TECHNICAL COMMITTEE AGENDA

Wednesday 30 January 2019

10:30 am Council Chamber

Level 2 Philip Laing House, 144 Rattray Street, Dunedin

Membership

Cr Andrew Noone	*(Chairperson)*
Cr Ella Lawton	*(Deputy Chairperson)*
Cr Graeme Bell	
Cr Doug Brown	
Cr Michael Deaker	
Cr Carmen Hope	
Cr Trevor Kempton	
Cr Michael Laws	
Cr Sam Neill	
Cr Gretchen Robertson	
Cr Bryan Scott	
Cr Stephen Woodhead	

Disclaimer

Please note that there is an embargo on agenda items until 48 hours prior to the meeting. Reports and recommendations contained in this agenda are not to be considered as Council policy until adopted.

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2. LEAVE OF ABSENCE

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5. CONFLICT OF INTEREST

Members are reminded of the need to stand aside from decision-making when a conflict arises between their role as an elected representative and any private or other external interest they might have.

6. PUBLIC FORUM

7. PRESENTATIONS

8. CONFIRMATION OF MINUTES

Recommendation

That the minutes of the meeting held on 28 November 2018 be received and confirmed as a true and accurate record.

Attachments

1. Technical Minutes 28 Nov 2018 **[8.1.1]**

9. ACTIONS

Status report on the resolutions of the Technical Committee.

Report	Meeting Date	Resolution	Status
An assessment of the Clean Heat Clean Air program's effectiveness	13/6/18	*That this report be used to inform the review of ongoing financial incentives for Air Quality, proposed for 2018/19 in the 2018-2018 Draft Long-Term Plan*	OPEN
Lake Hayes Restoration	1/8/18	*That the consultant report by Castalia be re-framed into a more public intelligible document.*	IN PROGRESS (Castalia have been briefed)
Lake Hayes Restoration	18/10/18	*Dr Palmer to follow up on receipt of the revised Castalia report*	OPEN
Lake Snow technical workshop	18/10/18	*The CE engage on the with CEs at the*	

recommendations		*regional CEOs meeting on 8 November 2018 on the primary objectives from the workshop.* *Invite Regional Councils and MPI to formally endorse and support the proposed research programme and to discuss funding arrangements.*	IN PROCESS

10. MATTERS FOR NOTING

10.1. Director's Report on Progress

Prepared for: Technical Committee

Report No. EHS1840

Activity: Governance Report

Prepared by: Gavin Palmer, Director Engineering, Hazards and Science
Ben Mackey, Acting Manager Natural Hazards

Authoriser: Gavin Palmer, Director Engineering, Hazards and Science

Date: 23 January 2019

PURPOSE

[1] This report provides an update on the following matters:

- Lake Hayes water quality remediation;
- Lower Waitaki River Control Scheme;
- November 2018 Otago Flood, and;
- Leith Flood Protection Scheme.

STAFF RECOMMENDATION

That the Council:

1) ***Receives** this report.*
2) ***Notes** this report.*

LAKE HAYES WATER QUALITY REMEDIATION

[2] Lake Hayes remediation options were presented to Technical Committee in August 2018 for consideration. The committee requested further information via the following resolution[1]:

"*That staff develop options for consideration by Council on the remediation of Lake Hayes including a comprehensive description and assessment of benefits, effectiveness, precedent, risks, costs, implementation timelines and funding*."

Staff have been collating this information and will report to Technical Committee in March 2019.

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[1] *Lake Hayes Restoration*, Report to 1 August 2018 meeting of Otago Regional Council Technical Committee, 26 July 2018, 17p.

[3] One of the potential methods of remediation involves adding water to Mill Creek from the Arrow Irrigation Scheme. Construction of the works for this offtake were required to be complete in December 2018 to fit around the construction of Millbrook's Dalgleish Farm golf course. Construction of a 120 m long buried pipe and a discharge structure were completed by ORC by the required date (Figure 1). If this water augmentation method is operationalised, an additional section of pipe and associated valve controls will need to be added at the top end to connect to the primary Arrow Irrigation Company pipeline.

[4] Council provided the sum of $100,000 in Year 1 of the 2018-2028 Long Term Plan for this enabling work. Actual costs to date for this work are approximately $160,000. These are higher than the budget provision largely due to the unexpected complexity of the works, the level of design and supervision required and unbudgeted legal costs.

Figure 1. Contractors preparing to install the outfall structure that could discharge Arrow Irrigation Scheme water into Hayes Creek, Arrowtown (14 December 2018).

LOWER WAITAKI RIVER CONTROL SCHEME

[5] The Lower Waitaki River Control Scheme reduces the flood and erosion hazard for approximately 6,100 hectares of land between the Waitaki Dam (near Kurow) and the coast (65km) (Figure 2). Management of the Scheme involves maintaining channel alignment and a clear fairway, maintaining 12 rock groynes and targeted and selective river bank protection.

Figure 2. Lower Waitaki River, looking upstream 17.5km from the coast, 30 August 2018 (photograph courtesy of Environment Canterbury).

[6] The Scheme lies in both Canterbury and Otago. For reasons of efficiency the Scheme is maintained by Environment Canterbury (ECan) with ORC making a financial contribution. Meridian Energy Ltd (Meridian) contributes 40% of Scheme funding requirements.

[7] Cr Brown and I attended the annual meeting of the Lower Waitaki River Scheme Liaison Group on 14 December 2018. Staff of ECan updated the Group on river management work undertaken in 2017/18 and the year to date, and the work plan and budget proposed by ECan for 2019/20. The work plan and budget were approved by the Group. The contribution to be made by ORC in 2019/20 is the same as that provided in the ORC 2018-2028 Long Term Plan ($149,589 excluding GST). Meridian's contribution will be $220,000.

[8] The management strategy and implementation plan developed jointly by ORC and ECan staff in 2015 is continuing to provide a sound basis for Scheme planning and operations[1].

[9] Monitoring and enforcement of the Resource Management Act, Regional Plan: Water and bylaws for activities within Otago remain the responsibility of ORC. The Liaison Group was advised of the draft Otago Navigation Safety Bylaw[2]. The draft provisions to do with structures in rivers were noted.

[1] *Lower Waitaki River Management Strategy*, Report to 22 April 2015 meeting of Otago Regional Council Technical Committee, 9 April 2015, 14p.

[2] *Otago Regional Council Navigation Safety Bylaw 2018 Draft for Public Consultation,* Otago Regional Council.

NOVEMBER 2018 OTAGO FLOOD

[10] Staff are progressing actions arising from the November 2018 Otago flood[1]. The Lower Clutha Flood Protection and Drainage Scheme[2] and the Lower Taieri Flood Protection Scheme[3] reduced the flood hazard during the event for approximately 30,000 hectares of land including the townships of Balclutha and Mosgiel and Dunedin International Airport. The peak flow in the Clutha River/Mata-Au (2,700m3/s) was the highest since 1999.

[11] Actions underway include channel cross-section surveys in the Clutha River/Mata-Au (both river branches, Barnego to the coast), Lower Taieri River (Outram bridge to the coast), Silver Stream (Three Mile Hill bridge to Taieri River confluence) and Contour Channel (base of Maungatua foothills). The surveys will enable the significance of changes in channel cross-section to be assessed, by comparing with previous surveys. The surveys will inform the scheme performance reviews that are provided for in the 2018/28 Long Term Plan.

[12] The East Taieri Upper Pond (Lower Taieri Flood Protection Scheme) contained up to 28.8 million cubic metres of water during the flood, equivalent to 83% of its holding capacity. The floodwater occupied approximately 893 hectares of agricultural land and took approximately 20 days to drain (Figure 3).

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[1] *Director's Report*, Report to 28 November 2018 meeting of Otago Regional Council Technical Committee, 23 November 2018, 15p.

[2] *Natural Hazards on the Clutha Delta*, Otago, Otago Regional Council, May 2016, 135p.

