

THE BBC COMES TO CARDRONA – MAKING THE CASE FOR WASTEWATER AND WATER SUPPLY

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ABSTRACT

The village of Cardrona is located on the Crown Range / Cardrona Valley Road, with Queenstown to the south-west and Wanaka to the north-east. Cardrona currently has a permanent population of approximately 60 residents and a peak population that occurs during wintertime. However, the population is predicted to increase dramatically over the next 20 years as the area is experiencing growth.

Due to the absence of any publicly owned utilities serving the area, developers have so far been providing their own wastewater and water supply systems.

In recent years Cardrona has experienced two Norovirus outbreaks, thought to be caused by sewage contamination of drinking water. This reignited discussion regarding the need for a community wastewater system controlled by Queenstown Lakes District Council (QLDC). Previous engineering reports had failed to gain traction, so this project was given a fresh look as part of QLDC's Long Term Plan 2015-25.

NZ Treasury's National Infrastructure Unit (NIU) launched the 'Better Business Cases' (BBC) approach as a way to enable better informed decisions on public investments and to achieve the government's infrastructure objectives by 2030.

To show leadership in this area, QLDC sought early adoption of the BBC approach in revisiting this project.

KEYWORDS

Better Business Case approach, Cardrona, wastewater, water supply

1 INTRODUCTION

The village of Cardrona is located on the Crown Range / Cardrona Valley Road, with Queenstown to the south-west and Wanaka to the north-east. Cardrona currently has a small permanent population of approximately 60 residents, however, the population is predicted to increase dramatically over the next 20 years as the area is presently experiencing growth. A number of significant developments have been completed, have gained consent or are awaiting consent. The peak population occurs, and will continue to occur, during the winter period due to the nearby Cardrona ski fields and other winter activities that are provided in this picturesque location.

Due to the absence of any publicly owned utilities serving the area, developers have been providing their own wastewater and water supply schemes to serve their individual developments. At present there are three privately owned wastewater treatment plants in the village, plus a number of septic tank systems serving smaller properties and two privately owned water supply schemes with numerous individual household supplies.

1.1 EXISTING WASTEWATER TREATMENT PLANTS

The largest of Cardrona's wastewater systems is located at the Benbrae site, the second largest at the Phoenix 47 (Baxter 2009 Ltd) site, and there is a smaller plant that serves the Cardrona Hotel.

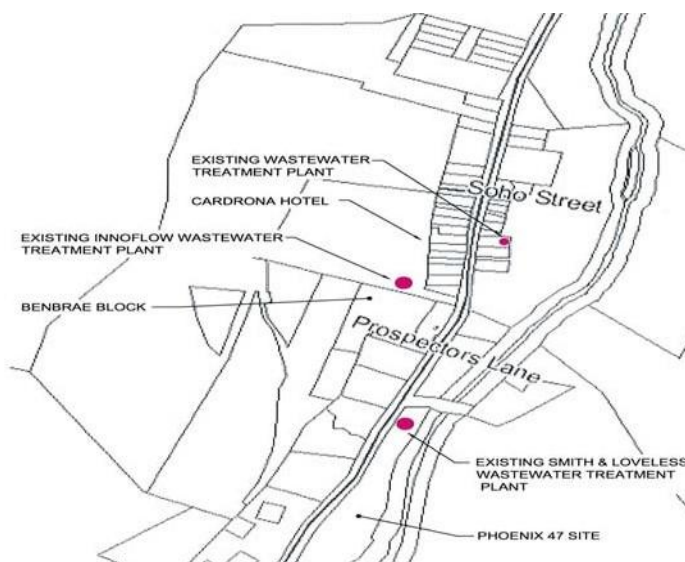
The Benbrae site, located on the western side of the Cardrona Valley Road, has an existing 'Innoflow' packaged treatment plant system. This system, installed in 2007, consists of a re-circulating textile packed bed reactor

(rtPBR) along with a sub-surface ‘drip irrigation’ field to disperse treated effluent to land above the Benbrae development. Land Discharge Consent (No.2005:423_V1) allows for up to 54m³/day of treated effluent to be dispersed of here. Owned and operated by a private utilities company, this treatment system currently accepts up to 40m³/day from the Benbrae development and, due to its modular design, this plant could be expanded to accept greater incoming flows.

