

Topic	Question	Response
Wet Weather Preparedness	<i>Memo providing a summary of some of the issues seen during July's wet weather events, and an overview of how Three Waters prepares and responds to these weather events</i>	Please see attached PDF

Memo

Date: 28 September 2022
From: Helen Beaumont, Head of Three Waters
To: Mayors and Councillors
Cc: Executive Leadership Team
Reference: 22/1296371

Wet Weather Response

1. Purpose of this Memo

- 1.1 To provide an overview of how Three Waters prepares and responds to weather events.
- 1.2 To provide a summary of some of the issues seen during the July weather events.

Please note that this memo is meant to inform from a Three Waters perspective only. It does not go into detail of all the other significant preparation and response actions of other Council units.

2. Wet Weather Response Procedure

- 2.1 The City Wide Wet Weather & Tidal Response Procedure (CSLD 004) and Plan 2018 (the Plan) describe and co-ordinate our operational response to rainfall and flood events. The Plan links to our contractor's (City Care) Response Plan. City Care is our primary land drainage and stormwater operations and maintenance contractor. City Care has capacity to undertake a wide range of response and civil works activities and are Council's primary agent in the field during events.
- 2.2 The Plan describes the areas where issues are typically encountered, the response to those issues and when a response is required. It outlines the process and triggers by which staff make decisions as to what and when actions are to occur.
- 2.3 The Plan defines wet weather events in four categories:

Business as usual	<40mm over 24 hours or <4mm per hour
Moderate event	40-60mm over 24 hours
Major event	60-100mm over 24 hours
Severe event	>100mm over 24 hours.
- 2.4 The Stormwater and Waterways Operations Team (SWOT) monitor rainfall and tide forecasts utilising a variety of information sources (MetService, NIWA, MetVuw & other international forecasters). Council has engaged a local forecaster, Meteorology Solutions, to review the forecasts, rationalise them to the local Christchurch context and provide forecasts every two days (and more frequently if an event of moderate size or greater is forecast). SWOT advises managers, other Council teams (including Capital Delivery and Roading) and our contractor when events are forecast to allow them to prepare for any action that may be required.
- 2.5 The trigger levels are based on operational experience and flooding data collected over the last few years. The triggers are regularly reviewed in the context of updated rainfall and tide statistics, understanding of river flows and changes in the capacity in the stormwater network. A precautionary approach is taken in the following situations:

- Already saturated ground
 - Likelihood of extended wet weather over many days
 - Low pressure weather systems tracking down from the tropics
 - Low pressure weather systems coinciding with extreme astronomical tides.
- 2.6 The Plan outlines the different ‘modes’ that Council will activate and the process by which decisions are made to activate based on the event forecast and in response to observations and measured data. The modes are:
- Monitor** Business as usual (BAU)
- Standby** BAU with a view to the possibility of Moderate, Major and Severe event. Contractors are instructed to prepare resources.
- Deploy** Moderate, Major and Severe event. Pre-emptive activities undertaken.
- Operate** Moderate, Major and Severe event. Planned and reactive activities undertaken.
- Cease** BAU
- 2.7 King tide events may trigger flooding in low lying coastal parts of the city even during fine weather – typically in Opawa and New Brighton. The call centre is notified of the dates of King Tide events so that they are prepared when calls about flooding come in.
- 2.8 Business as usual rain events (predicted to be less than 40mm over a 24 hour period and less than 4mm per hour) generally do not lead to anything more than surface ponding on some roads. It is standard practice to use many of our roads as secondary flow paths.
- 2.9 As part of the ‘Business as usual’ mode there are known areas vulnerable to flooding from either rainfall and/or high/king tide events where action is taken by the SWOT, co-ordinating with Roding Operations teams to minimise the risk of flooding. These areas include:
- Outfalls at Sumner and New Brighton blocked by high beach levels and susceptible to low rainfall events
 - Avon River at New Brighton Road susceptible to tidal inundation at very high/king tides particularly when combined with rainfall events
 - Heathcote River at Riverlaw, Clarendon and Richardson Terraces susceptible to tidal inundation at very high/king tides particularly when combined with rainfall events.
- 2.10 Closer to a forecast of moderate or greater wet weather event, the Plan process is followed to co-ordinate the response and assign actions to be completed including grille clearing, pump deployment, outfall excavation, communication to the public, co-ordination with other Council teams, communication with Civil Defence, contractor resourcing/preparation and making Council staff available to monitor and supervise the event.
- 2.11 There are also preparations undertaken across our water supply and wastewater networks:
- Water Supply - turn off some of our low lying wells, ensuring stream fed supplies have full reservoirs (Akaroa, Little River, Duvauchelle and Pigeon Bay), wash down some reservoir roofs
 - Wastewater - actively monitor and operate our wastewater pump stations, deploy additional pumps and lower the oxidation ponds at the Christchurch Wastewater Treatment Plant
- 2.12 Staffing through these events is also critical. The operations and maintenance teams will ensure an appropriate level of staffing and management is available 24/7.