[3] *Natural Hazards on the Taieri Plains*, Otago, Otago Regional Council, April 2013, 102p.

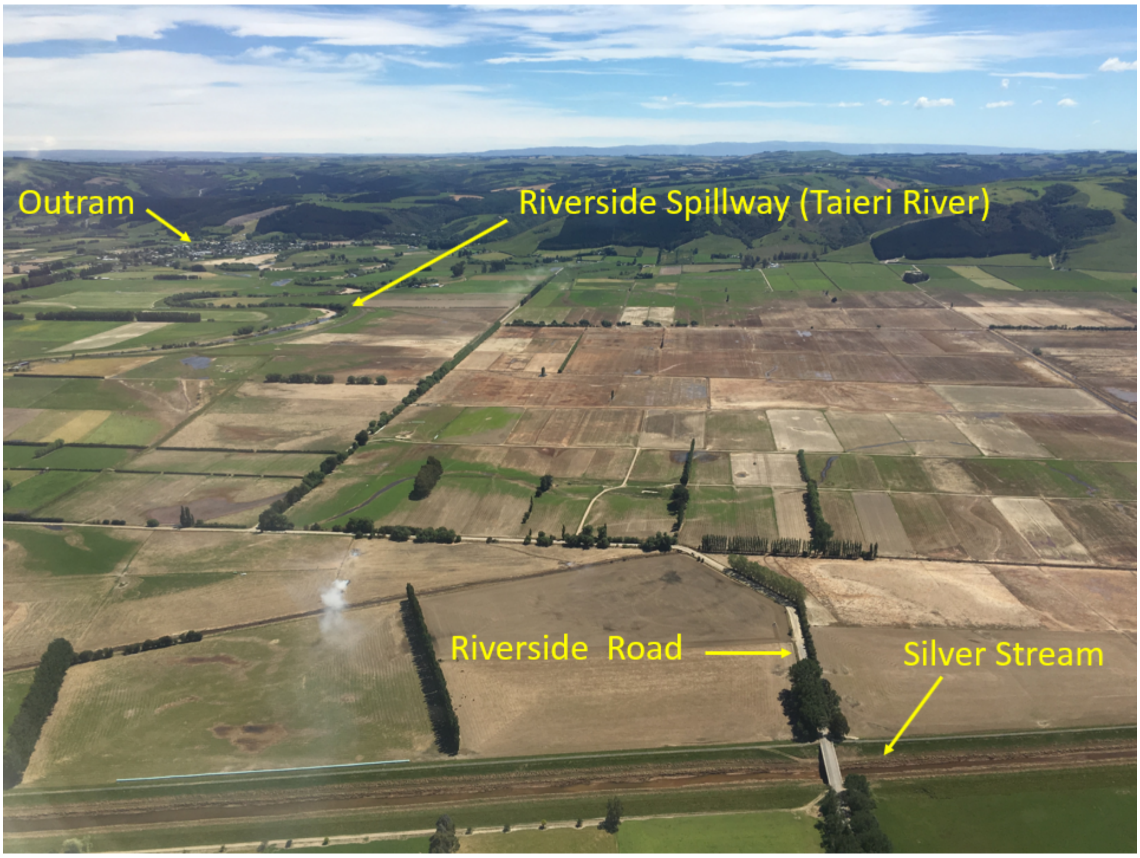

Figure 3. The western part of the East Taieri Upper Pond on 17 December 2018.

LEITH FLOOD PROTECTION SCHEME

[13] Preparations are being made by the contractor (Downer New Zealand Limited) and ORC for onsite works for the Dundas Street Bridge stage of the Leith Flood Protection Scheme. The proposed works will complete the flood protection capital works of the Scheme (Figure 4). The contractor has placed the order for manufacture and supply of the precast concrete units that will make up the new culvert at the western (true right) side of the bridge (Figure 5). 15 units of varying sizes weighing up to 16.5 tonnes each are required.

[14] The bridge will be closed to vehicular and pedestrian traffic from 11 February, to allow the works to be undertaken. This is later than initially planned as extra time is required to design and construct the temporary retaining wall. The wall stabilizes the ground supporting the adjacent residential properties. The bridge will reopen in August 2019. ORC communications staff have been liaising with communications staff of Dunedin City Council, Otago Polytechnic and the University of Otago regarding the closure date for the bridge.

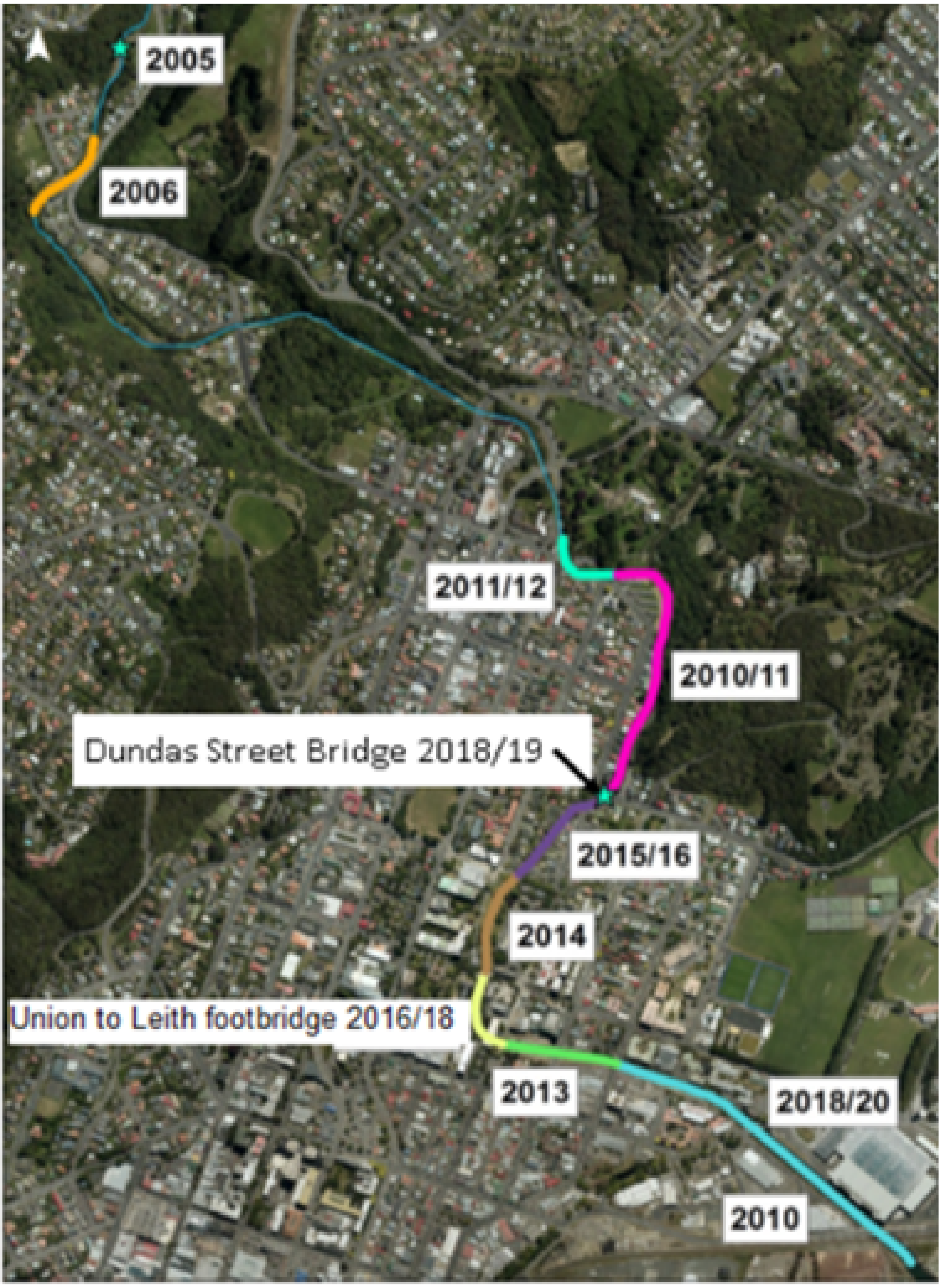

Figure 4. Staging of construction of the Leith Flood Protection Scheme.