The Phoenix 47 (Baxter 2009) site, located at the southern end of the village, has a Smith & Loveless ‘FAST’ (Fixed Activated Sludge Treatment) reactor treatment plant, which was installed in 2004. The aerated fixed-film bioreactor plant discharges treated effluent into dispersal trenches. The existing dispersal field currently has capacity for 20m³/day, but the treatment plant has the capacity to accept in excess of 30m³/day. Land Discharge Consent (No.2003.923) currently allows for dispersal of up to 20m³/day. The Smith & Loveless treatment plant and dispersal field can both be expanded to accept greater incoming flows.

The historic Cardrona Hotel (Complex Cardona Ltd) presently has a land discharge consent which allows for up to 12m³/day. The exact treatment and dispersal details are not fully known, but the consent conditions require the system to be a secondary aerobic treatment system (either a reticulating sand filter or a single pass intermittent sand filter). The effluent is then to be pumped into two dispersal trenches (minimum 31 metres long, 700mm wide and 2.6m deep) under the car park on the eastern side site of Cardrona Valley Road, opposite the Cardrona Hotel.

Figure 1: Plan of the existing Wastewater Treatment Plants



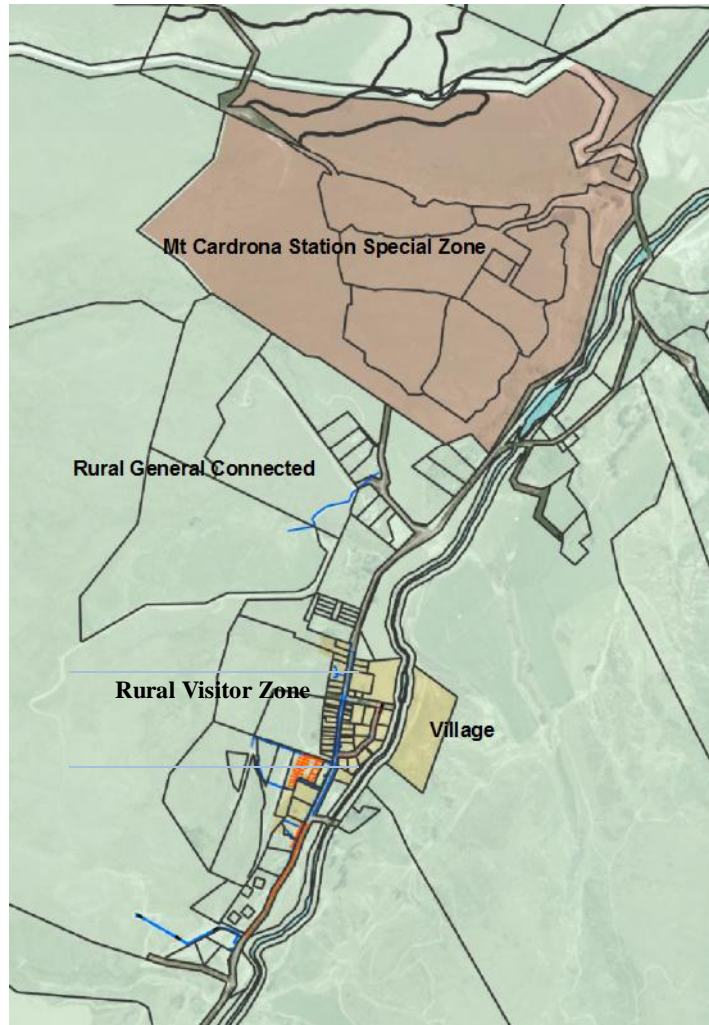
1.2 FUTURE DEVELOPMENT

The provision of a Cardrona village wastewater system is considered to be an essential part of the development of the village and to meet QLDC’s and residents’ concerns for the environmental and/or health protection of the community and downstream affected parties.

In addition to the existing development, consents have also been granted or are pending for a number of further developments that will significantly increase the village’s wastewater flows (Appendix C).

The majority of the village is located within the Rural Visitor Zone (RVZ) which has no specified density controls, therefore significant levels of further development could occur if sufficient demand is generated in the future.