3. Rainfall Events in July 2022

- 3.1 During July Christchurch experienced a series of three notable weather events in less than three weeks. The first event started on 11 July and had been preceded by wet weather a few days earlier.
- 3.2 The total rainfall depth in July broke the record for the highest monthly rainfall depth ever recorded at the weather stations at the Botanical Gardens and Christchurch Airport.
- 3.3 In Akaroa the monthly July rainfall of 472 mm was well below the monthly maximum of 647.1 mm set in February 1936.
- 3.4 The table below shows a comparative summary of the three events for the weather station at Botanical Gardens.

	First Event: 12 July	Second Event: 21 July	Third Event: 26 July
Start	11 July 2022 10pm	20 July 2022 7:30 pm	25 July 2022 5 pm
End	12 July 2022 7:15 pm	21 July 2022 9:30 pm	27 July 2022 1:15 am
Total Depth	54.4 mm	49.40 mm	96 mm
Max ARI	3.3 years (12 hours)	2.5 years (12 hours)	7.3 years (30 hours)
Peak Intensity	7.2 mm/hour	9.6 mm/hour	7.4 mm/hour
Time of Peak Intensity	12 July 2022 7:00 am	21 July 2022 2:00 am	26 July 2022 6:00 am

Table 1: Summary of July 22 Rainfall Events at Botanical Gardens

- 3.5 As with all rainfall events, the three events differed from each other in spatial distribution, peak intensities, duration and total rainfall depth.

First event 12 July

- 3.6 The first rainfall event had a moderate total rainfall depth and was calculated to have an average recurrence interval (ARI)¹ of 3.3 years. However, the rainfall coincided with astronomical high tides which were exacerbated by the effects of a low pressure system present.
- 3.7 A maximum tide level of 10.82 m RL was recorded in the estuary at Bridge Street and has a calculated ARI of 2.6 year.
- 3.8 The tide level recorded in the Styx River at the tide gates was 10.98 m RL with an ARI of 5 years.
- 3.9 The unfortunate combination of high rainfall and tide conditions caused flooding issues mainly in low lying coastal areas, where drainage was compromised during high tides or the area was directly impacted by tidal flooding.
- 3.10 In Akaroa the event was significant with a total rainfall depth of 135.8 mm and an ARI of 9.1 years. And with 15.3 mm/hr it had the highest intensity of the three storms.

Second event 21 July

- 3.11 With a total depth of 49.40 mm at Botanic Gardens the second event had a similar total rainfall depth and ARI to the first event. However, during the second significantly higher rainfall depths and intensities were measured in the western parts of the Port Hills which make up large parts of the upper Heathcote Catchment.

¹ An event ARI is the calculated average span of time between events and not reflective of the separation between two particular events of the same magnitude as can be seen in the July events.

- 3.11.1 The rain gauge in Worsleys Road in Cashmere recorded a total of 91.6 mm with a calculated ARI of 19 years. The impacts of this rain event were also exacerbated by the ground being saturated from the first event which meant the ground could not absorb much of the rain that fell.

Third event 26 July

- 3.12 The third event was the longest, had the greatest rainfall depth at the Botanical Gardens and with 7.3 years also had the highest calculated ARI. According to our wet weather response procedure it was classed as a major event. As with the second event, the pre-existing saturated ground from the previous events resulted in no water being able to be absorbed by the ground and therefore running off to the stormwater network.
- 3.13 After the third event a fourth event was forecast which triggered further response preparations but fortunately did not eventuate.
- 3.14 In Akaroa a similar rainfall depth was recorded as during the first event, but over a longer time period.