Figure 5. 1:25 scale physical model of the Water of Leith at Dundas Street bridge, looking downstream. The proposed new culvert is at the right of the bridge. The model was constructed at the Water Engineering Laboratory of the Department of Civil and Environmental Engineering, University of Auckland.

[15] Engineering works on the Union to Leith Footbridge stage of the Scheme resumed on 27 November 2018 following the flood that occurred on 20 November 2018 (Figure 6). The last of the instream bed level control weirs are being constructed and rock riprap is being placed between the weirs. As previously advised to committee, for reasons of efficiency the contractor (Downer New Zealand Ltd) has been retained to repair flood damage near the Leith footbridge, some of which occurred in earlier floods.

Figure 6. Water of Leith looking downstream towards the University of Otago Information Technology Services (ITS) Building (20 December 2018).

ATTACHMENTS

Nil

10.2. Recreational Water Quality monitoring in Otago

Prepared for:	Technical Committee
Report No.	EHS1841
Activity:	Governance Report
Author:	Rachel Ozanne, Environmental Resource Scientist
Authoriser:	Gavin Palmer, Director Engineering, Hazards and Science
Date:	30 January 2018

PURPOSE

[1] This report provides a brief update on current recreational water quality monitoring in Otago's rivers, lakes and coastal waters. Monitoring is undertaken at a suite of sites at weekly intervals over the summer months and focusses on human health risks relating to faecal contamination and/or potentially toxic cyanobacteria.

[2] New provisions in the National Policy Statement for Freshwater Management (NPS-FM) mean that the current programme will need to be revisited once Council identifies primary contact recreation sites in an update of the Regional Plan: Water (Water Plan). State of the Environment (SoE) river and lake sites that will be used to monitor progress towards achieving freshwater objectives established in the Water Plan relating to human health will also need to be identified.

STAFF RECOMMENDATION

That the Council:

1) ***Receives*** *this report.*

2) ***Notes*** *the summer monitoring programme.*

LEGISLATIVE RESPONSIBILITY

[3] Two main sources of legislation define the monitoring required to assess the water quality of areas used for contact recreation, the Resource Management Act (1991) and the Health Act (1956). The responsibility for overseeing these Acts is shared between Regional Councils, TLAs and the District Health Boards (DHBs). The document 'Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas', MfE and MoH (2003)[1] outlines how duties may be shared between the agencies involved.

[4] The NPS-FM now requires weekly human health risk surveillance monitoring using *E. coli* at identified primary contact sites during nominated times (i.e., swimming spots during

summer), with the methodology based on the existing national microbiological water quality guidelines

FAECAL INDICATOR BACTERIA

[5] The most common illnesses associated with swimming include gastroenteritis, respiratory illnesses, and skin and ear infections. These illnesses can be caused by a wide range of pathogenic organisms including viruses, bacteria and protozoan species – these include Salmonella, Campylobacter, Cryptosporidium, and Giardia (MfE and MoH, 2003). It is not feasible to analyse water samples for these pathogenic organisms. However, these pathogens are associated with enterococci and *Escherichia coli* (*E. coli*) bacteria that are specific to the gut of warm-blooded animals. Measurement of the concentration of these indicator bacteria gives an indication of the health risk associated with contact recreation arising from pathogenic organisms.

[6] Samples are analysed for the indicator bacteria enterococci at marine sites. This is because it survives better in saline waters than *E. coli*, providing a better indication of actual bacterial levels and therefore the potential risk. Samples collected at freshwater sites are analysed for the indicator bacteria *E. coli*. At estuarine or freshwater sites subject to tidal influences, dual testing of indicator bacteria is undertaken.

[7] All sampling and evaluation of results is undertaken in accordance with the 'Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas 2003' . (Table 1).

Table 1. Water quality guideline values and indicator organisms used to assess marine and freshwater recreational areas (MfE and MoH, 2003).

Response Level	Marine Water Enterococci CFU/100 mL Single Sample	Freshwater *E. coli* CFU/100 mL Single sample	Shellfish gathering waters Faecal coliforms CFU/100 mL (over season)
Surveillance/Green Mode	<140	<260	Median concentration < 14/100 mL and 90% of samples < 43/100 mL
Alert/Amber Mode	140 - 280	260 - 550	N/A
Action/Red Mode	>280*	>550	Median concentration > 14/100 mL and/or 90% of samples > 43/100 mL

CFU = Colony forming units on an agar plate.

[8] When water quality falls within the limits of the 'surveillance mode' (the 'Green' mode), the risk of contracting an illness from bathing is considered acceptable (MfE and MoH, 2003). If the water quality falls into the 'Alert/Amber' category (the 'Amber' mode) there is an increased risk of illness, but this risk is also considered acceptable. This result signals to agencies a requirement to conduct follow up sampling of the site to determine whether contamination levels have increased to the 'Action/Red' level (the 'Red' mode). If levels of bacteria exceed the levels set out in the 'Action/Red' mode, then contact recreation in the water is deemed to pose an unacceptable health risk. At this stage the the public is informed of the elevated risk of illness through sign-posting, media releases and/or phone or website. While freshwater exceedances are assessed for compliance on

the result of a single sample, the guidelines require two samples taken within 24 hours to exceed the action level of 280 enterococci CFU/100mL for marine waters.

FAECAL SOURCE TRACKING

[9] High priority sites, or sites with known water quality issues have been selected for faecal source tracking (FST). This involves processing samples for Polymerase Chain Reaction (PCR) analyses. PCR analysis uses bacterial DNA to identify which type of animals produced the *E.coli*. Assays specific for humans, herbivores, dogs and wildfowl are available.

[10] Additional samples for FST are taken at five sites - Kakanui at Clifton Falls, Lake Hayes, Mill Creek, Lake Wakatipu at Queenstown Bay and Lake Wakatipu at Frankton Bay. If routine sample results (from the recreational monitoring programme) show elevated *E.coli*, then FST analysis is undertaken.

NUISANCE ALGAL GROWTHS

[11] The ORC also carries out cyanobacteria bloom surveillance at selected river and lake sites over the summer (Figure 1). This monitoring follows current interim national guidance (MfE/MoH 2009)[2] for managing health risks posed by planktonic (floating) or benthic (bottom covering) cyanobacteria blooms.

[12] Cyanobacteria (commonly known as blue-green algae) are photosynthetic organisms that are integral parts of many terrestrial and aquatic ecosystems. An increasing number of cyanobacterial species are known to include toxin-producing strains. These natural toxins, known as cyanotoxins, are a threat to humans and animals when consumed in drinking water or by contact during recreational activities.

[13] In lakes, cyanobacterial species tend to float in the water column (planktonic). People using water bodies for recreational purposes are most likely to experience maximum exposure when a cyanobacterial bloom develops or forms surface scums near water entry points. Wind-driven accumulations of surface scums can result in toxin concentrations increasing by a factor of 1000 or more, and such situations can change within very short time periods (hours).

[14] In rivers Phormidium tends to form dense mats attached to the river bed (benthic). Phormidium occurs naturally in New Zealand environments, but under favourable conditions it can multiply, forming blooms.

[15] As the Phormidium mats become thicker, bubbles of oxygen gas become entrapped within them. This facilitates the detachment of the mat from the substrate and these loose mats can accumulate along the river margin during high flows. As flow recedes, these mats become exposed and may pose a health risk

[16] Some cyanobacterial species produce toxins, known as cyanotoxins. However, the rates of toxin production can vary, both within a mat, and between mats on the same river, meaning that identifying the health risk from any cyanobacteria present can be difficult. It is not currently understood what triggers toxin production in an algal mat. Dogs appear particularly susceptible to cyanobacterial poisoning, which is likely to be in part

behavioural. Dogs may become attracted to the musty smell of Phormidium when scavenging along the river edge.

