TECHNICAL COMMITTEE AGENDA

WEDNESDAY 21 MARCH 2018

Edinburgh Room, Municipal Chambers, The Octagon, Dunedin, commencing 9:00am

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 8:30 am on Monday 19 March 2018. Reports and recommendations contained in this agenda are not to be considered as Council policy until adopted.

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1. APOLOGIES

2. LEAVE OF ABSENCE

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4. CONFIRMATION OF AGENDA

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 31 January 2018 be received and confirmed as a true and accurate record.

Attachments

1. Minutes of the Technical Committee - 31 January 2018 **[8.1.1]**

9. ACTIONS

Status report on the resolutions of the Technical Committee.

Attachments

Nil

10. MATTERS FOR COUNCIL DECISION

11. MATTERS FOR NOTING

11.1. Floodbank Structural Integrity Assessment

Prepared for: Technical Committee
Activity: Governance Report
Prepared by: Chris Valentine, Manager Engineering
Date: 14 March 2018

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1. Précis

Tonkin and Taylor have undertaken a quantitative and qualitative assessment of scheme floodbanks[1]. This included a stability and integrity assessment of 214 km of scheme floodbanks located on the Lower Taieri and Lower Clutha floodplains, and in Alexandra. These floodbanks are essential to the operation of the Lower Taieri Flood Protection Scheme, Lower Clutha Flood and Drainage Scheme, and Alexandra Flood Protection Scheme. The purpose of the assessment was to determine the level of risk posed to the community and ensure the agreed level of service is being achieved. The assessment was a combination of field visual condition inspection and rating, field survey, and subsequent desktop analysis. It concluded that the floodbanks for all three schemes are in good condition and likely to perform well in a flood. Several issues were observed, and concerns raised which have been reported on in the assessment. These issues have been prioritised and will be addressed accordingly.

The flood on the 21 July 2017 proved a significant test to the standard of the Taieri floodbanks and provided an opportunity to repeat localised site inspections of condition immediately after the flood receded. Field observations immediately after the flood highlighted some vulnerabilities that were subsequently included in the project scope. The cause of and risk associated with the significant seepage observed at Mill Creek pump station, piping observed at Outram and seepage reported at the Silver Stream pump station were all incorporated into the project scope along with other observations from the flood.

The assessment has indicated some sections of the Lower Taieri Flood Protection Scheme that warrant further investigation. Investigations and actions with a higher priority will be undertaken this financial year from existing budgets; other investigations and significant physical works have been incorporated into the 2018/2028 Draft Long Term Plan (LTP).

2. Background

Flood protection on the Taieri plain dates back to the late nineteenth century with the scheme being improved and expanded over time (Figures 1, 2 and 3). Significant improvements and upgrades occurred after the 1980 flood. The Clutha flood defences started later on the Clutha Delta and were generally completed in the 1980s. The Alexandra Flood Protection Scheme was commissioned in 2003 because of significant flooding in 1994 and 1995 which was exacerbated by sediment deposition in Lake Roxburgh as a consequence of the Roxburgh hydro dam construction. The three schemes have a total of 214km of floodbank.

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[1] Floodbank Condition and Structural Integrity Assessment, Tonkin and Taylor (2018).

Reliable floodbanks are fundamental to the safety and viability of the communities they protect[1]. The 2016/17 Annual Plan included a performance target to "*Assess conditional and structural integrity of scheme floodbanks*" for the Lower Clutha, Lower Taieri, and Alexandra Schemes. Following a competitive tender process Council awarded a contract to assess floodbank capacity, condition and integrity, and structural strength and stability under design flood and earthquake conditions to Tonkin and Taylor. The scope was expanded in August 2017 after the July flood. A similar condition assessment was undertaken by Tonkin and Taylor for ORC in 2005[2].

The 2005 assessment only covered the Clutha and Taieri floodbank networks as the Alexandra floodbanks were relatively new. The 2005 assessment represents an important benchmark to measure the current floodbank condition against and successively into the future. The methodology follows the criteria set out in the Code of Practice (COP) for performance assessment of floodbank assets, developed jointly by regional councils. The purpose of the COP is to create a best practice guideline to provide a framework for assessing condition of flood protection assets.

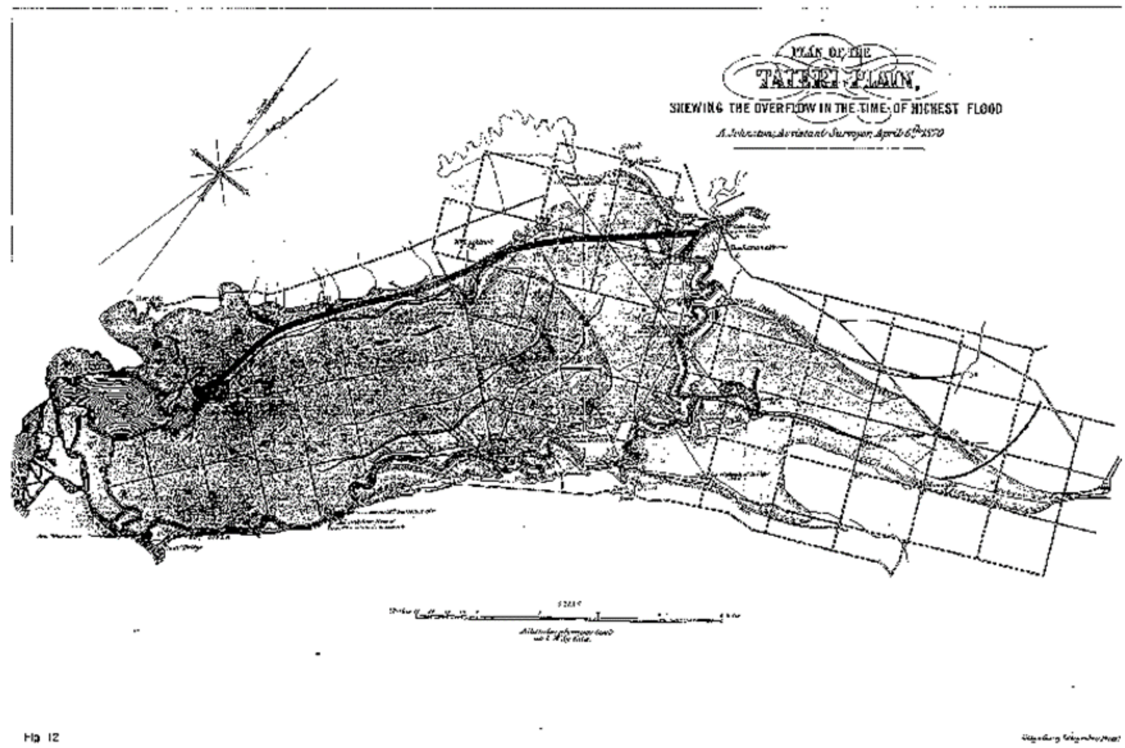

Figure 1 – Area of inundation of Lower Taieri floodplain in 1868 and concepts for some flood protection works

[1] Rangitaiki River Scheme Review April 2017 Flood Event - Final Report 17 September 2017 - Reference: A1046178, presented to the 29th November 2017 Technical Committee.

[2] Floodbank Stability Assessment, Lower Clutha and Taieri Flood Protection Schemes - Report 2005-486, presented to the 7th September 2005 Engineering and Hazards Committee.

Figure 2 – Area of inundation of Lower Taieri floodplain in 1923

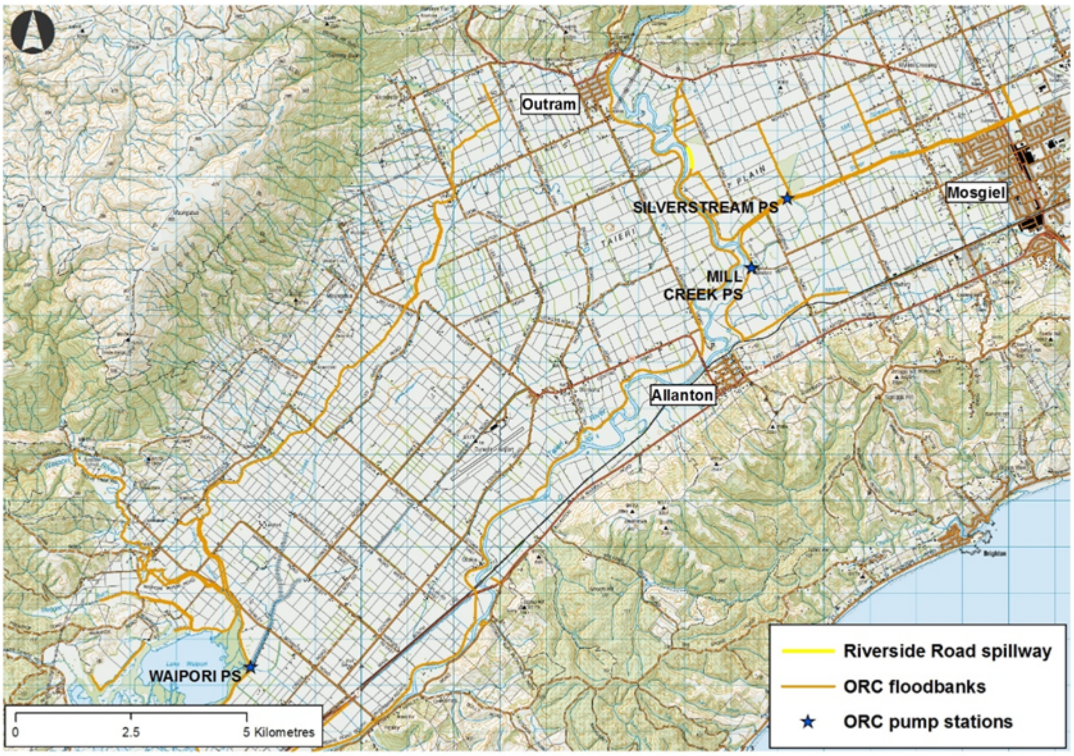

Figure 3 – Map showing location of pertinent infrastructure to flood and drainage schemes on the Taieri.