4. Preparation July 2022 – Stormwater and Waterways Operations

- 4.1 As per the Wet Weather Response Procedure rainfall and tidal forecasts were intensively monitored throughout the month of July.
- 4.2 Staff availability of Stormwater and Waterways Operations Team and City Care Land Drainage Team was established and responsibilities assigned prior to the individual events. COVID19 and other illnesses had reduced staff numbers, especially during the first event, and we were able to provide support from our other teams.
- 4.3 Critical outfalls and grills were checked in preparation for all events as per Wet Weather Response Procedure (2.1 above).
- 4.4 Critical stopbank sections were inspected for damage before the first event for which extreme high tides were forecast. Sand bags were placed to strengthen the waterside toe at the short sections of faulty terramesh stopbank sections at Avonside Drive and New Brighton Road. Sand bags were also placed on Waitaki Street stopbank to increase the crest height at the lowest points of the stopbank. Note, this was done as a precaution.
- 4.5 In anticipation of the first rainfall event the culvert inlet and outlets on St. Albans Creek under Papanui Road were manually and partially cleared to improve the drainage capacity for the Brenchley Ave area. Full clearance was not possible within the time frame as it requires specialist staff, heavy equipment, sediment control and traffic management. The channel of St Albans Creek immediately downstream of the culverts was also cleaned out.
- 4.6 At Flockton Invert, in addition to the four temporary pumps usually located on site, two more pumps were deployed for the first and third event. In Maces Road temporary pumps were deployed in all events. For the first event pumps were deployed in Southshore at nine locations and at two locations for the third event. A temporary pump was also deployed as a back-up at pump station PS220.
- 4.7 Water levels in two basins in the upper Heathcote catchment (Cashmere Valley and Wigram Basin) were monitored. Water was released from basins at maximum flow rate before each event to restore flood storage volume in the basin. The timing and discharge rates were determined by downstream river levels which were very closely monitored at all times. Because of persistent high downstream water levels and limited time between events it was not possible to fully empty the basins before each consecutive event.

- 4.8 Routine maintenance was carried out in Little River, Akaroa and other areas prior to the storms.
- 4.9 A digger was deployed to Le Bons Bay to be on stand by for beach openings as required.
- 4.10 The beach at Te Wairewa (Lake Forsyth) outlet canal was opened before the second event and again before the third event.
- 4.11 The Quick Capture App was trialled during the July events, being installed on Council staff field devices. The app allows the georeferenced recording of observations in the field capturing comments and photos in pre-determined categories. As soon as a recording is submitted in the field it is visible to flood response managers and other staff on a mapping tool. This information is able to be processed in real time and appropriate resources deployed.
- 4.12 Our Communications team also assisted in updating content on a dedicated 'wet weather' page on our website. This site continues to get updated and during events will be at the forefront of all our communications. A link to our rolling blog will also be available here. <https://ccc.govt.nz/services/water-and-drainage/stormwater-and-drainage/wet-weather-and-flooding/>

5. Response Actions July 2022 – Stormwater and Waterways Operations

- 5.1 Stormwater and Operations staff continuously monitored rainfall forecasts, rainfall recordings, river flows, tides and storage basin levels.
- 5.2 The gates of Woolston Tidal Barrage were opened, with rising river levels, to increase the river discharge capacity. The barrage gates were left open until about a week after the last event when the river levels had subsided sufficiently.
- 5.3 Checks for blockages at stormwater grills and outfalls including backflow control valves (BCVs) were carried out repeatedly. Blocked grates and blockages in the waterways and land drainage system were cleared as required.
- 5.4 During the first event critical sections of stopbanks were inspected during high tides to detect potential signs of failure and during low tides for damage.

Permanent and temporary pumps were run as required

- 5.5 During the first event an additional temporary pump was deployed and operated at Avonside Drive (near Emlyn Place) to assist with drainage from the residential area during high tides in the Avon River.
- 5.6 At Horseshoe Lake the new electric pump at PS205 was overwhelmed and the additional diesel pump turned on manually in Event 2 and 3.
- 5.7 The Cranford Basin system operated automatically until after the third event. Then Winters Drain Control Gate was closed manually to improve and speed up drainage of the Rossiters and Philpotts Drain catchments. In addition to that a temporary pump was deployed to pump water from Philpotts Road Drain into Winters Basin.
- 5.8 During the first event it was attempted to start up the temporary pump placed to assist PS220 (Hulverstone Drive) but failed which led to flooding of streets in Avondale

Basins and ponding areas

- 5.9 Wigram Basin and Cashmere Valley Basin in the upper Heathcote catchment were managed manually during the events. Based on downstream river levels outlet gates were closed and opened. Because of the short time interval between the events and persistent high downstream river levels the basins could not be fully emptied between

the events. This resulted in Cashmere Valley Basin reaching 100% capacity during the third event. Significant storage volume remained available at Wigram Basin.

- 5.10 During the events it became necessary to release water from Cashmere Valley basin while downstream river levels were still elevated above the trigger levels. This was done to recover storage capacity in the basin for the next incoming event. Water was released without flooding roads downstream. Management agreed that, if necessary, some flooding of roads would have been acceptable in this situation.
- 5.11 Curletts Basin (also upper Heathcote Catchment) was generally not in operation due to seepage issues through the embankment at the outfall structure. However, during the third event river levels in the upper Heathcote started to threaten floor levels and it was decided to close the gate and to store water in the basin. The seepage through the embankment was regularly checked and appeared to slightly increase with rising water levels in the basin. It was decided to open the gate gradually to release water towards the end of the event. Using the basin during the peak of the event helped to cap maximum river levels downstream.
- 5.12 Residents were regularly communicate with and staff were in regular discussions with other Council units such as Transport, Communications and Civil Defence.

