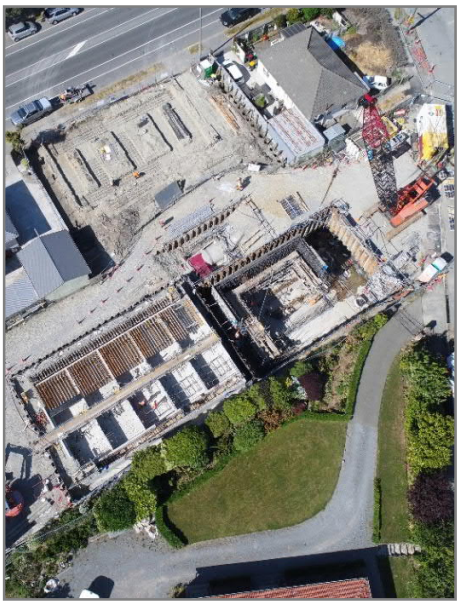
Land Drainage Recovery Programme

Summary Report



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Section 1. Introduction

The Canterbury earthquakes increased flood risk in some parts of the city by changing the topography and damaging land drainage infrastructure. The Land Drainage Recovery Programme (LDRP) was established by Christchurch City Council ("Council") in 2012 to understand the consequences of the earthquakes on the land drainage network within the city limits. In addition to the immense physical damage, the health and social impacts on communities has been severe. Therefore, the LDRP will also help to restore community resiliency and wellbeing.

1.1 Land Drainage Network

The land drainage system in Christchurch consists of rivers and tributaries, utility waterways, and stormwater pipe networks (Table 1).

Table 1 Summary of land drainage network

Feature	Approximate length (km)
Rivers	79 km
Tributaries	160 km
Utilities waterways (lined and unlined drains)	130 km
Stormwater pipe network	790 km

1.2 Network Damage

The LDRP sets out to deliver projects to:

- Repair damage to waterways and land drainage infrastructure; and
- Reinstate pre-quake levels of flood risk.

Damage to the network has taken a number of different forms:

- *Direct damage to waterways:* bed heave, bank slumping, subsidence, silting of bed and vegetation decline. Much of this damage has now been masked by ongoing natural processes.
- *Direct damage to structures:* damaged bridges, retaining structure, concrete lined channel cracking, tilting of outfall structures, and wall failure of timber lined drains. Some of this damage was addressed by the SCIRT work programme, but not all.
- *Change in flood risk*: land damage, tectonic shift and changing stream bed slopes have increased flood risk to properties and houses. Physical works to address change in flood risk include network capacity upgrades, which are typically far more expensive than direct damage repairs.

Damage is widespread across the city but more extensive in the eastern suburbs. The LDRP includes proposed work packages across many parts of the city.

1.3 Land Drainage Recovery

1.3.1 Goal

The goal of the recovery is to understand the consequences of the earthquakes on the land drainage network of rivers, streams, overland flow paths and major structures. These consequences will not all have a set solution, and some will require repair whereas for others adaption and careful management may be the best option.

Recovery of the land drainage network will be achieved when all identified responses are in place and flood risk has been returned to pre-earthquake levels or a new level of risk accepted by Council and the community. Responses range from physical works (e.g. engineered intervention such as stopbanks) to policy change (e.g. retreat or adaption).

Adaptive management means changing existing management practices to suit the revised environment and reviewing the practices regularly to ensure they are appropriate, efficient and accurate. Examples include: revising floor level requirements to address change in flood risk, changing weed harvesting frequency to manage increased low flow water levels or preparing for rainfall events by developing management plans.

1.3.2 Objectives

- To implement a prioritised programme of investigations and physical works to repair damage and restore flood risk to pre-earthquake levels; and
- Use a benefit/cost analysis and risk based approach to determine an appropriate response being either: physical works, retreat, adaptation or adaptive management.

1.4 LDRP Working Group

Councillors' objectives for the LDRP are informed and guided by the LDRP Working Group. This is a sub group of the Infrastructure Transport and Environment (ITE) Committee and comprises three Councillors including the Chair of ITE.

This group is not a decision making body but is a forum to update on programme and projects, seek councillor feedback and guidance, provide information and discussion on any land drainage or flood hazard issue from all parts of the business.

The Working Group has helped guide and support work with Community Boards and engagement with residents and stakeholders. They have been very supportive of the programme and projects to date.

1.5 Funding

The LDRP has been funded through Council's Long Term Plan (LTP), and included in the Annual Plan. From the commencement of the first investigations project FY13, the programme to July 2017 has spent $94.5 million (Table 2).

Table 2 LDRP spend to date FY13-17

Budget type	FY13	FY14	FY15	FY16	FY17	TOTAL
Investigations (OPEX)	$1,469,475	$1,652,850	$2,017,304	$5,040,600	$4,261,123	**$14,441,352**
Physical works (CAPEX)	-	-	$2,159,449	$26,478,804	$51,386,861	**$80,025,114**

The current year (FY18) has a budget of $68.1M. In the LTP 10-year horizon (FY19-28) $258M is budgeted (Table 3 and Appendix B).

Notably the fund for investigations is greatly reduced beyond FY18, and from FY19 is combined with the funds for operational flood response (should there be a need within a given year). The amount left for investigations may be insufficient for existing projects and if the ongoing modelling programme identifies any new areas for investigation.

Table 3 LDRP LTP budget for FY18-28

Budget	FY18	FY19	FY20	FY21	FY22	FY23
Investigations (OPEX)	$2,527,042	$413,452	$530,093	$682,320	$829,184	$981,129
Physical works (CAPEX)	$68,100,000	$23,142,318	$24,916,732	$29,800,871	$29,680,265	$24,336,211

Budget	FY24	FY25	FY26	FY27	FY28
Investigations (OPEX)	$1,067,501	$1,118,759	$1,168,598	$1,208,780	$1,263,136
Physical works (CAPEX)	$23,384,544	$16,305,933	$17,702,332	$21,209,610	$24,466,188

1.6 Summary Report Purpose

The purpose of this summary report is inform key stakeholders of the current status of the LDRP. The projects that form this programme of works are divided into two streams; "investigations"

projects, and "physical works" projects. This report will provide in some detail information on the current scope, priorities, programme, budget, and risks of the programme.

The programme has and will continue to operate in part reactively due to the changing nature of the rebuild and recovery effort. As such, the scope of the projects, programme and costs will have to be reviewed regularly. An updated summary report is required on a regular basis to identify and inform on important changes to the programme. The scope of the projects and the budget cost estimates have been based upon the latest understanding of the recovery effort. These estimates are subject to ongoing review and change.