3. Results

Floodbanks are susceptible to failure from a number of different modes of failure. The following modes of failure have been investigated:

- Overtopping during flood conditions leading to erosion/scour,
- Slope and foundation stability under static, non-flood conditions,
- Slope and foundation stability under flood conditions,
- Slope and foundation stability under seismic conditions, including consideration of liquefaction.
- Seepage through the floodbank and/or foundation of the floodbank leading to internal erosion/piping.

3.1 Floodbank Slope Stability

The static stability of ORC floodbank structures during non-flood and flood conditions has generally been accessed by Tonkin and Taylor as adequate. Floodbanks with steep riverside slopes are identified on the Lower Clutha Flood Protection and Drainage Scheme and Waipori River (Lower Taieri Flood Protection Scheme). The floodbank can be stable but the lack of berm[1] in some locations raises the potential for undermining of the floodbank, especially on outside bends. The likelihood of failure during an event is considered low if regular field observations are undertaken to identify and address any signs of scour early.

3.2 Freeboard and Overtopping Scour

Earth floodbanks are susceptible to failure due to erosive forces under overtopping (i.e. during superdesign events or in locations with less than design freeboard). Understanding the likelihood and location of overtopping is a requirement for understanding the likelihood and consequence of floodbank breaches for Lower Taieri and Lower Clutha. Figures 4 and 5 below show graphically the likelihood of failure due to overtopping of the floodbanks. In many cases, the likelihood of overtopping can be high, but with proper design of the floodbank the likelihood of scour and consequentially floodbank failure will be low.

[1] The land between the floodbank and the edge of the river channel. This acts as a sacrificial buffer during floods.

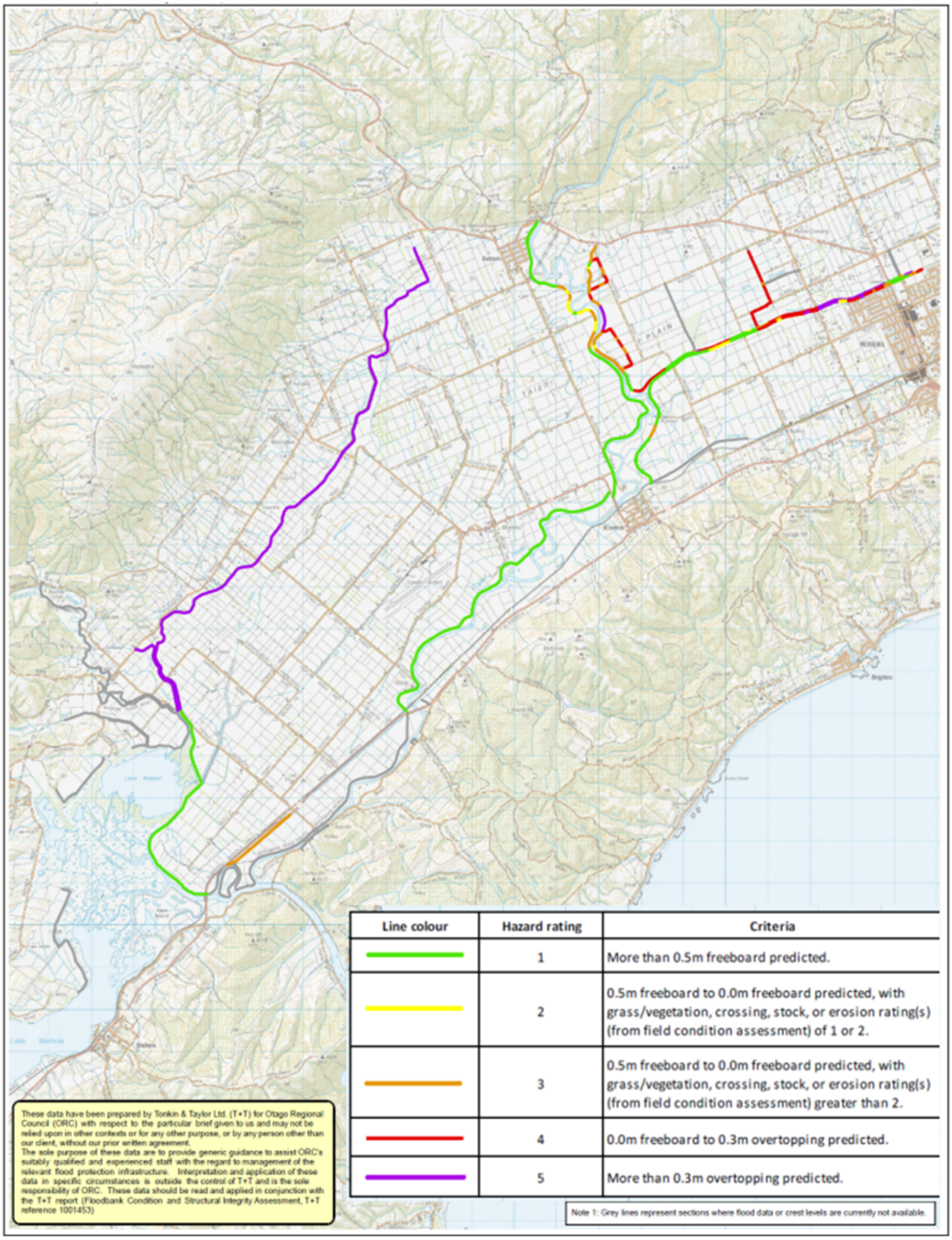

Figure 4 – Overtopping Risk for Lower Taieri Flood Protection Scheme

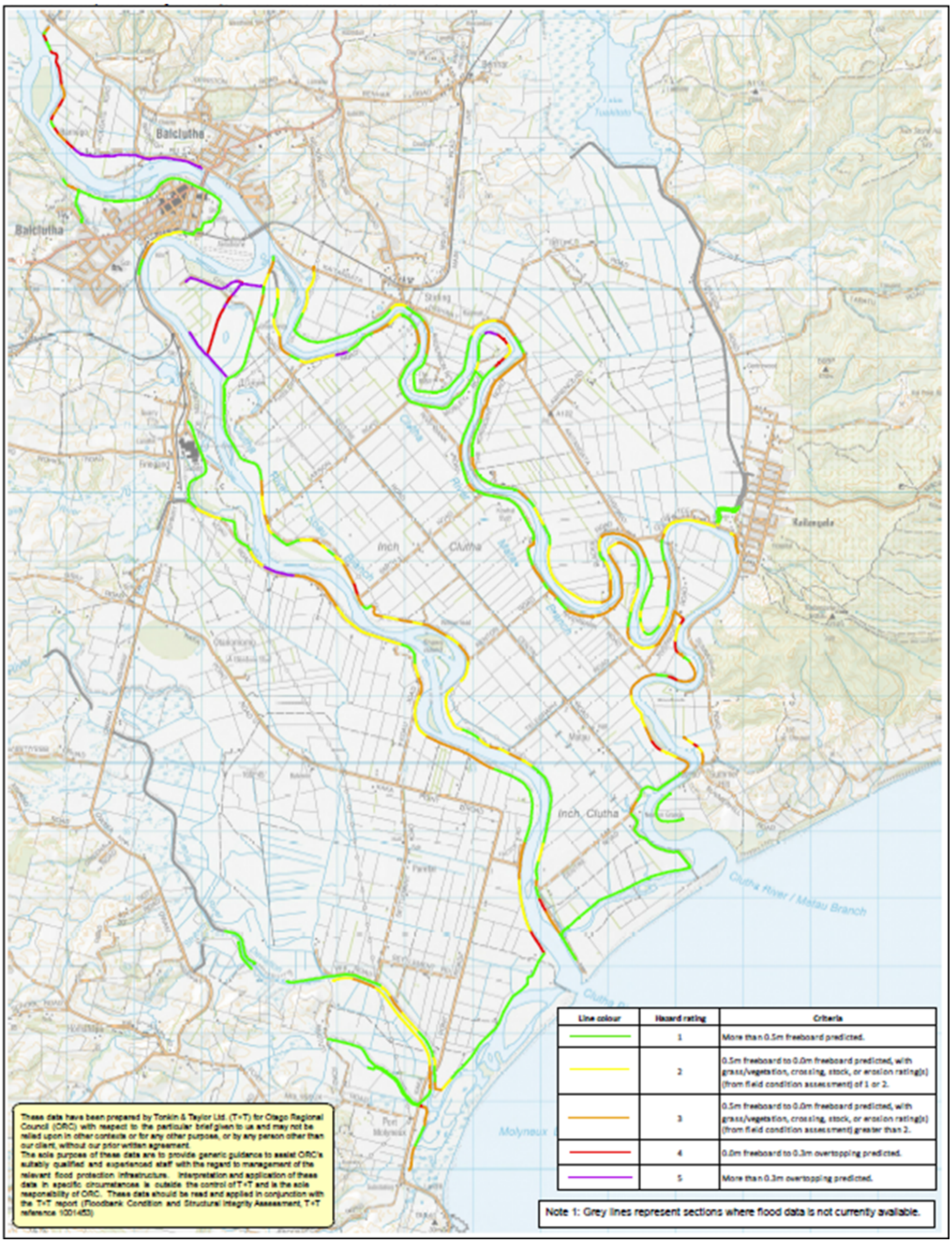

Figure 5 – Overtopping Risk for Lower Clutha Flood and Drainage Scheme

3.3 Maintenance

During their walkover assessment of the networks, Tonkin and Taylor noted a number of maintenance issues. Most relate to on-going management issues such as stock damage, vehicle crossings and trees in close proximity to floodbanks, and a schedule of these observations and their locations has been supplied. Staff are already investigating and actioning some of these issues and the remainder will be inspected and progressed according to priority.