[17] For planktonic and benthic algae, three levels of monitoring have been identified: surveillance (green mode), alert (amber mode) and action (red mode) which are detailed in Tables 2 and 3.

Table 2. Alert-level framework for planktonic cyanobacteria

Alert level	Actions (See section 2.4 for the recommended framework for roles and responsibilities relating to actions, and the text box at the beginning of Section 3 for advice on interpreting the guidance in this table.)
Surveillance (green mode) *Situation 1:* The cell concentration of total cyanobacteria does not exceed 500 cells/mL.[a] *Situation 2:* The biovolume equivalent for the combined total of all cyanobacteria does not exceed 0.5 mm^3/L.	• Undertake weekly or fortnightly visual inspection[b] and sampling of water bodies where cyanobacteria are known to proliferate between spring and autumn.
Alert (amber mode) *Situation 1:* Biovolume equivalent of 0.5 to < 1.8 mm^3/L of potentially toxic cyanobacteria (see Tables 1 and 2); **or** *Situation 2*[c]: 0.5 to < 10 mm^3/L total biovolume of all cyanobacterial material.	• Increase sampling frequency to at least weekly.[d] • Notify the public health unit. • Multiple sites should be inspected and sampled.
Action (red mode) *Situation 1:* ≥ 12 µg/L total microcystins; **or** biovolume equivalent of ≥ 1.8 mm^3/L of potentially toxic cyanobacteria (see Tables 1 and 2); **or** *Situation 2*[c]: ≥ 10 mm^3/L total biovolume of all cyanobacterial material; **or** *Situation 3*[e]: cyanobacterial scums consistently present.	• Continue monitoring as for alert (amber mode).[d] • If potentially toxic taxa are present (see Table 1), then consider testing samples for cyanotoxins.[f] • Notify the public of a potential risk to health.

Table 3. Alert-level framework for benthic cyanobacteria

Alert level[a]	Actions (See section 2.4 for the recommended framework for roles and responsibilities relating to actions, and the text box at the beginning of Section 3 for advice on interpreting the guidance in this table.)
Surveillance (green mode) Up to 20% coverage[b] of potentially toxigenic cyanobacteria (see Table 1) attached to substrate.	• Undertake fortnightly surveys between spring and autumn at representative locations in the water body where known mat proliferations occur and where there is recreational use.
Alert (amber mode) 20–50% coverage of potentially toxigenic cyanobacteria (see Table 1) attached to substrate.	• Notify the public health unit. • Increase sampling to weekly. • Recommend erecting an information sign that provides the public with information on the appearance of mats and the potential risks. • Consider increasing the number of survey sites to enable risks to recreational users to be more accurately assessed. • If toxigenic cyanobacteria (see Table 2) dominate the samples, testing for cyanotoxins is advised. If cyanotoxins are detected in mats or water samples, consult the testing laboratory to determine if levels are hazardous.
Action (red mode) *Situation 1:* Greater than 50% coverage of potentially toxigenic cyanobacteria (see Table 1) attached to substrate; **or** *Situation 2:* up to 50% where potentially toxigenic cyanobacteria are visibly detaching from the substrate, accumulating as scums along the river's edge or becoming exposed on the river's edge as the river level drops.	• Immediately notify the public health unit. • If potentially toxic taxa are present (see Table 2) then consider testing samples for cyanotoxins.. • Notify the public of the potential risk to health.

ORC'S RECREATIONAL WATER QUALITY MONITORING PROGRAMME 2018/2019

[18] The ORC has had a summer recreational water quality monitoring programme in place since 2006. The programme focuses on human health surveillance at sites popular for recreational pursuits involving immersion in the water, such as swimming.

[19] This season (2018-2019), weekly sampling commenced on 3 December 2018 and will run through until the end of March 2019. A total of 27 sites will be monitored for indicator bacteria and/or cyanobacteria (Figure 1), including two new sites for E. coli only (Lake Dunstan at Clyde Rowing Club and at Alpha Street) and one new site for E. coli and faecal source tracking (Lake Wakatipu at Queenstown Bay).

[20] Results of water sampling carried out at eight coastal sites between Sandfly Bay and St Clair Beach by the Dunedin City Council (DCC) augment ORC's summer recreational water quality monitoring programme. The DCC's sampling is a requirement of conditions on their coastal permits for Dunedin City's wastewater discharges.

[21] Water sample test results are compared against the National Microbiological Water Quality Guidelines (MfE/MoH 2003) to identify the level of health risk associated with swimming. This information is posted on the LAWA website over summer (www.lawa.org.nz), along with indicator bacteria data from swimming spots across New Zealand.

[22] LAWA also report an ‘overall bacterial risk’ for each recreational site alongside the weekly sampling result. The overall bacterial risk is a guide to give a general picture of water quality by determining a measure of health risk at a site. Updated annually, it is calculated from bacteria data (*E. coli* for freshwater or enterococci for coastal waters) collected over the last three years. This risk indicator doesn't include potentially toxic algal data.

[23] The overall bacterial risk presented on LAWA is based on the 95th percentile of routine sample results from the last three years (re-tests are excluded from analysis). In simple terms, if a site was calculated to have a 95th percentile of 200, then this means that 95 out of 100 times that this site was monitored, that the results were at or below 200 *E. coli* / 100 mL for freshwater sites, or 200 enterococci/100 mL for coastal beaches.

[24] The summer programme operates independently from ORC’s SoE monitoring programme and involves partnerships with the region’s territorial authorities and Public Health South. MfE/MoH (2003) has identified a recommended framework for roles and responsibilities between the authorities, the framework identifies responsibilities for notifying the public of potential health risks; collecting follow-up water samples when a routine weekly sample exceeds the recommended guideline; and tracking potential sources of faecal contamination, particularly where these are likely to be associated with stormwater or wastewater infrastructure.

[25] In Otago, Queenstown Lakes District Council, undertake follow up sampling if the ‘action’ level is reached, alongside public information (through sign installation and media). Central Otago District Council, Dunedin City Council, Waitaki District Council and Clutha District Council rely on ORC to provide these services.