Figure 2: Layout Plan



As a result of the proposed expansion to this area, QLDC and the community have identified that either a public or community wastewater system would be preferable to the continuing creation of a number of private systems; therefore a strategy for the community's wastewater requirements needs to be developed.

Various reports have been prepared over the last eight years to consider potential land dispersal locations and to determine the wastewater treatment and dispersal options that may be used effectively for the community.

These reports were undertaken when construction of the Mount Cardrona Station (MCS) Wastewater Treatment Plant was considered to be imminent and to be undertaken either prior to or concurrently with the development of the Mount Cardrona Station Special Zone (MCSSZ) and prior to any major development within the village. Subsequent events have delayed the development of the MCSSZ and consequently the construction of the wastewater treatment plant. Therefore, construction of the wastewater treatment facility was put on hold.

1.3 THE STRATEGIC ASSESSMENT

While development within the village is continuing, and with the potential to connect Cardrona Alpine Resort to a wastewater scheme, the pressure on QLDC to provide suitable infrastructure was growing.

The provision of a wastewater treatment scheme to serve the Cardrona village is therefore being considered by QLDC in order to meet the demands of the village, both in terms of further development and to meet the environmental concerns of residents.

Pressure to act also came following an outbreak of acute gastroenteritis at Cardrona in Aug/Sep 2012 involving 53 recognised cases. Two water supplies were found to contain the same Norovirus strain as that detected in

faecal specimens from cases. Environmental sampling found evidence of Norovirus in the surface discharge from at least one wastewater system and also in the Cardrona River downstream of the village. There is evidence that contamination from sewerage has been occurring for some time. There was also a large outbreak in 2006 at the Cardrona Alpine Resort, also caused by Norovirus contamination of the water supply.

In July 2013 a proposal was presented to QLDC to develop a reticulated wastewater system for the Cardrona Valley. This proposal included construction of the Cardrona Valley Pipeline (CVP) into Wanaka. The CVP would be capable of conveying wastewater from Cardrona village, adjacent ski resorts and other significant proposed developments. Wastewater from Cardrona Valley would be treated at the Wanaka Wastewater Treatment Plant (Project Pure). The Cardrona valley would be included as part of the Wanaka wastewater scheme.

Two years later, the following key factors have made it necessary to reconsider whether or not a wastewater pipeline to Wanaka is the best solution for Cardrona.

- i. Private schemes being offered to QLDC for purchase.
- ii. Reduced flow projections being forecast for Cardrona.
- iii. Significant design risks around the Cardrona Valley Pipeline solution.

2 DISCUSSION

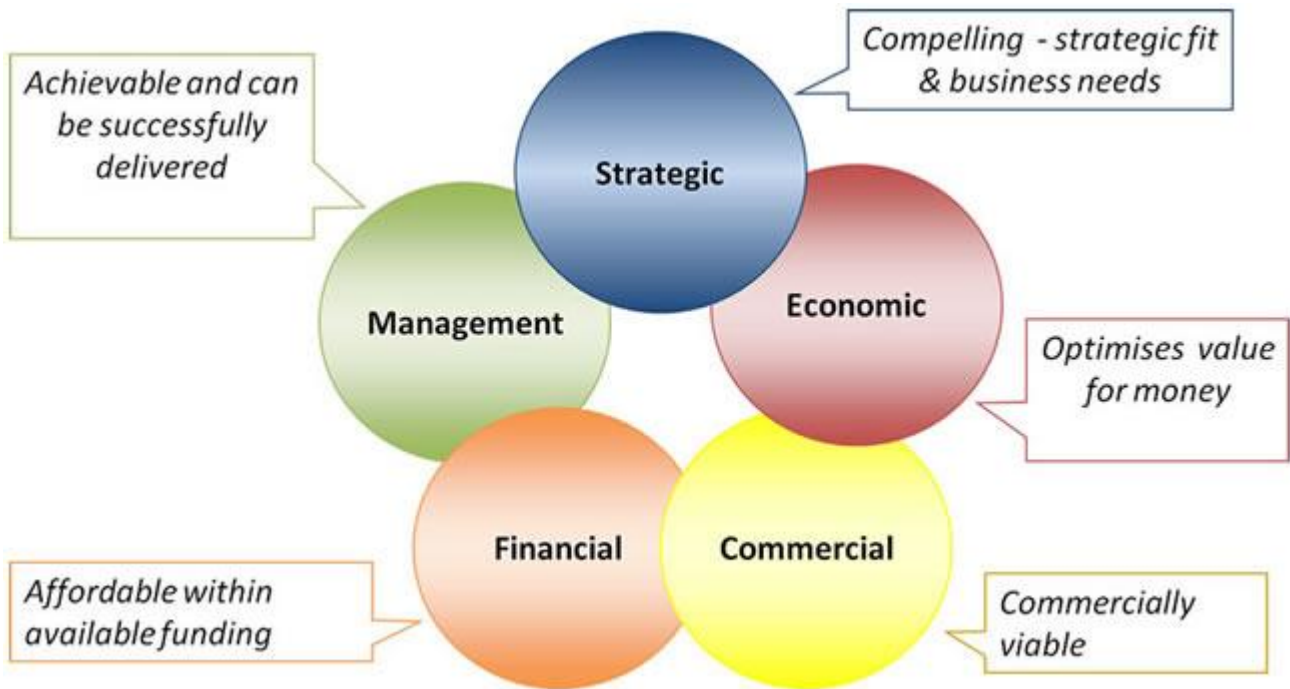
As mentioned above Cardrona has been the subject of various engineering reports investigating infrastructure options for the township. However, they have all stumbled to get across the line and secure investment. These investments have stalled for a number of reasons including lack of alignment, not being solution-focussed, being too big/ambitious, not being 'owned' by investors and not engaging with stakeholders – in other words, because the investment would 'fail to achieve expected benefits'.

