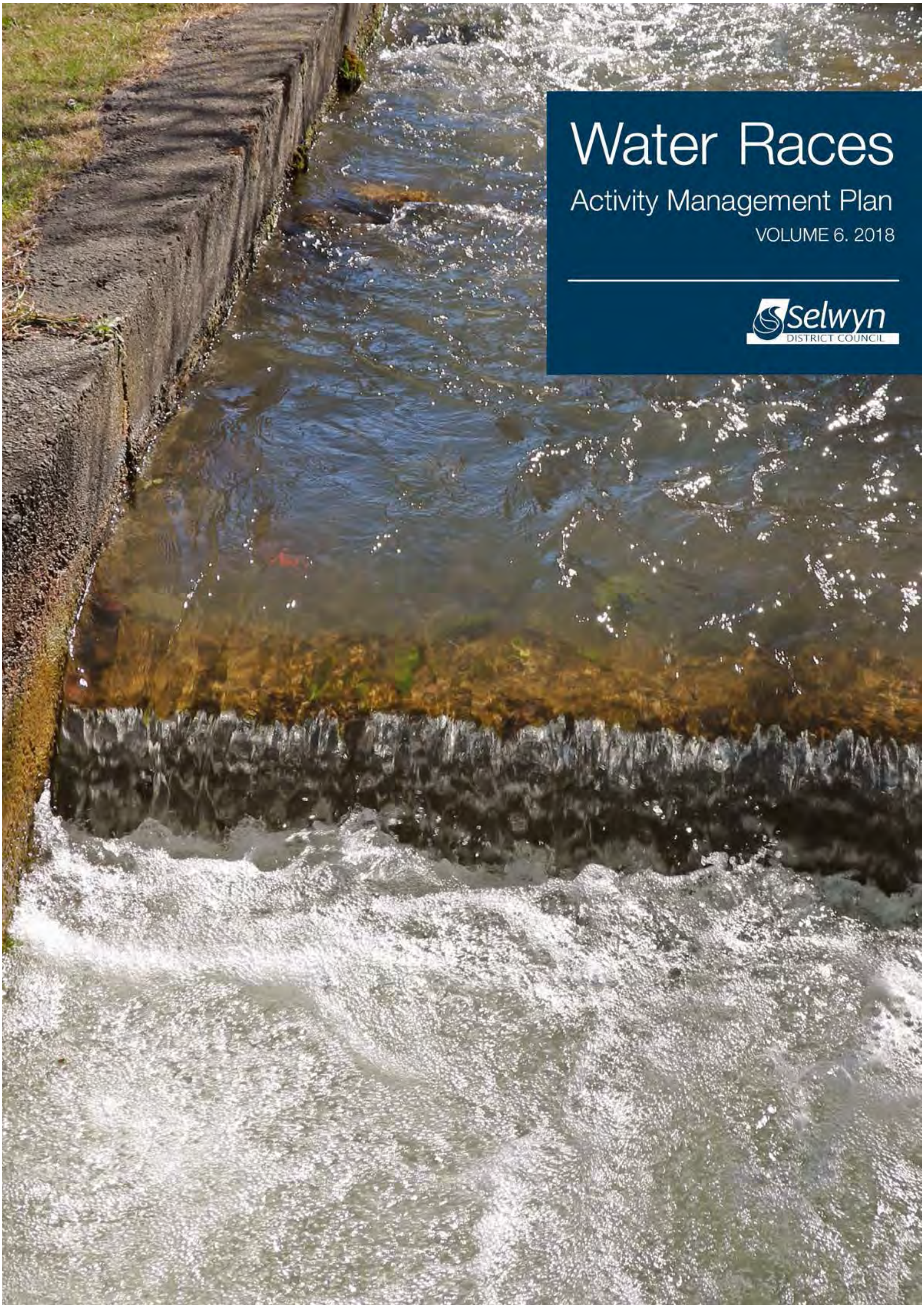

Water Races

Activity Management Plan

VOLUME 6. 2018

Selwyn District Council

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1.0 ELLESMERE WATER RACES

1.1 Scheme Summary

Description		Quantity
Scheme area (within scheme boundary)		50,158 ha
Scheme Coverage (1 Jan 2018)	Area of Full Charges	
	Minimum Charges (No.)	113
	Irrigators	7
Systems components	Intakes	2 (Grasslands & Lower Rakaia)
	Main Race	159.35km
	Local Race	106.68km
	Lateral Race	97.81km
	Other	4 flow gauging sites + 1 Flow level site
Water Source	via River	Rakaia River (Glenroy, Lower Rakaia)
History	Installation Date	Installed progressively from 1880
Value ($)	Replacement Cost	$18,447,270.26
	Depreciated Replacement Cost	$17,368,950.92
Financial	2018/2019 Estimate Annual maintenance cost % of total water race schemes	$566,910 24.77%
Water Take	Annual average (from Management Plan)	62.6 million m^3
	Consented Take	3,290 Lts/sec
Sustainability	Biodiversity	Groundwater recharge and natural habitat
	Amenity	Urban feature

1.2 Key Issues

The following key issues are associated with the Ellesmere Water Race system. A list of district wide issues are located in 5Waters Activity Management Plan: Volume 1.

Table 1-1 Ellesmere Scheme Issues

What's the Problem	What we plan to do
Impacts of CPW on the future of the water race scheme.	CPW stage 1, which traverses the northern extent of the Ellesmere water race scheme, is now complete. The number of requests for race closures has greatly increased. Council needs to carefully balance the request for race closures with the ecological and environmental benefits of keeping the races open.
Operating water race for biodiversity values will add financial pressure.	An alternative rating structure is proposed which takes into account benefits of the race network other than stock water. The alternative rating structure is one of the matters included in the 2018-28 consultation document.
Due to fluctuating river levels, resource consent conditions are not always met with manually operated intake gates.	Council will consider opportunities to budget for automation of the intakes where cost effective to improve consent compliance and reduce operational costs. Automated gates are currently installed on the Paparua and Upper Kowai intakes.
Effective management of stock water and separately consented irrigation water which is conveyed through the Council stockwater network	Irrigation agreements to be reviewed and updated.

1.3 Overview & History

The Ellesmere scheme serves the plains area between the Rakaia and Hororata Rivers from Te Pirita and Haldon in the northwest to Rakaia Huts and Southbridge in the southeast.

The source of water for the Ellesmere Water Race is the Rakaia River.

From the Grasslands intake (at Rakaia River) the main race traverses the main Rakaia Terrace in a sliding cut to gain access to the central plains area near the top end of Sharlands Road about 4kms east of Te Pirita Road. From this point the main race divides into two races, the main flow follows Sharlands Road down to the S.H.1. Main Highway. It has a number of laterals leading off it distributing water across the plain. Below the Main Highway it eventually joins into the upper half the Lower Rakaia intake race system.

The other race known as the Cross Race heads across the plain on a very flat grade, generally following the contour towards the Hororata River. This cross race has lateral races leading down the plains. It is also used to transport a flow of 80 to 100l/second from Grasslands Intake main race from the vicinity of Sharlands Road to the Haldon scheme race system at Mitchells Road. The Haldon intake and downstream races were closed during the 2015/16 year following public consultation and approval by Council.

Natural events impacting the water race network

Some damage to the scheme channels occurred following the September 2010 earthquakes. A significant amount of inspection occurred, with simple realignment work completed as required.

Significant damage occurred to the water races as a result of the wind event in September 2013. Repairs were carried out as a result of uprooted trees.

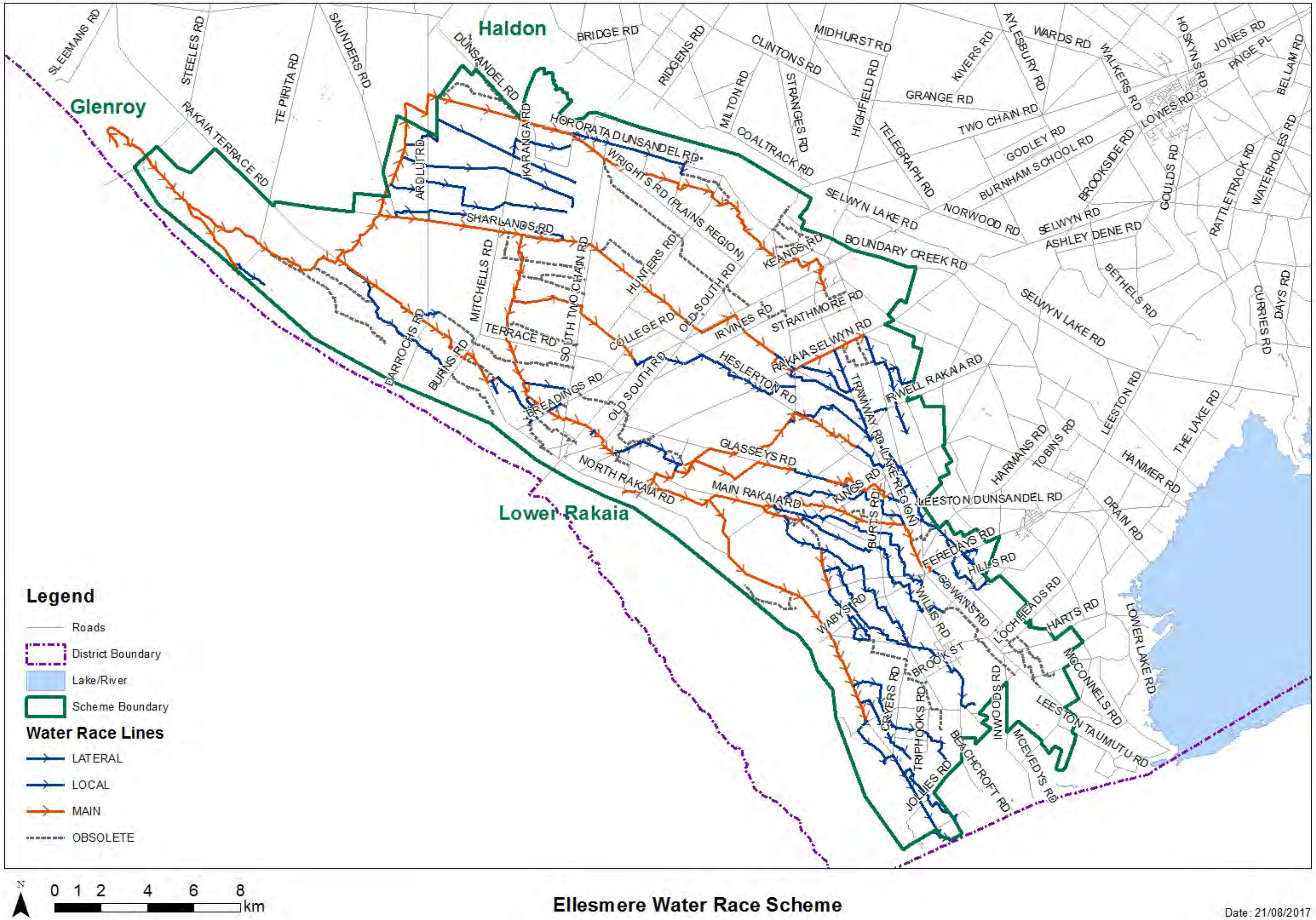

Figure 1-1 Scheme Map

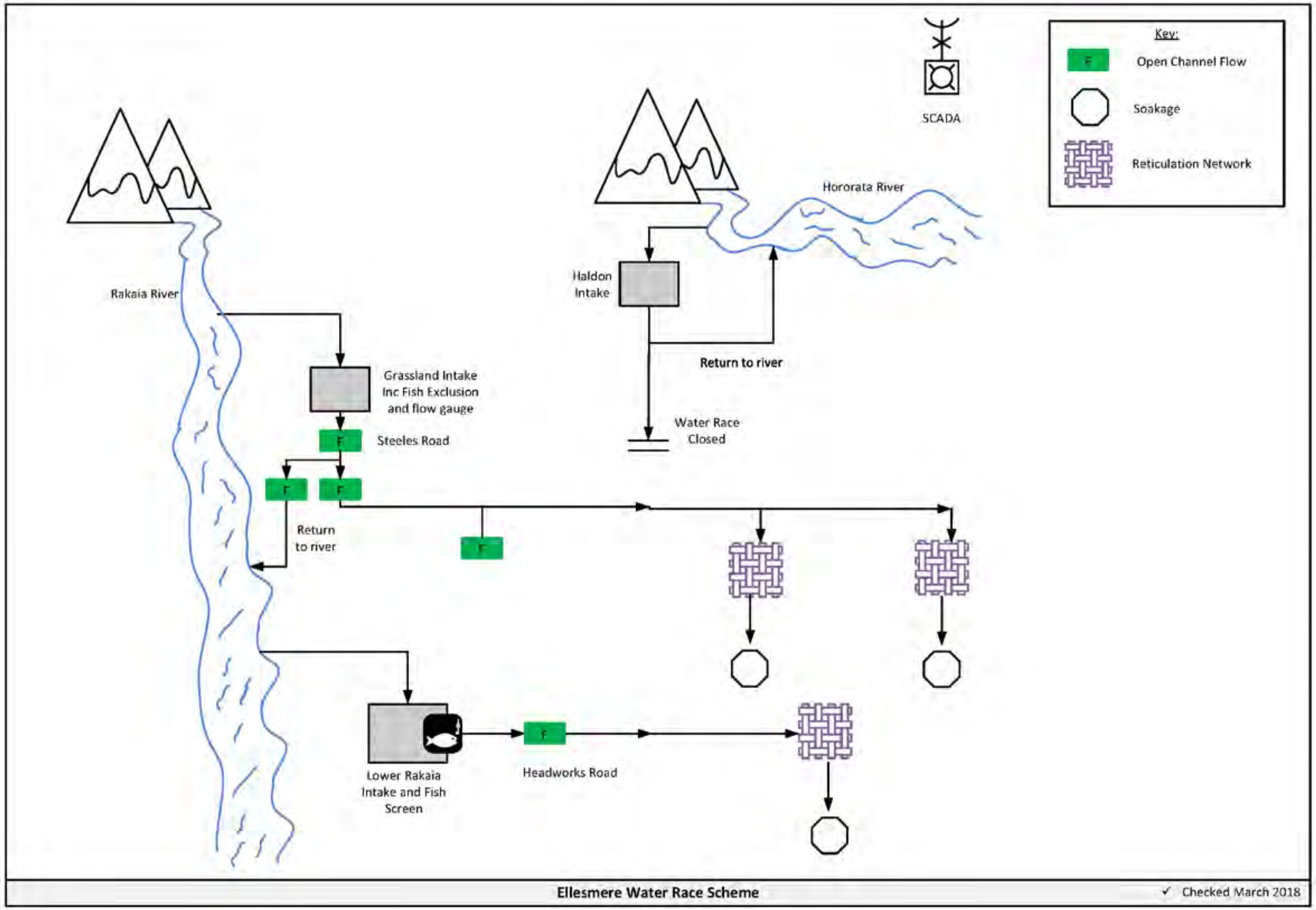

Figure 1-2 Scheme Schematic

1.4 Resource Consents

The Ellesmere water race scheme has a number of resource consents. Table 1-2 shows the water takes permitted by the resource consents at the three intakes and Table 1-3 details the resource consents for this scheme.

Table 1-2 Allowable Take

Intake	Base Minimum Flow (Lts/sec)	Maximum Take (Lts/sec)
Early's – Stock	732	732
Early's – Irrigation	1751	1751
Haldon (Hororata River)	341	500
Main South Rd (Lower Rakia)	466	500
Total	3,290	3,483

Table 1-3 Resource Consents

Consent	Description	Location	Date Issued	Expiry Date	Application Status
CRC011996	To take from Rakaia River at Headworks Road and Hororata River.	Stockwater Race Network	21/11/2011	21/11/2031	Issued – Active
CRC970986	To divert water from the Rakaia River.	Steeles Road, Te Pirita	21/11/2011	21/11/2031	Issued – Active
CRC153238	To divert, take and use water at Earlys Intake.	Steeles Road, Te Pirita	21/11/2013	21/11/2031	Issued – Active
CRC084966.1	Global Consent - To discharge contaminants onto land in circumstances where they may enter surface water.	Global Consent (Spraying)	21/06/2011	28/04/2020	Issued – Active
CRC012001	To discharge into the Hororata River from overflow and general discharge.	Stockwater Race Network	21/11/2011	21/11/2031	Issued – Active
CRC010976	To discharge unused water from race into the Rakaia River.	Steeles Road, Te Pirita	21/11/2011	21/11/2031	Issued – Active
CRC011993	To disturb the bed of the Hororata River.	Stockwater Race Network	21/11/2011	21/11/2031	Issued – Active
CRC972765	To discharge water to the Rakaia River.	Steeles Road, Te Pirita	21/11/2011	21/11/31	Issued – Active
CRC72766	To disturb the bed of the Rakaia River at Early's intake for the purpose of supplying stockwater.	Steeles Road, Te Pirita	12/12/1997	10/12/32	Issued – Active

The global consent to discharge liquid agrichemical expires during 2020. It is expected that aquatic protection will further limit the use of spraying.

In November 2011 a variation to the Rakaia River Water Conservation Order was made by Trust Power Ltd. Council staff had a number of concerns which they were submitted. An agreement was signed dated 11 July 2012 between the Council and TrustPower which stated:

"TrustPower will not, through the Coleridge Project, adversely affect the existing assets held and operated by the Council for the purposes of taking and conveying water from the Rakaia River for the purposes of stock water".

1.5 Scheme Assets

1.5.1 Intakes

Grasslands Intake - Grasslands Intake, formally referred to as Earlys Intake, consists of a temporary dozed channel in the river bed leading to a protected side channel of about 3 to 4 kilometres in length along the northern river bank to Grasslands intake structure where water is diverted into the scheme. Water can be diverted into this channel at several points depending on where the main river channel is situated after flooding in river. Best practice is generally to have two small diversions rather than one large diversion into the channel.

The irrigation race divide is located about 10 kilometres below this intake. At this point control gates are used to split the flow depending on scheme demand.

Lower Rakaia Intake - This intake is sited on the Rakaia River about 3kms downstream of the SH1 Rakaia Bridge. Road access to the intake gates is off the Main Rakaia Road onto Headworks Road. The intake consists of two concrete box structures and the control gates are sited at the end of this road on the northern bank of the Rakaia River.

1.5.2 Silt Ponds

Silt ponds are located at the Glenroy intake ponds.

1.5.3 Control Structures

Major divides are on the main races below the main intake control gates. The divides are a mixture of newer metal gates and boulder control gates sited where the main race flow requires splitting into equal or different flows. Each split race then goes in to serve a different part of the scheme. The weirs are required to be set to enable the correct amount of water to be diverted to serve the area required.

1.5.4 Monitoring Points

Monitoring structures are sited below intakes to measure the quantity of water taken from the source to enable the operator to have an understanding of what flows are present, confirm compliance with resource consents, record water take and monitor scheme demand.

The monitoring structures on the Ellesmere Water Race System are at Grasslands Intake downstream of the fish screen, the Lower Rakaia Intake, 40 metres downstream of the intake gate.

Council also has three other 'in race' monitoring stations to better manage flows, refer to Figure 1-2 for monitoring locations.

Installation of SCADA has occurred at the Grasslands Intake but not at the Lower Rakaia site. Flow gauging is ongoing at these sites.

1.5.5 Emergency Discharge Points

Emergency discharge points are located at the Early's Intake on the Terrace Lea propertyThere are no emergency discharge points within the race system.