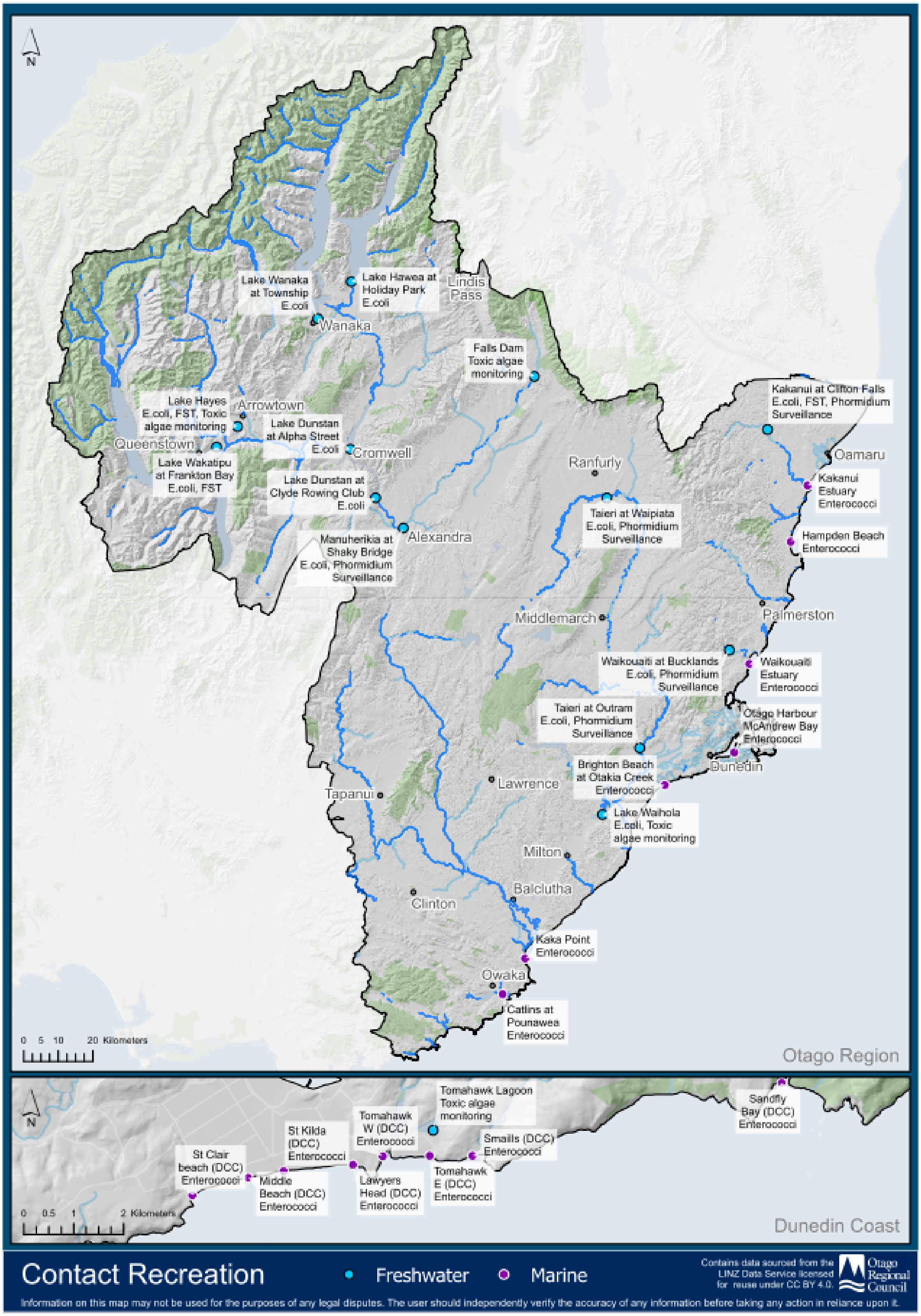

Figure 1 Summer recreational monitoring sites 2018/2019

NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT (NPS-FM)

[26] Existing recreational water quality monitoring in Otago will need to be formally reviewed as part of Council's programme to implement the NPS-FM. The NPS-FM requires all lakes and rivers to be managed for "human health for recreation" as a mandatory national value. New provisions introduced in August 2017[4] include Objective A3 to improve the quality of water in rivers and lakes so that is suitable for primary contact recreation more often. The *E. coli* attribute in the National Objectives Framework (NOF) is to be used to set the objective at a freshwater management unit (FMU) scale and monitor progress towards achieving it. Under the NOF, monitoring is required at a representative site or sites within each FMU, with sampling conducted at monthly intervals year-round regardless of weather or river flow conditions. This means that Council's river and lake SoE sampling data – and not the summer surveillance data – will inform progress towards the *E. coli* and (for lakes) cyanobacteria freshwater objectives. This same data will also inform progress with meeting regional swimming targets required under Policy A6 of the NPS-FM. The SoE sites to be used in the assessment will need to be identified for each FMU.[5]

[27] The NPS-FM now requires weekly human health risk surveillance monitoring using *E. coli* at identified primary contact sites during nominated times (i.e., swimming spots during summer), with the methodology based on the existing national microbiological water quality guidelines. This monitoring aligns with Council's existing summer surveillance programme outlined in this paper, but there may be changes to the number and location of monitoring sites to reflect the list of primary contact sites that are adopted in the Water Plan Review.

[28] Policy CB1 requires sites identified in a Regional Plan to be monitored as part of a surveillance programme. This monitoring is required, regardless of the level of risk to human health. The current focus on human health attributes does not tend to align with the public's perception of 'swimmable' rivers and lakes where other measures such as visual water clarity, sediment and nuisance algal growths are important in terms of recreational enjoyment. Guidelines already exist for some of these measures and it may be appropriate to monitor some of these attributes alongside faecal indicator bacteria.

DISCUSSION

[29] A 2017 discussion paper prepared for the regional sector[6] identified a number of significant short-comings with current surveillance monitoring and reporting in New Zealand. A key issue is that microbial risk information is retrospective, with indicator bacteria test results not available for at least 18-24 hours. This delay in receiving test results means the public cannot be informed of potential health risks in a timely manner.

[30] Real-time, or near real-time, monitoring of microbial water quality would provide the public with more up-to-date and useful information on health risks associated with swimming. While there have been a number of developments in quicker microbial testing, approaches that predict *near-future* expected microbial water quality would be most helpful. Like weather forecasts, predictions inherently carry a degree of uncertainty, but they provide recreational water users with *advance warning* of the likely risk associated with recreation. The degree of warning can be broken down into: a)

what is the expected *current* risk, and b) what is the *future* risk (e.g., tomorrow), which affects decisions about immediate and future recreational activity. Depending on their set-up, predictive tools can also provide information that has greater spatial and temporal application than monitoring at a single specific site.

[31] Several regions of New Zealand have invested in microbial or cyanobacteria bloom forecasting. Auckland's SafeSwim (https://www.safeswim.org.nz) microbial water quality forecast is probably the most sophisticated system, drawing on environmental variables such as tides, wind and rainfall to predict in-water faecal contamination. Several regions are using simple techniques for rivers involving 'mining' of existing data sets to establish reasonable site-specific relationships between *E. coli* and one or more of visual clarity, turbidity, flow or upstream catchment rainfall. Using one or more of these measures as proxies for *E. coli* contamination is an option ORC could explore, particularly in more data-rich catchments with SoE sites.

[32] Adding visual clarity or turbidity monitoring at surveillance sites would assist with the development of proxy measures as well as provide useful information on an important attribute of recreational (and general) water quality. Monitoring of visual clarity is also something the public could be involved in, offering opportunities for community engagement in water quality. With some initial training and periodic quality assurance checks, community volunteers should also be able to identify and estimate cyanobacteria abundance, particularly coverage of *Phormidium* mats in rivers. As we progress our FMU development and understanding these options could be further considered.

ATTACHMENTS

Nil

10.3. Contact Recreation Results 2018-2019

Prepared for: Technical Committee

Report No. EHS1842

Activity: Governance Report

Author: Rachel Ozanne, Environmental Resource Scientist

Authoriser: Gavin Palmer, Director Engineering, Hazards and Science

Date: 30 January 2019

PURPOSE

[1] This report provides a brief update on 2018/2019 recreational water quality monitoring results in Otago's rivers, lakes and coastal waters.

[2] This report is an addendum to the paper 'recreational water quality monitoring in Otago' presented to the Technical Committee on 30-Jan-19.

STAFF RECOMMENDATION

That the Council:

*1) **Receives** this report.*

BACKGROUND

[3] This season (2018-2019), weekly water quality sampling of recreational sites commenced on 3 December 2018 and will run through until the end of March 2019. A total of 20 sites are monitored for indicator bacteria.

[4] All sampling and evaluation of results is undertaken in accordance with the 'Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas 2003[1]'.

[5] Additional samples for faecal source tracking (FST) are taken at five sites - Kakanui at Clifton Falls, Lake Hayes, Mill Creek, Lake Wakatipu at Queenstown Bay and Lake Wakatipu at Frankton Bay. If routine sample results (from the recreational monitoring programme) show elevated *E.coli* concentrations, then FST analysis is undertaken by ESR (Institute of Environmental Science and Research, based in Christchurch).

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[1] Ministry for the Environment, Ministry of Health. 2003. *Microbiological Water Quality Guidelines for Marine and Freshwater Recreation Areas.* Ministry for the Environment, Wellington.