Section 2. Business Need

2.1 Social and Health Impacts

Since the earthquakes there have been a number of flood events. These flooding events have impacted on people's health and wellbeing, their ability to cope with uncertainty and change, and their ability to cope financially. The Mayoral Flood Taskforce in 2014 investigated the social and health impacts in the worst affected areas of Christchurch with the most vulnerable people and houses.

The Taskforce identified a number of key social impacts from frequent flooding:

- People are concerned about living in damp, mouldy houses and consider that living in warm, dry, healthy homes is a priority for physical health and for personal wellbeing;
- There is a reported increase in stress, depression, feelings of hopelessness, frustration, anger and powerlessness. These feelings are partly because of a perceived lack of coordination between the agencies, and a perceived lack of urgency and communication from the agencies. These feelings are also because of uncertainty about the future, financial worries, and living in cold, damp, unhealthy homes;
- Wastewater contamination of floodwater can put public health at risk and potentially jeopardise untreated potable water supply especially where wells or pump stations are in flood prone areas. Stress on the wastewater network from flooding can result in uncontrolled overflows, contamination of people's homes and properties (directly from the wastewater network or from contaminated floodwater), risk of illness and disease associated with contact with wastewater and repeated clean-up costs;
- Financial concerns including increased insurance excess, loss of equity in homes, insurance money running out, increased financial obligations such as having to service a mortgage and pay rent, increased electricity and heating costs, impacts on businesses (loss of revenue) and forced annual leave or leave without pay;
- People are concerned about the potential loss of community or fragmented communities and a loss of amenities;
- Uncertainty with timing of house repairs; and
- The time it may take to remedy or reduce flooding and uncertainty of what to do in the meantime.

The Taskforce stated that if flooding issues, particularly regular flooding, were not addressed in a timely manner then social degradation may occur. Houses could lose value and become derelict or be abandoned (potentially increasing crime) and this could directly impact on the fabric of the local community and the wider community. Confidence in the Christchurch rebuild could be undermined if this were to occur.

2.2 Economic Impacts

In addition to the social and health impacts there are direct and indirect impacts from the increase in flooding resulting from the earthquakes:

- *Direct impacts:* damage to houses, business and infrastructure, clean-up costs and flood management activities.
- *Indirect impacts:* reduced economic activity, inefficiency in transport network, increased insurance costs, stress on the public health system, delays in access for emergency response vehicles, social degradation from repeated flooding.

Historically land drainage infrastructure projects do not have 'positive' benefit cost ratios using conventional techniques due to the intermittent nature of flooding. However, they are often progressed based upon significant social impacts.

Building and access flooding pre-LDRP along Dudley Creek

Section 3. Guiding Principles

The LDRP uses guiding principles to establish which response, if any, is appropriate. These principles are focused on:

- Demonstrating earthquake effect
- Achieving significant social benefit
- Adherence to long term planning ('no regrets') and Council's six values[1] approach
- Levels of service

An engineering risk based approach is applied to the selection of projects to proceed into the later stages of design and construction.

Capital works have and will continue to proceed prior to the completion of investigations across the entire city. Decisions on adaptive management and 'do nothing' need to be justified and relate to the guiding principles.

3.1 Earthquake Effect

An earthquake effect must be identified and proposed physical works must clearly demonstrate remediation of earthquake impacts. For example, in-stream works must be located in areas of direct damage or proposed increases in network capacity must be linked to restoration of pre-quake flood risk. Any direct enhancement must be clearly identified as funding of this may require a separate funding source. Indirect enhancement is unlikely to be funded.

Earthquake damage to a pump station and bridges in Christchurch

[1] The six values are: ecology, landscape, recreation, heritage, culture, and drainage. This approach ensures that wider cultural, community and environmental values are taken into account when making decisions about surface water drainage.

3.2 Social Benefit

Any proposed responses need to provide benefit. This could include social and economic benefit, such as: reducing the frequency or severity of flooding, preventing social decline, or minimising damages. Any proposal with limited or no benefit should not be progressed.

3.3 'No Regrets'

Proposed responses need to be consistent with long term planning objectives and not compromise any responses to sea level rise. In general the works will not address sea level rise, but where they do (e.g. due to cost efficiencies in future-proofing the works) then this portion shall be clearly identified so that a funding path can be determined. The principle is that all projects should be consistent with proposed future works and investment should not impede long term strategies. Responses should also be consistent with Council's six values approach, ensuring that cultural, community and environmental values are taken into account.

3.4 Levels of Service

The LDRP will deliver to Council's most recent Long Term Plan (2018 - 2028) when it is published, and will support Council in achieving the levels of service and strategic priorities relating to stormwater and flood protection.

Work is being done under the LDRP to better understand current and future flood risk. This may include better definition around above floor, below floor, property flooding, street flooding, residential versus commercial, return interval risk e.g. 1 in 50 years, 1 in 10 years, etc. It is proposed that a report for decision be taken to Council once the City Wide Modelling project has provided better data for consideration. This information could be used in future Long Term Plans.

LDRP project options are being developed to achieve suitable repair and remediation to reduce flooding. Enhancement is not a stated objective but is included in investigations to inform Council and possible future work programmes.

Section 4. Investigation Projects

The investigations / early work sub-programme has two key objectives:

- *To inform the physical works programme:* It provides the necessary information to allow for prioritisation and costing of high priority physical works; and
- *Deliver on high priority physical works:* The programme has balanced investigations against high priority physical works to minimise any lag in construction.

This approach has enabled flexibility between investigations and physical works so that any investigations do not precede physical works by a significant period.

There has been a total of 115 investigation projects identified to date, which is eight additional to the 107 identified in the 2015 Summary Report. Names, status, and the location of the latest or final report for each project is provided in Appendix A - LDRP Investigation Projects. These are organised into seven categories, as summarised in Table 4. Of the projects, 83% have been completed (Note: projects have also been marked complete if they have been determined to be no longer necessary, or merged with another LDRP project). Of the remaining projects, 12 are on hold due to financial constraints on operational budgets.

Table 4 Investigations progress summary by category

LDRP Programme Category	Complete	Underway or on Hold	Total
Analysis, Optioneering & Concept Design	11	2	13
Downstream Rivers	21	1	22
Lined & Unlined Drains	8	3	11
Modelling	5	2	7
Operations	3	-	3
Planning and Policy	7	-	7
Upstream Rivers and Tributaries	43	9	52
Total	**98**	**17**	**115**

The City Wide Modelling project, which is due for completion late 2018, may identify other areas of interest, which will stimulate new investigations projects. However, due to the investigation budget greatly reducing beyond the end of the current financial year (FY18), additional operational funding may need to be sought if the investigations programme is to continue.