1.5.6 Soak Holes

Soak holes allow excess water taken from the intake, to meet additional usage to be discharged without flooding properties when demand reduces. Maximum flow to each soak hole is 10 L/sec. The Ellesmere scheme has 37 soak holes (including privately owned).

1.5.7 Pipe Summary

A summary of material and diameter for pipes and aquaducts, where known, is shown below in Figure 1-3 and Figure 1-4.

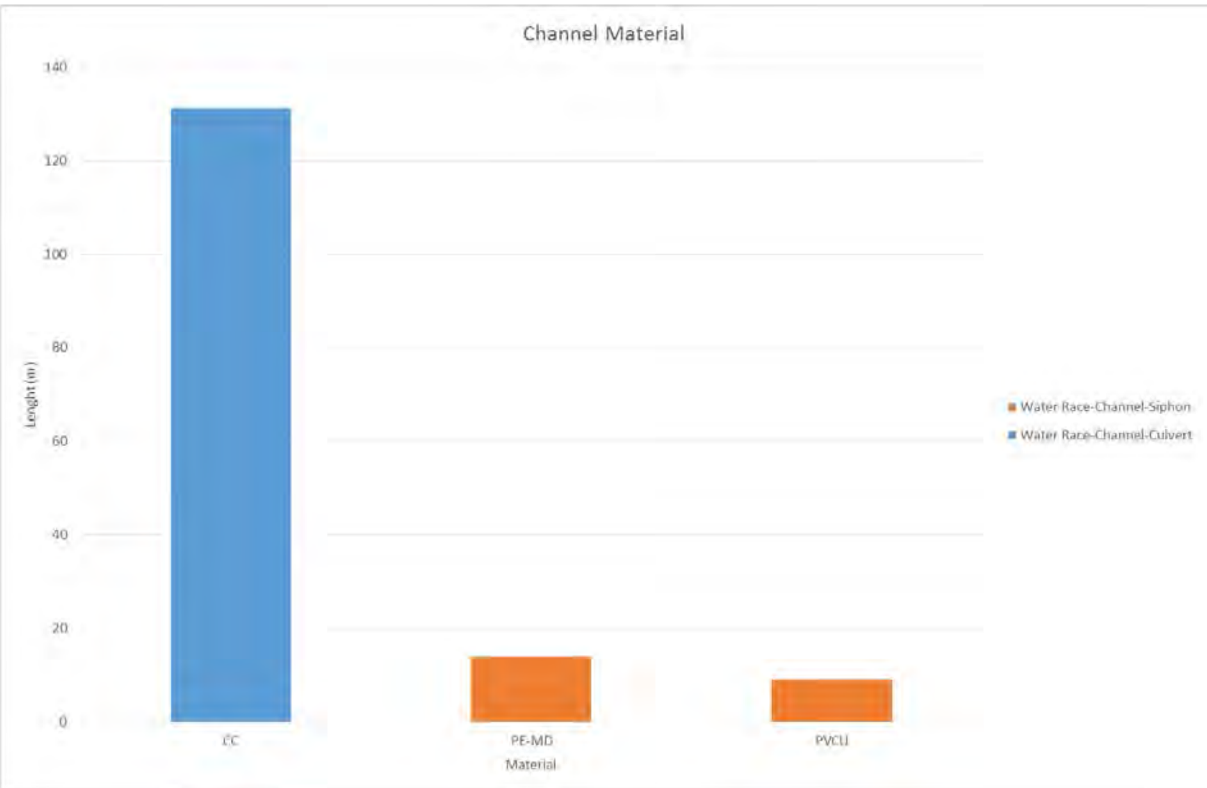

Figure 1-3 Pipe Material – Ellesmere

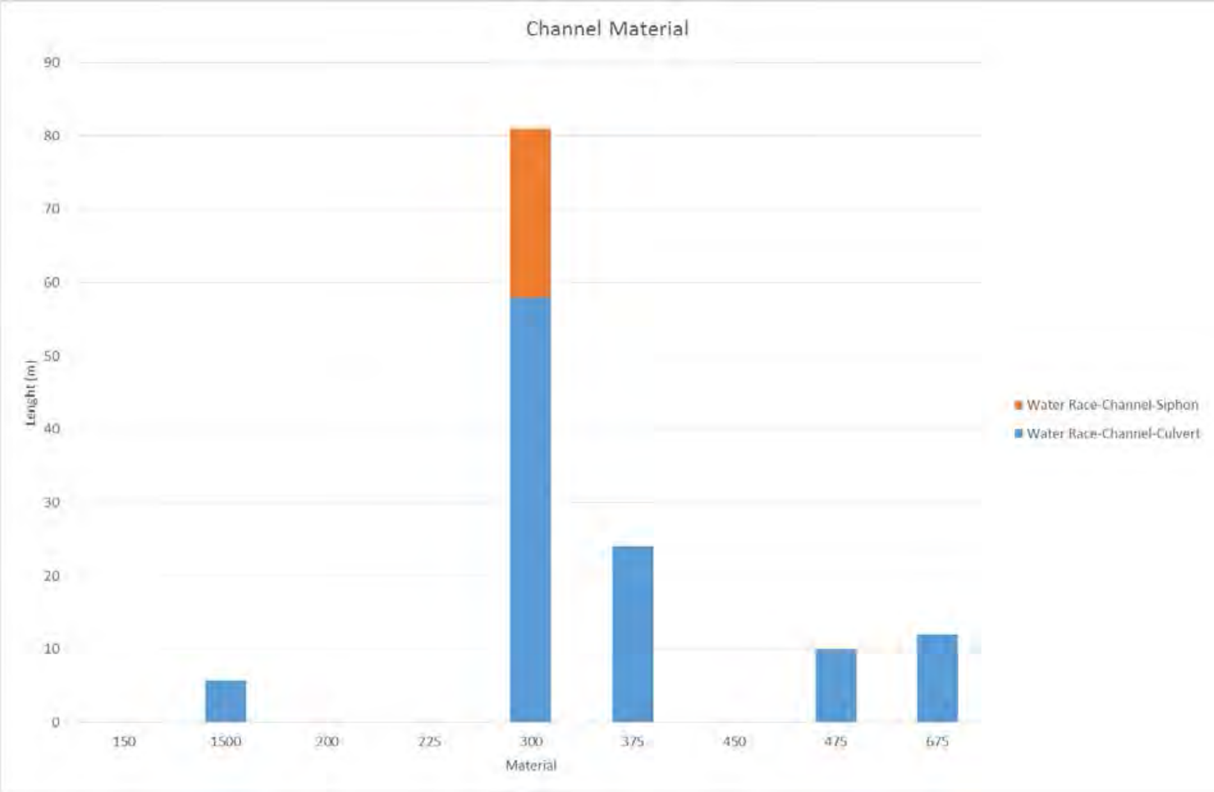

Figure 1-4 Pipe Diameter – Ellesmere

1.6 Operational Management

The scheme is operated in two sections, the first being from Early's intake to just below the Main South Road, and the Lower Rakaia Intake servicing just below Main South Road.

Personnel from Canterbury Grasslands monitor and manage the Glenroy Scheme to ensure allocated water is available to the Council Scheme.

The Council's nominated Contractor carries out an inspection of main divides and race flows.

From the above inspection the Council nominated Contractor can ascertain which races require additional or less water. Adjustments can then be made to major divides as required.

The lower section requires inspection of the main intake at Headworks Road, the river and cleaning of the intake grill and adjusting flows as required followed by checking main divides and races. It also involves discussing and adjusting flows into the lower area with the Upper Rakaia Intake Operator.

1.7 Irrigation

There are seven irrigators which hold their own consents and take from the upper part of the Ellesmere scheme. The Lower Rakaia Diversion group also take water from on the lower part of the Ellesmere Scheme. Irrigation agreements are required with each user. The agreement covers individual water allocations and monitoring responsibilities.

In 2015 Council established new irrigation agreements with the Ellesmere irrigators. As part of this agreement Council agreed to clear the irrigation return to the river on an ongoing basis.

In 2014 Council met with representatives of the Lower Rakaia Diversion group. Council are charged a share of the costs of the Lower Rakaia Diversion group based on their share of the total take. This is invoiced to Council.

1.8 Environmental Management

1.8.1 Water Quality Issues

Water quality in races can be affected by runoff and stock activity in races. Runoff containing fertiliser and organic nutrients is difficult to manage. Stock activity (especially cattle, horses and deer) can affect water quality by increasing sedimentation from bank erosion and disturbance of the bottom of the race channel. Direct defecation and surface runoff can also add to elevated faecal coliform levels.

Improved management of the water race network will need to address stock movement in races. Maintenance contractors and users need to be aware of the effect of operation and maintenance activities on water race quality.

1.8.2 Management Approach

The Council will use a combination of the following to address water quality issues:

- Watering bays are being promoted for water races that serve all stock farming properties (excluding sheep). This will allow limited and controlled access to races for stock drinking purposes. The remaining length of races to be fenced off/hot wired so that animals only have access to the race for drinking purposes. This is 'best practice' for managing stock access to races.
- The Council will provide guidance to race users on design/layout of watering bays
- Maintenance contractors will ensure that subcontractors use clean and sound machinery when working in riverbeds.
- Maintenance Contractors will be required to monitor and minimise discharge of surplus water from the race network

1.8.3 Demand Management

Environment Canterbury as the consenting authority are requiring demand management practices to be implemented as part of new or reviewed consent conditions. This is due to water allocations in most areas of the district being assumed as fully committed.

Selwyn District Council has addressed demand management within its Water Race Management Plan.

An efficiency audit has not been undertaken for the Ellesmere scheme.

1.9 Photos of Main Assets

Photo 1: Lower Rakaia Intake Channel

Photo 2: Lower Rakaia fish screen

Photo 3: Typical flow gauging site

1.10 Risk Assessment

A risk assessment has been undertaken for the Ellesmere scheme. The key output from the risk assessment is the identification of any extreme and high risks which need to be mitigated. In order to mitigate these risks they have been included and budgeted for in the projects within this LTP. Table 1-4 Risk Priority Rating details the risk priority rating and Table 1-5 outlines the risks for this scheme.

Table 1-4 Risk Priority Rating

Risk Score	Level of Risk	Risk Response
> 50	Extreme	Awareness of the event to be reported to Council. Urgent action to eliminate / mitigate / manage the risk. Document risk and action in the AMP.
35-50	Very High	Risk to be eliminated / mitigated / managed through normal business planning processes with responsibility assigned.
14-35	High	Manage risk using routine procedures.

3.5-14	Moderate	Monitor the risk.
< 3.5	Low	Awareness of the event to be reported to Council. Immediate action required to eliminate / mitigate / manage the risk. Document risk and action in the AMP.

Table 1-5 Risks - Ellesmere

Risk	Action/Project	Year Identified	2014 Risk Rating	2017 Risk Rating	Residual Risk Rating
Public Health and Safety risks at intakes - lower rakaia	Health and Safety improvements	2014	10	10	10
Non-consented activities	Renewal of consents	2014	27	27	6

The list of district wide risks can be found in 5Waters Activity Management Plan: Volume 1.

1.11 Asset Valuation Details

The total replacement value of assets within the Ellesmere Scheme is $18,437,928 with further details in Table 1-6 below. The majority of value, 98%, is made up of channels.

Table 1-6 Replacement Value, Ellesmere

Asset Class 1	Asset Class 2	Sum of Replacement Value
Plant and Equipment		$40,611
Water Race Reticulation	Channel	$18,145,684
	Divide	$70,590
	Gate	$16,917
	Inlet-Outlet-Point	$78,853
	Structure	$85,273

Channels are broken down into Culverts, Lateral, Locals and Mains. Main races have a larger cross sectional area in comparison to locals and laterals. Replacement values for these different types of channels are shown in Figure 1-5 below.

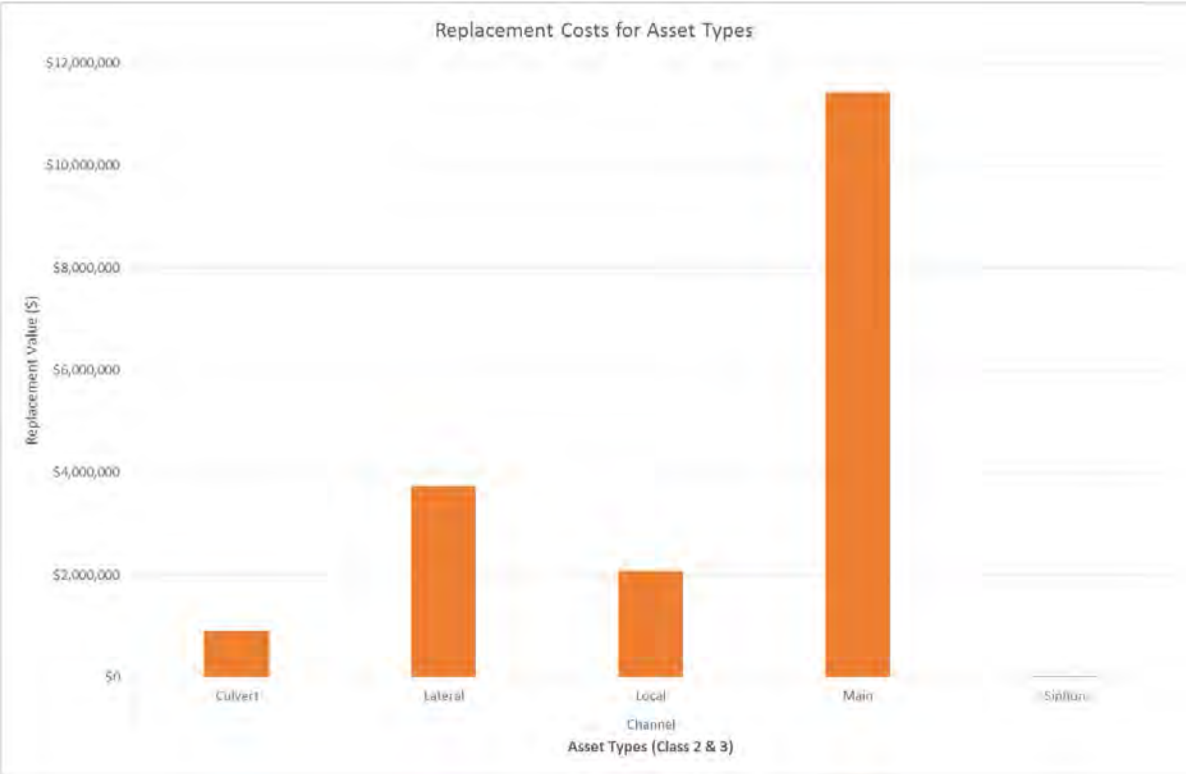

Figure 1-5 Replacement Costs for Ellesmere Channels

1.12 Renewals

The renewal profile has been taken from the 2017 5 Waters Valuation. A graph showing the renewals for this scheme are shown by Figure 1-6 below. The majority of assets requiring renewal are culverts which occur in period 2019-2022

The open race channels are taken as having infinite lives (renewal by maintenance) and therefore renewals are not budgeted for these assets types.

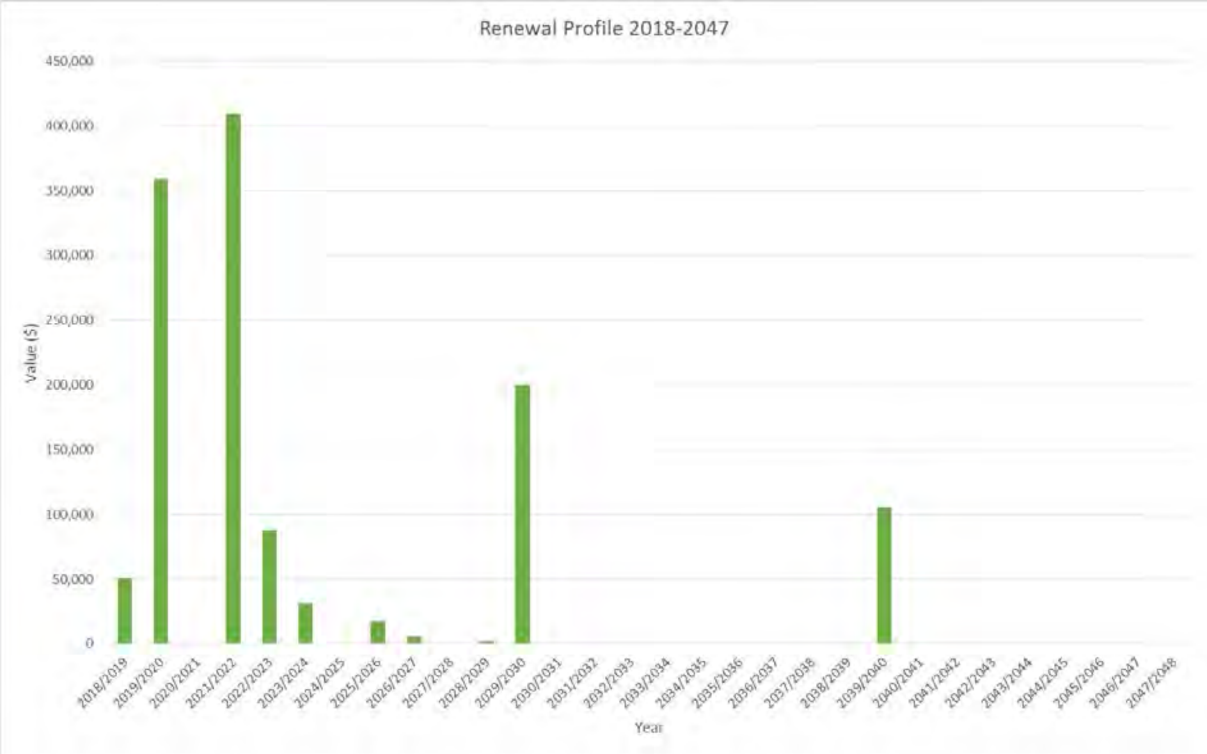

Figure 1-6 Ellesmere Water Race Renewal Profile

There are many aging structures within the water race network these include gates, intake structures, and culverts. These assets are near the end of their life and will require increased funding moving into the future.

1.13 Critical Assets

The criticality model for Ellesmere has been updated for the 2017 AcMP. The methodology of the criticality model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the criticality has been calculated for the reticulation assets. Table 1-7 and Figure 1-7 below shows the calculated criticality for all of the assets within this scheme that have a recorded known length.