By using the Better Business Case (BBC) process and its supporting principles, it was hoped that this time would be different and that an investment in Cardrona's infrastructure could finally get across the line. The BBC supporting principles emphasise that:

- there are **no surprises** because of early, planned and staged engagements with key stakeholders
- stakeholders pursue a **campaign to deliver benefits** not a compliance document to get the money
- there is a commitment to **early and sustained thinking** not a fast track to writing
- there is evidence of **fit-for-purpose analysis** around the decision being sought.

The BBC process is based around 'The Five Case Model' which is the best practice standard recommended by the UK's HM Treasury and adopted by NZ Treasury. It is a systematic and disciplined model for thinking based around five key questions that aim to give decision-makers the information they require to justify investment.

Figure 3: The Five Case Model



2.1 PLANNING AND SCOPING

Although the official BBC scoping document was not used, the general principles were followed around right sizing the capacity/capability of the team, right sizing the effort, and right sizing the engagement. It was identified to the team early on that the following key challenges lay ahead of them:

1. Reviewing the demand projections.
2. Assessing the risks around the existing preferred option.
3. Managing the perception that too much time and money was being wasted on reports.

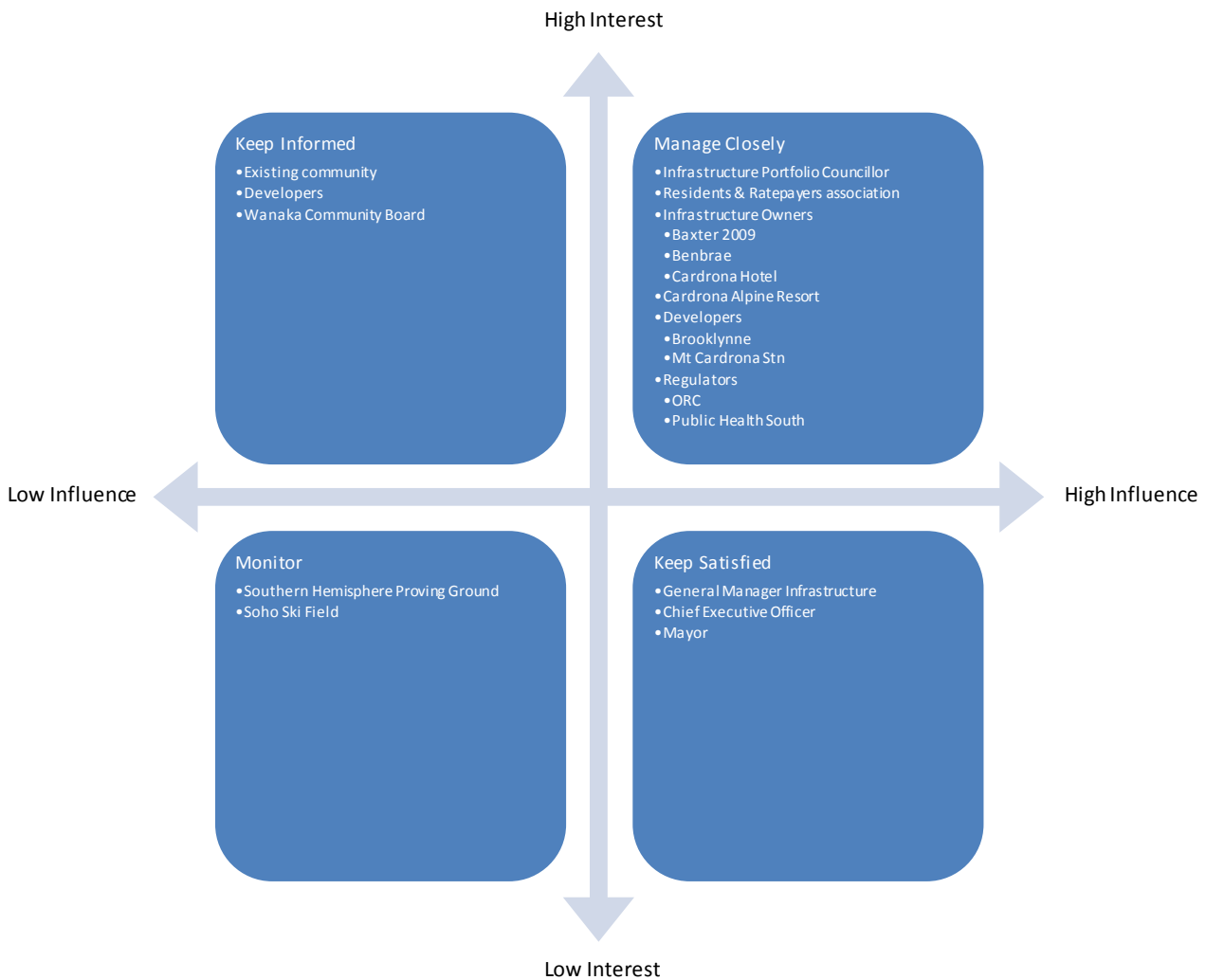
Deference to the third point resulted in some short cuts around the BBC process being attempted, however these were met with limited success. In the end, it was found that taking key stakeholders 'on the journey' resulted in a more comprehensive understanding and a better consensus was reached. The costs for this were accepted.