RESULTS

[6] Results from ORC's recreational monitoring programme are shown in Figure 1 below. Figure 2 shows results from faecal source tracking analysis.

Results	Site				Resample			Resample	Resample		Resample	Resample	Resample	
		3-Dec-18	10-Dec-18	17-Dec-18	20-Dec-18	28-Dec-18	3-Jan-19	5/01/2019	6-Jan-19	7-Jan-19	8-Jan-19	9-Jan-19	10-Jan-19	14-Jan-19
Waitaki District														
Freshwater	Kakanui River at Clifton Falls	548	770	649		613	921			2420				2420
Marine	Kakanui Estuary at Kakanui Bridge	41	10	10		30	63			862				52
	Hampden Beach	10	10	10		20	10			173				10
Dunedin City														
Freshwater	Taieri River at Outram Glen	291	153	153		291	43			2420	14			228
	Waikouaiti at Bucklands	166	11	228		75	64			2420				921
Marine	Otokia Creek at Brighton	10	52	10		74	121			1106	68			763
	Macandrew Bay	10	10	10		52	10			1401	92			30
	Waikouaiti Estuary	10	20	10		10	10			350				10
Clutha District														
Freshwater	Lake Waihola at Jetty	14	15	172		31	56			153				22
Marine	Kaka Point	10	10	10		10	10			10				10
	Catlins at Pounawea	10	10	10		20	10			10				10
Central Otago District Council														
Freshwater	Taieri River at Waipiata	214	517	172		130	140			2420				1414
	Lake Dunstan at Alpha Street	14	9	>2420		3	2			10				1
	Lake Dunstan at Clyde Rowing Club	73	3	12		1	21			11				15
	Manuherikia River at Shaky Bridge	152	140	101		141	102			2420	370			435
Queenstown Lakes District														
Freshwater	Lake Hayes (Shallows)	43	16	687	39	2	88			770		410	77	4
	Lake Wanaka at Roys Bay	4	3	22		3	109			225				37
	Lake Hawea at Holiday Park	5	5	6		5	6			1				1
	Lake Wakatipu at Queenstown Bay	31	3	816	10	2	488	920	92	345		2400	410	3
	Lake Wakatipu at Frankton Bay	16	22	57		2	517	56		1414		250	85	1

Figure 1 Results from contact recreation sampling December 2018 to January 2019. Green cells show water quality is good and risk to health is low (E.*coli* <260 cfu/100ml), amber cells indicate the health risk has increased (*E.coli* 260-550 cfu/100ml) and red cells indicate an unacceptable health risk (*E.coli* >550cfu/100ml)

Site	Date Received	*E. coli* cfu/100ml	General GenBac / 100 mls	Human BacH / 100 mls	Human BiADO / 100 mls	Ruminant BacR / 100 mls	Proportion Ruminant	Ruminant Sheep / 100 mls	Ruminant Cow / 100 mls	Avian GFD / 100 mls
Kakanui at Clifton Falls	03/12/2018	548	30,000	42	<21	1,500	10-50%	9	13	39
Kakanui at Clifton Falls	10/12/2018	770	32,000	<17	<21	1,000	10-50%	23	3	42
Kakanui at Clifton Falls	18/12/2018	649	20,000	22	<21	740	10-50%	46	<2	26
Lake Wakatipu at Queenstown Bay	18/12/2018	816	44,000	<17	<21	<18	ND			280
Lake Hayes at Mill Creek Shallows	18/12/2018	687	49,000	<17	<21	270	1-10%			170

Figure 2 Faecal Source Tracking results

DISCUSSION

[7] LAWA reports that 'water quality at many river and beach swimming spots is affected in wet weather as a result of urban or rural runoff. In urban areas rainwater collected from roofs, roads, car parks and other surfaces is piped directly into rivers, streams and the coast. During its travels, this storm water picks up sediment, rubbish, contaminants, and dog and bird droppings. Sewer overflows can also occur in urban areas during wet weather. In rural areas, excess rainwater flows over the land and into nearby streams and rivers, picking up manure and other contaminants along the way. At some river, lake and coastal sites, heavy rain and wind can churn up sediments from the bottom of the waterway or sea, releasing pathogens in the sediments back into the water.

[8] Many of the 'exceedances' in Figure 1 (orange and red cells) are related to high rainfall the day prior to the sample being taken. For example, widespread rainfall fell across

Otago on the 6-Jan-19 which adversely affected results from sampling on 7-Jan-19, similarly high rainfall on the 13-Jan-19 adversely affected results from sampling on 14-Jan-19.

[9] Queenstown Lakes District Council, following elevated *E.coli* concentrations from ORC sampling, resample every day until *E.coli* concentrations return a result below 260 cfu/100ml. QLDC has resampled three sites (Lake Hayes, Lake Wakatipu at Queenstown Bay and Lake Wakatipu at Frankton Bay), results are shown in Figure 1. Results from resampling are available the next day (QLDC use the Watercare laboratory in Queenstown) and results are reported on LAWA.

[10] Otago Regional Council has resampled sites in Central Otago (using analysis provided by Watercare) and Dunedin City (using analysis provided by Eurofins in Dunedin), these results are returned the next day and reported on LAWA.

[11] FST results are shown in Figure 2.

a. At all sites there is no or little evidence of a human source in the samples tested (both human markers are required to be present for a positive human result).
b. In the Kakanui samples, both avian and ruminant sources were detected and relative to the general marker the ruminant source accounts for 10-50% of the general marker detected. Further testing indicated that the ruminant source was both sheep and cow, but only sheep on the 18-Dec-18.
c. In Lake Hayes, the proportion ruminant was 1-10% which suggests a very minor contribution from ruminant, the majority being avian.
d. In Lake Wakatipu there is no evidence of either human or ruminant markers, only an avian source was detected.

[12] The samples taken at Queenstown Bay on 17-Dec-18, 3-Jan-19, 5-Jan-19 were taken in 'choppy, rough' conditions and clean samples were difficult to take. The FST informs us that bird species are likely a significant source of bacteria and it is known that gull/duck faeces has a naturally high concentration of *E.coli* compared to other sources.

[13] It is likely that the shores of the lake are a non-point source of *E.coli* contamination (from gulls/ducks). Strong northerly winds bring waves to the beach, those waves churn up the sand/sediment and carry the *E. coli* back out into the water.

[14] The Kakanui at Clifton site has recorded consistently high *E.coli* concentrations this season. In 2013 an investigation concluded that roosting gulls in the gorge upstream of Clifton were the cause of the high *E.coli* concentrations, this investigation is to be repeated (with FST analysis) at sites above and below the gull colonies, when flows have receded.

NEXT STEPS

[15] An update will be provided in March

ATTACHMENTS

Nil

10.4. Wanaka Basin-Cardrona Gravel Aquifer Groundwater Model Report

Prepared for: Technical Committee
Report No. PPRM1867
Activity: Environmental: Water
Author: Neil Thomas, Groundwater Service Leader (Pattle Delamore Partners Ltd)
Endorsers: Tanya Winter, Director Policy Planning and Resource Management
Date: 9 January 2019

PURPOSE

[1] This report details the results of a groundwater model developed by Pattle Delamore Partners ('PDP') that simulates the effect of groundwater abstraction on surface water flows and recommends an appropriate allocation approach. The findings from the study are included in the Wanaka Groundwater Model Report (*Attachment 1*).

EXECUTIVE SUMMARY

[2] The National Policy Statement for Freshwater Management 2014 (amended 2017) ('NPSFM') requires the Otago Regional Council ('ORC') to set allocation limits and a minimum flow or water levels for all Freshwater Management Units in the Otago region.

[3] To meet the requirements of the NPSFM, ORC is moving through a process of collecting technical information that will support the process of setting tailored groundwater allocation limits for the Wanaka Basin/Cardrona Alluvial Gravel Aquifer ('Wanaka Aquifer') and connected surface water resources, such as the Cardrona River and Bullock Creek.

