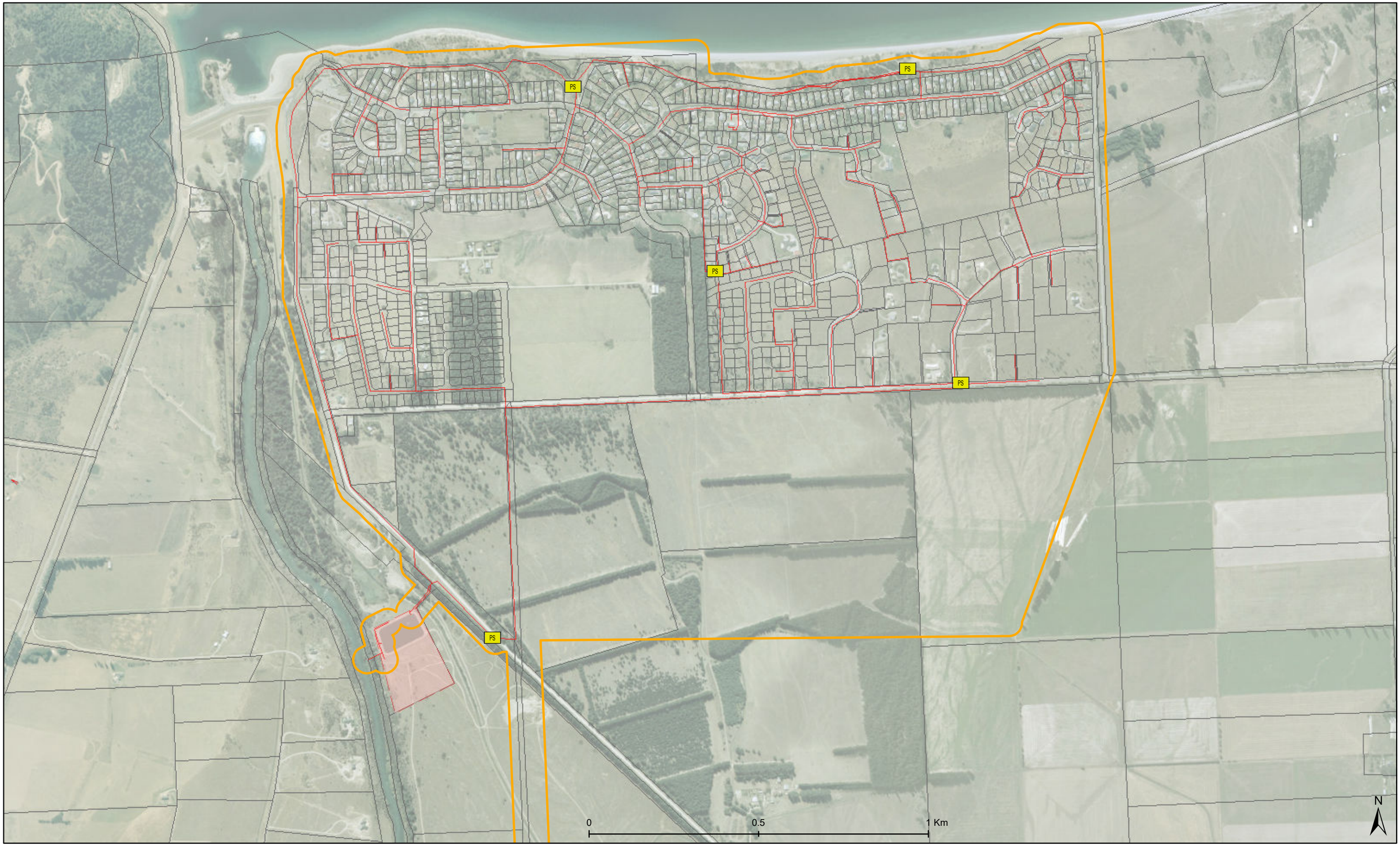
N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Hawea Flat

Area of Assessment

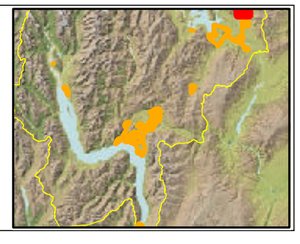




QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Lake Hawea

Area of Assessment
Sewer Network
PS sPumpstation
sTreatmentPlant



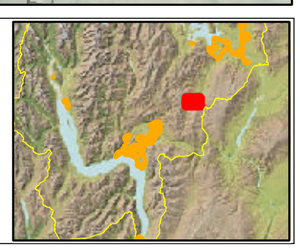
0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Cardrona

Area of Assessment
Sewer Network
sTreatmentPlant



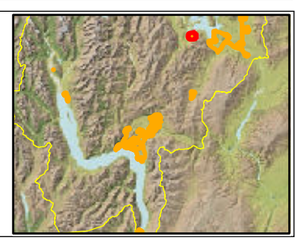
0 0.5 1 Km

N

QUEENSTOWN LAKES DISTRICT COUNCIL

Existing and Future Wastewater Network Areas – Glendhu Bay

Area of Assessment
Sewer Network
sTreatmentPlant



Appendix B – Physical Response Flow Chart

QLDC Wastewater Network Overflow Incident Response Process

OVERFLOW EVENT

NOTIFICATION VIA NETWORK ALARMS
- Early warning network alarm will automatically alert contractor to overflow

NOTIFICATION VIA A CALL IN FROM THE PUBLIC
- During work hours calls will be directed to a QLDC Operator
- After-hours calls will be directed to our after-hours call centre.

TARGET TO REACH SITE WITHIN ONE HOUR OF NOTIFICATION
We can do this because we have people, trucks and equipment available in both Wanaka and Queenstown 24 hours a day 7 days a week.

IDENTIFY TYPE OF OVERFLOW

Overflow to Water

SAFETY OF THE PUBLIC
Overflow to be stopped and contained. Booms and nets may be deployed to manage floating pollutants. No swimming signage to be erected

IDENTIFICATION AND RESPONSE
Identify cause of overflow, remove blockages/cause and undertake immediate repair. Response may include vacuum truck and/or jetting equipment, CCTV inspection and above ground clean up to remove visible solids. If complete repair isn't immediately possible, schedule maintenance as soon as possible.

MONITORING
Ongoing E.coli testing until 'no swim' signage can be removed. Follow up CCTV investigation to check adequacy of repair (if required).

Overflow to Land

SAFETY OF THE PUBLIC
Overflow to be stopped and contained and area cordoned. Contamination signage erected if required.

IDENTIFICATION AND RESPONSE
Identify cause of overflow, remove blockages/cause and undertake immediate repair. Response may include vacuum truck and/or jetting equipment, CCTV inspection and above ground clean up. If in-situ repair isn't immediately possible, schedule maintenance for as soon as possible.

MONITORING
Follow up CCTV investigation to check adequacy of repair (if required).

SAFETY IS KEY
Identify and collect site appropriate equipment depending on type of overflow.
Conduct any additional planning work that may be required for the specific event-resources, plant, equipment.

AUTHORITIES NOTIFIED
Where overflow has reached land and poses a public health risk - Ministry of Health
Where overflow has reached water - Ministry of Health + Otago Regional Council

INCIDENT REPORT PREPARED

LESSONS LEARNT WITH CONTRACTOR AND QLDC

Appendix C – Ecology Assessment

Queenstown Lakes District Council

Wastewater Network Consent: Assessment of Ecological Effects

ryder

Queenstown Lakes District Wastewater Overflow Discharge Network Consent: Assessment of Ecological Effects

Prepared for: Queenstown Lakes District Council

By: Ryder Environmental Limited

Author:

Dean Olsen

Internal Review

Greg Ryder

Document version: 28/03/2019

Cover photo (G. Ryder): View of Lake Hāwea from pump station #30, 24 August 2018

Ryder Environmental Limited
195 Rattray Street
PO Box 1023
DUNEDIN, 9054
New Zealand

Phone: 03 477 2119

www.ryderenv.nz

Executive summary

Queenstown Lakes District Council (QLDC) operates wastewater reticulation systems servicing a number of communities in the district including the greater Queenstown area, Wanaka (including Albert Town and Luggate), and Lake Hāwea. With any wastewater scheme, there is the potential for overflows to occur. This Assessment of Ecological Effects presents an assessment of the existing environments where such wastewater overflows may occur, including water quality (including microbiological), ecology, and fisheries, and considers the actual and potential adverse effects of discharges of wastewater to such receiving environments. It was prepared to support the broader Assessment of Environmental Effects prepared for QLDCs Wastewater Overflow Discharge Network Resource Consent application.

Most of the waterways in the Queenstown Lakes District have good to excellent water quality and support highly valued aquatic ecosystems, such as those recognised in the Water Conservation (Kawarau) Order. Lakes Hāwea, Wakatipu and Wanaka are microtrophic, characterised by high water clarity, low nutrients and low algal biomass and large volumes of this very high-quality water from these lakes form the Clutha/Mata-Au and upper Kawarau Rivers. Many of the tributaries of these waterbodies have similarly high water quality, particularly in their upper reaches. There are, however, some exceptions. The Shotover River, for example, has naturally high sediment loads, while water quality in Lake Hayes is poor, having been degraded by historical land-use practices as well as contemporary inputs of nutrients and sediment.

The generally high water quality in many of the waterways in the Queenstown Lakes District means that they are potentially sensitive to inputs of nutrients, sediment and animal or human waste.

The highest risk sites identified were associated with sites near embayments on Lakes Wanaka and Wakatipu (pump stations near Roys Bay and Bremner Bay in Lake Wanaka, Queenstown Bay and Frankton Beach in Lake Wakatipu), pump stations near the shore of Lake Hayes, a pump station near Bullock Creek (Wanaka), one pump station on the banks of Luggate Creek and another in a reserve near the Arrow River. There is also a general risk associated with the presence of a wastewater system in close proximity to waterways, such as in Queenstown and Wanaka. This general risk is likely to be affected by factors such as the density of urban development, topography, proximity to waterways and presence of potential flowpaths to waterbodies (e.g. stormwater systems).

CONTENTS

1. Introduction

Queenstown Lakes District Council (QLDC) operates wastewater reticulation systems servicing a number of communities in the district including the greater Queenstown area, Wanaka (including Albert Town and Luggate) and Lake Hāwea. With any wastewater scheme, there is the potential for overflows to occur. This Assessment of Ecological Effects supports the broader Assessment of Environmental Effects prepared for QLDC's Wastewater Overflow Discharge Network Resource Consent application.

This report presents the available information on the existing environments where wastewater overflows may occur, including water quality (including microbiological), ecology, and fisheries, and assesses the actual and potential adverse effects of discharges of wastewater to these receiving environments. These assessments extend to areas of future development of wastewater systems in the Queenstown Lakes District.

The broader Assessment of Environmental Effects contains a fuller description of the project.

2. Ecological Assessment Methodology

This assessment consisted of a desktop literature review of ecological and water quality information for potential receiving waters along with site visits to 35 sites within the existing wastewater network as well as 12 sites that are part of planned future wastewater systems or that may become part of the QLDC network. In addition, water quality and biomonitoring[1] data received from Otago Regional Council and NIWA was analysed and presented to establish the existing water quality of water bodies.

Water quality outcomes for different water bodies were compared with Schedule 15 of the Otago Regional Plan: Water (RPW) (see Section 2.2).

2.1 Approach to risk assessment

The approach used to assess the ecological risk associated with wastewater overflows to freshwater in this report consisted of two primary considerations:

1) The risk of any wastewater overflow entering freshwater, and

2) The actual and potential effect(s) of wastewater overflows entering freshwater.

The risk of wastewater entering freshwater at the 35 existing sites and 11 potential future sites identified was assessed based on a measurement of the distance from the potential source of wastewater to water. Where a clear flow path was identified during the site visit or from aerial photographs[2], the distance to water was measured along this path. Such flow paths included roadways and stormwater systems, where these discharged to surface waters. Where no clear pathway was identified, the distance to water was measured as the shortest straight-line distance to water considering the local topography (i.e. water cannot flow up hill). The landcover of each potential flow path was also considered based on aerial photographs. Impervious surfaces (e.g. concrete, asphalt) would provide minimal infiltration of wastewater, so would potentially facilitate rapid transport to surface waters, and were therefore were considered to represent a higher risk of wastewater reaching surface waters than vegetated areas (e.g. rank grass). These factors and the resulting level of risk are set out in Table 1 below. While presented as discrete bands in Table 1, these factors are actually continuous variables and the risk of wastewater entering each of the pump stations and other notable parts of the network was considered based on the combination of each of these factors. The assessment of risk set out in Section 6.1 was based on the combination of distance to water, presence of a flow path and the ground cover.

[1] Periphyton and macroinvertebrate monitoring data
[2] QLDC web-based GIS layer

Table 1 Characteristics used to determine the risk of wastewater entering freshwater in this assessment.

Distance to water	Flow path	Ground cover	Risk
>200 m	No	-	Negligible
>200 m	No	Rank grass, thick vegetation	Low
100-200 m	Possible flow path present	Grass, shrubs with good undergrowth	Low-mod
100-200 m	Flow path present	Sparse grass or trees with little undergrowth	Moderate
40-100 m	Flow path present	Gravel, rock, bare soil	Mod-high
0-40 m	Clear flow path present	Impervious (e.g. concrete, asphalt)	High

The actual and potential adverse effects of wastewater overflows on freshwater ecology were based on an assessment of the likely consequences of wastewater overflow to the various types of waterbody (see Section 3 for descriptions of the existing environment for the different types of waterbody found in the Queenstown Lakes District).

This assessment considered the sensitivity of receiving environments (including the capacity to dilute contaminants as well as the existing state of each waterbody) along with the significance of the values in the receiving environment. For rivers, this assessment included consideration of the size of the river (flow) as well as water velocities/channel gradient (which affects the aeration rate and sediment deposition rate) as well as current water quality. In lakes, this assessment included consideration of the size of the lake (volume), residence time of water, exposure of the area that could potentially be affected by an outflow (considering wind directions, currents), tributary inflows and proximity to the lake outlet.

Table 2 below sets out the consequences and resulting level of effects.

Table 2 Description of the assessment of the potential effects of wastewater overflows on freshwater ecosystems.

Oxygen	Sediment		Growths		Odour	Scums/foam	Assessed level of effects
	Sedimentation	Clarity	Fungus	Periphyton			
Oxygen levels unchanged	Limited sedimentation	Water clarity not noticeably changed	No sewage fungus evident	Periphyton similar to areas upstream of overflow	No noticeable odour	No scums or foams	Low
Oxygen levels slightly lower than expected but unlikely to cause any ecological effect	Some localised deposits of fine sediment on channel margins and in backwaters (rivers) or thin layer of sediment on macrophytes or natural substrate in vicinity of overflow	Slight reduction in clarity	Very limited fungus growths in vicinity of overflow	Some moderate growths of algal mats or filamentous algae in the vicinity of overflow	Slight odour in vicinity of overflow	Minor scums or foams in immediate vicinity of overflow	Low-mod
Oxygen levels lower than normal which may cause stress for aquatic organisms	Some sedimentation on channel margins and in backwaters (rivers) or layer of sediment on macrophytes or natural substrate in vicinity of overflow	Obvious reduction in water clarity	Some fungus growth evident in vicinity of overflow	Moderate growths of algal mats or filamentous algae , in the vicinity of overflow	Noticeable odour in vicinity of overflow	Scums/foams evident in vicinity of overflow	Moderate
Oxygen levels at levels that may cause stress for aquatic organisms and lead to mortality if prolonged	Moderate sedimentation, deposited fine sediment covers much of the surface of natural substrate and macrophytes	Noticeable reduction in water clarity	Substantial fungus growth evident, mostly in vicinity of overflow	Moderate to thick growths of algal mats or filamentous algae mostly in the vicinity of overflow	Strong odour in vicinity of overflow	Conspicuous scums/foams in vicinity of overflow	Mod-high
Oxygen concentrations likely to drop to levels that may lead to the death of aquatic organisms	Severe sedimentation, deposited fine sediment completely covers the surface of natural substrate and may smother macrophytes	Marked reduction in water clarity	Substantial growths of sewage fungus extending well beyond the vicinity of overflow	Thick growths of algal mats or filamentous algae extending well beyond the vicinity of overflow	Strong odour extending beyond the vicinity of overflow	Conspicuous scums or foams evident beyond the vicinity of overflow	High

2.2 Statutory considerations

2.2.1 Water Conservation (Kawarau) Order

The Water Conservation (Kawarau) Order (WCO) includes provisions for water bodies that may be affected by the wastewater discharges considered in this report. These are outlined in Schedule 2 of the WCO, attached as Appendix A. Water quality provisions in the Kawarau WCO includes reference to water quality classes from Schedule 3 of the Resource Management Act (see Appendix B for the water quality standards for each of these water quality classes).

2.2.2 Lake Wanaka Preservation Act

The Lake Wanaka Preservation Act 1973 recognises the value the community places on the water quality of Lake Wanaka. Section 4 of the Lake Wanaka Preservation Act 1973 outlines the purposes of the Act, which includes the following purpose:

(d) to maintain and, as far as possible, to improve the quality of water in the lake.

2.2.3 Regional Plan: Water - Schedule 15

Schedule 15 of the RPW describes the characteristics of good water quality in lakes and rivers along with numerical water quality limits and targets for waterbodies across Otago. Table 3 below sets out the numerical water quality limits/targets for receiving water groups (RWGs) in the Queenstown Lakes District. It is worth noting that nitrate-nitrogen and dissolved reactive phosphorus limits apply to flowing water sites (RWGs 2 & 3), while limits on total nitrogen and total phosphorus apply to lakes (RWGs 4 & 5).

The limits/targets in Schedule 15 are not limits that apply to any potential discharge, but rather set out the long-term water quality objectives for receiving waters. As such, Schedule 15 is included here to provide context on the existing state of receiving waters and the long-term objectives for these water bodies.

It is important to note that in river sites these limits/targets apply as 5-year, 80th percentiles when flows are below median flows at the relevant flow reference site. That is, 80% of values collected when flows are at or below the median flow at the appropriate flow reference site over a 5-year period should be below the Schedule 15 limit.

Table 3 Numerical limits and targets for good water quality in lakes and rivers in the Queenstown Lakes District from Schedule 15 of the Otago Regional Plan: Water. RWG = receiving water group, NNN = nitrate-nitrite nitrogen, DRP = dissolved reactive phosphorus.

RWG	NNN mg/L	Total nitrogen mg/L	DRP mg/L	Total phosphorus mg/L	Ammoniacal nitrogen mg/L	*E. coli* cfu[3]/100 mL	Turbidity NTU	Tributaries within QLDC boundary
2	0.075	-	0.01	-	0.1	260	5	Arrow River, Cardrona River, Clutha River (Luggate to sea), Kawarau River (downstream of Shotover confluence), Luggate Creek, Mill Creek, Shotover River
3	0.075	-	0.005	-	0.01	50	3	Clutha River/Mata-Au above Luggate, Dart River, Kawarau River (above Shotover), Matukituki River, tributaries of Lakes Hāwea, Wakatipu & Wanaka
4	-	0.55	-	0.033	0.1	126	5	Lake Hayes
5	-	0.1	-	0.005	0.01	10	3	Lake Hāwea, Lake Wakatipu, Lake Wanaka

[3] Colony forming units. When culturing microbes, it is uncertain if a colony arose from one cell or a group of cells and expressing results as colony-forming units reflects this uncertainty.

3. Receiving environments

3.1 Very large rivers (Clutha/Mata-Au, Kawarau)

The natural values of the Clutha/Mata-Au and Kawarau Rivers from Schedule 1A of the RPW are set out in Appendix C. A number of the outstanding characteristics of the Kawarau River recognised in Schedule 2 of the Kawarau WCO (Appendix A) are presented in Schedule 1A of the RPW. These include the wild and scenic characteristics, natural characteristics, scientific value and recreational values (Appendix A). Schedule 2 also states that water quality is to be managed to Water Quality Class CR (Appendix A).

3.1.1 Ecology

Close to the lake outlets, both the Clutha/Mata-Au and Kawarau Rivers have very high water quality with low nutrients, *E. coli* and turbidity (Appendix D – Figures 1-5) and highly productive ecosystems (particularly in upper Clutha/Mata-Au).

Fish

Longfin eel, kōaro, common bully, upland bully, brown trout have been recorded from both the upper Clutha/Mata-Au and Kawarau Rivers. Rainbow trout, and quinnat salmon have been recorded from the upper Clutha/Mata-Au and are likely to also be present in the Kawarau River. Of the native fish present, longfin eel and kōaro are classified as 'at risk – declining', while common and upland bully are classified as "not threatened" (Dunn et al. 2018).

3.1.2 Fishery

The upper Clutha/Mata-Au is recognised as a nationally significant trout fishery[4] (Otago Fish & Game Council 2015), with in excess of 20,000 angler days recorded in the 2001/2002 and 2007/08 National Angler Surveys, although angler usage was substantially lower in the 2014/15 survey (Unwin 2016). Meanwhile, the Kawarau River supports a locally significant trout fishery with relatively consistent usage by anglers across the three most recent angler surveys.

[4] A naturally self-sustaining trout fishery.

3.2 Medium-large rivers (Hāwea, Shotover)

The natural values of the Hāwea and Shotover Rivers from Schedule 1A of the RPW are set out in Appendix C. A number of the outstanding characteristics of the Shotover River recognised in Schedule 2 of the Kawarau WCO (Appendix A) are presented in Schedule 1A of the RPW. These include the wild and scenic characteristics, natural characteristics (in particular, the high natural sediment load and active delta), scientific value (in particular, the high natural sediment load and active delta) and recreational values (Appendix A). Schedule 2 also states that water quality is to be managed to Water Quality Class CR (Appendix A).

3.2.1 Ecology

The Shotover River has extremely good water quality, with low levels of NNN, ammoniacal nitrogen and dissolved reactive phosphorus at the Bowen's Peak monitoring site (Appendix D – Figures 1-3). Counts of *E. coli* indicate a very low level of faecal contamination, although occasionally *E. coli* counts exceed alert (260 cfu/100 mL) and Action (550 cfu/100 mL) levels (Appendix D – Figure 4). However, the Shotover River carries naturally high loads of suspended sediment (Appendix D – Figure 5), as recognised in Schedule 2 of the Kawarau WCO (Appendix A).

Fish

The Shotover River supports a limited population of native fish, with a single longfin eel caught from the mainstem close to the SH6 bridge and records of kōaro from a number of tributary streams. Brown and rainbow are also present. Meanwhile kōaro, longfin eel, common bully, brown trout and rainbow trout have been recorded from the Hāwea River. Both longfin eel and kōaro are classified as 'at risk – declining' (Dunn *et al.* 2018).

The Hāwea River generally has very low *E*. coli concentrations, with the long-term median concentration of 1.6 cfu/100 mL (Appendix D – Figure 4)and water clarity is generally high, with turbidity ranging from 0.2 to 2 NTU (Appendix D – Figure 5), corresponding to a clarity range of 1.4 to 12.1 m.[5]

3.2.2 Water clarity and colour (hue)

High sediment loads and low water clarity are a feature of the Shotover River (Ludgate & Ryder 2008), as recognised by the WCO – see Appendix A), with the median water clarity (July 2008-December 2017) of less than 1 m (Appendix D – Figure 6). The low water clarity in the Shotover River means that it is unsuitable for swimming most of the

[5] Based on the relationship between turbidity and black disc clarity at the nearby National River Water Quality Network site in the Clutha River at the Luggate Bridge between February 1989 and December 2017. Turbidity and clarity relate to one-another as an inverse power relationship: Clarity = 2.7215 *Turbidity$^{-0.929}$, the R^2 for this relationship is 61.7%.

time naturally (MfE 1994, ANZECC 2000). However, the high sediment loads in the Shotover are natural and its recognised significance for kayaking, rafting and jetboating indicates that the limited visibility in the Shotover does not affect these activities.

3.2.3 Fishery

The Shotover River supports a locally significant trout fishery and angler usage of the Shotover has generally been low, with the exception of the 2001/02 season (Unwin 2016). The trout fishery in the Hāwea River is regionally significant (Otago Fish & Game Council 2015), although there has been a substantial reduction in angler effort since the 2001/02 survey. No international angler effort was record in either river during the 2014/15 season. It is likely that the reduction in angler effort in the Hāwea River is a result of the invasion and establishment of Didymo (*Didymosphenia geminata*). Didymo can reach very high levels of cover and biomass, which is unsightly, can affect macroinvertebrate communities and fish numbers (Jellyman & Harding 2016) and can be a nuisance to anglers by fouling their equipment. Spawning in the Hāwea River is thought to contribute to trout populations in the broader upper Clutha catchment.

3.3 Small-medium rivers

Four small- to moderate-sized rivers flow through or adjacent to urban areas within the Queenstown Lakes District: Arrow River (Arrowtown), Cardrona River (Albert Town), Luggate Creek (Luggate) and Mill Creek (Lake Hayes catchment). The natural values of these waterbodies from Schedule 1A of the RPW are set out in Appendix A.

3.3.1 Ecology

Water quality in the Arrow River is generally good with low concentrations of ammoniacal nitrogen and DRP and *E. coli* (Appendix D – Figures 2-4). NNN concentrations in the lower Arrow River were elevated during the sampling period available (August 1998-June 2014; Appendix D – Figure 1). A substantial amount of water (maximum rate of take of approximately 680 l/s) is abstracted from upstream of Arrowtown by the Arrow Irrigation Company (Olsen *et al.* 2017). Given the magnitude of this abstraction, it is expected to reduce the capacity of the lower river to dilute any inputs of contaminants, especially during the irrigation season (October-April).

A recent catchment water quality study found that water quality in the Cardrona River is generally high, with very low levels of ammoniacal nitrogen and dissolved reactive phosphorus (Appendix D – Figures 2-3; Olsen, 2016). However, concentrations of NNN exceeded the Schedule 15 limit in the lower Cardrona River (Olsen 2016).

Concentrations of NNN at the Mount Barker monitoring site were elevated (Appendix D – Figure 1).

Concentrations of NNN (Appendix D – Figure 1) and ammoniacal nitrogen (Appendix D – Figure 2) in Luggate Creek were typically low, while concentrations of DRP were relatively high (Appendix D – Figure 3) and exceed the Schedule 15 target (0.0152 mg/L cf. 0.01 mg/L[6]). Concentrations of *E. coli* in Luggate Creek were generally low, although they can exceed guidelines for contact recreation at times, usually in association with high rainfall and high flow events (Appendix D – Figure 4). Turbidity in Luggate Creek was generally low (Appendix D – Figure 5).

Water quality in Mill Creek, does not meet the Schedule 15 targets (see Table 3[7]) for NNN (0.36 mg/L cf. 0.075 mg/L) and *E. coli* (440 cfu/100 mL cf. 260 cfu/100 mL)[8] (Appendix D – Figures 1 & 4). However, dissolved reactive phosphorus concentrations (0.008 mg/L cf. 0.01 mg/L) and turbidity (4.11 NTU cf. 5.0 NTU) are within the Schedule 15 limit[8] (Appendix D – Figures 3 & 5).

Fish

Arrow River – The Arrow River supports a limited population of native fish, with a single record of kōaro from close to the confluence of Soho Creek, and it appears that the abundance of kōaro in the Arrow catchment is very low (Olsen *et al.* 2017). Brown trout and rainbow trout can be locally abundant in the Arrow River and in the Soho Creek sub-catchment. Kōaro is classified as 'at risk – declining' (Dunn *et al.* 2018).

Cardrona – Fish populations include longfin eels, kōaro, upland bullies and Clutha flathead galaxias (*Galaxias* sp. D) as well as brown and rainbow trout (Ravenscroft *et al.* 2017). Clutha flathead galaxias are classified as 'nationally critical', the highest threat classification in New Zealand, while longfin eels and kōaro are classified as 'at risk – declining' (Dunn *et al.* 2018). Clutha flathead galaxias are mostly found in tributaries of the Cardrona where trout are not present, with the exception of the lower reach between the Mount Barker flow monitoring site and the SH8 bridge where limited numbers of Clutha flathead galaxias have been recorded.

Luggate Creek – Brown trout, rainbow trout and kōaro have been recorded from the Luggate Creek catchment. Kōaro is classified as 'at risk – declining' (Dunn *et al.* 2018).

Mill Creek – Common bully, kōaro, brown trout and perch (*Perca fluviatilis*) have been recorded from the Lake Hayes catchment[9], although perch are likely to be mainly confined to Lake Hayes. Populations of kōaro and common bully are landlocked. Kōaro are classified as "at risk – declining", while common bully are not considered to be

[6] http://archive.orc.govt.nz/Documents/Publications/Research%20And%20Technical/surface-water-quality/2016/2016%20SOE%20report%20card.pdf
[7] On page 7
[8] https://www.orc.govt.nz/media/6120/2018-wq-report-card-arrow-basin-pdf.pdf
[9] New Zealand Freshwater Fish Database, records downloaded 8 August 2018

threatened (Dunn *et al.* 2018).

Macroinvertebrates

No macroinvertebrate data are available for the Arrow River. However, macroinvertebrate communities collected from the Cardrona River at Mount Barker between 2001 and 2015 were consistent with good to excellent water quality, and have been stable over this period (Olsen 2016). Olsen (2016) undertook macroinvertebrate surveys throughout the Cardrona catchment, with communities in the upper Cardrona River and tributaries (all upstream of Mount Barker) in October 2014 consistent with good water quality, although sites below Mount Barker indicated that water/habitat quality was fair. Macroinvertebrate sampling in February 2015 followed a similar pattern, but the macroinvertebrate community at most sites included a greater proportion of taxa that are tolerant of poor water quality, probably the result of the low, stable flows and warmer water temperatures before this sampling occasion.

Macroinvertebrate sampling in Luggate Creek at the SH6 bridge is undertaken annually as part of ORC's State of the Environment (SoE) monitoring programme. Macroinvertebrate community index (MCI) scores for this site over the last 10 years have consistently been between 100 and 112, indicating good water/habitat quality.

3.3.2 Faecal indicator bacteria

At low flows, *E. coli* concentrations are generally low at most sites in the Cardrona River (Olsen 2016). *E. coli* counts in SoE samples from the Cardrona River at Mount Barker (2007-2016) show that 3% of readings were above "action" level (>550 cfu/100 mL) and only 6% of readings were above "alert" level (>260 cfu/100 mL) (Appendix D – Figure 4). It is likely that some or all of these readings are attributable to high flows at the time of sampling.

Similarly, *E. coli* counts in SoE samples from Luggate Creek at the SH6 bridge (2007-2016) show that 2% of readings were above "action" level (>550 cfu/100 mL) and only 5% of readings were above "alert" level (>260 cfu/100 mL)(Appendix D – Figure 4). Again, it is likely that some or all of these elevated readings are likely to be attributable to high flows at the time of sampling.

3.3.3 Fishery

Both the Arrow and Cardrona Rivers support locally significant fisheries, although the proximity of the Arrow River to the tourist towns of Arrowtown and Queenstown means that it is especially popular with international anglers (Unwin 2016). Most angler effort in both these fisheries is early in the fishing season (November-April for the Arrow River, October-April for the Cardrona River) and likely reflects anglers targeting post-spawn adult fish before they drop back into the Clutha/Mata-Au (Cardrona) or Kawarau (Arrow)

Rivers as flows drop (Unwin 2016). No angler effort has been recorded from Luggate Creek in any of the National Angler Surveys (Unwin 2016).

3.4 Streams

A number of small streams flow through the urban areas of Wanaka and Queenstown including Bullock Creek, Horne Creek and numerous other small tributaries. Of these, Schedule 1A of the RPW identifies both Bullock Creek and Horne Creek as having significant habitat for trout spawning and juvenile rearing, and as having a significant presence of trout (in the lower reaches of Horne Creek) (Appendix C). Furthermore, Horne Creek is also identified as having unimpeded access through to Lake Wakatipu and being free of weeds (Appendix C).

There is limited information on the water quality and ecology of these smaller streams. Despite their small size, these smaller streams may carry contaminants to larger water bodies.

3.4.1 Ecology

Fish

Native fish potentially present include longfin eel, kōaro (especially lake tributaries), common bully (lakes tributaries) and upland bully[10]. Clutha flathead galaxias are potentially present in tributaries of upper Clutha River[11], particularly where trout are absent. Clutha flathead galaxias are classified as 'nationally critical', the highest threat classification in New Zealand, while longfin eels and kōaro are classified as 'at risk – declining' (Dunn *et al*. 2018).

Many of the small tributary streams of the upper Clutha and Lakes Hāwea, Wakatipu and Wanaka provide habitat for trout spawning and are likely to be recruitment sources for trout populations in larger receiving water bodies.

3.5 Large lakes (Lakes Hāwea, Wakatipu and Wanaka)

Lakes Hāwea, Wakatipu and Wanaka are large (141-291 km^2), deep (311-392 m maximum depth) glacial lakes fed by large alpine rivers that drain from the Southern Alps and foothill ranges. Their catchments are dominated by steep alpine areas that are very sparsely populated, with the only major settlements being located close to the outlets of each lake: Hāwea, Queenstown and Wanaka, respectively. In the Wakatipu

[10] New Zealand Freshwater Fish Database, records downloaded 8 August 2018
[11] New Zealand Freshwater Fish Database, records downloaded 8 August 2018

catchment there are settlements (Glenorchy and Kingston) at either end of the lake.

These three large lakes are renowned for the high quality of their water, especially their clear waters and the blue hue of their water which, in part, results from the high clarity of their water (Appendix D – Figure 7). This high clarity is due, in part, to low nutrient availability (Appendix D – Figures 8-9) which results in these lakes supporting a low biomass of phytoplankton (Appendix D – Figure 10). All three of these lakes can be classified as microtrophic systems.[12]

High water clarity also allows high penetration of ultra-violet radiation into the water, killing bacteria, which results in very low *E. coli* concentrations (Appendix D – Figure 11). These characteristics are reflected in the Schedule 15 limits for these water bodies (Table 3).

3.5.1 Ecology

Fish

Fish populations include longfin eel (*Anguilla dieffenbachii*), kōaro (*Galaxias brevipinnis*), common bully (*Gobiomorphus cotidianus*), upland bully (*Gobiomorphus breviceps*), brown trout (*Salmo trutta*), rainbow trout (*Onchorhynchus mykiss*) and quinnat salmon (*Onchorhynchus tshawytscha*)[13]. Populations of kōaro and common bully are landlocked. Longfin eel and kōaro are classified as "at risk – declining", while other native species are not considered to be threatened (Dunn *et al.* 2018).

Macroinvertebrates

Macroinvertebrate communities of Lakes Hāwea, Wakatipu and Wanaka have been surveyed on a number of occasions by various researchers (Biggs & Malthus 1982, Stark 1993, Kelly & Hawes 2005, Thompson & Ryder 2008). The results of these studies suggest that these lakes support similar macroinvertebrate communities, with snails (*Potamopyrgus antipodarum*, *Gyraulus*, *Lymnaea* and *Physa*), chironomid midges (*Chironomus*, Orthocladiinae, Tanypodinae), worms (Oligochaeta, Nematoda) and caddis flies (especially the purse-cased caddis *Paroxyethira*) among the most common taxa collected. Kelly & Hawes (2005) found exotic macrophyte beds supported higher macroinvertebrate densities and diversity than native macrophyte beds.

Freshwater mussels (*Echydridella menziesii*) are present in Lakes Hāwea, Wakatipu and Wanaka (Thompson & Ryder 2002, Goldsmith *et al.* 2007) and are listed as "at risk – declining" by Grainger *et al.* (2014).

[12] Microtrophic (a trophic level of less than 2) is defined as lakes with very good water quality. Such lakes are clear and blue with very low levels of nutrients and algae (https://www.lawa.org.nz)
[13] New Zealand Freshwater Fish Database, records downloaded 8 August 2018

Macrophytes

One measure of the ecological condition of lakes is LakeSPI (Lake Submerged Plant Indicators) based on the composition of native and invasive plants (Clayton & Edwards 2006). The LakeSPI score for Lakes Wakatipu and Wanaka indicate that they are in 'excellent' condition, although the macrophyte community of Lake Wakatipu is in better condition, with a very high native condition and a low level of invasive impact (Table 4). In comparison, Lake Wanaka has a slightly lower overall LakeSPI, slightly lower native condition and higher invasive impact, with two invasive oxygen weeds present: *Elodea* and *Lagarosiphon*, while only *Elodea canadiensis* is present in Lake Wakatipu (Table 4).

Table 4 Macrophyte survey data for Lakes Wakatipu and Wanaka. Data from https://lakespi.niwa.co.nz/

Lake	Native submerged plants recorded	Invasive submerged plants recorded	Max depth (m) of submerged aquatic plants				LakeSPI		
			Year	Native plants	Charophyte meadows	Invasive	LakeSPI	Native condition	Invasive impact
Lake Wakatipu	Charophyte meadow	*Elodea*	2001	35	25	-	98	97	0
	Native pondweeds		1992	50	50	8	90	93	13
	Native milfoils		1982	45	45	7	94	95	6
	Isoetes								
	Charophyte species								
	Turf community								
Lake Wanaka	Charophyte meadow	*Elodea*	2011	20	18	8	81	87	25
	Native pondweeds	*Lagarosiphon*	2001	20	20	-	80	81	19
	Native milfoils		1982	35	25	-	94	91	0
	Isoetes								
	Charophyte species								
	Turf community								

Clayton *et al.* (1986) sampled macrophytes to the maximum vegetation depth (where possible) at various sites in Lake Hāwea, with a maximum depth of 36 m sampled. Stark (1993) recorded the macrophyte species present in samples taken from a range of depths (up to 4 m in Lakes Hāwea and Wanaka and up to 6 m in Lake Wakatipu). Kelly & Hawes (2005) collected samples from between 3-5 m in Lake Wanaka. Thompson & Ryder (2008) collected macrophyte and macroinvertebrate samples at depths of between 1-12 m in Lakes Hāwea and Wanaka.

Most of the macrophyte species recorded from each lake (

Table 5) were native and not threatened (based on Lange *et al.* 2013). However, Stark (1993) recorded the quillwort *Isoetes kirkii*, which is classified as 'at risk – declining', from both Lakes Wakatipu and Wanaka, although Kelly & Hawes (2005) recorded *Isoetes alpinus* from Lake Wanaka. *Isoetes alpinus* is classified as not threatened (Lange *et al.* 2013). Stark (1993) also recorded the marsh arrow grass *Triglochin palustris* from Lake Wanaka, which is classified as 'threatened – nationally critical' (Lange *et al.* 2013).

The presence of Maniototo button daisy *Leptinella maniototo* and curly dock *Rumex crispus* in shallow (<1 m) parts of Lake Hāwea probably reflect the variability of water levels resulting from the management of Lake Hāwea for hydroelectric power generation. Maniototo button daisy is often found growing close to water, in ephemeral wetlands and at sites subject to seasonal flooding and drying episodes.[14]

All three lakes support deep water bryophyte (mosses and liverworts) communities. In Lake Hāwea these occur to 35 m, in Lake Wakatipu to 60 m and down to 50 m in Lake Wanaka (de Winton & Beever 2004). Coffey and Clayton (1988b) recorded bryophytes to a maximum depth of 70 m in Lake Wakatipu, while de Winton and Beever (2004) found bryophytes to a maximum depth of 60m, with the average maximum depth limit of 41.5m. These communities require very high water clarity and are rare internationally.

[14] http://www.nzpcn.org.nz/flora_details.aspx?ID=913

Table 5 Macrophyte taxa recorded from Lakes Hāwea, Wakatipu and Wanaka by [1] = Clayton et al. 1986, [2] = Stark (1993), [3] = Kelly & Hawes (2005) and [4] = Thompson & Ryder (2008).

Lake Hāwea	Lake Wakatipu	Lake Wanaka
Chara corallina[1,2,4]	*Chara corallina*[2]	*Chara corallina*[2,4]
Chara braunii[1]	*Chara fibrosa*[2]	*Chara fibrosa*[2]
Crassula sinclairii[2]	*Nitella* spp. [2]	*Nitella pseudoflabellata*[4].
Elodea canadensis[2,4]†	*Elatine gratioloides*[2]	*Nitella hookeri*[4]
Glossostigma diandrum[2]	*Glossostigma diandrum*[2]	*Nitella hyalina*[4]
Glossostigma elatiinoides[2]	*Isoetes kirkii*[2] ‡	*Elatine gratioloides*[2]
?Juncus sp.[2]	*Lilaeopsis* sp. [2]	*Elodea canadensis*[2,3,4]†
Leptinella maniototo[2]*	*Myriophyllum triphyllum*[2]	*Glossostigma elatinoides*[4]
Lilaeopsis sp.[2]	*Pilularia novae-zelandiae*[2]	*Glossostigma diandrum*[2]
Myriophyllum aquaticum[4]	*Potamogeton cheesemanii*[2]	*Isoetes alpinus*[3]
Myriophyllum triphyllum[2,4]	Moss (*Lycopodium* spp.) [2]	*Isocetes kirkii*[2,4] ‡
Pilularia novae-zelandiae[2]		*?Juncus* sp.[2]
Potamogeton cheesemanii[2,4]		*Lagarosiphon major*[3,4]†
Rumex crispus[2]*		*Lilaeopsis ruthiana*[4]
Moss (*Lycopodium* spp.)[2]		*Myriophyllum aquaticum*[4]
Nitella hooker[1,4]		*Myriophyllum pedunculatum*[2]
Nitella hyalina[4]		*Myriophyllum triphyllum*[2,3,4]
Nitella pseudoflabellata[1,4]		*Pilularia novae-zelandiae*[2]
		Potamogeton cheesemanii[2,3,4]
		Ranunculus limosella[2]
		Triglochin palustris[2] §
		Moss (*Lycopodium* spp.)[2,4]
		Lagarosiphon major[3,4]

* Not typically a submerged aquatic macrophyte
† Invasive species
‡ Native, at risk – declining
§ Native, threatened – nationally critical

3.5.2 Faecal indicator bacteria

Recreation monitoring in Lake Hāwea (December 2014-March 2018) indicates that the microbial water quality is excellent, with low overall risk for contact recreation, with all readings over the last three years being <50 cfu/100mL. Similarly, limited sampling water quality in Roys Bay in Lake Wanaka (December 2017 – March 2018), indicates that *E. coli* concentrations are generally low (<72 cfu/100 mL), representing a low overall risk for contact recreation. However, contact recreation sampling at Lake Wanaka at the Township site in 2014-15 resulted in two samples that exceeded 550 cfu/100mL[15], while all samples collected over the 2015/16 contact recreation season were below

[15] http://archive.orc.govt.nz/Documents/Publications/Research%20And%20Technical/surface-water-quality/2015/2014%202015%20Contact%20Rec%20report%20card.pdf

550 cfu/100 mL[16]. Recent sampling in Lake Wakatipu shows that whilst the water quality in the Frankton Arm generally has a high level of compliance with guidelines for contact recreation, two values were recorded during the 2017/18 season that exceeded 550 cfu/100 mL ('Action' level[17]) and one value was recorded that was between 260 and 550 cfu/100 mL ('Alert' level[17]). One other non-compliance was recorded in the 2015/16 bathing season, with an 'Alert' level reading recorded on 25 January 2016.

3.5.3 Fisheries

All three lakes support nationally significant fisheries for trout and salmon (Otago Fish & Game 2015). Angler usage is very high in all three lakes, although the level of use estimated for the 2014/15 season was lower than in the 2007/08 season in Lakes Hāwea and Wanaka, while effort in Lake Wakatipu has been more consistent through time (Unwin 2016).

The Kawarau WCO recognises the fishery in Lake Wakatipu as being an outstanding characteristic (Appendix A).

3.5.4 Water clarity and colour (hue)

Scenic values have been identified as outstanding in all three lakes, particularly the colour of their water (Schedule 1A of the RPW). The colour of water is affected by the absorption and scattering of light. In very clear water, longer wavelengths of light (red, yellow, green) are absorbed by water molecules, while shorter wavelengths (blue) penetrate the water to a greater extent and are more likely to be scattered and reach the eye of an observer, giving very clear water a blue hue. The introduction of sediment particles, particulate or dissolved organic matter and phytoplankton can alter the hue by absorbing and/or scattering different wavelengths of light, giving the water a green, yellow or brown hue. As noted in section 2.1, the blue hues of Lakes Hāwea, Wakatipu and Wanaka partly result from the very high clarity of their waters, with low amounts of suspended sediment and low phytoplankton biomass, especially in the main bodies of these large lakes.

[16] http://archive.orc.govt.nz/Documents/Publications/Research%20And%20Technical/surface-water-quality/2016/Contact%20Recreation%20report%20card%202015-16.pdf

[17] Ministry for the Environment & Ministry of Health (2002). Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment, Wellington. See Appendix C for an outline of the alert levels for freshwater contact recreation monitoring.

3.6 Medium lakes (Lake Hayes)

Lake Hayes is a medium-sized lake with an area of 276 ha and a maximum depth of 33 m. It is a nutrient-rich lake (eutrophic[18] – Figures 1-4) as a result of historic catchment development (including top dressing) and land-use intensification as well as contemporary activities in its catchment, which results in periodic algal blooms and fish kills.

Schedule 1A of the Otago Regional Plan: Water identifies the following values for Lake Hayes: Weed free (absence of aquatic pest plants (eg *Lagarosiphon*) identified in the Pest Management Strategy for Otago 2009[19]), significant presence of eel and significant presence of trout.

3.6.1 Ecology

Water quality in the main tributary to the lake, Mill Creek, does not meet the Schedule 15 targets (see Table 3[20]) for NNN (0.36 mg/L cf. 0.075 mg/L) and *E. coli* (440 cfu/100 mL cf. 260 cfu/100 mL). However, dissolved reactive phosphorus concentrations are within the Schedule 15 limit (0.008 mg/L cf. 0.01 mg/L). The current water quality in Lake Hayes (Appendix D – Figures 7-11) likely reflects the combined effects of contemporary nitrogen discharges in combination with the internal load of phosphorus from historic land-use practices.

Fish

Common bully, kōaro, brown trout and perch (*Perca fluviatilis*) have been recorded from the Lake Hayes catchment[21]. Populations of kōaro and common bully are landlocked. Kōaro are classified as "at risk – declining", while common bully are not considered to be threatened (Dunn *et al.* 2018).

Invertebrates

Freshwater mussels (*Echydridella menziesii*) are recorded as present in Lakes Hayes in the New Zealand freshwater fish database and are listed as "at risk – declining" by Grainger *et al.* (2014).

[18] The LAWA website defines a Eutrophic lake as one having an abundant accumulation of nutrients that support a dense growth of algae and other organisms, the decay of which depletes the shallow waters of oxygen in summer resulting in death of animal life.
[19] Although see Section 3.6.1 – Macrophytes. The invasive macrophytes *Elodea canadensis* and *Ranunculus trichophyllus* are present in Lake Hayes.
[20] Page 7
[21] New Zealand Freshwater Fish Database, records downloaded 8 August 2018

Macrophytes

The LakeSPI score for Lake Hayes based on a survey in 2001 indicates that it was in 'moderate' condition, with an overall score of 26%, a native condition score of 14% and an invasive impact score of 69%[22]. These scores represent the dominance of the macrophyte community of Lake Hayes by invasive species. Despite Schedule 1A of the RPW listing Lake Hayes as "Weed free", the invasive macrophytes *Elodea canadensis* and *Ranunculus trichophyllus* are present.

3.6.2 Faecal indicator bacteria

ORC monitors water quality for suitability for contact recreation at one site for Lake Hayes – Lake Hayes at Mill Creek shallows. This site generally has a high level of compliance with guidelines for contact recreation (Appendix D – Figure 11), although in the 2017/18 season three values were recorded that exceeded 550 cfu/100 mL ('Action' level) and four values were recorded that were between 260 and 550 cfu/100 mL ('Alert' level). Single values in the 2015/16 and 2016/17 seasons also reached the 'Alert' level reading.

Lake Hayes also periodically has blooms of potentially toxic cyanobacteria (*Anabaena*), which can pose a risk to recreational users and has resulted in health warnings to avoid contact with its waters being issued.

[22] https://lakespi.niwa.co.nz/lake/54190

3.6.3 Fishery

Lake Hayes supports a regionally significant fishery for trout and wildlife habitat (Otago Fish & Game 2015). European perch are also present and contribute to the fishery. Angler usage of Lake Hayes has declined since the 2001/2002 National Angler Survey (Unwin 2016).

3.6.4 Water clarity and colour (hue)

Low water clarity (Appendix D – Figure 7), particularly associated with algal blooms, can detract from the scenic value of Lake Hayes at times.