Table 1-7 Length of Assets per Criticality Level

Criticality Bands		Length (m)
5	Low	249,141
4	Medium-Low	151,121
3	Medium	3,938
2	Medium-High	2,550
1	High	0

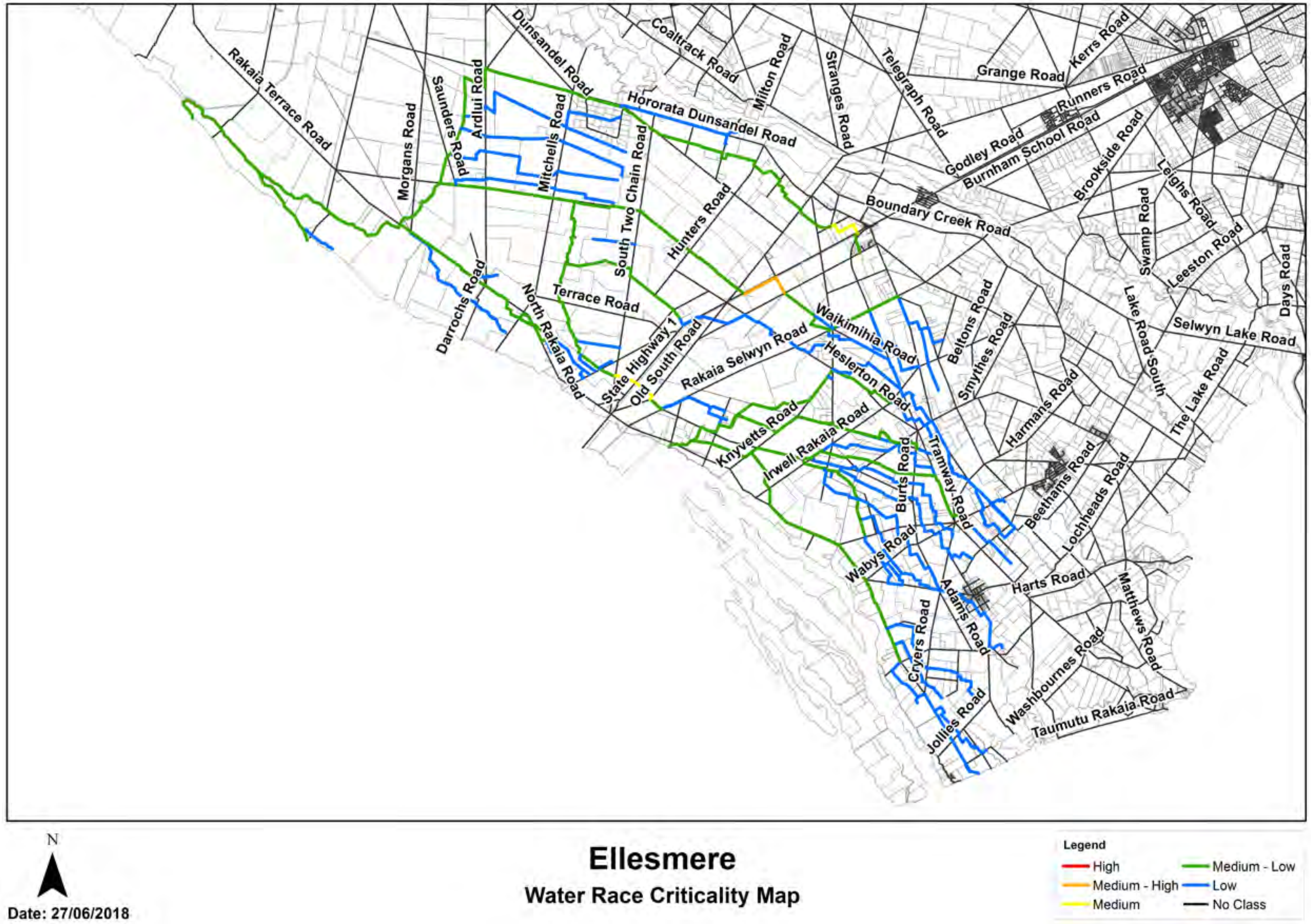

Figure 1-7 Criticality Map

1.14 Asset Condition

The asset condition model was run for Ellesmere in 2017. The methodology of the model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the model has been calculated for the reticulation assets (particularly pipes). Figure 1-8 below shows the level of asset condition for all of the assets within this scheme that have a recorded known condition.

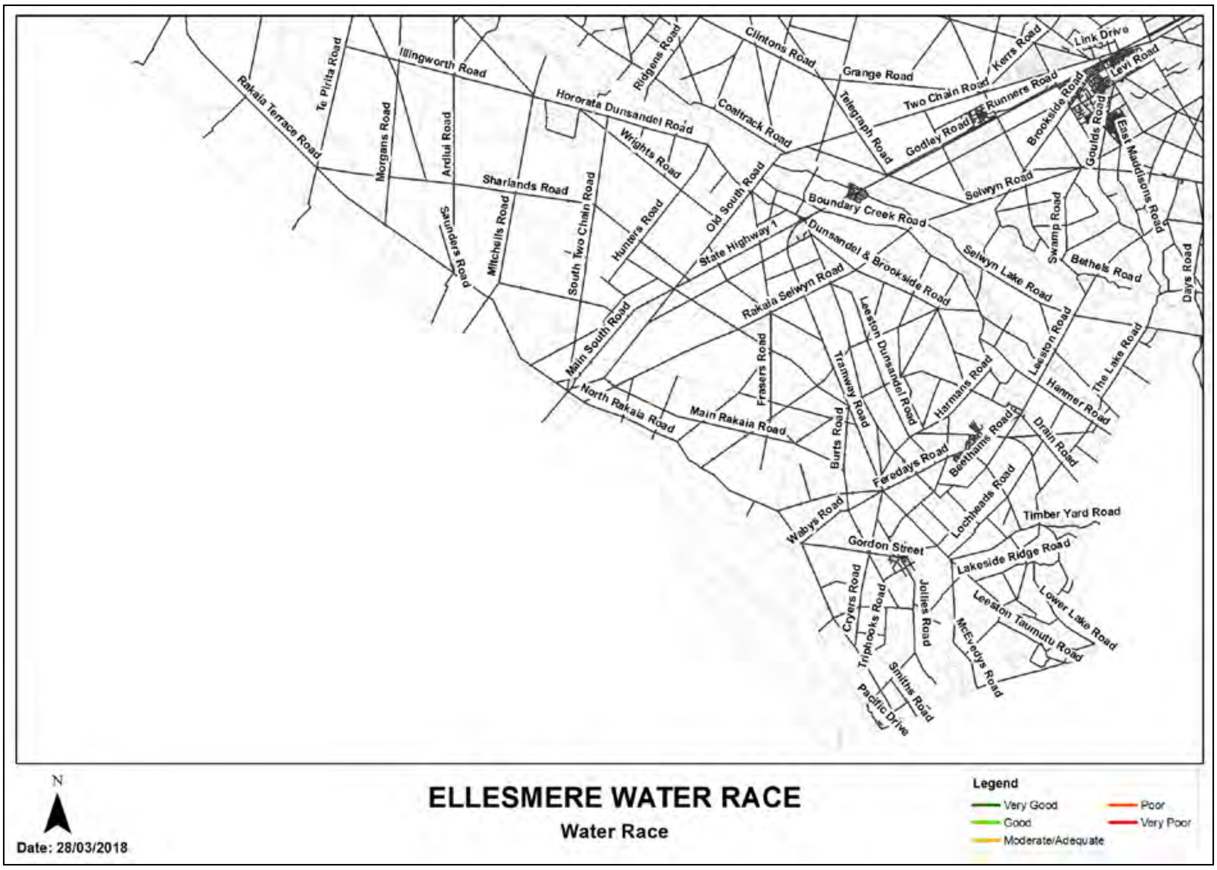

Figure 1-8 Asset Condition - Ellesmere

Table 1-8 provides a description of the condition rating used within the condition model.

Table 1-8 Asset Condition Grading

Condition Rating	Grading
1.0	Excellent
2.0	Good
3.0	Moderate
4.0	Poor
5.0+	Fail

1.15 Funding Program

The 10 year budgets for Ellesmere are shown by Table 1-9 and Figure 1-9. Budgets are split into expenditure, renewals, projects and capital projects.

All figures are ($) not adjusted for CPI "inflation". They are calculated on historical data, and population growth where relevant.

Table 1-9 Ellesmere Budget Summary

Years	Expenditure	Renewals	Projects	Capital Projects
2018/2019	$566,910	$50,411		
2019/2020	$559,196	$359,382		
2020/2021	$549,196			
2021/2022	$549,196	$409,382		
2022/2023	$549,196	$87,772		
2023/2024	$549,196	$31,293		
2024/2025	$549,196			
2025/2026	$549,196	$17,212		
2026/2027	$549,196	$5,765		
2027/2028	$549,196			
Total	$5,519,674	$961,217		

An explanation of the categories within the budgets are as follows below:

- Expenditure consists of operation and maintenance costs;
- Renewals are replacement of assets which are nearing or exceeded their useful life;
- Projects are investigations, decisions and planning activities which exclude capital works; and
- Capital projects are activities involving physical works.

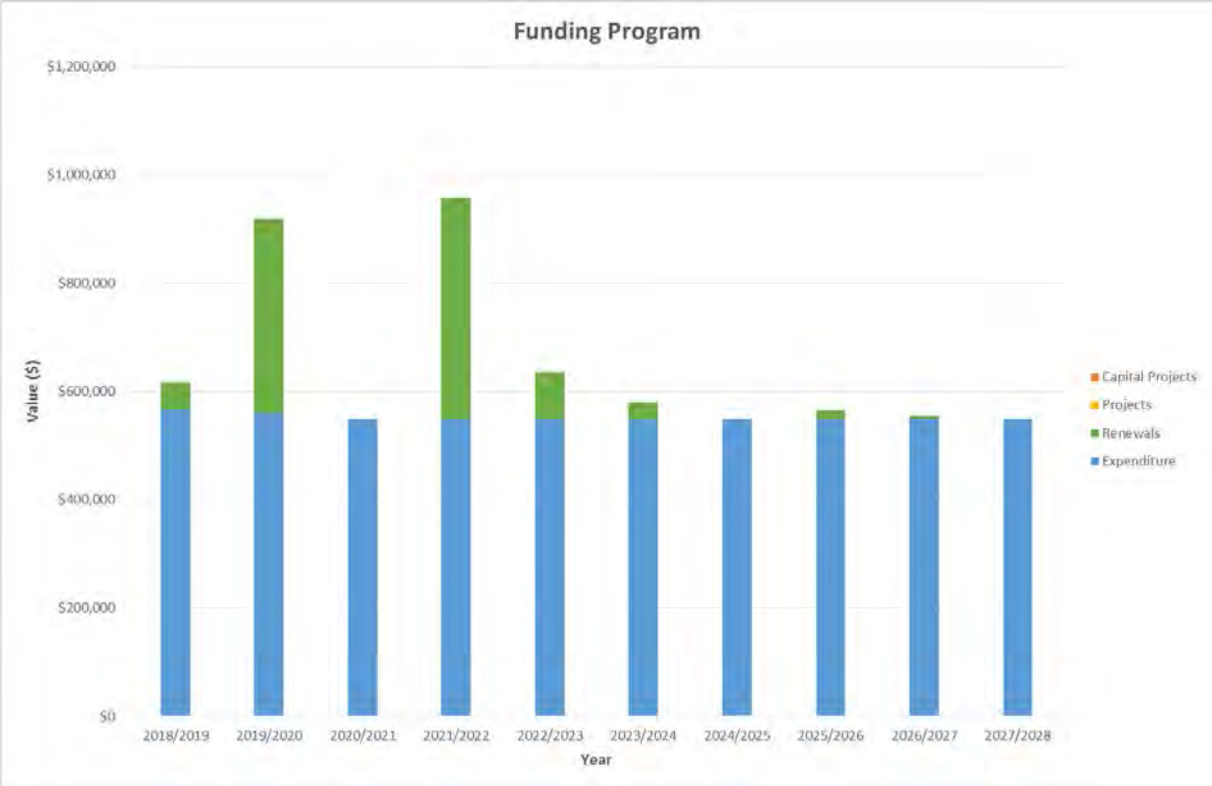

Figure 1-9 Ellesmere Funding Summary

There are no major projects for Ellesmere water races in the LTP budget.

The list of district wide projects can be found in 5Waters Activity Management Plan: Volume 1.

2.0 MALVERN WATER RACES

2.1 Scheme Summary

Description		Quantity
Scheme area (within scheme boundary)		61,684 ha
Scheme Coverage (as at 1 June 2018)	Area of Full Charges	
	Unit Charge (No.)	337
	Irrigators	3
Systems components	Intakes	8 (including springs)
	Main Race	214.37km
	Local Race	63.14km
	Lateral Race	633.86km
	Other	1 Aqueduct 3 Tunnels 5 Data logged Flow gauging sites + CPW gauging site
Water Source	via River	Waimakariri River, Selwyn River and Springs
History	Installation date	Installed progressively from 1885
Value ($)	Replacement Cost	$71,036,363.47
	Depreciated Replacement Cost	$34,531,642.85
Financial	2018/2019 estimate Annual maintenance cost % of total budget	$813,800 35.56%
Water Take	Annual average (from Management Plan)	36.2 million m^3
	Consented Take	1,375 Lts/sec
Sustainability	Biodiversity	Groundwater recharge and natural habitat
	Amenity	Urban features

2.2 Key Issues

The following key issues are associated with the Malvern Water Race system. A list of district wide issues are located in 5Waters Activity Management Plan: Volume 1.

Table 2-1 Malvern Scheme Issues

What's the Problem	What we plan to do
Council are facing a large peak in forecast renewals for large infrastructure including the Kowai and Waimakariri tunnels	Plan to undertake condition assessments and budget for major repairs of these assets considering the future of these schemes. Consider the closure of inefficient infrastructure
Impacts of CPW on the future of the water race scheme.	Council will continue to work with CPW to best service the needs of the rate payers.
Due to fluctuating river levels, resource consent conditions are not always met with manually operated intake gates.	Council will consider opportunities to budget for automation of the intakes where cost effective to improve consent compliance and reduce operational costs.
Flow monitoring required for season springs which is impractical, costly and there is no alternative location for this water.	Council has applied for a consent variation to remove the need to monitor these seasonal springs which have traditionally discharged to the race network to manage flooding.
Operating race for biodiversity values will add financial pressure.	An alternative rating structure is proposed which takes into account benefits of the race network other than stock water. The alternative rating structure is one of the matters included in the 2018-28 consultation document.

2.3 Overview & History

The Malvern scheme serves the plains areas between the Waimakariri River on the north side and Selwyn River and from Springfield Township and Glentunnel to the boundary of the Paparua scheme and totals some 61,684 hectares.

This scheme requires a very high level of operator “hands on” maintenance to ensure a good and adequate supply of water to consumers. This is due to diverse water sources (Kowai, Waimakariri, Selwyn Rivers) and a number of springs.

Natural events impacting the water race network

Following the September 2010 and February 2011 earthquakes there was damage to the Lower Kowai 950m brick barrel tunnel. A detailed condition assessment was undertaken and repair work was scheduled and completed in 2012.

Significant damage occurred to the water races as a result of the wind event in September 2013. Repairs were carried out as a result.

Sinkholes are known to form over the second “Bull’s” tunnel, investigations are ongoing.

CPW shared water use agreement.

The Council's Long Term Plan 2015-2025 identifies one of the major projects to be the Council's commitment to 'work with Central Plains Water to develop a concept for converting the Kowai River sourced water race network (part of the Malvern Water Race Scheme) into a combined water race and irrigation network. This concept will then be used for further consultation with the community.' [1]

The Council entered into agreement with CPW on 16th December 2016. The philosophy of the Agreement is to achieve a mutually beneficial cost neutral position. While the Scheme will benefit from a potential 200l/s of reliable water for irrigation, the added value the Scheme will provide to the community includes providing a robust and secure long term piped water supply to both the Sheffield and Springfield drinking water treatment stations. Which, from a water quality perspective enables the Council to avoid use of shallow groundwater during periods of high turbidity in adjoining rivers, or as required for capacity augmentation; and providing the necessary water quantity to support future township expansion. In addition, a piped stock water supply to shareholders and non-shareholders will ensure this historical network is upgraded to a high quality, efficient utility.

Kowai Water Race Tunnel

During the 2015/16 and 2017/18 summers, Council has trailed running the Malvern Water Race scheme without the lower Kowai River intake. This trial has been successful, but has resulted in longer periods where the Waimakariri River intake has been in use and increased maintenance requirements of the Upper Kowai Intake.