[4] ORC developed an initial computer model of the Wanaka Aquifer in 2011, which was used to investigate the potential effect of varying the groundwater allocation on flows in the Cardrona River and Bullock Creek. Since 2011, further data have been collected, including surface water flows along the Cardrona River and flows in Bullock Creek, as well as additional groundwater level data. PDP were engaged by ORC in 2017 to recalibrate and update the Wanaka Basin groundwater model to include the new data.

[5] The model indicates that the area to the east of a line north east of Mt Barker is poorly connected to the Cardrona River and Bullock Creek. Therefore, an appropriate groundwater allocation approach to the Wanaka Basin could be to split the area into two zones. One zone represents the areas where groundwater abstraction will affect flows in the Cardrona River and in Bullock Creek, and the recommended limit in that area should be defined on the basis of an acceptable stream depletion effect. The second zone would represent the area to the east of a line north-east of Mt Barker to the Clutha River.

RECOMMENDATION

That the Committee:

1) Notes this report.

2) Notes that the Wanaka Groundwater Model Report will be made publicly available and will be provided to Cardrona catchment water users.

BACKGROUND

[6] The National Policy Statement for Freshwater Management 2014 (amended 2017) ('NPSFM') requires the Otago Regional Council ('ORC') to set allocation limits and a minimum flow or water levels for all Freshwater Management Units in the Otago region.

[7] To meet the requirements of the NPSFM, ORC is moving through a process of collecting technical information that will support the process of setting tailored groundwater allocation limits for aquifers in Otago. In the Wanaka Basin / Cardrona Alluvial Gravel Aquifer ('Wanaka Aquifer'), groundwater is closely connected to the Cardrona River where groundwater discharge supports flows in the lowest section of the river. Aquifer discharges also support baseflows in Bullock Creek which flows through the centre of Wanaka township. Groundwater abstraction will affect baseflow in these connected surface waterways and therefore an integrated maximum groundwater allocation limit (MAL) that accounts for the effect of groundwater abstraction on surface water flows is required.

ISSUE

[8] ORC developed an initial computer model of the Wanaka Aquifer in 2011, which was used to investigate the potential effect of varying the groundwater allocation on flows in the Cardrona River and Bullock Creek. Computer simulations of groundwater include many parameters which are frequently poorly defined at the start of a modelling exercise. However, the model parameters can be constrained by comparing the model estimate of groundwater levels and surface water flows to observed groundwater levels and flows. Due to limited data, the initial model was not constrained to surface water flows and therefore the forecasted effects of varying the groundwater allocation on flows was uncertain.

[9] Since 2011, further data have been collected, including surface water flows along the Cardrona River and flows in Bullock Creek, as well as additional groundwater level data. PDP were engaged by ORC in 2017 to recalibrate and update the Wanaka Basin groundwater model to include the new data. Specific objectives of the recalibration included:

- Estimate the effects of groundwater abstraction on baseflows in the lower part of the Cardrona River and in Bullock Creek;
- Quantify the modelled uncertainty associated with those estimates;
- Consider the effect of additional groundwater abstraction on groundwater levels and existing groundwater users;
- Consider the effect of irrigation on groundwater levels; and

- Consider potential allocation options across the Wanaka Basin.

DISCUSSION – MODEL RESULTS

Groundwater movement in the Wanaka Cardrona Gravel Aquifer

[10] The Wanaka Aquifer is bounded by Lake Wanaka to the west, the Clutha River to the north and east, and by low permeability schist strata to the south. Groundwater in the aquifer is sourced from rainfall recharge (including additional recharge due to irrigation) as well as seepage losses through the bed of the Cardrona River. Proportionally, seepage losses from the Cardrona River are calculated to make up a large part (around 60%) of the aquifer water balance.

[11] Groundwater movement in the aquifer is from the south-west towards the main aquifer discharge points which are the Cardrona River downstream of the State Highway 6 Bridge, and Bullock Creek. Groundwater discharge also occurs into the Clutha River to the north-east and Lake Wanaka to the north-west.

[12] A computer model has been developed to represent that system and to estimate the effect of groundwater abstraction on flows in the Cardrona River. The groundwater model was calibrated to, and represents well, the flows in the Cardrona River at Ballantyne Road and the Clutha confluence, in Bullock Creek and groundwater levels at a number of points within the aquifer.

Effects of groundwater abstraction on surface water flows

[13] The model suggests that there is a lag between the onset of abstraction and surface water depletion effects in the river such that the effect of overall abstraction on the river will eventually approach the long-term average annual abstraction rate after around 10 years of pumping. The overall effect of peak groundwater abstraction rates on river flows are likely to be smoothed and attenuated in time. That is in contrast to the effect from surface water abstractions, where the peak effect of abstraction on river flows occurs immediately. However some groundwater abstractions located close to the surface waterways will have a more immediate effect. The model also indicates that, in areas progressively further east of the Cardrona River, groundwater has a progressively smaller connection to the Cardrona River.

[14] The existing allocation to consented groundwater takes across the Wanaka Basin (as the aquifer is currently defined) is approximately 8.4×10^6 m^3/year (excluding dewatering takes). However, the consented allocation from the aquifer exceeds actual groundwater abstraction. Based on metered groundwater abstraction rates over the last 3 years (from July 2015 to July 2018), the average actual groundwater abstraction rate is around 42 L/s (1.3×10^6 m^3/year). The model results indicate that average abstraction rate results in around 23 L/s of flow depletion in the Cardrona River, and around 10 L/s of flow depletion on Bullock Creek on average. The remaining effect occurs on the Clutha River and Lake Wanaka.

[15] To put that current effect of abstraction into context, baseflow in the Cardrona River is around 300 L/s at the Clutha confluence, meaning that actual groundwater abstraction reduces baseflow by around 8%. Likewise, baseflow in Bullock Creek is in the order of 400 L/s and therefore the current depletion effect is around 3% of low flows.

[16] The model represents the groundwater system between 2015 and 2018 and, on average, actual groundwater abstraction during that time was around 10% of the consented allocation. Therefore, effects on the river could increase if users utilised more of their consented allocation. To maintain the status quo and avoid further decline in the baseflows in the Cardrona River and Bullock Creek, the current level of groundwater abstraction should not increase further.

Modelled uncertainty

[17] Analysis of the model and its predictions indicates that there is some uncertainty around those predictions, and the peak effect of abstraction on low flows falls into a 95th percentile confidence range of approximately 23 L/s ±11 L/s for the Cardrona River and 9.7 L/s ±2 L/s for Bullock Creek.

Effects of abstraction and irrigation on groundwater levels

[18] Groundwater abstraction also results in a reduction in groundwater levels. Based on existing rates of abstraction, the greatest decline predicted using the model will occur to the east of the Cardrona River, where declines of up to 0.5 m occur. However, smaller declines of up to around 0.3 m are also predicted to occur to the west of the Cardrona River.

[19] There is extensive irrigation across the Wanaka Basin both to the east and west of the Cardrona River. Irrigation water is sourced from both groundwater and also from significant intakes along the Cardrona River. That irrigation has the effect of locally increasing groundwater levels, particularly where border dyke irrigation is used. Based on the model results, irrigation increases groundwater levels by up to 0.4 m in some areas of localised border dyke irrigation. Smaller increases of around 0.1 m occur elsewhere across the model area.

OPTIONS

[20] Groundwater allocation typically intends to achieve specific aims and outcomes, including the protection of values assigned to surface water receptors that are dependent on groundwater discharges. The key surface water receptors within the Wanaka Basin are the Cardrona River and Bullock Creek. Both surface water receptors have values assigned to them, although specific low flow limits are not yet defined. Therefore, it is not yet possible to set a groundwater allocation limit which is based on achieving the low flow limits in the key surface water receptors.