4. Characteristics of wastewater

This section explains the characteristics of wastewater.

4.1 Organic matter

Organic matter is a major constituent of wastewater and comes from human faeces, food waste and soaps (MfE 2003).

4.2 Suspended solids

The term suspended solids refers to particulate matter larger than 2 µm and includes inorganic and organic material. The organic component of total suspended solids (TSS) can be determined by the loss of mass on ignition at a temperature of 550-600°C – termed the volatile fraction (VSS). The difference between TSS and VSS of a sample represents the inorganic fraction. The concentration of suspended solids in wastewater can exceed 200 mg/L.

4.3 Nutrients

The major nutrients present in wastewater are nitrogen and phosphorus, which are both produced by the breakdown of organic matter. Nitrogen is also present as urea in the urine of humans, which can be converted to ammonia/ammonium ions in water, which is usually rapidly oxidised to nitrate in high-oxygen aquatic environments. Phosphorus is also present in some detergents and these can be a source of phosphorus in wastewater. Typical concentrations of nitrogen and phosphorus in wastewater are 40 mg/L and 15 mg/L, respectively.

4.4 Others

Wastewater can also contain a range of other contaminants including metals (especially from trade waste), industrial or household chemicals (e.g. surfactants), as well as chemicals that may interfere with the physiology of organisms exposed to them (e.g. endocrine disruptors).

5. Ecological impacts of wastewater discharges entering freshwater

5.1 Organic matter

The introduction of wastewater rich in organic matter, along with high loads of bacteria, can lead to high biochemical oxygen demand (BOD) as oxygen is consumed during the aerobic breakdown of organic matter. This can lead to low oxygen in the receiving environment, especially when there is little aeration or inflows of oxygenated water. The BOD_5 of untreated wastewater is around 200–300 g/m^3, while the BOD_5 for a healthy aquatic ecosystem would be less than 5 g/m^3 (MfE 2003) and probably less than 1 g/m^3 for the larger alpine lakes of the Queenstown Lakes District. Organic matter occurs in dissolved or particulate forms and both can affect the colour and/or clarity of water by affecting how light is scattered and/or absorbed. Organic matter usually absorbs longer wavelength light (red, yellow) giving the water a red, brown or yellow appearance, while particles suspended in the water increase the scattering of light, reducing light penetration (see Section 3).

High concentrations of organic matter can fuel the growth of fungal growths, such as the aptly named "sewage fungus". Sewage fungus refers to the growth of a community dominated by heterotrophic[23] organisms, fed by organic matter-rich discharges. In instances of the prolonged discharge of untreated wastewater, sewage fungus can rapidly grow to cover the stream bed, excluding other types of periphyton, reducing oxygen concentrations, causing unpleasant odours when river levels drop and leading to changes in macroinvertebrate communities.

5.2 Suspended solids

Suspended solids have direct and indirect adverse effects on aquatic ecosystems and these effects can vary depending on the organic content. The adverse effects of organic matter are covered in Section 5.1. High suspended solid concentrations can lead to sedimentation of gill surfaces (of fish and invertebrates), the smothering of eggs or redds (nests), abrasive damage of skin or respiratory surfaces. Indirect effects include changes in invertebrate prey resulting from sedimentation of substrate.

Suspended sediment (and organic matter) can also lead to changes in the clarity and colour of receiving waters, with flow-on effects on ecosystems. For example, reduced water clarity can reduce the effective feeding range of trout and salmon by reducing their ability to see and intercept prey. Changes in clarity and water colour can also reduce light penetration, which can affect the depth range of macrophytes and

[23] Heterotrophic organisms are unable to manufacture their own food from simple chemical compounds, so consume organic matter, which is then broken down

periphyton.

5.3 Nutrients

5.3.1 Nutrient enrichment

Both nitrogen and phosphorus are essential nutrients for plant growth, but as their concentrations increase, they can lead to excessive growths of macrophytes and periphyton.

Nitrate is usually the predominant form of bioavailable nitrogen in freshwater and is, therefore, an important indicator of nutrient enrichment of freshwater systems and the effects of nitrate enrichment would be expected to be seen at concentrations far below the concentrations at which the toxic effects of nitrate are expected to be observed (see 'Nitrate toxicity' below). Schedule 15 of the RPW sets out limits for NNN for receiving environments in various parts of Otago (Table 3). The limit for RWGs 2 and 3 (0.075 mg/L) is lower than the ANZECC (2000) guideline for upland rivers (0.167 mg/L), reflecting the very low levels of NNN in water bodies in these parts of Otago, including most of the rivers and streams in the Queenstown Lakes District. Of the river/stream sites in the Queenstown Lakes District sampled by ORC as part of State of the Environment monitoring, only Mill Creek fails to meet the Schedule 15 limit for nitrate-nitrate. In addition, inputs of groundwater to the lower Cardrona River (from the SH6 bridge downstream) mean that NNN concentrations in this section of the Cardrona are also likely to exceed the Schedule 15 limit.

Phosphorus is a limiting nutrient in many Otago rivers and any increase in the concentration of dissolved reactive phosphorus is expected to increase the rate of the accrual of periphyton biomass, increasing the potential for the nuisance growths.

Because of the retention and complex internal cycling of nutrients in lakes, limits are usually applied on total nutrient concentrations. Therefore, the addition of any nutrients in whatever form (dissolved, organic, particulate) to lakes is expected to increase the productivity of the receiving water, reflected in higher phytoplankton biomass.

Wastewater typically has low concentrations of nitrate-nitrogen, with most of the nitrogen occurring as ammoniacal nitrogen. However, any ammoniacal nitrogen is expected to be rapidly oxidised under the conditions found in most surface water receiving environments in the Queenstown Lakes District. Inputs of nitrogen have the potential to impact the ecosystem values of these waterbodies by significantly increasing the concentration of bioavailable nitrogen (especially compared to the very low background levels of nitrate nitrogen), with effects including localised proliferations of periphyton and phytoplankton. Excessive growth of periphyton can lead it to over-grow macrophytes and lead to the macrophytes dying-off. However, given that the duration of any overflow is expected to be short, this limits the potential for such

discharges to affect aquatic ecosystems.

5.3.2 Nitrogen toxicity

In addition to being an essential nutrient, the two primary forms of nitrogen in freshwater can also be toxic to aquatic life. Ammoniacal nitrogen occurs in two forms in freshwater: free (unionised) ammonia (NH_3) and ammonium ions (NH_4^+), with these two forms occurring in equilibrium with the balance between the two forms determined by water temperature and pH (ANZECC 2000[24]). Of the two forms, unionised ammonia is more toxic to aquatic life. The discharge of untreated wastewater to freshwater is expected to be a significant source of ammoniacal nitrogen.

The National Policy Statement for Freshwater Management (NPS: FM, 2014, amended 2017) National Objectives Framework (NOF) sets out attribute states for ammonia toxicity, with "A" band concentrations being set to protect 99% species protection level, with an annual median of ≤0.03 mg NH_4-N/L and annual maximum value of ≤0.05 mg NH_4-N/L, with both values being based on pH 8 and temperature of 20°C[25]. All waterbodies considered here are in A-band for ammonia toxicity, with the exception of Lake Hayes, which would be in Band B (based on annual maximum ammoniacal nitrogen concentrations). The Schedule 15 limits for ammoniacal nitrogen in the RPW (Table 3) are well below those in the NOF and the limits for Receiving Water Groups 3 and 5 are equivalent to the ANZECC (2000) guidelines for upland rivers (0.01 mg/L), while the limit for Receiving Water Groups 1, 2 and 5 (0.1 mg/L) exceeds the ANZECC (2000) guidelines for upland (0.01 mg/L) and lowland rivers (0.021 mg/L). Therefore, the input of significant concentrations of ammoniacal nitrogen from wastewater overflows have the potential to impact the ecosystem values of these waterbodies (due to low background ammoniacal nitrogen and resulting presence of sensitive species). However, the duration of any overflow is expected to be short, limiting the potential for any acute toxic effect of such discharges.

Oxidised forms of nitrogen are also toxic to aquatic life. Of these nitrite (NO_2^-) is the more toxic form, although it is rare to observe appreciable concentrations of nitrite ions in oxic surface freshwaters, as it is usually rapidly oxidised to nitrate under such conditions. However, nitrate (NO_3^- is also toxic to aquatic life at sufficient concentrations and is also included in the NOF[26], with an annual median value of ≤1 mg NO_3-N/L and annual 95th percentile of ≤1.5 mg NO_3-N/L representing "A" band. All waterbodies considered here would be in A-band for nitrate toxicity. The nitrate bands in the NOF relate to nitrate toxicity, not the ecosystem effects of nitrate enrichment. Nitrate toxicity refers to the direct effect of nitrate on organisms causing mortality while nitrate can also indirectly affect aquatic ecosystems through its role as a nutrient for aquatic plant life. Nitrate enrichment can lead to prolific growths of

[24] Section 8.3.7.2
[25] Compliance with numeric attribute states should be undertaken after pH adjustment.
[26] The NOF values for nitrate relate to nitrate toxicity, not to effects relating to it as a nutrient.

aquatic plants (including periphyton and phytoplankton) with flow-on ecosystem effects.

5.4 Others

Wastewater can also contain a range of other contaminants including metals (especially from trade waste), industrial or household chemicals (e.g. surfactants), as well as chemicals that may interfere with the physiology of organisms exposed to them (e.g. endocrine disruptors).

Table 6 Summary of actual and potential adverse effects of wastewater discharges to freshwaters

Potential effect	Description
Oxygen depletion	High biochemical oxygen demand may cause depletion of oxygen in vicinity of discharge, particularly where limited current/mixing leads to low dispersion. This can lead to oxygen stress in fish and invertebrates.
Sediment:	
Sedimentation	Potential for direct or indirect effects. Direct effects include sedimentation of gill surfaces or smothering of eggs or redds (nests), abrasive damage of skin or respiratory surfaces. Indirect effects may include changes in invertebrate prey resulting from sedimentation of substrate.
Clarity	Suspended sediment (and organic matter) can lead to changes in the clarity and colour of receiving waters.
Growths:	
Fungus	Wastewater contains high levels of organic matter, which can lead to growths of heterotrophic organisms, such as sewage fungus.
Algae	The high concentrations of nutrients (nitrogen and phosphorus) in wastewater can lead to proliferation of filamentous algae.
Pathogens	Wastewater contains human waste, which contains bacteria, protozoa and viruses that can lead to illness in humans and other mammals that ingest contaminated water.
Odour	At high concentrations, wastewater can give water an unpleasant odour.
Scums/foam	Dissolved organic matter, surfactants and oils in wastewater can lead to the formation of scums and foams in receiving waters.
Endocrine disruptors	Wastewater can contain hormones (e.g. from contraceptive pills) or other chemicals that can disrupt the physiology of aquatic organisms.

6. Risk and effects assessment

6.1 Assessment of risk of wastewater overflows entering freshwater

The first part of the risk and effects assessment was to assess each identified potential overflow location for the risk of wastewater entering surface waterbodies based on the distance to water, presence of surface flow paths and land cover (as described in Section 2.1).

The results of this risk assessment for the 35 locations within the wastewater network and 12 future sites assessed is presented in Table 8. Most of these locations were pump stations but also included engineered overflow points, manholes and pipe crossings.

Ten sites were identified as "high risk" of wastewater entering surface waters in the event of a discharge (Table 8). These sites included pump stations at Lake Wanaka, Bullock Creek, Luggate Creek, a roadside drain that enters the Arrow River, a small stream that enters Lake Wakatipu at Sunshine Bay, Lake Wakatipu, Lake Hayes, Stone Creek and Buckler Burn (Table 8). Sixteen sites with moderate-high risk were identified in Lake Wanaka, Luggate Creek, Shotover River, several sites around Lake Wakatipu (including the Frankton Arm and at Kingston), Mill Creek, Lake Hayes, Stone Creek and Buckler Burn (Table 8).

Seven sites were identified as having a "negligible" risk of wastewater entering water (Table 8) due to their distance from surface waterbodies, a lack of obvious surface flowpath, and the presence of surfaces that will reduce the likelihood of wastewater reaching surface waterbodies (see Table 1). Sites assessed as having a negligible risk included at two locations within the lower Cardrona catchment, two sites in Luggate Creek, one location at Bush Creek (Arrow catchment) and two sites at Lake Hawea (Table 8).

6.2 Assessment of adverse effects of wastewater overflows on receiving environments

6.2.1 Large rivers (Kawarau & Clutha/Mata-Au)

These rivers contain low levels of nutrients, *E. coli* and suspended sediments and support significant ecological values, however their large flows (and therefore considerable dilution capacity) means that they are generally relatively insensitive to wastewater discharges, and adverse effects on river biota due to a very occasional, short-term discharge of untreated wastewater are correspondingly unlikely.

Three pump stations near the Clutha River were identified as having a moderate to high risk of wastewater entering the river in the case of overflow (Table 8), although the risks of adverse ecological effects associated with such a discharge are assessed as being low given the large flow of the upper Clutha River and high velocity water, which will rapidly dilute and disperse contaminants (Table 7). One pump station near the Kawarau River was identified as having a low to moderate risk of wastewater entering the river in the case of overflow due to the distance to water (52 m), and groundcover of rank grass (Table 8), and the risks of adverse ecological effects associated with such a discharge are also assessed as being low to moderate given the large flow of the Kawarau (Table 8).

Included in the future developments to the QLDC wastewater network assessed was a proposed wastewater pipeline from Lake Hāwea village to a wastewater treatment plant at Wanaka Airport, including a pipe bridge across the Clutha River. In the event of a breach of this pipe, there would be a high risk of wastewater entering the Clutha River, but the risks of adverse ecological effects associated with such a discharge are assessed as being low given the large flow of the Clutha River at this location. It would be expected that with adequate maintenance, the risk of such a breach would be extremely low, although this was beyond the scope of this assessment.

6.2.2 Medium-Large rivers (Hāwea & Shotover Rivers)

Both the Hāwea and Shotover Rivers contain low levels of nutrients and *E. coli*, although the Shotover can carry high loads of suspended sediments. The large flows (and therefore dilution capacity) of these rivers mean that they are also expected to generally be relatively insensitive to wastewater discharges.

One pump station near the Shotover River was identified as having a moderate to high risk of wastewater entering the river in the case of overflow due to its proximity of the pump station to the river, the steepness of the slope between the pump station and the river and the vegetation in the area being pine trees (with limited understory) (Table 8). However, the risks of adverse ecological effects associated with such a discharge are assessed as being low-moderate due to the large flow, high water velocities and naturally high sediment load in the Shotover River (Table 7).

Development of the alluvial flats on the true left (north) bank of the Lower Shotover has resulted in wastewater infrastructure being in relatively close proximity to the Shotover River. However, there is a low risk of wastewater reaching the Shotover (as a result of distance, lack of clear flowpaths and vegetation in the area) and the size and high sediment load of the lower Shotover (Table 8), the risk associated with waste water discharging to the lower Shotover was assessed as being low to moderate.

One pump station near the Hāwea River was identified as having a negligible risk of wastewater entering the river in the case of overflow due to it being a long distance from surface water and the lack of clear flowpaths to the Hāwea (Table 8).

6.2.3 Small-medium rivers

Low levels of nutrients, *E. coli* and suspended sediments in these rivers mean that they are expected to be highly sensitive to inputs of nutrients, microbes and sediments in wastewater discharges during periods of low flows. However, this is expected to be less of a risk during periods of higher flows, when there will be greater dilution with high quality water from the upper catchments. Flows in these rivers are highly seasonal, with the lowest flows occurring in summer and autumn months (Olsen et al. 2017, Ravenscroft et al. 2017).

Mill Creek has high levels of nitrogen, *E. coli* and suspended sediments and the bed of Mill Creek is dominated by fine sediments. As a result, it is not expected to be as sensitive to wastewater discharges as many other waterways within the QLDC district. However, given that Mill Creek discharges to Lake Hayes (approximately 2.5 km downstream), any nutrients or sediment that enters Mill Creek will contribute to nutrient and sediment loads to Lake Hayes, which will contribute to the continuation of poor water quality in Lake Hayes. There may be some attenuation of nitrogen before it enters Lakes Hayes (such as denitrification), but it is not possible to estimate the extent to which this may occur. Any phosphorus or sediments contributed to Mill Creek are expected to enter Lake Hayes.

Two pump stations near the Cardrona River were assessed as having a negligible risk of wastewater entering water due to the distance from and the lack of clear flowpaths to the nearest surface water (Table 8). A wastewater pipeline from Cardrona Village to a proposed wastewater disposal area near the ski field access road was assessed as a potential future addition to the QLDC wastewater network. Generally, the risk of wastewater from this pipeline entering surface water is assessed as being low, as the pipeline is to be buried alongside the path of Cardrona Valley Road. However, the pipe will cross several small streams, which discharge to the Cardrona a short distance downstream of the road. Therefore, the risk of wastewater entering water is generally assessed as low, but will be high where pipes cross tributary streams. The ecological risk associated with a discharge of wastewater to these small tributaries is assessed as high, with a moderate risk associated with such a discharge then entering the Cardrona River.

Of the four pump stations near to Luggate Creek, two stations were a considerable distance from the creek and were assessed as having a negligible risk of wastewater entering water as a result (Table 8). However, one pump station was assessed as having a moderate risk and another as having a high risk (Table 8). Luggate Creek has a minimum flow of 180 l/s (Schedule 2A of the RPW), meaning that the river has limited capacity to dilute any wastewater discharges when at low flows and there is moderate to high risk of adverse effects if one occurs (Table 7).

A pump station near Mill Creek has been identified as having a moderate-high probability of wastewater entering water in the case of overflow, while the ecological

risks associated with such as discharge are assessed as being moderate, but with high risks of localised effects in Mill Creek (Table 7). The risk associated with the discharge of nutrients and sediment entering Lake Hayes is assessed in Section 6.2.6 and Table 7.

One other pump station was assessed as having a moderate risk of wastewater entering the Arrow River in the event of an overflow (Table 8), and the risk of potential adverse ecological effects associated with such a discharge is assessed as being moderate (Table 7).

Included in assessments was a proposed wastewater pipeline from Glenorchy to a proposed wastewater disposal area near the Glenorchy Airport. Generally, the risk of wastewater from this pipeline entering surface water is assessed as being low, as the pipeline is to be buried alongside the path of the Glenorchy-Queenstown Road. However, the pipe will cross the Buckler Burn, most likely under the existing road bridge. The vegetation under the Buckler Burn bridge is sparse, with the area under the bridge being dominated by steep bedrock. The risk associated with this pipeline will generally be low, but will be high where it crosses any streams. The size of the Buckler Burn means there is a moderate risk of ecological effects arising from the discharge of wastewater.

6.2.4 Streams and small rivers

Most small streams in the Queenstown Lakes District are expected to contain low levels of nutrients, *E. coli* and suspended sediments and they are expected to be highly sensitive to wastewater discharges. These streams are expected to provide habitat for trout spawning and rearing, and those that are close to large lakes are expected to support kōaro. Most of these values are not expected to be significantly affected by infrequent wastewater discharges, although there may be more sensitive receiving waters downstream (e.g. tributaries of the lakes). However, a lack of dilution means that any discharge has potential to impart significant, short-term, effects on local water quality and ecological values (Table 7).

Pump stations near Bullock Creek, an unnamed tributary of Lake Wakatipu near Fernhill and an unnamed tributary of the Arrow River, have been identified as having a moderate-high probability of wastewater entering water in the case of overflow (Table 8). Bullock Creek (Wanaka) flows through a highly built up area and is highly accessible and supports high values. Given its small size and high values, the risks associated with any wastewater discharges are high (Table 7).

The small roadside drain near Arrowtown has very limited flow, but is not expected to contain significant values. The main risk associated with a discharge from this pump station is if wastewater was to be flushed downstream into areas with higher values, including the Arrow River itself (3 km downstream).

It was also identified that in the case of an overflow at the pump station in Fernhill, it would be likely to enter a small unnamed tributary of Sunshine Bay in Lake Wakatipu.

Given the small flow of this stream, the risk of adverse effects from an overflow is potentially high as this small stream is likely to provide habitat for kōaro which could be affected. This stream also enters Lake Wakatipu, and therefore any overflow may also affect the ecological values in a localised area of the lake.

The risks associated with a proposed pipeline from Jacks Point to Frankton was included in these assessments. Generally, the risk of wastewater from this pipeline entering surface water is assessed as being low, as the pipeline is to be buried along a formed track. However, the pipe will cross a number of ephemeral streams that were dry during my site visit and were also dry at the time that GoogleMaps StreetView imagery was captured in August 2017. Whilst there is high risk of wastewater entering the bed of these streams in the event of a ruptured pipe, given they are ephemeral, the risk of wastewater entering surface water is assessed as low to moderate (Table 7). Given these streams appear to be ephemeral, they are unlikely to support significant aquatic values, and so the ecological risk associated with any wastewater discharge is assessed as being low.

Included in assessments was a proposed wastewater pipeline from Glenorchy to a proposed wastewater disposal area near the Glenorchy Airport. Generally, the risk of wastewater from this pipeline entering surface water is assessed as being low, as the pipeline is to be buried alongside the path of the Glenorchy-Queenstown Road. However, the pipe will cross Stone Creek, most likely under the existing road bridge. The vegetation under the bridge is sparse and relatively steep. The size of Stone Creek means there is a moderate to high risk of ecological effects arising from the discharge of wastewater.

Current development in Luggate is on the true left (west) side of Dead Horse Creek. However, development of the true right (east) side of Dead Horse Creek is underway and the wastewater network will cross Dead Horse Creek to connect to the greater wastewater network in Luggate. Given that this will involve a wastewater pipe crossing Dead Horse Creek, there is a high probability of wastewater entering Dead Horse Creek in the event of a leak. Given the small size of Dead Horse Creek, the risk of ecological effects arising from such a leak is assessed as being moderate to high.

It is proposed that wastewater from Luggate will be connected to a wastewater treatment plant near Wanaka Airport. Given that this will involve a wastewater pipe crossing Luggate Creek, there is a high probability of wastewater entering Luggate Creek in the event of a leak. The risk of ecological effects arising from such a leak is assessed as being moderate. Based on field visits and consideration of topographical maps and aerial photographs, it does not appear that the proposed pipeline will cross any other surface waterbodies.

6.2.5 Large lakes

The very low levels of nutrients, *E. coli* and suspended sediments in these lakes means

that they are expected to be highly sensitive to the local effects of wastewater discharges. All three large lakes support significant ecological values. Whilst individual wastewater overflows are not expected to adversely affect the overall health of these lakes, they may cause significant, localised adverse effects in the vicinity of the discharge. The areal extent of a wastewater plume and its associated effects on water quality and aquatic biota, and the duration of those effects, are highly variable and dependent on a range of factors, including the volume of the discharge, the prevailing weather (e.g., calm lake conditions versus significant wind and wave action, river flow), local topography (e.g., shallow versus deep bed profiles) and currents, etc.

Twelve pump stations near these lakes have been identified as having a moderate to high probability of wastewater entering surface water in the case of overflow (Table 8). The local risks associated with the discharge of wastewater are higher at a number of sites in these lakes due to local features that reduce the potential for dilution and/or dispersion (e.g. embayments) (Table 7). Notable sites include Roys Bay and Bremner Bay in Lake Wanaka, Queenstown Bay and Frankton Beach in Lake Wakatipu.

Whilst occasional discharges of wastewater are unlikely to contribute significantly to overall nutrient concentrations in these lakes individually, cumulatively they will contribute the overall nutrient load to these lakes. The cumulative effect of multiple discharges is difficult to assess without information on the frequency, volume and nutrient loads of the discharges. Given the extremely low nutrient concentrations in these lakes, even seemingly small individual discharges may contribute significant nutrient loads to these systems and may contribute to eutrophication, at least locally. Having said that, most likely scenarios for discharges to large lakes are likely to be short-term in nature. The contribution of such discharges to the overall nutrient loads of these lakes would be minimised by minimising the frequency, duration and volume of such discharges.

6.2.6 Medium lakes (Lake Hayes)

The high levels of nutrients in Lake Hayes mean that it is expected to be less sensitive to individual discharges of nutrients and sediment than lower-nutrient lakes, although wastewater discharges may have localised effects in the immediate vicinity of the discharge point.

Two pump stations near Lake Hayes have been identified as having a moderate-high probability of wastewater entering the lake in the case of overflow (Table 8). Both have localised risks associated with the discharge of wastewater, particularly localised sedimentation, deoxygenation within any wastewater plume and the risk of the proliferation of periphyton in the event of a prolonged discharge. Wildlife, particularly waterfowl, are often abundant in the shallows in the vicinity of Mill Creek.

A pump station near Mill Creek has been identified as having a moderate-high probability of wastewater entering water in the case of overflow (see Section 6.2.3).

Given that Mill Creek discharges to Lake Hayes (approximately 2.5 km downstream), any nutrients or sediment that enters Mill Creek is expected to contribute to nutrient and sediment loads to Lake Hayes, which will contribute to the continuation of poor water quality in Lake Hayes. There may be some attenuation of nitrogen before it enters Lakes Hayes (such as denitrification), but it is not possible to estimate the extent to which this may occur. Any phosphorus or sediments contributed to Mill Creek are expected, ultimately, to enter Lake Hayes.

Table 7 Summary of the assessment of the risks associated with each of the potential effects of wastewater discharges to freshwaters.

Potential effect		Large lakes	Lake Hayes	Streams	Small-medium rivers	Medium-large rivers	Large rivers	Values potentially affected
Oxygen		Low, but high locally	Mod-high	Mod-high	Moderate	Low-moderate	Low	Fish, invertebrates
Sediment	Sedimentation	Low-moderate, but high locally	Mod-high	Mod-high	Moderate	Low-moderate	Low	Fish, invertebrates, macrophytes
	Clarity	Low, but high locally	Low, but high locally	Moderate	Low-moderate	Low	Low	Fish, macrophytes, aesthetics
Growths	Fungus	Low	Low	Moderate	Low-moderate	Low	Low	Fish, invertebrates, macrophytes
	Periphyton/ phytoplankton	Moderate	Moderate	Moderate	Moderate	Low-moderate	Low	Fish, invertebrates, macrophytes
Odour		Moderate	Moderate	Mod-high	Moderate	Moderate	Moderate	Aesthetic
Scums/foam		Moderate	Mod-high	High	Mod-high	Moderate	Low-moderate	Aesthetic

Table 8 Risk assessment associated with potential discharge points from QLDC wastewater infrastructure.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Probability of waste water entering water	Risk associated with wastewater discharge
1	Wanaka	16	Lake Wanaka	Pump station on Lakeside Road on lake shore.	High	Moderate, but high locally
2	Wanaka	110	Lake Wanaka (Bremner Bay)	Pump station near the end of Waimana Place.	Low-mod	Moderate, but high locally
3	Wanaka	30	Lake Wanaka (Eely Point)	Pump station near Eely Point Access track.	Mod-high	Moderate, but high locally
4	Wanaka	120	Lake Wanaka (Roys Bay)	Pump station on Dungarvon Street. Possible stormwater route or along road.	Mod-high	Moderate, but high locally
5	Wanaka	105	Lake Wanaka (Roys Bay)	Pump station near Edgewater Resort.	Moderate	Moderate, but high locally
6	Wanaka	71	Bullock Creek	Pump station on Dungarvon Street.	High	Mod-high
7	Wanaka	210*	Cardrona River	Pump station on Riverbank Road.	Negligible	Moderate
8	Clutha outlet	70	Clutha River	Pump station at end of Clutha Outlet Road.	Mod-high	Low-mod
9	Albert Town	650	Cardrona River	Pump station on Albert Town-Lake Hāwea Road.	Negligible	Moderate
10	Albert Town	25	Clutha River	Pump station on Wicklow Terrace.	Mod-high	Low-mod
11	Albert Town	120	Clutha River	Pump station on Gunn Road.	Low-mod	Low-mod
12	Albert Town	114	Clutha River	Pump station on Alison Avenue.	Mod-high	Low-mod
13	Albert Town	70	Clutha River	Pump station on Alison Avenue.	Moderate	Low-mod
14	Luggate	400	Luggate Creek	Pump station on Pisa Road.	Negligible	Moderate
15	Luggate	374	Luggate Creek	Pump station on Alice Burn Drive (unformed).	Negligible	Moderate
16	Luggate	110	Luggate Creek	Pump station on Harris Place.	Moderate	Moderate
17	Luggate	15	Luggate Creek	Pump station on river bank near Church Road.	High	Mod-high
18	Arrowtown	42	Arrow River	Pump station on bank near Alexander Place above river.	Mod-high	Mod-high
19	Arrowtown	3	Roadside drain/Arrow River	Pump station near McDonnell Road.	High	Mod-high
20	Arrowtown	425	Bush Creek	Pump station beside Essex Avenue.	Negligible	Moderate
21	Arthur's Point	292	Shotover River	Pump station beside Atley Road.	Low	Low-mod
22	Arthur's Point	8	Shotover River	Pump station beside Oxenbridge Tunnel Road on bank of Shotover River.	Mod-high	Low-mod
23	Queenstown	34	Lake Wakatipu (Queenstown Bay)	Pump station on Marine Parade beside lake shore.	High	Moderate, but high locally

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Probability of waste water entering water	Risk associated with wastewater discharge
24	Queenstown	23/150	Small stream, Lake Wakatipu (Sunshine Bay)	Pump station on track off Glenorchy-Queenstown Road.	High	Moderate, but high locally
25	Queenstown	60	Lake Wakatipu (Frankton Arm)	Pump station on lake shore on Shoreline Road at Frankton Beach.	Mod-high	Moderate, but high locally
26	Queenstown	10	Lake Wakatipu (Frankton Arm)	Sewer main with overflow on lake shore on Allan Cresent at Frankton Beach.	High	Moderate, but high locally
27	Queenstown	25	Lake Wakatipu	Pump station beside Park Street.	High	Moderate, but high locally
28	Queenstown	25	Lake Wakatipu	Pump station on vehicle track off Cedar Drive.	Mod-high	Moderate, but high locally
29	Queenstown	52	Kawarau River	Pump station on vehicle track at end of Riverside Road.	Mod-high	Low-mod
30	Lake Hayes	84	Lake Hayes	Pump station beside access road to Mill Creek shallows.	Mod-high	Mod-high
31	Lake Hayes	13	Lake Hayes	Pump station on shore of Lake Hayes beside access track and carpark off Arrowtown-Lake Hayes Road.	High	Mod-high
32	Lake Hāwea	52	Lake Hāwea	Pump station on Hawea Esplanade Road near shoreline of Lake Hāwea.	Moderate	Moderate, but high locally
33	Lake Hāwea	98	Lake Hāwea	Pump station near Scotts Beach Road near shoreline of Lake Hāwea. No obvious flow path to lake.	Moderate	Moderate, but high locally
34	Lake Hāwea	380	Hāwea River	Pump station near Domain Road.	Negligible	Low-mod
35	Lake Hāwea	990	Lake Hāwea	Pump station on Cemetery Road.	Negligible	Moderate
36	Kingston	36	Lake Wakatipu	PROPOSED - Pump station at lakefront park across from Gloucester Street.	Moderate	Low-moderate, but high locally
37	Kingston	30	Lake Wakatipu	PROPOSED - Pump station at lakefront park across from Cornwall and Oxford Street.	Mod-high	Low-moderate, but high locally
38	Jacks Point	0	Various ephemeral creeks	PROPOSED - pipeline from Jacks Point to Frankton.	Low-mod	Low
39	Lower Shotover	>150	Shotover River	PROPOSED - wastewater network infrastructure for development on low-lying land on true left of the Shotover River	Low	Low-mod
40	Glenorchy	0 (pipe crossing)	Stone Creek	PROPOSED - pipeline from Glenorchy to potential disposal site at Glenorchy airport.	High	Moderate, but high locally

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Probability of waste water entering water	Risk associated with wastewater discharge
41	Glenorchy	0 (pipe crossing)	Buckler Burn	PROPOSED - pipeline from Glenorchy to potential disposal site at Glenorchy airport.	High	Moderate, but high locally
42	Cardrona	15	Cardrona River	PROPOSED - pipeline from Cardrona township to potential disposal site at skifield turn-off.	Low-high	Low-mod
43	Clutha near Wanaka airport	0 (pipe crossing)	Clutha River	PROPOSED - pipeline from Hāwea township to potential disposal site at Wanaka airport.	Low-high	Low
44	Luggate	0 (pipe crossing)	Luggate Creek	PROPOSED - pipeline from Luggate township to potential disposal site at Wanaka airport.	Low-high	Moderate
45	Luggate	0 (pipe crossing)	Dead Horse Creek	PROPOSED - wastewater from developments to east of Luggate township.	Low-high	Mod-high
46	Glendhu Bay	>55	Lake Wanaka (Glendhu Bay)	PROPOSED - Glendhu Bay campground	Moderate	Moderate, but high locally
47	Mill Creek	12	Mill Creek	PROPOSED - Pump station at Millbrook, near 18th hole.	Mod-high	Moderate
			Lake Hayes			Mod-high

7. References

Biggs BJF & Malthus TJ 1982. Macroinvertebrates associated with various aquatic macrophytes in the backwaters and lakes of the upper Clutha Valley, New Zealand, *New Zealand Journal of Marine and Freshwater Research, 16*:1, 81-88, DOI: 10.1080/00288330.1982.9515948

Carolyn W. Burns & S.F. Mitchell (1980) Seasonal succession and vertical distribution of zooplankton in Lake Hayes and Lake Johnson, *New Zealand Journal of Marine and Freshwater Research 14*, 189-204, DOI: 10.1080/00288330.1980.9515860

Clayton J & Edwards T 2006. Aquatic plants as environmental indicators of ecological condition in New Zealand lakes. In: Caffrey J.M., Dutartre A., Haury J., Murphy K.J., Wade P.M. (eds) Macrophytes in Aquatic Ecosystems: From Biology to Management. Developments in Hydrobiology, Vol 190. Springer, Dordrecht.

Clayton J, Schwarz A & Coffey B (1986) Notes on the submerged vegetation of lake Hawea, *New Zealand Journal of Marine and Freshwater Research* 20: 185-189, DOI: 10.1080/00288330.1986.9516142

Coffey, B.T. and Clayton, J.S. 1988b. Contrasting deep-water macrophyte communities in two highly transparent New Zealand lakes and their possible association with freshwater crayfish, *Paranephrops* spp. *New Zealand Journal of Marine and Freshwater Research 22*: 225-230.

de Lange PJ, Rolfe JR, Barkla JW, Courtney SP, Champion PD, Perrie LR, Beadel SM, Ford KA, Breitwiesser I, Schönbergfer I, Hindmarsh-Walls R, Heenan PB & Ladley K. 2018. Conservation status of New Zealand indigenous vascular plants, 2017. *New Zealand threat classification series 22.* Department of Conservation, Wellington. 82 p.

de Winton, M.D. and Beever, J.E. 2004. Deep-water bryophyte records from New Zealand lakes. *New Zealand Journal of Marine and Freshwater Research 38*: 329–340.

Dunn NR, Allibone RM, Closs GP, Crow SK, David BO, Goodman JM, Griffiths M, Jack DC, Ling N, Waters JM, & Rolfe JR 2018. Conservation status of New Zealand freshwater fishes, 2017. *New Zealand Threat Classification Series 24.* Department of Conservation, Wellington. 11 p.

Goldsmith R, Ludgate B, Stewart B & Ryder GI. 2007. Frankton Marina development – Lake ecological assessment. Prepared for John Edmonds and Associates on behalf of Queenstown Marina Developments Limited. Ryder Consulting, Dunedin.

Grainger N, Collier K, Hitchmough R, Harding J, Smith B & Sutherland D. 2014. Conservation status of New Zealand freshwater invertebrates, 2013. *New Zealand threat classification series 8.* Department of Conservation, Wellington. 28 p.

Jellyman PG & Harding JS 2016. Disentangling the stream community impacts of

Didymosphenia geminata: How are higher trophic levels affected? *Biological Invasions 18*: 3419-3435.

Kelly DJ & Hawes I 2005. Changes in macroinvertebrate communities and food web dynamics from invasive macrophytes in Lake Wanaka. *Journal of the North American Benthological Society 24:* 300-320.

Larned, S, Snelder, T, Unwin, M, McBride, G, Verburg, P, & McMillan, H (2015). Analysis of water quality in New Zealand lakes and rivers: Data sources, data sets, assumptions, limitations, methods and results. Prepared for the Ministry for the Environment. *NIWA Client Report no. CHC2015-033*. Wellington: NIWA.

Ludgate, B. & Ryder, GI. 2008. Otago Regional Council Shotover River proposed gravel extraction, training line and rock revetment construction and winning of Rastus Burn rip rap: Aquatic ecology and water quality assessment. Prepared by Ryder Consulting Ltd.

Ministry for the Environment & Ministry of Health. 2002. Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment, Wellington. 89 p. plus appendices.

Ministry for the Environment 2003. Sustainable Wastewater Management – A Handbook for Smaller Communities. Ministry for the Environment, Wellington. 133 p. plus appendices.

Olsen DA (2016) Water quality study - Cardrona River catchment. Otago Regional Council, Dunedin. 54 p.

Olsen DA, Lu X & Ravenscroft P 2017. Update of scientific information for the Arrow catchment: 2012-2017. Otago Regional Council, Dunedin. 40 p.

Otago Fish & Game Council 2015. Sports fish and game management plan for Otago Fish and Game region 2015-2025. Otago Fish & Game Council, Dunedin. 98 p.

Ravenscroft PR, Lu X, Mohssen M, Augspurger J & Olsen D. 2018. Update of scientific information for the Cardrona catchment: 2011-2017. Otago Regional Council, Dunedin. 47 p. + appendices.

Stark JD 1993. A survey of macroinvertebrate communities in seventeen South Island lakes. Prepared for the Electricity Corporation of New Zealand. *Cawthron Report No. 229.* 36 p.

Unwin MJ 2016. Angler usage of New Zealand lake and river fisheries: Results from the 2014/15 National Angling Survey. Prepared for Fish & Game New Zealand. NIWA Client Report 2016021CH. 59 p.

Appendix A

Water Conservation (Kawarau) Order – Schedule 2

Schedule 2
Waters to be protected

cl 2

All map references are NZMS 1 unless otherwise stated

Waters	Outstanding characteristics	Restrictions and prohibitions
Kawarau River mainstem from Scrubby Stream to Lake Wakatipu control gates (S133:940715 to S132:615707)	(c) wild and scenic characteristics; (c) natural characteristics, in particular the return flow in the upper section when the Shotover River is in high flood; (d) scientific values, in particular the return flow in the upper section when the Shotover River is in high flood; (e) recreational purposes, in particular rafting, jetboating, and kayaking.	(i) no damming allowed; (ii) water quality to be managed to Class CR standard.
Nevis River mainstem gorge from Nevis Crossing to Kawarau River confluence (NZTM: 5002690.6 N, 1287862.0 E to 4989927.5 N, 1285354.6 E)	(a) native fishery habitat (non-migratory galaxiids); (c) wild and scenic characteristics; (e) recreational purposes, in particular fishing and kayaking.	(i) no damming or diversion allowed; (ii) water quality to be managed to Class CR, Class F, and Class FS standards.

Waters	Outstanding characteristics	Restrictions and prohibitions
	(f) historical purposes, in particular goldmining.	
Dart River mainstem from Lake Wakatipu to confluence with Beans Burn (at or about S122:291916 to S113:226162)	(a) habitat for wildlife; (c) scenic characteristics; (c) natural characteristics, in particular natural turbidity; (d) scientific value, in particular natural turbidity; (g) significance in accordance with tikanga Maori, in particular sites at the mouth of the river.	(i) no damming allowed; (ii) braiding of water to be maintained.
Rees River mainstem from Lake Wakatipu to confluence with Hunter (at or about S123:301915 to S114:363204)	(a) habitat for wildlife; (c) scenic characteristics; (g) significance in accordance with tikanga Maori, in particular sites at the mouth of the river.	(i) no damming allowed; (ii) braiding of water to be maintained.
Diamond Lake, Diamond Creek, and Reid Lake (at or about S122:290050; S122:299036 to S123:305987)	(a) habitat for wildlife and quinnat salmon; (b) fishery.	(i) no damming allowed; (ii) fish passage to be maintained; (iii) water quality to be managed to Class F and Class FS standards.

Waters	Outstanding characteristics	Restrictions and prohibitions
Lake Wakatipu (from outlet at control gates (S132:615707) to confluences of Dart River (at or about S122:291916) and Rees River (at or about S123:301915) and including whole lake)	(b) fishery; (c) scenic characteristics; (d) scientific value, in particular water clarity, and bryophyte community; (e) recreational purposes, in particular boating; (g) significance in accordance with tikanga Maori, in particular sites at the head of the lake, and the legend of the lake itself.	(i) fish passage to be maintained; (ii) water quality to be managed to Class AE, Class CR, Class F, and Class FS standards.
Lochy River mainstem (S132:592511 to S142:328409 and S142:307380)	(b) fishery; (e) recreational purposes, in particular fishing.	(i) fish passage to be maintained; (ii) water quality to be managed to Class F and Class FS standards.
Von River mainstem (S132:353629 to S141:288380 and S131:216620)	(b) fishery; (e) recreational purposes, in particular fishing.	(i) fish passage to be maintained; (ii) water quality to be managed to Class F and Class FS standards.

Key:

Outstanding characteristics (s 199(2)(b) and (c) of Act):

(a) as habitat for terrestrial or aquatic organisms:

(b) as a fishery:

(c) for its wild, scenic or other natural characteristics:
(d) for scientific and ecological values:
(e) for recreational purposes:
(f) for historical purposes:
(g) for significance in accordance with tikanga Maori.

Restrictions and prohibitions:

References to classes are Water quality classes as in Schedule 3 of the Act.

Schedule 2: amended, on 12 December 2013, by clause 5 of the Water Conservation (Kawarau) Amendment Order 2013 (SR 2013/450).

Appendix B

Water Quality Classes

Schedule 2 of the Water Conservation (Kawarau) Order (WCO) outlines water quality classes for 'Waters to be protected', including the Kawarau River (Class CR), Shotover River (Class CR) and Lake Wakatipu (Classes AE, CR , F, FS). These water quality classes relate to Schedule 3 of the RMA and the relevant ones are outlined below:

1 Class AE Water (being water managed for aquatic ecosystem purposes)

(1) The natural temperature of the water shall not be changed by more than 3° Celsius.

(2) The following shall not be allowed if they have an adverse effect on aquatic life:

(a) any pH change:

(b) any increase in the deposition of matter on the bed of the water body or coastal water:

(c) any discharge of a contaminant into the water.

(3) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(4) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

2 Class F Water (being water managed for fishery purposes)

(1) The natural temperature of the water—

(a) shall not be changed by more than 3° Celsius; and

(b) shall not exceed 25° Celsius.

(2) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(3) Fish shall not be rendered unsuitable for human consumption by the presence of contaminants.

3 Class FS Water (being water managed for fish spawning purposes)

(1) The natural temperature of the water shall not be changed by more than 3° Celsius. The temperature of the water shall not adversely affect the spawning of the specified fish species during the spawning season.

(2) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

5 Class CR Water (being water managed for contact recreation purposes)

(1) The visual clarity of the water shall not be so low as to be unsuitable for bathing.

(2) The water shall not be rendered unsuitable for bathing by the presence of contaminants.

(3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

Appendix C

Schedule 1A of RPW

Table 9 Natural values of waterbodies potentially affected by wastewater overflows in the Queenstown Lakes District from Schedule 1A of the RPW.

Water body	Ecosystem Values	Outstanding natural feature or landscape	Significant indigenous vegetation and significant habitat of indigenous fauna	Areas with a high degree of naturalness
Arrow River	Psize, Psand, Ppass, Pgravel, Hspawn, Hjuve, Weedfree, Trout	-	-	A high degree of naturalness above 900 m asl.
Bullock Creek	Hspawn(t), Hjuve(t), Trout			
Cardrona River	Pboulder, Psand, Pgravel, Hspawn, Hjuve, Weedfree, Trout, Eel, Rarefish. Invrare (mid to upper reaches)	-	Significant habitat for flathead galaxiid	A high degree of naturalness above 900 m asl.
Clutha River/Mata-Au *between Alexandra and Lake Wanaka*	Psize, Prock, Pgravel, Hspawn(t&s), Hriparian, Hjuve(t&s), Trout, Eel, Salmon, Rarefish, Birddiv	-	Significant habitat for flathead galaxiid (tributaries).	-
Kawarau River *between Lake Dunstan and Lake Wakatipu*	Psize, Pgravel, Prock, Trout, Salmon, Eel, Rarefish. Weedfree upstream of Lake Dunstan	Outstanding: (a) for its wild, scenic characteristics; (b) natural characteristics, in particular the return flow in the upper section when the Shotover River is in flood; (c) for scientific values, in particular the return flow in the upper section when the Shotover is in flood; (d) for recreational purposes, in particular rafting, jet boating and kayaking. Spectacular and rugged river gorge, schistose landscape, fast flowing white water and rapids, old gold sluicing landscape, from confluence with Arrow River to Lake Dunstan.	Significant habitat for kōaro including many tributaries.	-
Hāwea River	Psize, Weedfree, Hspawn, Hjuve, Trout, Salmon, Eel	-	-	-

Table 9 Natural values of waterbodies potentially affected by wastewater overflows in the Queenstown Lakes District from Schedule 1A of the RPW.

Water body	Ecosystem Values	Outstanding natural feature or landscape	Significant indigenous vegetation and significant habitat of indigenous fauna	Areas with a high degree of naturalness
Lake Hāwea	Psize, Psand, Weedfree, Hjuve(t&s), Eel, Trout, Salmon	Scenic values within the wider landscape context of the surrounding mountains, particularly colour of the water.		
Lake Hayes	Psand, Psilt, Weedfree, Hriparian, Eel, Trout			
Horne Creek	Weedfree. Hspawn(t), Hjuve(t), Ppass, Trout in lower reaches			
Luggate Creek	Weedfree, Rarefish. Invrare upstream of F40: 040924		Significant habitat for koaro	-
Mill Creek	Pgravel, Psand, Hspawn, Hjuve, Weedfree, Rarefish		*Significant habitat* for roundhead galaxiid.	A high degree of naturalness above 900 metres asl.
Shotover River	Pgravel, Pboulder, Psand, Prock, Psize, Weedfree, Hriparian, Birddiv, Birdrare	Outstanding: (a) for its wild and scenic characteristics; (b) for its natural characteristics, in particular the high natural sediment load and active delta at confluence with Kawarau River; (c) scientific value, in particular the high natural sediment load and active delta at confluence with Kawarau River; (d) for recreational purposes, in particular rafting, kayaking and jet boating; (e) for historical purposes, in particular gold mining. Spectacular and rugged river gorge, schistose landscape, fast flowing white water and rapids, old gold sluicing landscape, in main stem between confluence with Iron Stone Stream and Arthur Point. Wild and scenic characteristics, from confluence with Iron Stone Stream to its source	Lochnagar and Lake Creek, outstanding: (a) Essential characteristics that determine the ecosystem's integrity, form, functioning and resilience. Significant habitat: Areas of importance to internationally uncommon species - black fronted tern, banded dotterel - in main stem between Arthur Point and its source.	A high degree of naturalness above 900 metres asl.

Table 9 Natural values of waterbodies potentially affected by wastewater overflows in the Queenstown Lakes District from Schedule 1A of the RPW.

Water body	Ecosystem Values	Outstanding natural feature or landscape	Significant indigenous vegetation and significant habitat of indigenous fauna	Areas with a high degree of naturalness
Lake Wakatipu	Psize, Ppland, Weedfree, Hjuve(t&s), Hriparian, Eel, Trout, Salmon, Sigveg, Rarefish, Invrare	Outstanding: (a) as a fishery; (b) for its scenic characteristics; (c) for scientific value, in particular water clarity, and bryophyte community; (d) for recreational purposes, in particular boating; (e) for historical purposes; (f) for significance in accordance with tikanga Maori, in particular sites at the head of the lakes, and the legend of the lake itself. Scenic values within the wider landscape context of the surrounding mountains, particularly: - clear blue colour of the water, - river deltas, and beaches, particularly uncommon beach features between Rat Point and White Point	Significant habitat for koaro including many tributaries. Significant vegetation: Rare association of aquatic plants.	A high degree of naturalness above 900 m asl.
Lake Wanaka	Psize, Psand, Eel, Trout, Salmon, Sigveg, Rarefish, Invrare	Scenic values within the wider landscape context of the surrounding mountains, particularly the unmodified lake level, water quality and colour of the water.	Significant vegetation: Rare association of aquatic plants.	