3.4 Liquefaction Risk

The Tonkin and Taylor report has highlighted the risk of liquefaction failure of the Waipori floodbank in a 1000-year return period earthquake. Detailed investigative work has already been carried out on the Waipori section of floodbank[1] but to a lesser return period of 500 years. The 2018 Tonkin and Taylor report concluded that the Waipori floodbank is likely to be compromised in a large earthquake, as such ORC is developing appropriate contingency plans. A failure of the Waipori floodbank would result in flooding of West Taieri similar to the June 1980 floods. The area includes Dunedin International Airport. The possible extent of inundation is shown in Figure 6 for a "sunny day" failure. The actual area inundated depends on sea level and is therefore influenced by tidal state and future climate change.

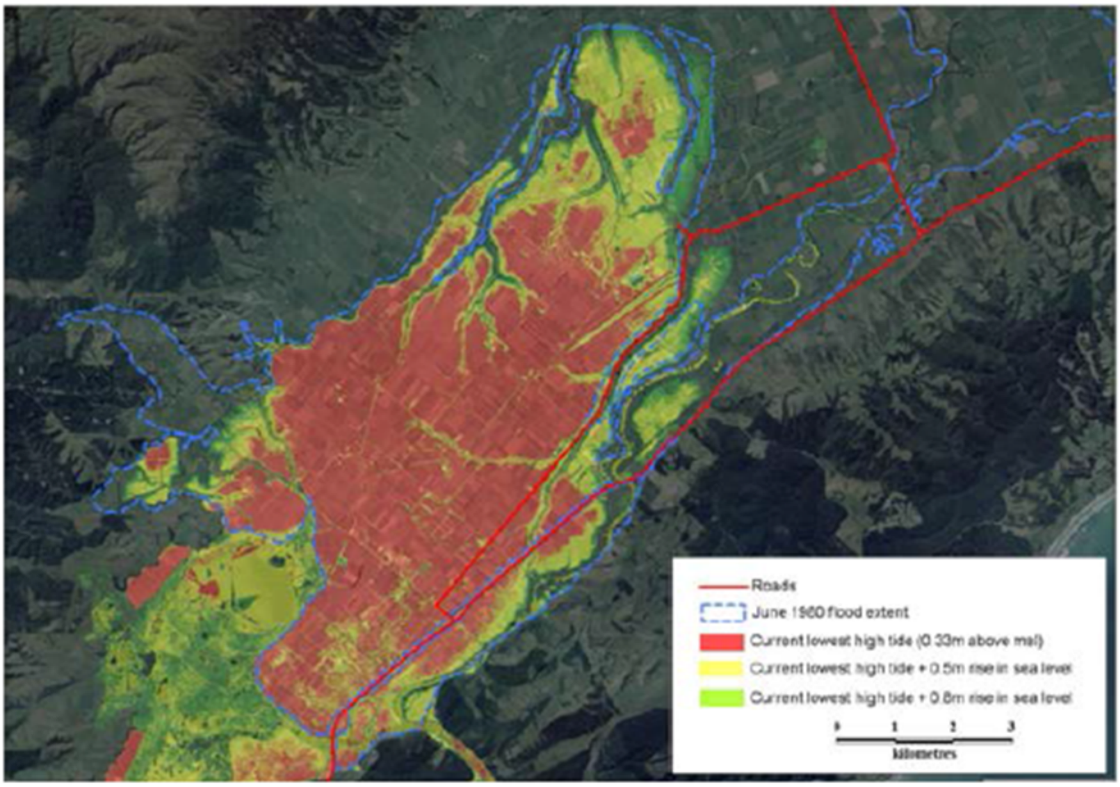

Figure 6 – Extent of inundation in West Taieri following the hypothetical failure of Waipori floodbank on a "sunny day". Note the correlation with June 1980 flooding and the floods of 1868 and 1923 (Figures 1 and 2).

4. Learning from July 2017 Flood

An additional component to Tonkin and Taylor's brief was to undertake a detailed assessment of areas where seepage, scour, or instability was observed during or after the July 2017 flood. These areas are outlined below.

4.1 Mill Creek Pump Station

Seepage of floodwaters around the downstream interface of the Mill Creek pump station floodbank interface resulted in a piping failure starting from seepage past the soil sheetpile interface resulting in significant internal erosion of the floodbank fill (Figure 7). The failure occurred progressively over several hours on the morning of 22 July 2017. Failure of the Taieri River left bank floodbank in this location would result in

[1] GeoSolve (2016). Seismic Assessment of the Waipori Floodbank

significant and catastrophic flooding of over 800ha of farmland and damage to infrastructure including the Mill Creek pump station itself.

A temporary fix has been undertaken which includes an engineered fill material within the floodbank void and around the floodbank to sheetpile interface, along with heightened emergency preparedness including having materials readily available to mitigate any further seepage. A long-term design solution and construction thereof has been allowed for in the first year of the 2018/2028 Draft Long Term Plan. The solution will aim to be consistent with modern design standards and include provision for controlled internal drainage of any seepage water with adequate capture of fine materials.

Figure 7 – Mill Creek Pump Station. Left Photo: Cavity scoured away within floodbank post July 2017 event. Right Photo: Sandbags installed during event to arrest seepage of floodwater through Taieri left bank floodbank.

4.2 Piping

During a flood, water can seep beneath a floodbank, especially where the floodbanks are relatively high, or foundation soils have some permeability, and where the flood has a relatively long duration. Piping is the process by which fine materials are removed by the seeping water from beneath a floodbank resulting in increased seepage and acceleration of sediment removal, until ultimately the floodbank fails. Observations during the July 2017 flood at Outram and along Allanton Road showed signs of seepage with very small boils of sediment observed. Failure of the Taieri River right floodbank at Outram could result in flooding to 7000ha of land, including the townships of Outram and Momona, Dunedin International Airport and significant infrastructure.

The results of the Tonkin and Taylor investigation show that seepage is likely to occur on the Taieri and Clutha floodbanks during floods at or close to the design event. The likelihood of floodbank failure due to piping is generally low to very low for both schemes. The likelihood of piping in Alexandra is very low due to the modern construction and ground conditions.

4.3 Riverside Road Spillway

Tonkin and Taylor have raised concerns about the performance of the Riverside Road spillway structure at a design level event (Figure 8). Failure of the spillway would severely compromise the operation of the Lower Taieri Flood Protection Scheme in both East Taieri and West Taieri, as the peak flow attenuation would be compromised. It would also potentially cause sudden and catastrophic flooding of the East Taieri Upper Pond. Further review of performance and integrity have been recommended and strengthening works are likely required subject to the outcome of that assessment. Allowance has been made in the 2018/2028 Draft Long Term Plan for these assessments and future works. In the interim, repairs will be necessary following any significant future overtopping events. The extent of damage will be proportional to the magnitude and duration of overtopping.

Figure 8 – Riverside Road Spillway showing scour damage post July 2017 flood.

4.4 Silver Stream Pump Station

Floodbank seepage adjacent to the true left abutment was observed by staff during the July 2017 flood event. Failure of the Silver Stream right floodbank at the Silver Stream pump station would compromise the performance of the Lower Taieri Flood Protection Scheme and potentially lead to failure of further floodbanks affecting land within the East Taieri Lower Pond and/or parts of West Taieri. Based on recent events at the nearby Mill Creek Pump Station, initial indications are that piping may be developing at Silver Stream Pump Station. Further assessment and reinstatement work involving subsurface investigation has been recommended. Scour has occurred below the concrete head wall which incorporates the pump station discharge pipes. Investigations into options to address this scour are underway. There is also uncertainty with the condition of the pump discharge pipes, this requires further investigation which is now underway.

5. Discussion

Vulnerabilities that have been identified by Tonkin and Taylor will be prioritised and addressed based on risk. Issues identified are being addressed through the 2018/2028 Draft Long Term Plan or in the current financial year under operational budgets. It is important that all issues are closely monitored, and appropriate emergency action plans are in place until the vulnerabilities identified are addressed.

More detailed investigative work is planned for the current financial year regarding Mill Creek and Silver Stream pump stations, Riverside Road spillway, and Outram piping where a high risk of failure has been identified. Remedial work could be extensive, and allowance has been made in the 2018/2028 Draft Long Term Plan to investigate and implement solutions over a number of years.

Table 1 details the estimated cost of future work linked to the findings and recommendations in the Tonkin and Taylor floodbank investigation, for budget planning purposes. Cost estimates will be reviewed and refined over time. The final scope and costs of these works will be informed by detailed design for each activity and the outcome of the Taieri flood scheme performance assessment.

Table 1 – Allowances made in 2018/2028 Draft Long Term Plan for works to address risks relating to floodbank integrity

	Year 1	Year 2	Year 3
Silver Stream pump station floodbank integrity	$30k		
Mill Creek floodbank integrity	$200k		
Riverside Road Spillway reinforcement works	$250k		
Riverside Road Spillway performance improvements			$750k
Localised crest levelling at floodbanks		$500k	
Construct weighting blanket at Outram	$300k		
Scheme performance assessment	$50k	$60k	

6. Recommendation

a) *That this report be noted.*

Endorsed by: Gavin Palmer
Director Engineering, Hazards & Science

Attachments

Nil

11.2. Review of surface water State of the Environment Monitoring

Prepared for: Technical Committee
Activity: Environmental - Water Quality and Quantity SOE
Prepared by: Dr Dean Olsen, Manager Resource Science
Date: 14 March 2018

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1. Précis

A report outlining the results of a review of the surface water State of the Environment (SoE) monitoring programme undertaken by NIWA was taken to Technical Committee on 25 January 2018. An action arising from that Technical Committee was for more information to be provided to Councillors on the existing SoE sites. The purpose of this report is to outline the purpose of ORC's water quality monitoring, to provide more information on the proposed changes to the SoE network, to outline the catchment investigations proposed in the 2018-2028 Draft Long Term Plan (LTP) and to consider the addition of Lake Dunstan to the lakes monitored.