Multi-hazard analysis is currently underway and will help inform decisions on long term flood plan management strategies for the lower reaches of the Avon, Heathcote & Styx River and Sumner. The results of this analysis will directly impact the LDRP physical works programme.

Overall the projects cover:

- A wide geographical area of Christchurch including private, public, residential and commercial areas
- A range of activities (e.g. flood hazard assessment, ecological studies, engineering optioneering and groundwater assessment and modelling)
- Only the land drainage network in areas affected by the earthquakes

The programme schedule was driven by the highest priority projects and their precedents. Due to the interconnectedness and interdependencies of many of the projects, some are progressing in advance of their priority due to efficiencies with other high-priority works.

Looking across the Avon-Heathcote Estuary from the site of LDRP 525 Southshore Emergency Bund

Section 5. Physical Works Programme

5.1 Prioritisation

Council and community expectations of the programme are high with a strong desire to see the most flood prone areas remediated as soon as possible. Considerable efforts are going into prioritising projects at programme level to enable the greatest benefits in the shortest time. There are also a number of other considerations at a programme level to factor in:

- The City Wide Models, validated by flood observations and floor level surveys, will better define the extent of flood risk and will inform long-term sustainable decision making.
- The City Wide Economic Assessment Tool is now available to better define cost benefit assessments that do not easily consider differences between above and below floor flood risk, infrastructure versus policy responses, future climate change effects, etc.
- The Flood Intervention Policy, which was established in 2016 to provide assistance at a property-level for the most vulnerable, where an area-wide solution cannot be implemented in a timely manner.
- Changes to the Levels of Service may occur, either through an LDRP initiative or externally.
- The Strategy and Transformation Group's Surface Water Strategy (2009).
- The ongoing consideration of enhancement within projects. Project investigations consider the cost and benefits of a number of options and identify costs for repair, remediation, and enhancement. So far enhancement has only occurred where it is cost neutral or funding can be provided from a source other than LDRP.
- Feedback from project investigations has allowed programme estimates to be refined. This will continue to be the case as the remaining investigations are completed.

5.2 Scenario 4a

Previously, a prioritised physical works package was developed based upon an engineering intervention approach. This was updated with 2017 project names and is provided in Appendix C. The budget estimate for this scenario totals $1.2 billion (+/-40%).

This scenario categorised projects into groups and then prioritised those groups. The prioritisation of the groups was based upon a range of weighted qualitative and quantitative criteria, including: flood risk and effects; cost benefit; alignment with long-term planning objectives and other programmes; and the five non-drainage values (ecology, landscape, recreation, heritage and culture).

The works proposed by Scenario 4a included a range of engineering intervention measures, such as stopbanks, pump stations, channel modifications, storage, and those at property level (e.g. house purchase, on property bunding, or house raising and resale). These were for the purpose of the scenario only and did not pre-determine the approach that might be taken in any catchment.

The 2017 update to Scenario 4a did not re-adjusted the prioritisation and only minor edits were made to the cost estimates, where projects are underway and costs are known. The scenario will be re-run in more depth once the City Wide Models are available for use.

5.3 Early Works (2015 – 2017)

Following on from the development of Scenario 4a a number of projects were initiated as capital projects across the first three years of the physical works programme (Table 5). The completion of the Dudley bypass at the end of FY17 meant 81 properties were protected from above floor flooding in a 50 year event. The remaining projects are ongoing in FY18.

Table 5 Capital project spent for FY15-17

LDRP ID	Project	$M Spent			Total
		FY15	FY16	FY17	
54	Dudley Creek	2.2	9.5	27.1	**38.8**
54	Shirley Stream Culvert	-	2.5	0.9	**3.4**
44	Integrated City Wide Modelling	-	1.0	0.8	**1.9**
500	Upper Heathcote Storage	-	7.3	3.8	**11.0**
501	Bell Creek	-	1.2	5.2	**6.4**
501	Linwood Canal and Cuthberts Drain South	-	-	-	**0.0**
502	Matuku Waterway	-	0.1	1.3	**1.4**
503	Cranford Basin Active Management	-	3.7	1.1	**4.8**
504	Stormwater Infrastructure Economic Model	-	0.2	0.08	**0.3**
505	Sumner Waterways	-	-	-	**0**
506	Dudley Creek Tributaries	-	-	-	**0**
507	Temporary Stopbank Management	-	0.1	2.2	**2.3**
508	Lower Avon Stopbanks Preliminary Design	-	-	-	**0**
509	Knights Drain – Stage 1		0.7	4.1	**4.8**
509	Knights Drain Ponds	-	-	-	**0**
510	Wairarapa, Wai-iti and Tributaries	-	-	-	**0**
511	Upper Avon	-	-	-	**0**
512	No. 1 Drain	-	0.01	0.6	**0.6**
513	PS 205	-	-	0.04	**0.04**
514	Brittans Drain	-	0.01	-	**0.01**
515	Estuary Drain	-	0.03	0.3	**0.4**
516	Knights Drain – Wainoni Park	-	0.01	0.3	**0.3**
517	Residual House Remediation	-	-	2.0	**2.0**
518	Mid-Heathcote Bank Stabilisation	-	-	0.3	**0.3**
519	City Outfall	-	0.03	0.0	**0.03**
520	Wigram East Retention Basin	-	-	1.3	**1.3**
	TOTAL	**2.2**	**26.5**	**51.3**	**80.0**

5.4 Current Status

A new version of Scenario 4a will be prepared once the City Wide Models are available to clarify and prioritise the risk to each catchment. This will reflect the many changes to the programme since the development of the scenario, including:

- Completion of the tidal barrier study. It was resolved by Councillors not to progress further investigations into a tidal barrier at this stage.
- Further flood events in July 2017 highlighting priority areas in the Lower Heathcote and Southshore.
- The completion of the Stormwater Economic Tool, allowing for new prioritisation based on cost/benefit, including the intangible costs of flooding.
- The Flood Intervention Policy allowing for property-level works or purchase of the most vulnerable where there is no other timely catchment-wide scheme.
- Identification of opportunities to align with other projects from across Council.
- Ongoing completion of investigations projects.

In the interim, the following provides an update on the progress of each of the Scenario 4a project groups. By the end of FY18 these projects will have successfully protected over 100 houses from over-floor flooding and approximately 2,800 properties from underfloor or on-property flooding during an extreme 50 year event.