6. Stream and River Levels

- 6.1 The response in water levels for the events was influenced by wet antecedent conditions, which result in higher rainfall runoff rates than with dry ground conditions.
- 6.2 The highest water levels in tidally influenced reaches of rivers and streams were observed during the first event.
- 6.3 In other areas the third event caused the highest river levels recorded during July. An exception is the middle reach of the Heathcote River at Buxton Terrace where the second event caused the highest water level.
- 6.4 A summary of recorded river levels at key locations is presented in the table below:

<u>Waterway & Location</u>	First Event: 12 July	Second Event: 21 July	Third Event: 26 July
Max WL Heathcote @ Ferniehurst	16.79 m RL	16.97 m RL	16.99 m RL
Max WL Heathcote @ Buxton	12.22 m RL	12.48 m RL	12.41 m RL
Max WL Heathcote @ Opawa	10.92 m RL	10.51 m RL	10.63 m RL
Max WL Dudley Creek @ Aylesford St	12.87 m RL	12.50 m RL	13.01 m RL
Max WL Avon @ Gloucester	12.86 m RL	12.90 m RL	13.0 m RL
Max WL Avon @ PS205	10.94 m RL	10.52 m RL	10.67 m RL
Max WL Styx @ Harbour Road	10.26 m RL	10.07 m RL	10.28 m RL
Max WL Hughes Drain @ Le Bons Bay	11.08 m RL	10.73 m RL	10.58 m RL

Table 2: Key river levels

- 6.5 The rivers generally coped well and analysis has shown that the flooding potential during the July events was relatively moderate. This is indicated by the flow in the Avon at Gloucester St. The catchment above Gloucester St has not had major development in recent years or, indeed, any significant flood mitigation. It is noteworthy therefore, that since 2014 there have only been the two events (2021 & 2022) where the flow was in excess of 20m³/s. This compares to 16 events with comparable flows between 1991 and 2014 - or on average about one every 18 months.

- 6.6 In spite of the July 2022 monthly total rainfall breaking very longstanding records, the events were spread out across the month and the size of stormwater flow that Council stormwater infrastructure needed to handle in July 2022 was relatively moderate.

7. Localised Flooding Issues

- 7.1 Over the three events minor river flooding and surface ponding affected many areas in greater Christchurch.
- 7.2 Flooding occurred on roads, private properties, garages, commercial and out-buildings, parks and rural land. A number of roads had to be closed for public safety but also to protect private properties and infrastructure from the effects of vehicle wash. Some properties were not safely accessible.
- 7.3 There were media reports of buildings flooded above floor level during the three rainfall events in July, however, Council has not been able to confirm these reports.
- 7.4 Individual areas affected by flooding are identified and discussed in more detail in Appendix 1 of this Memo.

8. Next steps

- 8.1 Generally speaking the stormwater network and flood protection infrastructure performed well and communications enabled residents to be prepared before each event and well informed during the rainfall events.
- 8.2 The new 'wet weather' website page will be updated and ready to deploy for future events.
- 8.3 The trial of the Quick Capture App, for rapid communications on the performance of the network, was successful and this will be rolled out to the team. Documentation and training will be provided.
- 8.4 A number of minor repairs and maintenance works will be completed over the next few weeks and months.
- 8.5 Council continues to work with Environment Canterbury to look at options for waterways and drainage works for Banks Peninsula communities. This may lead to the establishment of new river / drainage rating districts to fund and coordinate any required works.

Attachments Ngā Tāpirihanga

No.	Title	Page
A	Discussion of Localised Flooding Issues	

Signatories / Ngā Kaiwaitohu

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Discussion of Localised Flooding Issues