2. Types of freshwater quality monitoring

State of the Environment monitoring is a term that has previously been loosely applied to any long-term monitoring undertaken by Council. Councils are required under Section 35(2)(a) of the Resource Management Act (RMA) to monitor the state of the whole or any part of the environment to the extent that is appropriate to enable the local authority to effectively carry out its functions under the RMA. Monitoring must also reference any indicators or other matters prescribed by regulation.

ORC monitors freshwater quality for several reasons. These include:

- Long-term monitoring for the purpose of reporting on the state and trends in water quality in Otago;
- Investigations of selected catchments to inform community education and compliance activities ("catchment monitoring");
- Plan effectiveness monitoring (e.g. Plan Change 6A).

These categories are not mutually exclusive, and monitoring undertaken to achieve the above purposes is also used to inform the compliance and education activities undertaken by Council.

The review undertaken by NIWA focused on the first category of monitoring. State and trend reporting is undertaken every five years and has taken on additional importance as a means of reporting against the National Policy Statement – Freshwater Management (NPS-FM). The Regional Plan: Water identifies five Receiving Water Groups (RWG) in Otago, with these being analogous to the Freshwater Management Units (FMU) required under the NPS-FM. Councils are required to monitoring and report against the NPS-FM for each FMU in their region. The NIWA review clearly showed that our current SoE network over-represented RWGs 1 and 2 and had very few sites in RWG3. Further, NIWA made recommendations regarding possible approaches to monitoring in lakes (RWGs 4 & 5).

The revisions to the SoE network are aimed to address these issues and to allow us to make accurate and unbiased statements about the water quality and ecological state in Otago's waterways. To satisfy requirements under the NPS-FM, it is necessary to be able to make these statements about all Freshwater Management Units in Otago (in

Otago, this refers to the Receiving Water Groups (RWGs) in Schedule 15 of the RPW), as well as at a regional scale.

3. SoE Network options

Following the NIWA review and recommendations regarding network representativeness, three network options were developed. The following maps (Figures 1-3) present the networks proposed under each of the three network options. In these figures, the sites labelled as "Other" are long-term monitoring sites that will be sampled for other purposes (e.g. plan effectiveness, to inform estuary monitoring), but will not be reported on as part of the 5-yearly state and trends reporting. They will be reported on as part of other programmes (e.g. plan effectiveness, estuary monitoring).