LDRP High Priority

This included 15 projects targeting areas outside of Dudley Creek and the main rivers. Over 1,600 properties were identified by the Earthquake Commission (EQC) as having Increased Flood Vulnerability (IFV) were included in these areas.

The investigations component for the high priority projects are complete. Construction has begun for a number of these projects including Avon Temporary Stopbanks, Bells Creek, Cranford Basin, Shirley Stream, Knights Drain and Upper Heathcote Storage. Investigations into Brittans Drain and City outfall Drain are yet to find an economically viable solution.

Flood Intervention Policy (FIP)

At the Council meeting of 10 December 2015, the Council resolved to adopt a policy to intervene at an individual property level where habitable floor levels are at risk of frequent flooding (in a 10 year average recurrence interval event), there has been exacerbation of flooding due to the Canterbury earthquake sequence and there is no timely catchment-wide solution. This is known as the Flood Intervention Policy and has to date been applied in the Dudley Creek catchment and along the Heathcote River.

Dudley Creek

The Dudley Creek project area was one of the areas worst affected by post-earthquake flooding. The Flockton Street area had 70 per cent of the city's homes with repeated flooding above the floor since the quakes. The nearly complete, Council-approved works will reduce the number of homes likely to flood above the floor in an extreme event from 91 to 10. In a one in 10 year storm event the number of floor levels at risk reduces from 55 to zero. Overall, the work will reduce flooding depth for at least 585 properties. This option has effectively returned to, or improved on, pre-earthquake flood risk for most of the catchment. Seven properties were purchased through use of the Flood Intervention Policy as part of this project.

LDRP construction in Dudley Creek

Avon River Flood Protection

In Scenario 4a, the Avon Temporary Stopbank Management Project was second only to Dudley Creek in order of priority. This project recognised the importance of maintaining the existing assets while new plans are underway. The temporary stopbank repairs are now near completion, and are designed to provide approximately 20 years of service. This gives sufficient time for a longer term strategy for flood management alongside the Avon River.

Future flood management may consist of stopbanks, pumping or land use change. Given that much of the land is designated Residential Red Zone (RRZ) all proposals will be in discussion with Regenerate Christchurch and Land Information New Zealand (LINZ).

Because of the protection afforded by the temporary stopbank repairs and the ongoing discussions with central government, investigations have not progressed beyond initial feasibility. A multi hazard analysis is currently underway. This will help inform decision making on Avon Floodplain management. The detailed design of any scheme is scheduled to commence in FY23 with implementation from FY24.

Over 1,100 properties identified by EQC as having Increased Flood Vulnerability (IFV) are included in the extent of these works.

The Avon River

Heathcote River Flood Protection

Damage to land and infrastructure alongside the Heathcote River has increased the severity of flooding to existing flood prone land, most of which lies within the floodplain defined by the river terraces. There are also some new areas now exposed to the risk of inundation. There have also been effects on existing flood mitigation infrastructure, stormwater systems, critical roads, wastewater overflows, as well as other services. Properties adjacent to the Heathcote River were noted by the Mayoral Flood Taskforce (May 2014) as being the second most significant cluster of post-earthquake flooding after the Dudley Creek catchment.

The Heathcote investigations have progressed significantly, and were catalysed further by the flooding in July 2017. Four storage basins are in detailed design or under construction in the Upper Heathcote area, in addition to the early works basin built on Sparks Road. Dredging of the lower reaches is set to commence this year and the Flood Intervention Policy is to be used to purchase 25-35 particularly vulnerable properties. Low stopbanks also remain a potential option for the mid and lower Heathcote, and preliminary design has commenced with the expectation of public consultation in coming years. It should be noted that, these fixes will only address the frequent flooding problems and the catchment will require further works to reduce risk of flooding during larger, less frequent events, and the effects of climate change.

Over 1,300 properties identified by EQC as having Increased Flood Vulnerability (IFV) are included in the extent of the works in this programme.

Styx River Flood Protection

The Styx catchment is largely rural but also includes significant urban areas of Christchurch and Belfast and some commercial and industrial areas. Investigations have been progressing in the area, but as this area contains no properties identified by EQC as having IFV outside of the RRZ, and no properties were identified during the Mayoral Flood Taskforce, this was given lower priority. The flood management works could include stopbanks and floodwalls, ring banking of

some isolated areas, and backflow prevention. It is also noted that this area will be severely affected by future sea level rise. Economic viability of any scheme would need close consideration.

Estuary and Sumner Flood Protection

This includes Southshore, Redcliffs and parts of Sumner. Flooding of this area is driven by extreme tide events. The potential options include stopbanks, floodwalls, pumpstations, new or repaired pipework and land use change. A tidal barrier pre-feasibility study covered the Southshore area but was dismissed from further investigation by Council.

Given the multiple hazards that threaten these areas a more detailed multi-hazard analysis project is underway to consider potential options for the long term. This will be significantly progressed by late 2018. In the interim a temporary bund has been constructed along the estuary side of Southshore.

Over 100 properties identified by EQC as having Increased Flood Vulnerability (IFV) are included in these areas.

LDRP Medium/Low Priority

This list included areas where flood risk was known or suspected to have increased as a result of the earthquakes, but were ranked lower in the multi-criteria priority rating. Medium and low priority projects areas included over 350 and 200 properties respectively as identified by EQC as having IFV.

Many of the investigations of these areas are now completed, with the remaining few due for completion imminently or on hold due to budgetary constraints. As these are completed the projects form part of the capital programme, and are prioritised appropriately.

5.5. Ongoing Programme

The priority and cost estimates of the programme is under constant revision. A further change is anticipated following the completion of the City Wide Modelling study and the resulting outputs. It is likely that some of the projects identified within the list provided below will be re-prioritised and other projects may progress in advance of those currently identified. Balancing physical works programmes also requires changes to the identified capital spend for individual projects.

Currently the physical works programme as part of the draft LDTP budgeted until 2028 with a total budget of $238M spread across those years (Appendix B).

As part of the LTP process the LDRP is seeking ongoing funding to enable delivery of the full list of projects (as per Appendix C) or their alternatives.

Section 6. Governance, Uncertainty and Risks

6.1 Project Governance

There are over 100 projects under the programme and these cover a wide range of subject matter areas from detailed science through to bulk construction. Therefore, it is not possible to have one governance group which can both be involved in the detail of projects and provide sufficient overview of the programme as a whole. Each project has its own Project Control Group, made up of 3-5 key internal stakeholders. These groups are formed with the intention of drawing on the expertise available from teams other than Land Drainage, and also so that members can distribute their understanding of the project back within their own teams. These groups typically meet monthly and provide oversight at a project level, with key responsibilities to maintain good project management and project outcomes consistent with Council strategy.