[1] Selwyn District Council: Long Term Plan 2015 – 2025 pg. 80

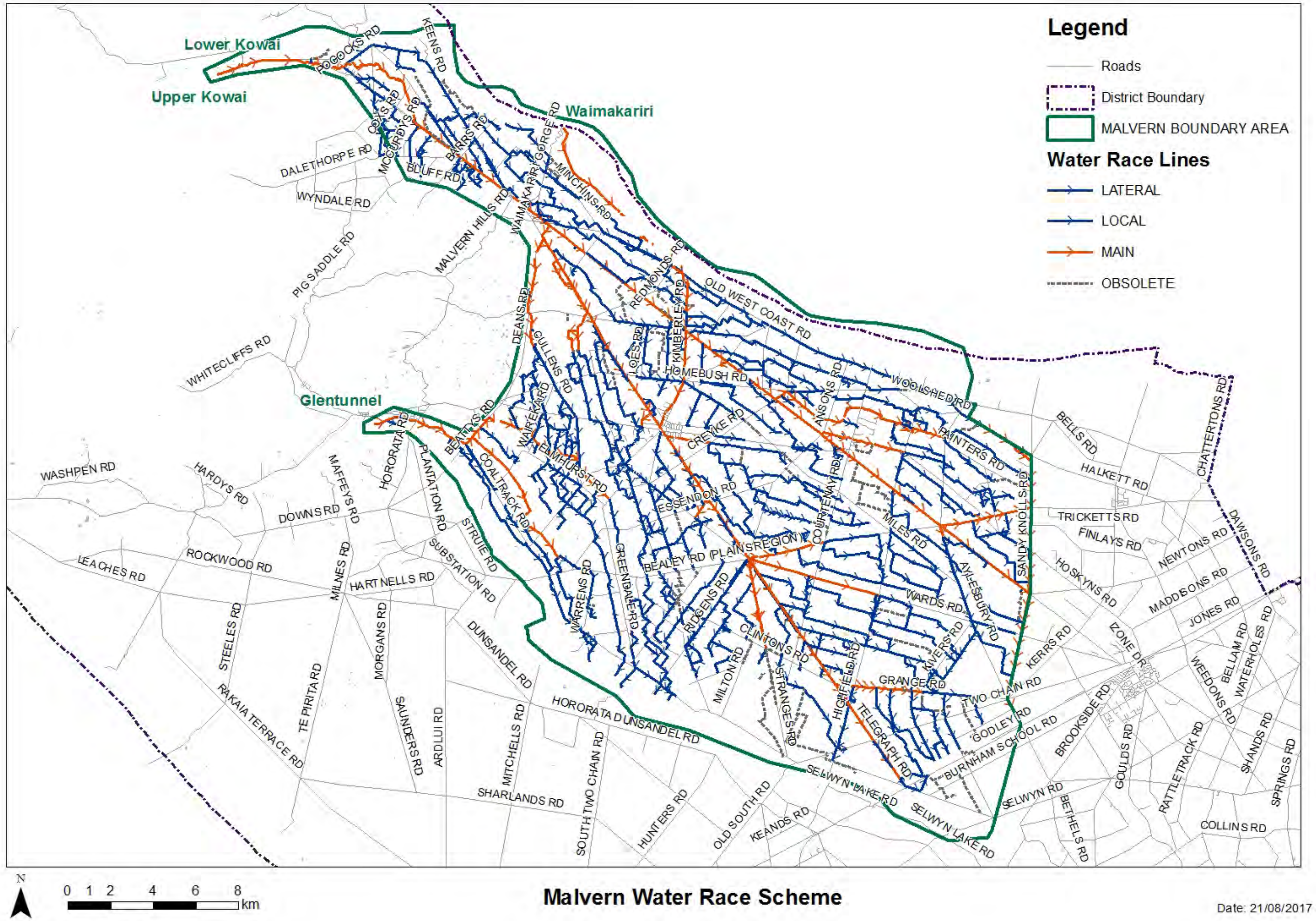

Figure 2-1 Scheme Map

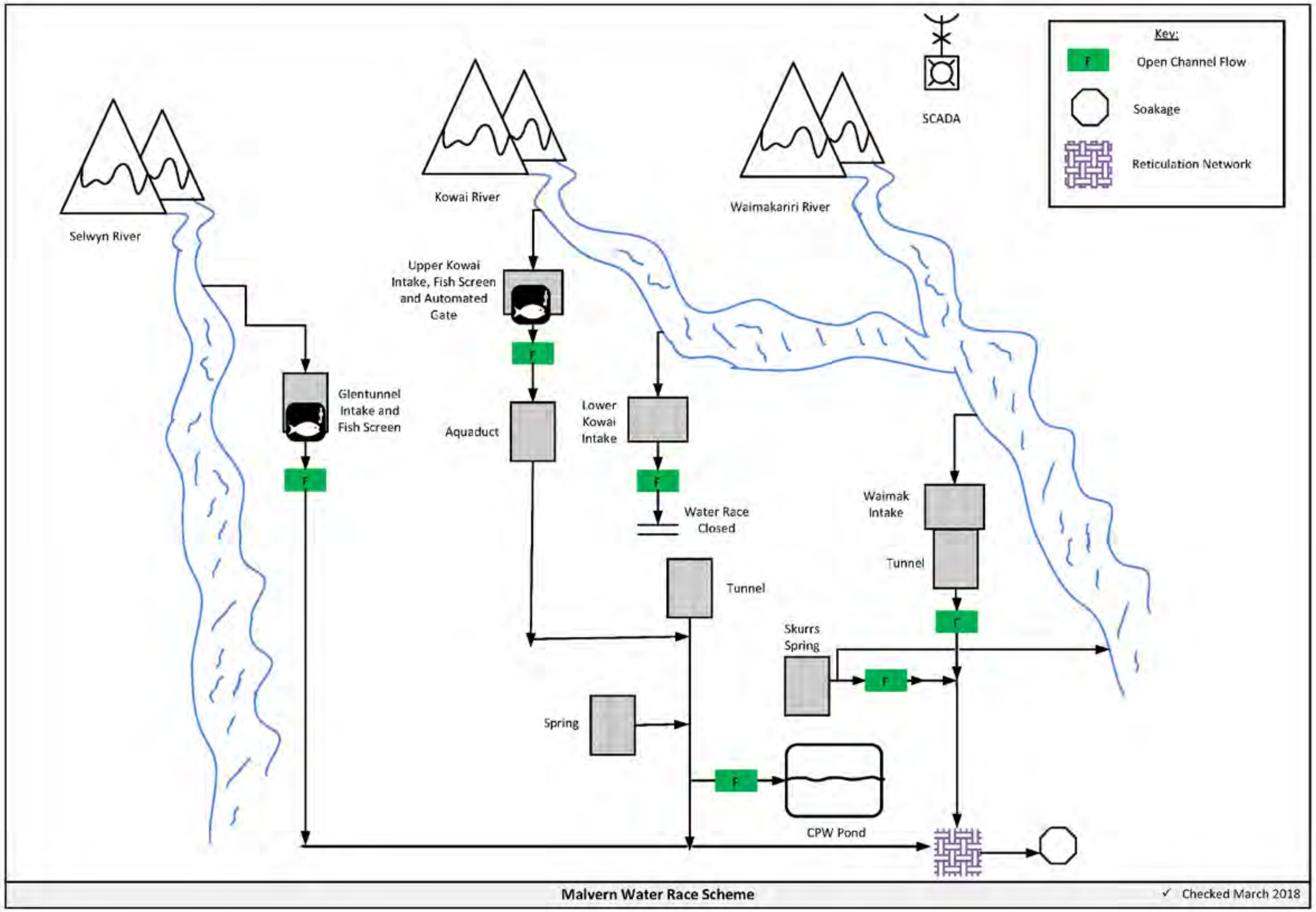

Figure 2-2 Scheme Schematic

2.4 Resource Consents

The Malvern water race scheme has a number of resource consents. Table 2-2 shows that water takes permitted by the resource consents at the intakes, and Table 2-3 details the resource consents for this scheme.

Table 2-2 Allowable Take

Intake	Base Minimum Flow (Lts/sec)	Maximum Take (Lts/sec)
Kowai - Lower	Nil	300
Waimakariri River Gorge	630	700
Waimakariri River spring	60	60
Glentunnel	250	250
Total	**1,375**	**2,210**

Table 2-3 Resource Consents

Consent Number	Description	Location	Date Issued	Expiry Date	Application Status
CRC012002	To disturb the beds and banks of the Kowai River, Waimakariri River, Selwyn River, Bishops Gully Creek, Skurrs Spring, Springfield Creek and Blacks Creek for the purpose of maintaining intake structures and maintaining diversion braids.	Stockwater Race Network	31/01/2008	05/11/2028	Issued - Active
CRC012004	To discharge water and water containing contaminates into land and/or water from the stockwater scheme at a number of points into waterways, drains and soak pits.	Stockwater Race Network	31/01/2008	05/11/2028	Issued - Active
CRC160916	To take and use surface water	Stockwater Race Network	16/01/2015	05/11/2025	Issued – Active
CRC084966.1	Global Consent - To discharge contaminants onto land in circumstances where they may enter surface water.	Global Consent	21/6/2011	28/4/2020	Issued - Active
CRC155937	To divert, take and use water.	Springfield Township, Springfield	28/08/15	5/11/2028	Issued - Active

The global consent to discharge liquid agrichemical expires during 2020. It is expected that aquatic protection will further limit the use of spraying.

2.5 Water Quality

Under consent CRC012004 Council were required to undertake water quality sampling. A summary of these results can be found in Table 2-4 below.

Table 2-4 Sampling Results

Site No	Location	Sample Date	Total Coliform MPN/100ml	E.Coli MPN/100ml	Turbidity NTU	Nitrate-Nitrogen mg/L	Nitrite-Nitrogen mg/L	Dissolved Reactive Phosphor mg/L
1	Waimakariri Gorge Intake	21/04/2010	101	24	2.6	<1.0	<0.002	<0.02
2	Upper Kowai Intake	8/09/2009	84	none detected	16.2	1.0	0.0052	<0.02
3	Lower Kowai Intake	22/08/2009	120	7	58.4	<1.0	<0.002	<0.02
4	Bishop Creek Booster	20/10/2009	2419	613	5.0	<1.0	0.0023	<0.02
6	Springfield Creek booster No 1	1/12/2009	>2419	326	6.1	<1.0	<0.002	<0.02
9	Glentunnel Intake	3/03/2010	1120	74	<1.1	<1.0	<0.002	<0.02
10	McCurdys Road	31/05/2010	1733	161	11.1	<1.0	0.008	0.02
11	Bluff Road	11/01/2010	>2419	272	5.5	<1.0	<0.002	<0.02

2.6 Scheme Assets

2.6.1 Intake

The Malvern Water Race System has four main intakes:

- The Waimakariri River
- The Upper Kowai River
- The Lower Kowai River
- The Selwyn River

The main source of water for the Malvern scheme in the winter months is the Kowai River. There are two intakes sited on the Kowai River, these intakes serve about 80% of the Malvern scheme during the winter months and early spring months. The Glentunnel intake supplies the other 20%.

Waimakariri Intake - The Waimakariri intake consists of a small lead-in channel that extends from the intake control gates up the riverbed for approximately 50 to 60 metres around the bottom of the cliff. The length depends on the location of the river braids. This is followed by a 95-metre section of rock tunnel. A 300-metre length of deep excavated main race leads away from the tunnel outlet. The intake structure is set back into the riverbed rock terrace. On the front of this structure there are two vertical sluice gates set into a wooden frame. The 95-metre rock tunnel leads directly away from the control gates and is subject to filling with river material if the gates are not closed before major flooding.

Skurrs Spring - The site is 1.5 km downstream of the Waimakariri intake. It discharges into the main race at a rate of 60 litres per second and this is a constant flow all year round. Ten litres per second is diverted back to the Waimakariri River.

Upper Kowai Intake - The intake structure is sited on the southern bank of the Kowai River and constructed into the rock face of the riverbank. The structure is constructed of concrete walls and the floor is bedded into the rock face, a steel grill, two wooden sluice control gates, and 80 metres downstream of the intake is a shingle removal structure. This section of river has a steep grade and a large grill is used to protect the intake from large rocks and gravel which move down the river when in flood.

If the rain is very heavy and run-off from the surrounding hills enters the main race an emergency discharge spill point located 1 km downstream of the intake would be used. It is used to prevent major flooding downstream in the Springfield Township. The water from this spill point discharges back into the Kowai River.

Downstream 1.4km of the intake is a large aqueduct with a butylene liner that carries water across the gully. This must be inspected daily for debris. The flow monitoring point is also sited at this location and flow must be recorded at this point daily.

Lower Kowai Intake - The intake consists of a small dam, gratings, control gates, a section of open race with a concrete river protection floodwall, a small 30 metre tunnel with a floodgate at its entrance. There is a second section of open race leading to a large 950 metre long brick barrel tunnel fitted with floodgates at the entrance.

A small gravel weir is constructed in the riverbed at the Lower Intake to divert water to ensure the intake retains sufficient flows.

Directly behind the intake control gate, a 30 metre long concrete floodwall leads down the main race from the intake to protect the main race from moderate to high flooding. Water race flow is monitored at this point.

The Lower Kowai Intake is fed into the Malvern Scheme through two tunnels and joins the upper Kowai race about 1km downstream of the SH73 Bridge becoming one main race.

As flows in the river drop, the intake gate has to be adjusted to keep race flows up to the required scheme demand. This demand will change from low demand in summer period to high demand in the winter months.

Glentunnel Intake - The Glentunnel Intake consists of one sluice control gate, and a medium size gravel and boulder weir spanning across the Selwyn riverbed. Some 450 metres downstream from the intake in the main race is a floodgate and spill point channel to divert flood water back to the Selwyn River.

The intake is a simple sluice gate set on the western bank of the Selwyn River. The main race feeds away from the gate through the Hororata Golf Course and on through the Coalgate Township. This intake supplies the area between the Hawkins, Selwyn and Waireka Rivers as well as joining the Kowai system near Bangor to supply the Greendale area of the scheme.

The height of the weir is 1.5m, the width is 5m and the length is 50m. A section of the dam is constructed to allow natural flows to occur and allowing for fish passage. The dam is constructed with a “weak section” so this section can be “overtopped” or fail in floods. This approach avoids the need to reconstruct the entire dam after flooding.

2.6.2 Silt Ponds

There are no operational silt ponds within the Malvern Water Race Scheme. Silt is removed through the annual cleaning programme. Historically, there was a silt pond down stream from the Waimak Intake.

2.6.3 Control Structures

Divides are on the main races below the main intake control gates. The divides are a mixture of single or multiple control gates are sited where the main race flow requires splitting into equal or different flows. Each split race then goes in to serve a different area of the scheme.

2.6.4 Monitoring Points

The monitoring sites on the Malvern Water Race System are sited at approximately 1.5 km downstream of the Waimakariri Intake tunnel, Upper and Lower Kowai Intakes on the Kowai above the SH73 bridge, Glentunnel Intake at the golf course on the Selwyn River, and Selwyn intake Bridge Street south of Coalgate Township off the Selwyn River. Skurrs Spring is also monitored.

The intake flows are measured and are reported upon to comply with resource consent take conditions.

There is no monitoring of the race flows that cross the boundary from the Malvern water race system to the Paparua scheme but generally these are very small flows (< 5 l/s).

2.6.5 Emergency Discharge Points

Emergency and Buffer Discharge points on main races, and on some minor races, are required to dump surplus water from the race system. This normally occurs when water from heavy rain has entered the race system causing flooding. This water is required to be quickly removed from the system to prevent flooding at downstream flooding or when dewatering is required to permit work on a section of race.

These Emergency Discharge and Buffer Points are located at:

- Upper Kowai Main race 300 metres above SH73 Kowai Bridge
- Odges Divide SH73 into Bishops Creek exiting into the Hawkins River
- Kirwee in Railway Reserve 200 metres below Township into a large soak hole
- Glentunnel below the intake 450 metres at the bottom end of the golf course back into the Selwyn River
- Waiwaniwaniwa River at west end of race fluming that crosses the river discharges into Waianiwaniwa River
- Hewitt Spill Point
- West end of Blacks Creek siphon discharges into Blacks Creek
- Waimakariri terrace race 6 emergency spill weirs back to the Waimakariri River
- Judd’s Siphon Waimakariri race back to the Waimakariri River
- Old West Coast Road and Redmond’s Road small race on north side of road discharge point into Gully back to Waimakariri River
- Old West Coast Road and Pitt’s Road small race on north side of road discharge into Gully back to Waimakariri River
- Old West Coast Road and Cooks Road small race on north side of road discharge into drain back to Waimakariri River

2.6.6 Soak Holes

Soak holes allow excess water to be taken from the intake to buffer additional usage such as high water use and at the end of races. A maximum of 10 l/sec per soak hole is permitted. There are 71 soak holes (including privately owned) in the Malvern scheme.

2.6.7 Pipe Summary

A summary of material and diameter for pipes (culverts and aquaducts), where known, is shown below in Figure 2-3 and Figure 2-4.

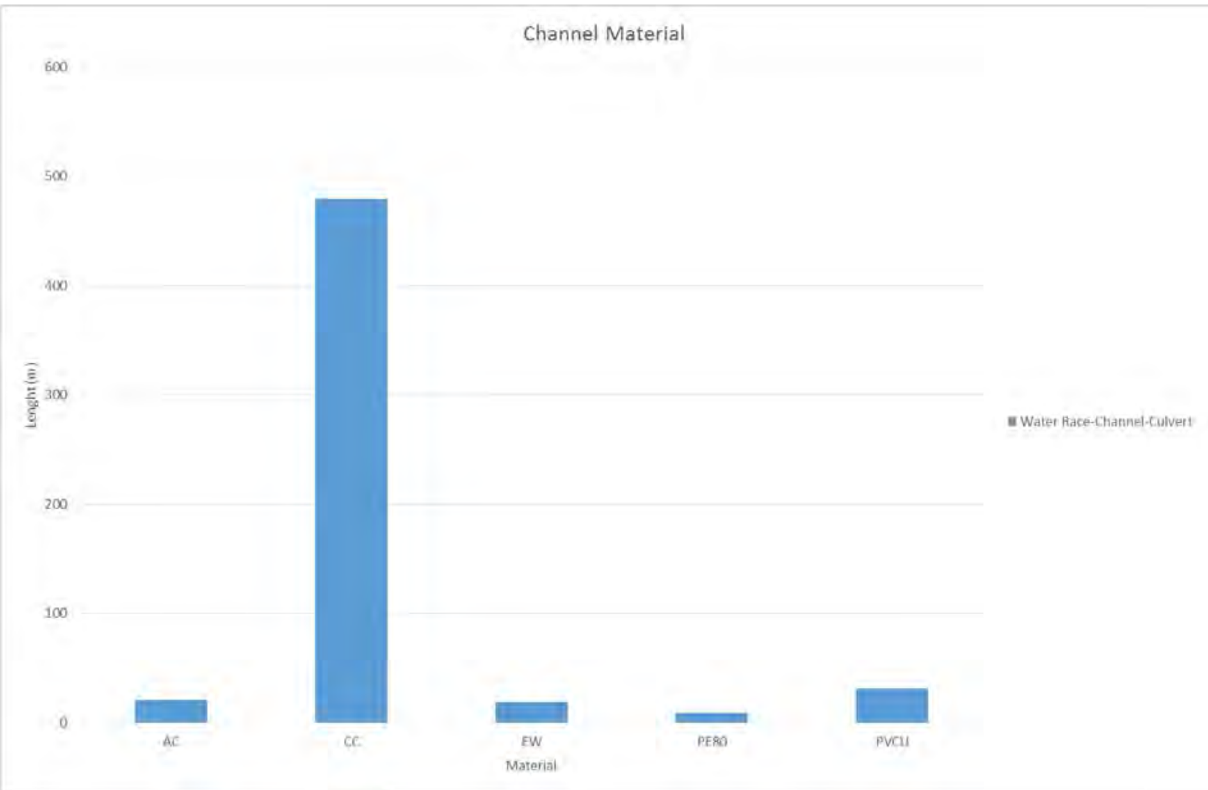

Figure 2-3 Pipe Material - Malvern

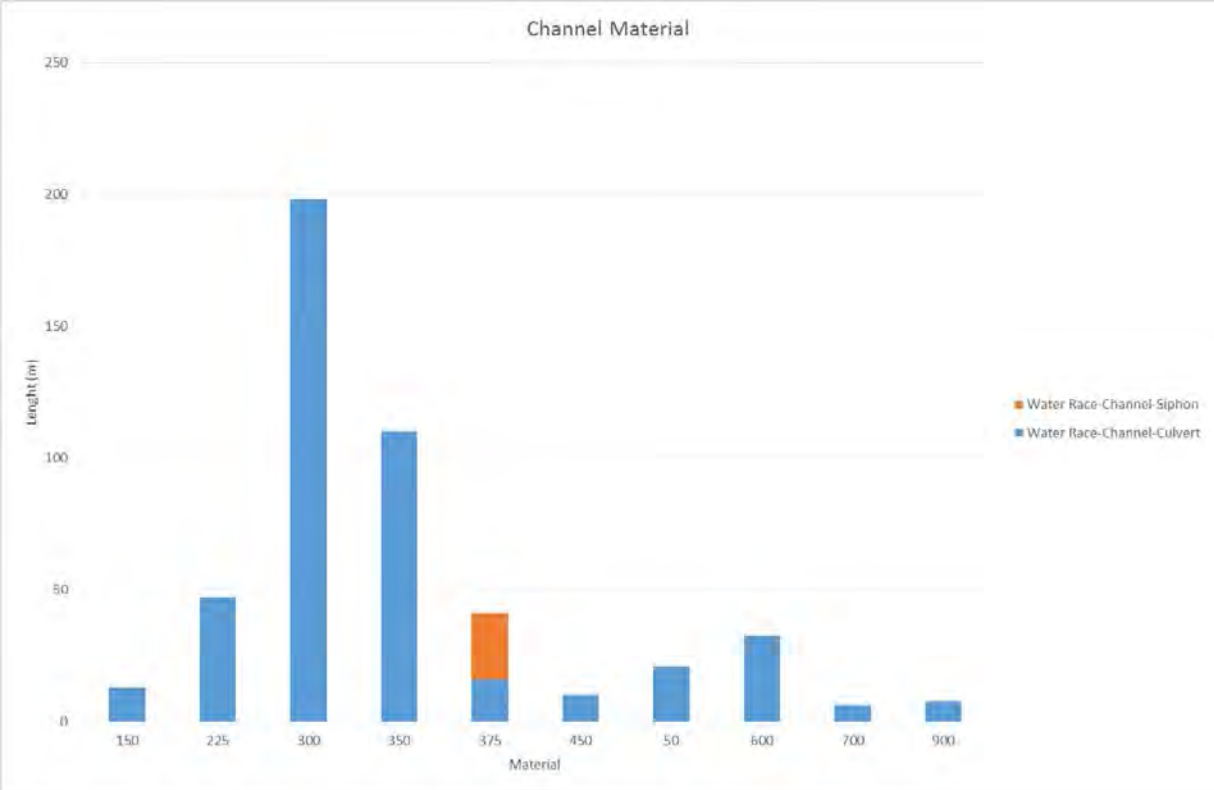

Figure 2-4 Pipe Diameter – Malvern

2.7 Operational Management

Presently the scheme is operated from two intakes during the winter months being the Upper Kowai River Intake and the Selwyn River Glentunnel Intake. In the spring, summer and autumn months the scheme is operated with up to four intakes, the Waimakariri Gorge, Upper and Lower Kowai and the Glentunnel Intake.