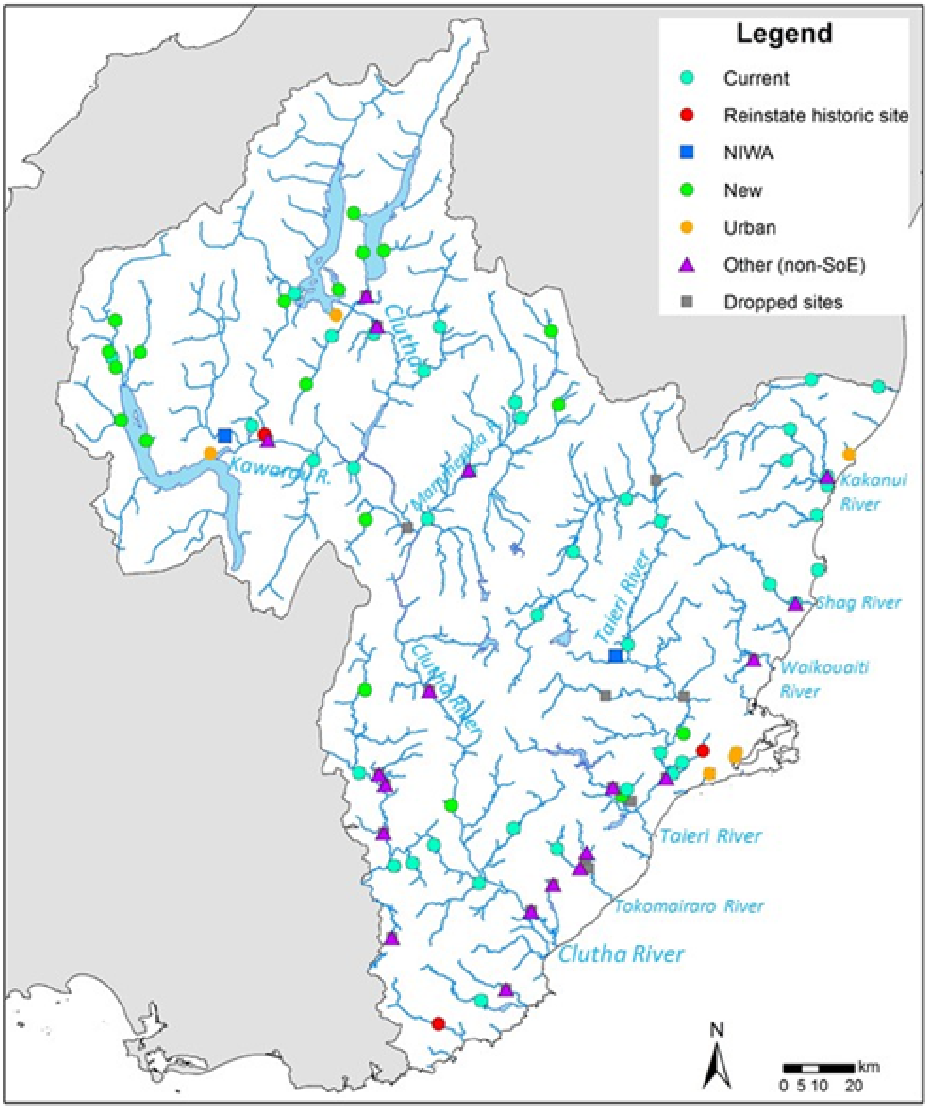

Figure 1 River monitoring network Option 1 – 65 SoE sites

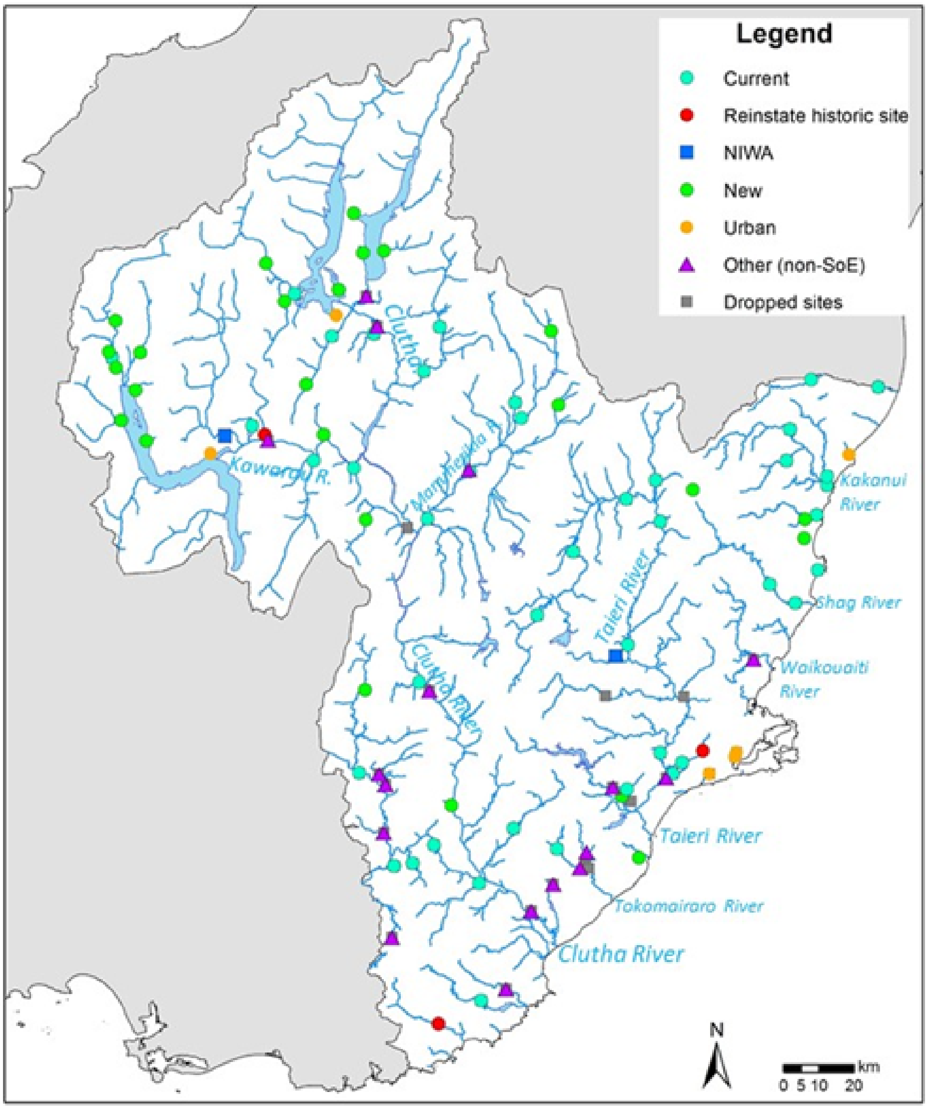

Figure 2 River monitoring network Option 2 – 75 SoE sites

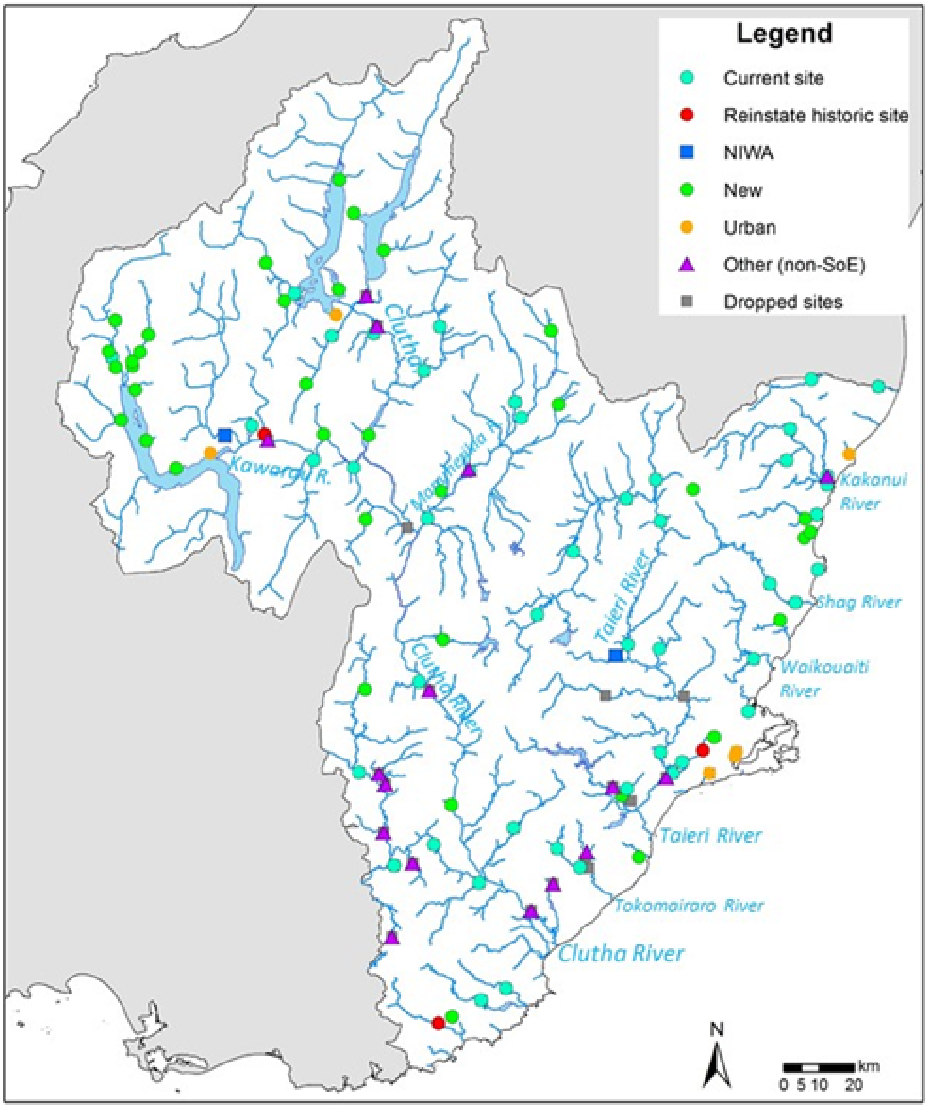

Figure 3 River monitoring network Option 3 – 90 SoE sites

4. Catchment monitoring

In addition to SoE monitoring, catchment studies usually involve short-duration (with data collection usually over a full year), intensive (multiple sampling sites) sampling within a catchment. These studies complement SoE monitoring by providing a greater level of detail on the spatial variability in water quality within a catchment. Another purpose of these studies may be to support policy development. These studies may be undertaken as one-offs but are often planned so that each catchment is revisited on an approximately ten year cycle. The catchment studies proposed over the next ten years (in the 2018/28 LTP) are summarised in Table 1. The proposed changes to SoE monitoring do not affect or alter the catchment monitoring programme.

Table 1 Planned catchment water quality studies

	Year											
	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30
Lake Hayes catchment	M	R										
QL urban streams	M	M	R									
Wanaka rural streams		M										
Leith & Lindsay		M	R									
Pomahaka			M	R								
Waikouaiti			M	R								
Wakatipu rural streams				M	R							
Tokomairaro				M	R							
Kakanui					M	R						
Upper Taieri						M	R					
Lower Taieri							M	R				
Shag								M	R			
Lindis									M	R		
Manuherikia									M	R		
Cardrona										M	R	
Waianakarua										M	R	
Tuakitoto											M	R
Waiwera											M	R

5. Other catchment monitoring

In addition to catchment investigations, there is provision for water quality monitoring in up to five catchments to inform education and the compliance monitoring plan. The catchments identified for the 2018/19 year are Awamoko, Bannock Burn, Taieri upstream of Waipiata, Thomsons Creek and Waiareka Creek. The changes proposed to the SoE network do not affect or alter the locations or timing of this monitoring.

6. Monitoring of Lake Dunstan

Lake Dunstan is currently monitored monthly from the shoreline at Dead Man's point. Lake Dunstan is monitored in this way because of the short residence time of water in both arms of the lake (5-10 days[1]) mean that the systems are more like a large, slow-flowing river rather than lake. In contrast, the mean residence time of Lake Wanaka is estimated to be 5-6 years.

Of the high country lakes monitored by Environment Canterbury (ECan), Lakes Aviemore and Benmore are comparable to Lake Dunstan. These two lakes are sampled 5 times per year by collecting a depth-integrated sample from near the deepest point in the lake by Helicopter. However, both lakes have much longer retention times than Lake Dunstan (Aviemore – 61 days, Benmore – 83 days). Other hydro lakes in Canterbury that have short residence times (Lakes Ruataniwha and Waitaki – both with retention times of less than 10 days) are not monitored as part of ECan's SoE programme, as they have several other sites on the river system.

[1] Schallenberg & Burns (1997) Phytoplankton biomass and productivity in two oligotrophic lakes of short hydraulic residence time, *New Zealand Journal of Marine and Freshwater Research*, 31: 119-134, DOI: 10.1080/00288330.1997.9516749

Environment Bay of Plenty and Waikato Regional Council currently monitor their hydro lakes as part of their river monitoring.

For these reasons, no changes are proposed to the way Lake Dunstan is monitored.

7. Recommendation

a) That this report is noted.

Endorsed by: Gavin Palmer
Director Engineering, Hazards & Science

Attachments

Nil

11.3. Director's Report on Progress

Prepared for: Technical Committee
Activity: Governance Report
Prepared by: Dr Dean Olsen, Manager Resource Science
Dr Jean-Luc Payan, Manager Natural Hazards
Chris Valentine, Manager Engineering
Dr Gavin Palmer, Director Engineering, Hazards and Science
Date: 14 March 2018

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1. Précis

This report presents an update on the following matters:

1. Climate, river flow and groundwater situation;
2. Groundwater monitoring in Glenorchy and Kingston;
3. Mt Roy Fire mudflow hazard;
4. Roxburgh debris flow hazards;
5. NZ SeaRise programme (South Dunedin);
6. Central Otago Stock Truck Effluent Disposal (STEDs), and;
7. Leith Flood Protection Scheme.

It is recommended that this report is received and noted.

2. Climate, River Flow and Groundwater Situation

After several months of very dry conditions, two ex-tropical cyclones (Fehi and Gita) brought significant amounts of rainfall to Otago in February. This resulted in rainfall totals that were well above average for the month (Figure 1, 2). As a result, the 30-day standardised precipitation index (SPI) has changed from moderately to severely dry, to severely to extremely wet for much of Otago, while the longer-term SPI (90-day) has most areas with close to normal rainfall (Figure 2).

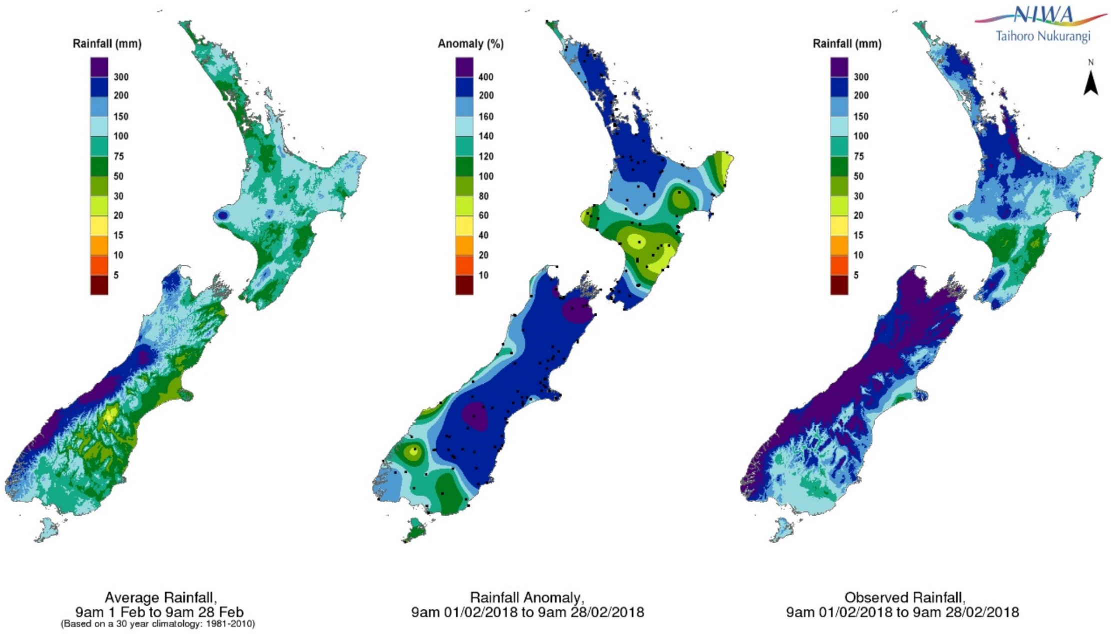


Figure 1: Comparison of long-term average February rainfall (left map), observed rainfall for February 2018 (right map) and the rainfall anomaly (deviation from the long-term average) for February 2018 (NIWA).