To give oversight of the programme of the whole there is a monthly Programme Control Group. This comprises 14 senior members of teams across Council, including parks, wastewater, land drainage operations, asset planning, communications, finance and strategy and transformation. This group is tasked with making sure the programme is true to its guiding principles and overall Council strategy, and that good programme management practices are being followed.

6.2 Change Management

The programme operates in part reactively due to the changing nature of the rebuild and recovery effort but in general has structured approach as set out in the programme. The scope of the projects, programme and costs is reviewed regularly to adapt to this.

The scope of the projects and the budget cost estimates have been based upon the latest understanding of the recovery effort (including hydraulic modelling of the main river stems, pre-feasibility assessments and catchment investigations). There is a range in confidence in the proposed physical works programme arising from:

- *Variation in investigations progress:* For example, the Heathcote investigations have progressed further than the Avon.
- *Alternative responses:* Much of the current physical works programme is based upon an engineering intervention approach. If the other responses (adapt, retreat) begin to form the bulk of the programme this could give rise to changes in the proposed work or cost estimates. The policy and investigations work to support the optimal response strategy is ongoing.
- *Ongoing review:* The proposed physical works programme is currently under review as part of the LTP. An updated Scenario 4a will be completed in late 2018/early 2019. This will update the cost estimates and scope of the physical works packages.

6.3 Risk Management

The programme risk register is the key management tool for programme-level risks. Risk identification covers all aspects of the programme throughout its lifecycle, including budget, procurement, programme administration, health and safety, and environmental.

Key risks to the programme include:

- *Power to implement:* Timeframes not being achievable, RMA processes cause increased time and cost or existing powers not available.
- *Land requirement:* Unable to get agreement with land owners, land acquisitions not viable estimated cost not realistic. May need to forcibly acquire land.
- *Resource availability:* Lack of in-house resources, or loss of resources, results in slower than expected programme delivery.

There may be the opportunity to seek further contribution from Government. The Crown did not initially recognise that the drainage network damage was the result of the earthquakes and funding was not included in the original cost share agreement, with a few minor exceptions.

6.4 Assumptions

There are some basic assumptions made in the development of the programme budget estimates:

- *Budget:* For the budget it is assumed that the projects will be delivered by external consultants. The project budget estimates have been priced at current market rates.
- *Contingency:* A uniform contingency of 40% has been applied to the budget estimates for projects still to be initiated. This has not been varied according to the individual project risk profiles but will be addressed at the project charter development stage.
- *Programme:* The timing of programme assumes unconstrained resources in the external market. This may be unrealistic as the market is near saturation point.
- *Reactive Projects*: As has happened to date, further new projects may be required and priorities of existing projects may be altered during the course of the remainder of the programme.

Section 7. Conclusions

The earthquakes significantly altered the performance of the land drainage network. Direct damage to waterways and structures has combined with land damage to significantly alter flood risk across much of Christchurch. Up to 9,000 properties have been identified as having increased flooding vulnerability due to the earthquake, with many of those at increased risk of floor level flooding.

The five years of the LDRP's investigations programme to date has identified a range of issues and solutions. Remediation of these issues will be costly and will require an ongoing commitment to funding. The LDRP has developed a physical works remediation programme, which is currently under review. An initial $238M is in the draft Long Term Plan, which provides funding until FY28. Ongoing funding beyond this is required to deliver on the remainder of the programme.

The programme will continue to develop with time as further investigations are completed, reviews undertaken and policies developed on alternative responses.

The LDRP programme cannot be undertaken in a vacuum, and the programme will work in tandem with a number of other initiatives from within Council and with Council's strategic partners to ensure an integrated approach to risk reduction and flood management.

Appendix A - LDRP Investigation Projects

Project Identifier	Project Name	Status	Latest/Final Report (Council Ref.)
LDRP 1	Modifying Land Drainage Maintenance Contracts for Earthquake Effects	Complete	15/832031
LDRP 2	Temporary Stopbank Management - Short to Medium Term	Complete	16/588681
LDRP 3	Downstream Rivers: Bank Treatment	Merged with LDRP 508	-
LDRP 4	Accommodating Recreational Needs	Undertaken on individual projects	-
LDRP 5	Detailed Design of the Desired Profile for Major Rivers	Not undertaken (Capex)	-
LDRP 6	Stopbank Detailed Design and Construction	Complete	15/376699
LDRP 7	Options and Guidelines for Outfall Structures and Open Channels	Complete	15/1148062
LDRP 8	Horseshoe Lake Stormwater Recovery Plan	Complete	16/263054
LDRP 9	Styx River Operational Water Levels	Complete	17/805243
LDRP 10	Pages Road Bridge Realignment Options	Not undertaken	-
LDRP 11	Jacksons Creek - Lower Heathcote	On hold	15/1500124
LDRP 12	Steamwharf Drain - Lower Heathcote	Complete	17/184282
LDRP 13	Heathcote Hill Catchments	On hold	17/917654
LDRP 14	Couling Creek - Lower Heathcote	Merged into LDRP 110	-
LDRP 15	Upper Heathcote - Above Colombo Street	Complete	16/1098039
LDRP 16	Hayton Stream	Merged into LDRP17	-
LDRP 17	Curletts and Haytons Catchment Investigation	On hold	17/1030660
LDRP 18	Cashmere Stream and Hendersons Basin	Merged into LDRP 88	-
LDRP 19	Travis Swamp Outfalls (Late Kate Sheppard Stream & Corsers Drain)	Complete	17/1222293
LDRP 20	Horseshoe Lake Tributaries (Snellings Drain, No. 1 Drain, No.2 Drain)	On hold	17/741981
LDRP 21	Shirley Stream - Lower Avon/Dudley Creek	Complete	17/1468209
LDRP 22	St. Albans Creek - Lower Avon/Dudley Creek	Complete	17/1468209
LDRP 23	Upper Avon, Ilam Stream And Okeover Stream	On hold	16/1459031
LDRP 24	Waimairi Stream	Merged into LDRP 64	-
LDRP 25	Wairarapa Tributaries (Cross & Taylor Streams)	Merged into LDRP 64	-
LDRP 26	Kaputone Stream - Upper Styx	Merged into LDRP 27	-
LDRP 27	Upper Styx River	On hold	15/93912
LDRP 28	Sumner Stream & Richmond Hill Stream	On hold	17/1336082
LDRP 29	Bells Creek Desired Profile - Lower Heathcote	Complete	16/634450
LDRP 30	Bank Stability Impacts	Merged into LDRP 97	-
LDRP 31	Reinstatement of Ecologically Sensitive Areas	Complete	18/7918
LDRP 32	Detailed Design of the Desired River Profile	Not undertaken (Capex)	-
LDRP 33	Condition and Damage Assessment	Complete	16/326169
LDRP 34	Silt Removal	Undertaken by operations team	-
LDRP 35	City Outfall Drain	Complete	17/1244244
LDRP 36	Bings Drain - Lower Avon/Dudley Creek	Complete	16/24744
LDRP 37	Knights Drain - Lower Avon	Complete	16/412597
LDRP 38	Brittans Drain - Lower Avon	Complete	16/509072