Heathcote Catchment – River Flooding

- 1.1 During the first event significant high tides combined with increased river flows from rainfall runoff resulted in relatively high river levels in tidally influenced downstream reaches of the river.
- 1.2 The maximum water level measured at Opawa Road Bridge was 10.92m RL which has only been exceeded four times in the last five years. The flooding triggered road closures. Private properties and most likely garages and outbuildings were also affected by flooding.
- 1.3 When comparing the river levels in Opawa it becomes clear that these high levels can be mainly attributed to the tidal levels. During the second and third events (with higher rainfall depths in the Heathcote catchment combined with relatively low high tides) maximum water levels at Opawa Road Bridge remained about 300-400 mm below the maximum level recorded during the first event.
- 1.4 Water levels recorded during the second and third event were the highest in the middle reaches of the Heathcote River between Hoon Hay and St Martins. The river breached the banks in places and flooded roads, private property, outbuildings and garages.
- 1.5 The high river flows were caused by rainfall runoff entering the river. Runoff was attenuated in the Cashmere Valley and Wigram retention basin. During the third event water was also stored in Curletts basin. A number of other basins that will form part of the overall Upper Heathcote Active Management System were partially filled as their controls are not fully operational yet.
- 1.6 The observed river flooding in the middle reaches shows that Heathcote River flooding can be partially mitigated. However, the river still receives a significant amount of runoff from a number of fully developed contributing catchments without retro-fitted flow attenuation. It is certain that the river levels would have been higher if runoff had not been stored in the operational basins. Further benefits are expected from additional basins and control systems becoming fully operational in the future.

Edgeware Road

- 1.7 There is regular and historic flooding affecting the road and also shops on the south side of Edgeware Road between Sherbourne Street and Colombo Street.
- 1.8 The flooding is driven by the high water level in St Albans Creek, during flood events, preventing clear outfall from the network into the downstream creek. The network is surcharging and there is no capacity for the surface runoff to drain resulting surface flooding. St Albans Creek has been identified as being severely constrained downstream of Edgeware Road.
- 1.9 A Council Report¹ on the Flood Management Options for Edgeware Road and Edgeware Village has been presented on 13 September 2022. Officer's recommendations are to continue engagement with the affected community, over time rely on the benefits of District Plan minimum floor level requirements, update the costs of and previously identified engineered option as a candidate for the next Long Term Plan and consider the construction of a full height kerb.

Earlham Street (Brooklands)

- 1.10 During the July events the Brooklands area around the Earlham Street area experienced inundation of roads and private rural land. No floor level flooding of residential buildings was

¹ TRIM 22/603241

reported. The ponded water drained very slowly and was helped along by private pumping activities.

- 1.11 The flooding is due to a combination of tidal and rainfall flooding. The poor drainage following an event is exacerbated by the very shallow groundwater in this low lying part of the city. Data analysis has shown that Waimakariri flood freshes only have minimal effect on water levels in this tidally influenced area.
- 1.12 During the first event recorded tidal water levels at the Styx Tide Gate was 10.98 m RL. At this level some of the small lower gaps between the sand dunes separating the settlement from Brooklands Lagoon would have been overtopped. To a small degree the water from the lagoon would have added to the inundation in the floodplain.
- 1.13 Land along Earlham Street is and will continue to be vulnerable to flooding. Ongoing climate change and sea level rise will make this worse.
- 1.14 A memo² to the Mayor dated 9 July 2021 explains the cause of flooding and options to improve the situation. It states that any improvements from intervention did not show sufficient benefits to be prioritised for funding in the LTP.
- 1.15 The City Council has a current "Coastal Hazards Adaptation Planning Programme" (CHAPP) that is progressing, including engagement with local communities. The first of these is in the Lyttelton Harbour basin.
- 1.16 The area around Brooklands and Spencerville will be addressed within this programme however no decisions have yet been made on the sequence and timelines for future Adaptation Areas to undertake planning. This planning process will work through the issues and scenarios and identify responsibilities.

Kainga Road (Brooklands)

- 1.17 The properties at 445 and 449 Kainga Road are located within a single row of properties in Brooklands along Kainga Road. The properties are zoned as *Flood Management Area*, *Flood Ponding Management Area* and *High Flood Hazard Management Area* in the District Plan. The District Plan land use zoning is *Rural Waimakariri Zone*.
- 1.18 Some of the other properties in the row are low lying, but 445 and 449 Kainga Road appear to have the lowest land levels averaging at 10.08 and 10.06 m RL. The low lying properties are surrounded by higher ground and the elevated Kainga Road. They do not have a natural overland drainage path. Kainga Road at its lowest point has a level of about 10.27 m RL.
- 1.19 The row of properties and Kainga Road are serviced by a drain in the front of the properties (Riverton Drain) which joins with an Environment Canterbury drain and is piped through a 300mm diameter pipe underneath the former stopbank into the Styx River at the tide gates. There is a BCV stopping water flowing back from the Styx River into the pipe.
- 1.20 Flooding affecting the above properties has been reported to Council in December 2021 and February 2022. Council received reports or complaints for the three July events this year. Flooding was affecting a number of properties but, did not breach a floor level and did not cause any issues with the road carriage way.
- 1.21 Flooding is caused by extremely low lying land without a natural overland drainage path. At times of elevated Styx river levels (greater than 10m RL) gravity flow into the river through the drainage system is impossible. Flooding has been exacerbated by the temporarily reduced pipe capacity.
- 1.22 The stormwater system has been last inspected in May 2022. During the inspection tree roots and some other damage was discovered in the pipe. The tree roots have been cut back as

² TRIM 21/978719

much as possible and the area around the BCV cleared. This section of pipe will need replacement.