Appendix D

Water quality figures - Rivers

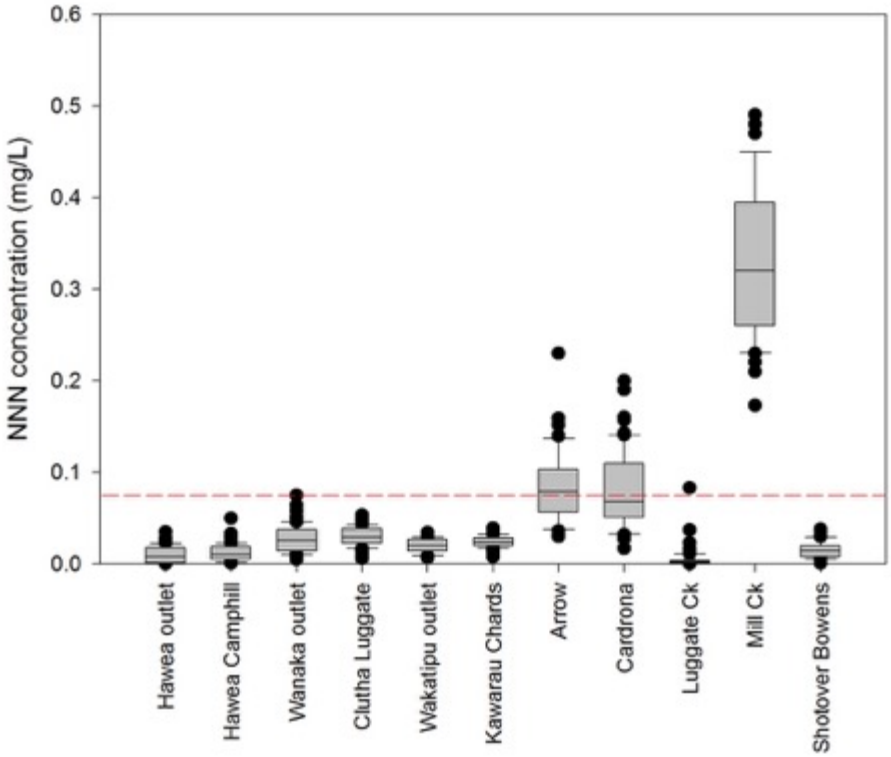


Figure 1 NNN concentrations in river sites. Data courtesy of Otago Regional Council. The dashed red line represents the Schedule 15 limit/target.

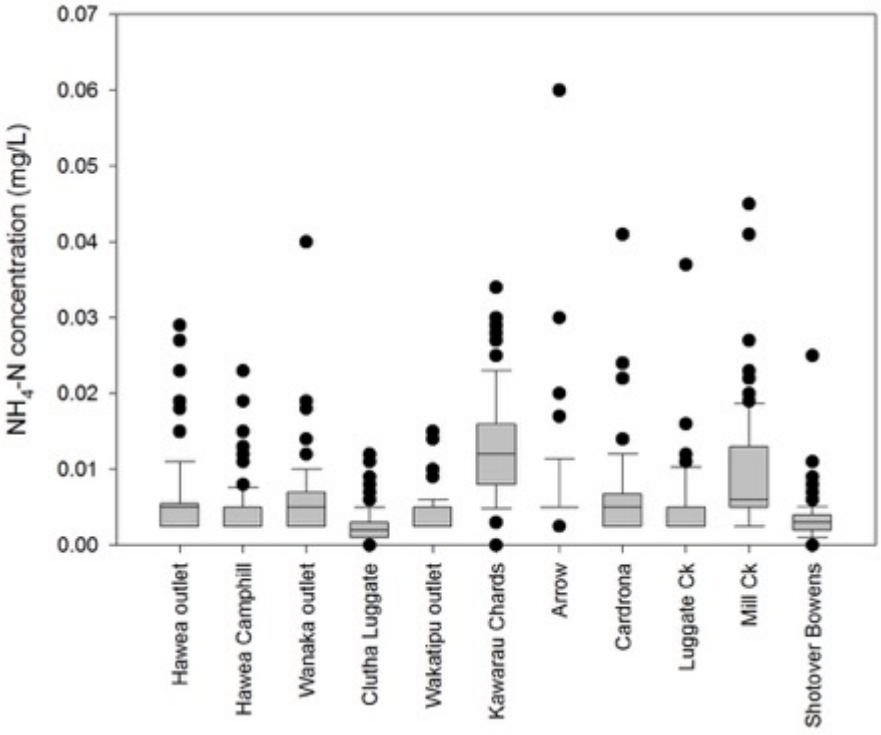


Figure 2 NH_4-N concentrations in riv er sites. Data courtesy of Otago Regional Council. The Schedule 15 limit for all sites is 0.1 mg/L.

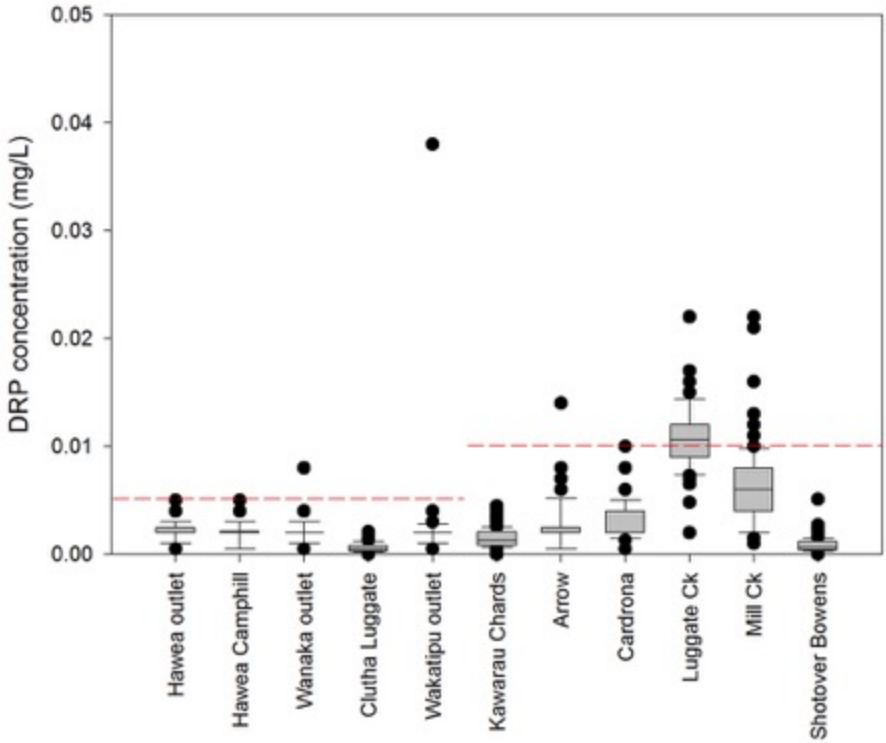


Figure 3 DRP concentrations in river sites. Data courtesy of Otago Regional Council. Dashed red lines represent the Schedule 15 limit/target.

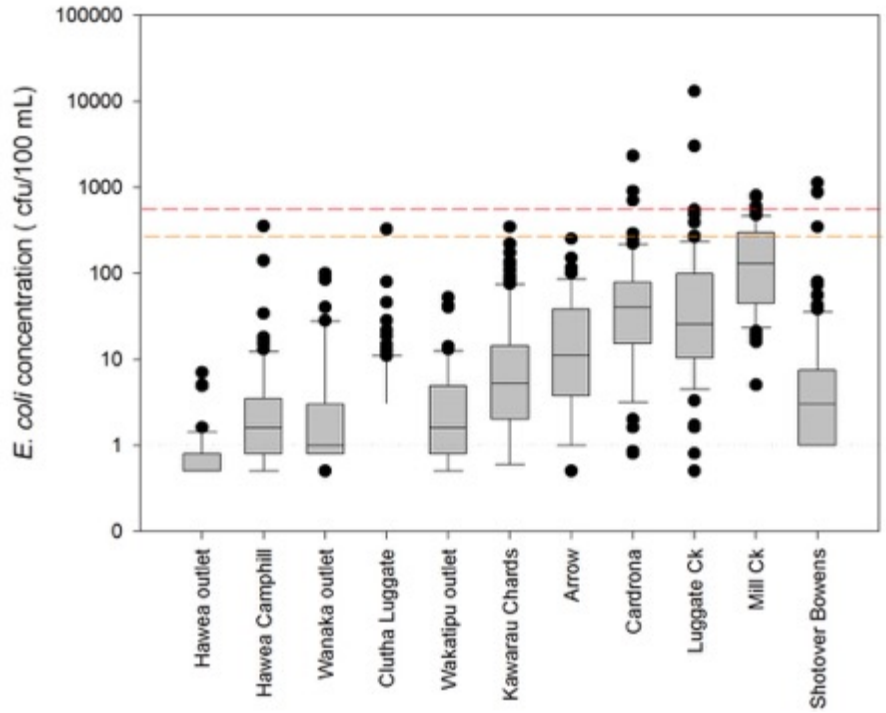


Figure 4 Counts of E. coli for river sites. Data courtesy of Otago Regional Council. The orange dashed line indicates the threshold for "alert" (orange) mode and the red dashed line indicates the threshold for "Action" mode based on MfE & MoH (2000).

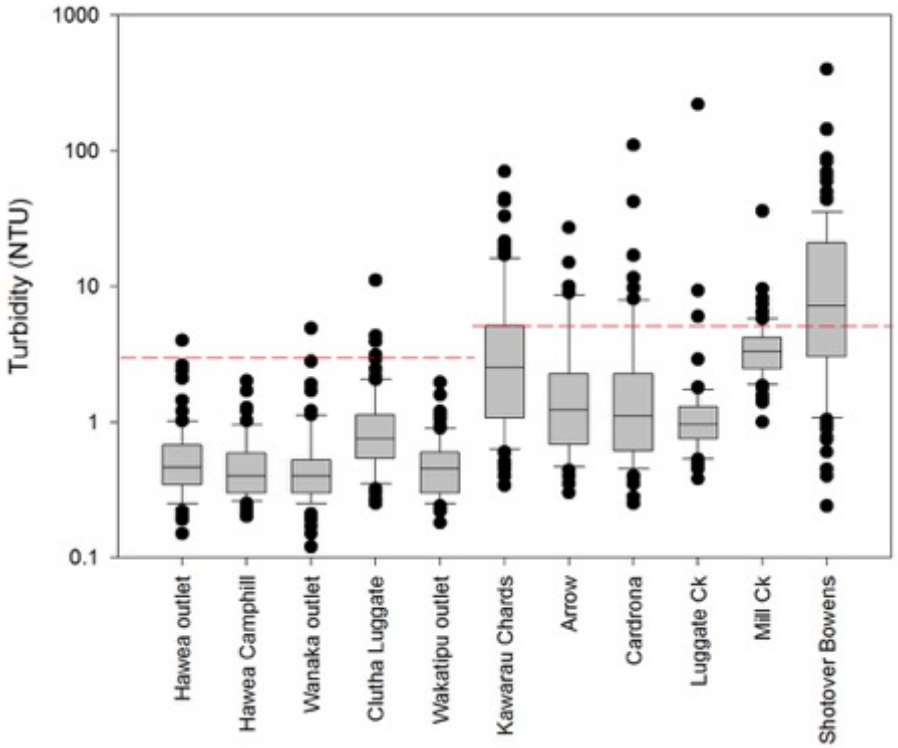


Figure 5 Turbidity at river sites. Data courtesy of Otago Regional Council. Dashed red lines represent the Schedule 15 limit/target.

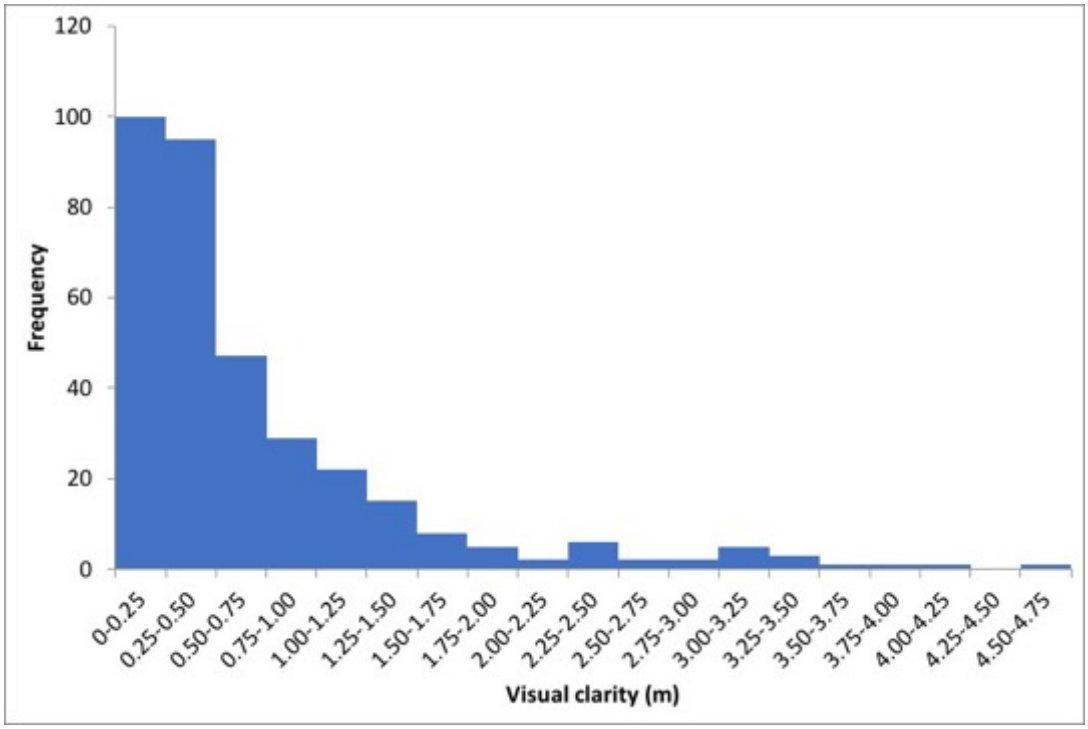


Figure 6 Histogram of visual clarity in the Shotover River at Bowen's Peak between February 1989 and December 2017. Data courtesy of NIWA.

Water quality figures - Lakes

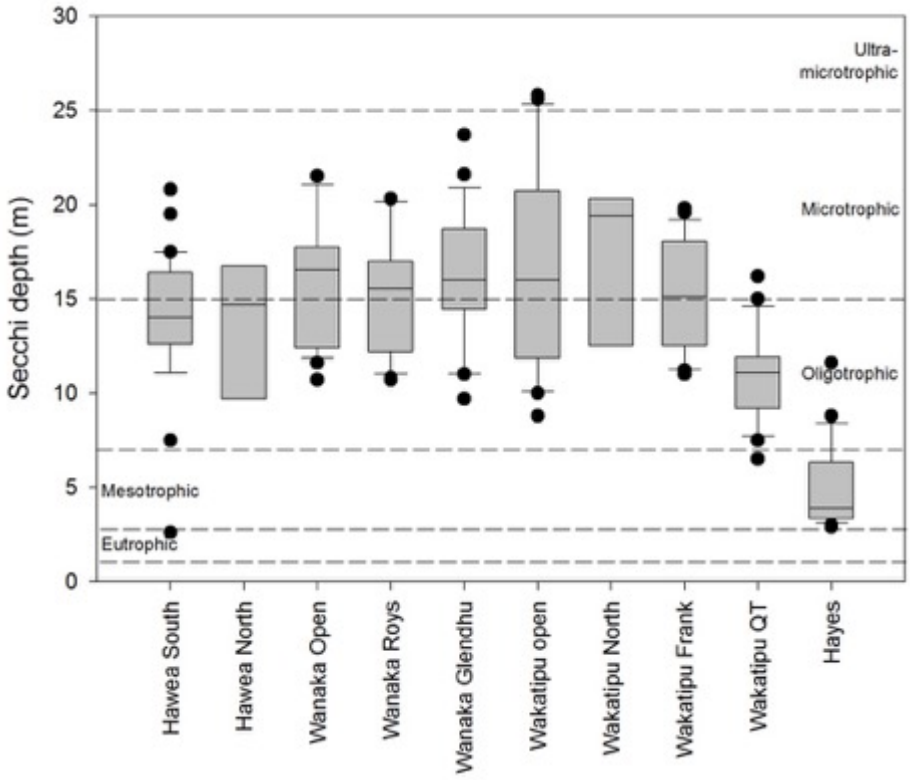


Figure 7 Water clarity (as measured by Secchi disc) at sites in Lakes Hāwea, Wanaka, Wakatipu and Hayes. Data courtesy of Otago Regional Council (ORC).

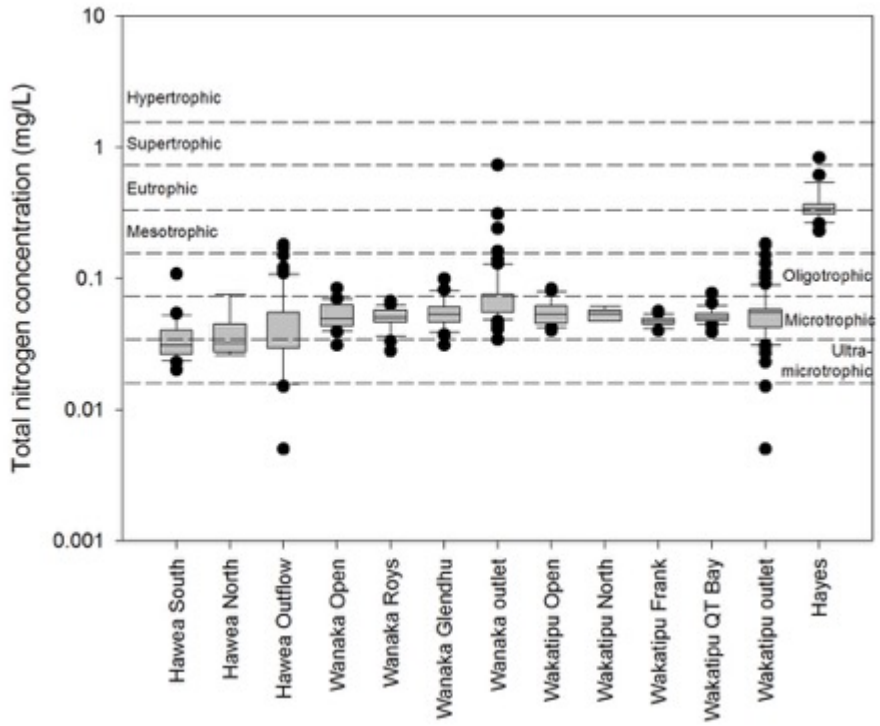


Figure 8 Total nitrogen concentrations (note logarithmic scale) at sites in Lakes Hāwea, Wanaka, Wakatipu and Hayes. Data courtesy o f Otago Regional Council. Concentrations for all sites are for samples taken at 10 m water depth, except for outlet sites.

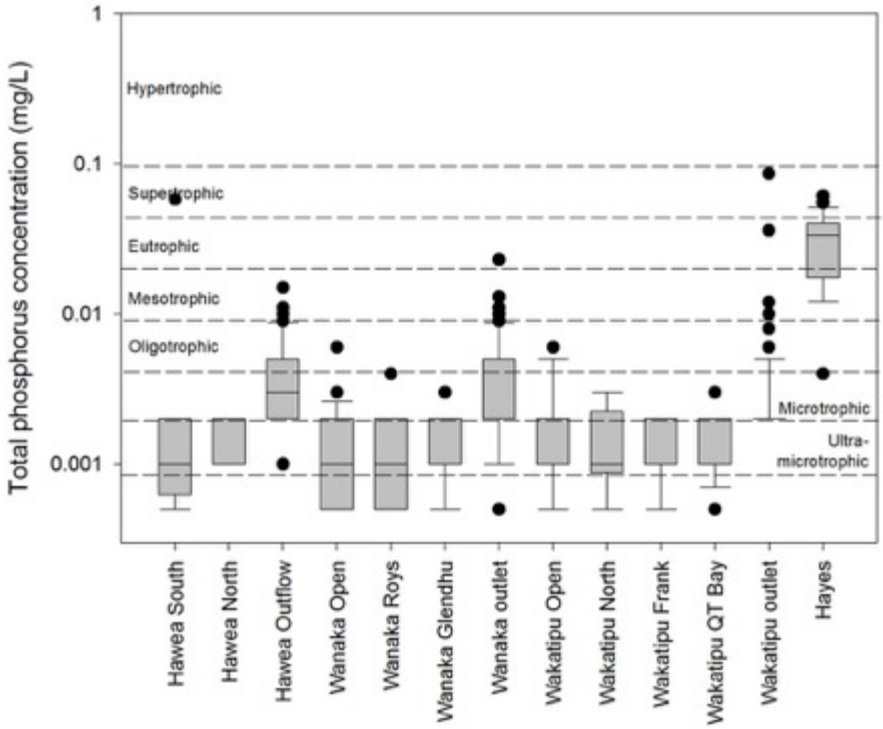


Figure 9 Total phosphorus concentrations (note logarithmic scale) at sites in Lakes Hāwea, Wanaka, Wakatipu and Hayes. Data courtesy of Otago Regional Council. Concentrations for all sites are for samples taken at 10 m water depth, except for outlet sites.

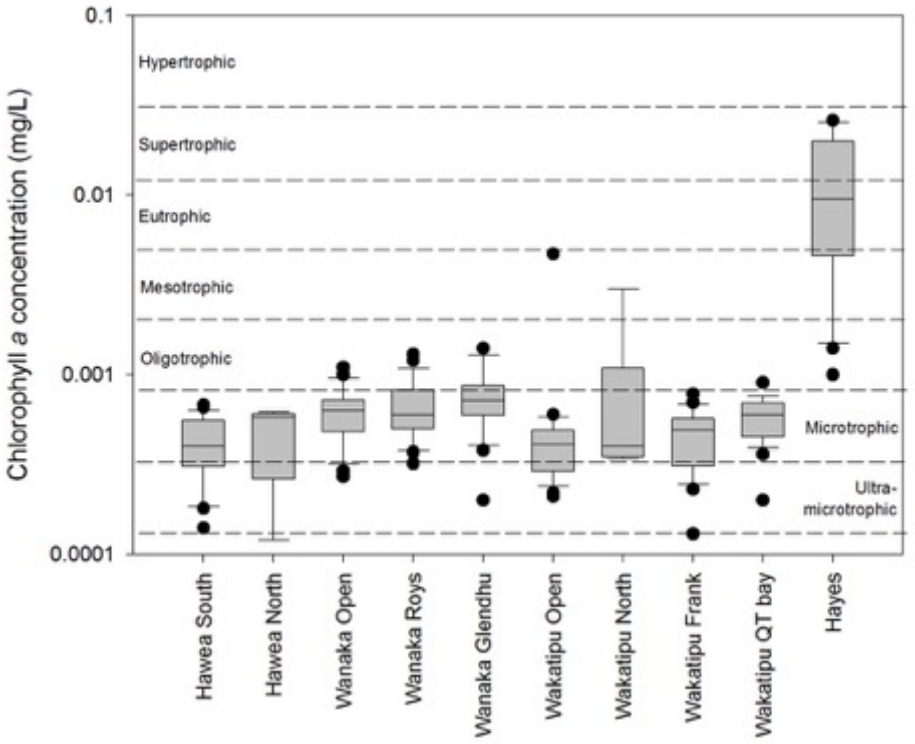


Figure 10 Chlorophyll a concentration (note logarithmic scale) at sites in Lakes Hāwea, Wanaka, Wakatipu and Hayes. Data courtesy of Otago Regional Council. Concentrations for all sites are for samples taken at 10 m water depth.

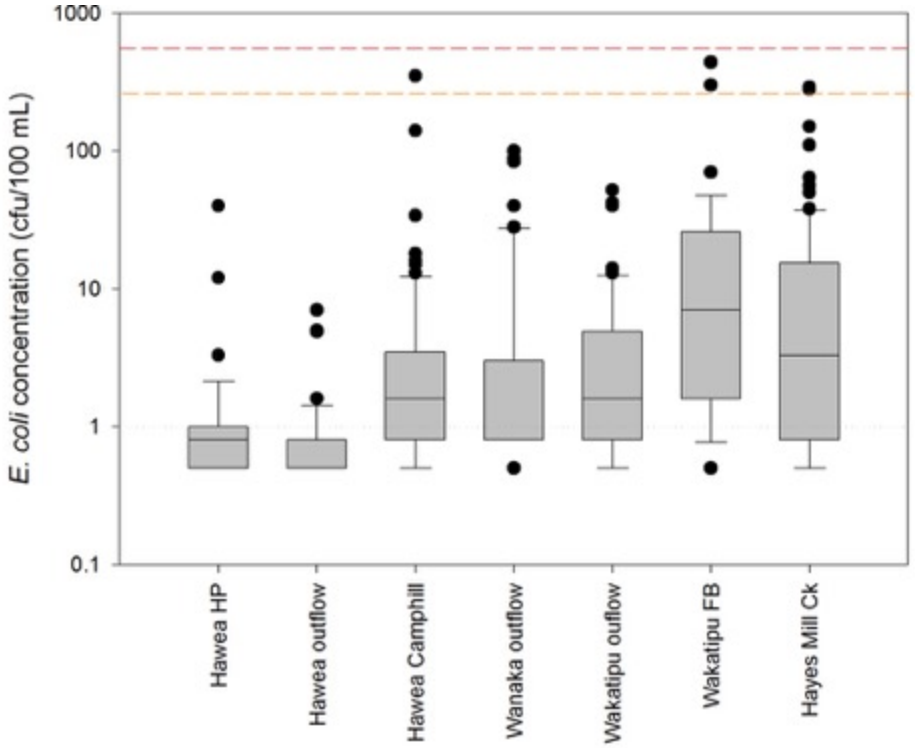


Figure 11 Counts of E. coli at sites in Lakes Hāwea, Wanaka, Wakatipu and Hayes. Data courtesy of Otago Regional Council. The orange dashed line indicates the threshold for "alert" (orange) mode and the red dashed line indicates the threshold for "Action" mode based on MfE & MoH (2000). Hawea HP = Lake Hāwea at Holiday Park, Wakatipu FB = Lake Wakatipu at Frankton Bay.

Appendix E

Water quality monitoring sites

Data for most sites were from State of the Environment monitoring undertaken by Otago Regional Council. Data for Clutha River at Luggate Bridge, Kawarau River at Chard Rd and Shotover at Bowen's Peak were downloaded from the NIWA Hydro Web Portal for Hydrometric and Water Quality data (https://hydrowebportal.niwa.co.nz/).

Table 10 Water quality data used in the preparation of this report, including site location and data period.

Site	Type	Location (NZTM)		Data period used	
		Easting	Northing	Start date	End date
Lake Hāwea South Open Water 10m	Lake	1304091	5060812	21/09/16	21/03/18
Lake Hāwea North Open Water 10m	Lake	1306729	5069868	17/02/17	22/02/18
Lake Wakatipu Open Water 10m	Lake	1259057	5001176	22/09/16	20/03/18
Lake Wakatipu North Open Water 10m	Lake	1242128	4997920	16/02/17	20/02/18
Lake Wakatipu at Frankton Arm 10m	Lake	1261119	5004619	22/09/16	20/03/18
Lake Wakatipu at Queenstown Bay 10m	Lake	1257916	5003815	22/09/16	20/03/18
Lake Wanaka Open Water 10m	Lake	1290615	5047684	21/09/16	21/03/18
Lake Wanaka at Roy's Bay 10m	Lake	1292418	5044082	21/09/16	21/03/18
Lake Wanaka at Glendu Bay 10m	Lake	1284603	5046355	21/09/16	21/03/18
Lake Hayes at Mid Lake 10m	Lake	1269730	5010987	22/09/16	9/04/18
Lake Hāwea at Holiday Park	Contact rec.	1302356	5053823	1/12/14	22/03/16
Lake Wakatipu at Frankton Bay	Contact rec.	1263337	5005985	1/12/14	22/03/16
Lake Hayes at Mill Creek Shallows	Contact rec.	1269921	5011934	5/01/12	22/03/16
Lake Hāwea Outflow at Dam	Outlet	1302520	5053536	16/02/12	21/05/18
Lake Wanaka at Outlet	Outlet	1294718	5047186	12/02/12	21/05/18
Lake Wakatipu at Outflow	Outlet	1263310	5005041	28/02/12	17/05/18
Arrow at Morven Ferry Road	River	1273547	5009605	12/08/98	13/06/14
Cardrona at Mt Barker	River			26/07/13	21/05/18
Hāwea at Camphill Bridge	River	1302363	5049022	16/02/12	21/05/18
Luggate Creek at SH6 Bridge	River	1304632	5038216	16/02/12	21/05/18
Mill Creek at Fish Trap	River	1269921	5012135	10/01/12	17/05/18
Clutha River at Luggate Bridge (AX1)	River	1305428	5040400	15/07/08	12/12/17
Kawarau River at Chard Rd (AX2)	River	1274418	5008062	15/07/08	12/12/17
Shotover River at Bowens Peak (AX3)	River	1262194	5009251	15/07/08	12/12/17

Appendix F

Locations of network features considered

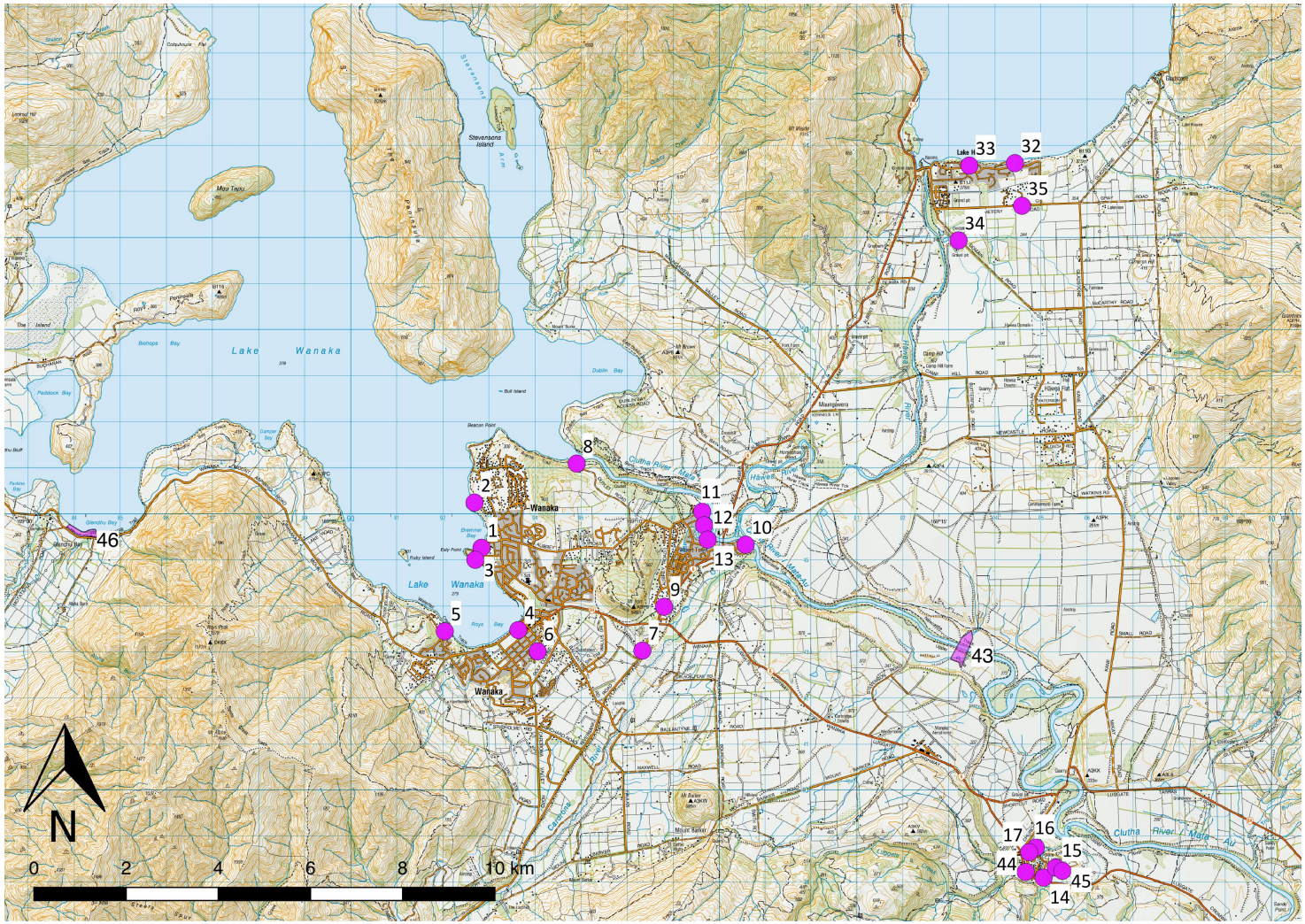


Figure 12 Location of Pump Stations in the Wanaka/Hāwea area.

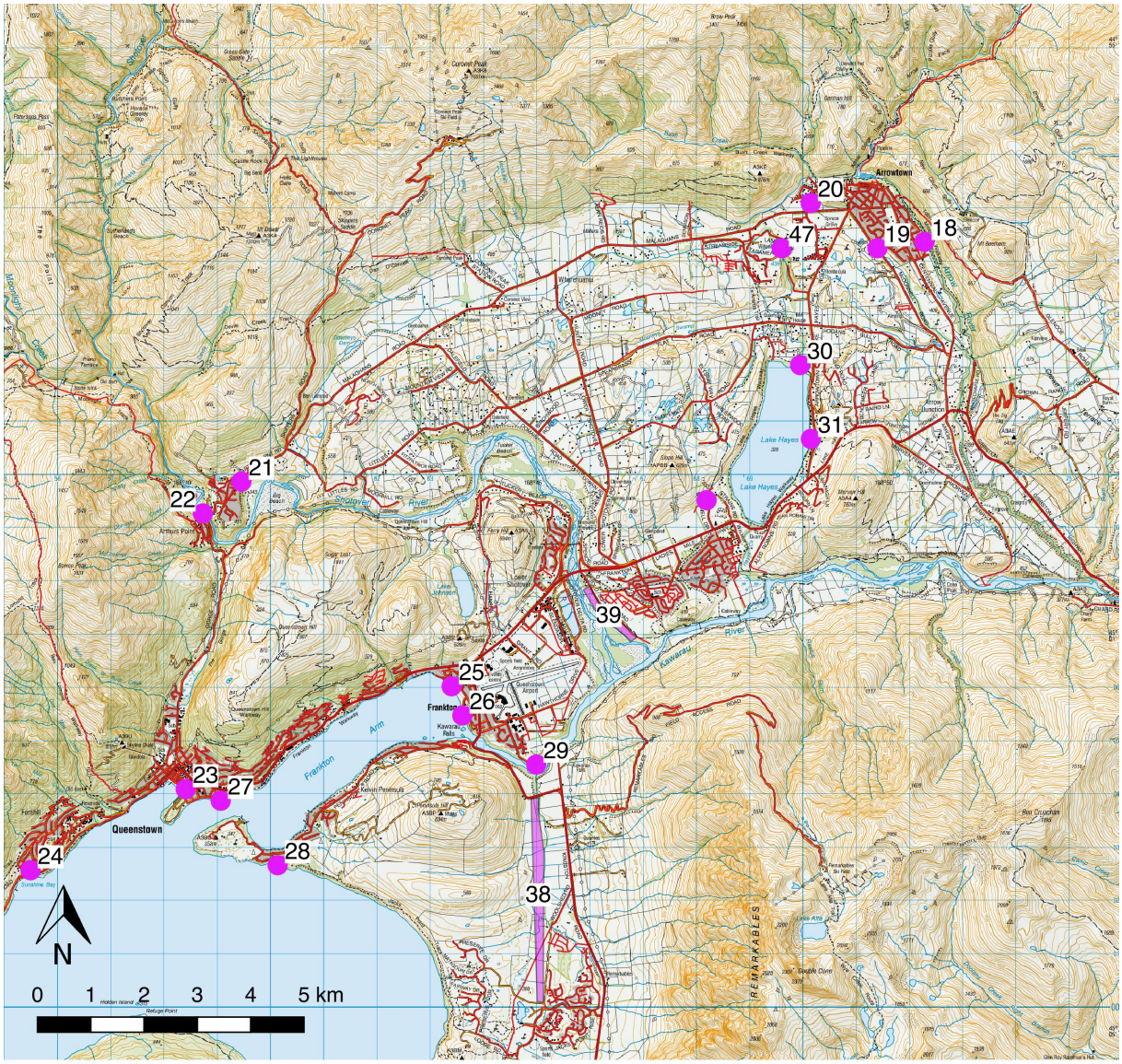


Figure 13 Location of Pump Stations in the Queenstown area.

Figure 14 Location of Pump Stations in Kingston.

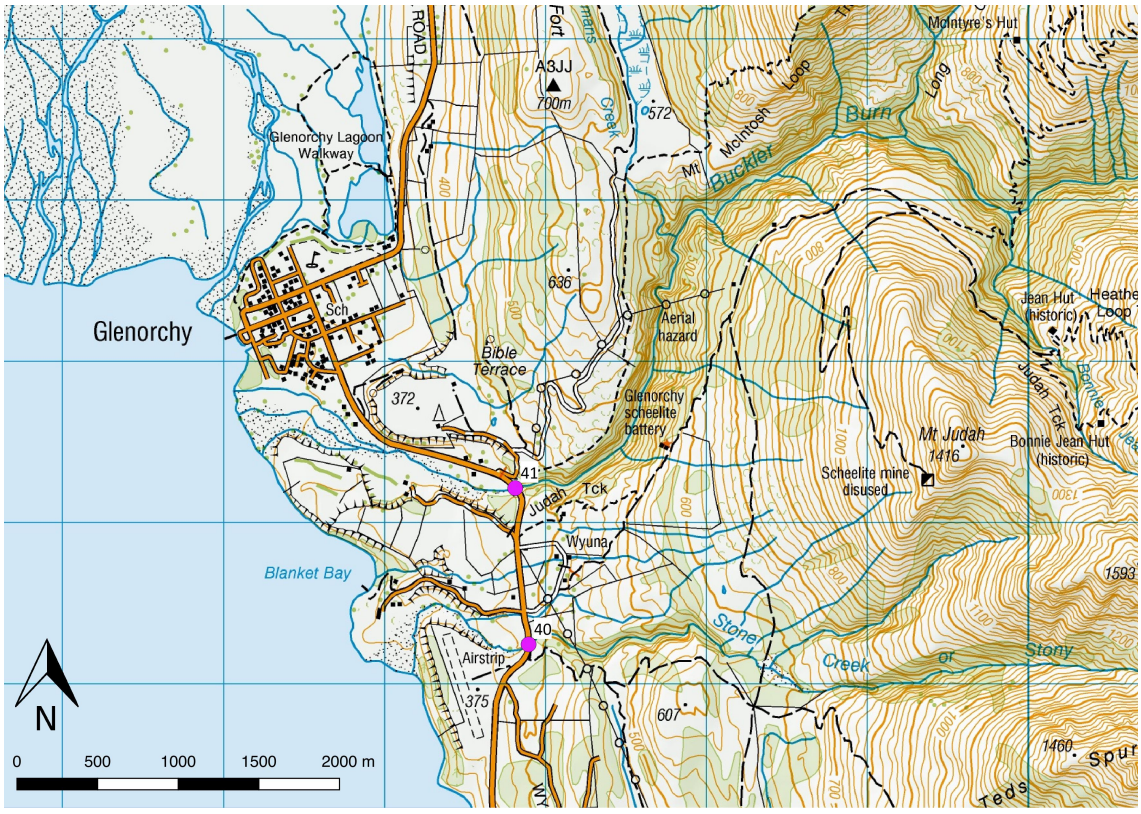


Figure 15 Location of Pump Stations in the Glenorchy area.

Appendix F

Risk Assessment

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
1	Wanaka	16	Lake Wanaka	Pump station on Lakeside Road on lake shore.	High	Yes	High	**High**	No vegetation	Large lake	**Moderate, but high locally**
2	Wanaka	110	Lake Wanaka (Bremner Bay)	Pump station near the end of Waimana Place.	Low-mod	No	Low-mod	**Low-mod**	Rank grass and scrub.	Large lake	**Moderate, but high locally**
3	Wanaka	30	Lake Wanaka (Eely Point)	Pump station near Eely Point Access track.	High	Yes	Moderate	**Mod-high**	Grass berm and beach.	Large lake	**Moderate, but high locally**
4	Wanaka	120	Lake Wanaka (Roys Bay)	Pump station on Dungarvon Street. Possible stormwater route or along road.	Moderate	Potential	Moderate	**Mod-high**	Possible stormwater route.	Large lake	**Moderate, but high locally**
5	Wanaka	105	Lake Wanaka (Roys Bay)	Pump station near Edgewater Resort.	Moderate	Potential	Moderate	**Moderate**	Possible flow path to pond, then on to lake.	Large lake	**Moderate, but high locally**
6	Wanaka	71	Bullock Creek	Pump station on Dungarvon Street.	Mod-high	Potential	High	**High**	Possible stormwater route or along road.	Stream	**Mod-high**
7	Wanaka	210*	Cardrona River	Pump station on Riverbank Road.	Low	No	Low	**Negligible**	No obvious surfacewater bodies nearby.	Small-medium river	**Moderate**
8	Clutha outlet	70	Clutha River	Pump station at end of Clutha Outlet Road.	Mod-high	Yes	Mod-high	**Mod-high**	Gravel tracks, grass and gravel.	Large river	**Low-mod**
9	Albert Town	650	Cardrona River	Pump station on Albert Town-Lake Hāwea Road.	Negligible	No	Low	**Negligible**	No obvious surfacewater bodies nearby.	Small-medium river	**Moderate**
10	Albert Town	25	Clutha River	Pump station on Wicklow Terrace.	High	No	Moderate	**Mod-high**	On grass-covered bank of Clutha River	Large river	**Low-mod**
11	Albert Town	120	Clutha River	Pump station on Gunn Road.	Low-mod	No	Low	**Low-mod**	Gravel road to Clutha, but no clear slope/flowpath to Clutha.	Large river	**Low-mod**
12	Albert Town	114	Clutha River	Pump station on Alison Avenue.	Mod-high	Yes	Moderate	**Mod-high**	Paddock and trees between pumpstation and Clutha River.	Large river	**Low-mod**
13	Albert Town	70	Clutha River	Pump station on Alison Avenue.	Moderate	Yes	Low	**Moderate**	Residential section between pumpstation and Clutha River.	Large river	**Low-mod**

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
14	Luggate	400	Luggate Creek	Pump station on Pisa Road.	Negligible	No	Low	**Negligible**	No obvious surfacewater bodies nearby.	Small-medium river	**Moderate**
15	Luggate	374	Luggate Creek	Pump station on Alice Burn Drive (unformed).	Negligible	No	Low	**Negligible**	No obvious surfacewater bodies nearby.	Small-medium river	**Moderate**
16	Luggate	110	Luggate Creek	Pump station on Harris Place.	Moderate	Potential	Mod-high	**Moderate**	Grass and gravel tracks. Possible stormwater route to Luggate Creek.	Small-medium river	**Moderate**
17	Luggate	15	Luggate Creek	Pump station on river bank near Church Road.	Mod-high	Yes	Moderate	**High**	Grass and willows on bank.	Small-medium river	**Mod-high**
18	Arrowtown	42	Arrow River	Pump station on bank near Alexander Place above river.	Mod-high	Potential	Moderate	**Mod-high**	Grass, willows and gravel tracks on bank.	Small-medium river	**Mod-high**
19	Arrowtown	3	Roadside drain/Arrow River	Pump station near McDonnell Road.	High	Yes	Mod-high	**High**	Small roadside ditch nearby, which ultimately flows into the Arrow River (3 km downstream).	Small-medium river	**Mod-high**
20	Arrowtown	425	Bush Creek	Pump station beside Essex Avenue.	Negligible	No	Low	**Negligible**	Grass and small trees. No surfacewater bodies nearby.	Stream	**Moderate**
21	Arthur's Point	292	Shotover River	Pump station beside Atley Road.	Low	No	Low	**Low**	Bush and paddock.	Medium-large river	**Low-mod**
22	Arthur's Point	8	Shotover River	Pump station beside Oxenbridge Tunnel Road on bank of Shotover River.	High	Yes	Low-mod	**Mod-high**	Pine trees, gorse and broom.	Medium-large river	**Low-mod**
23	Queenstown	34	Lake Wakatipu (Queenstown Bay)	Pump station on Marine Parade beside lake shore.	High	Yes	Mod-high	**High**	On lake shoreline, gravel beach to Queenstown Bay.	Large lake	**Moderate, but high locally**
24	Queenstown	23/150	Small stream, Lake Wakatipu (Sunshine Bay)	Pump station on track off Glenorchy-Queenstown Road.	High	Yes	Low-high	**High**	Small stream nearby, which flows into Sunshine Bay.	Stream/large lake	**Moderate, but high locally**

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
25	Queenstown	60	Lake Wakatipu (Frankton Arm)	Pump station on lake shore on Shoreline Road at Frankton Beach.	Mod-high	Yes	Mod-high	**Mod-high**	On lake shoreline, gravel beach to Frankton Beach.	Large lake	**Moderate, but high locally**
26	Queenstown	10	Lake Wakatipu (Frankton Arm)	Sewer main with overflow on lake shore on Allan Cresent at Frankton Beach.	High	Yes	Mod-high	**High**	Road/parking area and grass.	Large lake	**Moderate, but high locally**
27	Queenstown	25	Lake Wakatipu	Pump station beside Park Street.	High	Yes	Mod-high	**High**	Road, grass, trees and gravel.	Large lake	**Moderate, but high locally**
28	Queenstown	25	Lake Wakatipu	Pump station on vehicle track off Cedar Drive.	High	Yes	Moderate	**Mod-high**	Grass, trees and gravel.	Large lake	**Moderate, but high locally**
29	Queenstown	52	Kawarau River	Pump station on vehicle track at end of Riverside Road.	Mod-high	Yes	Moderate	**Mod-high**	Grass and gravel.	Large river	**Low-mod**
30	Lake Hayes	84	Lake Hayes	Pump station beside access road to Mill Creek shallows.	Mod-high	Yes	Mod-high	**Mod-high**	Road and grass.	Lake Hayes	**Mod-high**
31	Lake Hayes	13	Lake Hayes	Pump station on shore of Lake Hayes beside access track and carpark off Arrowtown-Lake Hayes Road.	High	Yes	Mod-high	**High**	Grass.	Lake Hayes	**Mod-high**
32	Lake Hāwea	52	Lake Hāwea	Pump station on Hawea Esplanade Road near shoreline of Lake Hāwea.	Mod-high	No	Moderate	**Moderate**	Near shoreline of Lake Hāwea	Large lake	**Moderate, but high locally**
33	Lake Hāwea	98	Lake Hāwea	Pump station near Scotts Beach Road near shoreline of Lake Hāwea. No obvious flow path to lake.	Mod-high	No	Moderate	**Moderate**	Near shoreline of Lake Hāwea. No obvious flowpath to lake.	Large lake	**Moderate, but high locally**
34	Lake Hāwea	380	Hāwea River	Pump station near Domain Road.	Low	No	Low	**Negligible**	No obvious flow path to river, paddocks and scrub.	Medium-large river	**Low-mod**
35	Lake Hāwea	990	Lake Hāwea	Pump station on Cemetery Road.	Low	No	Low	**Negligible**	No obvious surface water bodies in vicinity.	Large lake	**Moderate**

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
36	Kingston	36	Lake Wakatipu	PROPOSED - Pump station at lakefront park across from Gloucester Street.	High	No	Low-mod	**Moderate**	In close proximity to shoreline of Lake Wakatipu, but natural topography would result in ponding on grassed area between road and lake.	Large lake	**Low-moderate, but high locally**
37	Kingston	30	Lake Wakatipu	PROPOSED - Pump station at lakefront park across from Cornwall and Oxford Street.	High	Potential	Low-mod	**Mod-high**	In close proximity to shoreline of Lake Wakatipu, but natural topography would result in ponding on grassed area between road and lake. Stormwater drain may provide flow path to lake.	Large lake	**Low-moderate, but high locally**
38	Jacks Point	0	Various ephemeral creeks	PROPOSED - pipeline from Jacks Point to Frankton.	High	Yes	Low-mod	**Low-mod**	Several small ephemeral creeks crossed by potential pipeline route. Vegetation ranges from rank grass to vehicle track.	Streams	**Low**
39	Lower Shotover	>150	Shotover River	PROPOSED - wastewater network infrastructure for development on low-lying land on true left of the Shotover River	Low	No	Low-mod	**Low**	Willow and scrub. No clear flowpaths to lower Shotover River.	Medium-large river	**Low-mod**

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
40	Glenorchy	0 (pipe crossing)	Stone Creek	PROPOSED - pipeline from Glenorchy to potential disposal site at Glenorchy airport.	High	Yes	High	**High**	Pipe crossing under Glenorchy-Queenstown bridge. Rank grass on upstream side, broom scrub on downstream. Bare ground under bridge.	Stream	**Mod-high**
41	Glenorchy	0 (pipe crossing)	Buckler Burn	PROPOSED - pipeline from Glenorchy to potential disposal site at Glenorchy airport.	High	Yes	High	**High**	Pipe crossing under Glenorchy-Queenstown bridge. Beech forest on upstream side, willow and scrub on downstream. Bare ground under bridge.	Small-medium river	**Moderate, but high locally**
42	Cardrona	15	Cardrona River	PROPOSED - pipeline from Cardrona township to potential disposal site at skifield turn-off.	Low-High	No	Low-High	**Low-high**	Vegetation generally rank grass or pasture. Pipeline would cross several tributaries, higher risk at pipe crossings in case of leak.	Small-medium river	**Moderate, but high locally**
43	Clutha near Wanaka airport	0 (pipe crossing)	Clutha River	PROPOSED - pipeline from Hāwea township to potential disposal site at Wanaka airport.	Low-High	Yes	Low-mod	**Low-high**	Vegetation generally rank grass or pasture. Pipeline would cross water race near Butterfield Road-Newcastle Road.	Large River	**Low**
44	Luggate	0 (pipe crossing)	Luggate Creek	PROPOSED - pipeline from Luggate township to potential disposal site at Wanaka airport.	Low-High	Yes	Low-High	**Low-high**	Pipeline to cross Luggate Creek.	Small-medium river	**Moderate**

Table 11 Risk assessment for each of the locations assessed including the risk of wastewater entering surace water and the risks associated with wastewater discharges to that receiving environment type.