LDRP 39	Mairehau Drain - Lower Avon/Dudley Creek	Merged into LDRP 65	-
LDRP 40	Kruses Drain - Upper Styx	Merged into LDRP 27	-
LDRP 41	Lower Styx Repair Options	Ongoing	17/1494897
LDRP 42	Wilsons Drain - Otukaikino	Merged into LDRP 27	-
LDRP 43	Riccarton Main Drain - Upper Avon	On hold	16/527938
LDRP 44	Integrated City Wide Flood and Floor Level Modelling	Capex	-
LDRP 45	Effects of Earthquakes on Groundwater Levels	Ongoing	16/1345167
LDRP 46	Flockton Basin Rainfall Response Plan	Complete	15/653885
LDRP 47	Halswell River Catchment Modelling	Ongoing	15/820924
LDRP 48	Overland Flow Path Modifications	Undertaken on individual projects	-
LDRP 49	SCIRT Modelling Integration	Merged into LDRP 44	-
LDRP 50	Post-earthquake Filling of Land	Complete	15/643885
LDRP 51	Network Performance Against City Plan/By-Law Rules	Not undertaken	-
LDRP 52	Floor Levels and Building Platform Filling Policy	Complete (Charter only)	14/13526
LDRP 53	Cashmere Brook - Upper Heathcote	Merged into LDRP 15	-
LDRP 54	Dudley Creek Value Engineering	Complete	14/1336742
LDRP 55	Private Property & Land Drainage	Complete	16/93805
LDRP 56	Assessment of Filling Building Platforms	Complete	16/673206
LDRP 57	Port Hills	Complete	13/702171
LDRP 58	Bank Stability	Complete	13/957823
LDRP 59	Insurers' Responses	Complete	12/860090
LDRP 60	EQC Responses (no report)	Complete	-
LDRP 61	Stormwater Modelling	Complete	12/937429
LDRP 62	Pre-Feasibility Estuary Barrage	Complete	16/269999
LDRP 63	Investigation River & Tidal Flood Protection	Avon, Heathcote, Styx and Estuary - all in draft only	14/707854 14/171575 14/171486 14/171473
LDRP 64	Wairarapa & Wai-Iti Streams	On hold	16/107235
LDRP 65	Dudley Creek	Complete	14/331237
LDRP 66	Cranford Basin Active Management	Complete	16/13852
LDRP 67	LDRP Planning Review	-	-
LDRP 68	Owles Terrace - Lower Avon	Merged into LDRP 97	-
LDRP 69	Blake Street	Merged into LDRP 70	-
LDRP 70	Avondale Pumpstations and Outfalls	Merged into LDRP 97	-
LDRP 71	Mckenzie Ave and Tabart Street	Merged into LDRP 29	-
LDRP 72	Rawson Street	Merged into LDRP 97	-
LDRP 73	No 1 Drain	Complete	16/500995
LDRP 74	Estuary Drain (previously known as LDRP 55)	Complete	15/1361222
LDRP 75	Wainoni Road	Merged into LDRP 97	-
LDRP 76	Railway Drain	Merged into LDRP 41	-
LDRP 77	Grafton Street	Merged into LDRP 29	-
LDRP 78	Thames St Pipeline Upgrade (part of Dudley Creek project)	Merged into LDRP 54	-
LDRP 79	Knights/Nottingham	Complete	14/1403337

LDRP 80	Earlham Street	Merged into LDRP 92	-
LDRP 81	Lower Styx Road	Merged into LDRP 92	-
LDRP 82	Cooks/Lodges Drain	Merged into LDRP 97	-
LDRP 83	Woodpeckers On Mairehau Road	Merged into LDRP 19	-
LDRP 84	Queenspark Drive	Merged into LDRP 97	-
LDRP 85	Pegasus Avenue	Merged into LDRP 97	-
LDRP 86	Palmers Road	Merged into LDRP 97	-
LDRP 87	Avon Gayhurst-Barbadoes	Merged into LDRP 97	-
LDRP 88	Upper Heathcote Storage Options	Complete	17/32604
LDRP 89	House Raising Feasibility Study	Complete	17/674153
LDRP 90	Estuary Investigation River & Tidal Flood Protection	Merged into LDRP 97	-
LDRP 91	Sumner Near Cave Rock	Merged into LDRP 28	-
LDRP 92	Styx River & Tidal Flood Protection	On hold	TBA
LDRP 93	Heathcote US & DS Ensors Road	Merged into LDRP 97	-
LDRP 94	Tidal Barrier Impacts on Flood Defence Options - Stage 1	Complete	16/858095
LDRP 95	Wet Weather Event Recording	Complete	17/816668 17/1000668
LDRP 96	Upper Dudley Creek	Complete	17/1468209
LDRP 97	Multi-Hazard Analysis	Ongoing	17/742990
LDRP 98	Open Waterways Condition & Damage Assessment	Complete	16/1441588 17/101090
LDRP 99	Avon-CBD U/S Barbadoes (incorporated in Avon River Precinct)	Complete	-
LDRP 100	Matuku Waterway	Complete	16/522343
LDRP 101	Heathcote & Avon Summary of City Wide Modelling Results	Complete	TBA
LDRP 102	Stormwater Pump Station Design Specification	Complete	17/631589
LDRP103	Coxs Drain	Complete	18/61376
LDRP 104	PS210 Catchment	Merged into LDRP 20	-
LDRP 105	Linwood Canal	On hold	16/398201
LDRP 106	Cost Models	Complete	18/61445
LDRP 107	Citywide Modelling Analysis	Ongoing	TBA
LDRP 108	Residual Risk Investigations	Complete	16/1342052
LDRP 109	Pipe Condition Assessment	Complete	None
LDRP 110	Heathcote River Post EQ floodplain Management Strategies	Complete	17/1464035
LDRP 111	South New Brighton and Southshore Flood Intervention	Complete	17/88616
LDRP 112	Weather Study	Complete	TBA
LDRP 113	Sediment Budgets	Complete	TBA
LDRP 114	Tsunami Study	Complete	TBA
LDRP 115	Groundwater Levels with Climate Change	Ongoing	TBA