With this being the first project trialled at QLDC through the BBC framework, and the fact that it was a legacy project with plenty of historical reports, it was difficult to determine from the outset which business case type to use. The end product is based around the 'single stage light business case' but has been labelled as an indicative business case as there is further work required to confirm the preferred option.

2.1.1 KEY STAKEHOLDERS

One of the first steps in the BBC process is to identify and engage with your key stakeholders. The following matrix was used to do this.

Figure 4: Key Stakeholders



Four workshops were arranged in order to engage with key stakeholders. The first two workshops involved internal stakeholders only. The problems, benefits and objectives were defined in Workshop 1, and then short-listed options were selected from a long-list in Workshop 2. This ‘straw man’ was then taken through an external workshop to test our assumptions and conclusions (Workshop 3). A final external workshop was held to present and debate the economic assessment of the short-listed options and get buy-in to a preferred option (Workshop 4).

Splitting the workshops in this manner gave the team opportunity to fully understand the problem, as well as how to use the BBC tools effectively, before involving the key external stakeholders. This meant that when the meeting with the key external stakeholders took place, the team worked more efficiently and had sufficient time to debate the key sticking points.

2.2 THE STRATEGIC CASE – MAKING THE CASE FOR CHANGE

Is the proposed investment supported by a compelling case for change?

This project started with a thorough review of existing reports on the infrastructure issues facing Cardrona. While reviewing these reports it was our goal to confirm the strategic context for the investment and build up a robust case for change.

2.2.1 STRATEGIC CONTEXT

Previous reports were predominantly solution-focused and had very little information on how the proposed investment would help to achieve QLDC’s community outcomes, strategic objectives and plans. There was also

limited linkage to QLDC’s core statutory responsibilities under the Health Act 1956 and Local Government Act 2002.