[21] The 2011 study resulted in the development of two allocation options, including a single allocation limit of 5×10^6 m^3/year across the whole aquifer and an allocation limit of 8×10^6 m^3/year, together with trigger level restrictions across the eastern part of the aquifer. The model was used to investigate the effect of each of these options on flows in the Cardrona River and Bullock Creek.

Option 1: Allocation limit of 5×10^6 m^3/year

[22] Scenario runs using the groundwater model indicate that if actual abstraction rates increased to a seasonal total of 5×10^6 m^3/year baseflows in the Cardrona River could reduce by around 86 L/s (±34 L/s) and by around 36 L/s (±5.7 L/s) in Bullock Creek.

[23] A single allocation limit is simple to implement and easier for users of the resource to understand. However, the main disadvantage of a single groundwater allocation limit is that it effectively assumes that abstraction of groundwater from any part of the aquifer has the same peak effect on flows in the river, which may not be accurate in the Wanaka Basin.

Option 2: Allocation limit of 8 x 10^6 m^3/year plus trigger levels

[24] Based on the results from this model, an allocation limit of 8 x 10^6 m^3/year across the whole aquifer would result in stream depletion effect of 140.3 L/s (±46 L/s) on flows in the Cardrona River and stream depletion effects of up to 58.7 L/s (± 6.9 L/s) in Bullock Creek.

[25] Currently, the trigger levels where restrictions may be imposed are not yet defined. Furthermore, there is limited data across the easternmost part of the aquifer to derive a trigger level that could be related back to an allocation limit and the area over which those restrictions could be applied is also not yet defined. Therefore, setting a reasonable trigger level may be difficult based on the current state of knowledge for that part of the aquifer and Option 2 may be difficult to implement.

Alternative Option 3: Split allocation zone

[26] The alternative approach to setting a single allocation limit to the whole aquifer is to split the aquifer into two allocation zones. The purpose of restricting aquifer abstraction would be to protect flows in Bullock Creek and the Cardrona River. Hence it would be reasonable to apply a different limit to areas of the aquifer located some distance from those receptors, and where groundwater abstraction has little effect on flows.

[27] The model indicates that the area to the east of a line north east of Mt Barker is poorly connected to the Cardrona River and Bullock Creek (Figure 1 below). Therefore, an appropriate groundwater allocation approach to the Wanaka Basin could be to split the area into two zones. One zone represents the areas where groundwater abstraction will affect flows in the Cardrona River and in Bullock Creek, and the recommended limit in that area should be defined on the basis of an acceptable stream depletion effect.

[28] The second zone would represent the area to the east of a line north-east of Mt Barker to the Clutha River. If the thresholds in the Regional Plan: Water are applied in this eastern zone, the allocation limit should be set to around 0.75 × 10^6 m^3/year, representing 50% of recharge. Based on existing data, this limit may already be exceeded by existing groundwater abstraction consents. If the depletion effects on the Clutha River and local groundwater level effects are considered acceptable it is possible allocation could exceed 50% of recharge.

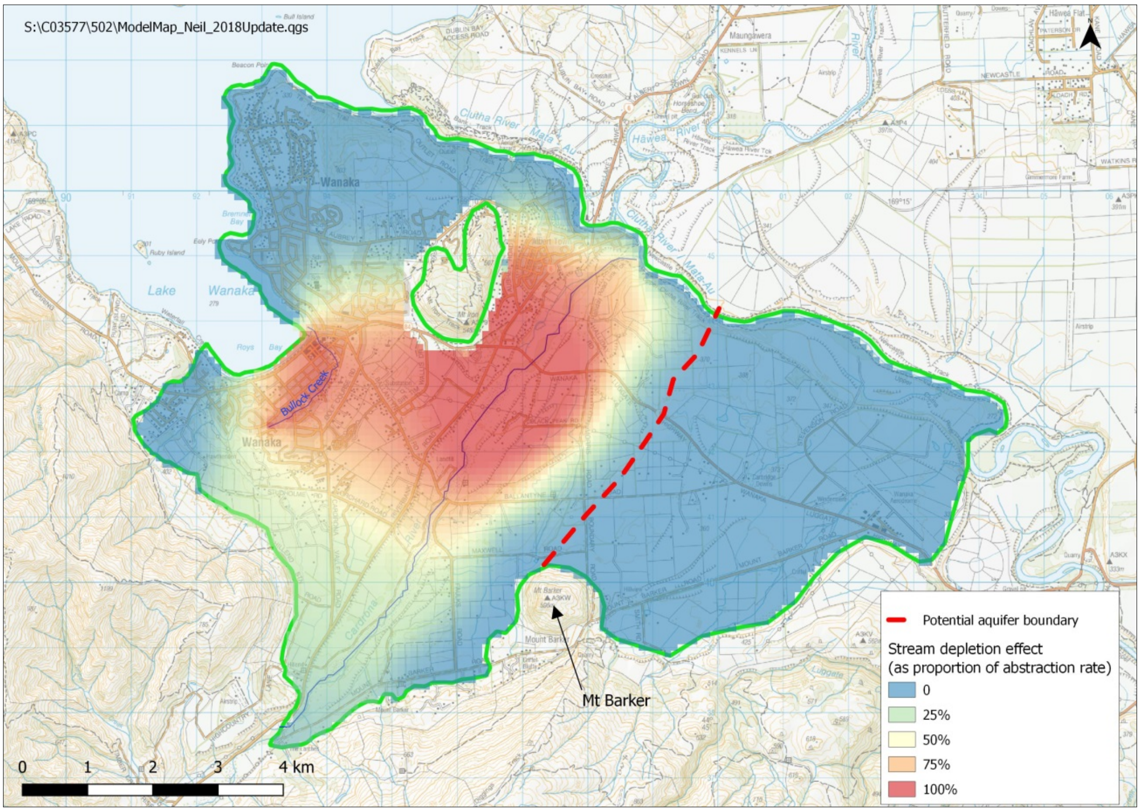

Figure 1: Map of stream depletion effects on the Cardrona River and Bullock Creek. Groundwater abstraction in areas shaded in blue will have very little or no effect on flows in the Cardrona River or Bullock Creek.

Evaluation of allocation options

[29] The Wanaka Aquifer groundwater model report identifies the splitting of the existing allocation zone (Option 3) as the most appropriate of these three options. This approach would ensure that users who are taking groundwater from parts of the aquifer that are more distant from the Cardrona River and/or Bullock Creek are not unduly restricted by a single allocation limit based on stream depletion effects on those surface waterbodies. Those distant takes would primarily affect the Clutha River.

[30] If this option to split the aquifer is pursued, careful consideration of the effect of abstraction on surface water flows, within only the western zone of the aquifer, will be required to ensure that the allocation limit is appropriate.

[31] The analysis may imply that no further groundwater should be allocated from the eastern zone, because the existing allocation is likely to be greater than the 50% of recharge threshold specified in the Regional Plan: Water. However, consideration of an appropriate specific limit would involve setting acceptable depletion effects on the Clutha River and groundwater levels.

[32] In addition, the actual water use compared to allocation could be reviewed to ensure that water is being used efficiently.

CONSIDERATIONS

Policy Considerations

[33] This report is for noting only. Therefore, there are no policy considerations at this time.

Financial Considerations

[34] As this report is for noting only, there are no financial implications at this time.

Significance and Engagement

[35] Not applicable.

Legislative Considerations

[36] Not applicable.

NEXT STEPS

[37] The findings from the Wanaka Groundwater Model Report will be used in the development of environmental flows and levels / allocation limits for the freshwater resources (surface water and groundwater) of the Cardrona Catchment and Wanaka Basin-Cardrona Gravel Aquifer. However, the development of these environmental flows and levels and allocation limits will involve the consideration of other technical studies and a broader range of ecosystem and community values.

ATTACHMENTS

1. Attachment 1 - Wanaka Groundwater Model Report prepared by Pattle Delamore Partners for the Otago Re **[10.4.1]**

11. NOTICES OF MOTION

12. CLOSURE