Pump station	Area	Distance to water (m)	Receiving water body/bodies	Description	Distance to water	Flow path	Risk associated with vegetation/surface permeability	Probability of waste water entering water	Notes	Receiving environment type	Risk associated with wastewater discharge
45	Luggate	0 (pipe crossing)	Dead Horse Creek	PROPOSED - wastewater from developments to east of Luggate township.	Low-High	Yes	Low-High	**Low-high**	Pipeline to cross Dead Horse Creek.	Stream	**Mod-high**
46	Glendhu Bay	>55	Lake Wanaka (Glendhu Bay)	PROPOSED - Glendhu Bay campground	Moderate	Yes	Low-mod	**Moderate**	Infrastructure along access track. Vegetation mostly short grass.	Large lake	**Moderate, but high locally**
47	Mill Creek	12	Mill Creek	PROPOSED - Pump station at Millbrook, near 18th hole.	High	Yes	Low-mod	**Mod-high**	Vegetation short grass (golf course).	Small-medium river	**Moderate, but high locally**
										Lake Hayes	**Mod-high**

Appendix G Site photos

Pump station 1

Figure 15 Pump station 1 on shoreline of Lake Wanaka at Bremner Bay.

Figure 16 Shoreline of Lake Wanaka at Bremner Bay near Pump station 1.

Pump station 2

Figure 17 Pump station 2 at the end of Waimana Place near Lake Wanaka.

Figure 18 Track leading from the end of Waimana Place to Lake Wanaka.

Figure 19 Shoreline of Lake Wanaka near Pump station 2.

Pump station 3

Figure 20 Pump station 3 located at Eely Point with Lake Wanaka in background.

Figure 21 Lake Wanaka at Eely Point near Pump Station 3.

Pump station 4

Figure 22 Pump station 4 on Dungarvon Street near Roy's Bay, Lake Wanaka.

Figure 23 Lake Wanaka at Roy's Bay near Pump station 4.

Pump station 6

Figure 24 Pump station 6 on Dungarvon Street near Bullock Creek.

Figure 25 Bullock Creek downstream of Dungarvon Street near Pump Station 6.

Pump station 10

Figure 26 Pump station 10 on Wicklow Terrace (Albert Town) with Clutha River in background.

Figure 27 Upper Clutha River near Pump station 10 on Wicklow Terrace, Albert Town.

Pump station 11

Figure 28 Pump station 11 on Gunn Road, Albert Town.

Figure 29 Access track from Gunn Road near Pump station 11 with Clutha River in background.

Pump station 12

Figure 30 Pump station 12 on Alison Avenue, Albert Town.

Figure 31 Reserve between Pump Station 12 and the Clutha River.

Pump station 16

Figure 32 Pump station 16 on Harris Place, Luggate.

Figure 33 Walkway to Luggate Creek from near Pump station 16 on Harris Place, Luggate.

Figure 34 View of Luggate Creek from end of walkway from Harris Place.

Pump station 17

Figure 35 View of pump station 17 near Church Street, Luggate from the true right bank of Luggate Creek.

Figure 36 Luggate Creek near Pump Station 17.

Pump station 18

Figure 37 Pump Station 18 near Alexander Place, Arrow Town.

Figure 38 View to Arrow River near Pump Station 18, Arrow Town.

Pump station 19

Figure 39 Pump station 19 beside McDonnell Road, Arrow Town.

Figure 40 Roadside ditch beside McDonnell Road, Arrow Town near Pump station 19.

Figure 41 Roadside ditch beside McDonnell Road, Arrow Town near Pump station 19.

Pump station 20

Figure 42 Pump station 20 beside Essex Avenue, Arrow Town.

Figure 43 Pump station 20 beside Essex Avenue, Arrow Town.

Pump station 21

Figure 44 Pump station 21 beside Atley Road, Arthurs Point near the Shotover River.

Figure 45 View to the Shotover River near Pump Station 21 on Atley Road, Arthurs Point.

Pump station 22

Figure 46 View towards Pump Station 22 (Oxenbridge Tunnel Road) from the opposite (true left) bank of the Shotover River.

Pump station 23

Figure 47 Pump Station 23 on Marine Parade on the shore of Queenstown Bay, Lake Wakatipu.

Figure 48 Shoreline of Queenstown Bay, Lake Wakatipu beside Pump Station 23, looking north-west.

Figure 49 Shoreline of Queenstown Bay, Lake Wakatipu beside Pump Station 23, looking south-east.

Pump station 24

Figure 50 Pump Station 24 near Glenorchy-Queenstown Road.

Figure 51 Small unnamed stream near Pump Station 24, off Glenorchy-Queenstown Road, Fernhill.

Pump station 25

Figure 52 Pump Station 25 on the shore of Lake Wakatipu at Frankton Beach.

Figure 53 Shoreline of Lake Wakatipu at Frankton Beach near Pump Station 25.

Pump station 26

Figure 54 Area of sewer main with overflow on lake shore of Lake Wakatipu at Frankton Beach on Allan Cresent.

Figure 55 Area of sewer main with overflow on lake shore of Lake Wakatipu at Frankton Beach on Allan Cresent.

Pump station 30

Figure 56 Pump Station 30 (foreground) looking towards Lake Hayes.

Figure 57 View towards Lake Hayes from Pump Station 30.

Pump station 31

Pump station on shore of Lake Hayes beside access track.

Figure 58 Pump Station 31 with Lake Hayes in the background.

Figure 59 Lake Hayes shoreline near Pump Station 31.

Pump station 32

Figure 60 Pump Station 32 on Hāwea esplanade track on the shore of Lake Hāwea.

Figure 61 View from Pump Station 32 towards Lake Hāwea.

Pump station 33

Figure 62 Pump Station 33 on Scotts Beach Road on the shore of Lake Hāwea.

Figure 63 View towards Lake Hāwea from Pump Station 33.

Pump station 34

Figure 64 Pump Station 34 on Domain Road near Lake Hāwea.

Pump station 35

Figure 65 Pump Station 35 on Cemetery Road near Lake Hāwea.

Kingston

Figure 66 Location of proposed pump station 36 at Kingston across from Gloucester Street.

Figure 67 Location of proposed pump station 37 at Kingston at the intersection of Cornwall and Oxford Streets.

Lower Shotover

Figure 68 Low-lying terrace near the lower Shotover River (to the right of the willows on the right-hand side of the photograph).

Glenorchy

Figure 691 Buckler Burn below the Glenorchy-Queenstown Road bridge.

Clutha River near Wanaka airport

Figure 70 Clutha River near the proposed pipe bridge from Lake Hāwea village to a treatment plant near Wanaka airport.

Luggate – Dead Horse Creek

Figure 71 Dead Horse Creek upstream of Alice Burn Drive.

Figure 72 Dead Horse Creek downstream of the State Highway 6 bridge.

Glendhu Bay

Figure 73 Glendhu Bay campground.

Figure 74 Glendhu Bay campground.

Figure 75 Alpha Burn where it passes through the Glendhu Bay campground before entering Lake Wanaka.

Mill Creek

Figure 71 Mill Creek upstream of Taramea, downstream of pump station 47.

Appendix D – Public Health Assessment

Wastewater overflow discharge consent - Queenstown Lakes District Council

Microbial risk assessment

Prepared for Queenstown Lakes District Council

April 2019

Final

Prepared by:
Neale Hudson

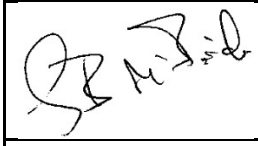
For any information regarding this report please contact:

Neale Hudson
Environmental Chemist/Group Manager
Catchment Processes
+64-7-856 1772
neale.hudson@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

NIWA CLIENT REPORT No: 2019063HN
Report date: April 2019
NIWA Project: BEC19201

Quality Assurance Statement		
	Reviewed by:	Graham McBride
	Formatting checked by:	Alison Bartley
	Approved for release by:	David Roper

3 April 2019 4.57 p.m.

Contents

Tables

Figures

Executive summary

Sewer leaks, blockages and sewer pump failure or occurrence of sewage flows that exceed sewer pump capacities have the potential to cause occasional discharge of raw sewage into streams and lakes in the Queenstown Lakes district. These occasional, aberrational discharges create conditions where increased risk of illness to recreational water users exposed to contaminated water exist.

Queenstown Lakes District Council provides wastewater reticulation and treatment services across the district, and wishes to better understand the human health risks arising from these accidental exposure events as part of the resource consent process.

Currently much of the data required to undertake a Quantitative Microbial Risk Assessment (QMRA) do not exist. These data are required to estimate the dilution of raw sewage under various river flow and rainfall conditions. Dilution of the raw sewage determines the concentration of pathogens in the receiving environment, which in turn determines the number of pathogens likely to be ingested by recreational users.

Despite this limitation, it is possible to estimate Individual Illness Risk for scenarios determined by:

- a selected "model" pathogen (in this case Norovirus, generally the most widespread pathogen in wastewater from urban areas)
- typical virus concentrations in raw sewage (from 1000 to 10^7 infectious units/L)
- commonly accepted water ingestion rates for recreational water user (swimmers), adjusted for child receptors
- a range of relative sewage dilution rates (from 1x to 100,000x).

Incorporating these assumptions in a model that allows "Monte Carlo"-type random sampling from many recreational events (1000), it is possible to estimate the Individual Illness Risk (IIR) or Individual Infection Risk for a group of 100 recreational users exposed on any random occasion, expressed as a percentage. These results indicate:

- Illness risk is always lower than the infection risk –illness requires infection, whereas infection does not necessarily lead to illness.
- Aggregation of pathogens decreases infectivity and risk of illness considerably, especially at low doses.
- The risk of illness or infection decreases as dilution increases.

These results indicate a potential for significant health risk arising from the discharge of untreated sewage in the conditions assumed in each scenario. Improved estimates of the health risks created by these discharges requires estimates of sewer and sewer pump leakage volumes or flows, stream flows at the time of the overflow events, and use of a mixing model. For lakes, use of a calibrated hydrodynamic model, able to represent the mixing, dilution and advection of contaminants within the lake will be required. A model of this nature would also allow the IIR to be calculated at any location within the lake model domain.

Irrespective of the availability of a hydrodynamic model that may improve estimation of the human health risk potential, occasional discharges should be anticipated and appropriate response plans developed. These very infrequent discharges are likely to occur despite the best efforts and careful management of Council infrastructure. Having in place well-developed and comprehensive response plans will ensure that

when these very infrequent overflow events occur, public health risk is protected and the risk to the community is minimised.

Practical information and strategies that may be incorporated in response plans is provided in the Ministry of the Environment/Ministry of Health “Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas" (2003). Among other things, these Guidelines recommend:

- public notification (signage, creation of exclusion zones and use of print and other modern media, such as social media) to encourage people to avoid certain areas and activities
- cross-agency cooperation and sharing of information and roles and responsibilities to maximise public health protection, and
- implementation of event-related monitoring activities, so that the extent of contamination (spatially and in time) is well known, and to ensure that the extent of the response plan is adequate.

The response plan included with the Assessment of Environmental Effects was reviewed as part of this health risk assessment, and we have concluded that it provides a suitable high-level indication of what would be done in response to a pollution event. Several recommendations were provided for consideration and possible inclusion to indicate more clearly how Queenstown Lakes District Council intends to respond to sewer overflows in an adaptive management approach.

If QLDC implements recommended response processes, then we consider that the risk to human health arising from occasional discharge of wastewater from the sewer network to be low to very low.

1 Background

Queenstown Lakes District Council (QLDC) provides wastewater reticulation services to the Queenstown Lakes District. Wastewater networks are subject to unpredictable factors which may lead to occasional accidental discharges of wastewater into the environment.

More specifically, wastewater may be discharged to land in circumstances where it may then enter a water catchment, or directly into a surface water catchment. The areas that may be subject to discharges may be utilised for several recreational purposes and may have broader amenity value to the community. The discharge of wastewater to areas with high amenity values (e.g., streams and rivers, or the lake foreshore) also creates the potential for measurable health risks.

NIWA was engaged by QLDC to undertake a public health risk assessment as part of the assessment of effects accompanying QLDC's wastewater network overflow discharges consent application. This report sets out the results of the Quantitative Microbial Risk Assessment (QMRA) process and makes recommendations for QLDC's management of public health risks. The Assessment of Environmental Effects[1] (referred to hereafter as the AEE) provides a fuller description of the project including the physical extent it covers within the Queenstown Lakes District. This is not repeated in this report.

[1] Prepared by Beca Ltd

2 Receiving environment

2.1 Location of discharges

The location of the current and future QLDC wastewater networks is explained in the AEE, with specific detail about the nature of the receiving waters set out in the ecological report prepared by Ryder Environmental Limited. In essence, discharges may occur to streams and rivers of varying size, as well as to lakes directly, and at a wide range of locations.

For the purpose of this assessment, key points to note include:

- Wastewater will be discharged into rivers and streams of varying sizes – this will determine the extent of immediate dilution available.
- The flow in all of the receiving streams will vary seasonally and in response to discrete rainfall events, which will also determine immediate dilution.
- Assuming the receiving streams are perennial, the duration of contamination at most stream and river discharge sites will probably be short (determined by the size and duration of the discharge and the flow in the stream).
- The contaminants of concern (pathogens) will always move in a downstream direction, and may be discharged to one of the lakes, or into a larger river.
- The duration of contamination in lakes is less easy to determine, and likely to depend on the persistence of contaminant plumes, and factors such as:
  - the temperature and density differences between diluted wastewater and lake waters
  - wind speed and direction, which will strongly influence localised wind mixing and determine the impact of larger-scale wind-driven currents, and
  - currents related to discharge of rivers from the lakes.

3 Assessing human health risks

Human health risks arising from exposure to microbial contaminants during recreational activities are generally assessed using recreational bathing monitoring programmes.

The Ministry for the Environment and Ministry of Health "*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas"* (MfE/MoH 2003) (MfE/MoH Guidelines) provide guidance regarding establishment and operation of recreational water quality monitoring programmes, and when interpreting the results derived from monitoring. Monitoring recreational water quality generally relies on use of faecal indicator bacteria (FIB) – *E. coli* in freshwaters. The MfE/MOH Guidelines are quite clear, however, that they should not be used during "exceptional circumstances". Exceptional circumstances relate to known periods of higher risk, such as during a "sewer rupture" or, in other words, any accidental discharge from the wastewater network. In these circumstances, alternate methods are required to assess human health risks arising from possible exposure to pathogens. These risks may be calculated using QMRA techniques, as explained hereafter.

This report explains the requirements for undertaking a QMRA, including data regarding receiving environment conditions and the choice of pathogens. In this study, several significant assumptions are required - justification of these choices is presented as well.

Risk assessment is applied to a diverse range of activities, including workplace health and safety, the design of structures, the planning and operation of space missions. Despite the diversity of these activities, several common factors need to be considered, and are provided here as definitions to guide the reader:

- **Hazard** - anything (e.g., work materials, equipment, methods, practices or activities) that has the potential to cause harm. In this case, the hazard is a wastewater discharge.
- **Risk** - the chance, high or low, that somebody may be harmed by the hazard. Risk is sometimes defined as **chance + hazard + exposure + consequence**, or "the likelihood of identified hazards causing harm in exposed populations in a specified time frame, including the severity of the consequences".[2] By its nature, risk is probabilistic and estimating risk requires the development of quantitative information.
- **Risk assessment** - the process of evaluating risks to individual safety and health arising from the hazards. It is a systematic examination of all aspects of an activity that considers:
  - what could cause injury or harm
  - whether the hazards could be eliminated, and if not
  - what preventive or protective measures are, or should be, in place to control the risks.

QMRA is a framework and approach that brings information and data together with mathematical models to address the spread of microbial agents through environmental exposures and to characterise the nature of the adverse outcomes. Although most microbes are harmless or beneficial, some are extremely dangerous – these are termed pathogens or Biological Agents of Concern (BAC). Although these have the potential to cause serious or fatal illness, they differ greatly in their physical characteristics, movement in the environment, and process of infection. These characteristics and the differences between potential pathogens are considered in the risk assessment process, to ensure that appropriate "model" pathogens are selected to assess human health risks.

[2] http://qmrawiki.canr.msu.edu/index.php/Quantitative_Microbial_Risk_Assessment

4 Methodology for conducting a QMRA

As indicated above, risk is probabilistic and estimating risk requires the development of quantitative information. We have generally followed two approaches, which we term conventional QMRA and reverse QMRA. The selection and use of one or both is principally determined by available data and information. We discuss both approaches briefly below.

4.1 Conventional QMRA modelling

QMRA consists of five basic steps:

A. Selection of the hazard(s), i.e., the pathogen(s) of concern—exposure to which can give rise to illness.

B. Assessment of exposure to the pathogen(s) at key sites (in terms of pathogen concentrations and duration of exposure).

C. Characterisation of human response to pathogen dose (creating suitable dose-response curves) – described in Appendix A.

D. Calculation of the health risk (in terms of infection and/or illness).

E. Communication of health risk, identifying appropriate response and mitigation actions.

Several components associated with or required for steps A-E are described in the schematic in Figure 4-1.

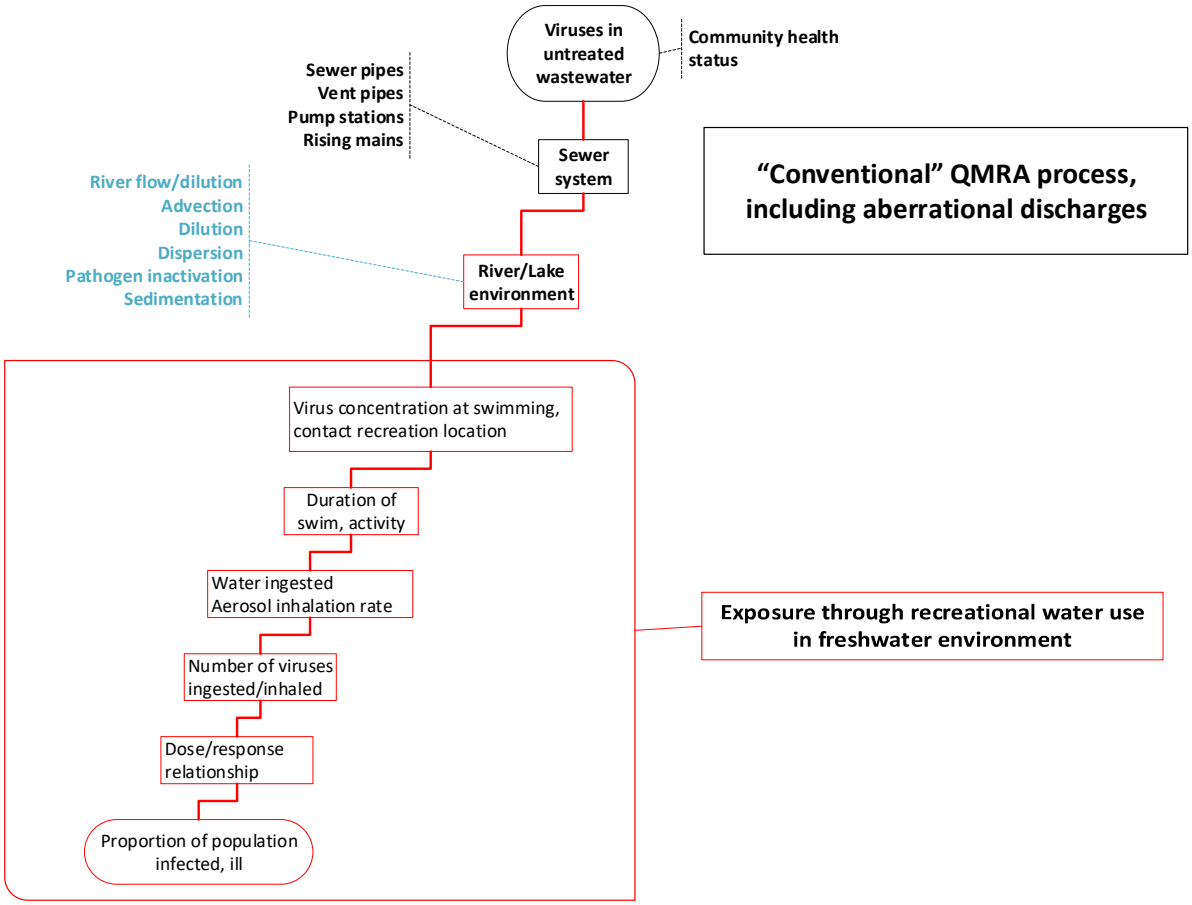


Figure 4-1: Process followed to relate human health risk to pathogen-contaminated surface waters. Items in blue are not available for this health risk assessment.

- The red lines and boxes in Figure 4-1 indicates the path followed from source ("Viruses in wastewater"), to the numbers of individuals likely to become infected or ill. Because a large representative "population" is used for the calculation, the results are generally expressed as a proportion.
- Callout boxes indicate the type of information or data required to make the process work.
- Data and information is required for the processes identified in the red boxes as well, but these data and information are less site-specific, and may be accessed from the literature, or values may be assumed (e.g., "Duration of swim or other activity").

In a full QMRA, these data and information are used as follows:

- Distributions of concentrations are created in response to a range of factors, such as river discharge/flow, tidal movements, tidal stage, rainfall, and wastewater treatment efficacy.
- Once these distributions are created, "recreational users" are exposed to a large number of likely concentrations, selected randomly using a Monte Carlo procedure.
- The pathogen concentration is also likely to vary widely according to the health status in the local community, the relative dilution of the wastewater, as well as in response to factors causing virus inactivation or attenuation. A likely range of concentrations based on measured values is used in this work – this is described in detail in Section 4.3.2.
- When calculating risks, use "Monte Carlo" statistical modelling, which calls for repetitive sampling from distributions and ranges of key variable concentrations, rather than just using single average concentration values. This approach is particularly important given that much of the risk is caused by combinations of inputs toward the extremes of their concentration ranges, the combined effects of which may not be detected when using average concentration values.
- The concentration of pathogens directly controls the size of infectious doses – the volume of water that needs to be ingested to be exposed to the number of organisms ('dose') required to cause infection.[3]
- This effectively allows the health risk to be estimated following exposure of a hypothetical large population size (typically 1,000 "individuals"), exposed on any particular "day".
- The output from this modelling process are estimates of **illness** risk (as opposed to just infection), attributable to the discharge of wastewater. These health risks were calculated for individuals engaged in **primary contact recreation** near the discharge. "Primary contact recreation" refers to activities such as swimming and paddling where full immersion is anticipated, i.e., ingestion of contaminated water is likely to be an outcome of recreation.

Items A), C) and D) above may be addressed using reported data, values from the scientific literature, or other information that is relatively easily available. Item B) however is more problematic. Review of existing information indicates that data are not currently available regarding the likely dispersion and dilution of materials discharged from the wastewater network to either streams or the lake. This makes

[3] Different individuals have different responses to a given dose, with some becoming infected, others not. Infectivity is therefore characterised by a dose-response curve ('function') and risk calculations need to be made for this range of sensitivity. Using averages to calculate a single risk value is highly inaccurate.

estimation of the concentrations of pathogens in receiving waters impossible, and as a consequence, estimation of the dose of pathogens to which human receptors may be exposed is also impossible.

Previously Palliser,Hudson (2018) attempted to estimate risks using information derived from expert opinion, information derived from other work (including advection, fate of sediment and likely impact of other contaminants on water), but the uncertainty arising from absence of key information makes such assessments overly conservative. While it is good to be cautious when considering risks arising from pathogen exposure (where the consequences can be severe), overly conservative risk estimation is likely to be unrealistic, alarmist and unhelpful when assessing human health risk.

4.2 Reverse QMRA approach

A "reverse QMRA" may be undertaken in some circumstances. This process recognises at the outset that key data and information are missing, and that a full QMRA is therefore impossible. Using certain assumptions, the process then focuses on the human health risk and the amount of dilution required to achieve accepted health risk thresholds, such as those defined in the MfE/MoH Guidelines. This approach was previously followed by Hudson,McBride (2017). In the case of the QLDC wastewater network, information is lacking for:

- measured wastewater volumes from overflow discharges
- the dilution and fate of diluted wastewater in the receiving environment, and
- the dilution of wastewater by stormwater during discharge events (where these coincide with rainfall events).

A reverse QMRA approach delivers a table of risk estimates associated with varying levels of wastewater dilution. These results allow the community, health and regulatory agencies to understand and make decisions based on the relative health risks.

4.3 Reverse QMRA assumptions

We considered the locations of recorded sewer and pump station leaks or discharges in Section 2. This identified locations at which measurable risk may have previously existed.

The varying and unknown dilution arising from discharge of untreated wastewater overflow discharge into streams, rivers and lakes are accounted for by considering a range of dilution scenarios. For this study, $\log_{10}$ of dilution ranged from 1 (10× dilution) through to 5 (100,000× dilution). Rather than attempting to predict where risks exist (because the information required to do this just not exist), we consider what human health risk is likely to exist for a series of dilutions.

Although the approach is less sophisticated than that provided by the full QMRA process, it allows the relative risks of illness to be estimated for the conditions likely to be created by each dilution scenario. This is adequate for the purposes of this assessment. To undertake a full QMRA exercise, it would be necessary to predict the fate and dilution of pathogens arising from the wastewater discharge. This would require (among other things):

- development of a mixing and dilution model for each of the streams where wastewater contamination could occur
- a calibrated hydrodynamic model foreach lake to which untreated wastewater could be discharged, or to which a contaminated stream may discharge; a model of this nature would require substantial calibration data, including (but not limited to):

- measured stream discharge data
- lake water current, speed and direction etc.

NIWA has undertaken the human health risk assessment using:

1. Recently published scientific literature that has revisited previously accepted relative risk factors.
2. Estimates of wastewater pathogen concentrations.
3. Estimates of the range of dilution likely to occur in the receiving water – in this approach, the extent of dilution required to achieve specific risk thresholds were identified, rather than estimating the likely concentrations of pathogens.
4. Estimates of virus ingestion rates.
5. Available dose-response relationships for a representative virus.

We describe these selections below:

4.3.1 Selecting the pathogen(s) of concern

Several viruses may be used for risk assessment. In this study we use a model pathogen – Norovirus. This is appropriate because Norovirus is reported to be the most common aetiological agent in receiving waters (e.g., Sinclair et al. 2009), and the infection ID_{50} is in the order of 20 virions (among susceptible people). The dose-response curve indicates that ~20% of people may become infected after ingestion of just one virion.

4.3.2 Assessing exposure - predicting doses

To turn concentrations into doses we need:

1. Wastewater virus concentrations.
2. Ingestion or inhalation rates for recreational users exposed to wastewater contaminated waters.

Details on how these factors have been modelled and enumerated are given in Table 4-1.

Water ingestion rates by swimmers—a key component of dose-calculation—were studied using novel biochemical procedures in a pilot study (Dufour et al. 2006). These authors report a clinical trial observing 53 volunteers involved in recreational swimming in an outdoor community swimming pool. Using cyanuric acid (a decomposition product of chlorine-stabilising chloroisocyanurate) as a tracer, the volume of water ingested during active swimming events lasting at least 45 minutes was calculated for each swimmer. It has become standard practice to apply these ingestion rates to water recreation.[4]

The focus on "primary contact recreation" does not imply that exposure through other forms of recreation does not create risk. The health risks associate with paddle-boarding or canoeing are likely to be lower (there is little opportunity for ingestion), unless the individual capsizes or falls into the water. At such time, they are likely to have similar ingestion rates as a swimmer, but the duration of exposure is likely to be shorter. If the individual remains in the water for a longer period, then both ingestion rate and duration of exposure are likely to be similar to those of the swimmer. The swimming health risk is therefore a reasonable surrogate for other recreational users.

[4] Personal communication: Jeff Soller, Soller Environmental, California (http://www.sollerenvironmental.com/env/main/Home.html).

Individuals standing on the banks or shoreline of a contaminated water body are unlikely to face measurable health risk, because no direct ingestion route exists.

Where discharge occurs to land and then to water following runoff, an additional contaminant source will exist – fomites. These are (generally) inanimate objects that are contaminated and which subsequently enable transfer of a pathogen to a target via a secondary route of exposure (e.g., oral or direct contact). Examples of fomites include contaminated soil, plants, toys and tools. Inundation of footpaths, parklands and play grounds following a wastewater discharge would create the circumstances where fomites might have a role in disease transmission. Work undertaken in other studies (e.g., in the Heathcote and Avon River catchments, Christchurch, (Palliser et al. 2009)) suggests that the numbers of individuals likely to be exposed to pathogens via contact with contaminated objects is small, and the degree of exposure is low to very low. Overall, these risks were considered best-addressed through pollution response procedures.

4.3.3 Characterising dose-response

These relationships are mostly inferred from data reported by "volunteer studies" (i.e., clinical trials). These have been done for a restricted number of viruses. In these studies, healthy adult volunteers (typically between 50 and 100, in groups of 10 or so) are individually challenged with a pathogen dose and their infection and illness states are monitored for a few days thereafter. Such a study has been conducted for noroviruses (Teunis et al. 2008). Occasionally data from viral illness outbreaks become available, from which dose-response information can be inferred.[5] Note that to perform QMRA calculations, comparability between the definition of "dose" used in the clinical trial or outbreak study and the methods used in assessing virus concentrations in the wastewater of concern is required. For example, when assessing pathogens in treated wastewater, noroviruses cannot be cultured, so a quantitative molecular-based laboratory procedure (Reverse Transcription Polymerase Chain Reaction "RT-qPCR") is used to detect the norovirus genome. Since RT-qPCR detects genetic material, the method picks up both viable and non-viable viruses. Since there are variants of the qPCR procedure, some harmonisation between the methods used in the clinical trial and wastewater Norovirus enumeration methods may be required (and is so in this study).

4.3.4 Conducting the health risk assessment

To adequately reflect limits to knowledge on key features of the risk assessment, Monte Carlo statistical modelling is used (Haas et al. 1999, McBride 2005a). In simpler models, key inputs are described by a single number (e.g., wastewater treatment plant (WWTP) influent pathogen concentration). However, such inputs are known to be variable and some are uncertain. The way this variability and uncertainty has been addressed is shown in Table 4-1. The proprietary Excel plug-in product "@RISK" was used to perform the calculations, incorporating factors that reflect these distributions and inputs (Palisade Corp 2013).[6] The models were run for 1,000 iterations for the selected virus, for the proposed virus concentration distribution, and for each of five dilution scenarios. During each iteration, 100 individuals were 'exposed', by taking a random sample from statistical distributions covering the range of possible doses received by individuals ingesting water possibly containing pathogen.

It can be appropriate to report the results in terms of infection (which is the approach taken for the freshwater component of the MfE/MoH Guidelines), rather than illness. For the present study where Norovirus is the model pathogen, we take standard values of the probability of illness, given that infection has occurred. The output metric is an individual's illness risks, to facilitate comparison with relevant

[5] An example is a study by Thebault et al. (2013) of norovirus illness outbreaks among consumers of oysters in southern France.
[6] The @RISK models use named cells as much as possible, to facilitate checking and readability.

guidelines. [7,8] We do however account for "aggregation" – clumping together of viral particles to form a single infectious mass, rather than existing as several or many discrete particles. The extent and likelihood of aggregation is determined by the presence and amount of organic matter able to facilitate attraction between and binding of these infectious agents.

[7] There is insufficient time and information to also compute DALY metrics (Disability-Adjusted Life Years) as often used when assessing health risks associated with drinking-water (WHO 2011, chapter 7).

[8] The individual's illness risk (IIR) is calculated as the total number of predicted illness cases divided by the total number of exposures to potentially contaminated water or shellfish flesh. It represents the risk to an individual swimmer or shellfish consumer on any day, having no prior knowledge of any contamination from the outfall. It is calculated via the Monte Carlo modelling, for which 100 individuals are exposed on each of 1,000 separate days, i.e., 10^5 exposures. The total number of cases is 1,000m where m is the mean infection case rate over 100 people (readily calculated by the Monte Carlo software—@RISK, Palisade Corp. 2013). So the individual's infection risk, expressed as a proportion, is 1,000m/10^5 = m/100. When expressed as a percentage, IIR = m%.

Table 4-1: Distributions and inputs for the QMRA. Plain numbers in the Statistics column are for typical health conditions in the local community; italicised numbers are for the rare case where there is a norovirus illness outbreak in that community. [a]

Component	Statistics		Distributions/comments
Influent virus concentrations			Bounded "hockey stick" distribution (McBride 2005a), strongly right-skewed with a hinge at the 95%ile.
Sewage norovirus concentration, genome copies per litre	Minimum = 10^3 *10^3* Median = 10^4 *10^6* Maximum = 10^6 *10^7*		Typical ranges found for New Zealand cities (e.g., Napier, New Plymouth—McBride 2011, 2012, 2016).
Duration of swim (hours)	Minimum = 0.1 Median = 0.5 Maximum = 4		Child receptor.
Swimmers water ingestion rate, mL per hour	Minimum = 20 Median = 53 Std. Dev. = 75 Maximum = 270		Lognormal distribution, for a child (adult rate is half this rate). For a review on this see Wood et al. (2015, sec. 6.2.1).
Dose-response equations and parameters	–		Appendix A Norovirus, disaggregated: beta-binomial [eq. (5)]: $\alpha = 0.04$, $\beta = 0.055$ (so $ID_{50,infection} = 26$); Pr(susceptible) = $P = 0.72$ (Teunis et al. 2008); Pr(ill | Infection) = 0.60 (Soller et al. 2010). Also Messner et al. (2014) exponential equation for aggregated norovirus: $Pr_{inf} = [1 - P\, e^{d/\mu}]$, where d = dose and μ = mean aggregate size (taken as $\mu = 1106$).

[a] Those high values, persisting for over a month, have not been seen in subsequent Mangere influent virus assays. Yet were they to recur during an undetected outbreak in the contributing community, one could expect elevated illness risk.

5 Estimating public health risk

Table 5-1 summarises the predicted number of illness cases (out of 100 people exposed on any random occasion) and the Individual Illness Risk (IIR). The Individual Infection Risk (IInR) is summarised in Table 5-2. The values in these tables indicate the proportion of exposed individuals who are predicted to either become ill or infected respectively. In both cases the proportion is expressed as a percentage.

- Comparison of the model output in Table 5-1 and Table 5-2 indicates that illness risk is always lower than the infection risk – illness requires infection, whereas infection does not necessarily lead to illness.
- In both Table 5-1 and Table 5-2, aggregation of pathogens decreases infectivity and risk of illness considerably.
- In both Table 5-1 and Table 5-2, the risk of illness and infection decreases as dilution increases.

It is informative to relate these illness or infection risks to those implicit in and defined in the MfE/MoH Guidelines (e.g., Hudson and McBride 2017; Hudson and Wadhwa 2017). For example, following grading of a recreational beach using FIB concentration derived from a weekly surveillance monitoring programme, it is possible to relate a B grade (where 95th percentile enterococci concentrations fall in a range from 41 to 200 enterococci/100 mL)[9] to a 1-5% gastrointestinal illness risk, or a 0.3 – 1.9% acute febrile respiratory illness risk. These risks can be restated as an average probability of illness of one case of gastroenteritis in 20 exposures, or approximately one case of acute febrile respiratory illness in 50 exposures.[10]

In the case of the Waimea Inlet (Hudson and McBride 2017), the illness risks derived from the QMRA modelling (similar to those summarised in Table 5-1 and Table 5-2 below) could be related directly to the MfE/MoH Guideline risks because the latter were derived from viral pathogens and a QMRA.

In the case of freshwaters, the MfE/MoH Guideline risk values relate to *E. coli* concentrations as an indicator of *Campylobacter* infection and illness risk. We do not currently have equivalent illness risks defined for viral pathogens in freshwater. For freshwaters therefore, we must identify and discuss human health risks entirely in terms of the risks of illness and infection for the model pathogens selected for the QMRA. In this assessment, we selected Norovirus.

These results indicate a potential for health risk arising from the discharge of untreated wastewater in the conditions assumed in each scenario. All other factors remaining constant, the health risk is strongly determined by dilution of the pathogen load discharged to water. Although absence of dilution and advection information limits the usefulness of these health risk estimates (for example, we cannot predict where any particular level of risk will apply, or the time period during which a level of risk will apply), the risks implicit in the MfE/MoH Guidelines may be used as examples of other levels of risk with which communities, regulatory agencies and community health protection professionals are familiar.

[9] Refer to Table D1 of the MfE/MoH Guidelines (p D6)
[10] Refer to Table H1 of the MfE/MoH Guidelines (p H25)

As discussed previously, swimming at a B grade recreational beach (where 95th percentile enterococci concentrations fall in a range from 41-200 enterococci/100 mL) has an inferred risk of one case of gastroenteritis in 20 exposures, or approximately one case of acute febrile respiratory illness in 50 exposures. An individual may consider this risk of illness to be high or low, but generally regulatory agencies and public health protection agencies would regard this beach grading as indicating "good to high" microbiological quality. Warning signs would not be present, and the public would not be discouraged from swimming at a beach with this grading, i.e., where this level of health risk applied. When considered using a traffic light approach, this grading would generally be regarded as green.

Currently we do not have actual or predicted dilution data, which makes it difficult to decide what level of risk exist, and whether as individuals or public health protection specialists the risk is "acceptable". As discussed in Section 4.1, more accurate estimation of the health impact of sewer discharges therefore requires use of a mixing dilution model at each discharge point, and use of a calibrated hydrodynamic model, able to represent the mixing, dilution and advection of contaminants within various lake receiving environments. A calibrated hydrodynamic model would also allow the IIR to be calculated at any location within the model domain.

Irrespective of whether a hydrodynamic model is available or not, or whether we have perfect knowledge regarding the actual concentrations at any point in the environment following an untreated wastewater discharge event, some form of response would be required to mitigate human health risk. This is discussed in Section 6.

Table 5-1: Individual Illness Results for aggregated and disaggregated norovirus for five concentration orders, assuming typical illness patterns in the local community. Norovirus concentrations were assumed to range from 1,000 (min), 100,000 (median) and $1E^7$ (maximum) (virus particles/L).

Statistic	Norovirus, disaggregated, for five log_{10} dilution orders					Norovirus, aggregated, for five log_{10} dilution orders				
	1	2	3	4	5	1	2	3	4	5
Min	16	3	0	0	0	0	0	0	0	0
5%ile	22	14	2	0	0	0	0	0	0	0
10%ile	23	17	3	0	0	0	0	0	0	0
15%ile	25	19	4	0	0	0	0	0	0	0
20%ile	26	20	4	0	0	0	0	0	0	0
25%ile	27	21	5	0	0	0	0	0	0	0
30%ile	27	22	6	0	0	0	0	0	0	0
35%ile	28	22	6	0	0	1	0	0	0	0
40%ile	29	23	7	0	0	1	0	0	0	0
45%ile	29	24	7	1	0	1	0	0	0	0
50%ile	**30**	**25**	**8**	**1**	**0**	**1**	**0**	**0**	**0**	**0**
55%ile	30	25	8	1	0	1	0	0	0	0
60%ile	31	26	9	1	0	1	0	0	0	0
65%ile	32	27	9	1	0	2	0	0	0	0
70%ile	32	27	10	1	0	2	0	0	0	0
75%ile	33	28	11	2	0	2	0	0	0	0
80%ile	34	29	11	2	0	2	0	0	0	0
85%ile	35	30	13	2	0	3	1	0	0	0
90%ile	36	31	14	3	1	4	1	0	0	0
95%ile	37	33	20	4	1	6	1	0	0	0
96%ile	38	34	23	8	2	11	2	0	0	0
97%ile	39	35	26	15	2	18	3	1	0	0
98%ile	40	36	29	20	3	25	4	1	0	0
99%ile	41	38	31	25	5	29	7	1	0	0
99.5%ile	42	39	33	27	7	32	9	2	0	0
99.9%ile	43	43	37	31	8	34	11	3	0	0
Max	46	43	38	31	9	35	12	3	1	0
Mean (= IIR)	**29.752**	**24.411**	**8.633**	**1.701**	**0.252**	**2.236**	**0.327**	**0.043**	**0.001**	**0**

Table 5-2: Individual Infection Results for aggregated and disaggregated norovirus for five concentration orders, assuming typical illness patterns in the local community. Norovirus concentrations were assumed to range from 1,000 (min), 100,000 (median) and 1.10^7 (maximum) (virus particles/L).

Statistic	Norovirus, disaggregated, for five $\log_{10}$ dilution orders					Norovirus, aggregated, for five $\log_{10}$ dilution orders				
	1	2	3	4	5	1	2	3	4	5
Min	29	4	0	0	0	0	0	0	0	0
5%ile	41	27	3	0	0	0	0	0	0	0
10%ile	43	31	5	0	0	0	0	0	0	0
15%ile	44	34	7	0	0	0	0	0	0	0
20%ile	45	35	8	0	0	1	0	0	0	0
25%ile	46	36	9	0	0	1	0	0	0	0
30%ile	47	37	10	1	0	1	0	0	0	0
35%ile	47	38	11	1	0	1	0	0	0	0
40%ile	48	39	12	1	0	2	0	0	0	0
45%ile	49	40	12	1	0	2	0	0	0	0
50%ile	**50**	**41**	**13**	**1**	**0**	**2**	**0**	**0**	**0**	**0**
55%ile	50	42	14	2	0	2	0	0	0	0
60%ile	51	43	15	2	0	2	0	0	0	0
65%ile	52	43	16	2	0	3	0	0	0	0
70%ile	52	44	17	2	0	3	0	0	0	0
75%ile	53	46	18	2	0	3	0	0	0	0
80%ile	54	47	19	3	0	4	1	0	0	0
85%ile	55	48	20	3	1	4	1	0	0	0
90%ile	57	50	22	4	1	5	1	0	0	0
95%ile	59	52	29	6	2	9	2	0	0	0
96%ile	60	52	39	17	2	17	2	1	0	0
97%ile	60	53	43	25	3	31	5	1	0	0
98%ile	61	55	48	31	6	43	7	1	0	0
99%ile	63	58	51	38	10	49	13	2	0	0
99.5%ile	64	60	53	41	11	51	14	2	0	0
99.9%ile	66	63	55	44	13	52	17	4	1	0
Max	67	69	56	47	13	55	18	4	1	1
Mean (=IInR)	**49.653**	**40.567**	**14.435**	**2.788**	**0.405**	**3.762**	**0.556**	**0.07**	**0.004**	**0.001**

6 Minimising adverse effects

From a public health protection perspective, the development of a suitable overflow response management plan is an essential requirement for minimising the potential adverse effects of wastewater discharges. Irrespective of whether results from a full QMRA are available or not, actions such as the following are essential:

- repair of the fault(s) in the sewer network and cessation of further discharge
- where possible, bunding and recovery of wastewater before it enters a stream or lake
- identification of areas where contamination is likely, taking measures to alert the public to this effect
- Notifying Otago Regional Council and public health authorities
- Signage to inform the public.

Once immediate response to a contamination event is underway, actions such as microbial water quality monitoring would be appropriate. Collection of samples would provide a direct measure of the concentration of faecal indicator organisms (specifically *E. coli*). The pollution response monitoring should have both a temporal and spatial perspective:

- water quality samples should be collected upstream of the discharge site, and at downstream sites, particularly at locations where recreational exposure is likely
- in the event of discharge of pathogens to lake waters, samples should be collected along the shoreline either side of the discharge point
- these spatial samples would help define the likely area where elevated risks may prevail, and further signage or public notification could be undertaken.
- The period over which samples should be taken would be determined by the results of the monitoring:
  - as long as elevated FIB concentrations are observed, monitoring should persist
  - once FIB concentrations have returned to typical or before discharge values, cessation of event-related monitoring should be considered
  - the decision to discontinue monitoring should probably involve stakeholder groups and be part of the overall response plan.

The signage and public notification will minimise risk to recreational users, and the sampling will help determine when waters may be considered safe again for recreational use. Several agencies are generally involved in these response activities, guided in part by the MfE/MoH recreational water quality guidelines, as well as other emergency response plans.

The discussion regarding the location and frequency of discharge events (Section 2.1) indicated that these events should probably be considered as being of extremely low probability.

The definition of hazards, risk and risk assessment provided in Section 3 indicates the requirement to also consider mitigation measures.

If a robust plan exists to respond adequately to discharge event such as these, it would be appropriate to consider these events to have extremely low probability and moderate risk, and the overall health risk to local communities will be low to very low. We have reviewed the incident response plan of QLDC, and we consider that:

1. It is suitable as a high-level strategy document, but that considerable additional detail should be provided before it can be considered sufficiently robust.

2. It should incorporate the term "adaptive management" as a descriptor, and

    i. the more detailed plan that should be associated with it should be implemented in an adaptive management framework

    ii. the plan should also be described as a "living document", and should be revised or modified to allow QLDC to better respond to future events.

3. The plan should also explicitly make reference to Section H of the MfE/MoH Guidelines, where the principles underlying a pollution-response strategy are described, and detailed information and practical guidance is provided. In part this will allow these response plans to be customised to meet local conditions and community expectations. One area where immediate further attention could be given is with regard to post-discharge monitoring.

    i. A suitable event-related microbiological water quality monitoring programme should be developed in association with other agencies, addressing aspects such as the sampling locations, frequency of sampling, and specific laboratory tests will be agreed.

    ii. In some circumstances it may be possible to utilise continuous water quality measurements of FIB surrogates, or other water quality variables to provide supporting information.

    iii. The water should be tested at the agreed frequency and locations until the water quality is back to acceptable standards.

    iv. Although limited water quality data exist for most of the Queenstown Lakes District, data derived from the recreational water quality monitoring programme operated by ORC provides approximately 25 water quality results annually for several sites in the region.

    v. These data are accessible from the LAWA website[11] and may be suitable for defining "typical water quality" for some parts of the Queenstown Lakes District. Graphical summaries of recent recreational monitoring derived from the LAWA website are included in Appendix D.

[11] https://www.lawa.org.nz/explore-data/swimming/

7 Conclusions

We have described why absence of key data makes conduct of a conventional QMRA impossible. However, by using a model pathogen, a series of assumptions and applying ranges and distributions of several input variables, we were able to relate health risk to the level of wastewater dilution. The results provided in Section 5 indicate a potential for health risk arising from the discharge of untreated wastewater in the conditions assumed in each scenario. All other factors remaining constant, the health risk is strongly determined by dilution of the pathogen load discharged to water.

These estimates of risk were compared with the levels of risk associated with recreational water quality grading to illustrate that approximately 3500× dilution would be required to reduce the illness risk for sewage discharged from the sewer network to less than 5% gastrointestinal illness risk, which is present in B grade waters (defined by the MfE/MoH (2003) recreational water quality guidelines).