The Malvern Scheme is divided and operated into two sections. There are two operators - Eastern operator who covers the area east and below Darfield bordering the Paparua scheme and the Western operator covers the area west and above Darfield to the foothills.

The Western operator checks the main intake gates, cleans intake grills, records the river flows at the flow monitoring sites, and when required adjusts the intake gates. It may also be necessary to carry out river diversion works to divert the flows to service the scheme. When any works are carried out within the riverbed the operator must notify ECAN and Selwyn District Council using the River Works Notification form.

The Western Operator may contact the Eastern Operator to ascertain flow requirements in the eastern area.

Adjustments can then be made at either the main intake or other major divides located at Odges, Waddington Main Divide Gates, Bulls Race on Waimakariri River Terrace and the grills located at each siphon, piped section and tunnel over this section of race, Tramway Road and the Kimberley Road main divides, Old West Coast Road (Bulls Race) and SH73 Waddington.

The Eastern Operator firstly inspects the main divides at Kirwee and Charing Cross. From information gained from checking these races the operator contacts the Western Operator and requests more or less water for the lower half of the scheme.

2.8 Irrigation

The Terrace Water Group had an agreement with Council to transport CPW consented water from the Waimakariri River via Council's intake and main race. This agreement ended December 2017 once CPW water became available

The Council entered into agreement with CPW on 16th December 2016 to share water resources in the Sheffield area. The philosophy of the Agreement is to achieve a mutually beneficial cost neutral position. The CPW Scheme will benefit from a potential 200l/s of reliable water for irrigation and Council will receive finantual and water security benefits.

2.9 Environmental Management

2.9.1 Water Quality Issues

Water quality in races is largely affected by runoff and stock activity in races. Runoff containing fertiliser and organic nutrients is difficult to manage. Stock activity (especially cattle, horses and deer) can affect water quality by increasing sedimentation from bank erosion and disturbance of the bottom of the race channel. Direct defecation and surface runoff can also add to elevated faecal coliform levels.

Improved management of the water race network will need to address stock movement in races. Maintenance contractors and users need to be aware of the effect of operation and maintenance activities on water race quality.

2.9.2 Management Approach

The Council will use a combination of the following to address water quality issues:

- Watering bays are being promoted for water races that serve all stock farming properties (excluding sheep). This will allow limited and controlled access to races for stock drinking purposes. The remaining length of races to be fenced off/hot wired so that animals only have access to the race for drinking purposes. This is 'best practice' for managing stock access to races
- The Council will provide guidance to race users on design/layout of watering bays
- Maintenance contractors will ensure that subcontractors use clean and sound machinery when working in riverbeds
- Maintenance Contractors will be required to monitor and minimise discharge of surplus water from the race network

2.9.3 Demand Management

Environment Canterbury as the consenting authority are requiring demand management practices to be implemented as part of new or reviewed consent conditions. This is due to water allocations in most areas of the district being assumed as fully committed.

Selwyn District Council has integrated demand management into the existing Water Race Management Plan.

An Efficiency Audit of the Malvern Scheme dated June 2010 indicated potential improvements to the Water Race scheme.

Table 2-5 Efficiency Audit Improvement

Improvement	Description	Comment
Reducing Infiltration or leakage	Most of the obvious leakage areas have been rectified and any new ones are fixed once they become apparent	Without committing to large scale lining of channels with clay, concrete or bentonite, it is unlikely that the chronic infiltration losses can be substantially reduced with current technology Suggested Action: Continue the development of a leakage measurement system and use it to obtain more accurate data about infiltration losses
Race rationalisation	There are races that could be decommissioned as they are either not required or could be replaced with short pipe feeds from adjoining races	SDC policy W107 allows the race network to be rationalised from the extremities of the Water Race
Control Improvements	Installation of additional automated control and monitoring points	Suggested Action: Investigate the installation of monitoring stations with automated/remote controls at key points within the system
Management Improvements	Most of the easy gains in scheme operation have been made. The Water Race management plan provides an improved framework for managing the schemes	Suggested Action: Fully implement the Water Race Management Plan as soon as possible

2.10 Photos of Main Assets

Photo 1: Waimakariri River Intake

Photo 2: Skurrs Spring

Photo 3 – Waimakariri Fish Screen

Photo 4: Upper Kowai Intake

Photo 5: Upper Kowai Fish Screen

Photo 6: Lower Kowai Intake

Photo 7: Glentunnel Intake Weir

Photo 8: Glentunnel Intake

Photo 9: CPW off take from Water Race Network

2.11 Risk Assessment

A risk assessment has been undertaken for the Malvern scheme. The key output from the risk assessment is the identification of any extreme and high risks which need to mitigated. In order to mitigate these risks they have been included and budgeted for in the projects within this LTP. Table 2-6 details the risk priority rating, Table 2-7 outlines the risks and the list of key projects is found in Table 2-12.

Table 2-6 Risk Priority Rating

Risk Score	Level of Risk	Risk Response
> 50	Extreme	Awareness of the event to be reported to Council. Urgent action to eliminate / mitigate / manage the risk. Document risk and action in the AMP.
35-50	Very High	Risk to be eliminated / mitigated / managed through normal business planning processes with responsibility assigned.
14-35	High	Manage risk using routine procedures.
3.5-14	Moderate	Monitor the risk.
< 3.5	Low	Awareness of the event to be reported to Council. Immediate action required to eliminate / mitigate / manage the risk. Document risk and action in the AMP.

Table 2-7 Risks - Malvern

Risk	Action/Project	Year Identified	2014 Risk Rating	2017 Risk Rating	Residual Risk Rating
Collapse of old tunnels Kowai	Condition inspection of water race tunnels	2014	10	3.5	3.5
Public Health and Safety risks at intakes	Health and Safety improvements	2014	10	10	10
Sink holes are developing	Develop standard soak hole repair procedures	2014	9	9	9
Siphons are a risk	Condition inspection of water race siphons	2014	12	12	10
Non-consented activities	Renewal of consents	2014	27	27	6
Collapse of old tunnels Waimak	Tunnel repairs	2017		20	10

The list of district wide risks can be found in 5Waters Activity Management Plan: Volume 1.

2.12 Asset Valuation Details

The total replacement value of assets within the Malvern Scheme is $71,002,799 with further details in Table 2-8 below. The majority of value, 98%, is made up of channels.

Table 2-8 Replacement Value, Malvern

Asset Class 1	Asset Class 2	Sum of Replacement Value
Plant and Equipment		$87,875
Water Race Reticulation	Channel	$69,905,371
	Divide	$484,716
	Gate	$131,685
	Inlet-Outlet-Point	$348,324
	Instruments	$11,296
	Structure	$33,532

Channels are broken down into open channels: Culverts, Lateral, Locals and Mains and well as closed channels: tunnels, siphons, culverts and aqueducts. Replacement values for these different types of channels are shown in Figure 2-5 below, the replacement value of the tunnels dominates this graph.

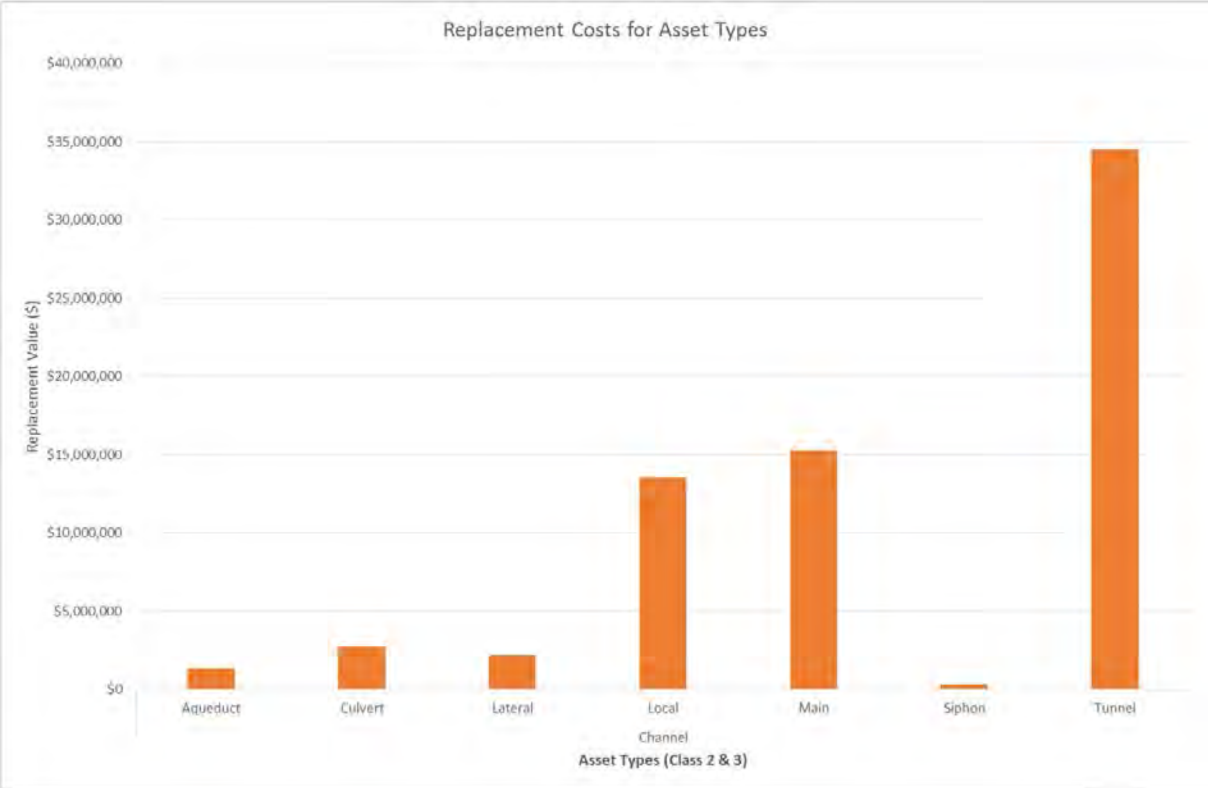

Figure 2-5 Replacement Costs for Malvern Channels

2.13 Renewals

The renewal profile has been taken from the 2017 5 Waters Valuation. A graph showing the renewals for this scheme are shown by Figure 2-6 below. The major asset groups requiring renewal is are tunnels, syphons and culverts.

The open race channels are taken as having infinite lives (renewal by maintenance) and therefore renewals are not budgeted for these assets types.

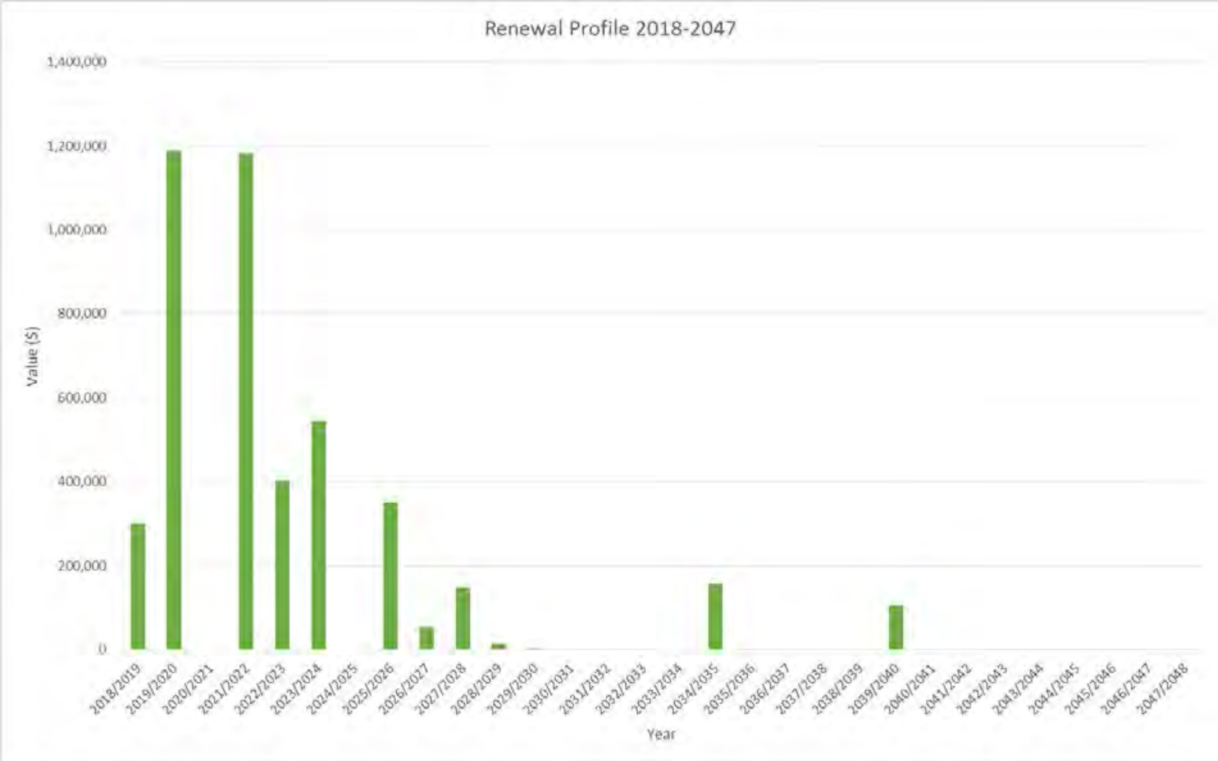

Figure 2-6 Malvern Water Race Renewal Profile[2]

There are many aging structures within the water race network these include gates, intake structures, tunnels, siphons, aqueducts and culverts. These assets are near the end of their life and will require increased funding moving into the future.

2.14 Critical Assets

The criticality model for Malvern has been updated for the 2018 AcMP. The methodology of the criticality model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the criticality has been calculated for the reticulation assets. Table 2-9 and Figure 2-7 below shows the level of criticality for all of the assets within this scheme that have a recorded known length.

Table 2-9 Length of Assets per Criticality Level

Criticality Bands		Length (m)
5	Low	694,894
4	Medium-Low	162,262
3	Medium	13,640
2	Medium-High	6,813
1	High	574

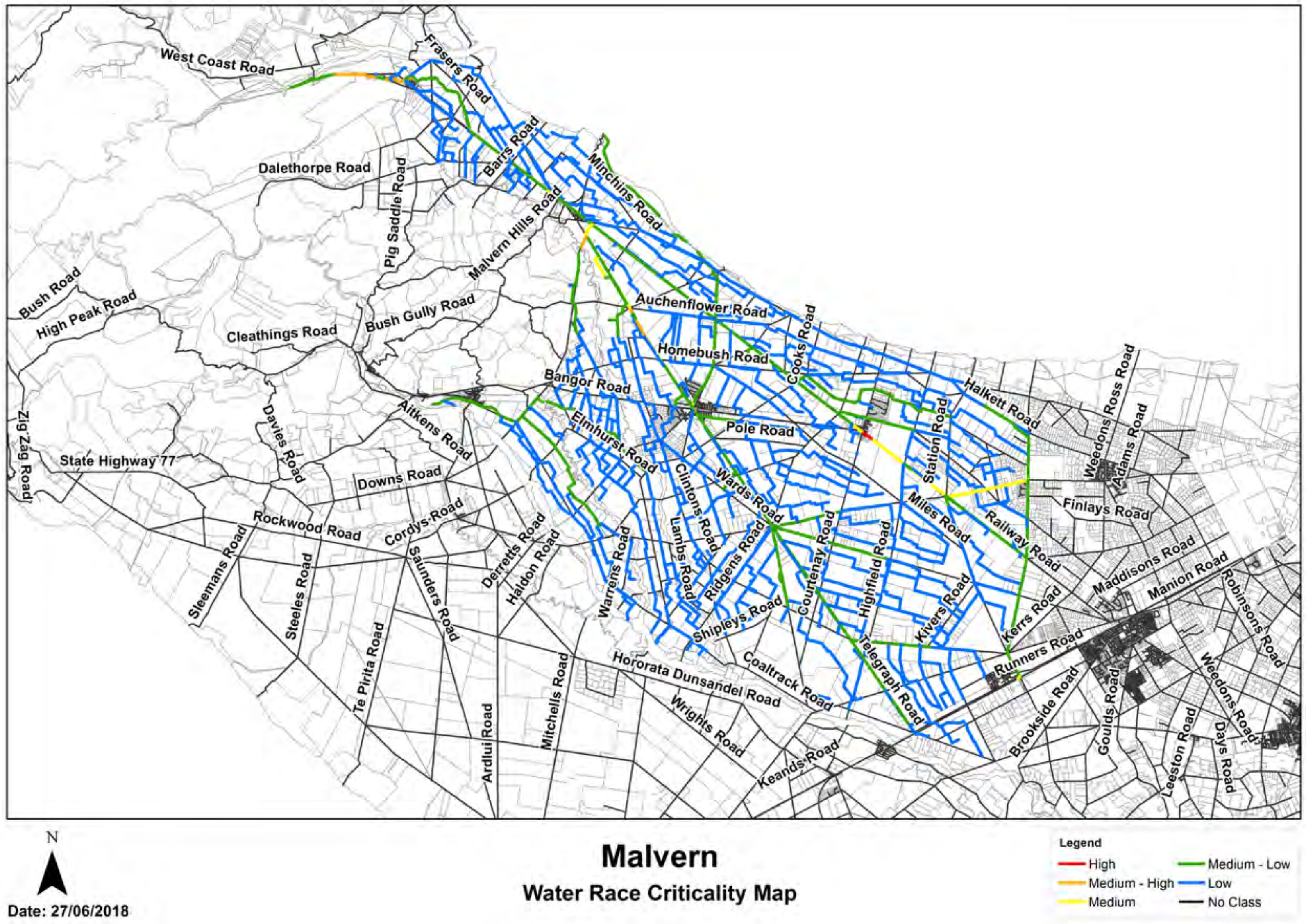

Figure 2-7 Criticality Map

2.15 Asset Condition

The asset condition model was run for Malvern in 2018. The methodology of the model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the model has been calculated for the reticulation assets (particularly pipes). Figure 2-8 below shows the level of asset condition for all of the assets within this scheme that have a recorded known condition.