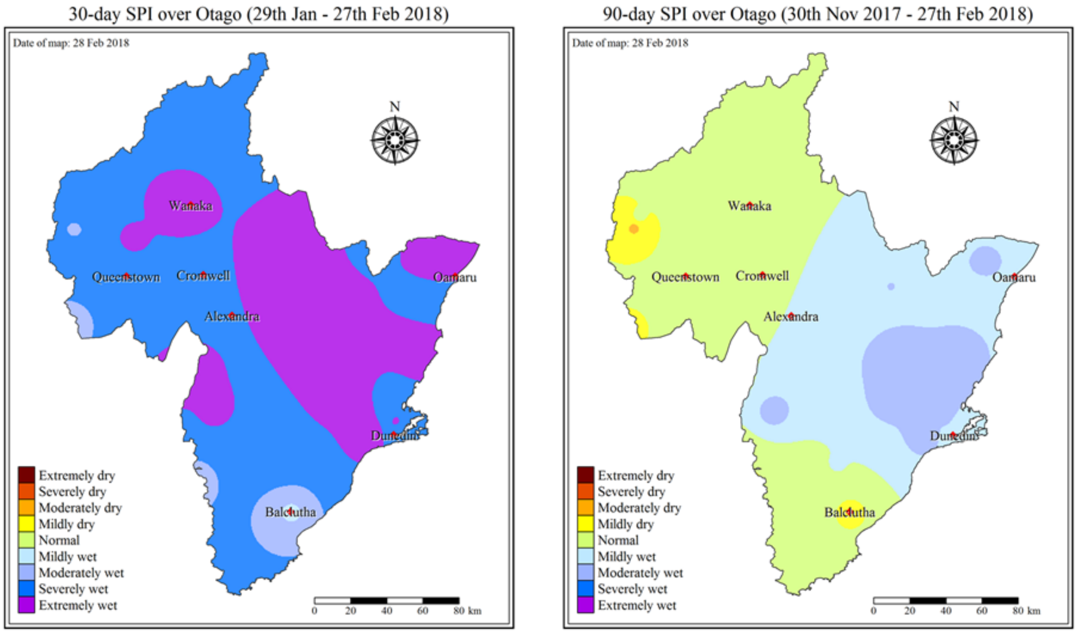


Figure 2: Maps of 30- and 60-day Standardised Precipitation Index (SPI[1]) to the end of February 2018 for Otago

Summary of NIWA Seasonal Outlook for Otago – March to May 2018

At the start of each month, NIWA produces a seasonal outlook for the upcoming 3 months. The following are the predictions for the period March-May:

Eastern Otago: Rainfall totals are about equally likely to be in the near (35%) to above normal (40%) range. Soil moisture levels and river flows are expected to be above normal (55%).

Western Otago: Rainfall totals are about equally likely to be in the near (40%) to above normal (35%) range. Soil moisture levels and river flows are expected to be normal (40%) to above normal (35% chance).

The full seasonal outlook can be viewed at: https://www.niwa.co.nz/climate/seasonal-climate-outlook/seasonal-climate-outlook-march-may-2018

River flows - February

The February 7-day low flows (7dLF) were generally lower than the long-term February averages in the Taieri, Central Otago and South Otago catchments, but higher than long-term February averages in all North Otago catchments (Table 1).

[1] SPI is a standardised index commonly used to indicate the dry/wet weather conditions based on observed rainfalls. Observed rainfalls in 49 rainfall sites around Otago have been utilised to produce the SPI maps shown.

Table 1 **February flow statistics for sites in the Taieri, Kakanui, North Otago, Manuherikia and South Otago catchments. All flows are expressed as 7-day February average low flows, i.e. the lowest flows averaged over a 7-day period within February.**

Site	Length of record (year)	Long-term February average (m^3/s)	Long-term February minimum (m^3/s)	Year of the long-term February minimum	Previous February with significant 7dLF (m^3/s)				February 2018 (m^3/s)	Minimum flow (m^3/s)
					1999	2003	2014	2015		
Taieri at Canadian Flat	35.3	1.183	0.490	1999	0.490	1.337	1.114	1.001	0.913	-
Taieri at Waipiata	25.5	1.922	0.749	1999	0.749	2.479	1.160	0.982	1.262	1.000
Taieri at Tiroiti	35.8	2.509	0.829	1999	0.829	1.664	1.625	1.088	1.754	1.100
Taieri at Sutton	57.5	3.082	0.861	1982	0.884	1.889	1.967	1.187	2.630	1.250
Taieri at Outram	49.9	6.186	1.042	1999	1.042	3.200	4.508	2.693	4.029	2.500
Kye Burn at Water Take d/s 300m	5.4	0.363	0.123	2015	NA	NA	0.315	0.123	0.838	-
Deep Stream at SH87	25.9	0.633	0.086	1999	0.086	0.650	0.778	0.620	0.561	-
Kakanui at Clifton Falls Bridge	36.9	0.896	0.317	1999	0.317	0.408	0.879	0.715	1.037	-
Kakanui at Mill Dam	28.2	1.015	0.237	1999	0.237	0.346	0.734	0.627	1.131	0.250
Kakanui at McCones	15.1	0.897	0.274	2009	NA	0.309	0.715	0.515	1.258	0.250
Waianakarua at Browns	12.9	0.598	0.119	2010	NA	NA	0.467	0.315	1.450	0.200
Shag at Craig Road	24.4	0.315	0.025	1999	0.025	0.056	0.259	0.135	0.382	0.150
Waikouaiti at 200m d/s DCC intake	3.4	0.309	0.175	2016	NA	NA	NA	0.214	0.412	-
Dunstan Creek at Beattie Road	15.3	0.658	0.139	2006	NA	0.283	NA	0.208	0.738	-
Manuherikia at Ophir	47.1	3.265	0.791	1999	0.791	2.716	2.027	1.625	2.134	0.820
Manuherikia at Campground	9.4	1.952	0.597	2015	NA	NA	0.797	0.597	1.079	-
Waitahuna at Tweeds Bridge	25.7	0.991	0.456	1999	0.456	0.732	0.958	0.892	0.843	0.450
Pomahaka at Burkes Ford	56.6	5.656	1.274	1971	2.220	5.306	5.414	6.337	5.512	3.600

Groundwater levels at restriction level bores

Schedule 4B of the Regional Plan: Water for Otago (RPW) identifies water levels at which the taking of groundwater will be restricted, and identifies the nature of the restriction, in terms of a reduction in the take of water authorised by water permits. The aquifer maximum height refers to the historic record of the water level or pressure head after the recharge season. Areas over which the restrictions apply are shown on Maps D1-D4 in the RPW.

There are currently 5 restriction level bores listed in the RPW. The detail of the aquifers concerned, the names of the reference bores and the respective restriction levels assigned to each bore as shown in Schedule 4B are presented below in Table 2. Groundwater levels at the nominated restriction level bores are starting to drop after a generally high seasonal recharge. The groundwater levels are still well above the restrictions levels (between 1.13 and 3.99m above); with the exception of the West Lower Taieri Momona Monitoring Bore for which the levels are only 0.21 m above the 25% restriction threshold. Historically, Momona Bore has reached this first restriction level on 10 occasions during 21 years of monitoring.

Table 2 Ground water levels in restriction level bores (from Schedule 4B of the RPW) in Otago aquifers

Aquifer	Aquifer reference Bore	Aquifer maximum height (m above datum)	Restriction levels (m above datum)			Current groundwater level (m above datum)	Difference between current level and 25% restriction level (m)
			25% restriction *	50% restriction	100% restriction		
North Otago Volcanic	Websters Well	130.8	126	125.5	125	129.99 (31/12/17)	3.99
Lower Taieri – West	Momona Bore	101.24	100	99.5	99	100.21 (27/12/17)	0.21
Lower Taieri – East	Harleys Well, Piezo. 2	112.5	110.5	110	109.5	113.93 (28/12/17)	3.43
Ettrick Basin	Cemetery Bore	172.29	170.29	169.79	169.29	171.42 (31/12/17)	1.13
Roxburgh Basin, (Coal Creek Terrace)	White-Hall Bore	189.5	188	187.8	187.5	189.48 (31/12/17)	1.48

Harleys Well - Piezo 2 replaced by Caledonia Drive Bore - Piezo 2

* When the aquifer reaches this level, there shall be either a 25% restriction or a water allocation committee, appointed by the Otago Regional Council, will implement a protocol to take all practical steps to curb the decline in the aquifer level so as to avoid a 50% restriction. If there is no water allocation committee or the water allocation committee does not use a protocol approved by the Council, the 25% water restriction will apply.

3. Priority of groundwater monitoring in Glenorchy and Kingston

At the 31 January meeting of Technical Committee, councillors noted that the priority of establishing groundwater monitoring in Kingston and Glenorchy was not stated in the review undertaken by Pattle Delamore Partners (PDP)[1]. It has been confirmed with PDP that additional groundwater monitoring in the Kingston and Glenorchy aquifers is of high priority because of the scale of proposed development in those areas and the limited monitoring that is currently available in those areas. This is consistent with staff opinion and staff have provided for the installation of appropriate monitoring bores for long-term SoE monitoring in Glenorchy, Kingston and the Queenstown Basin in year 1 (2018/19) of the 2018-28 Draft Long Term Plan.

4. Mt Roy Fire Mudflow Hazard

ORC is continuing to monitor the situation following the fire near Wanaka in early January. Nearly 100mm of steady rain fell near Wanaka on 1 February, but no significant mudflows were observed. The rainfall intensity during this event did not reach the levels commonly associated with mudflows initiation (25mm/hr).

To continue to assess and monitor the hazard, ORC is installing up to two rain gauges on the hillslope near the fire with the intention to make the data available via ORC's webpage. A scientist with international experience in analysing sediment run-off from burnt areas has been asked to assess any potential increase in hazards resulting from the fire.

ORC is working with Hillend Station to ensure vegetation is reinstated on the burnt area; it is anticipated vegetation will have a stabilising effect on the slopes. ORC and QLDC are updating affected residents on the situation.

[1] *Review of Groundwater Information and Models*, Report to Otago Regional Council Technical Committee, 25 January 2018.

5. Roxburgh Debris Flow Hazards

As previously reported to committee, heavy rainfall on 26th November 2017 resulted in debris flows and sediment deposited across several alluvial fans near Roxburgh, which damaged houses and closed SH8 in multiple places. A further period of heavy rainfall on 1 February resulted in further sedimentation which again closed SH8 near Black Jacks Creek.