In Section 2, risk was defined as "chance + hazard + exposure + consequence". Routine maintenance and management of the sewer network by QLDC will reduce the **chance** of discharge of untreated wastewater. The **hazard** is in part determined by the health status in the community, and is out of the control of QLDC. The development and implementation of a suitable overflow response management plan is an essential requirement for minimising human health risk associated with wastewater discharges. The response plan should allow for adaptive management, and should incorporate a suitable microbiological water quality monitoring plan. An inter-agency response, erection of physical barriers, signage, and other means of notifying the public will contribute to reducing the opportunities for the public to be exposed to potentially contaminated waters.

If QLDC implements the recommended response processes identified in Section 6 above then I consider the risk to human health arising from occasional discharge of wastewater from the sewer network to surface waters to be low to very low.

8 References

Abramowitz, M., Stegun, I.A. (1972) *Handbook of Mathematical Functions*. Dover, New York.

Akin, E.W. (1981) A review of infective dose data for enteroviruses and other enteric microorganisms in human subjects. *Presented at the U.S. EPA Symposium on Microbial Health Considerations of Soil Disposal of Domestic Wastewaters* (cited by Haas et al. 1999, copy available from the author).

ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. *Paper*, No. 4, Volume 3. Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand.

Atmar, R.L., Bernstein, D.I., Harro, C.D., Al-Ibrahim, M.S., Chen, W.H., Ferreira, J., Estes, M.K., Graham, D.Y., Opekun, A.R., Richardson, C., Mendelman, P.M. (2011) Norovirus vaccine against experimental human Norwalk virus illness. *New England Journal of Medicine*, 365: 2178–2187.

Atmar, R.L., Opekun, A.R., Gilger, M.A., Estes, M.K., Crawford, S.E., Neill, F.H., Ramani, S., Hill, H., Ferreira, J., Graham, D.Y. (2014) Determination of the human infectious dose-50% for Norwalk virus. *Journal of Infectious Diseases,* 209(7): 1016–1022.

Benschop, K., Minnaar, R., Koen, G., van Eijk, H., Dijkman, K., Westerhuis, B. et al. (2010) Detection of human enterovirus and human parechovirus (HPeV) genotypes from clinical stool samples: polymerase chain reaction and direct molecular typing, culture characteristics, and serotyping. *Diagnosis of Microbiological Infectious Diseases*, 68(2): 166-73.

Boehm, A.B., Soller, J.A., Shanks, O.C. (2015) Human-associated fecal quantitative Polymerase Chain Reaction measurements and simulated risk of gastrointestinal illness in recreational waters contaminated with raw sewage. *Environmental Science and Technology Letters,* 2(10): 270–275.

Burkhardt, W., Calci, K.R. (2000) Selective accumulation may account for shellfish-associated viral illness. *Applied and Environmental Microbiology*, 66(4): 1375–1378.

Charoenca, N., Fujioka, R.S. (1994) Association of staphylococcal skin infections and swimming. *Water Science and Technology*, 31(5-6): 11–17.

Corsi, S.R., Borchardt, M.A., Carvin, R.B., Burch, T.R., Spencer, S.K., Lutz, M.A., McDermott, C.M., Busse, M., Kleinheinz, G.T., Feng, X., Zhu, J. (2016) Human and bovine viruses and bacteria at three Great Lakes Beaches: Environmental variable associations and health risk. *Environmental Science and Technology*. DOI: 10:1021/acs.est.Sb04372.

Couch, R.B., Cate, T.R., Gerone, P.J., Fleet, W., Lang, D., Griffith, W., Knight, V. (1965) Production of illness with a small-particle aerosol of Coxsackie A21. *Journal of Clinical Investigation,* 44(4): 535–542.

Couch, R.B., Cate, T., Douglas, R.G. Jnr., Gerone, P.J., Knight, V. (1966a) Effect of route of inoculation on experimental respiratory viral disease in volunteers and evidence for airborne transmission. *Bacteriological Reviews,* 30(3): 517–531 (includes discussion).[12]

Couch, R.B., Cate, T., Fleet, W.F., Gerone, P.J., Knight, V. (1966b) Aerosol-induced adenoviral illness resembling the naturally occurring illness in military recruits. *American Review of Respiratory Diseases*, 93(4): 529–535.

Couch, R.B., Knight, V., Douglas, R.G. Jnr., Black, S.H., Hamory, B.H. (1969) The minimal infectious dose of adenovirus Type 4, the case for natural transmission by viral aerosol. *Transactions of the American Clinical Climatological Association*, 80: 205–211.

Crabtree, K.D., Gerba, C.P., Rose, J.B., Haas, C.N. (1997) Waterborne adenovirus: a risk assessment. *Water Science & Technology,* 35(11–12): 1–6.

Crawford, J.M., McBride, G.B., Bell, R.G. (2014) Quantitative Microbial Risk Assessment – Recent Advances in New Zealand and Their Application to Moa Point WWTP Bypass Discharges. *WaterNZ Annual Conference,* Rotorua, September.

da Silva, A.K., Le Saux, J.C., Parnaudeau, M., Elimelech, M., Le Guyader, F.S. (2007) Evaluation of removal of Noroviruses during wastewater treatment, using Real-Time Reverse Transcription-PCR: Different behaviors of genogroups I and II. *Applied and Environmental Microbiology,* 73(24): 7891–7897.

Doré, W., Flannery, S., Keaveney, S., Rajko-Nenow, P. (2013) Norovirus in wastewater and shellfish: Assessing the impact of wastewater treatment plant effluent on norovirus contamination in shellfisheries. *EPA STRIVE Report,* 2008-EH-MS-7_S3, Ireland.

DRG (2002) Project Manukau Pilot Study. Pilot plant investigations, surrogate study results and recommendations. *Disinfection Review Group report to Watercare Services Ltd.*

Dufour A.P., Evans O., Behymer T.D., Cantú R. (2006) Water ingestion during swimming activities in a pool: a pilot study. *Journal of Water and Health*, 4: 425–430.

ESR (2016) New Zealand Exposure Factors Handbook: Recommended Values. *Client Report* 16002, prepared for Ministry of Health: 28.

Flannery, J., Keaveney, S., Rajko-Nenow, P., O'Flatery, V., Doré, W. (2012) Concentration of norovirus during wastewater treatment and its impact on oyster contamination. *Applied and Environmental Microbiology*, 78(9): 3400-3406.

Fong, T.-T., Phanikumar, M.S., Xagoraraki, I., Rose, J.B. (2010) Quantitative detection of human adenoviruses in wastewater and combined sewer overflows influencing a Michigan River. *Applied and Environmental Microbiology,* 76(3): 715–723.

Fu, C.Y., Xie, X., Huang, J.J., Zhang, T., Wu, Q.Y., Chen, J.N., Hu, H.Y. (2010) Monitoring and evaluation of removal of pathogens at municipal wastewater treatment plants. *Water Science and Technology*, 61(6): 1589–1599.

[12] Title cited in error in Haas et al. (1999): "Production of illness with a small-particle aerosol of adenovirus Type 4".

Gerba, C.P. (2000) Risk assessment. In: *Environmental Microbiology* (Gerba, C.P., Maier, R.M. and Pepper, I.L., Eds.): 557–571. Academic Press, London.

Gerba, C., Nwachuku, N., Riley, K.R. (2003) Disinfection resistance of waterborne pathogens on the United States Environmental Protection Agency's Contaminant Candidate List (CCL). *Journal of Water Supply: Research & Technology – AQUA,* 52(2): 81–94.

Gerba, C.P., Rose, J.B., Haas, C.N., Crabtree, K.D. (1996) Waterborne rotavirus: a risk assessment. *Water Research*, 30(12): 2929–2940.

Gray, J.J., Green, J., Gallimore, C., Lee, J.V., Neal, K., Brown, D.W.G. (1997) Mixed genotype SRSV infections among a party of canoeists exposed to contaminated recreational water. *Journal of Medical Virology*, 52: 425–429.

Haas, C.N. (1983) Estimation of risk due to low doses of microorganisms: a comparison of alternative methodologies*. American Journal of Epidemiology*, 118(4): 573–582.

Haas, C.N. (2002) Conditional dose-response relationships for microorganisms: development and application. *Risk Analysis,* 22(3): 455–463

Haas, C.N., Rose, J.B., Gerba, C.P. (1999) *Quantitative Microbial Risk Assessment.* John Wiley, New York: 449.

Hewitt, J., Leonard, M., Greening, G.E., Lewis, G.D. (2011) Influence of wastewater treatment process and the population size on human virus profiles in wastewater. *Water Research*, 45(18): 6267–6276.

Horwitz, M.S. (2001) Adenoviruses. In: Knipe D.M., Howley P.M. (Eds). *Fields Virology Fourth Edition*. PA: Lippincott Williams and Wilkins.

Hudson, N., McBride, G. (2017) Quantitative Microbial Risk Assessment for Waimea Inlet, Nelson: Sewer pump station overflows. Prepared for Nelson City Council. October 2017. *Report* No. 2017348HN: 76.

Hudson, N., Wadhwa, S. (2017) Quantitative Microbial Risk Assessment for Waimea Inlet, Nelson - Spatial assessment of risk. Prepared for Nelson Regional Sewerage Business Unit, October 2017. *Report* No.: 77.

Janes, V.A., Minnaar, R., Koen, G., van Eijk, H., Dijkman-de Haan, K., Pajkrt, D., Wolthers, K.C., Benschop, K.S. (2014) Presence of human non-polio enterovirus and parechovirus genotypes in an Amsterdam hospital in 2007 to 2011 compared to national and international published surveillance data: a comprehensive review. *European Surveillance,* 9(46): http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20964

Jones, M.K., Watanabe, M., Zhu, S. Graves, C.L., Keyes, L.R., Grau, K.R., Gonzalez-Hernandez, M.B., Iovine, N.M., Wobus, C.E., Vinje, J., Tibbetts, S.A., Wallet, S.M., Karst, S.M. (2014) Enteric bacteria promote human and mouse norovirus infection of B cells. *Science*, 346(6210): 755 DOI: 10.1126/science.1257147

Kundu, A., McBride, G., Carpenter, T., Wuertz, S. (2013) Adenovirus-Associated Health Risks for Recreational Activities in a Multi-Use Coastal Watershed Based on Site-Specific Quantitative Microbial Risk Assessment. *Water Research*, 47(16): 6309–6325.

Lees, D.N., Henshilwood, K., Green, J., Gallimore, C.I., Brown, D.W.G. (1995) Detection of small round structured viruses in shellfish by Reverse Transcription-PCR. *Applied and Environmental Microbiology,* 61(12): 4418–4424.

Lindesmith, L., Moe, C., Marionneau, S., Ruvoen, N., Jiang, X., Lindbland, L., Stewart, P., le Pendu, J., Baric, R. (2003) Human susceptibility and resistance to Norwalk virus infection. *Nature Medicine*, 9: 548–553.

Lodder, W.J., de Roda Husman, A.M. (2005) Presence of noroviruses and other enteric viruses in sewage and surface waters in the Netherlands. *Applied and Environmental Microbiology*, 71: 1453–1461.

Matthews, J.E., Dickey, B.W., Miller, R.D., Felzer, J.R., Dawson, B.P., Lee, A.S., Rocks, J.J., Kiel, J., Montes, J.S., Moe, C.L., Eisenberg, J.N.S., Leon, J.S. (2012) The epidemiology of published Norovirus outbreaks: a review of risk factors associated with attack rate and genogroup. *Epidemiology and Infection*, 140(7): 1161–1172.

McBride, G.B. (2005a) *Using Statistical Methods for Water Quality Management: Issues, Problems and Solutions*. John Wiley & Sons, New York.

McBride, G.B. (2005b) Computational issues in using pathogen dose-response relationships. *AWA Specialty Conference on Contaminants of Concern in Water*, Canberra 22–23 June (available on CD Rom, Australian Water Association).

McBride, G.B. (2011) A Quantitative Microbial Risk Assessment for Napier City's ocean outfall wastewater discharge. *NIWA Client Report* HAM2011-016, Project NAP11203, Report to Napier City Council: 38.

McBride, G.B. (2012) An assessment of human health effects for a quantitative approach based on Norovirus. *NIWA Client Report* No: HAM2012-150, prepared for New Plymouth District Council, Project NPD13202: 27. December.

McBride, G.B. (2014a) Norovirus dose-response in sewage-related QMRA: The importance of virus aggregation. International Environmental Modelling and Software Society (iEMSs), *7th International Congress on Environmental Modelling and Software*, San Diego, California, USA, D.P. Ames, N.W.T. Quinn, A.E. Rizzola (Eds.), June 15–19. http://www.iemss.org/sites/iemss2014/papers/iemss2014_submission_48.pdf

McBride, G. (2015) Motueka Wastewater Scheme: Health Risk Assessment. Prepared for Tasman District Council. *NIWA Client Report* HAM2014-110, Project TAS15201: 22. (report dated 2014, but addendum issued in 2015).

McBride, G.B. (2016) Quantitative microbial risk assessment for the discharge of treated wastewater: Proposed sub-regional wastewater treatment facility at Clark's Beach, South Manukau. Report prepared for Watercare Services Limited. *NIWA Client Report* HAM2016-018, Project WSL16202: 42.

McBride, G.B., Salmond, C.E., Bandaranayake, D.R., Turner, S.J., Lewis, G.D., Till, D.G. (1998) Health effects of marine bathing in New Zealand. *International Journal of Environmental Health Research,* 8: 173–189.

McBride, G.B., Stott, R., Miller, W., Bambic, D., Wuertz, S. (2013) Discharge-based QMRA for estimation of public health risks from exposure to stormwater-borne pathogens in recreational waters in the United States. *Water Research*, 47(14): 5282–5297.

Messner, M.J., Berger, P., Nappier, S.P. (2014) Fractional Poisson—a simple dose-response model for human norovirus. *Risk Analysis.* DOI: 10.1111/risa.12207.

MfE/MoH (2003) Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas. Ministry for the Environment and Ministry of Health, Wellington, New Zealand. (http://www.mfe.govt.nz/fresh-water/tools-and-guidelines/microbiological-guidelines-recreational-water)

Mims, C., Dockrell, H.M., Goering, R.V., Roitt, I., Wakelin, D., Zuckerman, M. (2004) *Medical Microbiology.* Third Edition. PA: Elsevier.

Nordgren, J., Matussek, A., Mattsson, A., Svensson, L., Lindgren, P-E. (2009) Prevalence of norovirus and factors influencing virus concentrations during one year in a full-scale wastewater treatment plant. *Water Research,* 43: 1117–1125.

Osuolale, O., Okoh, A. (2015) Incidence of human adenoviruses and hepatitis A virus in the final effluent of selected wastewater treatment plants in Eastern Cape Province, South Africa. *Virology Journal,* 12: 98.

Palisade Corp (2013) *@RISK*, v.6.1.2. Ithaca, New York.

Palliser, C., Hudson, N., Ball, A., (ESR Ltd) (2009) Quantitative microbial risk assessment associated with sewer discharges to the Avon and Heathcote river catchments. URS10201. NIWA, Hamilton: 160

Palliser, C.C. (2011) Calculation of the public health risk associated with the discharge of treated effluent form the Army Bay Wastewater Treatment Plant. Prepared for Watercare Services Ltd. *NIWA Client Report* HAM2011-109, Project WSL11204.

Palliser, C., Pritchard, M. (2012) Public health risk assessment for Snells-Algies WWTP. Prepared for Watercare Services Ltd. *NIWA Client Report* HAM2012-143. NIWA Project WSL12206.

Palliser, C., McBride, G., Goodhue, N., Bell, R., Stott, R. (2013) Fonterra Whareroa Dairy Factory and Hawera WWTP, Stage 2: QMRA based on the combined discharge. *NIWA Report* HAM2013-050 to Fonterra Cooperative Group Ltd and South Taranaki District Council, Project BEC12204, July.

Palliser, C., Hudson, N. (2018) Human health risk assessment. Consumption of fish caught off Wynyard Wharf. NIWA client report prepared for Auckland Council, Project SCJ19GOV. *Report* No.: 18.

Parshionikar, S.U., Willian-True, S., Fout, G.S., Robbins, D.E., Seys, S.A., Cassady, J.D., Harris, R. (2003) Waterborne outbreak of gastroenteritis associated with a norovirus. *Applied and Environmental Microbiology*, 60(9): 5263–5268.

Rechenburg, A., Kistemann, T. (2009) Sewage effluent as a source of Campylobacter sp. in a surface water catchment. *International Journal of Environmental Health Research*, 19(4): 239–249.

Rose, J.B., Sobsey, M. (1993) Quantitative risk assessment for viral contamination of shellfish and coastal waters. *Journal of Food Protection*, 56(12): 1043–1050.

Schiff, G.M., Stefanovic, G., Young, B., Pennekamp, J.K. (1984a) Minimum human infective dose of enteric virus (echovirus 12) in drinking water. *Monographs on Virology*, 15: 222–228.

Schiff, G.M., Stefanovic, G.M., Young, E.C., Sander, D.S., Pennekamp, J.K., Ward, R.L. (1984b) Studies of echovirus-12 in volunteers: determination of minimal infectious dose and the effect of previous infection on infectious dose. *Journal of Infectious Diseases,* 150(6): 858–866.

Schmidt, P.J. (2014) Norovirus dose-response: Are currently available data informative enough to determine how susceptible humans are to infection from a single virus? *Risk Analysis* DOI: 10.1111/risa.12323.

Schoen, M.E., Ashbolt, N.J. (2010) Assessing pathogen risk to swimmers at non-sewage impacted recreational beaches. *Environmental Science and Technology,* 44(7): 2286–2291.

Sima, L.C., Schaeffer, J., Le Saux, J.-C., Parnaudeau, S., Elimelech, M., Le Guyader, F.S. (2011) Calicivirus removal in a membrane bioreactor wastewater treatment plant. *Applied and Environmental Microbiology*, 77(15): 5170–5177.

Simpson, D., Jacangelo, J., Loughran, P., McIlroy, C. (2003) Investigation of potential surrogate organisms and public health risk in UV irradiated secondary effluent. *Water Science and Technology*, 47(9): 37–43.

Sinclair, R.G., Jones, E.L., Gerba, C.P. (2009) Viruses in recreational water-borne disease outbreaks: a review. *Journal of Applied Microbiology,* 107(6): 1769–1780.

Soller, J.A., Bartrand, T., Ashbolt, N.J., Ravenscroft, J., Wade, T.J. (2010) Estimating the primary etiologic agents in recreational freshwaters impacted by human sources of fecal contamination. *Water Research,* 44(16): 4736–4747.

Soller, J.A., Schoen, M.E., Varghese, A., Ichida, A.M., Boehm, A.B., Eftim, S., Ashbolt, N.J. Ravenscroft, J.E. (2014) Human health risk implications of multiple sources of faecal indicator bacteria in a recreational waterbody. *Water Research*, 66: 254–264.

Stott, H.R., McBride, G.B. (2009) Quantitative Microbial Risk Assessment for wastewater discharge from Warkworth Treatment Plant: Health risks for recreational water users and consumers of raw shellfish. *Draft NIWA Client Report* HAM2008-203, Project ROD08203. Report to Rodney District Council: 51.

Stott, R., McBride, G.B. (2011) Health Risk Assessment for Westland Milk Products Wastewater Disposal – Hokitika. Prepared for Westland Milk Products. *NIWA Client Report* HAM2011-093 for Westland Milk Products, Project WMP11201: 77.

Straub, T.M., Höner zu Bentrup, K., Orosz-Coghlan, P., Dohnalkova, A., Mayer, B.K., Bartholomew, R.A., Valdez, C.O., Bruckner-Lea, C.J., Gerba, C.P., Abbaszadegan, M., Nickerson, C.A. (2007) In vitro cell culture infectivity assay for human noroviruses. *Emerging Infectious Diseases*, 13(3): 396–403.

Suptel, E.A. (1963) Pathenogenesis of experimental Coxsackie virus infection. *Archives of Virology,* 7: 61–66.

Teunis, P.F.M., Nagelkerke, N.J.D, Haas, C.N. (1999) Dose-response models for infectious gastroenteritis. *Risk Analysis,* 19(6): 1251–1260.

Teunis, P.F.M., van den Brandhof, W., Nauta, M., Wagenaar, J., van den Kerkhof, H., Van Pelt, W. (2005) A reconsideration of the Campylobacter dose-response relation. *Epidemiology and Infection,* 133: 583–592.

Teunis, P.F.M., Moe, C.L., Liu, P., Miller, S.E., Lindesmith, L., Baric, R.S., Le Pendu, J., Calderon, R. (2008) Norwalk virus: How infectious is it?' *Journal of Medical Virology*, 80: 1468–1476 (and Supplementary Information, available from the author).

Teunis, P.F.M., van der Heijden, O.G., van der Giessen, J.W.B., Havelaar, A.H. (1996) The dose-response relation in human volunteers for gastro-intestinal pathogens. *RIVM Report,* No. 284 550 002, Antonie van Leeuwenhoeklaan 9, PO Box 1, NL-3720 BA Bilthoven, The Netherlands.

Thebault, A., Teunis, P.F., Le Pendu, J., Le Guyader, F.S., Denis, J.B. (2013) Infectivity of GI and GII noroviruses established from oyster related outbreaks. *Epidemics,* 5: 98–110.

Thompson, S.S., Jackson, J.L., Suva-Castillo, M., Yanko, W.A., Jack, Z.E., Kuo, J., Chen, C-L., Williams, F.P., Schnurr, D.P. (2003) Detection of infectious human adenoviruses in tertiary-treated and ultraviolet-disinfected wastewater. *Water Environment Research,* 75(2): 163–170.

van den Berg, H., Lodder, W., van der Poel, W., Vennema, H., de Roda Husma, A-M. (2005) Genetic diversity of noroviruses in raw and treated sewage water. *Research in Microbiology*, 156: 532–540.

Viau, E.J., Lee, D., Boehm, A.B. (2011) Swimmer Risk of Gastrointestinal Illness from Exposure to Tropical Coastal Waters Impacted by Terrestrial Dry-Weather Runoff. *Environmental Science and Technology*, 45(17): 7158-7165.

Ward, R.L., Bernstein, D.L., Young, C.E., Sherwood, J.R., Knowlton, D.R., Schiff, G.M. (1986) Human rotavirus studies in volunteers: determination of infectious dose and serological response to infection. *Journal of Infectious Diseases*, 154(5): 871.

WHO (2003) Guidelines for safe recreational water environments. Volume 1, *Coastal and fresh waters.* World Health Organization, Geneva. http://www.who.int/water_sanitation_health/bathing/srwe1/en/

WHO (2011) *Guidelines for drinking-water quality*. World Health Organization, Geneva http://www.who.int/water_sanitation_health/publications/dwq_guidelines/en/

Wood, S., Hawes, I., McBride, G., Truman, P., Dietich, D. (2015) Advice to inform the development of a benthic cyanobacteria attribute. *Cawthron Report,* No. 2752 to Ministry for the Environment: 91. To be posted on MfE website mid-April.

9 Acknowledgements

Fruitful background discussions held with Dr Peter Teunis (RIVM, The Netherlands), Jeff Soller (Soller Environmental, CA, USA), Professor Stefan Wuertz (University of California, Davis), Desmond Till (retired microbiological consultant, Eastbourne, Wellington), Peter Loughran (MWH, Dunedin), my colleague Dr Rebecca Stott (NIWA, Hamilton), and others have contributed to the information and approach that is used in the QMRA approach developed by NIWA, and used in part and summarised in this document.

10 Glossary of abbreviations and terms

Aetiological agent	Microorganisms and microbial toxins that cause disease in humans.
Beta-Binomial dose-response curve	A mathematically-derived infection dose-response curve for variable infectivity, in which individual doses are known.
Beta-Poisson dose-response curve	A mathematically-derived infection dose-response curve for variable infectivity, in which only mean doses are known.
Conditional illness probability	The probability of illness at a given dose given that infection has already occurred.
Conditional infection dose-response models	The (simpler) mathematical form of a dose-response equation that results when individual doses are known. (More complicated mathematical functions arise when individual doses are not known).
Hypergeometric functions	Mathematical equations that defy simple calculation, yet are important in the analysis of clinical trial data and outbreak data for the infection response of a population exposed to a pathogen, and where individual doses are randomly distributed about a known mean value.
Illness ID_{50}	The dose required to cause illness in 50% of an exposed population, who are already infected.
Infection ID_{50}	The dose required to cause infection in 50% of an exposed population.
PCR	Polymerase Chain Reaction, a molecular technique for virus enumeration using DNA segment matching.
QMRA	Quantitative Microbial Risk Assessment.
RT-qPCR	Reverse-transcription quantitative PCR, used for RNA viruses.
Sequelae	An illness that is the result of a previous disease.
Simple binomial dose-response curve	A mathematically-derived infection dose-response curve for constant infectivity, in which individual doses are known.
Simple exponential dose-response curve	A mathematically-derived infection dose-response curve for constant infectivity, in which only mean doses are known.
$TCID_{50}$	Median Tissue Culture Infectious Dose: A laboratory culture technique measuring the amount of virus that produces a cytopathic effect in 50% of cell cultures inoculated.
Virion	Shorthand for “virus particle”.

Appendix A Dose-response functions

For infection

Standard clinical trial procedures involve challenging groups of volunteers with aliquots taken from serially-diluted preparations whose well-mixed concentrations are measured. Doses in individuals' challenges are not measured. Consequently only the average dose given to each member of a group is known. Nevertheless, by making two simple assumptions the mathematical form of the infection dose-response equation can be obtained (Haas et al. 1999, McBride 2005a):

1. The "single-hit" hypothesis: That a single pathogen, surviving the body's barriers (e.g., acidic digestion system) and reaching a potential infection site, is sufficient to cause infection.
2. Poisson distribution of pathogens in the preparation—as is appropriate for a random well-mixed population.

The mathematical result, after averaging across each group's individual Poisson-distributed doses, is the single-parameter "simple exponential" equation:

$$\Pr_{inf}(d) = 1 - e^{-rd} \quad (1)$$

where d is the average doses given to each group, "e" is the standard exponential number (the base of natural logarithms, e = 2.7183…), and r is the probability that a pathogen survives the body's defences and reaches an infection site.

Sometimes host-pathogen interactions are such that a constant value of r is implausible (e.g., because of differential immunity, or varying pathogen virulence, as indicated by lack of fit to the single-parameter model). In that case r is replaced by a standard two-parameter beta distribution with shape parameter α and location parameter β. The mathematical result is the much-more-difficult-to-evaluate[13] Kummer hypergeometric function (denoted as ${}_1F_1$):

$$\Pr_{inf}(d) = 1 - {}_1F_1(\alpha, \alpha + \beta, -d) \quad (2)$$

For obvious reasons this can be called the "beta-Poisson" equation.[14] Fortunately in many cases we find that β >> 1 and α << β, in which case this equation can be well-approximated by the following equation (confusingly, also called "beta-Poisson"):

$$\Pr_{inf} = 1 - \left(1 + \frac{d}{\beta}\right)^{-\alpha} \quad (3)$$

However this approximation is inadequate for noroviruses because the fitted parameter doublet (α = 0.04 and β = 0.055, Teunis et al. 2008) constitute a serious breach of the approximation-validity criteria (α << β, β>>1). Analysis of clinical trial data for noroviruses therefore calls for specialist software that can evaluate (2), as reported by Teunis et al. 2008, Thebault et al. (2013).

[13] Equation (2) can't be evaluated in Excel.

[14] Because a two-parameter (α and β) beta distribution is used instead of the single parameter r and the doses are assumed random, i.e., Poisson-distributed. Strictly, β is not properly a location parameter for equation (2), but it is for its approximation equation (3) (because d is simply divided by β in that equation: increasing the value of β shifts the curve to the right).

Simplifying the infection dose-response calculations for QMRA

Good QMRA practice, especially for virulent pathogens, is to "expose" *multiple* people on each exposure occasion.[15] In that case the individual doses are known (i.e., are calculated and assigned to individuals by the model) so that there is no need for Poisson-averaging. This somewhat simplifies the mathematical development of the infection dose-response formulae such that for constant r the simple one-parameter exponential model is replaced by the simple binomial model:

$$\mathrm{Pr}_{\mathrm{inf}} = 1-(1-r)^{i} \tag{4}$$

where *i* is the individual's dose.

Also, the two-parameter beta-Poisson model (the ${}_1F_1$ functional form) is replaced by the "beta-binomial" model:

$$\mathrm{Pr}_{\mathrm{inf}} = 1-\frac{\mathrm{B}(\alpha,\beta+i)}{\mathrm{B}(\alpha,\beta)} \tag{5}$$

where B is the standard beta function (Abramowitz & Stegun 1972) and α and β are as defined previously. This equation can be simply evaluated in Excel.[16]

These two equations have been described by Haas (2002) as conditional infection dose-response models, the condition being that individual doses are known.

The following figures (Figure A-1a&b) give examples of these functions for adenovirus 4 and for Norwalk virus, for both conditional and unconditional infection dose-response models.

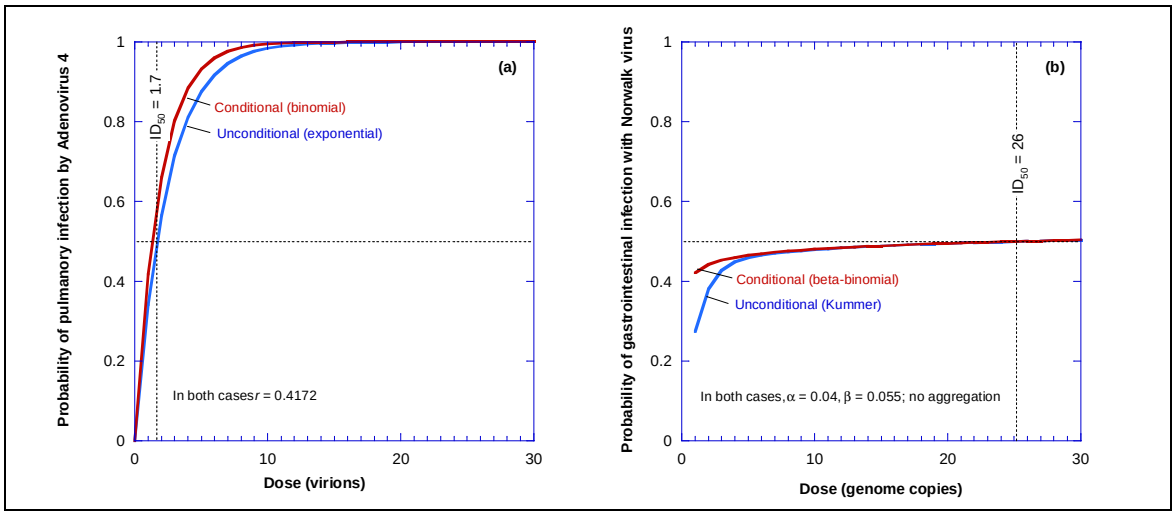


Figure A-1: Conditional and unconditional infection dose-response curves. (a) single-parameter models for adenovirus 4, and (b) double-parameter models for Norwalk virus (only for susceptible individuals).

[15] To not do so gives rise to implausible risk profiles. For example if only one individual is exposed per exposure occasion—as a representative of a group visiting a contaminated beach—and if the probability of infection given ingestion of one pathogen is high (say, 20%), then probabilities of infection *between* 0% and 20% are impossible. The resulting risk profile becomes extremely jagged (McBride 2005b). In such cases exposing a group of people per exposure occasion (say, 100), each with different doses (some swim for a few minutes, others for an hour or so), allows many values between 0 and 20% to be calculated.

[16] To do so we note that B(α,β) = Γ(α)Γ(α)/Γ(α+β), where Γ is the standard Gamma function (Abramowitz & Stegun 1972). Standard Excel includes the natural logarithm of the gamma function (as the function 'GAMMALN'), so that we can derive : Pr = 1 – EXP{GAMMALN(β+*i*) + GAMMALN(α+β) – [GAMMALN(α+β+*i*) + GAMMLN(β)]}.

These graphs highlight some important features of infection dose-response curves:

- The single-parameter models (e.g., Figure B-1a) rise inexorably to unit probability, precisely because their common parameter (r) is constant.
- The double-parameter models (e.g., Figure B-1b) "flatten out" well before reaching unit probability.[17]
- Whilst the relatively high infection ID_{50} for Norwalk virus (26 genome copies among susceptible individuals) occurs on the flattened top of its dose-response curve, infection probabilities are still appreciable at much lower doses.[18]
- The unconditional curves have a jagged profile around the conditional forms, yet deploying the latter in a QMRA gives rise to the same averaged risk.[19]
- Whilst the adenovirus 4 infection dose-response curve is in all respects more severe than that for Norwalk virus, for two reasons that doesn't mean that it is the most severe pathogen:
    i. adenoviruses that can cause respiratory ailments are a minor part of the total adenovirus population in sewage,[20] with most causing gastro-intestinal illness
    ii. exposure to respiratory adenoviruses (via inhalation, e.g., whilst surfing) tends to be lower than ingestion of water whilst swimming.[21]

However, having double-stranded DNA, adenoviruses are more resistant to disinfection processes.

For illness

Some individuals who become infected (e.g., as measured by serological response, or by evidence of pathogen shedding) may not go on to exhibit symptoms, i.e., they are asymptomatic. In that case, to obtain the unconditional probability of illness (given dose) we first need to calculate the conditional probability of illness given infection for each dose, denoted as $Pr_{ill|inf}$. The probability of illness is calculated as:

$$Pr_{ill} = Pr_{ill|inf} Pr_{inf} \quad (6)$$

Two common approaches are used for the conditional illness function:

[17] In fact these models approach unit probability only for enormous doses.
[18] The "flat top" is caused by the variable host-pathogen interactions, including a proportion of exposed population who high (but incomplete) immune. There is also another group who are completely immune.
[19] That's because applying the unconditional form to a single individual representing a group of people, as is common practice, doesn't capture the fact that, by good luck, some people at a beach will avoid exposure whilst the averaged dose is above zero (McBride 2005b).
[20] Typically respiratory serotypes are detected less frequently than adenovirus F serotypes and so the gastro-intestinal (GI) disease-causing serotypes tend to predominate in sewage studies (Osuolale & Okoh 2015). However, a proportion of respiratory versus GI serotypes detected will depend on the cell line used for culture assays and the target primers for molecular methods. For example, Hewitt et al. (2011) used cell line 594 and reported that culturable adenoviruses were mainly A-E types (which are respiratory and conjunctivitis serotypes) and there was still around 3 log presence in effluents.
[21] Water-contact-related respiratory illness is an area worthy of further research, particularly in the light of the respiratory illness rates reported in the one New Zealand epidemiological study on this matter—McBride et al. (1998). In that study (at seven New Zealand beaches) those rates were generally more prominent than gastrointestinal rates, a phenomenon that is not fully understood.

Hazards model

Teunis et al. (1999) developed hazard models for the illness given infection, with two forms:

Decreasing hazard
$$\Pr_{ill|inf}(d) = 1 - \left(1 + \frac{\eta}{d}\right)^{-r} \quad (7)$$

and

Increasing hazard
$$\Pr_{ill|inf}(d) = 1 - (1 + \eta d)^{-r} \quad (8)$$

where η is a location parameter, and *r* is a shape parameter.[22]

Dose independence

Existing models of the conditional probabilities of illness (the condition being that infection has already occurred) are held in some doubt internationally. For example, the norovirus model (Teunis et al. 2008) predicts substantial infection probabilities at very low doses, but predicts substantial illness probabilities (among the infected) only at very high doses. A large body of work has taken the view that the conditional probability of illness-given-infection should be independent of dose—Schoen & Ashbolt (2010), Soller et al. (2010, 2015), Viau et al. (2011) and Boehm et al. (2015). Indeed, that approach is endorsed by WHO (2011), with the result that for the pathogens considered here the conditional illness probabilities are on the order of ½.

[22] The decreasing hazards model has only been reported for a clinical trial on adults exposed to *Campylobacter* (Teunis et al. 1999): All other conditional illness models that I am aware of infer an increasing hazards model, including a *Campylobacter* outbreak study for children (Teunis et al. 2005).

Appendix B Echovirus 12 clinical trial data analysis

Echovirus is a member of the enterovirus family. Haas et al. (1999) reported fitting a one-parameter simple exponential model to clinical trial data for an echovirus 12 study (Akin 1981),[23] with an estimated infection ID_{50} = 54 virions, corresponding to their calibrated *r* value of 0.0128.[24] Haas (1983) had earlier fitted a slightly different value to the Akin data, with $r = 0.012$ (giving infection ID_{50} = 58) and also a two-parameter beta-Poisson curve (with $\alpha = 1.3$ and $\beta = 75$), so that the infection ID_{50} [$= \beta(2^{1/\alpha} - 1)$] = 53. Clearly, these approaches give consistent results with an infection ID_{50} about 50.

The beta-Poisson result was used in the QMRA performed for the Mangere wastewater treatment upgrade (DRG 2002, Simpson et al. 2003), this choice being particularly influenced by the observation that enterovirus illness can give rise to more serious consequences (i.e., sequelae) relative to other virus groups.

Akin's data were in fact preliminary results from an ongoing clinical trial, full results of which were reported three years later in Schiff et al. (1984a&b). Their 1984a paper is the proceedings of a conference held two years earlier in Herzliya, Israel. It contains the Akin data. But the 1984b document (a peer-reviewed journal paper) multiplied all the doses, including those reported by Akin, by a factor of 33, to account for the re-analysis of the stock dose suspension using a more sensitive cell line[25]. These published data were analysed by Teunis et al. (1996) giving rise to a two-parameter "beta-Poisson" model ($\alpha = 0.401$, $\beta = 227.2$, as reported by Teunis et al. 1996) and a higher infection ID_{50} = 1052 virions.[26]

We propose to use the beta-Poisson model ($\alpha = 1.3$ and $\beta = 75$, with infection ID_{50} = 53 virions). Note that this conflicts with the approach taken in the increasingly-influential CAMRA website[27] ($\alpha = 1.06$ and $\beta = 171.3$), giving rise to an infection ID_{50} = 922. This has implications for the enterovirus concentrations to be presented to this dose-response function in the QMRA calculations.[28]

[23] This widely-quoted paper (Akin 1981) seems to have been read by only a few, given its appearance only in the "grey literature", decades past. The author of this report has a copy, courtesy of Professor Haas (Drexel University), which is available on request.

[24] For the simple exponential model, algebraic manipulation shows that $ID_{50} = -\ell n(½)/r \approx 0.693/r$.

[25] At page 864 of Schiff et al. (1984b): "The original plaque assay used for determination of the titre of the echovirus-12 pool and of the various challenge doses administered to volunteers was based on the use of LLC-MK_2 cells and an agar overlay procedure; in the present study this assay was shown to be significantly less sensitive than the plaque neutralization assay involving RD cells and a soft agar overlay procedure. The latter system increased the plaquing efficiency of the challenge virus by 33-fold."

[26] For the approximate beta-Poisson model, algebraic manipulation shows that $ID_{50} = \beta(2^{1/\alpha} - 1)$.

[27] Center for Advancing Microbial Risk Assessment Not http://qmrawiki.canr.msu.edu/index.php/Dose_Response

[28] The adopted dose-response function refers to echovirus 12 data gathered using the "LLC-MK_2" cell line (Schiff et al. 1984a). The CAMRA dose-response function refers to data re-analysed using "RD" cell line. Comparison of dose-response functions for other members of the enterovirus group (e.g., polio virus, hepatitis A, coxsackie) indicates that ID_{50} of the order of 50 is more tenable than of the order of 1000.

Appendix C Debate about norovirus infection dose-response

We have taken a form of norovirus infection dose-response that has become an "industry standard" in the last five years. It is based on a clinical trial, and is broadly supported by an outbreak study on French oysters (Thebault et al. 2013). That choice reflects a reasonable precautionary stance. Two recent contributors to the journal *Risk Analysis* have presented findings that norovirus may be even more infectious (Messner et al. 2014), or less infectious (Schmidt 2014) than the industry standard dose response, depending largely on the assumed degree of virus aggregation. There is currently much debate about all that. For example, another writer used data from a new clinical trial to claim that norovirus is much less infectious than the industry standard (Atmar et al. 2011, 2014) (this analysis appears to be flawed, as it ignored the role of aggregation, see McBride 2014a).

The role of noroviruses in QMRA will continue to be contentious, not least because a recently published procedure for their enumeration by culture (Jones et al. 2014) supplanted an earlier unsuccessful claim to such a procedure (Straub et al. 2007). This reflects the fact the QMRA is still an emerging discipline, with a number of issues that will take years to resolve. Nonetheless, experience indicates that QMRA is a more informative approach to human health risk assessment relative to that provided by levels of indicator bacteria derived from epidemiological studies at sites generally far-removed from the effects of discharges from large wastewater treatment plants.

Appendix D Recent microbiological water quality data

Results derived from recent recreational water quality monitoring. Note that the y-axis scale is variable.

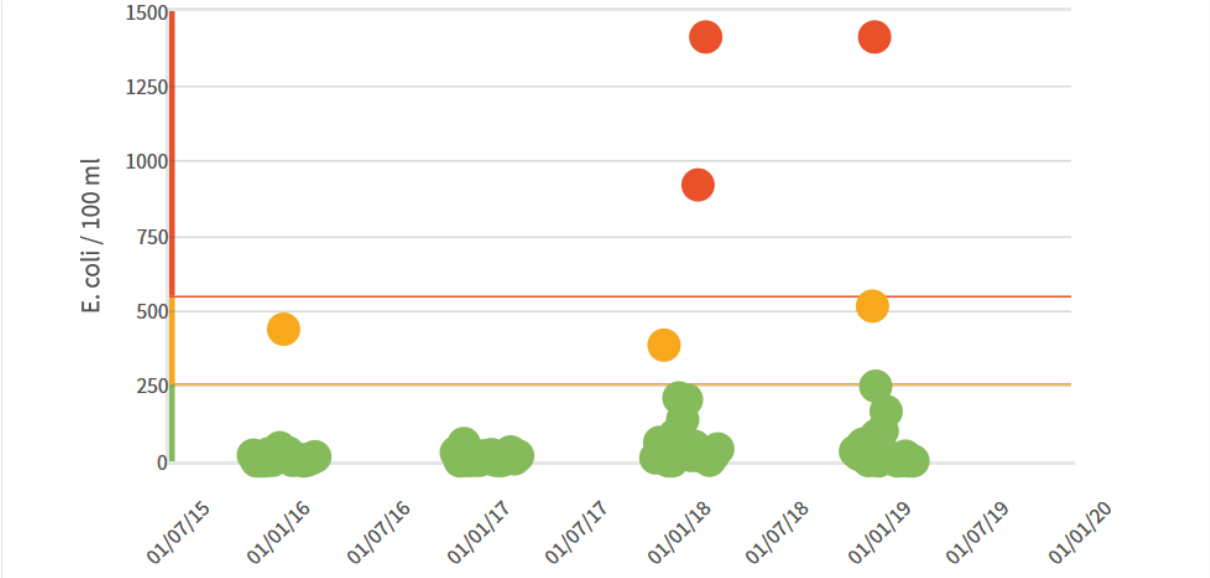


Figure D-1: Microbial water quality for the Lake Wakatipu at Frankton Bay monitoring site. The red and yellow lines define the thresholds between "not suitable for swimming" and "caution advised" (550 *E. coli*/100 mL) and "caution advised" and "suitable for swimming" (260 *E. coli*/100 mL), which are defined according to the 95th percentile value for each bathing season (this figure presents each data point). This figure was copied from the LAWA website https://www.lawa.org.nz/explore-data/otago-region/swimming/lake-wakatipu-at-frankton-bay/swimsite.

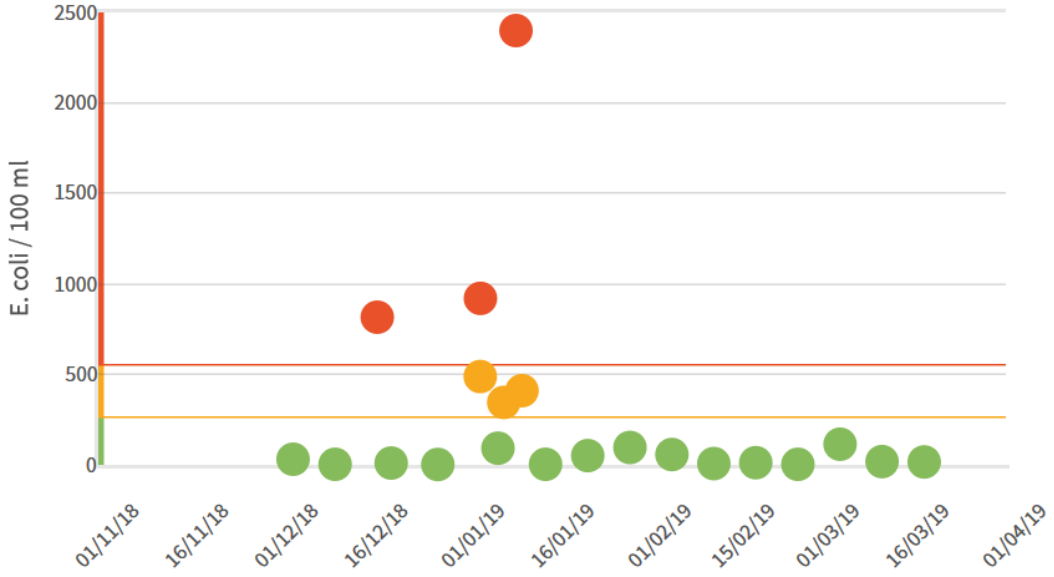


Figure D-2: Microbial water quality for the Lake Wakatipu at Queenstown Bay monitoring site. The red and yellow lines define the thresholds between "not suitable for swimming" and "caution advised" (550 *E. coli*/100 mL) and "caution advised" and "suitable for swimming" (260 *E. coli*/100 mL), which are defined according to the 95th percentile value for each bathing season (this figure presents each data point). This figure was copied from the LAWA website https://www.lawa.org.nz/explore-data/otago-region/swimming/lake-wakatipu-at-queenstown-bay-1/swimsite.

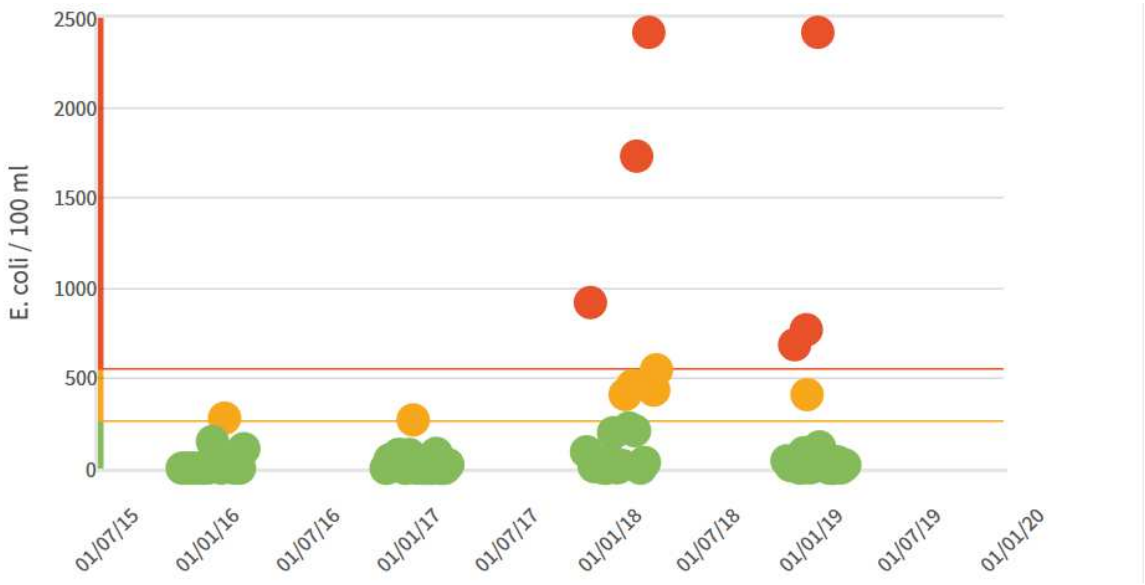


Figure D-3: Microbial water quality for the Lake Hayes at Mill Creek Shallows monitoring site. The red and yellow lines define the thresholds between "not suitable for swimming" and "caution advised" (550 *E. coli*/100 mL) and "caution advised" and "suitable for swimming" (260 *E. coli*/100 mL), which are defined according to the 95th percentile value for each bathing season (this figure presents each data point). This figure was copied from the LAWA website https://www.lawa.org.nz/explore-data/otago-region/swimming/lake-hayes-at-mill-creek-shallows/swimsite.