Appendix B - LDRP Physical Works Project Draft 2018-2028 LTP Budgets

LDRP#	Projects	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
54	Dudley Creek	10.3	0.4									
44	Integrated City Wide Modelling	1.3										
500	Upper Heathcote Storage – Cashmere/Worsley	4.0	0.9	4.2	6.9							
501	Bell Creek	10.3	1.1	0.5								
501	Linwood Canal and Cuthberts Drain South	0.9										
502	Matuku Waterway	1.1										
503	Cranford Basin Active Management	3.1	1.2									
505	Sumner Stream and Richmond Hill Waterway					0.5	2.0					
506	Dudley Creek Tributaries	0.1				2.8	3.1	2.5				
507	Temporary Stopbank Management	3.1										
508	Lower Avon Stopbanks Preliminary Design	0.04										
509	Knights Drain Ponds	1.4	0.2	0.06	6.3							
510	Wairarapa, Wai-iti and Tributaries					2.0	2.1					
511	Upper Avon					1.0	1.0					
512	No. 1 Drain	2.9	1.1									
513	PS 205	0.7	1.5									
515	Estuary Drain	1.9										
516	Knights Drain – Wainoni Park	2.9										
517	Flood Intervention Policy	6.6	10.5				7.6	9.9	4.1	4.0	4.0	4.0
518	Mid-Heathcote Bank Stabilisation	3.4	0.1	1.3								
520	Wigram East Retention Basin	4.5	2.7									
521	Avon Floodplain Management Implementation						8.5	11.0	12.2	13.7	17.2	20.5
522	Heathcote Floodplain Management Implementation											
523	Flood Remediation Reticulation Works	0.7	0.1	0.5								
524	EQ Waterway & Retic Repair	0.7										
525	Southshore Emergency Bund	1.7	0.5									
526	Curletts Flood Storage	2.0	1.4	0.5	1.1	4.1						
527	Heathcote Dredging	2.0	1.0	8.0	5.4							
528	Eastman Wetlands	1.6	0.8	9.8	9.4							
529	Heathcote Low Stopbanks	0.2	0.1	0.1	0.6	19.2						
	TOTAL	**68.1**	**23.1**	**24.9**	**29.8**	**29.7**	**24.3**	**23.4**	**16.3**	**17.4**	**21.2**	**24.5**

Appendix C – Updated LDRP Physical Works Scenario 4a

Project	Cost estimate ($) (incl. investigations)	Flooded properties benefiting ⑤	EQC Increased Flooding Vulnerability (IFV) properties	Qualitative priority Score /100	Quantitative flood priority Score /100 ⑥	Weighted priority score /100 ⑦	Design Stage ⑧	Cumulative Cost	Cumulative properties benefited ⑤
1 - Dudley									
LDRP 64 Dudley Creek	$50 M	532	316	85	97	91	Con	$50 M	532
2 - Temporary Stopbank Management									
① LDRP 507 Avon Temporary Stopbank Management - Short-medium term stopbank management	$5 M	0	0	73	95	84	Con	$55 M	532
3 - Land Drainage Recovery Programme High Priority									
LDRP 506 St. Albans Creek - Lower Avon/Dudley Creek - Restore pre-EQ channel capacity	$16 M	246	100	86	85	86	Con	$71 M	778
LDRP 501 Bells Creek Desired Profile - Lower Heathcote - PS with stream and pipe upgrades	$15 M	927	592	78	90	84	Con	$86 M	1705
LDRP 503 Cranford Basin Active Management - Maximise benefit of ponding area	$9 M	119	57	84	72	78	Con	$95 M	1824
LDRP 21 Shirley Stream - Lower Avon/Dudley Creek - Restore pre-EQ channel capacity	$1 M	78	78	78	74	76	Fin	$96 M	1902
② LDRP 519 City Outfall Drain - repair	$2 M	0	314	63	82	72	Feas	$98 M	1902
② LDRP 514 Brittans Drain - Lower Avon - Pipe and stream drainage upgrades with PS or storage	$3 M	118	76	73	70	72	Feas	$101 M	2020
LDRP 509 & 516 Knights Drain - Lower Avon - Stopbank and pump to river	$16 M	66	66	71	62	67	Con	$117 M	2086
LDRP 500 Upper Heathcote Storage - Above Colombo Street	$41 M	379	74	46	87	67	Con	$158 M	2465
LDRP 36 Bings Drain - Lower Avon/Dudley Creek - Restore pre-EQ channel capacity	$2 M	30	29	61	64	62	Fin	$160 M	2495
4 - Avon Flood Protection Programme									
① LDRP 508 & 521 - Avon D/S Gayhurst - New stopbanks, new alignment	$210 M	1030	641	83	97	90	C	$370 M	3525
LDRP 521 Avondale - Stopbank and 2 pumpstations to river	$8 M	288	288	67	79	73	P	$378 M	3813
LDRP 521 - Wainoni Road - New stormwater pipe network discharging to golf course	$1 M	56	24	49	44	47	P	$379 M	3869
LDRP 521 Avon Gayhurst-Barbadoes	$31 M	86	12	49	34	42	C	$410 M	3955
LDRP 521 CBD - Avon-CBD U/S Barbadoes - Flood walls through CBD	$66 M	62	62	32	51	41	C	$476 M	4017
5 - Heathcote Flood Protection Programme									
LDRP 522 Lower Heathcote D/S Ensors Rd - Stopbanks and floodwalls	$162 M	1053	798	81	93	87	C	$638 M	5070
LDRP 522 Heathcote U/S Ensors Rd - Stopbanks and floodwalls	$206 M	291	210	48	92	70	C	$844 M	5361
6 - Estuary Flood Protection Programme									
LDRP 97 Multi-hazard analysis: Estuary Investigation River & Tidal Flood Protection - Stopbanks and floodwalls	$177 M	1264	116	78	89	83	C	$1021 M	6625
7 - Land Drainage Recovery Programme Medium/Low Priority									
④ LDRP 510 Wairarapa & Wai-iti Streams - Channel capacity upgrades and diversions	$33 M	259	198	71	84	77	P	$1054 M	6884
LDRP 505 Sumner - Floodwalls, stopbanks, pipe and channel upgrades	$11 M	280	10	78	67	73	P	$1065 M	7164
④ LDRP 510 Cross and Taylor Streams - Restore pre-EQ channel capacity	$2 M	91	66	63	75	69	P	$1067 M	7255
④ LDRP 511 Upper Avon, Ilam Stream and Okeover Stream - Floodwalls or stopbanks with pumpstation	$6 M	251	158	54	80	67	P	$1073 M	7506
LDRP 510 Waimairi Stream - Upper Avon - Restore pre-EQ channel capacity	$3 M	122	47	58	69	63	P	$1076 M	7628
LDRP 11 Jacksons Creek Desired Profile - Lower Heathcote - Restore pre-EQ channel capacity	$4 M	114	114	63	54	58	P	$1080 M	7742
LDRP 512 No 1 Drain - Widen channel through golf course	$3 M	59	59	62	46	54	Con	$1083 M	7801
LDRP 515 Estuary Drain - channel repair and network extension	$3 M	101	101	52	52	52	Con	$1086 M	7902
LDRP 41 Railway Drain - Restore pre-EQ channel capacity	$3 M	73	7	45	49	47	P	$1089 M	7975
LDRP 12 Steamwharf Drain - Lower Heathcote - Increase channel capacity to get flow to river	$1 M	21	17	57	36	47	P	$1090 M	7996
LDRP 501 Bells Creek: Grafton Street - PS and pipeline to Jackson Creek	$2 M	71	49	45	48	46	P	$1092 M	8067
LDRP 27 Kruses Drain - Upper Styx - Restore pre-EQ channel capacity	$1 M	49	13	50	41	45	P	$1093 M	8116
③ LDRP 503 Thames St Pipeline Upgrade - Upgrade pipeline to maximise use of Tay St Drain pumpstation	$ M	29	11	60	26	43	Con	$1093 M	8145
LDRP 13 Heathcote Hill Catchments - Lower Heathcote - Restore capacity of hill waterways	$2 M	14	7	53	30	41	P	$1095 M	8159
LDRP 19 Travis Swamp Outfalls - Restore pre-EQ channel capacity	$1 M	26	26	38	43	40	P	$1096 M	8185
LDRP 27 Upper Styx River - Restore pre-EQ channel capacity	$4 M	31	0	38	39	38	P	$1100 M	8216
LDRP 97 Cooks/Lodges Drain - Upgrade pump station capacity	$4 M	41	41	50	23	36	P	$1104 M	8257
LDRP 97 Queenspark Drive - Soakage and storage or local upgrades	$2 M	39	39	43	25	34	P	$1106 M	8296
LDRP 513 Horseshoe Lake stormwater recovery plan - PS or outlet capacity upgrade	$2 M	63	0	51	16	34	P	$1108 M	8359
LDRP 27 Wilsons Drain - Otukaikino - Restore pre-EQ channel capacity	$1 M	99	0	29	38	33	P	$1109 M	8458
LDRP 43 Riccarton Main Drain - Upper Avon - Upgrade pipes and open channel	$5 M	16	16	43	20	32	P	$1114 M	8474