- 1.23 Consent plans show that the residential dwelling at 449 Kainga Road has a finished floor level of 11.8 m RL which is about 1700 mm above average ground levels on the property. The floor level of the dwelling at 445 Kainga Road appears to be very low and close to ground level. The LDRP floor level database estimates the finished floor level to be about 10.3 m RL.
- 1.24 However, at a water level of about 10.27 m RL water would start overflowing from Riverton Drain across Kainga Road at its lowest point (at 415 Kainga Road) at onto lower land on the other side of the road. This means there is topographical limit as to how high water levels can raise in Riverton Drain.

Maces Road

- 1.25 Street flooding occurs on Maces Road around the Ruru Road intersections and also onto flood onto commercial properties, in particular 230 Maces Road where "Move-X" is located. A temporary pump is deployed to take water from the stormwater network and discharge into Charlesworth Drain. However, a combination of the low lying area of Maces Road and the limited stormwater network means that the pump provides limited relief. No capital work is currently planned to be undertaken to resolve this issue.

Avondale (Catchment Serviced by PS220 at Hulverstone Drive)

- 1.26 The catchment serviced by PS220 at Hulverstone Drive has experienced ongoing street flooding over the last couple of years with near floor level flooding.
- 1.27 This flooding is due primarily to the failure of one of the pumps at PS220 which is currently in the process of being repaired. A temporary pump is deployed as required to provide relief which is successful in part. The pump repair is expected to resolve this issue.

Brenchley Avenue

- 1.28 The inundated Brenchley area is low lying and surrounded by higher ground. With no overland or secondary flow path available drainage is completely reliant on the stormwater network.
- 1.29 During all three events road and property flooding including at least one garage was observed in the Brenchley Ave area. No above floor level flooding was reported. However, the flooding at a property downstream of the catchment was within 20mm of the floor level. Floor level flooding was only avoided by the actions of the owner who pumped water from a low lying area surrounding the building back into the stream.
- 1.30 Staff have investigated the flooding issues in this area in March 2022 and documented the findings in a memo.³
- 1.31 The memo has identified a few required operational and maintenance actions to improve the situation. Most of them have been addressed. However during the events it became clear that the increased downstream flow rates into St Albans Creek were worsening the flood risk at a property downstream.
- 1.32 The remaining action (silt removal) in culvert pipes will now be carried out in conjunction with additional improvement of a culvert downstream of the property that was close to floor level flooding.
- 1.33 Modelling predicts catchment flooding even with a clear network.

³ TRIM 22/330825

- 1.34 The 2018 LDRP investigation⁴ has concluded that to alleviate the flood risk a major scheme would be needed, but it was not justified when compared with other Council priorities.
- 1.35 On 17/8/2022 The Papanui Community Board resolved a Notice of Motion requesting a report with advice of the resources required to assess a capital project to remediate the flood risk.

Tidal Flooding in Lower Avon Catchment

- 1.36 Low lying areas that are directly protected by the temporary Avon River stopbanks experienced extensive surface flooding during the first event (combined rainfall and tidal event). A number of roads were impassable, properties including garages and outbuildings inundated. At some locations flood waters threatened floor levels of residential properties. No reports of property flooding above residential floor level have been received.
- 1.37 The Avon River levels rose to within 150mm of the stopbank crest in some places, but the stopbanks held up well, were not breached or suffer other catastrophic damage. There are some locations where there is minor seepage coming through the stopbank during elevated levels in the Avon River- including Admirals Drive and New Brighton Road upstream of Pages Road Bridge.
- 1.38 The flooding was caused by a combination of rainfall runoff accumulating in low lying land and lack of drainage through the network into the Avon River during high tides. The flooding was exacerbated by back flow from the Avon River entering the stormwater system through faulty BCVs and other faulty parts of system. Also, during high tides flood water is seeping through the ground underneath temporary stopbanks rising above the surface and adding to the inundation and /or preventing drainage of surface ponding on land behind the stopbanks.
- 1.39 Examples of affected areas were:
- Pages Road (Bexley)
 - New Brighton Road (New Brighton)
 - Union Road (Tovey Street)
 - Owles Terrace
- 1.40 Some of the faulty stormwater systems will be redesigned and replaced in conjunction with the construction of the long term stopbanks and other OARC work. At the moment it is not practical and to replace pipes underneath existing temporary stopbanks as the stopbanks would have to be removed and rebuild.
- 1.41 The long term stopbanks will be placed away from the river where possible and have below ground foundation material that will reduce seepage underneath the stopbanks. The long term stopbanks are designed to prevent seepage through their core.
- 1.42 Operational and maintenance work is ongoing to check, repair and replace the BCVs. Bower Ave to Pages valve system has been upgraded with new BCVs. Localised blockages or other faults are attended to as BAU.