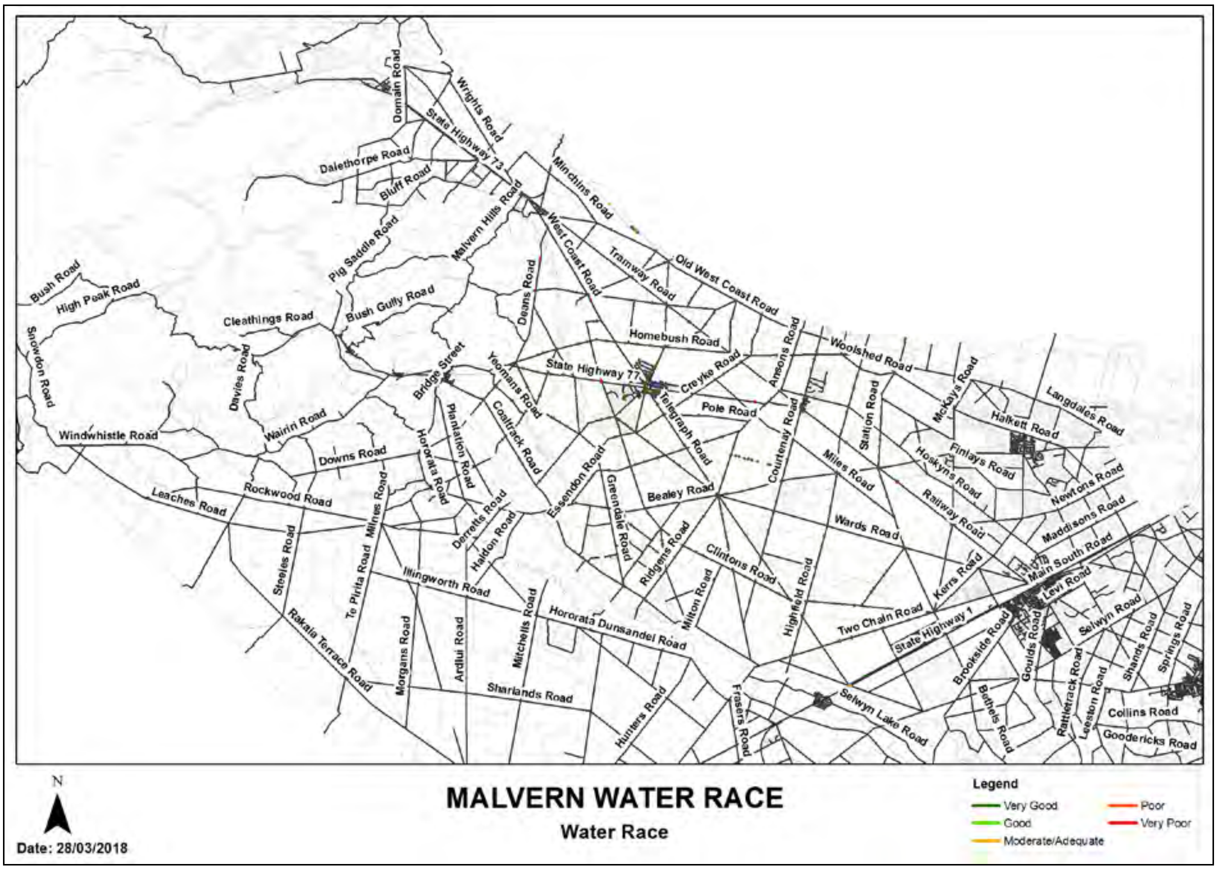

Figure 2-8 Asset Condition - Malvern

Table 2-10 provides a description of the condition rating used within the condition model.

Table 2-10 Asset Condition Grading

Condition Rating	Grading
1.0	Excellent
2.0	Good
3.0	Moderate
4.0	Poor
5.0+	Fail

2.16 Funding Program

The 10 year budgets for Malvern are shown by Table 2-11 and Figure 2-9. Budgets are split into expenditure, renewals, projects and capital projects.

All figures are ($) not adjusted for CPI "inflation". They are calculated on historical data, and population growth where relevant.

Table 2-11 Malvern Budget Summary

Years	Expenditure	Renewals (Actual)	Projects	Capital Projects
2018/2019	$813,800	$300,000	$3,000	$120,000
2019/2020	$806,800	$1,188,974	$20,000	
2020/2021	$798,300			
2021/2022	$798,300	$1,180,603		
2022/2023	$788,300	$403,547		
2023/2024	$788,300	$543,847		
2024/2025	$788,300	$1,668		
2025/2026	$788,300	$350,749		
2026/2027	$788,300	$53300		
2027/2028	$788,300	$147389		
Total	$7,947,000	$4,170,076	$23,000	$120,000

An explanation of the categories within the budgets are as follows below:

- Expenditure consists of operation and maintenance costs;
- Renewals are replacement of assets which are nearing or exceeded their useful life;
- Projects are investigations, decisions and planning activities which exclude capital works; and
- Capital projects are activities involving physical works.

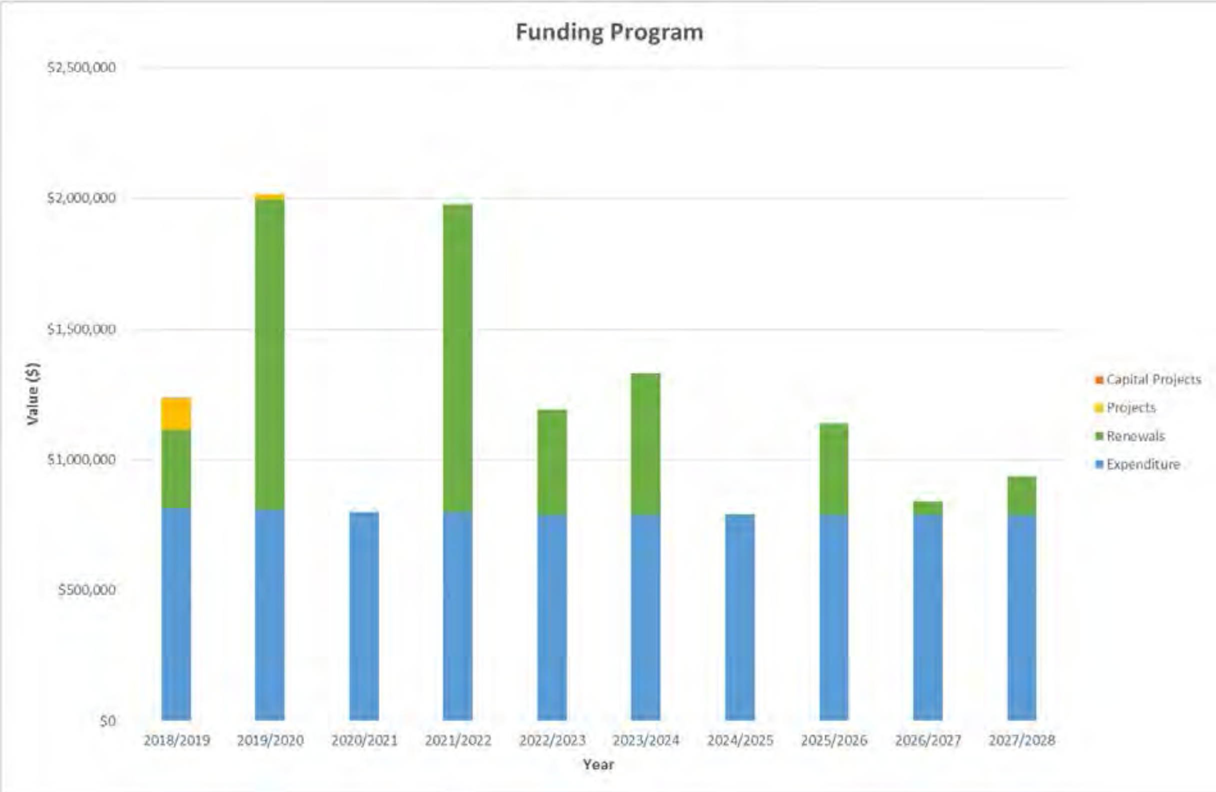

Figure 2-9 Malvern Funding Summary

There are three major projects for Malvern water races in the LTP budget. It is important to note that there may be a number of closures of water races within the coming years.

Table 2-12 Key Projects

Account Label	GL	Description	Year 1 ($)	Year 2 ($)	Year 3 ($)	Years 4 to 10	Funding Spilt[3]
Projects	395490068	Condition inspect siphons		$20,000			100% LoS
Projects	395190080	Sink hole repair procedure	$3,000				100% LoS
Capital Projects	3951098	Waimak tunnel invest design and repair	$120,000				100% LoS

The list of district wide projects can be found in 5Waters Activity Management Plan: Volume

Discussion on Projects

Projects have been determined based on their:

- Relevance to the scheme
- Requirement to be completed under legislation
- Ability to bring the scheme up to or maintain the Level of Service required under council's Asset Management Policy.

Many projects are **jointly** funded by more than one scheme and activity. Each scheme pays a pro-rata share only, equivalent to the number of connections.

Discussion on Capital and Projects

Where relevant, Capital (Levels of Service) and Capital (Growth) projects have been included in the scheme financial details.

Levels of Service Projects and growth splits have been provided to ensure the costs of population driven works are clear.

[3] Where LoS refers to Level of Service and G refers to Growth

3.0 PAPARUA WATER RACES

3.1 Scheme Summary

Description		Quantity
Scheme area (within scheme boundary)		35,837 ha
Scheme Coverage (as at 1 June 2018)	Area of Full Charges	
	Unit Charge (No.)	1355
	Irrigators	59
Systems components	Intakes	1
	Main Race	117.12km
	Local Race	103.32km
	Lateral Race	223.57km
	Other	2 settling ponds
Water Source	via River	Waimakariri River (Paparua intake)
History	Install date	Installed progressively from 1885
Value ($)	Replacement Cost	$21,380,905.89
	Depreciated Replacement Cost	$18,839,571.12
Financial	2018/2019 estimate Annual maintenance cost % of total budget	$887,600 38.79%
Water Take	Annual average (from Management Plan)	41.3 million m^3
	Consented Take	2,031 Lts/sec (including irrigation)
Sustainability	Biodiversity	Groundwater recharge and natural habitat
	Amenity	Urban features

3.2 Key Issues

The following key issues are associated with the Paparua Water Race system. A list of district wide issues are located in 5Waters Activity Management Plan: Volume 1.

Table 3-1 Paparua Scheme Issues

What's the Problem	What we plan to do
Vandalism at the Paparua intake.	The Paparua intake is subject to ongoing vandalism which will be monitored and onsite improvements made where practical.
Health and Safety Risk	Health and Safety inspections and improvements
Operating race for biodiversity values will add financial pressure.	Review options for alternative funding.
Operating race for biodiversity values will add financial pressure.	An alternative rating structure is proposed which takes into account benefits of the race network other than stock water. The alternative rating structure is one of the matters included in the 2018-28 consultation document.

3.3 Overview & History

The Paparua scheme serves a variety of smaller farms and a large number of lifestyle blocks. It consists of an intake on the southern bank of the Waimakariri River at Intake Road feeding into races, which fan out across the plains towards Christchurch in the East and Burnham in the south.

The intake although still within the flood plain of the river is a simple concrete weir with a vertical sluice gate on the protected southern branch of the river. The water is led to this channel as necessary after each major fresh or flood in the river. In a flood the intake is protected by a combination of willow plantings and the mechanism of the river in the active main flood plain area overtopping the low bank of the dozed channel and washing the weak portion downstream.

From the river, water is fed through an intake race for some 500 metres. This race then divides into two races leading to two sedimentation pond areas where most of the sand and silt is allowed to settle out before the water feeds into the scheme.

The scheme from here consists of a series of main and subsidiary races feeding water to properties throughout the scheme area which generally covers the area of the old Paparua County totalling approx. 35,000 hectares with 2,966ha of Christchurch City area served.