Further research was undertaken and the important pieces were pulled together and summarised to help ensure the investment proposal was well aligned when addressing the following key issues:

1. The current ad-hoc nature of development has caused significant risk to public health.
2. There is the potential for significant growth in Cardrona.
3. Addressing these factors poses a significant affordability issue for the Cardrona community.

2.2.2 THE NEED FOR INVESTMENT

All parties seemed in agreement that there was a clear need for investment in Cardrona, but again previous reports had not clearly documented the problem or the evidence of the problem. This evidence has now been documented along with clear problem statements (cause and effect) and investment objectives. The agreed problems statements and investment objectives are:

Table 1: Problem statements and investment objectives

Problem statements	Investment Objectives
Water contamination linked to Norovirus outbreak	To have zero illness attributable to a communal water supply by 2016.
	To have zero illness attributable to a communal wastewater scheme by 2017.
Wastewater treatment plants are failing and needing resource consent renewal which is requiring greater investment.	To ensure all properties have access to a legal wastewater treatment and disposal system by 2020.
A lack of 3-Water infrastructure is restricting growth.	To ensure no development, that is permitted under current zoning, is inhibited by a lack of 3-waters infrastructure from 2017.

These investment objectives were developed with internal stakeholders, including an elected representative, and then agreed with key external stakeholders in a workshop.

Initially, attempts were made to move forward with generic objectives such as ‘to enable development’, but this was found to be problematic when evaluating options. By generating SMART (specific, measurable, achievable, relevant, time-bound) objectives, it was found that the definition and evaluation of options was much clearer and easier for all stakeholders to follow and understand.

2.2.3 THE CASE FOR CHANGE

To help build a more compelling case for investment the investment objectives were expanded to define the existing arrangements, business needs, scope, benefits, risks, constraints and dependencies.

Table 2: Investment Objective 1

Objective 1	To have zero illness attributable to a communal water supply by 2016.
Existing arrangements	Two private bores located in the centre of the village. The main community supply has a new chlorine dosing pump and UV unit installed. The UV unit is not an accredited system with the NZDWS.
Business Needs	A secure water supply source and treatment solution that significantly reduces the risk of future outbreaks.
Scope	A core requirement is to improve the existing treatment and management to comply with NZDWS. A more desirable solution would include finding a more secure water supply source.
Benefits	Residents, visitors and businesses will benefit from reduced illness meaning less days off sick and less loss of revenue. Reputation as a tourist destination will be maintained.
Risks	Not reaching agreement on the management of the water supply schemes. Ongoing contamination from the disposal of wastewater in the village. Not being able to transfer an existing water take to a new location and/or entity. Not finding a new secure water supply source.
Constraints & dependencies	Existing water takes are currently over-allocated in the Cardrona Valley. Success is greatly improved if wastewater disposal ceases in and around the village.

Table 3: Investment Objective 2

Objective 2	To have zero illness attributable to a communal wastewater scheme by 2017.
Existing arrangements	Three private treatment plants and disposal fields located in and around the village. Baxter2009 is acting as a community supply. The remainder of the village are operating on septic tanks. Cardrona Alpine Resort is keen to get their wastewater off the mountain.
Business Needs	Wastewater disposal that does not pose a significant risk to public health.
Scope	A core requirement is to improve the existing treatment and disposal systems. A more desirable solution would include consolidating the number of plants and disposal fields and locating these away from any potable water takes.
Benefits	Residents, visitors and businesses will benefit from reduced illness meaning less days off sick and less loss of revenue. Reputation as a tourist destination will be maintained.
Risks	Not reaching agreement on the management of the wastewater schemes. ORC may impose stringent discharge standards. Community objection to location of treatment plants. Not finding acceptable funding arrangements.
Constraints & dependencies	Success is greatly improved if potable water takes are moved upstream of any wastewater disposal fields.