Damwatch Engineering have completed an initial assessment of the increased flood risk from the sediment lobes extending into the Clutha River, and concluded there is a marginal increase in flood hazard associated with high flows in the Clutha River. A complementary assessment of the debris flow hazard by GNS Science will be completed in the next few weeks. It includes an assessment of whether any changes in vegetative cover has affected the debris flow hazard. This will inform decisions on the need for further channel clearance works and on catchment vegetation management.

A public meeting is planned for early April in Roxburgh to review the flood events and explain what is known about the ongoing hazard from the alluvial fans. This will be attended by representatives of ORC, Central Otago District Council (CODC), New Zealand Transport Agency (NZTA), and GNS Science.

6. NZ SeaRise programme (South Dunedin)

On 15 February staff participated in a workshop that forms part of the NZ SeaRise programme. Representatives of GNS Science, Victoria University of Wellington and the University of Otago attended and presented at the workshop. Details around the geo-hydrologic data that is available or will be collected in South Dunedin to inform the work were discussed as well as project planning.

The NZ SeaRise programme is a 5-year research programme. ORC's contribution to the programme will be the construction of an improved groundwater model and expansion of the groundwater monitoring network in South Dunedin. The network presently comprises the four bores installed and operated by ORC and two bores installed as part of the Curious Minds project[1] (Figure 3). The model will utilise the region-specific estimates of relative sea level rise that will be developed by the programme. The estimates will be available in 2020 and existing estimates and guidance will be used in the meantime.

1 *Curious Minds South Dunedin: What lies beneath – looking at the changing ground environment in South Dunedin*, Report to Otago Regional Council Communications Committee, 7 September 2017.

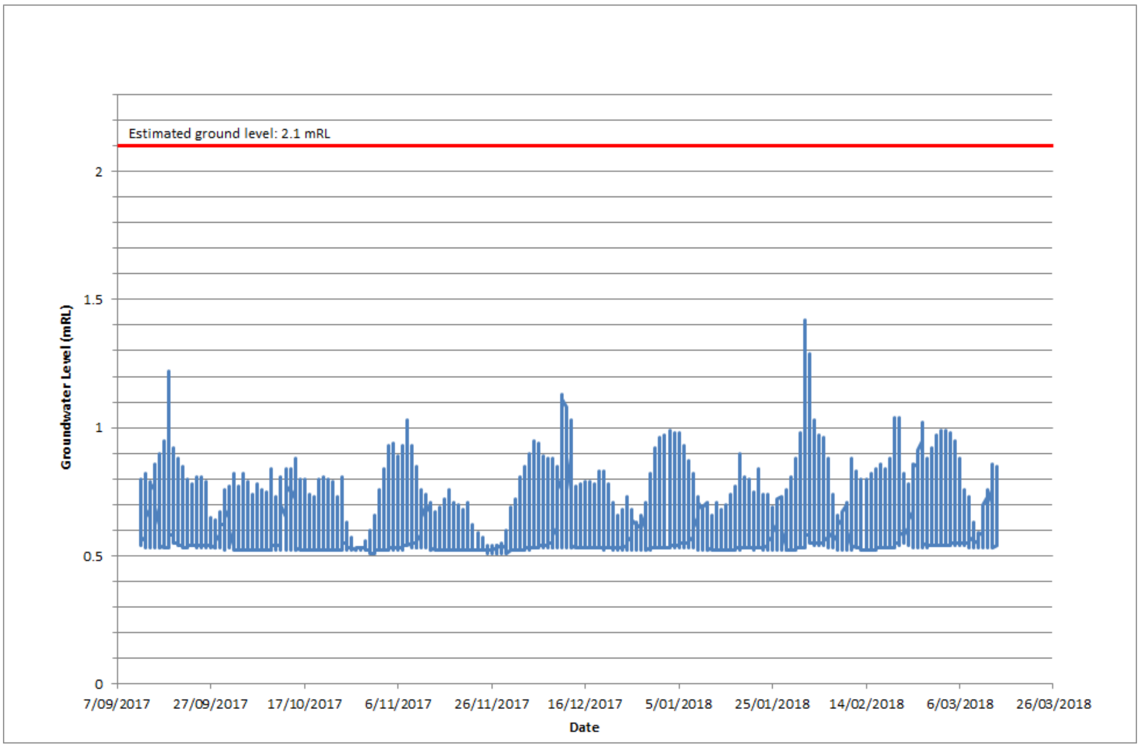
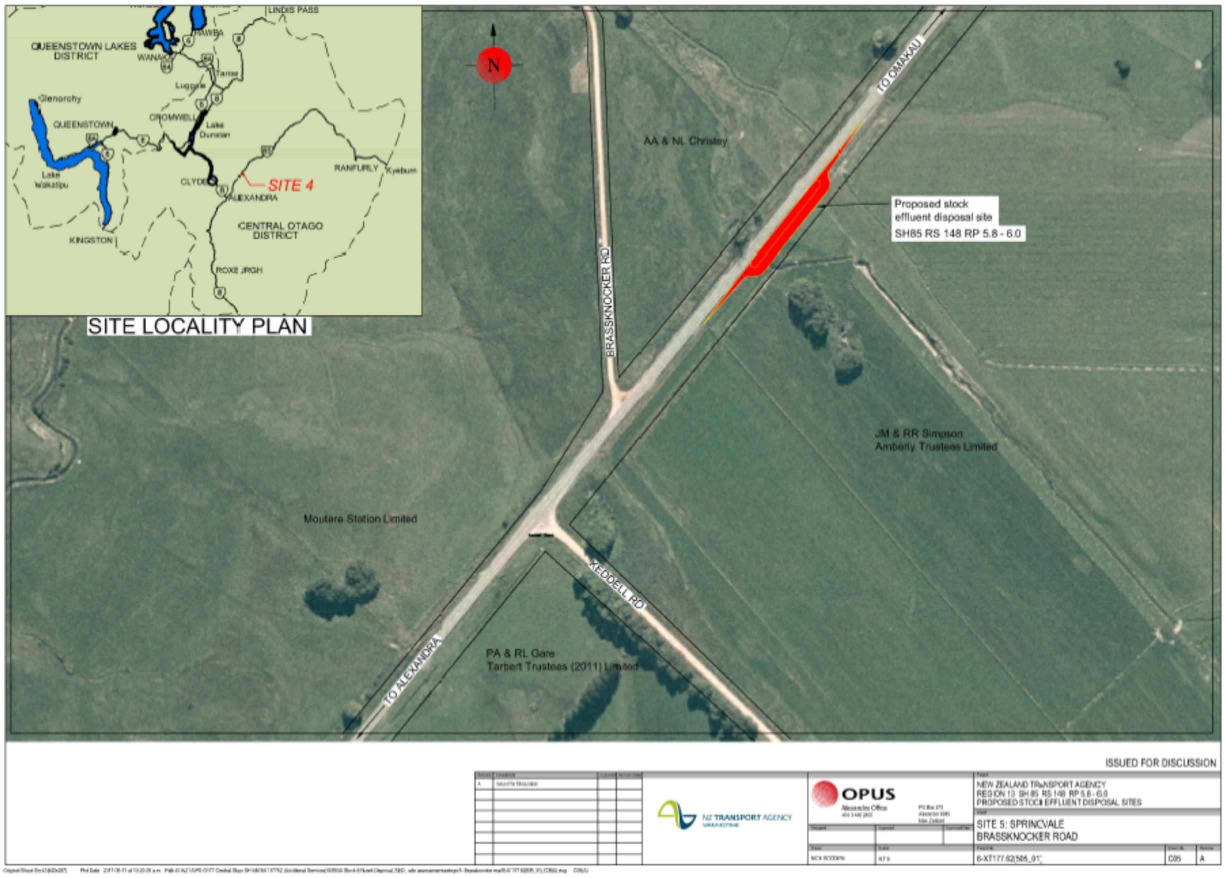


Figure 3: **Groundwater levels at Bayfield High School installed as part of the Curious Minds project (ground elevation estimated from LiDAR data). The other bore was installed at Kings High School.**

Consideration is being given to how to conceptualise and model the water cycle within South Dunedin. The "9 Waters" must be managed in an integrated way, accounting for how their interaction will change over time due to the effects of climate change and other influences.

7. Central Otago Stock Truck Effluent Disposal (STEDs)

Tenders have been invited and closed on 16 March for the construction of a Stock Truck Effluent Disposal Site (STEDS) on State Highway 85 near Brassknocker Road. CODC and NZTA both concur with this site selection. A second site in the vicinity of Cromwell is required to complete the network of STEDS across Otago and Southland (Figure 4, 5, 6). Consultation on the second site is ongoing with CODC and NZTA.