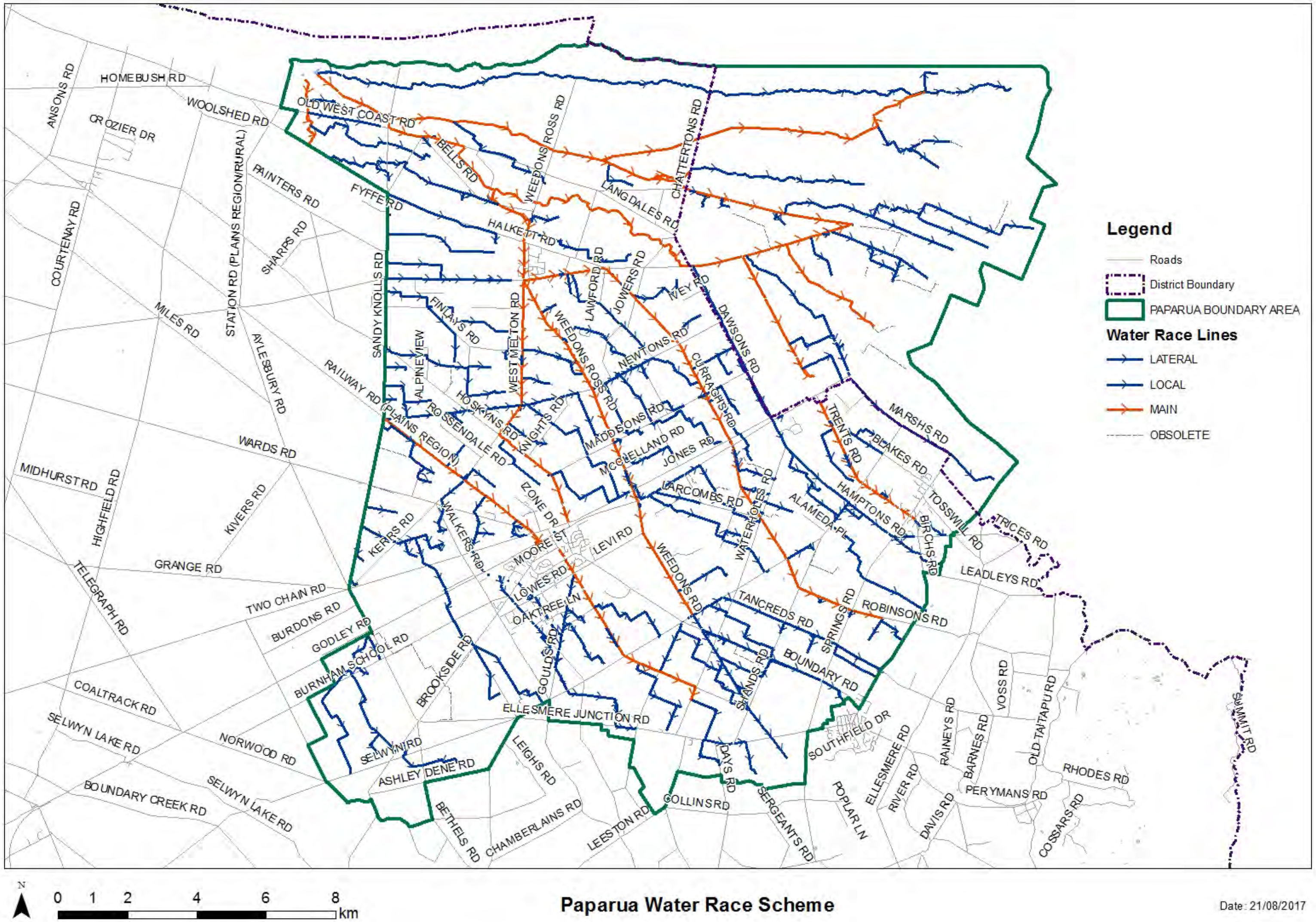

Figure 3-1 Scheme Map

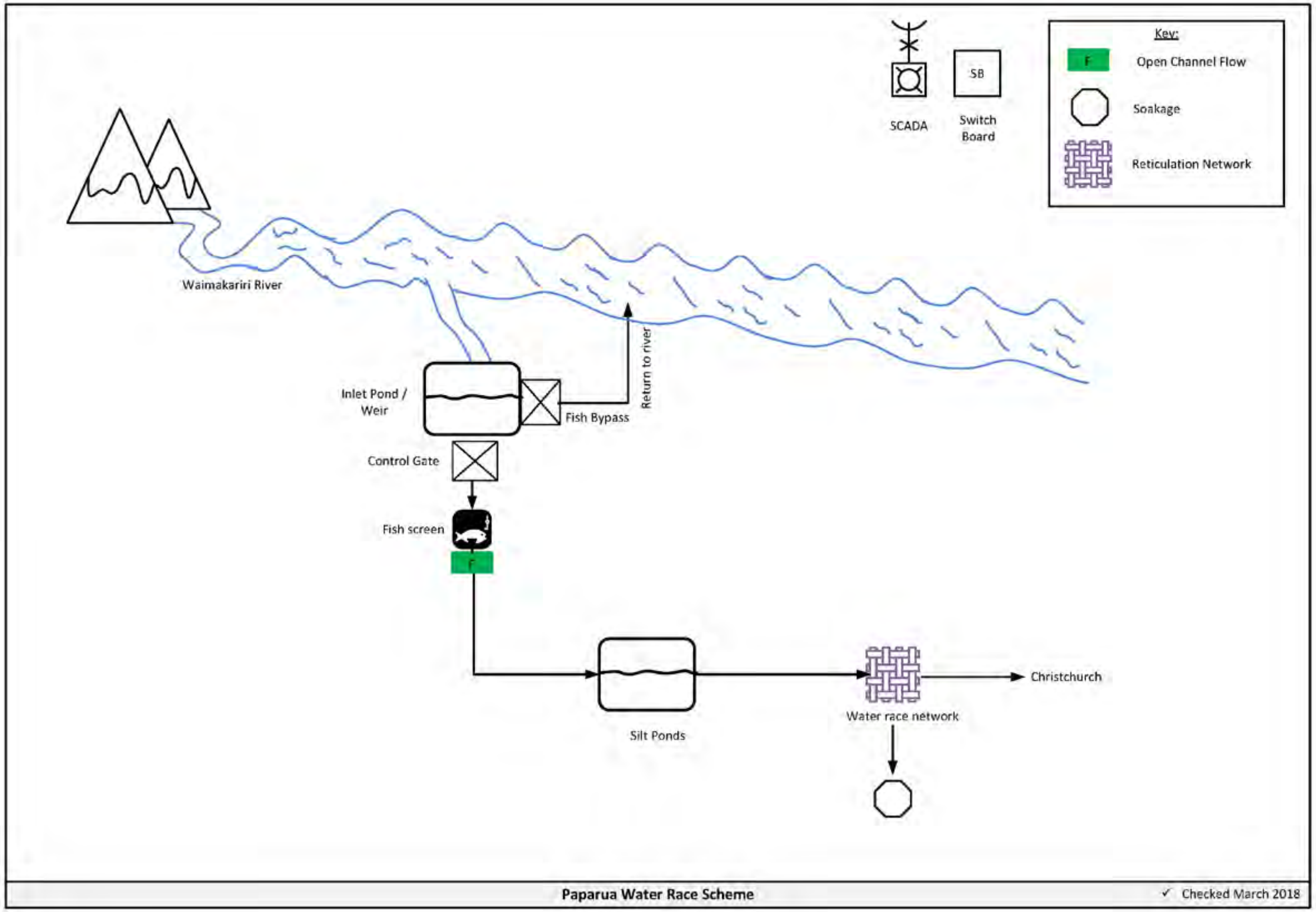

Figure 3-2 Scheme Schematic

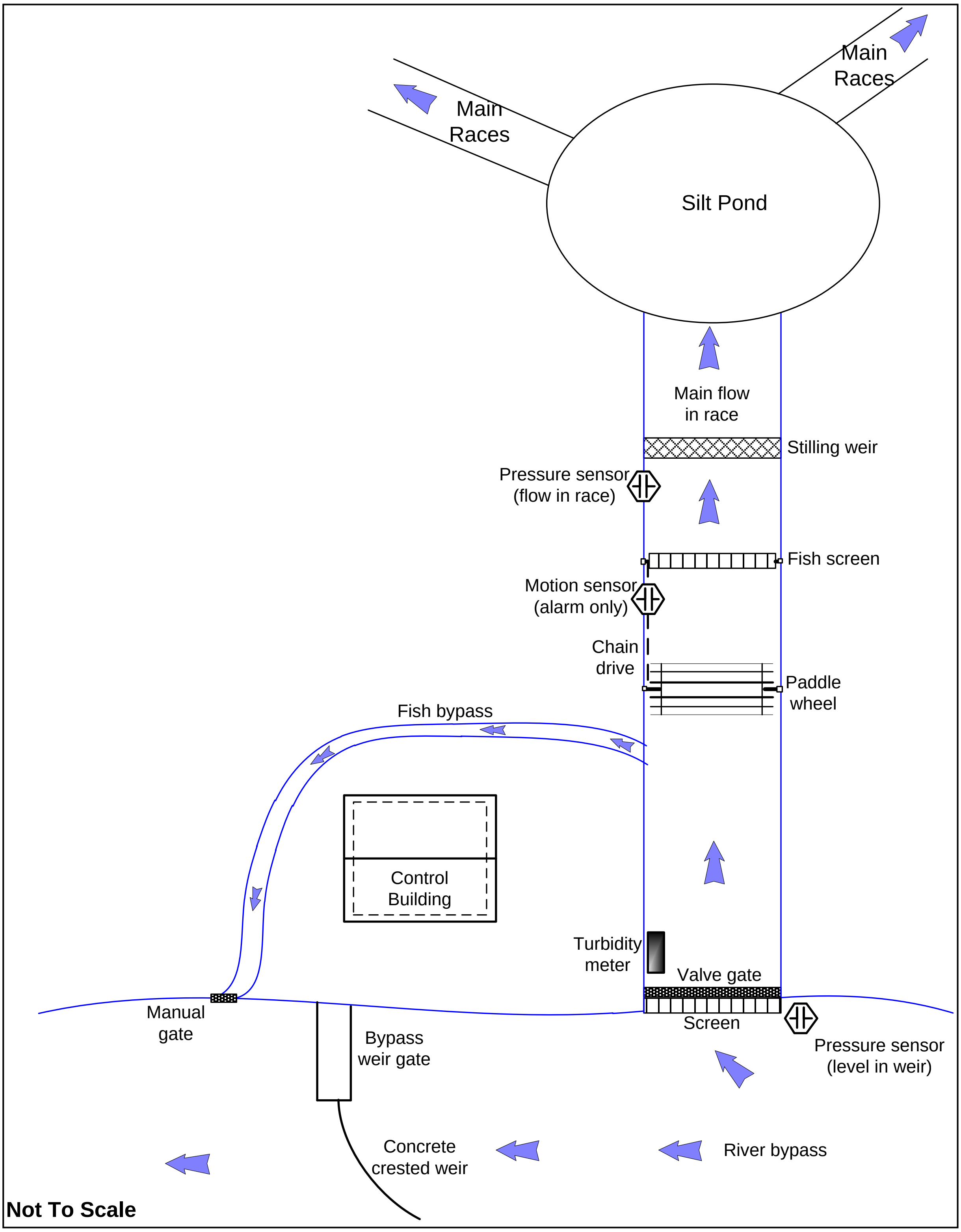

Figure 3-3 Intake Scheme Schematic

3.4 Resource Consents

The Paparua water race scheme has a number of resource consents. Table 3-2 shows that water takes permitted by the resource consents at the three intakes and Table 3-3 details the resource consents for this scheme.

Table 3-2 Allowable Take

Intake	Base Minimum Flow (Lts/sec)	Maximum Take (Lts/sec)
Intake Rd – Stock water	1231	1331
Intake Rd - Irrigation	800	800
Total	**2,031**	**2,131**

Table 3-3 Resource Consents

Consent Number	Description	Location	Date Issued	Expiry Date	Application Status
CRC012005	To disturb the bed of the Waimakariri River to maintain intake and discharge structures	Stockwater Race Network	10/12/2002	10/12/2037	Issued - Active
CRC012006	To take a maximum flow of 1430 litre per second from the Waimakariri River at the Waimakariri Gorge intake and to take a maximum flow of 800 litres per second from the Waimakariri River at the Paparua intake for stockwater and irrigation supply	Stockwater Race Network	10/12/2002	10/12/2037	Issued - Active
CRC012007	To discharge water and water containing contaminants into land and/or water from the stockwater scheme at several points into drains and soakpits	Stockwater Race Network	10/12/2002	10/12//2037	Issued - Active
CRC084966.1	Global Consent - To discharge contaminants onto land in circumstances where they may enter surface water	Global Consent	21/06/2011	28/04/2020	Issued - Active

The global consent to discharge liquid agrichemical expires during 2020. It is expected that cultural and aquatic protection will further limit the use of spraying.

3.5 Water Quality

Under resource consent CRC012006 Council were required to undertake water quality sampling from May 2003 to December 2004. A summary of the results, sampled on 14 December 2004, is below in Table 3-4.

Table 3-4 Sampling Results

Map sample location	E.coli Count	Nitrate Nitrogen g/m3	Temp C	Turbidity g/m3
Marshes Road NZMS 260 M36:7265-3663	2100	0.5	14	12
Marshes Road NZMS 260 M36:7265-3664	Dry	Dry	Dry	Dry
Marshes Road NZMS 260 M36:7265-3665	Dry	Dry	Dry	Dry
Tosswill Road NZMS 260 M36: 7151-3512	300	<0.05	13	28.4
Tosswill Road NZMS 260 M36: 7151-3512	Dry	Dry	Dry	Dry
Tosswill Road NZMS 260 M36: 7151-3512	Dry	Dry	Dry	Dry
Lincoln Township NZMS 260 M36: 6832-3017	350	0.06	14	6.84
Lincoln Township NZMS 260 M36: 6832-3017	Dry	Dry	Dry	Dry
Lincoln Township NZMS 260 M36: 6832-3017	Dry	Dry	Dry	Dry
Ellesmere Road NZMS 260 M36: 7036-3002	Dry	Dry	Dry	Dry
Ellesmere Road NZMS 260 M36: 7036-3002	Dry	Dry	Dry	Dry
Ellesmere Road NZMS 260 M36: 7036-3002	Dry	Dry	Dry	Dry
Days Road NZMS 260 M36:6474-2834	4100	0.08	12	49.6
Days Road NZMS 260 M36:6474-2834	400	0.19	11	14.17
Days Road NZMS 260 M36:6474-2834	1600	0.09	10	42.1

3.6 Scheme Assets

3.6.1 Silt Ponds

There are two silt ponds, which are used to settle out river silt from the Waimakariri River in times of flood. The ponds are accessed through a locked gate about 100 metres from the river end of Intake Road. These ponds are situated about 1 kilometre below the Main Race Intake Control gates.

The first pond (1.23ha) is situated above the start of the Harewood Race and is the larger of the two ponds. The silt progresses down the main race to a wider channel section just before the pond and silt settles out in the channel.

The second pond (0.44ha) is smaller in size and the silt is allowed to settle in the pond itself and is cleaned out to bank. Pond number two has minimal storage. The race, known as the Sandy Knolls, leads away from this pond and supplies water to the Rolleston and Burnham area.

If there is a total outage, or gates are closed completely at the intake and there is no flow into the race system within 24 hours, the upper half of the Paparua Race system drops to a very low flow. After 24 hours of outage at the intake the whole upper half of the scheme will be out of water. The lower half of the Paparua scheme starts to be affected by lack of flow into the scheme.

3.6.2 Control Structures

Divides are on the main races below the main intake control gates. The divides are a mixture of single or multiple control gates sited where the main race flow requires splitting into equal or different flows. Each split race then goes on to serve a different area of the scheme.

3.6.3 Monitoring Points

Monitoring structures are sited below intakes to measure the quantity of water taken from the source. The main monitoring site is located immediately downstream of the intake and fish screen. The only other monitoring structures on the Paparua Water Race System are approximately 400 metres downstream of the main intake where there are two control gates that divide the flow into two races. They are used to measure flows to ensure compliance with resource consent requirements and to compile a history of the intake flow.

Each of these races has a section of race that has had its cross-sections calibrated by a certified hydrologist to enable measurement of the flows.

3.6.4 Emergency Discharge Points

There are discharge points on main races, and on some minor races, to dump surplus water from the race system. These are used in an emergency, or when work is required on a section of race, and can be dewatered using the emergency discharge point.

An emergency is when water has got into the race system from heavy rain causing. This water is required to be quickly removed from the system to prevent flooding at downstream culverts or overtopping and affecting roads, property, crops or buildings. This water can be removed from one discharge point or several, up to 3 to 4, depending on the amount of water to be removed. Also excess water may be taken from the race to buffer additional usage such as high irrigation and sudden shut down of the irrigation systems. Flood discharge points on the race system are sited at:

- Scout Camp on West Coast Road and Buchannan’s Road intersection
- Old West Coast Road and Main West Coast Road intersection
- Sandy Knolls Road and Railway Road
- Newton’s and West Melton Road intersection

3.6.5 Soakholes

Soakholes allow excess water to be taken from the intake to buffer additional usage such as high water use. Maximum flow to each soakhole is 10 L/sec. The Paparua scheme has 104 soakholes (including privately owned).

3.6.6 Pipe Summary

A summary of material and diameter for pipes (culverts and aquaducts), where known, is shown below in Figure 3-4 and Figure 3-5.

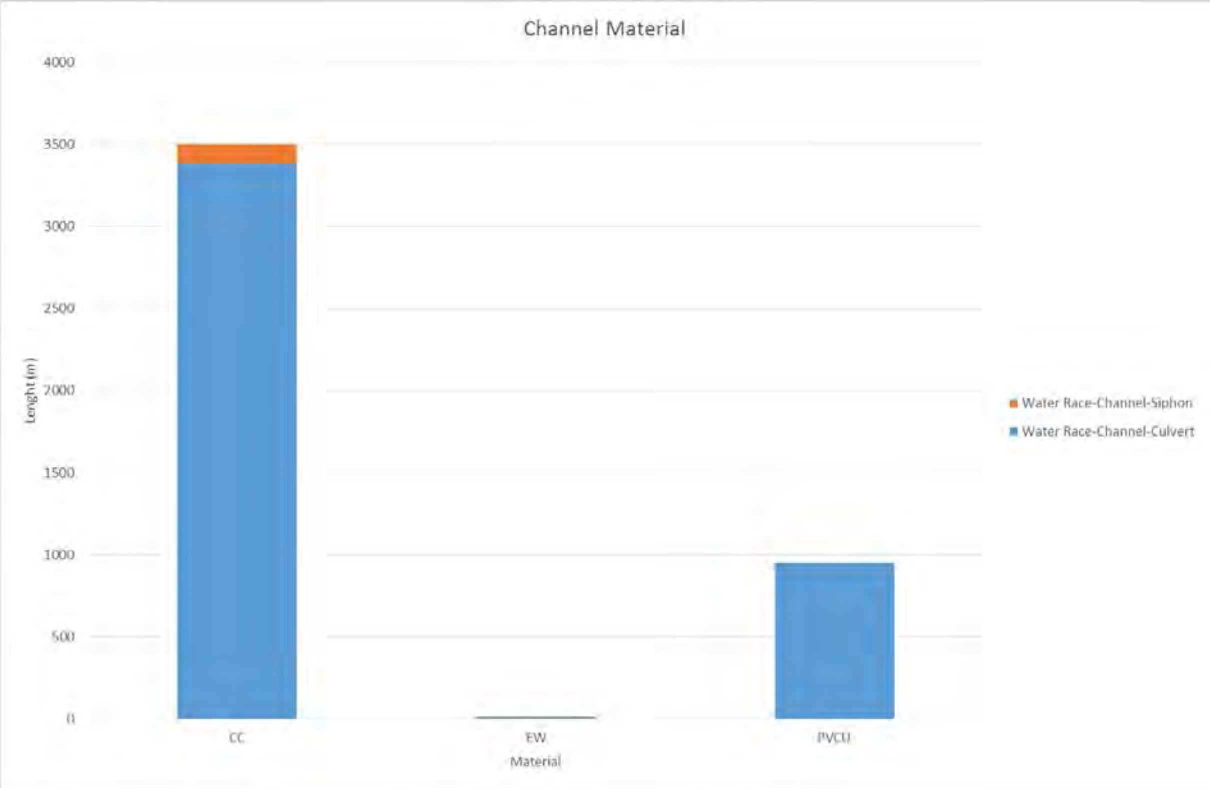

Figure 3-4 Pipe Material - Paparua

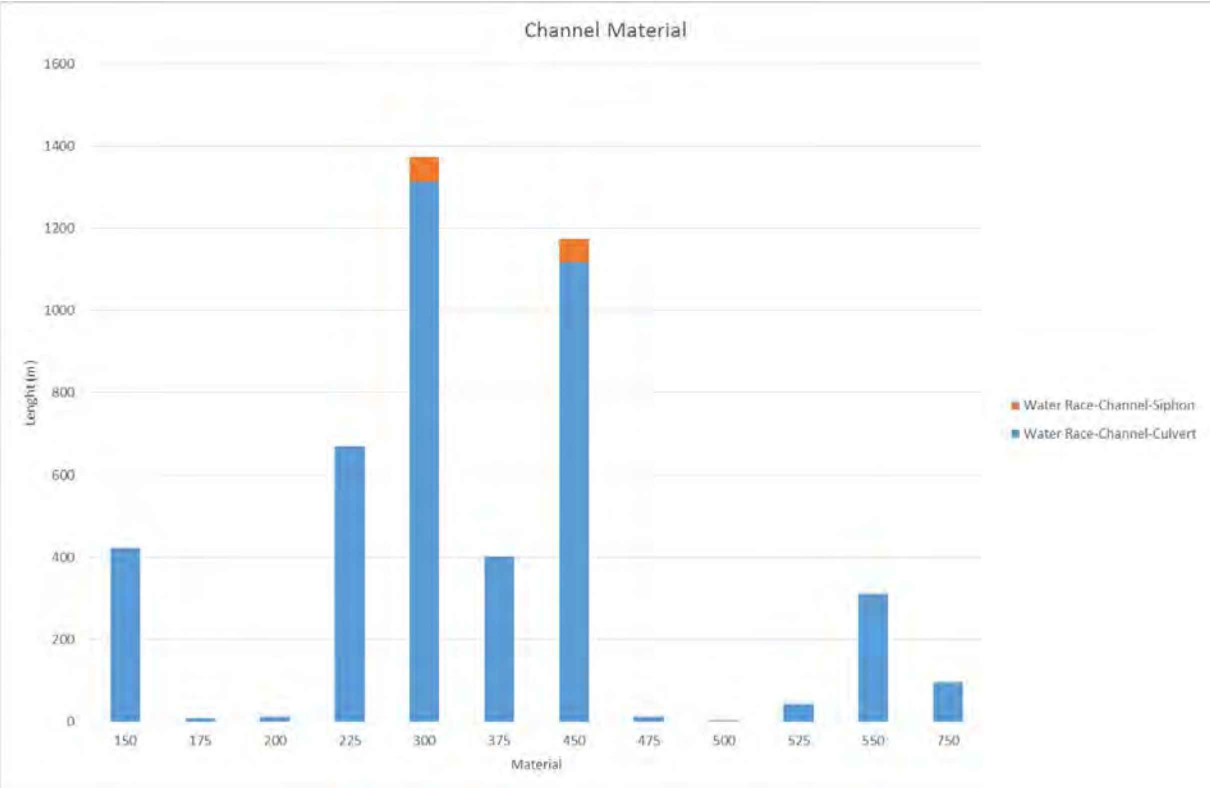

Figure 3-5 Pipe Diameter - Paparua

3.7 Operational Management

Presently the scheme is operated in two sections, being the western area, including the intake, and the eastern area. The boundary between the two being the Main South Road along Sandy Knolls Road to Newtons Road and then to the airport area.

The Western Operator checks the main intake gates, river flows, cleans intake grills and when required adjusts intake gates and adjustable weirs. Contact with the Eastern Operator then occurs to ascertain flow requirements in the eastern area. Adjustments then can be made at either the main intake or the other major divides located at Bells Divide, SH73/Sandy Knolls, SH73/Weedons Ross Road, SH73/Langdales Road, SH73/Kirk Road to ensure the correct flow into the eastern area. When there is a total outage of the intake, flows in the upper half of the Paparua race scheme fall away in 6- 8 hours.

3.8 Irrigation

There are 56 property owners on the Paparua Scheme that have authorisation from the Selwyn District Council for use of water from the water race system for irrigation. Irrigation agreements are required with each user. The agreement covers individual water allocations, monitoring responsibilities and details recommended water management practices.

Due to consent conditions, restrictions occur when the flow in the Waimakariri River is less than 63 cubic metres per second. In the event of this occurring rosters are developed to assist irrigation when restrictions are imposed on irrigation. A graph is also sent to the irrigators detailing the steps down in the river and indicating how many litres are available at any one time. When the river reaches 41 cumecs all irrigation ceases. The Council has instigated in conjunction with all irrigators a system that allows irrigators to call Council and receive information on River levels, any restrictions imposed and the appropriate “roster”.

3.9 Environmental Management

3.9.1 Water Quality Issues

Water quality in races is largely affected by runoff and stock activity in races. Runoff containing fertiliser and organic nutrients is difficult to manage. Stock activity (especially cattle, horses and deer) can affect water quality by increasing sedimentation from bank erosion and disturbance of the bottom of the race channel. Direct defecation and surface runoff can also add to elevated faecal coliform levels.

Improved management of the water race network will need to address stock movement in races. Maintenance contractors and users need to be aware of the effect of operation and maintenance activities on water race quality.

3.9.2 Management Approach

The Council will use a combination of the following to address water quality issues:

- Watering bays are being promoted for water races that serve all stock farming properties (excluding sheep). This will allow limited and controlled access to races for stock drinking purposes. The remaining length of races to be fenced off/hot wired so that animals only have access to the race for drinking purposes. This is ‘best practice’ for managing stock access to races.
- The Council will provide guidance to race users on design/layout of watering bays
- Maintenance contractors will ensure that subcontractors use clean and sound machinery when working in riverbeds.

- Maintenance Contractors will be required to monitor and minimise discharge of surplus water from the race network

3.9.3 Demand Management

Environment Canterbury as the consenting authority are requiring demand management practices to be implemented as part of new or reviewed consent conditions. This is due to water allocations in most areas of the district being assumed as fully committed.

Selwyn District Council has integrated a demand management plan into the existing Water Race Management Plan.

An Efficiency Audit of the Paparua Scheme dated January 2004 indicated potential improvements to the Water Race scheme. A summary of the potential improvements are detailed in the table below:

Table 3-5 Potential Improvements

Improvement	Description	Comment
Reducing infiltration or Leakage	Most of the obvious leakage areas have been rectified and any new ones are fixed once they become apparent.	Without committing to large scale lining of channels with clay, concrete or bentonite, it is unlikely that the chronic infiltration losses can be substantially reduced with current technology Suggested Action: Continue the development of a leakage measurement system and use it to obtain more accurate data about infiltration losses
Race Rationalisation	There are races that could be decommissioned as they are either not required or could be replaced with short pipe feeds from adjoining races.	SDC Policy W107 allows the race network to be rationalised from the extremities of the Water Race. Suggested Action: Investigate the possibility of rationalisation further with a view to optimising the network to meet current consumers.
Control Improvements	Installation of additional automated control and monitoring points.	Suggested Action: Investigate the installation of monitoring stations with automated/remote controls at key points within the system.
Management Improvements	Most of the easy gains in scheme operation have been made. The Water Race Management Plan provides an improved framework for managing the schemes.	Suggested Action: Fully implement the Water Race Management Plan as soon as possible.