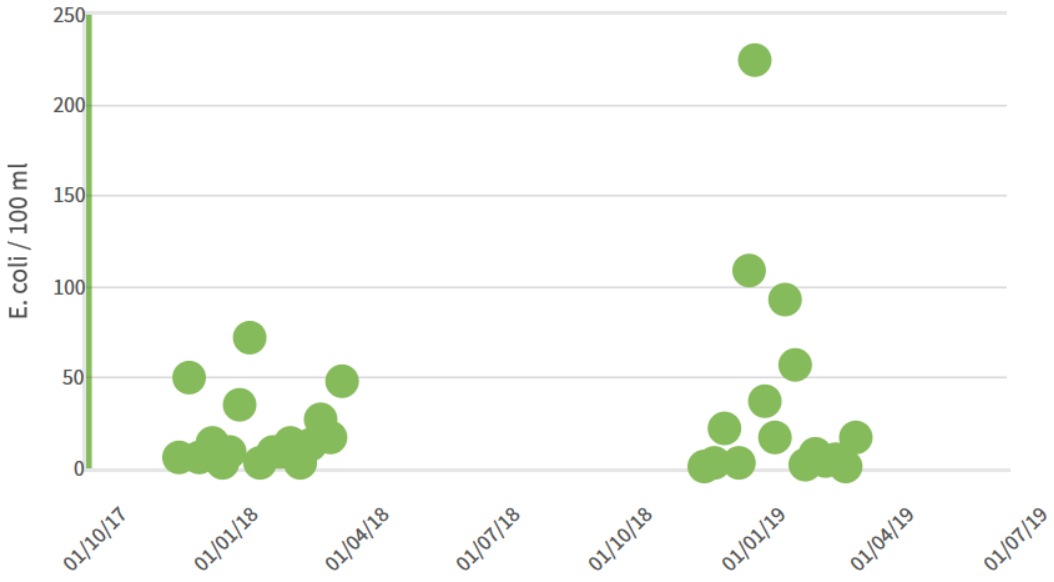


Figure D-4: Microbial water quality for the Lake Wanaka at Roy Bay monitoring site. All results indicate "suitable for swimming" (260 *E. coli*/100 mL) status, defined according to the 95th percentile value for each bathing season (this figure presents each data point). This figure was copied from the LAWA website https://www.lawa.org.nz/explore-data/otago-region/swimming/lake-wanaka-at-roys-bay-shore/swimsite.

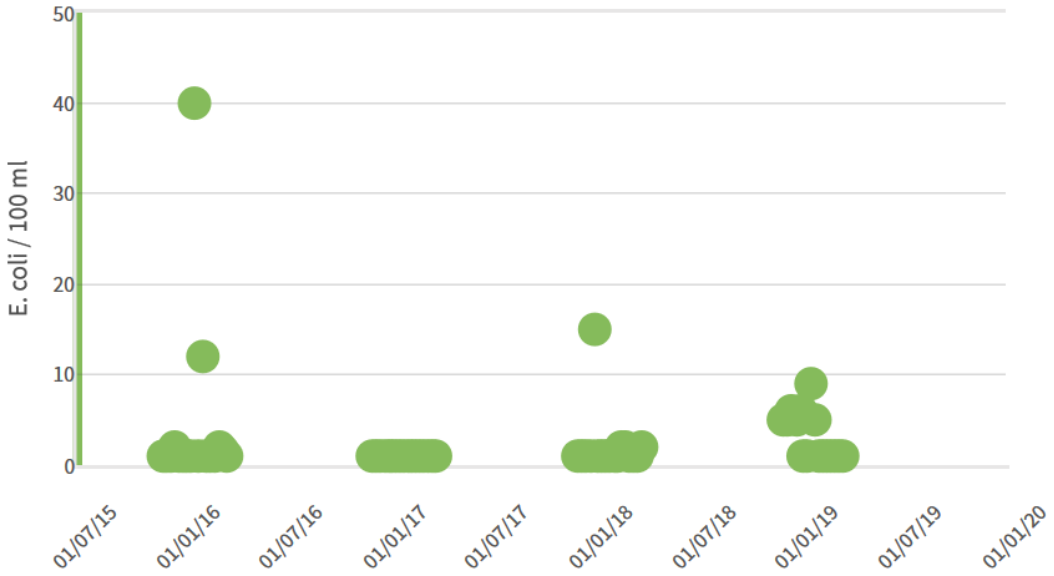


Figure D-5: Microbial water quality for the Lake Hawea at Holiday Park monitoring site. All results indicate "suitable for swimming" (260 *E. coli*/100 mL) status, defined according to the 95th percentile value for each bathing season (this figure presents each data point). This figure was copied from the LAWA website https://www.lawa.org.nz/explore-data/otago-region/swimming/lake-hawea-at-holiday-park/swimsite.

Appendix E - Engagement and Consultation

Private Bag 50072, Queenstown 9348, New Zealand
QUEENSTOWN, 10 Gorge Road, Phone +64 3 441 0499, Fax +64 3 450 2223
WANAKA, 47 Ardmore Street, Phone +64 3 443 0024, Fax +64 3 450 2223

media release

QUEENSTOWN LAKES DISTRICT COUNCIL

www.qldc.govt.nz

To:	All Media
From:	QLDC Communications
Date:	Monday, 29 October 2018
Subject:	Community drop-in sessions to discuss wastewater network overflows

Drop-in sessions will be held in Wanaka and Queenstown in early November to educate the community about our wastewater networks and the overflows that occasionally occur into the environment.

QLDC General Manager Property and Infrastructure Peter Hansby said a key purpose of these drop-in sessions is to talk to the community about what causes overflows, how we respond to them, and our commitment to protecting public health and the environment.

“We want to raise awareness about how everyone can play a big part in reducing the likelihood of overflows occurring. The network is essential in protecting our community from unnecessary exposure to wastewater but occasionally overflows into the environment occur due to blockages and breaks,” said Mr Hansby.

“These are usually avoidable and often caused by things like fats, sanitary items, wet wipes, and building materials incorrectly being put into the system, or from tree roots growing near pipes,” he said.

As part of QLDC’s 2018-2028 Ten Year Plan, a number of improvements to the wastewater network are planned to reduce the likelihood of overflows occurring, and further protecting key recreational areas from contamination.

“QLDC is currently preparing a resource consent application to the Otago Regional Council for those occasions when overflows do occur. We have good practices in place to respond to an overflow, but this process gives us the opportunity to review those practices and make sure that we are responding in the best way to protect public health and the environment,” said Mr Hansby.

In parallel to the drop-in sessions, QLDC is also working with local businesses to ensure wastewater best practice. This includes a review of the existing Trade Waste Bylaw.

The drop-in sessions will be held on the following dates:

- **Queenstown/Arthurs Point/Frankton/Lake Hayes/Arrowtown session:** Thursday 8 November from 6:00pm-7:30pm at the Queenstown Event Centre.
- **Wanaka/Albert Town/Hawea/Luggate session:**
  Monday 12 November from 6:00pm-7.30pm at the Lake Wanaka Centre.

ENDS.

For more information please contact QLDC Communications via communications@qldc.govt.nz or call 03 441 1802.

OUR WASTEWATER NETWORK

Wastewater networks protect communities from unnecessary exposure to wastewater. Exposure can affect our health and wellbeing.

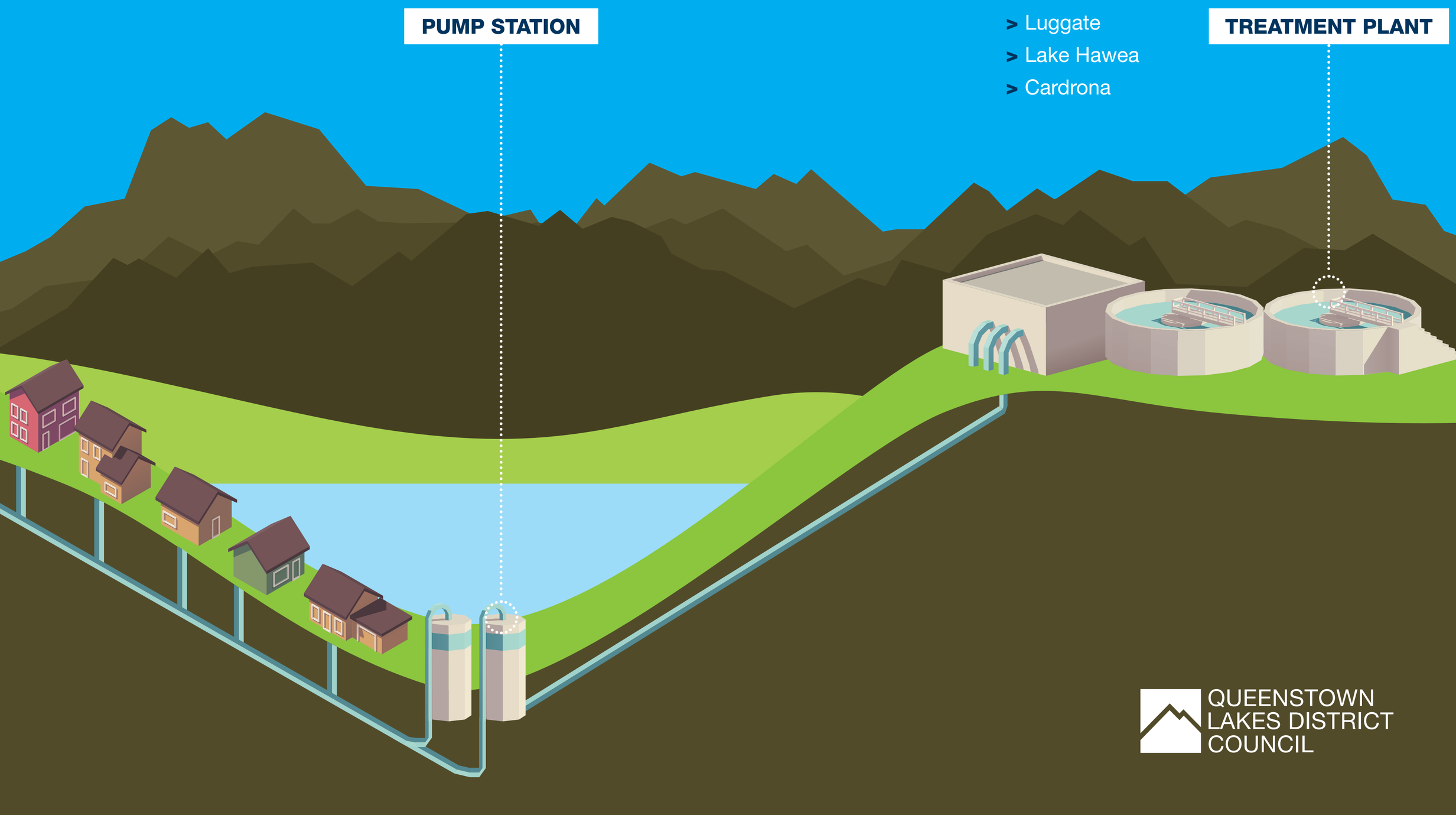
Wastewater is toilet wastes and household grey water from kitchens, bathrooms and laundries; and trade wastes, which are liquid waste from commercial and industrial businesses.

Wastewater pipes transport wastewater away from households and businesses to wastewater treatment plants.

This network uses a combination of gravity and pumped systems to carry the wastewater to the treatment plants. Our landscape means that typically the wastewater which flows under gravity, does so in the direction of our lakes and rivers (as these are low points in our district). Pump stations located at these natural low points lift the wastewater to higher levels, to continue its journey under the power of gravity to the treatment plant.

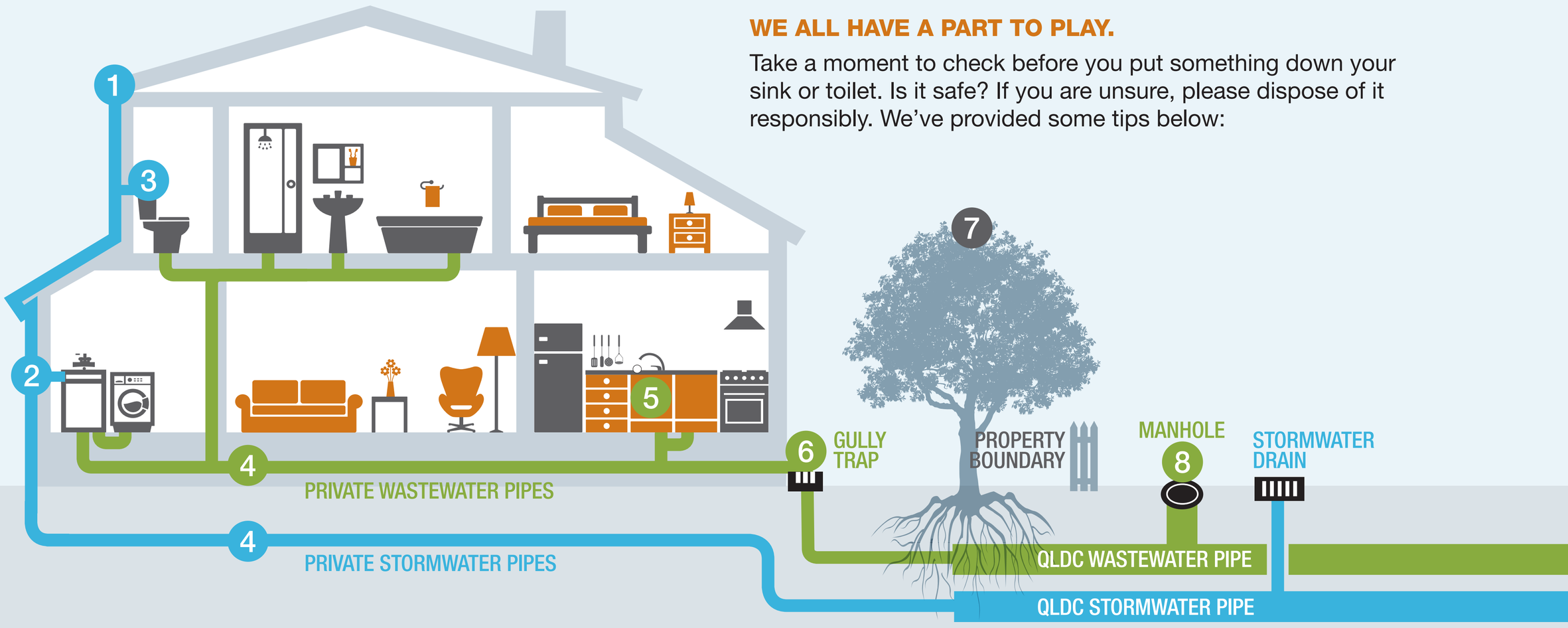
Across our district we have approximately 420km of wastewater pipes and 65 pump stations that cover the following locations:

- Queenstown including Sunshine Bay and Fernhill
- Arthurs Point
- Frankton Road between Queenstown and Frankton
- Frankton
- Lower Shotover including Quail Rise
- Shotover Country, Lake Hayes Estate, and Lake Hayes area
- Arrowtown
- Wanaka
- Albert Town
- Luggate
- Lake Hawea
- Cardrona



QUEENSTOWN LAKES DISTRICT COUNCIL

LOOKING AFTER OUR PIPES



WE ALL HAVE A PART TO PLAY.

Take a moment to check before you put something down your sink or toilet. Is it safe? If you are unsure, please dispose of it responsibly. We've provided some tips below:

1 STORMWATER DOWNPIPE & DRAIN

Where possible, ensure your property has separate stormwater and wastewater pipes. When stormwater enters the wastewater network, it can cause overflows. Check that the stormwater drains on your property connect to the stormwater network. If any drains smell or look like they have sewage in them, there may be a problem.

2 RAINWATER OR RETENTION TANKS

Tanks can collect water from hard surfaces and store it for many uses:

- watering your garden
- washing your car
- supplying your washing machine and toilet.

3 TOILET

Flush toilet paper and human waste only.

4 PRIVATE PIPES

Ensure your private stormwater and wastewater pipes are connected properly and maintained.

5 KITCHEN SINK

Scrape cooking fat into the bin. Fat can harden when it cools and may block pipes. Coffee grounds should also go in your bin, compost pile, or on your garden.

6 GULLY TRAP

Ensure your gully trap is raised off the ground to prevent rainwater from entering the wastewater network. Raised gully traps also protect your family's health by ensuring that wastewater will not overflow into your home if there is a blockage.

7 PLAN YOUR TREE PLANTING

Before planting a tree, check that it's not going to grow over your pipes or ours.

8 MANHOLES

Give us a call.
If you come across any wastewater overflow from a manhole, or you come across a missing, dislodged or damaged manhole cover, contact us urgently on
03 441 0499 (Queenstown) or
03 443 0024 (Wanaka).

HAZARDOUS WASTE

Do not pour hazardous waste such as paint, pesticides, solvents and used automobile oil down any drain, toilet or sink. To find out how to dispose of hazardous waste, visit **www.qldc.govt.nz** and search 'hazardous waste'.

SEPTIC TANKS

If you have a septic tank, ensure it is regularly maintained and checked by a professional. Septic tanks need a pump-out service every three to five years to remove scum and sludge build-up.

If you need help checking your private property drains, pipes, and connections, contact the Plumbers, Gasfitters and Drainlayers Board: visit pgdb.co.nz to find out more.

QUEENSTOWN LAKES DISTRICT COUNCIL

PIPES UNDER PRESSURE

Wastewater flows easily through the pipes when only human waste and toilet paper is flushed, and when only soapy water is put down our pipes.

Do your part to help reduce wastewater overflows in our district.

SO WHAT HAPPENS WHEN OUR WASTEWATER DOESN'T FLOW EASILY?

When blockages and breaks occur, the flow of wastewater is restricted. This can result in a build-up of pressure in our pipes and can cause wastewater to back up. Sometimes this wastewater back up results in an overflow into our environment, typically out of manholes or at our pump stations.

If these overflows can't happen at a pump station or from a manhole there is a risk that wastewater will release back up through our toilets, showers and sinks. This exposure to wastewater could affect our health and wellbeing.

DID YOU KNOW

Washing your coffee grounds down your sink contributes to the blockages in our wastewater pipes?

WHAT SHOULDN'T YOU PUT DOWN YOUR SINKS, TOILETS, SHOWERS AND OUTSIDE DRAINS?

Anything that is not water, human waste, toilet paper, or soaps. This includes no food and fats, sanitary items and wet wipes, or washing building materials down your drains. These items cause blockages and breaks in our pipes meaning wastewater can't flow freely.

- ✓ Water
- ✓ Human waste
- ✓ Toilet paper
- ✓ Soaps
- ⊘ Food
- ⊘ Fats
- ⊘ Sanitary items
- ⊘ Wet wipes
- ⊘ Building materials

WHAT ELSE CONTRIBUTES TO BLOCKAGES AND BREAKS?

Fat from cafes and restaurants poured down our wastewater pipes causes blockages. QLDC is working with businesses on ways to better manage the way that fat and other trade wastes are disposed of to reduce the likelihood of blockages occurring.

Breaks in our wastewater pipes are also caused by tree roots. Before planting large tree varieties, you can ask QLDC for information about the location of pipes to help to avoid this.

Building materials during construction washed into our drains is another contributor to breaks and blockages in our pipes.

Occasionally our district experiences wet weather storm events that result in extra water getting into our underground wastewater pipes. This can also happen if lake levels rise and result in flooding. These wet weather events can make it more difficult for wastewater to flow through the pipes, resulting in a build-up of pressure and the potential for our wastewater to back up.

QUEENSTOWN LAKES DISTRICT COUNCIL

HOW WE RESPOND TO OVERFLOWS

How does QLDC know an overflow has happened?

Our main pump stations located near our lake foreshores are alarmed so we receive early warning of any issues with the flow of wastewater. We can then undertake preventative measures to reduce the likelihood of an overflow occurring. In their day to day work our operations and maintenance teams also look out for overflows.

We also receive phone calls through our call centre from members of the community who alert us that an overflow has occurred. Our call centre is open 24 hours a day 7 days a week.

What is QLDC doing to reduce wastewater overflows?

The 2018-2028 Ten Year Plan adopted by QLDC this year includes funding for a number of improvements to our wastewater system. These improvements include upgrades to our pump stations, pipes and wastewater treatment plants.

We also undertake preventative maintenance by checking our pump stations and pipes regularly to identify any cracks or areas where blockages are starting to form. We then fix these before a problem occurs.

How does QLDC know an overflow has happened?

As soon as we know a wastewater overflow has occurred we:

AIM TO REACH THE LOCATION WITHIN ONE HOUR.

We can do this because we have people, trucks and equipment available in both Wanaka and Queenstown 24 hours a day 7 days a week.

IDENTIFY THE CAUSE OF THE WASTEWATER OVERFLOW AND UNDERTAKE REPAIRS ONSITE.

Where it isn't possible to undertake repair work onsite we schedule it to be done as soon as we can.

STOP AND CONTAIN THE WASTEWATER OVERFLOW AND CORDON OFF THE AREA.

These cordons are to keep the public safe from unnecessary exposure and may include closing off our recreational spaces, beaches and waterways.

COLLECT WATER SAMPLES AND HAVE THEM TESTED.

This is in the instances that the overflow reaches our lakes or rivers in the vicinity of the overflow. We keep testing until the water is back to normal quality again.

CLEAN UP THE OVERFLOW.

This can involve cleaning up the ground around the overflow using a special vacuum machine, and water blasting pipes to make sure they become clear and freely flowing again. If an overflow has occurred into our lakes or rivers we also use booms and nets to capture and pick up any waste.

NOTIFY THE RELEVANT AUTHORITY.

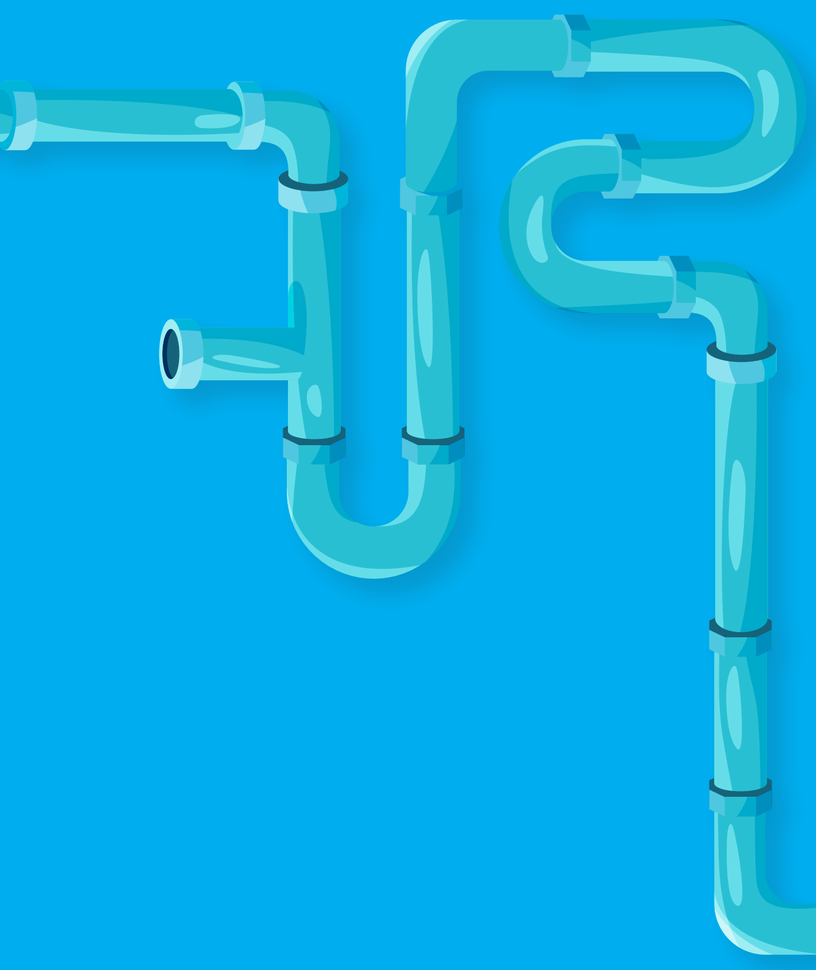
This is usually the Ministry of Health. Where wastewater overflows have reached our lakes and rivers, we also notify the Otago Regional Council.

QUEENSTOWN LAKES DISTRICT COUNCIL

RESOURCE CONSENT FROM OTAGO REGIONAL COUNCIL

Why do we need a resource consent?

Wastewater overflows cannot be completely prevented from occurring, therefore QLDC requires a resource consent to authorise these overflows when they do happen. Obtaining a resource consent for these overflows puts in place an approved process to manage any adverse effects of an overflow, so that it is clear for QLDC, Otago Regional Council, and the community.



Wastewater Overflow Discharge Network Resource Consent

QLDC is currently preparing the resource consent application to be submitted to the Otago Regional Council. It is anticipated that the application will be submitted in the next few months.

The application focuses on the management of adverse effects on public health and the environment, both when an overflow is responded to, and over time through improvements to our pump stations and pipes to reduce the likelihood of overflows occurring.

QLDC has good practices in place to respond to an overflow when it happens. Preparing the resource consent application includes looking at these practices to make sure we are responding in the best way to protect public health and the environment.

We have engaged technical experts who are currently considering the impacts of an overflow on the ecology of our lakes and rivers, and on the health of people if they were exposed to wastewater in the environment.

Consultation

Our consultation for this resource consent application includes these community drop in sessions where we want to hear from our community on this matter.

We have also been collaboratively engaging with Ngāi Tahu, the Ministry of Health, Fish and Game, and the Department of Conservation to help us prepare the resource consent application.

Consultation with the community and these groups will continue throughout the resource consent process.

QUEENSTOWN LAKES DISTRICT COUNCIL

QUEENSTOWN LAKES DISTRICT COUNCIL

Scuttlebutt

THE QUEENSTOWN LAKES DISTRICT COUNCIL NEWSLETTER // **NOVEMBER 2018** // **ISSUE 128**

WELCOME RESPONSIBLE CAMPERS

Plans are now in full swing to welcome responsible campers to the district, while responding to the clear message from our local community that improvements are needed to protect our environment and ability to enjoy it.

MORE DETAILS ON PAGE 08

INSIDE

Tell us if you want to save paper and read Scuttlebutt online. See page 21 for details.

Scuttlebutt is printed on paper sourced from sustainably managed forests.

Scuttlebutt is recyclable. Please recycle me.

FROM THE CHAMBERS

There's either a Council or Committee meeting happening almost every week of the year.

Here's a quick snapshot of some of the issues that have been across the Council table recently.

NAVIGATION SAFETY BYLAW 2018

An amendment to the Navigation Safety Bylaw proposed new speed rules for the upper part of the Clutha River. A submissions hearing was held on 3 October. To ensure any change can be in place in time for the busy summer season, the Council will hold an extraordinary meeting on 20 November to adopt the bylaw.

ALCOHOL BAN BYLAW

Back in September we held a submissions hearing on a proposed Alcohol Ban Bylaw. The bylaw proposed an earlier start time for the Queenstown CBD alcohol ban and a full liquor ban on National Crate Day.

The hearings panel's recommendation was considered at the Council meeting on 25 October and if adopted, the new bylaw will become operational in time for summer 2018/19.

REPRESENTATION REVIEW ENTERS THE NEXT STAGE

There have been no objections and appeals to the Council's final representation proposal for the next Council election.

The Council had proposed only a minor change to the Arrowtown boundary to increase the ward population to bring it more in line with the member/population proportion elsewhere in the district.

Although this change does bring the Arrowtown Ward closer to the statutory benchmark, it's still non-compliant so the Council's proposal will now be referred to the Local Government Commission for a final decision.

The Council is hopeful that the Commission will be supportive of the proposal to retain a slightly enlarged Arrowtown Ward that elects one Councillor, especially as most submitters were in favour of this.

The Local Government Commission's decision will be made by April 2019.

FUTURE OF WANAKA SKATE PARK LOOKS BRIGHT

Stage Three of the Wanaka Skate Park development might still be a wee way off but it took one step closer to becoming a reality with the Wanaka Community Board recently giving it the thumbs up. Council has included $203,000 in 2019/20 in the Ten-Year Plan for the project which will cost about $640,000 all up. The Wanaka Skate Group will look to fundraise for the balance of the project cost.

DECISIONS ON FREEDOM CAMPING AT LAKE HAYES AND SHOTOVER DELTA

It's been a busy time for hearings, with submissions on the Freedom Camping Bylaw/Lake Hayes Reserve Management Plan Amendment also heard during September.

This bylaw proposed restrictions on freedom camping at the Shotover Delta and Lake Hayes North and formalises a Council decision controlling freedom camping in these locations made earlier in 2018.

The Council is very conscious that freedom camping is something the community feels very strongly about, but is equally aware that many visitors enjoy responsibly camping in our district. The Council hopes to be able to balance some of these factors with its Responsible Camping Strategy which is due to be reported to Council on 25 October. The strategy seeks to promote the sustainable use of our environment for visitor and community experience through well managed, coordinated and responsible camping in the district. You can read more about camping on page 8.

READ MORE AT

www.qldc.govt.nz/agendas-and-minutes

LET THE CHILDREN PLAY!

Queenstown's brand new playground opened for all on a gorgeous Friday afternoon back in the first week of school holidays, with families flocking to the play space on the edge of Lake Wakatipu.

Queenstown Lakes District Council's Cory Ratahi kicked things off with a karakia and Mayor Jim Boult was there to cut the ribbon. He thanked all those involved in the project and remarked on the importance of the playground to the area.

"With a million locals and visitors passing by we wanted to provide an exciting, innovative and fun space for them to stop in and enjoy as a family. This playground will assist in creating a town centre that families want to congregate and spend time in, and celebrates the unique Queenstown environment."

After that, authority for the rest of the opening was handed over to the children - their main item on the agenda being to test out the new playground.

A line formed fast for the face painter and bubbles were made and popped, while hula hoops showed a few too many parents some practise might be in order. The slides were an instant hit, and shouts and gurgled excitement passed through underground sound tubes to different parts of the playground. Swings swung, and the music bridge was played all throughout the afternoon.

Now all that remains is for the playground to be given a formal name. Playground McPlayface, perhaps? Perhaps not, but we'll announce its official title soon.

Mayor Jim Boult officially opens the new playground on Queenstown's waterfront.

RESIDENT SURVEY ONLINE NOW

The latest resident and ratepayer satisfaction survey results are on our website.

Areas that saw a positive shift this year include the public transport offering in Queenstown and the continued efforts to manage freedom camping. However some areas experienced a dip in results indicating a community under pressure, affected by unprecedented growth and affordability issues.

We are working hard to respond to these matters as achieving great outcomes is at the heart of everything we do.

This is the last time we'll run the satisfaction survey in this format. Our new annual Quality of Life survey will take the reins from here, helping us to explore and understand wider social issues affecting the district.

Read the full results at www.qldc.govt.nz

MUSEUM 70 YEARS YOUNG

Support our local heritage. Visit **www.museumqueenstown.com/members-donation/** and become a member today!

The Lakes District Museum celebrates its 70th birthday this month.

In 1948, the MP for Central Otago, Mr William Bodkin announced that as part of the Centenary of Otago he would like to see a museum established in the Lakes District. He was concerned that the gold mining history was being lost.

Arrowtown put up its hands as a town where this district museum could be established and in late 1948 it started in the former sample rooms next to the Ballarat Hotel. In 1956 it moved to the former Bank of New Zealand building at the other end of Buckingham street where it remains to this day.

Over the last 70 years it has grown to become one of the best innovative small museums in New Zealand. Not only is it the districts museum, it also is an information centre, bookshop, art gallery and family research centre.

A full time education team caters for visiting schools. The museum also owns and operates the Arrowtown Post Office. In addition to collecting objects relating to the district's history, there is also a strong focus on recording the stories of current and former residents through an oral history recording project and also collecting relevant documents and photographs.

A new storeroom has recently been built to cater for the ongoing collection. The museum has also been a strong advocate and facilitator for the protection and restoration of many of the districts remaining heritage buildings.

Museum director David Clarke is calling to the community to continue to support the museum.

"70 years is a great milestone and so much has been achieved. We're hopeful the local community will continue to support the museum by advocating for our heritage, visiting the museum and considering becoming members," he said.

lakes district museum & gallery arrowtown 70 YEARS 1948-2018

The original Lakes District Museum back in 1948, next to the former Ballarat Hotel.

70 years on, the Lakes District Museum at its present day location at the other end of Buckingham Street, Arrowtown.

FRESH TURF FOR JACK REID PARK

Jack Reid Park has been a bit of a mud bath lately but that doesn't worry home tenants, Arrowtown Rugby Club.

On the contrary, the club is set to start next season – its 30th anniversary year – playing on brand new turf with significantly improved drainage and irrigation thanks to Council's investment.

Work to date has involved site clearance and earthworks to increase the size of the rugby field, followed by installation of the new drainage and irrigation system.

The turf will be established from November through to February during which time the sports field will remain fenced off to ensure a successful grow-in period over the summer months.

If the weather plays ball, the new facility will be ready for kick off in March next year to coincide with the start of the 2019 Central Otago Rugby season.

Arrowtown Community Centre overlooking the pitch will also be open by then providing brand new change rooms and other facilities for rugby and other community groups like Arrowtown Scouts.

ARROWTOWN RUGBY CLUB JUBILEE 2019

19 APRIL 2019-
21 APRIL 2019

"Three days of memories, fun, laughter, some rugby and of course a few cold ones"

ARROWTOWN RUGBY CLUB

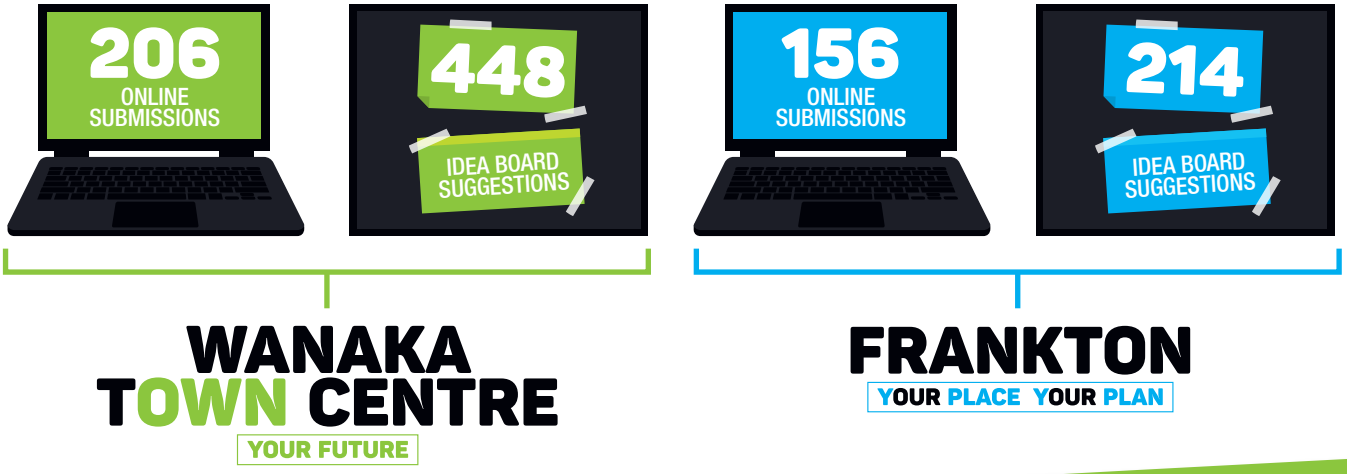
To celebrate 30 years since it reformed, Arrowtown Rugby Club is holding a celebration of its past, present and future next Easter weekend. The invitation is out there for everyone associated with the club's proud history to join them for "three days of memories, fun, laughter, some rugby and of course a few cold ones" starting on Good Friday (19 April).

FEELING ENGAGED? WE THINK SO!

THANKS FOR ALL THE IDEAS!

Wanaka and Frankton, you are awesome! Thank you for all the feedback and attendance at our Masterplan early engagement events during August and September. We've had a great time getting out talking to you and all of the ideas and insights provided are so important at this stage of the two projects.

Over the four week period we participated in a range of community events, spoke to hundreds of people and spread the message far and wide.



VISIT WWW.QLDC.GOVT.NZ TO CHECK OUT ALL THE FEEDBACK AND KEY THEMES

NEXT STEPS

The feedback will be fed into a vision/key outcomes workshop with community stakeholders and the project team to further develop and evaluate options for both Frankton and Wanaka Town Centre Masterplans.

The ideas board at Queenstown Events Centre captured ideas from all ages.

QLDC communications coordinator Tessa Payze discussing the Wanaka Masterplan at The Festival of Sport and Recreation held at Wanaka Recreation Centre.

Mount Aspiring College students taking part in an ideation exercise held at the high school.

PROGRESS IN QUEENSTOWN

The Queenstown Town Centre Masterplan project is continuing at pace. The Spatial Framework and Design Guidelines were adopted by Council in June this year. We have also produced a booklet for investors and the general community to tell the story of how we propose to transform the Town Centre in stages over the next ten or so years.

You can read the Town Centre Masterplan story and other documents online at **www.qldc.govt.nz/queenstown-town-centre**

WELCOME RESPONSIBLE CAMPERS

Continued from cover page.

Mayor Jim Boult says the plans will build on the bold move already made to ban overnight camping at Lake Hayes, Shotover Delta and Wanaka waterfront in response to community concern.

"This summer you'll see further facilities and education for visitors to make sure they're staying in the right places and treating our environment with respect, and stronger enforcement for those that are not," Mayor Boult said.

"Our focus is on educating campers and trialling initiatives that could guide the future strategy for managing responsible and sustainable camping in the district," he said.

"The important thing is that we're agile enough to change our approach if something we're trialling isn't working," Mayor Boult said.

Three overnight camping hubs and two amenity hubs for day use will be fully operational come early November when the visitor influx is set to start.

To support the hubs, there are a range of other plans in place to provide information to campers and reassurance to locals, including;

01
12x camping ambassadors based at hubs, key locations and roaming throughout the district when possible educating campers on where and how to camp responsibly

02
Increased monitoring of camping hubs to ensure responsible behaviour

03
Increased signage and new information boards to direct non self-contained campers to appropriate camping grounds

04
Real time maps and updates through a joint venture with Campermate, New Zealand's most widely used app for information to campers

05
Support and collaboration from the Motorhome industry

06
New education brochure widely distributed within and outside the district

A multi-agency model has been used to ensure a well-managed and coordinated approach to the plans for managing camping this summer, as well as the development of a Responsible Camping Strategy which was due to be considered by the Council as Scuttlebutt went to print.

"We're grateful to our colleagues at the Department of Conservation, New Zealand Transport Association, Ministry of Business, Employment and Innovation and Land Information New Zealand for the support and input as we work together to strike the balance of addressing the community's concerns and providing a good camping experience for visitors," Mr Boult said.

Everything we do to promote responsible and sustainable camping this summer is a trial. If something isn't working, we'll change it.

QUEENSTOWN LAKES DISTRICT COUNCIL

Information for locals

An important part of the work underway for the summer period is providing information for locals so you know what to expect and clearly understand what's allowed and what's not. Importantly, we also want you to feel assured that all of the hubs will be closely monitored, camping ambassadors will be roaming and monitoring situations regularly and enforcement for those camping irresponsibly will be increased across the district.

You can read more information about responsible camping especially for locals at **www.qldc.govt.nz/responsible-camping**

Sleeping on the streets

Did you know fully certified self-contained campervans **ARE ALLOWED** to park overnight on the side of a road as long as it is outside of a residential area. If you do see any campers parked overnight within a residential area, please report it to us by phone

QUEENSTOWN
03 441 0499

WANAKA
03 443 0024

FLUSH IT OUT

Some plumbing fittings have the potential to allow minute traces of metals to accumulate in water standing in the fittings for several hours.

Although the health risk is small, the Ministry of Health recommends that you flush a mugful of water from your drinking water tap each morning before use to remove any metals that may have dissolved from the plumbing fittings.

We are recommending this simple precaution for all households, including those on public and private water supplies.

WANAKA LAKEFRONT DEVELOPMENT PLAN UNDERWAY

The Wanaka Lakefront Development Plan got underway earlier this month with work starting on the new Mount Aspiring Carpark at the southern end of Wanaka's lakefront.

The carpark will include 68 parking spaces, 9 bike parks, public toilets, native landscaping and a connection to a future pedestrian promenade.

The Lakefront Development Plan is all about creating better connections to the lakefront for pedestrians, which might make kicking things off with a new carpark a bit odd. But we promise there's a method to the madness.

While future parts of the development plan will remove parking from the lakefront to allow more space for people to enjoy the area, there is still a need to provide some parking. This carpark will retain around the same number of parking spaces but open up the wider lakefront for public enjoyment.

QLDC Councillor and Wanaka Community Board Chair Quentin Smith said he is looking forward to seeing more people walking, swimming, picnicking and cycling rather than the row of vehicles that currently exists for a large part of the year.

"We're really excited to finally see dirt being turned and this represents the beginning of a long-term project to improve this space."

Work on the car park is set to be complete by Christmas in 2018.

Check out **www.qldc.govt.nz/major-projects** for more info

WANAKA OFFICE MAKEOVER

Since our last issue of Scuttlebutt, a lot has happened at the Ardmore Street, Wanaka office.

The old St John building has been demolished to make way for two new relocatable offices and the existing office is currently being refurbished. While all of this is going on, our Wanaka staff are housed at 33 Reece Crescent until the move back to Ardmore Street in December.

We'll keep you posted about key activity and dates through our website and Facebook page and also in local media.

QUEENSTOWN LAKES DISTRICT COUNCIL

Check out the difference a spring clean makes to our Town Centre streets! This photo was taken in Queenstown Mall during the recent deep clean of CBD streets in Queenstown and Wanaka.

Parks Delivery Team Leader Adrian Hoddinott says following the clean a sealant was trialled outside the Night and Day in Queenstown and Kai Whakapai in Wanaka.

"We were keen to explore whether a sealant would make future street cleaning easier and how effective it might be in strengthening the surface of pavers from wear and tear caused by high foot traffic," he said.

"The trial will also give us a good indication about whether preserving the pavers with sealant makes financial sense in the future," he said.

GOING GREEN IN YOUR KITCHEN

One third of food produced globally is wasted - that is 1.3 billion tonnes of food that is never eaten.

When we throw our food into the bin, we don't see the harmful greenhouse gases that it will release once it is in the landfill. We also don't see the fuel and resources that went into producing this food. So if you don't eat all of your leftovers, have a go at composting them!

Composting is a natural and easy way to recycle your food and green waste - plus using it on your garden improves nutrient levels in the soil, prevents erosion, and improves water absorption.

HOW TO GET STARTED

There are a few different ways to compost, depending on how much time and space you have.

If you have ever thought about setting yourself up with traditional backyard composting, Bokashi bins or a worm farm then now is the time! Either head along to a Dr Compost workshop this month or check out our tips at **www.qldc.govt.nz/home-composting**

Find out which method will suit you best, and get lots of tips to get your compost humming.

FREE COMPOSTING WORKSHOPS

Find out which composting method will suit you best. Dr Compost aka Ben Elms is our resident composting and garden guru and has all the tips to help get your compost humming.

He's making his way around the district this month to host a number of workshops and answer your questions at local market days:

- **Sunday 28 October 10.00am-1.00pm:** Wanaka Market at Lake Wanaka Centre
- **Monday 29 October 6.30pm-8.30pm:** Wanaka "Easy Ways to Compost" Workshop at St John's Rooms
- **Wednesday 31 October 6.30pm-8.30pm:** Wanaka "Grow Your Own Veggies" Workshop at St John's Rooms

Reserve your **FREE** ticket at **www.eventbrite.co.nz**

WORM POWER

Did you know we provide a subsidy to local residents for Bokashi composting systems and tiger worms for worm farms.

Find out how to get yours today! **www.qldc.govt.nz/home-composting**

Please note: you'll need to provide contact details/ proof of address at time of purchase.

QUEENSTOWN LAKES DISTRICT COUNCIL

BAGS NOT!

It just doesn't make sense to produce or buy something that is only used for a few minutes but lasts hundreds of years in landfill.

That's why QLDC supports the Government's recent proposed ban on single-use plastic bags. In our journey towards zero waste, we support actions that move us away from a throwaway culture, and tackling plastic bags is a vital starting point.

In our submission to the Government, we recommended they develop a collaborative approach to community action and communication. We suggested that their campaign involve simple and positive messages to help deal with common challenges, such as bin liners and dog litter bags.

We also recommended some other key points:

> Implement the ban outside of peak tourist seasons.

> Improve the labelling of recyclable packaging so that it is clearer, more consistent, and user friendly.

> Include all single-use plastic bags - including compostable ones - as they are a contaminant to recycling and there is currently no system in place to collect the bags or process them effectively.

From 1 July 2019 we'll be getting rid of our own blue rubbish bags! Watch this space for updates on the new rubbish and recycling collection service coming soon.

MINDFUL CONSUMPTION

One of the best ways to reduce plastic is to engage and inspire individuals, families, communities and businesses to be mindful of their consumption of single-use items.

Kate Meads aka The Nappy Lady is heading our way in November to help do just this.

For a humorous and inspirational evening, secure your spot at one of her **Waste Free Parenting** or **Foodlovers Masterclass** workshops **www.thenappylady.co.nz/workshops-queenstownwanaka.html**

FOODLOVERS MASTERCLASS –
Monday 19 November, 6.00pm, Lake Wanaka Centre

WASTE FREE PARENTING –
Sunday 25 November, 6.00pm, Lake Wanaka Centre

WASTE FREE PARENTING –
Monday 26 November, 6.00pm, Queenstown Memorial Centre

Tickets are $25 with a free goodie bag worth over $100! Register today at **www.thenappylady.co.nz**

USING EVERY DROP WISELY

Water is one of our most precious resources and with summer just around the corner, it's time to start thinking about water conservation.

We all have a role to play in conserving water and there are a number of simple things we can do to make sure the water keeps flowingthere's enough water for everyone.

BATHROOM

Did you know?
The recommended temperature setting for hot water is 60°C. When your thermostat is set too high, water and energy are wasted to cool down very hot water. Ask an electrician or plumber to adjust your thermostat if needed.

Reduce your shower time – every minute you cut from your usual shower time could save two to three buckets of water (up to 20L) a day.

Use a bucket to catch excess water while you shower - this can be used later to clean your car or mop your floors.

Turn off the water when brushing your teeth or shaving – this will use around 1L of water instead of 5L.

TOILET

Did you know?
Small drips leaking from your toilet cistern can result in thousands of litres wasted. Check for leaks in your toilet by putting a few drops of food colouring in the cistern. If colouring ends up in the toilet bowl without flushing, you have a leak which should be repaired.

Use the half-flush button on your toilet - the latest four-star toilets use as little as 3L for a half flush and 4.5L for a full flush.

Consider replacing an old toilet - most new toilets use around 7L per flush while older toilets use around 12L per flush.

LAUNDRY

Did you know?
Up to a quarter of your household's water is used in the laundry.

Check the efficiency of your washing machine - an inefficient washing machine can use 200L of water per wash. Front-loading washing machines typically use about 50% less water, 35% less detergent and 30% less energy than equivalent-sized top-loading washing machines.

Wash full loads whenever possible rather than half loads - this will save water and energy.

WATER RESTRICTIONS

The forecasts are pointing to another hot, dry summer so as things heat up please keep in mind that there's a good chance water restrictions could be in place for your area.

To make it easier to understand what water restriction level is in effect, we'll be rolling out some pretty swish water restriction signage across the district in November/ December.

These signs will be installed on main roads into towns and major suburbs across the district.

Keep an eye out for these new signs when you're on the roads and also check our Facebook page for specific water restriction updates.

BREATHE EASY

We're thrilled to be supporting the Fresh Air Project, piloting in Queenstown from November.

A project being delivered in partnership between The Cancer Society and Southern DHB, the Fresh Air Project is for cafés to promote their outdoor dining areas as smokefree from November 2018-March 2019.

The pilot has already been hugely successful in Christchurch, Nelson and Whangārei and is another step on the journey to Smokefree Aotearoa 2025.

So far the following local businesses have committed to becoming smokefree for the pilot: The Exchange, Odelay and Café Society Five Mile.

Public support for smokefree outdoor dining is strong. People are more aware than ever of the harms caused by second hand smoke drift and are keen to protect staff and customers from exposure. A huge shout-out to the local cafés that are already proudly smokefree: Vudu, Bespoke, Patagonia, Bonjour Arrowtown and Taste and Savour.