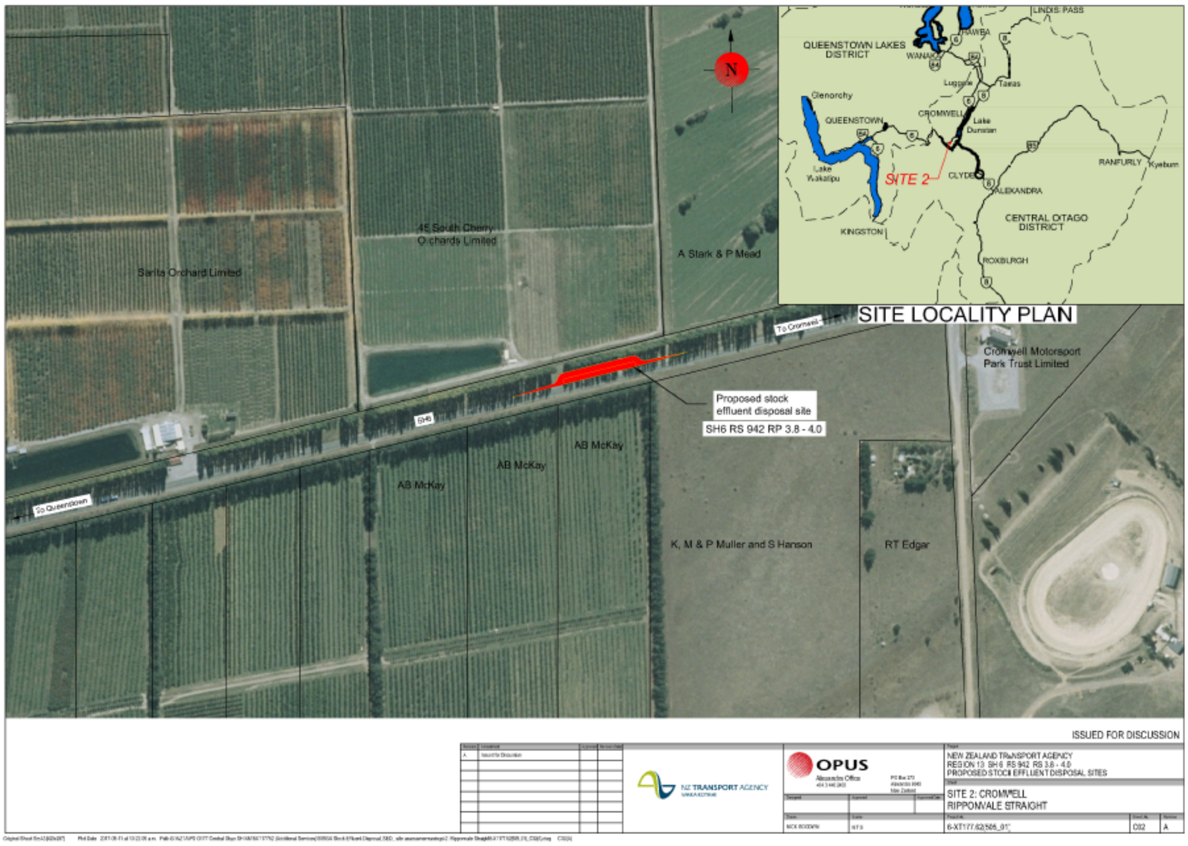


Figure 4: STED Site Locality Plan, State Highway 85 near Brassknocker Road

Figure 5: STED Site Locality Plan, State Highway 6 on Ripponvale Straight

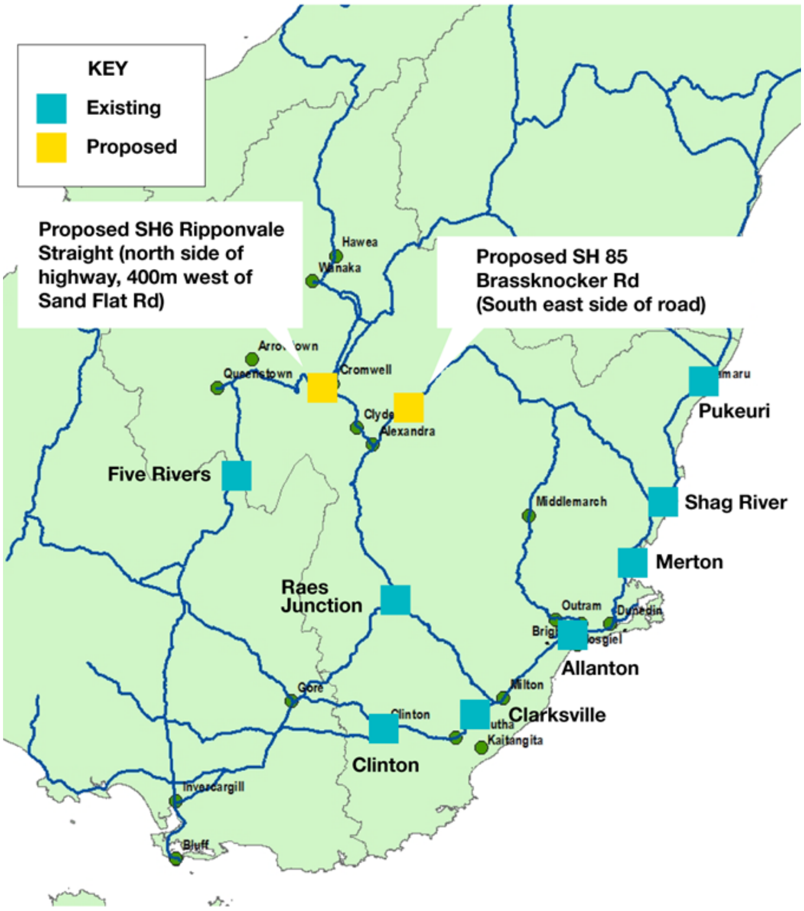


Figure 6 The Otago and Southland network of STEDs

Figure 7: ORC STED Site, Milton/Clarksville

8. Leith Flood Protection Scheme

Engineering works on the Union to Leith Footbridge stage of the Leith Flood Protection Scheme are progressing. The part of the construction site adjacent to the right bank wall upstream of the University of Otago Information Technology Services (ITS) building has now been handed back to the university. Work has commenced at the base of the wall on the inside of the channel (Figure 8).

Figure 8: Works to foundation of Water of Leith right bank wall upstream of ITS building (13 March 2018). The photograph is looking upstream.

Two significant rain events in the last month have caused damage to temporary works resulting in additional costs and time delays (Figure 9, 10). A value engineering workshop has taken place with the main contractor (Downer New Zealand Ltd) to review the programme and work towards completion of the project by June 2018.

Figure 9: Leith Flood Protection Scheme works between Union Street and Leith Footbridge; this photograph was taken during low flows.

Figure 10: Leith Flood Protection Scheme works between Union Street and Leith Footbridge. The photographs in Figures 9 and10 are looking towards the left bank below the ITS building. This photograph was taken on 1 February 2018 at a flow of approximately 48m^3/s; peak flow during this event was 61m^3/s. The Scheme design flow is 171m^3/s.

Physical hydraulic model investigations of the hydraulics of the Water of Leith at the Dundas Street Bridge are continuing. The modelling is being undertaken by the University of Auckland School of Civil and Environmental Engineering. The model has been modified and run to include the proposed culvert at 4m in width and 4.2m height (Figure 11). This configuration addresses the primary project objective of conveying a design flood with freeboard under the Dundas Street Bridge. The physical model output is being used to inform an imminent risk workshop which is intended to quantify community and stakeholder risks. Construction of the works is programmed for this Summer, with construction tenders to be invited in June.

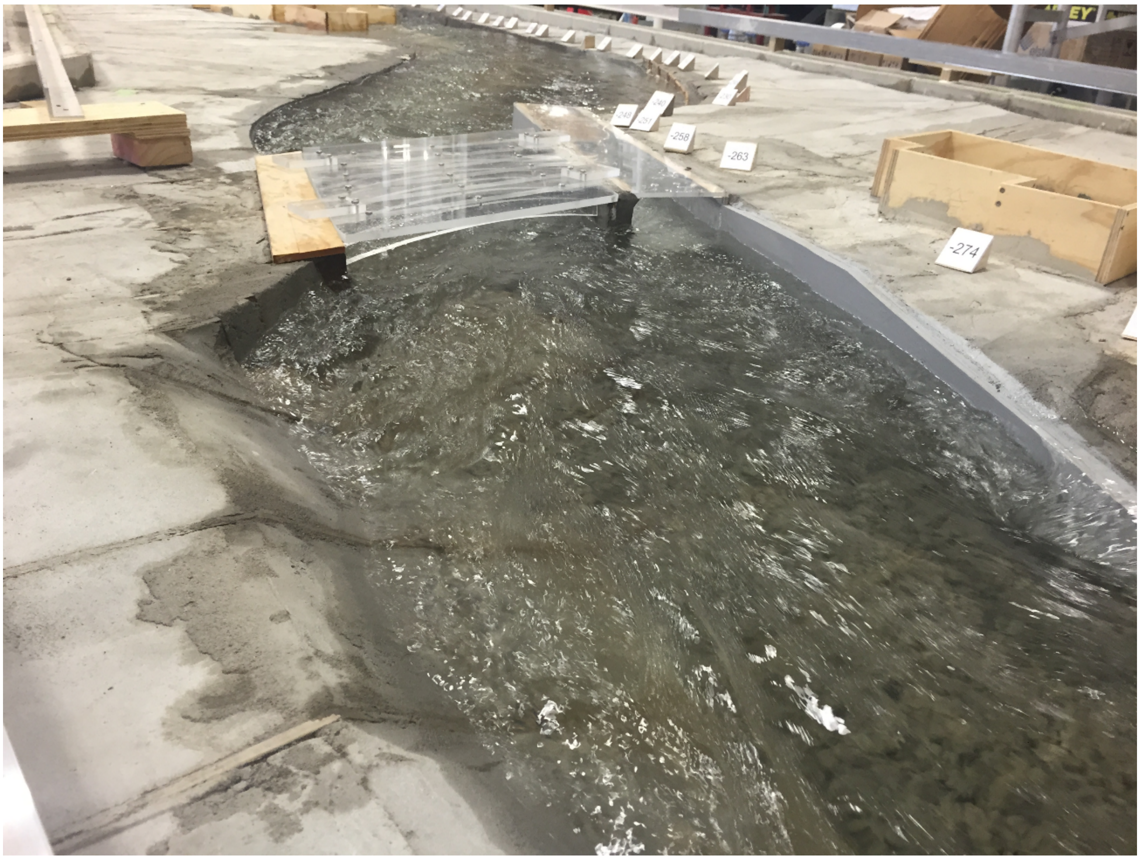


Figure 11: Physical modelling of new culvert at Dundas Street bridge at a flow of 171 m^3/s (model scale 1:25). The photograph is looking downstream with the culvert at the true right side of the channel.

The Leith Amenity project working group has met three times, including a team site walkdown. In consultation with community feedback, the working group has identified several key themes and guiding principles to steer the project. Consultation is ongoing, and we are still receiving community feedback through the web-based engagement platform. A 'master plan' for the lower Leith is starting to take shape. Further detail is provided in the Director's Report to Communications Committee.

9. Recommendation

a) This report is received and noted.

Endorsed by: Gavin Palmer
Director Engineering, Hazards & Science

Attachments

Nil

12. NOTICES OF MOTION

13. CLOSURE