Wigram Subdivision

- 1.43 In the July events relatively deep street flooding was reported in Wigram Subdivision in the area around Sioux Avenue and Bennington Way along Fyfe Street. Surface flooding in this area has been observed previously.
- 1.44 There is thought to be an issue with the swale in Mustang Drainage Reserve. Interestingly the downstream basins had remaining capacity. Grills and culverts were checked and found to be clear and functional. Further investigation is required.

⁴ TRIM 16/251304

- 1.45 Further flooding was reported at The Runway near Napier Drive where a localised blockage has been identified and cleared. The bushes causing the blockage have been removed.

Philpotts

- 1.46 Philpotts Road Drain overflowed onto the northern end of Philpotts Road and onto private property surrounding a residential dwelling. This appears to be due to the water level downstream in Winters Road Drain being high and not allowing water to discharge from Philpotts Road Drain into the drain. A review of the management of the surrounding infrastructure indicates this may be able to be rectified by operating control gates differently to reduce the volume of water discharging into Winters Road Drain upstream of the confluence of Philpotts Road Drain which will allow water to drain from the Philpotts Road Drain catchment.
- 1.47 Due to the complicated nature of drainage in this area with drainage catchment being interconnected, this will be implemented and monitored during the next rain event to determine its effectiveness

Teapes Road

- 1.48 A residential dwelling on Teapes Road in the Ouruhia rural area was inundated above floor level. The dwelling is on a property at a low point in the immediate catchment and at risk of potential flooding. Further investigation found that the flooding was caused by a blocked sump grate underneath large trees that drop a lot of vegetation. The grate has historically been kept clear by a local resident in the community. However, it has now been fenced off by the property owner and is no longer easily accessible to the public. The current property owner has advised that they will keep the grate clear in the future.

Hendersons Road / Sparks Road

- 1.49 Flooding across Hendersons Road occurred during the July rain events. This is due primarily to Cashmere Stream, which the Sparks Road Wetland discharges into, being at full capacity. As such, the water in the wetland and on the opposite side of Hendersons Road spilled onto the carriageway. There is no immediate work planned to remedy this situation although further investigation will be required.

McBratneys

- 1.50 Street flooding occurred at the roundabout at the Gayhurst Road and McBratneys Road intersection. This regular flooding is thought to be caused by a combination of limited inlet capacity and a reduction in hydraulic grade during times of high water levels in the Avon River. Further investigation into this issue is required.

Shirley Stream / Emmet Street Area

- 1.51 During the July events, but especially in the third event properties and roads were inundated in two areas at Emmet Street near Orcades Street and near Orontes Street. Flood levels did not breach the relatively high floor levels in the area. However, flooding was quite deep, some of the affected houses were practically inaccessible. After the rainfall event the flooding appeared to have receded slower than expected.
- 1.52 Both areas are low lying and surrounded by higher ground. There is no natural overland flow path to Shirley Stream which is separated from the ponding area at Emmet Street by high land. The Council stormwater network drains the one through twin 375mm pipes at Orcades Street and the other area through a 375mm pipe at Orontes Street.
- 1.53 Regular flooding is caused by the unfortunate topography combined with an under-capacity stormwater pipe system to convey peak flow.

- 1.54 During the third event a backflow prevention valve broke and a dislocated part caused a blockage in one of the twin stormwater pipes under Orcades Street further reducing the already limited drainage capacity.
- 1.55 As part of the LDRP Programme upgrades to Shirley Stream were investigated⁵. Also an additional pipe outfall from Orontes Street to Emmet Street was modelled. The results showed only minimal improvement in flood levels. The option was found not to be viable.

Flockton Area

- 1.56 During the July 2022 events, street and property flooding including garages occurred in the Flockton area. The lowest lying areas such as Harrison Street, Flockton Street, Thornton Street Francis Ave were most affected. Council is not aware of any above floor flooding of residential dwellings in this area.
- 1.57 Temporary pumps at the Flockton Invert were operating as required during first and third event. It appeared that the pump rates were not sufficient at times. The forecast for the second event did not meet the threshold for pump deployment.
- 1.58 The main flooding mechanism is backing up from Dudley Creek downstream. However, blocked road sumps could have contributed to the flooding as well.
- Investigations whether the operational procedure of deploying temporary pumps to pump over Flockton Invert is sufficient and effective in the long term. A new permanent electrical pump station could increase the pump capacity, reduce carbon emissions, eliminate the reliance on weather forecasts to make deployment decisions and free up contractor resources during events but could come at significant capital cost. Pump stations about this location were investigated as part of the original Dudley Creek Flood Remediation options assessment.
- 1.59 The objective of the Dudley Creek Flood Remediation Scheme was to restore the flood risk in the Flockton Area to pre-earthquake levels. It is considered that this objective has been met, but it is expected that residual flooding in this area will continue to occur. After the July events Councillors and Community Board members have shown interest in investigations into the effectiveness of Dudley Creek.