3.10 Photos of Main Assets

Photo 1: Intake gate, control building and fish screen

Photo 2: Inlet Weir

Photo 3: Control Gate

Photo 4: Sediment Pond 1

Photo 5: Sediment Pond 2

3.11 Risk Assessment

A risk assessment has been undertaken for the Paparua scheme. The key output from the risk assessment is the identification of any extreme and high risks which need to mitigated. In order to mitigate these risks they have been included and budgeted for in the projects within this LTP. Table 3-6 details the risk priority rating and Table 3-7 outlines the risks for this scheme.

Table 3-6 Risk Priority Rating

Risk Score	Level of Risk	Risk Response
> 50	Extreme	Awareness of the event to be reported to Council. Urgent action to eliminate / mitigate / manage the risk. Document risk and action in the AMP.
35-50	Very High	Risk to be eliminated / mitigated / managed through normal business planning processes with responsibility assigned.
14-35	High	Manage risk using routine procedures.
3.5-14	Moderate	Monitor the risk.
< 3.5	Low	Awareness of the event to be reported to Council. Immediate action required to eliminate / mitigate / manage the risk. Document risk and action in the AMP.

Table 3-7 Risks – Paparua

Risk	Action/Project	Year Identified	2014 Risk Rating	2017 Risk Rating	Residual Risk Rating
Collapse of old tunnels Kowai	Condition inspection of water race tunnels	2014	10	3.5	3.5
Public Health and Safety risks at intakes	Health and Safety improvements	2014	10	10	10
Sink holes are developing	Develop standard soak hole repair procedures	2014	9	9	9
Siphons are a risk	Condition inspection of water race siphons	2014	12	12	10
Public Health and Safety risks at intakes	Health and Safety improvements	2014	10	10	7
Siphons are a risk	Condition inspection of water race siphons	2014	12	12	10
Non-consented activities	Renewal of consents	2014	27	27	6
Collapse of old tunnels Waimak	Tunnel repairs	2017		20	10

The list of district wide risks can be found in 5Waters Activity Management Plan: Volume 1.

3.12 Asset Valuation Details

The total replacement value of assets within the Paparua Scheme is $21,372,756 with further details in Table 3-8 below. The majority of value, 93%, is made up of channels.

Table 3-8 Replacement Value, Paparua

Asset Class 1	Asset Class 2	Sum of Replacement Value
Plant and Equipment		$56,872
Water Race Reticulation	Channel	$19,963,580
	Divide	$588,247
	Gate	$49,977
	Inlet-Outlet-Point	$665,462
	Instruments	$11,296
	Structure	$37,322

Channels are broken down into open channels: culverts, lateral, locals, mains, siphons and culverts. Main races are have a larger cross sectional area in comparison to locals and laterals. Replacement values for these different types of channels are shown in Figure 3-6 below.

Figure 3-6 Replacement Costs for Paparua Channels

3.13 Renewals

The renewal profile has been taken from the 2017 5 Waters Valuation. A graph showing the renewals for this scheme are shown by Figure 3-7 below. The majority of assets requiring renewal are culverts which occur in the period 2019-2023.

The open race channels are taken as having infinite lives (renewal by maintenance) and therefore renewals are not budgeted for these assets types.

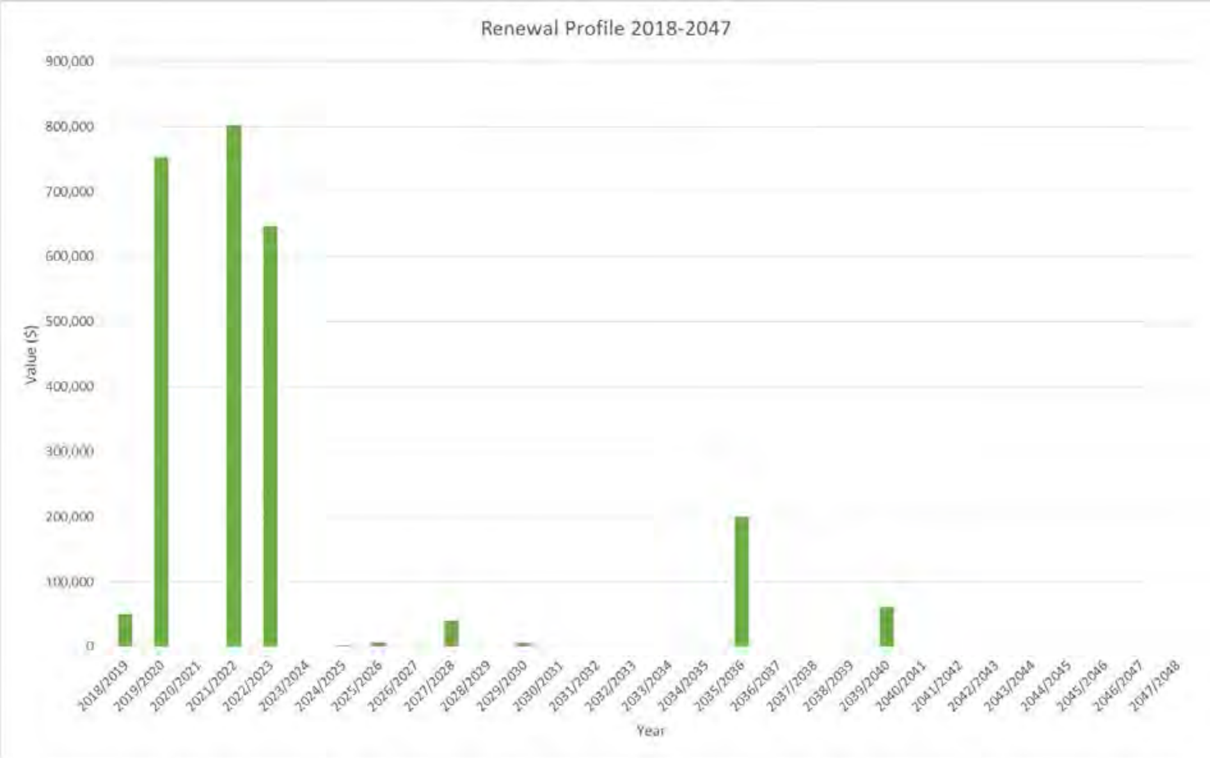

Figure 3-7 Paparua Water Race Renewal Profile

There are many aging structures within the water race network these include gates, intake structures, tunnels, siphons, aqueducts and culverts. These assets are near the end of their life and will require increased funding moving into the future.

3.14 Critical Assets

The criticality model for Paparua has been updated for the 2018 AcMP. The methodology of the criticality model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the criticality has been calculated for the reticulation assets. Table 3-9 and Figure 3-8 below shows the level of criticality for all of the assets within this scheme that have a recorded known length.

Table 3-9 Length of Assets per Criticality Level

Criticality Bands		Length (m)
5	Low	336,483
4	Medium-Low	102,946
3	Medium	5,645
2	Medium-High	11
1	High	0

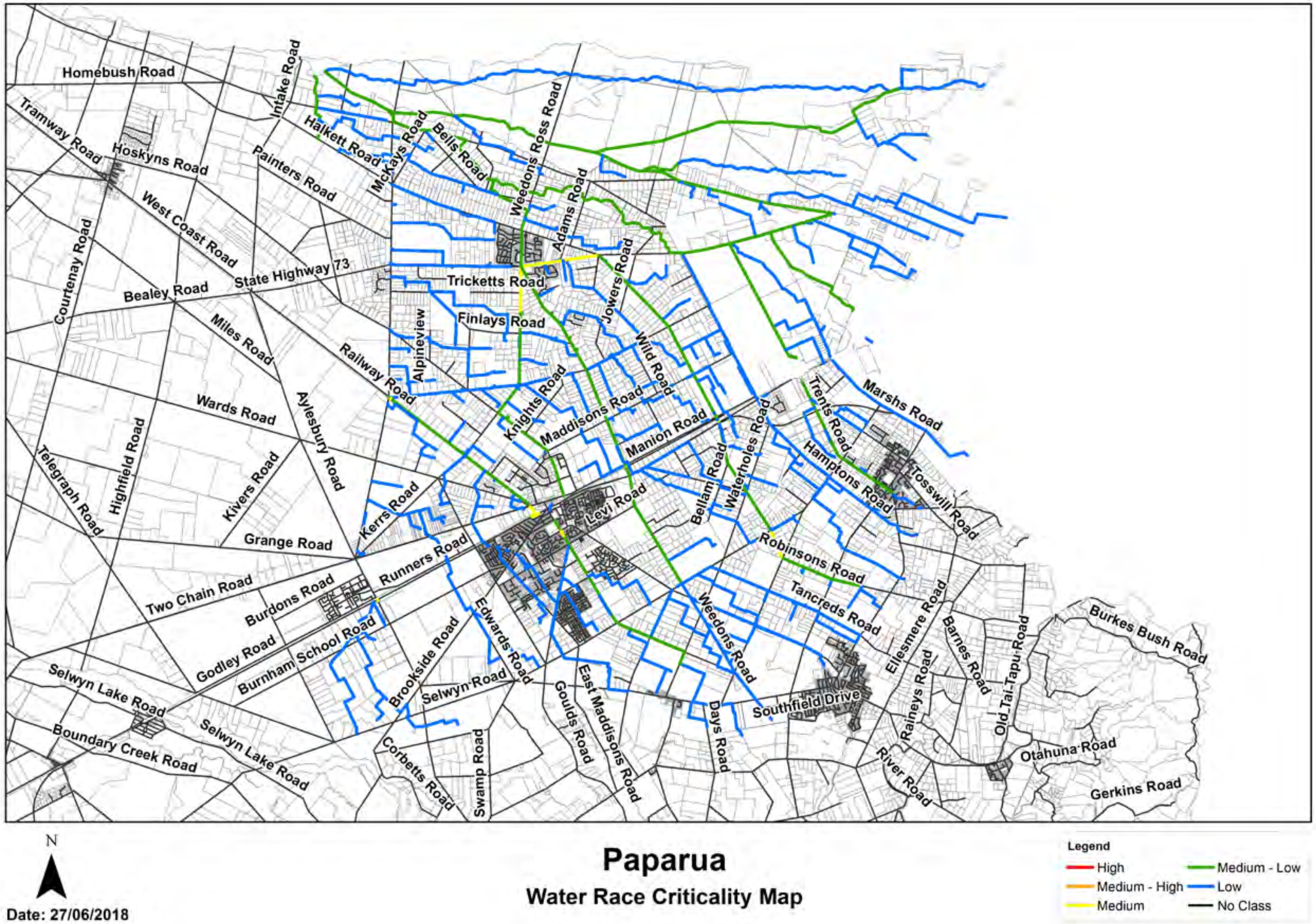

Figure 3-8 –Criticality Map

3.15 Asset Condition

The asset condition model was run for Paparua in 2017. The methodology of the model can be found in 5Waters Activity Management Plan: Volume 1 and it provides details of how the model has been calculated for the reticulation assets (particularly pipes). Figure 3-9 below shows the level of asset condition for all of the assets within this scheme that have a recorded known condition.

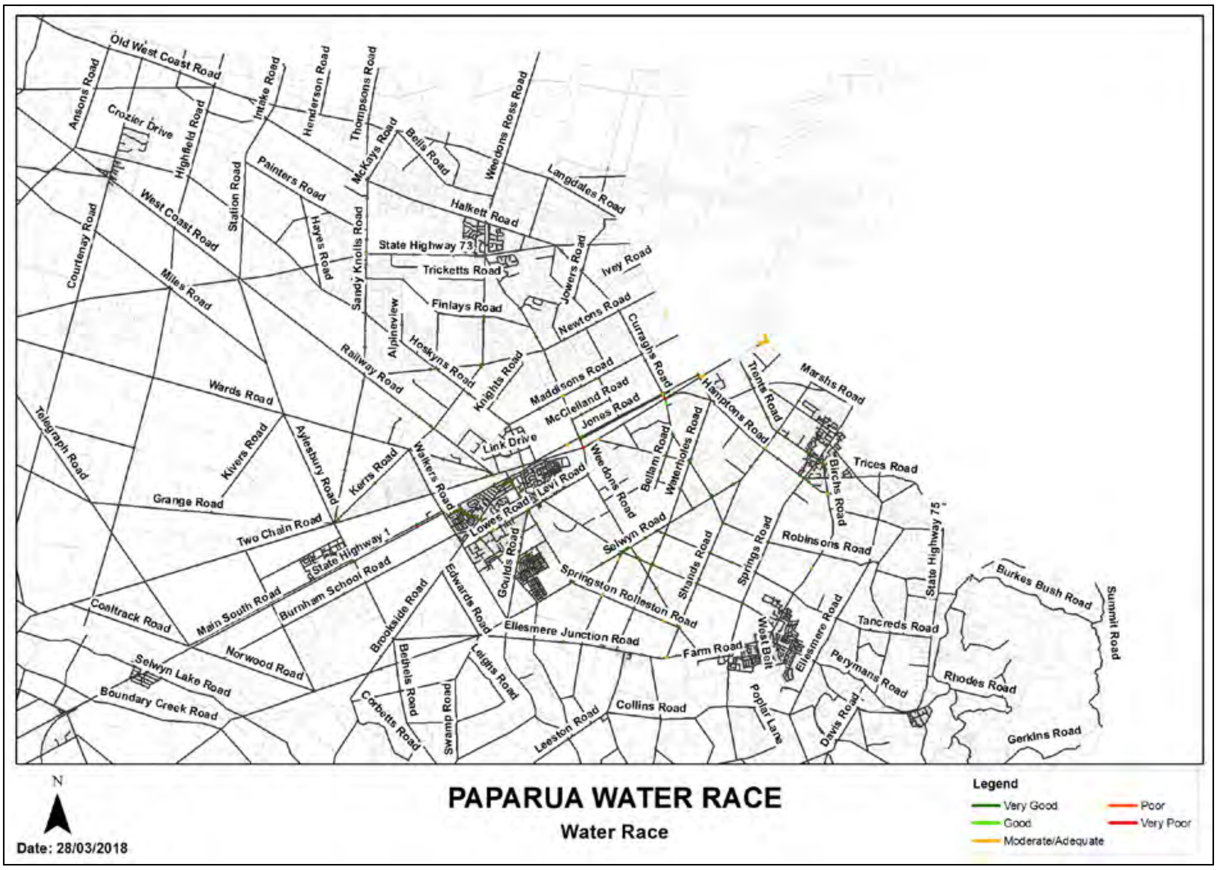

Figure 3-9 Asset Condition - Paparua

Table 3-10 provides a description of the condition rating used within the condition model.

Table 3-10 Asset Condition Grading

Condition Rating	Grading
1.0	Excellent
2.0	Good
3.0	Moderate
4.0	Poor
5.0+	Fail

3.16 Funding Program

The 10 year budgets for Paparua are shown by Table 3-11 and Figure 3-10. Budgets are split into expenditure, renewals, projects and capital projects.

All figures are ($) not adjusted for CPI "inflation". They are calculated on historical data, and population growth where relevant.

Table 3-11 Paparua Budget Summary

Years	Expenditure	Renewals	Projects	Capital Projects
2018/2019	$887,600	$50,000		
2019/2020	$877,600	$753,176		
2020/2021	$867,600			
2021/2022	$867,600	$801,731		
2022/2023	$857,600	$647,557		
2023/2024	$857,600			
2024/2025	$857,600	$1,668		
2025/2026	$857,600	$6,774		
2026/2027	$857,600			
2027/2028	$857,600	$40,913		
Total	$8,646,000	$2,301,820		

An explanation of the categories within the budgets are as follows below:

- Expenditure consists of operation and maintenance costs;
- Renewals are replacement of assets which are nearing or exceeded their useful life;
- Projects are investigations, decisions and planning activities which exclude capital works; and
- Capital projects are activities involving physical works.

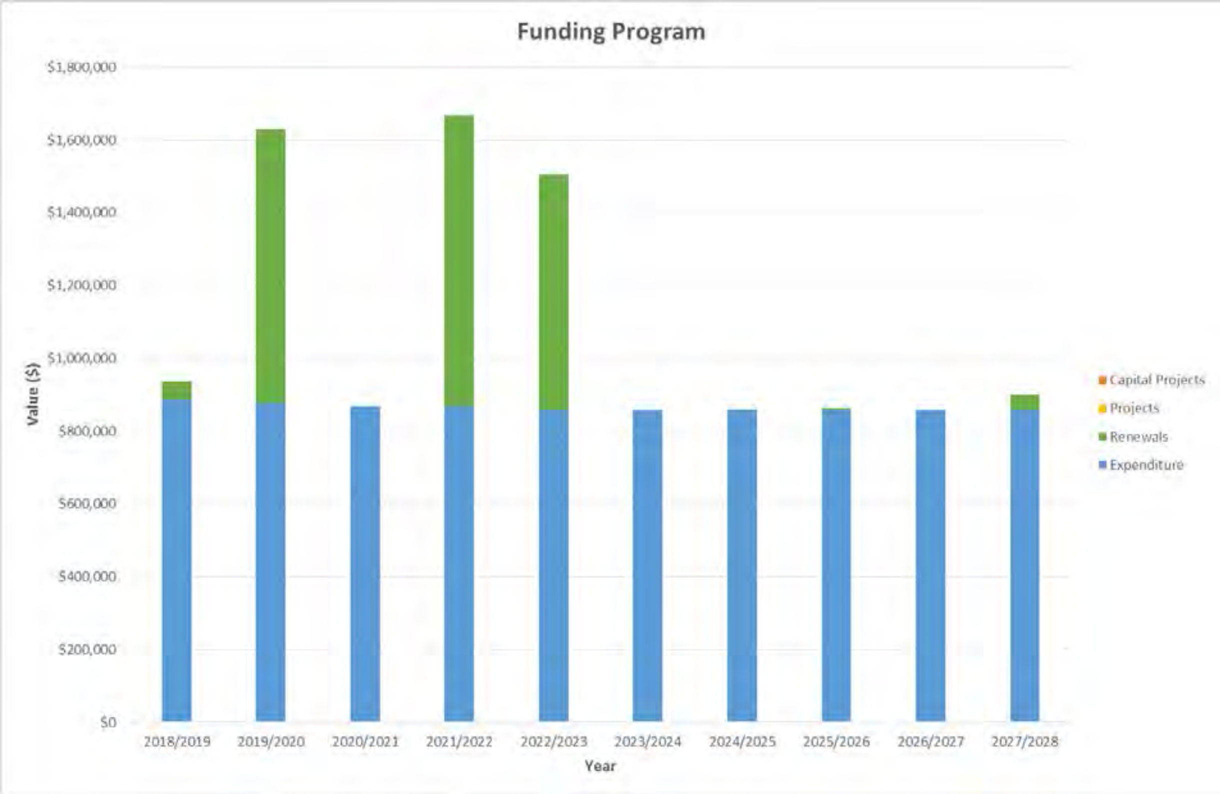

Figure 3-10 Paparua Funding Summary

There are no major projects for Paparua water races in the LTP budget. It is important to note that there may be a number of closures of water races within the coming years.

The list of district wide projects can be found in 5Waters Activity Management Plan: Volume 1.