If your café is interested in becoming smoke free, please visit: **freshairproject.org.nz**
or contact Emily Nelson at SDHB 03 450 5159 or Diana Power at The Cancer Society, phone 03 446 6622

WHY GO SMOKEFREE?

Everyone wants to breathe easy while they're enjoying a meal outdoors. We often talk about the obvious health benefits of being smokefree, but there are many other benefits for cafés if they decide to go smokefree:

PROTECT THE ENVIRONMENT:
Cigarette butts are the single most common piece of litter in the world Nationally, around 60 million butts are discarded into the environment each year. They might be small, but they're toxic and they contaminate stormwater, aquatic environments and urban neighbourhoods.

IT HELPS PEOPLE QUIT:
Most people who smoke want to quit. Exposure to smoking can trigger cravings and make it harder for those trying to quit.

IT PROTECTS OUR CHILDREN:
Kids copy what they see, so reducing exposure to smoking reduces the likelihood that children will start to smoke.

MOST OF YOUR CUSTOMERS WANT SMOKEFREE OUTDOOR DINING:
In Christchurch the Fresh Air Project six month pilot found that 95% of almost 2,000 customers were in support of smokefree outdoor dining and 72% were more likely to visit the venue again because they were smokefree outdoors.

WE'RE GETTING PREPARED

Take a bow! When it comes to understanding the impacts of natural disasters and being prepared for emergencies, our residents are ahead of the field.

A recent survey by Emergency Management Otago shows that eight out of every ten households in the district have taken at least some steps to prepare for the aftermath of an earthquake, storm, flood, wildfire or slip.

Perhaps it's not surprising that locals are thinking about storing drinking water, keeping supplies of non-perishable food and arranging alternative ways to cook. There have been several times this winter when wind and snow has brought down power lines and blocked roads – just ask someone from Glenorchy – and Jack's Point residents also had their water supply disrupted recently. In other words, it doesn't take the Alpine Fault to disturb your daily life.

Almost half of the Queenstown Lakes District residents who took part in the survey said that they still planned to do more to be prepared for emergencies. If you're one of them, here are some simple things you can do to make life easier for you and those who rely on you.

Talk to your family and make a plan so everyone knows what to do in the event of an emergency. Decide where you will meet up if something happens during the working day, or while your kids are at sport or after-school care.

If you have young children, elderly or unwell family members and pets, make sure your plans take account of their needs. One of the biggest surprises in Emergency Management Otago's survey was that four out of every ten people with a pet said they hadn't thought about including their animals in their family survival plans.

It's not just an earthquake or landslide that can cut your water supply and power or block your roads. Infrastructure failure can also disrupt normal life, as Jacks Point residents experienced earlier this month.

BASIC SUPPLIES EVERY HOME SHOULD HAVE TO COPE FOR AT LEAST THREE DAYS:

Stores of water – at least nine litres for every person including your pets

Non-perishable food

An alternative means of cooking – a BBQ or camp stove is ideal

Torches or camping lights and spare batteries

First aid kit

Sturdy bin liners and some kitty litter for an emergency toilet

Hand sanitiser and wet wipes for basic hygiene

Sufficient medication for anyone in your household with a medical condition

Check **www.otagocdem.govt.nz** for more advice on preparing for emergencies.

TRAFFIC AND PARKING BYLAW UPDATE

Thank you to everyone who provided feedback on the proposed new bylaw for traffic and parking. We're currently reviewing all submissions and hearings will be held in Wanaka and Queenstown soon.

WANAKA: 31 October from 10:00am in the Armstrong Room, Lake Wanaka Centre.

QUEENSTOWN: 1 November from 1:00pm in the Council Chambers, Gorge Road.

LAGAROSIPH-ON YA BIKE

The war on lagarosiphon continues as a range of agencies work together to tackle the noxious weed choking our waterways.

Help prevent the spread of Lagarosiphon. Please check and clean your boats and fishing equipment every time you enter and leave our lakes.

WILLOW REMOVAL IN KAWARAU RIVER

The Queenstown Zoological Gardens is set to benefit from a major operation that's removed more than 150 tons of wood from the Kawarau River near Queenstown.

A 24 ton excavator was floated up the river on a barge to extract the wood from the riverbed back in September.

The whole project has been a joint effort funded by Land Information New Zealand (LINZ) and Otago Regional Council, with contractors Boffa Miskell carrying out the work.

"This was a pretty unique project that took an innovative approach to resolve a significant problem", says Marcus Girvan who oversaw the work.

"The wood under the water was like a dense jungle making it very difficult for divers to carry out work to tackle lake-weed."

The wood has been removed to allow hessian matting to be laid on the river bed to prevent the spread of the invasive pest plant lagarosiphon.

"This was a very difficult operation, but it's paid off," says LINZ Biosecurity Director Dave Mole.

"Removing the dead wood so we can lay biodegradable hessian matting will massively curtail the growth of lagarosiphon. This innovative matting is cost effective and a 'green' control method that allows native vegetation to flourish."

Preventing lagarosiphon from growing in the Kawarau River is part of the wider work being done in Lake Wakatipu.

An unexpected benefit from the work in the river has been a much-appreciated gift for Queenstown Zoological Gardens. The recovered willows are being chipped into mulch, and will be gifted to the zoo.

Work to lay the hessian matting in the Kawarau River is expected to happen early next year and will be part funded by QLDC.

TACKLING THE PEST PLANT IN WANAKA

Good progress is being made to contain and eradicate the pesky lake weed from the lake bed of Lake Wanaka. A range of methods are being used to tackle key concern areas with hessian matting proving effective over larger areas. We ask that boaties using Roys Bay in particular be mindful of the matting to avoid damaging it as they launch.

NEW WEBSITE SHOWCASES FILMMAKING HEARTLAND

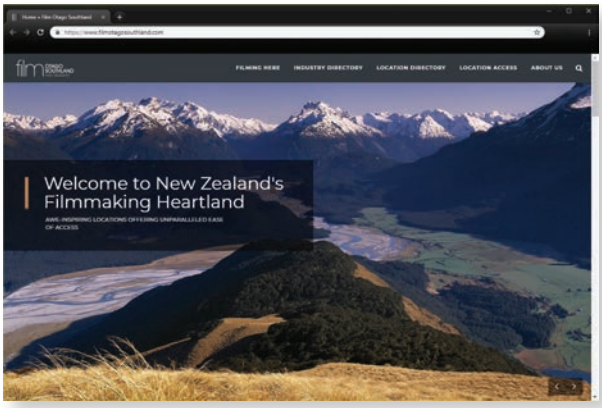
The team at Film Otago Southland has just launched a new website and is inviting local businesses to get themselves listed in the online directory.

Film Otago Southland is the Regional Film Office covering the southern half of the South Island. With office space in Queenstown provided by QLDC, the team provides a range of services, information and support for production companies looking to shoot here.

Members of the local film community can list their industry-specific services for free. Other local businesses who interact with the film industry such as hotels and retailers can list in the directory for an annual fee.

Film Otago Southland is also happy to receive good quality photos of potential filming locations around the district for its online locations directory.

Check out the new site!
www.filmotagosouthland.com



KEEPING OUR PIPES FLOWING

Our network of wastewater pipes is critical in protecting our community from unnecessary exposure to wastewater.

Most households and businesses connect to our wastewater pipes. Wastewater is then treated at one of our treatment plants.

Wastewater flows easily through the pipes when only human waste and toilet paper is flushed, and when only soapy water is put down drains.

Blockages and breaks occur when things like coffee grinds, fats, sanitary items, wet wipes, and construction materials are put into the network. Another culprit for pipe damage is tree roots.

PIPES UNDER PRESSURE

Blockages and breaks restrict wastewater from flowing freely through the pipes. These restrictions can cause wastewater to back up and overflow into our environment, typically from manholes or pump stations. If these overflows can't happen, there is a risk that wastewater will release through toilets, showers, and sinks.

When we are notified of an overflow, we aim to reach the location within one hour. We are responsible for stopping, containing, and cleaning up the overflow.

IMPROVEMENTS AND UPGRADES

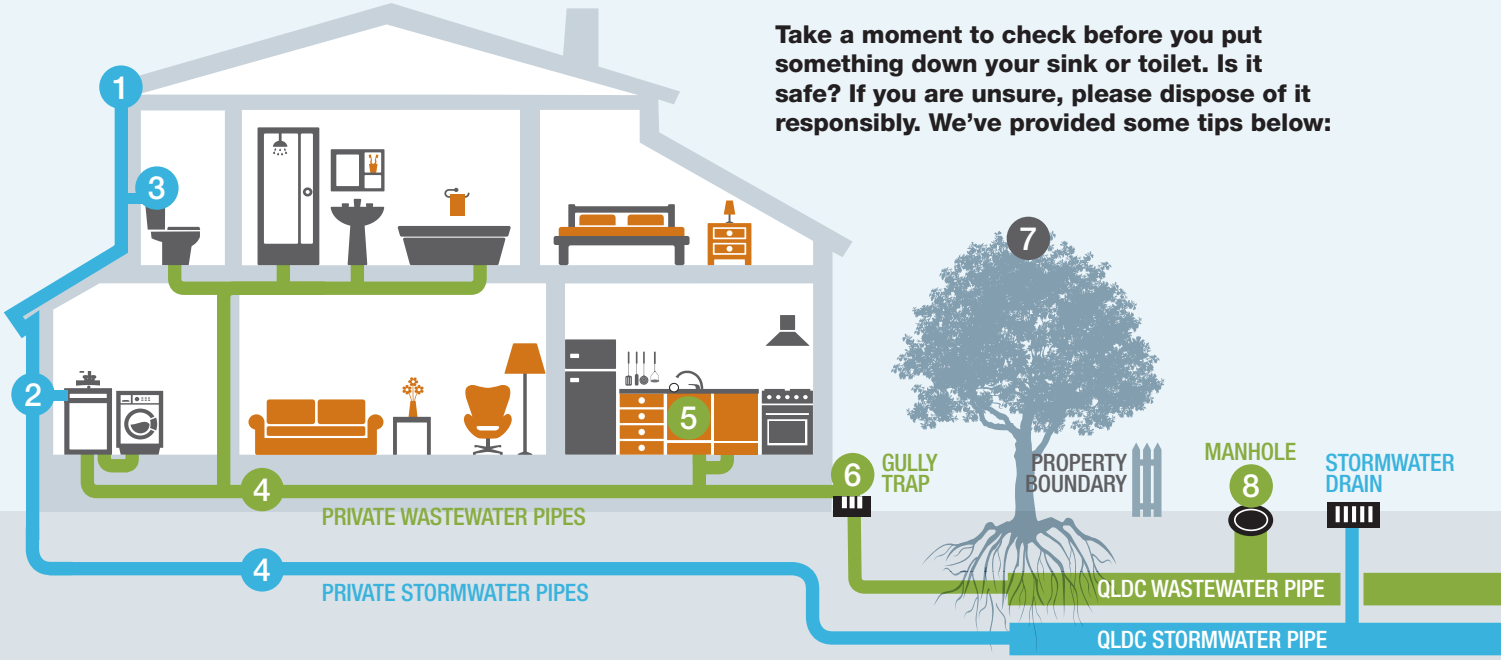
As part of our 2018-2028 Ten Year Plan, we'll be making improvements to the network to help reduce the likelihood of overflows occurring.

We will be applying for a resource consent from Otago Regional Council for those occasions when overflows do occur. The consent will require demonstration of best practice network management and regular reporting on what we are doing to reduce the likelihood of overflows.

If you'd like to find out more about wastewater overflows and our planned improvements, we'll be holding drop-in sessions in Wanaka and Queenstown in early November. Keep an eye on Facebook and local media for details.

QUEENSTOWN LAKES DISTRICT COUNCIL

WE ALL HAVE A PART TO PLAY



Take a moment to check before you put something down your sink or toilet. Is it safe? If you are unsure, please dispose of it responsibly. We've provided some tips below:

1 STORMWATER DOWNPIPE & DRAIN

Where possible, ensure you property has separate stormwater and wastewater pipes. When stormwater enters the wastewater network, it can cause overflows. Check that the stormwater drains on your property connect to the stormwater network. If any drains smell or look like they have sewage in them, there may be a problem.

2 RAINWATER OR RETENTION TANKS

Tanks can collect water from hard surfaces and store it for many uses:

- watering your garden
- washing your car
- supplying your washing machine and toilet.

3 TOILET

Flush toilet paper and human waste only.

4 PRIVATE PIPES

Ensure your private stormwater and wastewater pipes are connected properly and maintained.

5 KITCHEN SINK

Scrape cooking fat into the bin. Fat can harden when it cools and may block pipes. Coffee grounds should also go in your bin, compost pile, or on your garden.

6 GULLY TRAP

Ensure your gully trap is raised off the ground to prevent rainwater from entering the wastewater network. Raised gully traps also protect your family's health by ensuring that wastewater will not overflow into your home if there is a blockage.

7 PLAN YOUR TREE PLANTING

Before planting a tree, check that it's not going to grow over your pipes or ours.

8 MANHOLES

Give us a call.
If you come across any wastewater overflow from a manhole, or you come across a missing, dislodged or damaged manhole cover, contact us urgently on 03 441 0499 (Queenstown) or 03 443 0024 (Wanaka)

HAZARDOUS WASTE

Do not pour hazardous waste such as paint, pesticides, solvents and used automobile oil down any drain, toilet or sink. To find out how to dispose of hazardous waste, visit **www.qldc.govt.nz** and search 'hazardous waste'.

SEPTIC TANKS

If you have a septic tank, ensure it is regularly maintained and checked by a professional. Septic tanks need a pump-out service every three to five years to remove scum and sludge build-up.

If you need help checking your private property drains, pipes, and connections, contact the Plumbers, Gasfitters and Drainlayers Board: visit pgdb.co.nz to find out more.

A WILDING SUCCESS!

The Wakatipu Wilding Conifer Group is going from strength to strength in their crusade against wilding trees.

The past twelve months have been group's biggest season to date, largely thanks to the huge effort put in by volunteers.

LAST YEAR IN NUMBERS:

$1,945,568	spent on wilding control in the past financial year
9,400	volunteer hours
8,000	trees removed from Cecil Peak this season
12,000	trees removed from the face of the Remarkables
383 ha	of wildings sprayed

WHY CONTROL THE TREES

- Protection of biodiversity
- Reduced fire risk
- Protects landscapes
- Water availability
- Recreation Values

ADOPT A PLOT

The Adopt a Plot programme is a new approach to tackling the wilding problem. Rather than a few volunteers looking after a large area, the program seeks to engage with many people who can provide intensive control of smaller areas.

If you or a group you're involved in is interested in adopting a plot or volunteering – get in touch at **www.wakatipuwilding.co.nz/#adopt-a-plot**

PROJECT LITEFOOT WIN-WIN

Win-Win is not a common result in the sporting world, but Project Litefoot is working hard to change that.

Project Litefoot is a charitable Trust made up of some of our top sportspeople who since 2008 have been competing against each other to see who can reduce their environmental impact the most and inspire others to become environmental champions.

The charity's lead initiative is called LiteClub, a free service available to sports clubs to help improve environmental efficiency of clubrooms, therefore reducing running costs freeing up money to go back into what really matters, the sport.

Since it was launched in 2011, LiteClub has visited 1,334 clubs from Kaitaia to Invercargill and made changes calculated to save $7.6 million dollars for sport.

Locally, LiteClub has so far visited 14 community sports clubs. The team will be back in the district in February / March next year and keen to hear from local clubs keen to get involved. The best part, it's all free thanks to funding from The Lion Foundation and other local funders like the Otago Community Trust.

Interested? Register your group online to secure a visit from LiteClub liteclub.org/register-your-club

Tell us if you want to save paper and read Scuttlebutt online.

Just email **services@qldc.govt.nz** with the word "newsletter" in the subject line, and be sure to include your name and postal address so we can cross you off the postal mailing list and send you a website link to Scuttlebutt instead.

You'll not only receive Scuttlebutt earlier, but also help QLDC trim the amount we spend on printing and postage to keep you informed – that's a win for everyone.

Our Queenstown based field team.

BEST OFFICE IN THE WORLD

The Queenstown Lakes District is known around the world for its natural splendour, but not all of it formed by its own accord. Plenty of credit belongs to the gardeners in our Parks & Reserves Field team, based in Queenstown and Wanaka.

At 7.30am every morning they're already on the job. There's Kara and Jessica from Canada; Leo from China; Kazumi from Japan; Rodrigo from Brazil and Beth from Southland. They gather at their depot in the Queenstown Gardens, fondly referred to by Jessica as "the best office in Queenstown" and with a view of the Gardens and Lake Wakatipu, it's hard to argue with that.

Rain or shine, they kick things off with a litter run through the skateboard park and over to the lakefront, then back through the gardens. The team does a general tidy up, and then there's planting, trimming and composting to be done. In winter they add mulching into the mix and a whole lot of a leaf blowing in autumn. Sometimes, they even have to shoo the odd inebriated person on. Just the other morning, they found two people wallowing in the lake shallows.

While the team are split between spring and summer regarding what season they prefer, there's a resounding chorus of "being outside" when they're asked what they love most about the job.

For Rodrigo though, it's the natural choir which follows him on the job. "I love the birds singing," he says, and everyone starts to nod their heads animatedly. "The Tūī– it's beautiful."

As for Beth, while Australia's Rugby team might not be the best, she's a big fan of their tourists who visit the gardens. "Australians, in particular, are really appreciative of the work done here and they share that with the team. It makes your day."

The team has just wrapped up a heap of work around the brand new Queenstown playground, planting natives and riparian plants along the stream that runs through the site. The team loved it, but they've definitely got favourite projects.

"Pruning the roses," says Kazumi. Beth agrees with this, and they explain how it's a technical operation which leaves them both feeling extremely satisfied.

Kara and Jessica have a different take on things.

"Using the powertools," smiles Kara. Jessica takes it further, remarking how nice it is to watch a garden or planting come together after the team have taken part in planning it themselves.

"We often get our own control of designing how a planting is going to look and feel," which makes the finished product even better.

"I feel like we're in the Hilton here. We're always in the sun," says Beth, adding that they don't get cold in the winter either. Jessica runs through all the warm gear they've been provided; from beanies and gloves to waterproof layers and everything required to make it through the colder months comfortably.

It's a gig all the members of the team are openly and visibly fond of, one which has currently got a few free spaces to fill. **QLDC's Parks & Reserves Field team are on the lookout for both new gardeners and custodians in Queenstown and Wanaka**, and with spring here and summer on the way, they're enviable positions to snag.

If you're interested in applying for either role we'd love to hear from you. Please visit: **http://qldc.qjumpers.co.nz/jobs/**

OUR LOCAL GOOD SORTS

Bringing home a new baby is an exciting and special time but it can be challenging too, especially for those who are living away from family networks.

As well as helping to give our teeniest locals a great start in life, connecting families and creating networks is a key goal of the recently launched Queenstown Lakes Baby Box Trust, says trustee Jan Maxwell.

“Every year, up to 500 local families will receive a Baby Box, free of charge from the Queenstown Lakes Baby Box Trust on the arrival of their new bundle,” Mrs Maxwell said.

“A Baby Box contains all the basics a new baby needs for a good start in life: safe bedding, natural and organic clothing, and baby products including hand-made goods created by local volunteers and other donations from local businesses.

New families will also receive resources and support to help them start family life off on the right foot.

“Thanks to the help of St John and other local charities we’ll also be providing a website and social media platforms to help new parents connect and get access to resources and information about caring for their new babies,” she said.

“Often new parents in this district are away from their families and can feel isolated when a new baby arrives. So helping new parents form valuable connections is an important part of our work and the ongoing friendships will no doubt become the legacy of this project,” she said.

“We have been absolutely overwhelmed by the generosity of local people knitting, sewing and stitching warm and safe products for new mums and bubs and all the donations from local businesses. It’s when people come together like this for the greater good is when we see true community and it’s wonderful to be a part of,” Mrs Maxwell said.

If you are interested in supporting the Baby Box project please contact either **Jan Maxwell on 027 233 7934** or **Vanessa van Uden on 027 229 6008**.

Baby Box was introduced in Finland in 1938 and helped the country achieve one of the world’s lowest infant mortality rates. Although new to New Zealand, the Baby Box is now popular worldwide.

Baby Box Trustees Jan Maxwell and Vanessa Van Uden with the first recipients of the Queenstown Lakes Baby Box.

QUEENSTOWN LAKES DISTRICT COUNCIL

LIBRARIES NEVER SLEEP WITH NEW WEBSITE

Queenstown Lakes District Libraries has a brand new website offering an improved service at any time of day.

Created in partnership with Central Otago Libraries, the new site provides easy and comprehensive access to all library services in the wider region.

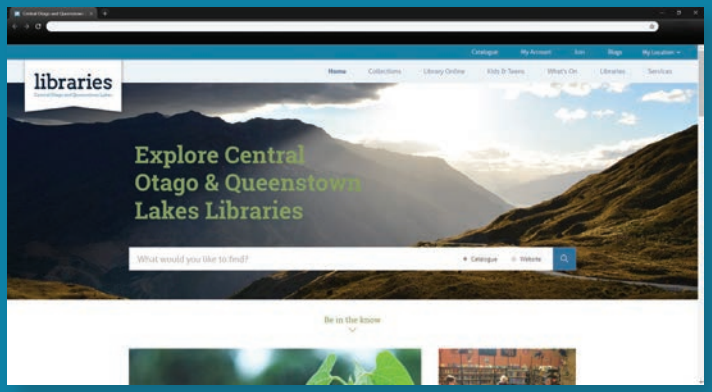
Sue Gwilliam, district librarian at Queenstown Lakes District Libraries said there's a much clearer, contemporary design with simple navigation to different sections including collections, kids and teens, local history resources, events and fees.

"Our service doesn't end when the libraries close at the end of day. Our new website makes it much easier for borrowers to renew or reserve items and access digital resources 24/7 from anywhere in the world via our eLibrary," said Sue.

"You can borrow and download eBooks, audiobooks, worldwide magazines and newspapers in any language and stream independent films to your TV or device. All you need is your library membership ID and our new website of course!"

The new libraries website coincides with the launch of brand new Instagram and Twitter feeds to complement the existing Facebook page:

Facebook **@qtlakeslibraries**
Instagram **@qldclibraries**
Twitter **@qldclibraries**
Website **libraries.codc-qldc.govt.nz**



QLDC CONTACT LIST AND HOURS

QLDC & SERVICE CENTRES

Queenstown Office:
10 Gorge Road
Private Bag 50072
Queenstown
Customer Services:
Phone: 03 441 0499
E-mail: services@qldc.govt.nz
www.qldc.govt.nz

Wanaka Office:
47 Ardmore Street
Wanaka
Phone: 03 443 0024
Office Hours:
Mon–Fri 8.00am–5.00pm

QUEENSTOWN EVENTS CENTRE

Arrowtown Athenaeum Hall
Queenstown Memorial Hall
Lake Hayes Pavilion
Lake Wanaka Centre
Alpine Aqualand
Sports fields
Phone: 03 450 9005

WANAKA RECREATION CENTRE

Wanaka Pool
Indoor Courts
Phone: 03 443 9334

TRANSFER STATIONS

Wakatipu: 110 Glenda Drive
Frankton Industrial Area
Phone: 03 4510106
Upper Clutha: Cnr of Ballantyne & Riverbank Roads
Phone: 03 443 6063

HARBOURMASTER

Phone: 027 434 5289 and 027 414 2270
Email: harbourmasterqt@smsl.co.nz

LIBRARIES

Arrowtown Buckingham Street Phone: 03 442 1607
Hours: Monday–Friday 10.00am–5.00pm Saturday 10.30am–12.30pm

Glenorchy Islay Street Phone: 03 442 4378
Hours: Wednesday 1.30pm–3.30pm Friday 5.00pm–7.00pm (6 month trial)

Queenstown 10 Gorge Road Phone: 03 441 0600
Hours: Mondays, Tuesdays, Wednesdays & Fridays 9.00am–5.30pm
Thursdays 9.00am–7.00pm Saturdays 10.00am–5.00pm

Wanaka Bullock Creek Lane Phone: 03 443 0410
Hours: Mondays, Tuesdays, Wednesdays & Fridays 9.00am–5.30pm
Thursdays 9.00am–7.00pm Saturdays 10.00am–5.00pm

Hawea 14 Myra Street Phone: 03 443 9371
Hours: Monday 10.00am–12noon
Tuesday & Wednesday 10.00am–5.00pm
Saturday 10.00am–2.00pm

Kingston Phone: Queenstown 03 441 0600
Hours: Saturday 10.00am–2.00pm

Makarora Phone: 03 443 8342
Hours: Tuesday 11.00am–1.00pm & Wednesday 6.00pm–8.00pm

Frankton Pop-up Library at Queenstown Events Centre
Hours: Every Monday 10am-12pm
Every Friday 3pm-5pm

Scuttlebutt is published bi-monthly by Queenstown Lakes District Council to inform ratepayers and residents of council activities.

EDITOR: REBECCA PITTS
rebecca.pitts@qldc.govt.nz
Feedback and ideas are welcome.

TO ADVERTISE CONTACT:
Sarah Douglas
sarah.douglas@qldc.govt.nz

SCUTTLEBUTT // NOVEMBER 2018 // ISSUE 128 // **www.qldc.govt.nz**

towards sustainability

ISSN 1177-133X

Appendix F – Statutory and Non-Statutory Assessment

Contents

1 Purpose of Appendix

This appendix sets out the statutory context for the Network Consent. It also provides a detailed assessment of the relevant statutory and non-statutory documents as summarised in section 6 of the Assessment of Environmental Effects (AEE). The statutory legislation for resource consents is the Resource Management Act 1991 (RMA), with sections relevant to this resource consent application set out below. Under the RMA, Regional Plans contain the rules for discharges to the environment and the management of associated effects.

2 Statutory Context

2.1 Section 15

Queenstown Lakes District Council (QLDC) is seeking resource consent from Otago Regional Council (ORC) to discharge wastewater overflows from its network to freshwater receiving environments, or onto land in circumstances where it may enter freshwater. This application, referred to as the 'Network Consent' seeks to authorise existing and unmanaged wastewater overflows from both the existing QLDC owned and managed wastewater networks and identified future wastewater networks. These unmanaged discharges are not a new or proposed occurrence and can occur anywhere within the entire QLDC network.

Section 15 of the RMA states:

(1) No person may discharge any—

(a) contaminant or water into water; or

(b) contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or

(c) contaminant from any industrial or trade premises into air; or

(d) contaminant from any industrial or trade premises onto or into land—

unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan as well as a rule in a proposed regional plan for the same region (if there is one), or a resource consent.

Pursuant to section 15(1)(a) and (b), an assessment of the proposal against section 105(1) is included in the below assessment (see section 6).

2.2 Section 104

In considering an application for resource consent the ORC, pursuant to section 104(1) must (subject to Part 2), have regard to:

(1)(a) Any actual and potential effects on the environment of allowing the activity; and

(1)(ab) Any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity; and

(1)(b) Any relevant provisions of—

(i) a national environmental standard:

(ii) other regulations:

(iii) a national policy statement:

(iv) a New Zealand coastal policy statement:

(v) a regional policy statement or proposed regional policy statement:

(vi) a plan or proposed plan; and

(1)(c) Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

An assessment of the proposal against section 104(1) is included in the below assessment (see section 4).

Section 104(1) sets out that all applications for resource consent must be considered subject to Part 2. The High Court decision in *RJ Davidson Family Trust v Marlborough District Council,* [1] adopted the *King Salmon* approach to Part 2 in considering applications for resource consent under section 104. That decision created some uncertainty as to how the words "subject to Part 2" in section 104 were to be applied, and was appealed. The Court of Appeal, in its recent decision, found that it would be inconsistent with the scheme of the RMA to allow regional or district plans to be rendered ineffective by general recourse to Part 2 in deciding resource consent applications.[2] Consideration of Part 2 may be appropriate in the context of resource consent applications, however if a plan has been competently prepared having regard to Part 2, reference to Part 2 will not be required if doing so would add nothing to the evaluative exercise.[3] For this resource consent and AEE an assessment has been undertaken of the proposal against Part 2[4] for the following reasons:

- For completeness purposes; and
- The Regional Plan: Water was notified on 28 February 1998 and made operative on 1 January 2004. Its development therefore was primarily during the early years of the RMA being enacted. It has not been fully reviewed since. As such the consideration or not of Part 2 occurred between 15 and 20 years ago.

2.3 Section 104B

Council, after considering an application for resource consent for a discretionary activity or non-complying activity –

(a) may grant or refuse the application; and
(b) if it grants the application, may impose conditions under section 108 of the RMA.

1 *RJ Davidson Family Trust v Marlborough District Council* [2017] NZHC 52.

2 *R J Davidson Family Trust v Marlborough District Council* [2018] NZCA 316 at [78].

3 *R J Davidson Family Trust v Marlborough District Council* [2018] NZCA 316 at [75].

4 In summary in section 6 of the AEE, and further below in section 1.2 of this Appendix.

2.4 Section 105

As this resource consent is to authorise a discharge under section 15, section 105(1) also applies in decision making.

- *Section 105 Matters relevant to certain applications*

(1) If an application is for a discharge permit or coastal permit to do something that would contravene section 15 or section 15B, the consent authority must, in addition to the matters in section 104(1), have regard to—

(a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and

(b) the applicant's reasons for the proposed choice; and

(c) any possible alternative methods of discharge, including discharge into any other receiving environment.

An assessment of the proposal against section 105(1) is included in the below assessment (see section 6).

3 Statutory Assessment: RMA Part 2

3.1 Section 5 – Purpose and Principles

The purpose of the RMA is to promote the sustainable management of natural and physical resources. Sustainable management is defined in Section 5 (2) as:

"….. managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while –

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment."

Comment:

Wastewater networks are crucial for protecting communities from unnecessary contaminant exposure and maintaining public health. A network approach of conveying wastewater to centralised treatment sites is considered desirable compared to dispersed, individual treatment sites such as septic tanks or smaller localised networks. This is because centralised treatment plants seek to remove wastewater flows from residential environments while providing cost effective and uniform treatment of a hazardous substance. As such, a wastewater system provides for the protection of human health, through enabling people and communities, in addition to their health and safety, to provide for their social, economic and cultural wellbeing.

The proposed conditions of consent set out a physical response framework for overflow events, providing for the protection of natural and physical resources and the health and safety of communities. Additionally, network improvements, monitoring and reporting requirements are identified in order to meet the foreseeable needs of future generations. Through these proposed consent conditions, the potential effects caused by the overflow events on the environment and to human health can be remedied and mitigated.

3.2 Section 6 – Matters of National Importance

Section 6 of the RMA addresses matters of national importance that shall be recognised and provided for. The following matters are considered relevant to this proposal:

(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development.

(c) The protection of significant indigenous vegetation and significant habitats of indigenous fauna.

(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes and rivers.

(e) The relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga:

Comment:

The proposal recognises and provides for the preservation of the natural character of Otago's lakes and rivers. This preservation is twofold through the development and use of public wastewater networks, compared to no networks and through management of overflow events in comparison to the current unmanaged status quo. In addition to the continued capital investment in QLDC's reticulated network, preservation is recognised and provided for through immediate physical response actions on notification of a wastewater overflow event and ongoing monitoring and reporting.

In recognising and providing for the protection of indigenous flora and fauna, an ecological assessment of the receiving environments was undertaken. This assessment did not identify any significant indigenous vegetation or habitats for indigenous fauna. Further, the aforementioned immediate physical responses seek to protect any non-significant habitats for indigenous flora and fauna.

The proposed management of overflows will not alter existing access to and along lakes and rivers in the Otago Region. As such, the maintenance of public access is provided for.

As outlined in Section 4 of the AEE, Māori have been engaged from an early stage in the formulation of the proposal. Through this, a Cultural Impact Statement has been commissioned and relationships between iwi, their culture and traditions have been recognised and provided for. The proposed management actions both immediate physical responses and network improvements will seek to maintain these relationships and traditions with ancestral lands, water, sites, wāhi tapu and taonga.

Consequently, in terms of Section 6 of the RMA, the matters identified above are recognised and provided for through the formulation of management actions in the event of a wastewater overflow event.

3.3 Section 7 – Other Matters

Section 7 of the RMA recognises that:

"in achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have particular regard to –

(a) Kaitiakitanga

(b) The efficient use and development of natural and physical resources.

(c) The maintenance and enhancement of amenity values.

(f) Maintenance and enhancement of the quality of the environment.

Comment:

The proposal is considered to be consistent with section 7(a) of the RMA as particular regard has been given to Kaitiakitanga through early and continued engagement with iwi outlined in Section 4 of the AEE.

Additionally, the proposal is considered to be consistent with sections 7(b), (c) and (f). As outlined in sections 1 and 2 of the AEE, wastewater overflow events already occur and are currently unmanaged. The establishment of a management regime for these overflow events and future network improvements seek to use resources efficiently and maintain and enhance amenity values and environmental quality.

Consequently, the proposal is considered to be consistent with the section 7 matters identified above.

3.4 Section 8 – Treaty of Waitangi

Section 8 of the RMA requires the principles of the Treaty of Waitangi to be taken into account in resource management decisions.

As outlined in section 4 of the AEE, iwi have been engaged from an early stage and throughout the preparation of the proposal. This engagement has included two hui with the project team, Aukaha and Te Ao Mārama to discuss the purpose, intent and response actions in relation to the proposal. Additionally, the preparation of a Cultural Impact Statement has been sought from associated rūnanga. It is considered that the proposal is in accordance with Section 8 of the RMA as the effects of the proposal on values of local iwi have been considered.

4 Statutory Assessment: Section 104

4.1 Section 104(1)(a) - Actual and Potential Effects

The actual and potential effects of the proposal are addressed in Section 5 of the AEE.

This assessment finds the suite of proposed consent conditions can adequately avoid, remedy and mitigate the effects of the proposal.

4.2 Section 104(1)(b) – Relevant Legislative Provisions

4.2.1 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management (NPSFM) sets out the objectives and policies for the management of freshwater on a national basis. The following objectives are considered relevant to this application.

Table 4-1: Assessment against the relevant provisions in the NPSFM

Provision Number	Provision summary	Assessment
Objective A1	To safeguard: a) the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of fresh water and; b) the health of people and communities, as affected by contact with fresh water; in sustainably managing the use and development of land, and discharges of contaminants.	It is acknowledged that the discharge, being wastewater overflow events currently exist in an unmanaged form and cannot be fully avoided or guaranteed to not occur in the future. However, the existence of the wastewater network seeks to sustainably manage physical and natural resources while protecting public health. In acknowledgement of the above, the response approach to the overflows, sought by the conditions of consent, seek to protect the health of people and communities and ecological values associated with the lakes and rivers of the Queenstown Lakes District. This approach lays out physical response procedures to manage the discharge of contaminants into waterbodies and to land. These measures seek to protect the ecosystems and habitats of freshwater bodies and the health of water users.
Objective A2	The overall quality of fresh water within a freshwater management unit is maintained or improved while: a) protecting the significant values of outstanding freshwater bodies; b) protecting the significant values of wetlands; and c) improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated.	
Objective C1	To improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment.	

4.2.2 National Policy Statement for Urban Development Capacity

The National Policy Statement on Urban Development Capacity (NPSUDC) sets out the objectives and policies on future urban growth and infrastructure capacity on a national basis. In particular, the NPSUDC states an aim of ensuring supply of housing to meet demand.

This application is for the discharge of wastewater overflows into freshwater receiving environments from both the existing public network and future networks to come under QLDC ownership and management. It is noted that the management of effects, being the physical responses and network improvements, will be the same in both existing and future residential environments.

Consequently, the proposal is considered to be consistent with the NPSUDC as it will allow for the management of potential future overflow events in future residential environments.

4.2.3 Cultural Impact Statement

A Cultural Impact Statement has been commissioned to assist in the assessment of the objectives and policies of the following statutory and non-statutory documents. At point of lodgement, this CIS has not been received from Ngāi Tahu.

The below assessments on mana whenua values are reflective of having not received the CIS and are made in good faith from discussions during engagement.

4.2.4 Proposed Otago Regional Policy Statement

The following objectives and policies of the proposed Regional Policy Statement for Otago (PRPS) are considered relevant to this application.

Objective / Policy	Comments
Chapter 1 – Resource Management in Otago is integrated	
Objectives	
1.1 Recognise and provide for the integrated management of natural and physical resources to support the wellbeing of people and communities in Otago	The proposal recognises and provides for the integrated management of natural and physical resources. An example of this integrated management includes wastewater network improvements to reduce the occurrence of wastewater overflows, which will in turn improve the quality of freshwater bodies, being physical resources, in the long term. This integrated management seeks to support the wellbeing of people and communities in Otago.
Policies	
1.1.1 Achieve integrated management of Otago's natural and physical resources, by all of the following: a) Coordinating the management of interconnected natural and physical resources; b) Taking into account the impacts of management of one resource on the values of another, or on the environment c) Recognising that resource may extend beyond the immediate, or directly adjacent, area of interest; d) Ensuring that resource management approaches across administrative boundaries are consistent and complementary; e) Ensuring that effects of activities on the whole of a resource are considered when that resource is managed as subunits.	The proposal achieves the integrated management of Otago's natural and physical resources. The interconnectedness of physical resources (wastewater network) and natural resources (freshwater environments) is explicitly recognised within the proposal. This relationship, and the impacts of one resource on another, is reflected in proposed consent conditions identifying network improvements will assist to minimise overflow events and thus seek to protect natural resources. Additionally, assessments of both natural and physical resources recognise that an overflow event may extend beyond the immediate resource.

1.1.3 Provide for the social and cultural wellbeing and health and safety of Otago's people and communities when undertaking the subdivision, use, development and protection of natural and physical resources by all of the following: a) Recognising and providing for Kāi Tahu values; b) Taking into account the values of other cultures; c) Taking into account the diverse needs of Otago's people and communities; d) Promoting good quality and accessible infrastructure and public services; e) Avoiding significant adverse effects of activities on human health.	The social and cultural values of Kāi Tahu and Otago's people and communities have been provided for through early and continued engagement throughout the preparation of the proposal. Additionally, network improvements and established and ongoing public education on the wastewater network will seek to promote good quality infrastructure that is used appropriately by the community. This, in addition to immediate physical responses to overflow events, will seek to avoid significant adverse effects on human health.
Chapter 2 - Kāi Tahu values and interests are recognised and kaitiakitaka is expressed	
Objectives	
2.1 The principles of Te Tiriti o Waitangi are taken into account in resource management processes and decisions	The principles of Te Tiriti o Waitangi have been taken into account in the formation of this proposal through early and continued engagement with iwi.
2.2 Kāi Tahu values, interests and customary resources are recognised and provided for.	Kāi Tahu values, interests and customary resources have been recognised through the early and ongoing engagement process. These values, interests and resources have been subsequently provided for through the proposed suite of consent conditions including network improvements, monitoring, reporting and physical response procedures.
Policies	
2.1.2 Ensure that local authorities exercise their functions and powers, by: a) Recognising Kāi Tahu's status as a Treaty partner; and b) Involving Kāi Tahu in resource management processes implementation; c) Taking into account Kāi Tahu values in resource management decision-making processes and implementation; d) Recognising and providing for the relationship of Kāi Tahu's culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taoka; e) Ensuring Kāi Tahu have the ability to: i. Identify their relationship with their ancestral lands, water, sites, wāhi tapu,	QLDC has exercised its functions and powers as a local authority by engaging Kāi Tahu early on and throughout the preparation of the proposal. This involvement has allowed QLDC to work collaboratively with Kāi Tahu to ensure values have been taken into account and culture and traditions recognised and provided for. Iwi management plans and have been taken into account in the formulation of proposed consent conditions and associated response procedures and a Cultural Impact Statement sought.

and other taoka; ii. Determine how best to express that relationship; f) Having particular regard to the exercise of kaitiakitaka; g) Ensuring that district and regional plans: i. Give effect to the Ngāi Tahu Claims Settlement Act 1998; ii. Recognise and provide for statutory acknowledgement areas in Schedule 2; iii. Provide for other areas in Otago that are recognised as significant to Kāi Tahu; h) Taking into account iwi management plans.	
2.2.1 Manage the natural environment to support Kāi Tahu wellbeing by all of the following: a) Ensuring the sustainable management of resources supports their customary uses and cultural values in Schedules 1A and B; b) Safeguarding the life-supporting capacity of natural resources	The infrequent nature of overflows and proposed consent conditions will assist in managing the natural environment. This management seeks to support Kāi Tahu wellbeing by safeguarding the life supporting capacity of both terrestrial and freshwater natural resources.
2.2.2 Recognise and provide for wāhi tūpuna, as described in Schedule 1C by all of the following: a) Avoiding significant adverse effects on those values which contribute to wāhi tūpuna being significant; b) Avoiding, remedying, or mitigating other adverse effects on wāhi tūpuna; c) Managing those landscapes and sites in a culturally appropriate manner	Wastewater network overflows currently exist and do not have an approved, consented response. Proposed response procedures will seek to remedy and mitigate potential adverse effects on wāhi tūpuna. These procedures have been developed in response to early and continued engagement with iwi.
Chapter 3 - Otago has high quality natural resources and ecosystems	
Objectives	
3.1 The values of Otago's natural resources are recognised, maintained and enhanced.	The values of Otago's significant and highly valued natural resources, in particular freshwater, have been recognised through stakeholder and community engagement and seek to be maintained and protected through the suite of proposed consent conditions.
3.2 Otago's significant and highly-valued natural resources are identified, and protected or enhanced	
Policies	
3.1.1 Manage fresh water to achieve all of the following: a) Maintain or enhance ecosystem health in all Otago aquifers, and rivers, lakes, wetlands, and their margins; b) Maintain or enhance the range and extent of habitats	Wastewater overflow events currently occur within the network without a consented management response. In the short, medium and long terms, physical response procedures will be implemented in the occurrence of an

provided by fresh water, including the habitat of trout and salmon; c) Recognise and provide for the migratory patterns of freshwater species, unless detrimental to indigenous biological diversity; d) Avoid aquifer compaction and seawater intrusion in aquifers; e) Maintain good water quality, including in the coastal marine area, or enhance it where it has been degraded; f) Maintain or enhance coastal values; g) Maintain or enhance the natural functioning of rivers, lakes, and wetlands, their riparian margins, and aquifers; h) Maintain or enhance the quality and reliability of existing drinking and stock water supplies; i) Recognise and provide for important recreation values; j) Maintain or enhance the amenity and landscape values of rivers, lakes, and wetlands; k) Control the adverse effects of pest species, prevent their introduction and reduce their spread; l) Avoid, remedy or mitigate the adverse effects of natural hazards, including flooding and erosion; m) Avoid, remedy, or mitigate adverse effects on existing infrastructure that is reliant on fresh water	overflow event. As such, these procedures will seek to maintain the existing ecosystems, habitats, quality, functions and values associated with fresh water in the Otago Region. Further, network improvements including capital investment, monitoring and reporting will seek to achieve this policy in the medium to long term. This will be achieved through seeking to minimise overflow events.
3.1.2 Manage the beds of rivers, lakes, wetlands, their margins, and riparian vegetation to achieve all of the following: a) Maintain or enhance their natural functioning; b) Maintain good water quality, or enhance it where it has been degraded; c) Maintain or enhance ecosystem health and indigenous biological diversity; d) Maintain or enhance natural character; e) Maintain or enhance amenity values; f) Control the adverse effects of pest species, prevent their introduction and reduce their spread; g) Avoid, remedy or mitigate the adverse effects of natural hazards, including flooding and erosion; h) Maintain or enhance bank stability.	The wastewater overflow events already occur and have the potential to adversely affect the beds of rivers and lakes. The suite of proposed consent conditions lays out a physical response approach QLDC will activate in the event of an overflow. Rapid clean-up of overflow events and remediation and/or repair will occur as soon as practicable. This approach will minimise the ability of overflows to settle on the beds of rivers or within lakes. Additionally, this response will seek to maintain the natural character and amenity values associated with the regions lakes and rivers.

3.1.3 Ensure the efficient allocation and use of water by undertaking all of the following: a) Requiring that the volume of water allocated does not exceed what is necessary for its efficient use; b) Encouraging the development or upgrade of infrastructure that increases use efficiency.	Proposed consent conditions include the reporting of network improvements through capital investment over time. This will seek to encourage the development and upgrade of the network to enable more efficient infrastructure.
3.1.9 Manage ecosystems and indigenous biological diversity in terrestrial, freshwater and marine environments to achieve all of the following: a) Maintain or enhance ecosystem health and indigenous biological diversity; b) Maintain or enhance biological diversity where the presence of exotic flora and fauna supports indigenous biological diversity; c) Maintain or enhance areas of predominantly indigenous vegetation; d) Recognise and provide for important hydrological services, including the services provided by tussock grassland; e) Recognise and provide for natural resources and processes that support indigenous biological diversity; f) Maintain or enhance habitats of indigenous species and the habitat of trout and salmon that are important for recreational, commercial, cultural or customary purposes g) Control the adverse effects of pest species, prevent their introduction and reduce their spread.	The proposed suite of consent conditions seeks to maintain the existing freshwater ecosystems and in the long term, minimise overflow events. Physical response procedures that can be implemented 24/7 will be activated immediately upon notification of an overflow event. These procedures will seek to maintain ecosystem health and enhance this when compared with overflow events that are not managed. Additionally, network improvements and further infrastructure development will seek to minimise future overflow events.
3.1.12 Encourage, facilitate and support activities which contribute to enhancing the natural environment, by one or more of the following: a) Improving water quality and quantity; b) Protecting or restoring habitat for indigenous species; c) Regenerating indigenous species; d) Mitigating natural hazards; e) Protecting or restoring wetlands; f) Improving the health and resilience of: i. Ecosystems supporting indigenous biological diversity; ii. Important ecosystem services, including pollination; g) Improving access to rivers, lakes, wetlands and their	The proposal encourages and facilitates the enhancing of the natural environment by creating a framework to respond to wastewater overflows. This framework will seek to maintain and improve water quality through a response procedure to be implemented in the event of a wastewater overflow. Additionally, reporting on capital infrastructure investment and data gathering on overflow events can assist in future mitigation planning and thus encourage the enhancement of the natural environment.

margins, and the coast; h) Buffering or linking ecosystems, habitats and areas of significance that contribute to ecological corridors; i) Controlling pest species.	
3.2.2 Protect and enhance areas of significant indigenous vegetation and significant habitats of indigenous fauna, by all of the following: a) Avoiding adverse effects on those values which contribute to the area or habitat being significant; b) Avoiding significant adverse effects on other values of the area or habitat; c) Remedying when other adverse effects cannot be avoided; d) Mitigating when other adverse effects cannot be avoided or remedied; e) Encouraging enhancement of those areas and values which contribute to the area or habitat being significant; f) Controlling the adverse effects of pest species, preventing their introduction and reducing their spread.	Wastewater overflows cannot be fully avoided as they are unpredictable in both time, space and quantity. As a result, QLDC have proposed a range of consent conditions including a response procedure that will seek to remedy and mitigate the adverse effects when an overflow occurs. Further, increased investment in the wastewater network will seek to minimise overflow events and thus seek to minimise and where practical, avoid adverse effects.
3.2.4 Protect, enhance and restore outstanding natural features, landscapes and seascapes, by all of the following: a) Avoiding adverse effects on those values which contribute to the significance of the natural feature, landscape or seascape; b) Avoiding, remedying or mitigating other adverse effects; c) Recognising and providing for the positive contributions of existing introduced species to those values; d) Controlling the adverse effects of pest species, preventing their introduction and reducing their spread; e) Encouraging enhancement of those areas and values which contribute to the significance of the natural feature, landscape or seascape.	Overflow events currently occur with no consented response approach. The suite of proposed consent conditions outlining physical responses and network improvements will seek to protect both outstanding and highly valued features and landscapes from potential adverse effects in the short and long terms.
3.2.6 Protect or enhance highly valued natural features, landscapes and seascapes by all of the following: a) Avoiding significant adverse effects on those values which contribute to the high value of the natural feature, landscape or seascape; b) Avoiding, remedying or mitigating other adverse effects; c) Recognising and providing for positive contributions of existing introduced species to those values;	

d) Controlling the adverse effects of pest species, preventing their introduction and reducing their spread; e) Encouraging enhancement of those values which contribute to the high value of the natural feature, landscape or seascape.	
3.2.14 Protect outstanding freshwater bodies by all of the following: a) Avoiding significant adverse effects on those values which contribute to the water body being outstanding; b) Avoiding, remedying or mitigating other adverse effects on the water body; c) Controlling the adverse effects of pest species, preventing their introduction and reducing their spread; d) Encouraging enhancement of those values which contribute to the water body being outstanding.	The physical response approach to overflow events outlined in the proposed conditions will seek to protect outstanding freshwater bodies. This will be achieved through mitigation and remediation in the form of clean up efforts. Further adverse effects will be sought to be avoided through long term investment in the wastewater network to minimise the likelihood of overflow events occurring.
Chapter 4 - Communities in Otago are resilient, safe and healthy	
Objectives	
4.3 Infrastructure is managed and developed in a sustainable way.	Further investment in the wastewater network and ongoing monitoring and reporting will assist in manging and developing QLDC infrastructure sustainably.
4.6 Hazardous substances, contaminated land and waste materials do not harm human health or the quality of the environment in Otago.	The suite of proposed consent conditions enables the protection of human health and the quality of Otago's environment. This is sought through immediate response procedures upon an overflow event being notified to QLDC, and longer term investment in QLDC wastewater networks.
Policies	
4.3.1 Manage infrastructure activities, to achieve all of the following: a) Maintaining or enhancing the health and safety of the community; b) Avoiding, remedying or mitigating adverse effects of those activities on existing land uses, including cumulative adverse effects on natural and physical resources; c) Supporting economic, social and community activities; d) Improving efficiency of use of natural resources; e) Protecting infrastructure corridors for infrastructure needs,	Overflow events already exist, and existing response procedures are not formally covered under a consent. Through the response framework proposed in the conditions of consent, the health and safety of the community will be enhanced and maintained while the adverse effects on natural and physical resources will be remedied and mitigated. Additionally, through managing overflow events economic, social and community activities will be supported while protecting the operational requirements of the wastewater

now and for the future; f) Increasing the ability of communities to respond and adapt to emergencies, and disruptive or natural hazard events; g) Protecting the functional and operational requirements of lifeline utilities and essential or emergency services	network.
4.5.7 Achieve the strategic integration of infrastructure with land use, by undertaking all of the following: a) Recognising the functional needs of infrastructure of regional or national importance; b) Locating and designing infrastructure to take into account all of the following: i. Actual and reasonably foreseeable land use change; ii. The current population and projected demographic changes; iii. Actual and reasonably foreseeable change in supply of, and demand for, infrastructure services; iv. Natural and physical resource constraints; v. Effects on the values of natural and physical resources; vi. Co-dependence with other infrastructure; vii. The effects of climate change on the long term viability of that infrastructure; viii. Natural hazard risk. c) Locating growth and development: i. Within areas that have sufficient infrastructure capacity; or ii. Where infrastructure services can be upgraded or extended efficiently and effectively; d) Coordinating the design and development of infrastructure with land use change in growth and redevelopment planning.	QLDC seeks to achieve the strategic integration of infrastructure and land use through its 30 year Infrastructure Plan, its Assets Management Strategy 2018 – 2048, and Proposed District Plan. These documents recognise the functional needs and importance of infrastructure and seek to enable infrastructure where growth and development is anticipated to occur. Additionally, the parameters of this application include those areas envisaged to be future growth areas where infrastructure may not yet be fully established, and where there are existing urban settlements which are not currently on the wastewater network. The management of effects resulting from overflow events on these existing and future areas will be undertaken in accordance with the proposed conditions of consent.
4.6.6 Promote an integrated approach to the management of the use, storage and disposal of waste materials	Existing and ongoing education initiatives focusing on trade waste will seek to educate industry on proper use, storage and disposal of waste materials. This will seek to reduce the burden on the wastewater network of inappropriate materials disposed of in it. A condition of consent is proposed which requires QLDC to continue its education programmes and report on these annually.