LDRP 27 Kaputone Stream - Upper Styx - Restore pre-EQ channel capacity	$2 M	11	0	36	26	31	P	$1116 M	8485
LDRP 79 Knights/Nottingham - Restore pre-EQ channel capacity	$1 M	2	2	60	2	31	C	$1117 M	8487
LDRP 64 Mairehau Drain - Lower Avon/Dudley Creek - Restore pre-EQ channel capacity	$1 M	16	1	55	5	30	P	$1118 M	8503
LDRP 20 Horseshoe Lake Tributaries No.2 Drain - Restore pre-EQ channel capacity	$2 M	8	4	42	18	30	P	$1120 M	8511
LDRP 83 Woodpeckers on Mairehau Road - Soakage and storage or local upgrades	$1 M	19	19	43	10	27	P	$1121 M	8530
LDRP 97 Multi-Hazard Analysis: Pegasus Avenue - Raising of ground levels or pumpstation	$4 M	25	25	36	15	26	P	$1125 M	8555
LDRP 41 Sheppards Drain - Lower Styx - Restore pre-EQ channel capacity	$1 M	6	0	38	8	23	P	$1126 M	8561
LDRP 17 Curletts Stream - Upper Heathcote - Restore pre-EQ channel capacity	$1 M	20	20	30	13	22	P	$1127 M	8581
LDRP 31 Reinstatement of ecologically sensitive areas - Allowance to improve damaged ecosystem health	$1 M	0	0	31	0	15	P	$1128 M	8581
LDRP 17 Hayton Stream - Upper Heathcote - Restore pre-EQ channel capacity	$1 M	0	0	30	0	15	P	$1129 M	8581
8 - Styx FPP									
LDRP 92 Styx River & Tidal Flood Protection - Protection of non-Residential Red Zone land	$55 M	47	0	63	21	42	C	$1184 M	8628
LDRP 41 Earlham Street - Low lying area may require pumpstation	$1 M	14	0	49	7	28	P	$1185 M	8642
LDRP 41 Lower Styx Road - PS to drain low lying area	$4 M	9	0	42	3	22	P	$1189 M	8651
Grand Total	**$1189 M**								
Lower bound of cost estimate ⑪	$760 M								
Upper bound of cost estimate ⑪	$1627 M								

Notes:

① Temporary stopbank management has same benefit as LDRP 521 (permanent stopbanks)

② Currently no scheme has been identified that meets acceptable cost/benefit criteria. Costs are shown here for indicative purposes only

③ Cost estimate included in the LDRP 503 Cranford Basin Active Management costs further up the prioritisation list

④ If Wairarapa/Wai-Iti convey more flow they may increase flooding through Mona Vale so LDRP 511 Upper Avon may need to be partially implemented

⑤ The 'properties benefitting' is approximate only, and relates to the property and not floor levels. In the cumulative count there is some double counting. It is intended to provide an indication of comparative flooding severity rather than a precise measure of flooded properties.

⑥ The quantitative flood priority score is based on weightings of property counts within the areas of benefit using the following weightings: IFV-25%; 50 year flood extent-25%; June 2013-15%; March 2014-15%; Taskforce-20%.

⑦ The weighted priority score is the average of the qualitative and quantitative priority scores

⑧ Design stage upper and lower cost certainty limits:

	Symbol	Lower	Upper
Pre-investigation - Costs based on extrapolation of similar projects. No identification of scheme components. Lowest level of confidence.	P	-50%	50%
Concept - Locations identified, quantities calculated, costs independently reviewed. Moderate level of confidence.	C	-40%	40%
Feasibility - Concept design advanced, costs independently reviewed. High level of confidence.	Feas	-10%	30%
Construction	Con	-5%	10%
Complete/ finished	Fin	0%	0%