Lyttelton Harbour

- 1.60 The Roading Team reported the area around the Gebbies Pass Rd / Charteris Bay Rd intersection area was flooded.
- 1.61 A property near Waiake Stream flooded. It is not clear whether any buildings were affected. The owner believes it was due to the culvert under Charteris Bay Road being blocked with debris. There was no debris when it was inspected however it could have been cleared by someone else.

Little River

- 1.62 Little River township area around the shops was flooded. There was water flowing across the highway near the memorial gate at Little River Domain. The highway was closed.

Duvauchelle

- 1.63 The banks of Pawsons Stream through the Akaroa Golf Club (Duvauchelle) were scoured and the abutments and approaches to some of the golf clubs bridges were damaged.
- 1.64 Pawsons Stream through the show grounds overtopped the channel and flowed across toward Duvauchelle Showground Drain. This flooded the highway and came close to flooding

⁵TRIM 17/1468209 & 16/251304

the Plunket building at 6063 Christchurch Akaroa Road. A large scour hole has developed in the bank above the Plunket Building.

- 1.65 Council will work with the Golf Club to address the damage to Pawsons Stream.
- 1.66 The roadside drain (Duvauchelle Drain) on Pawsons Valley Rd was overwhelmed and water flowed across the road and into the properties around 41 to 35 Pawsons Valley Rd. There are no reports of flooded buildings. The driveways etc. were covered in sediment. Water also flowed into and flooded the Department of Conservation yard at 13 Pawsons Valley Rd. The yard was left covered in sediment. Duvauchelle Drain also overflowed across the highway.
- 1.67 Water was flowing through the properties at 9 & 7 Seafeld Rd from the highway roadside drain. The property owner believes Pipers Stream backed up into the highway roadside drain and then overtopped and flowed through 9 & 7 Seafeld Rd. Water flowed through the ground floor of one house and the garage of the other. It also damaged the shared driveway.
- 1.68 Council received complaints about the roadside drains at Robinsons Bay Valley Rd not being maintained. The complainants believe that this caused flooding damaging the road and flooding in properties.

Akaroa

- 1.69 Akaroa Recreation Ground area, including Rue Lavaud, Rue Jolie and Rue Brittan flooded due to a blocked outfall of a stormwater pipe which is known to be a reoccurring problem. The outfall was cleared by City Care before the storm but it is unclear how well this was done. There is a possibility that the worker did not fully understand what needed doing. The outlet was unblocked during the event and flooding reduced. Improvements to the outfall structure are being discussed.
- 1.70 Also flooding of the same Recreation Ground area from Grehan Stream South Branch and possibly smaller waterways. Lack of capacity in Grehan Stream South Branch at the Rue Lavaud Bridge led to water flowing onto road and into Recreation Ground. Rue Jolie Bridge and its approaches was damaged possibly due to debris. A building at 40 Rue Jolie was flooded.
- 1.71 Slip in gully above Onuku Road came down waterway and into Claire Lane. The Onuku Road inlet was blocked and buried, mud was deposited around houses and PROW at 30 Hempleman Drive. Debris blocked drains at the top of Claire Lane walkway steps causing damage to the steps.
- 1.72 A private and possibly unconsented bridge was damaged at 61 Grehan Valley Rd. The abutment was washed out and the bridge collapsed. The remains of the bridge were removed by the property owner.

Little Akaloa

- 1.73 Flow from Little Akaloa Stream flooded properties and potentially houses in the lower township area. The roadside channel at 584 Little Akaloa Road has been damaged and needs repair. Water from the roadside channel at 584 Little Akaloa Road flowed across the road and through the property at 583 Little Akaloa Road.

Le Bons Bay

- 1.74 Le Bons Bay had flooding/ponding around Le Bons Bay Road from the Rue de la Mer intersection area around to where the road turns parallel to the beach. This ponding stayed for days after the rain.
- 1.75 The Hughes Stream beach outfall did not cause flooding.

Okains Bay

1.76 The road was impassable due to fairly deep flooding across the road near 1093 Okains Bay.