4.6.8 Manage the storage, recycling, recovery, treatment and disposal of waste materials by undertaking all of the following: a) Providing for the development of facilities and services for the storage, recycling, recovery, treatment and disposal of waste materials; b) Avoiding adverse effects on the health and safety of people, and avoiding, remedying and mitigating adverse effects on the environment and other values; c) Minimising risk associated with natural hazard events; d) Restricting the location of activities that may result in reverse sensitivity effects near waste management facilities and services.	QLDC is investing significant funds in its wastewater infrastructure over the coming years including new and upgraded treatment plants and, where possible, establishing new pump stations away from sensitive environments. This investment seeks to reduce the frequency of overflows and thereby avoid adverse effects from an inadequate or non-existent wastewater network. Additionally, industry education will seek to minimise inappropriate waste in the wastewater network and thus manage effective disposal.
Chapter 5 - People are able to use and enjoy Otago's natural and built environment	
Objectives	
5.4 Adverse effects of using and enjoying Otago's natural and physical resources are minimised.	Proposed physical response measures will seek to minimise the adverse effects on Otago's natural and physical resources. When discharged to water, closing of beaches and notification will occur. Following clean up, monitoring will enable the beaches to be reopened for public use as soon as it is safe in accordance with swimming guidelines. These measures seek to minimise the adverse effects of using and enjoying Otago's natural resources.
Policies	
5.4.1 Manage discharges that are objectionable or offensive to Kāi Tahu and/or the wider community by: a. Avoiding significant adverse effects of those discharges; b. Avoiding, remedying or mitigating other adverse effects of those discharges.	Wastewater overflows can occur anywhere in the network and their location and scale are hard to predict prior to an occurrence. Through the suite of proposed consent conditions, a physical response approach and network improvements are proposed. These physical responses allow for overflows to be mitigated and remediated as soon as possible upon notification of an event. While the overflows can't entirely be avoided, systems and procedures such as pump station / network alarms provide early warning of issues in the system which lead to overflows occurring and action is taken in advance to avoid them in these circumstances. Network improvements will seek to minimise the potential for these discharges to occur over time. As will the continuing education programme proposed with

	the community including construction and other industries.
5.4.2 Apply an adaptive management approach, to avoid, remedy or mitigate actual and potential adverse effects that might arise and that can be remedied before they become irreversible, by both: a) Setting appropriate indicators for effective monitoring of those adverse effects; and b) Setting thresholds to trigger remedial action before the effects result in irreversible damage.	An type of adaptive management response is proposed within the suite of consent conditions. QLDC will seek to remedy and mitigate actual and potential effects before they become irreversible by catering physical responses to the overflow event. Annual reporting is also proposed in order to better understand these events. This reporting will identify numbers of overflows, duration, extension, work done and future additions. This data can then be used to identify hot spot areas and best management practice, reflecting the application of adaptive management.
5.4.3 Apply a precautionary approach to activities where adverse effects may be uncertain, not able to be determined, or poorly understood but are potentially significant.	It is noted wastewater overflows already exist and do not have a consented management regime. The proposed suite of consent conditions includes both immediate physical responses to overflow events and longer term network improvements. Physical responses include the ability to respond to overflows 24/7 and usage of specialist equipment for discharge to both land and water. Network improvements include increased capital investment identified in the QLDC 30 year Infrastructure Plan, Assets Management Strategy 2018 – 2048, and Long Term Plan in addition to increased monitoring and reporting. These conditions apply a precautionary approach in rapid remediation and monitoring of overflows as increased information is collated.

4.2.5 Otago Regional Policy Statement (RPS)

Operative RPS

The RPS provides an overview of the resource management issues of the Otago Region.

Objective / Policy	Comments
Chapter 6 Water	
Objectives	
6.4.2 To maintain and enhance the quality of Otago's water resources in order to meet the present and reasonably foreseeable needs of Otago's communities	The proposed physical response approaches and network improvements seek to maintain and enhance Otago's water resources to meet the present and foreseeable needs to Otago's communities through rapid remediation and minimisation of events over time.
6.4.3 To safeguard the life-supporting capacity of Otago's water resources through protecting the quantity and quality of those water resources	The proposed response approaches to overflow events, sought from the proposed conditions of consent, seeks to protect the quality of Otago's water resources. Subsequently through this protection, the life-supporting capacity of these waters will be safeguarded.
6.4.4 To maintain and enhance the ecological, intrinsic, amenity and cultural values of Otago's water resources	The proposed physical response approaches seek to maintain the ecological, intrinsic, amenity and cultural values of Otago's water resources. Additionally, proposed network improvements, monitoring and reporting will seek to protect these values into the long term.
6.4.5 To avoid, remedy or mitigate degradation of water resources resulting from the use, development or protection of the beds and banks of Otago's water bodies and of adjacent land areas	Proposed physical and network response approaches seek to remedy and mitigate degradation of water resources.
Policies	
6.5.1To recognise and provide for the relationship Kāi Tahu have with the water resource in Otago through: (a) Working toward eliminating human waste and other pollutants from entering all water bodies; and (b) Consulting with Kāi Tahu over any application that would result in the mixing of waters from different water bodies and the setting of water flows and levels	Kāi Tahu, through Te Ao Mārama and Aukaha have been engaged and consulted throughout the preparation of this application and have indicated that they will be providing a Cultural Impact Statement (not received at the time of lodgement). Further, network improvements over time will seek to minimise human waste and other pollutants entering water bodies.

6.5.5 To promote a reduction in the adverse effects of contaminant discharges into Otago's water bodies through: (a) Adopting the existing water quality of Otago's water bodies as a minimum acceptable standard; and (b) Investigating and where appropriate, enhancing water quality so that as a minimum standard it is suitable for contact recreation and aquatic life where: (i) There is a high public interest in, or use of the water; or (ii) There is a particular Kāi Tahu interest in the water; or (iii) There is a particular value to be maintained or enhanced; or (iv) There is a direct discharge containing human sewage or wastes from commercial or industrial activities; and (c) Requiring that all discharges into Otago's water bodies maintain the standard for the receiving waters after reasonable mixing; and (d) Promoting the discharges to land where practicable and where there are no significant adverse effects on groundwater or surface water resources or soil; and (e) Preparing contingency responses for accidental pollution spills; and (f) Investigating and addressing the effects of diffuse source discharges on water quality; While considering financial and technical constraints.	Wastewater overflow events are random and already exist throughout QLDC's network. They are also typical of most if not all wastewater networks in New Zealand. While management and contingency responses currently exist in the occurrence of an overflow event, these measures are not formally part of a consent process. The proposed suite of consent conditions seeks to reduce adverse effects of wastewater overflows through agreed and consented contingency responses and long term network improvement to minimise future events. It is acknowledged Kāi Tahu hold a particular interest in water and have been engaged in the preparation of this application and associated responses for overflows events. Additionally, QLDC has already established and will continue to provide community education on the functioning of wastewater networks and what can and can't be safely disposed of in these networks. This will seek to reduce the frequency of overflows caused by foreign objects and blockages in the network. Overall, the outcomes sought from the proposed suite of consent conditions seek to promote a long term reduction in overflow events and an agreed and consented contingency response for overflow events to public and private land as well as freshwater.
Chapter 9 Built Environment	
Objectives	
9.4.1 To promote the sustainable management of Otago's built environment in order to: (a) meet the present and reasonably foreseeable needs of Otago's people and communities; and (b) provide for amenity values; and (c) conserve and enhance environmental and landscape	The continued operation and expansion of QLDC's wastewater network will promote the sustainable management of Otago's built environment. A wastewater network allows the conveyance of materials to central treatment plants and thus seeks to conserve and enhance the environment through removing waste.

quality; and (d) recognise and protect heritage values	Further, future areas covered by this application will meet the reasonably foreseeable needs of Otago's people and communities.
9.4.2 To promote the sustainable management of Otago's infrastructure to meet the present and reasonably foreseeable needs of Otago's communities	Overflow events already occur and do not have a consented management response. The proposed conditions of consent set out a management response to promote sustainable development and seek to manage adverse effects. QLDC's Proposed District Plan, 30 year Infrastructure Plan, Assets Management Strategy 2018 – 2048, and Long Term Plans promote the sustainable management of Otago's infrastructure. This is achieved though the identification of areas of future development and the provision of infrastructure to service these areas. This is crucial as it allows sustainable growth in the knowledge that infrastructure can be enabled and provided when required as opposed to development without infrastructure. Additionally, established and ongoing education by QLDC to the public on the functioning of a healthy wastewater network will promote sustainable management of infrastructure through preventative and pre-emptive measures.
9.4.3 To avoid, remedy or mitigate the adverse effects of Otago's built environment on Otago's natural and physical resources	The proposed physical response approach to overflow events, network improvements and an established and ongoing public education campaign seek to remedy and mitigate potential adverse effects on Otago's natural and physical resources, in particular freshwater.
Policies	
9.5.1 To recognise and provide for the relationship Kāi Tahu have with the built environment of Otago through: (a) considering activities involving papatipu whenua that contribute to the community and cultural development of Kāi Tahu; and (b) recognising and providing for the protection of sites and resources of cultural importance from the adverse effects of the built environment	Through early and continued engagement in the preparation of the proposal, Kāi Tahu have identified the freshwater resources of Otago as holding cultural importance. The response approaches outlined in the suite of proposed consent conditions seeks to assist in providing for the protection of this resource by remedying and mitigating the adverse effects of wastewater overflows.

9.5.4 To minimise the adverse effects of urban development and settlement, including structures, on Otago's environment through avoiding, remedying or mitigating: (a) discharges of contaminants to Otago's air, water or land; and (b) the creation of noise, vibration and dust; and (c) visual intrusion and a reduction in landscape qualities; and (d) significant irreversible effects on: (i) Otago community values; or (ii) Kāi Tahu cultural and spiritual values; or (iii) the natural character of water bodies and the coastal environment; (iv) habitats of indigenous fauna; or (v) heritage values; or (vi) amenity values; or (vii) intrinsic values of ecosystems; or (viii) salmon or trout habitat	The proposed suite of physical response consent conditions seek to remedy and mitigate irreversible effects arising from the overflow events on Otago's air, land, water on both the short, intermediate and long term. Network improvements and monitoring, as proposed in the suite of consent conditions, allows for the long term collection of data and gradual improvement and upgrading of QLDC wastewater infrastructure. This will seek to allow for the potential future avoidance of the majority of overflow events. Additionally, continued engagement with Kāi Tahu and community groups seek to address cultural and spiritual values.
Chapter 10 Biota	
Objectives	
10.4.1 To maintain and enhance the life-supporting capacity and diversity of Otago's biota	Proposed response approaches to overflow events seek to maintain the life-supporting capacity and diversity of Otago's biota.
10.4.2 To protect Otago's natural ecosystems and primary production from significant biological and natural threats	The response approach to overflow events, as proposed in the suite of consent conditions, seeks to protect Otago's natural ecosystems from potential contaminants.
Policies	
10.5.1 To recognise and provide for the relationship Kāi Tahu have with mahika kai in Otago through: (a) working towards eliminating the disposal of human wastes and pollution into or onto mahika kai; and (b) facilitating the maintenance and enhancement of access to places of traditional gathering of mahika kai; and (c) recognising the need to maintain and enhance mahika kai	Early and continued engagement with Kāi Tahu recognises the need to maintain and enhance mahika kai. In addition, long term network improvements will seek to work towards minimising the disposal of human wastes and pollution into or onto mahika kai.
Chapter 13 Wastes and hazardous Substances	
Objectives	

13.4.1 To protect Otago's communities, environment and natural resources from the adverse effects of the waste stream	The proposed suite of consent conditions seek to protect the environment and natural resource from the adverse effects of an overflow event.
Policies	
13.5.1 To recognise and provide for the relationship Kāi Tahu have with natural and physical resources when managing Otago's waste stream through: (a) providing for the management and disposal of Otago's waste stream in a manner that takes into account Kāi Tahu cultural values; and (b) working towards eliminating human wastes and other pollutants from entering Otago's waterways	Kāi Tahu have been engaged from an early stage in the preparation of the application. Network improvements over time, sought in the conditions of consent, will work towards minimising the likelihood of human waste and other pollutants dentering Otago's waterways.
13.5.3 To avoid, remedy or mitigate the adverse effects resulting from the discharge of liquid wastes in Otago through: (a) requiring, where practicable, the treatment of liquid wastes at the point where they are treated: (b) encouraging a reduction in the volume and concentration of liquid wastes within a waste stream by: (i) educating waste generators about the need to reduce wastes, and methods of doing this; (ii) encouraging waste audits; and (iii) requiring justification for consents to dispose of liquid waste; and (c) encouraging a reduction in the volume and concentration of liquid wastes within the waste stream	Wastewater overflows already exist and occur unpredictably throughout the network. Network improvements over time will seek to reduce the quantity of both overflow events and discharge volume. Additionally, ongoing education by QLDC to both the public and trade industry will seek to encourage greater awareness of the wastewater network. This greater awareness of the functioning of the wastewater network will seek to encourage waste generators to dispose of waste correctly and where possible encourage and reduction in total volume of liquid wastes.
13.5.10 To address the adverse effects of unauthorised discharges on the environment through: (a) educating the public about the adverse effects of such discharges and the necessity to avoid them; and (b) taking appropriate action in response to unauthorised discharge incidents	An established and ongoing education campaign seeks to educate the public on the functioning of the wastewater network and how to avoid exacerbated risk of wastewater overflows. Additionally, proposed physical responses will seek to address the adverse effects of any discharge through prompt remediation.

4.2.6 Otago Regional Plan: Water

Objective, Policy		Comment
Chapter 4	**Kāi Tahu ki Otago – Water Perspective**	
Issues		
4.13.5	Discharge of human waste and other contaminants to Otago's water bodies from point and non-point sources is an affront to Kāi Tahu.	These discharges are existing and cannot be entirely avoided. Kāi Tahu have been engaged early on and throughout the development of proposed consent conditions.
Chapter 7	**Water Quality - General**	
Objectives		
7.A.1	To maintain water quality in Otago lakes, rivers, wetlands, and groundwater, but enhance water quality where it is degraded	The suite of proposed consent conditions will seek to maintain the quality of Otago's freshwater.
7.A.2	To enable the discharge of water or contaminants to water or land, in a way that maintains water quality and supports natural and human use values, including Kāi Tahu values	Proposed consent conditions will enable overflow events that do not detract from, and will maintain water quality, Kāi Tahu, values and natural and human use.
7.A.3	To have individuals and communities manage their discharges to reduce adverse effects, including cumulative effects, on water quality	Prior to the preparation of this proposal, QLDC have endeavoured to educate the public on wastewater management. This education has focused on network operation, common problems including what can and can't be put through the wastewater network and what individuals can do to better the network. Recently, this education campaign has increased from articles in Scuttlebutt magazine to public drop in sessions. This education campaign will continue as part of the future network improvements. A condition of consent for continuing the education programme is proposed.

Policies		
7.B.1	Manage the quality of water in Otago lakes, rivers, wetlands and groundwater by: (a) Describing, in Table 15.1 of Schedule 15, characteristics indicative of good quality water; and (b) Setting, in Table 15.2 of Schedule 15, receiving water numerical limits and targets for achieving good quality water; and (c) Maintaining, from the dates specified in Schedule 15, good quality water; and (d) Enhancing water quality where it does not meet Schedule 15 limits, to meet those limits by the date specified in the Schedule; and (e) Recognising the differences in the effects and management of point and non-point source discharges; and (f) Recognising discharge effects on groundwater; and (g) Promoting the discharge of contaminants to land in preference to water.	The suite of proposed consent conditions will seek to manage the quality of water in Otago lakes, rivers and wetlands through rapid remediation and repair of wastewater overflow events.
7.B.2	Avoid objectionable discharges of water or contaminants to maintain the natural and human use values, including Kāi Tahu values, of Otago lakes, rivers, wetlands, groundwater and open drains and water races that join them	Future network improvements identified in long term plans will seek to reduce the frequency of overflows occurring and minimise the effects of them on the receiving environments in the medium to long term.
7.B.3	Allow discharges of water or contaminants to Otago lakes, rivers, wetlands and groundwater that have minor effects or that are short-term discharges with short-term adverse effects	Wastewater overflows to water will be rapidly remedied upon notification and generally result in short term adverse effects before diffusion.
7.B.4	When considering any discharge of water or contaminants to land, have regard to: (a) The ability of the land to assimilate the water or contaminants; and (b) Any potential soil contamination; and (c) Any potential land instability; and (d) Any potential adverse effects on water quality; and (e) Any potential adverse effects on use of any proximate coastal marine area for contact recreation and seafood gathering	Wastewater overflows can happen at any point in the network meaning a discharge can occur on a variety of landscapes. To mitigate potential adverse effects on both the land and water, physical response procedures are proposed upon notification of an overflow.

7.B.6	When assessing any consent to discharge contaminants to water, consider the need for and the extent of any zone for physical mixing, within which water will not meet the characteristics and limits described in Schedule 15, by taking account of: (a) The sensitivity of the receiving environment; and (b) The natural and human use values, including Kāi Tahu values; and (c) The natural character of the water body; and (d) The amenity values supported by the water body; and (e) The physical processes acting on the area of discharge; and (f) The particular discharge, including contaminant type, concentration and volume; and (g) The provision of cost-effective community infrastructure; and (h) Good quality water as described in Schedule 15	Wastewater overflows currently occur within the QLDC network and can be difficult to avoid due to their ability to occur at any time and any place within the network. As a result, the contaminants already have the potential to discharge to water. The suite of proposed consent conditions will seek to remedy and mitigate any adverse effects on sensitive freshwater receiving environments. This mitigation will occur through immediate response remediation and long term network improvements. These response approaches have been developed alongside Kāi Tahu and community engagement and thus seek to take account of the uses and values of these receiving environments.
7.B.8	Encourage adaptive management and innovation that reduces the level of contaminants in discharges	Continual upgrades of QLDC's wastewater network seeks to minimise total overflow events. Additionally, public education on what can be disposed of and what should not be disposed of within the wastewater network seeks to reduce the total level of contaminants in potential discharges.
Policies 7C - Policies for discharges of human sewage…specified contaminants…		
7.C.1	When considering applications for resource consents to discharge contaminants to water, to have regard to opportunities to enhance the existing water quality of the receiving water body at any location for which the existing water quality can be considered degraded in terms of its capacity to support its natural and human use values	There are limited opportunities to enhance existing water quality of the large receiving environments.

7.C.2	When considering applications for resource consents to discharge contaminants to water, or onto or into land in circumstances which may result in any contaminant entering water, to have regard to: (a) The nature of the discharge and the sensitivity of the receiving environment to adverse effects; (b) The financial implications, and the effects on the environment of the proposed method of discharge when compared with alternative means; and (c) The current state of technical knowledge and the likelihood that the proposed method of discharge can be successfully applied	Discharges are anticipated to be infrequent and can occur at any point in the QLDC wastewater network. Due to current technology, there are no feasible alternatives to the overflow discharges. However, network improvements over time and new technology will work towards reducing overflow frequencies.
7.C.3	When considering any resource consent to discharge a contaminant to water, to have regard to any relevant standards and guidelines in imposing conditions on the discharge consent	Microbiological water quality guidelines for marine and freshwater recreational areas published by the Ministry for the Environment have been considered in establishing the receiving environment (i.e. presence of E. coli from general sources like bird etc) but are not appropriate for use in the case of a wastewater discharge (i.e. E. coli from a human source). Proposed physical response procedures when an overflow is to water including potential closures, signage and monitoring. This closure of beaches is to allow for the monitoring of water quality to ensure safe contact recreation. Guidelines to enable safe recreation are identified in the publication *Microbiological water quality guidelines for marine and freshwater recreational areas* published by the Ministry for the Environment.
7.C.4	The duration of any new resource consent for an existing discharge of contaminants will take account of the anticipated adverse effects of the discharge on any natural and human use value supported by an affected water body, and: (a) Will be up to 35 years where the discharge will meet the water quality standard required to support that value for the duration of the resource consent;	Resource consent is sought for a period of 35 years as proposed physical responses and network improvements will seek to enable discharges reduce impacts on water quality standards.

	(b) Will be no more than 15 years where the discharge does not meet the water quality standard required to support that value but will progressively meet that standard within the duration of the resource consent; (c) Will be no more than 5 years where the discharge does not meet the water quality standard required to support that value; and (d) No resource consent, subsequent to one issued under (c), will be issued if the discharge still does not meet the water quality standard required to support that value	
7.C.9	To support the coordination of measures to remedy or mitigate the adverse effects associated with accidental spills which could potentially contaminate water	Physical responses outlined in the proposed suite of consent conditions will support the coordination of measures to remedy and mitigate the adverse effects associated with an overflow event.
Chapter 12	**Rules Water Take Use and Management**	
12.A	Discharge of Human Sewage	
12.A.A.1	The discharge rules in section 12.A apply where a discharge contains human sewage	Resource consent is required as a discretionary activity pursuant to Rule 12.A.2.1.
12.A.1	Permitted activities: No resource consent required	
12.A.2.1	Except as provided for by Rules 12.A.1.1 to 12.A.1.4, the discharge of human sewage to water, or onto or into land in circumstances where it may enter water, is a discretionary activity	
12.B	Discharge of hazardous substances, hazardous wastes, specified contaminants, and stormwater; and discharges from industrial or trade premises and consented dams	
12.B.A.2	The discharge rules in section 12.A apply in addition to 12.B where a discharge contains human sewage	Resource consent is required as a discretionary activity pursuant to Rule 12.B.4.2.
12.B.4.2	The discharge of any hazardous substance to water or onto or into land in circumstances which may result in that substance entering water is a discretionary activity, unless it is: (a) Permitted by a rule in 12.B.1; or (b) Provided for by a rule in 12.B.2 or 12.B.3.	
12.B.4.3	The discharge of water or any contaminant covered in section 12.B.1 or 12.B.2, to water or onto or into land in circumstances which may result in that water or	

	contaminant entering water, is a discretionary activity, unless it is: (a) Permitted by a rule in 12.B.1; or (b) Provided for by a rule in 12.B.2, 12.B.3, 12.B.4.1 or 12.B.4.2.	
12.C	Other Discharges	
12.C.A.1	Discharge rules in section 12.C apply to any discharge not provided for in sections 12.A, 12.B or 13.5	Resource consent is required as a discretionary activity pursuant to Rule 12.C.3.2.

5 Assessment: Section 104(1)(c) Other Matters

The following are considered to be relevant statutory and non-statutory matters to be considered for this application.

5.1 Lake Wanaka Preservation Act 1973

The Lake Wanaka Preservation Act makes provision for the preservation of the normal water levels and shoreline of Lake Wanaka, and the maintenance and improvement of its water quality.

5.1.1 Section 4 – Purpose

The purposes of the Lake Wanaka Preservation Act 1973 is:

(a) to prevent the water in the body of the lake from being impounded or controlled by, or, as far as possible, obstructed by, any works except in an emergency:

(b) to prevent the natural rate of flow of lake water between the outlet of the lake which forms the source of the Clutha River and the confluence of that river and the Cardrona River from being varied or controlled by any works except in an emergency:

(c) to preserve, as far as possible, the water levels of the lake and its shoreline in their natural state:

(d) to maintain and, as far as possible, to improve the quality of water in the lake.

5.1.2 Section 5 - Guardians of Lake Wanaka

(1) The Minister of Conservation may, on such terms and conditions as the Minister may from time to time specify, appoint such persons as the Minister thinks fit to be the Guardians of Lake Wanaka.

(1A) The persons appointed to be Guardians must include a person nominated by Te Rūnanga o Ngāi Tahu (as established under section 6 of Te Runanga o Ngai Tahu Act 1996).

(2) The functions of the Guardians of Lake Wanaka shall be—

(a) generally, to report and make recommendations to the Minister of Conservation on any matter affecting the purposes of this Act, on the use of the lake for recreational purposes, and on any other matter concerning the lake which the Minister of Conservation may from time to time specify; and

(b) in particular—

(i) to declare as an emergency any state of affairs existing when the lake water appears likely to attain such a level as to cause loss or damage to human life, livestock, or property by flooding:

(ii) to consult the Otago Regional Council from time to time on those functions of the Otago Regional Council which may affect the lake, and to advise the Minister of Conservation of any such consultation and its outcome:

(iii) to give advice to the Minister of Conservation on any matter referred to the Minister under subsection (1) of section 11.

Comment:

The ways in which the wastewater overflows are responded to, as set out in the proposed conditions of consent, will provide for the protection of natural resources. For this reason, the proposal is consistent with the Lake Wanaka Preservation Act in that it will maintain and as far as possible, improve the water quality in the lake through management of overflows.

5.2 Water Conservation (Kawarau) Order 1997

Pursuant to section 199 of the RMA; the purpose of a water conservation order is to recognise and sustain –

(a) Outstanding amenity or intrinsic values which are afforded by waters in their natural state:

(b) *Where waters are no longer in their natural state, the amenity or intrinsic values of those waters which in themselves warrant protection because they are considered outstanding.*

5.2.1 Relevant matters:

Section 3 – Preservation in natural state

(1) It is declared that the waters described in Schedule 1 contain 1 or more of the following outstanding amenity and intrinsic values which are afforded by waters in their natural state:

(a) natural and physical qualities and characteristics that contribute to—

(i) people's appreciation of pleasantness of waters:

(ii) aesthetic coherence:

(iii) cultural and recreational attributes:

(b) biological and genetic diversity of ecosystems:

(c) essential characteristics that determine the ecosystem's integrity, form, functioning, and resilience.

(2) Because of the outstanding amenity and intrinsic values recognised in subclause (1), these outstanding values shall be sustained.

(3) Because of the outstanding amenity and intrinsic values recognised in subclause (1), it is declared that the water bodies set out in Schedule 1 are outstanding in their natural state.

(4) Because the water bodies set out in Schedule 1 are recognised to be outstanding in their natural state, they must be preserved as far as possible in their natural state.

(5) Except as provided in clauses 5 and 6, the exercise by a regional council of its functions and powers under section 30(1)(e) and (f) of the Act (as they relate to water) are restricted or prohibited so as to retain the preserved waters as far as possible in their natural state.

Section 4 – Protection of characteristics

(1) *It is declared that the waters set out in Schedule 2 which are no longer in their natural state contain 1 or more amenity and intrinsic values which warrant protection because they are considered outstanding.*

(2) *Because of the outstanding amenity and intrinsic values recognised in subclause (1), these outstanding values shall be sustained.*

(3) *Because of the outstanding amenity and intrinsic values recognised in subclause (1), it is declared that the water bodies described in Schedule 2 contain 1 or more of the following outstanding characteristics, as set out in Schedule 2:*

- *(a) as a habitat for terrestrial and aquatic organisms:*
- *(b) as a fishery:*
- *(c) for its wild, scenic, and other natural characteristics:*
- *(d) for scientific values:*
- *(e) for recreational, or historical purposes:*
- *(f) for significance in accordance with tikanga Māori.*

(4) *Because of the outstanding characteristics specified in subclause (3), the characteristics of the waters, as set out in Schedule 2, are protected.*

(5) *Except as provided in this order the exercise by a regional council of its functions and powers under section 30(1)(e) and (f) of the Act (as they relate to water) are restricted or prohibited as set out in Schedule 2.*

Section 5- Exemptions

The restrictions and prohibitions in clauses 3(5) and 4(5) and Schedule 2 do not limit the regional council's functions or powers to grant a resource consent or to make a rule for any part of the preserved waters or protected waters for all or any of the following purposes:

(a) maintenance or protection of any network utility operation (as defined in section 166 of the Act) or any public or private road or any bridge:

(b) maintenance of soil conservation and river protection works:

(c) research into, protection of, enhancement of, or restoration of, values and characteristics for which the water bodies are being preserved or protected, as the case may be:

(d) *on the same or similar conditions for any lawful use of water being undertaken immediately before the date on which this order came into force.*

Comment:

The ways in which the wastewater overflows are responded to, as set out in the proposed conditions of consent, will provide for the preservation of identified amenity and intrinsic values, and the protection of identified outstanding characteristics. For these reasons, the proposal is consistent with the Water Conservation (Kawarau) Order 1997 and will allow for the protection of network operation pursuant to Section 5.

5.3 Iwi Management Plans

5.3.1 Cultural Impact Statement

As per section 4.2.3 of this appendix, a Cultural Impact Statement has not been received at point of lodgement of the application. Kāi Tahu are best placed to provide the assessment of cultural impacts. Without this it is difficult to make an assessment of the identified relevant Iwi Management Plans. However, the relevant objectives and policies of both Iwi Management Plans have been identified within sections 5.3.2 and 5.3.3.

5.3.2 Kāi Tahu Ki Otago – Natural Resources Management Plan 2005

The Kāi Tahu Ki Otago- Natural Resources Management Plan sets out the important natural resources to local iwi and the direction of the future management of these resources. Chapter 5 outlines the issues, objectives and policies for the entire Otago Region while Chapter 10 outlines the same for the specific Clutha/Mata-Au Catchments. Through this Management Plan, freshwater bodies are one area that Kāi Tahu seeks to preserve and protect.

The relevant sections of objectives and policies of the Kāi Tahu Ki Otago Natural Resources Management Plan are provided below.

Issue, Objective, Policy		Comment
Chapter 5	**Otago Region**	
Section 5.3 - Wai Māori		
Objectives		
5.3.3	The spiritual and cultural significance of water to Kāi Tahu ki Otago is recognised in all water management. The waters of the Otago Catchment are healthy and support Kāi Tahu ki Otago customs. There is no discharge of human waste directly to water. Contaminants being discharged directly or indirectly to water are reduced. Flow regimes and water quality standards are consistent with the cultural values of Kāi Tahu ki Otago and are implemented throughout the Otago Region and lower Waitaki Catchment.	
Policies		
5.3.4	*General* To require an assessment of instream values for all activities affecting water. To promote the cultural importance of water to Kāi Tahu ki Otago in all water management within the Otago Region and Lower Waitaki Catchment. To promote co-ordinated research into water-related issues that provides for Kāi Tahu ki Otago input.	

	To protect and restore the mauri of all water. To encourage the use of the Cultural Health Index as a tool for monitoring waterways. To oppose any further cross mixing of waters. *Discharges:* To require land disposal for human effluent and contaminants. To require consideration of alternatives and use of new technology for discharge renewal consents. To encourage Kāi Tahu ki Otago input into the development of monitoring programmes. To require monitoring of all discharges be undertaken on a regular basis and all information, including an independent analysis of monitoring results, be made available to Kāi Tahu ki Otago. To encourage Management Plans for all discharge activities that detail the procedure for containing spills and including plans for extraordinary events. To require all discharge systems be well maintained and regularly serviced. Copies of all service and maintenance records should be available to Kāi Tahu ki Otago upon request. To require visible signage informing people of the discharge area; such signs are to be written in Māori as well as English. To require groundwater monitoring for all discharges to land	
Section 5.4 – Wāhi Tapu		
Objectives		
5.4.3	All wāhi tapu are protected from inappropriate activities. Wāhi tapu throughout the Otago region are protected in a culturally appropriate manner.	
Policies		
5.4.4	To require consultation with Kāi Tahu ki Otago for activities that have the potential to affect wāhi tapu *Discharges* To discourage all discharges near wāhi tapu	

Section 5.5 - Mahika kai and biodiversity		
Objectives		
5.5.3	Habitats and the wider needs of mahika kai, taoka species and other species of importance to Kāi Tahu ki Otago are protected. Mahika kai resources are healthy and abundant within the Otago Region. Mahika kai is protected and managed in accordance with Kāi Tahu ki Otago tikaka. Indigenous plant and animal communities and the ecological processes that ensure their survival are recognised and protected to restore and improve indigenous biodiversity within the Otago Region.	
Policies		
5.5.4	To promote catchment-based management programmes and models, such as Ki Uta Ki Tai. To require Kāi Tahu ki Otago participation in the management of mahika kai, both introduced and indigenous. To identify mahika kai sites and species of importance to Kāi Tahu ki Otago. To require that all assessments of effects on the environment include an assessment of the impacts of the proposed activity on mahika kai. To promote the protection of remaining indigenous fish habitat by: Identifying waterways that exclusively support indigenous fish.	
Chapter 10 – Clutha/Mata-Au Catchments		
Section 10.2 – Wai Māori		
Policies		
10.2.3	To encourage the adoption of sound environmental practices, adopted where land use intensification occurs. To promote sustainable land use in the Clutha/Mata-au Catchment. To encourage all consents related to subdivision and lifestyle blocks are applied for at the same time including, land use consents, water consents, and discharge consents. To require reticulated community sewerage schemes that have the capacity to accommodate future population	

	growth.	
Section 10.3 – Wāhi Tapu		
Policies		
10.3.3	To require that wāhi tapu sites are protected from further loss or destruction.	
Section 10.4 – Mahika Kai and Biodiversity		
Policies		
10.4.3	To support programmes and initiatives that enhances mahika kai. To encourage customary use practises	

As set out in section 4 of the AEE, consultation has been undertaken with Ngāi Tahu, via its appointed representatives, Te Ao Mārama and Aukaha, throughout the preparation of this consent.

5.3.3 Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan 2008

The Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan 2008, The Cry of the People – Te Tangi a Tauira, sets out the functions of Te Ao Mārama Inc which is authorised to represent the four Southland Rūnanga Paptipu in resource management matters.

The Management Plan's purpose is to:

- *describe the values underpinning the relationship between Ngāi Tahu ki Murihiku and the natural environment;*
- *identify the primary issues associated with natural resource and environmental management in the takiwā, from the perspective of Ngāi Tahu ki Murihiku;*
- *articulate Ngāi Tahu ki Murihiku policies and management guidelines for natural resource and environmental management, wāhi tapu and wāhi taonga*.

Further, this Plan provides a tool to:

- *enable Ngāi Tahu ki Murihiku to effectively and proactively apply cultural values to the management of natural resources, wāhi tapu and wāhi taonga;*
- *assist regional, territorial and national authorities to understand Ngāi Tahu ki Murihiku values and perspectives, and thus fulfil their statutory obligations under the Resource Management Act 1991, Ngāi Tahu Claims Settlement Act 1998, Local Government 2002 and other relevant legislation;*
- *provide a tool recognising the importance of consultation, but as such does not replace the need for direct communication and dialogue with Ngāi Tahu ki Murihiku.*

The relevant sections of this Management Plan have been provided below.

Issue, Objective, Policy		Comment
Chapter 3.4	**High Country and Foothills**	
Section 3.4.9 – General Water Policy		
Ngāi Tahu ki Murihiku General water policy is found in Section 3.5: Southland Plains, provision 3.5.10. The policies as outlined in Section 3.5 Southland Plains, provisions 3.5.10-3.5.20 and Section 3.3 Fiordland, provision 3.3.12 are applicable and should be read in the context of activities occurring in, around, on or affecting high country waterways.		
Policies		
3.3.12 Lakes	Require that ngā roto waimāori where Statutory Acknowledgements apply are recognised for their special associations to Ngāi Tahu irrespective of expiry dates of 20 years contained in the Ngāi Tahu Claims Settlement (Resource Management Consent Notification) Regulations 1999. This means that places identified as Statutory Acknowledgements should continue to be: identified in relevant district and regional plans and policy statements as notice of their cultural importance to Ngāi Tahu (noting on plans); considered a trigger for a notice of application to Ngāi Tahu with respect to resource consents relating to, or impacting on, such areas (notice of applications); given regard to by Councils, the Environment Court and Historic Places Trust when decisions are made about who has the right to comment and be listened to, or to appear in court (Standing); accepted as evidence of the relationship of Ngāi Tahu with a particular area in any proceedings under the Resource Management Act or Historic Places Act. Require that ngā roto waimāori subject to Deeds of Recognition are recognised for their special associations to Ngāi Tahu in perpetuity. This means that: the cultural importance of such places is identified in relevant plans and policy; the landholding Crown agency (either DOC or LINZ) must have particular regard to the views of Ngāi Tahu ki Murihiku in relation to the management of these areas.	

	Maintain and protect the cultural, spiritual, historic and traditional association of Ngāi Tahu ki Murihiku with ngā roto waimāori in Fiordland. All Ngāi Tahu Whānui, current and future generations, must have the ability to access, use and protect ngā roto waimāori, and the history and traditions that are part of such landscapes. Protect, and where needed enhance, the mauri or life supporting capacity of ngā roto waimāori. Avoid the use of ngā roto waimāori as a receiving environment for the discharge of contaminants (e.g. industrial, residential, recreational or agricultural sources)	
3.4.12 Mahinga Kai	Advocate for timely and appropriate consultation with Ngāi Tahu ki Murihiku with respect to areas that are considered particularly significant in terms of mahinga kai. All endeavours should be taken to protect areas and avoid inappropriate use and development. Furthermore management plans should recognise for taonga species as listed in the Ngāi Tahu Claims Settlement Act 1998 and all other species considered taonga by Ngāi Tahu ki Murihiku. Advocate for the protection, restoration and enhancement of waterways, riparian margins, wetlands, and tarns as a means of protecting and enhancing indigenous biodiversity.	
3.4.13 Hazardous Substances	Require appropriate consultation with regards to Hazardous Substances or New Organisms applications. Pre application, site visits, and presentation of findings are encouraged. Continued liaison with Te Rūnanga o Ngāi Tahu is essential. Consultation and communication of highly technical information should in addition be presented in plain language, to enable rūnanga (and other community groups) to make informed decisions. Consider any application for Hazardous Substances or New Organisms in terms of the potential effects, both positive and adverse, on indigenous biodiversity. Advocate for use of Cultural Impact Assessments when considering applications for Hazardous Substances and New Organisms to appropriately assess the environmental impacts on cultural values held by Ngāi Tahu ki Murihiku.	

	Oppose the use of any hazardous substances where it is likely that such use will have an affect on water quality and land, influencing the life supporting and productive capacity of both.	
3.5.10 General Water Policy	Work with local authorities and other statutory agencies involved in freshwater management to ensure that cultural values and perspectives associated with freshwater management are reflected in statutory water plans, best practice guidelines and strategies, and in resource consent processes for activities involving water. Protect and enhance the mauri, or life supporting capacity, of freshwater resources throughout Murihiku. Manage our freshwater resources wisely, mō tātou, ā, mō ngā uri ā muri ake nei, for all of us and the generations that follow. Promote the management of freshwater according to the principle of ki uta ki tai, and thus the flow of water from source to sea. Protect and enhance the customary relationship of Ngāi Tahu ki Murihiku with freshwater resources.	
3.5.11 Rivers	Promote river management that adopts the priorities established in the Te Rūnanga o Ngāi Tahu Freshwater Policy 1997. The priorities are: Priority 1: Sustain the mauri of the waterbodies within the catchment. Priority 2: Meet the basic health and safety needs of humans (drinking water). Priority 3: Protect cultural values and uses. Priority 4: Protect other instream values (indigenous flora and fauna). Priority 5: Meet the health and safety needs of humans (sanitation). Management of our rivers must take into account that each waterway has its own mauri, guarded by separate spiritual guardians, its own mana, and its own set of associated values and uses. Adopt a precautionary approach for any activity involving a waterway where there is an absence of detailed knowledge of that waterway (ecology, flow regimes, species, etc). Require that rivers recognised as Statutory	

Acknowledgements be recognised for their special associations to Ngāi Tahu beyond the expiry date of 20 years. This means that places identified as Statutory Acknowledgements should continue to be:

– Identified in relevant district and regional plans and policy statements as notice of their cultural importance to Ngāi Tahu (noting on plans).

– Considered a trigger for a notice of application to Ngāi Tahu with respect to resource consents relating to, or impacting on, such areas (notice of applications).

– Given regard to by Councils, the Environment Court and Historic Places Trust when decisions are made about who has the right to comment and be listened to, or to appear in court (Standing).

– Accepted as evidence of the relationship of Ngāi Tahu with a particular area in any proceedings under the RMA or Historic Places Act.

The cultural importance of particular rivers (e.g. Statutory Acknowledgements, rivers associated with whakapapa and identity) must be reflected in the weighting of Ngāi Tahu responses and submissions on consents associated with these rivers.

Promote the use of State of the Takiwā environmental monitoring for Murihiku river catchments.

Promote the use of the Cultural Health Index (CHI) as a tool to facilitate monitoring of stream health, and to provide long term data that can be used to assess river health over time.

Use riparian enhancement, buffer zones, fencing, and related streamside management tools as conditions of consent to ensure that human use of rivers and their water does not compromise river health.

Avoid the use of rivers as a receiving environment for the discharge of contaminants (e.g. industrial, residential, recreational or agricultural sources).

Prioritise the restoration of those waterbodies of high cultural value, both in terms of ecological restoration and in terms of restoring cultural landscapes.

Ensure that activities in upper catchments have no adverse effect on mahinga kai, water quality and water

	quantity in lower catchments. Promote environmental education programmes that raise awareness about appropriate land management practices adjacent to our rivers, including riparian management. This includes education about avoiding adverse effects of livestock on riparian areas and waterways.	
3.5.12 Discharge to Water	Avoid the use of water as a receiving environment for the direct, or point source, discharge of contaminants. Even if the discharge is treated and therefore considered "clean", it may still be culturally unacceptable. Generally, all discharge must first be to land. Assess discharge to water proposals on a case by case basis, with a focus on local circumstances and finding local solutions. Consider any proposed discharge activity in terms of the nature of the discharge, and the sensitivity of the receiving environment. When existing rights to discharge to water come up for renewal, they must be considered in terms of alternative discharge options. When assessing the alternatives to discharge to water, a range of values, including environmental, cultural and social, must be considered in addition to economic values. Any discharge activity must include a robust monitoring programme that includes regular monitoring of the discharge and the potential effects on the receiving environment. Require robust monitoring of discharge permits, to detect non-compliance with consent conditions. Noncompliance must result in appropriate enforcement action to discourage further non-compliance. Promote the use of the Cultural Health Index (CHI) as a tool to facilitate monitoring of stream health, and to provide long term data that can be used to assess river health over time. Ngāi Tahu ki Murihiku consider activities involving the discharge of contaminants to water a community issue. For this reason, ngā rūnanga may, where seen as appropriate, recommend that a consent application be notified.	

3.5.12 Water Quality	The role of Ngāi Tahu ki Murihiku as tangata whenua and kaitiaki of water must be recognised and provided for in all water quality management. Strive for the highest possible standard of water quality that is characteristic of a particular place/waterway, recognising principles of achievability. Require cumulative effects assessments for any activity that may have adverse effects of water quality. Avoid the use of water as a receiving environment for the direct, or point source, discharge of contaminants. Generally, all discharge must first be to land. Avoid impacts on water as a result of inappropriate discharge to land activities. When assessing the effects of an activity on water quality, where the water source is in a degraded state, the effects should be measured against the condition that the water source should be, and not the existing condition of the water source. Require the use of buffer zones, riparian areas, bunds and other mechanisms to prevent stormwater and other wastewater from entering waterways. Water quality definitions, categories, and standards must be determined, measured, and assessed with cultural values and indicators alongside scientific information. Such indicators and values centre on the ability of the waterway to support life, and the fitness of water for cultural uses. Require robust monitoring of discharge permits, to detect non-compliance with consent conditions. Noncompliance must result in appropriate enforcement action to discourage further non-compliance.	
3.5.16 Mahinga Kai and Biodiversity	Consider the actual and potential effects of proposed activities on mahinga kai places, species and activities when assessing applications for resource consent. Use the enhancement of mahinga kai places, species and activities to offset or mitigate the adverse effects of development and human activity on the land, water and biodiversity of Murihiku.	
3.5.20 Freshwater Fisheries	All Ngāi Tahu Whānui, current and future generations, must have the capacity to access, use and protect native fisheries, and the history and traditions that are part of customary use of such fisheries, as guaranteed	

	by the Treaty of Waitangi. Advocate for the protection, restoration and enhancement of waterways, riparian margins, and wetlands as a means of protecting and enhancing freshwater fishery values.	

6 Statutory Assessment: Section 105(1)

In accordance with section 105(1)(c) of the RMA, alternative methods for the proposed discharges have been assessed.

It is noted that it is not possible to provide a reticulated network that can be guaranteed never to overflow. This is because the network will be designed and constructed to a certain 'event' or standard which can't account for every scenario. Additionally, the system cannot always account for human or non-human influenced factors, such as blockages by foreign objects or damage by tree roots, the predominant cause of overflows in the QLDC wastewater network.

Theoretically, QLDC could rebuild the entire wastewater network ensuring that the pipes are constructed in accordance with modern-day best practice technology, standards and guidelines. While this option would ensure a reduction in overflows caused by defects in the pipeline, this would still not eliminate the overflows as this is only one cause of the many causes of overflows. Additionally, this option would be a significant up front cost to QLDC ratepayers with a large construction period, disturbance to the entire district with re-routing of traffic, construction noise, and disruption to the wastewater service (which in itself could pose serious risk to public health and the environment).

As set out in the AEE the QLDC wastewater network on average is relatively new and therefore it would not be cost effective to totally replace this at this current time. It is more appropriate and feasible to upgrade the network over time such as that proposed by QLDC through its Infrastructure Assets Management Strategy and the investments it is making through its Long Term Plan.