Table 4: Investment Objective 3

Objective 3	To ensure all properties have access to a legal wastewater treatment and disposal system by 2020.
Existing arrangements	The Hotel's wastewater disposal consent expires in 2016 and Baxter2009's consent expires in 2019. The remainder of the village are operating on septic tanks. Cardrona Alpine Resort currently have a 5 year consent for wastewater disposal.
Business Needs	Consented wastewater disposal system/s for the existing and future communities.
Scope	A core requirement is to service the existing community. A more desirable solution would include consolidating the number of plants and disposal fields and incorporating the wider Cardrona Valley community.
Benefits	Ratepayers will benefit by avoiding any enforcement costs imposed on them by the ORC for not complying with the ORC Water Plan. Residents, visitors, businesses and wildlife will benefit from the improved management of water quality in the Cardrona River catchment.
Risks	Not reaching agreement on the management of the wastewater schemes. ORC may impose stringent discharge standards. Community objection to location of treatment plants. Not finding acceptable funding arrangements.
Constraints & dependencies	The Hotel's consent expires in 2016 and Baxter2009's consent expires in 2019. Cardrona Alpine Resort currently have a 5 year consent for wastewater disposal.

Table 5: Investment Objective 4

Objective 4	To ensure no development, that is permitted under current zoning, is inhibited by a lack of 3-waters infrastructure from 2017.
Existing arrangements	Under current Rural Visitor Zone rules there is no minimum lot size but lack of access to a community wastewater scheme means developments are limited through having to provide wastewater treatment and disposal solutions.
Business Needs	Access to suitable 3-waters infrastructure for all residential and visitor zoned land that enables the zone to be fully developed.
Scope	A core requirement is to service the existing Rural Visitor Zone. A more desirable solution would include both the Mt Cardrona Special Zone and the Cardrona Alpine Resort.
Benefits	Ratepayers will benefit by being able to fully realise the value of their property investment.
Risks	Not reaching agreement on the management of the wastewater schemes. ORC may impose stringent discharge standards. Community objection to location of treatment plants. Not finding acceptable funding arrangements.

These tables proved to be a very useful way of communicating the case for change to the elected representatives ('the investors') in a succinct way.

2.3 ECONOMIC CASE – DETERMINING POTENTIAL VALUE FOR MONEY

Does the preferred investment option optimise value for money?

2.3.1 CRITICAL SUCCESS FACTORS

To help screen the options, five critical success factors are used. These are based around the standard five case model on which the BBC framework is built. They help to quickly drop out those options that do not align strategically, are not good value for money, are not commercially viable, and are unaffordable or unachievable.

Table 6: Critical Success Factors

Generic Critical Success Factors	Broad Description	Proposal-Specific Critical Success Factors
Strategic fit and business needs	How well the option meets the agreed investment objectives, related business needs and service requirements, and integrates with other strategies, programmes and projects.	Alignment with District Plan, 30yr Infrastructure Strategy & Regional Plans.
Potential value for money	How well the option optimises value for money (i.e. the optimal mix of potential benefits, costs and risks).	Right solution, right time at the right price.
Supplier capacity and capability	How well the option matches the ability of potential suppliers to deliver the required services, and is likely to result in a sustainable arrangement that optimises value for money.	Is it a sustainable arrangement (external).
Potential affordability	How well the option can be met from likely available funding, and matches other funding constraints.	Are there no funding constraints.
Potential achievability	How well the option is likely to be delivered given the organisations ability to respond to the changes required, and matches the level of available skills required for successful delivery.	Ability and skills to deliver (internal).

2.3.2 IDENTIFY SHORT-LISTED OPTIONS

To undertake a full and robust options assessment, the long-list options assessment framework was adopted. This framework allowed the key stakeholders to work through hundreds of potential options and combinations of options to ascertain the favoured short-listed options for detailed analysis.

Table 7: Long list options generation

Dimension	Description	Options within each Dimension
Scale, scope and location	<i>In relation to the proposal, what levels of service (supply) and coverage (user) are possible? For example, by levels of functionality, geographic coverage, population/user base, etc.</i>	<ul style="list-style-type: none"> • <i>status quo</i>....Do nothing • Wastewater only • Water supply only • Wastewater and water supply
	<i>Scale and location</i>	<ul style="list-style-type: none"> • <i>status quo</i>....Existing communal schemes only • Rural Visitor Zone only • Current "Village" • Village + Mt Cardrona Stn (MCS) • Village + Cardrona Alpine Resort (CAR) • Village + MCS + CAR

Service solution	<i>How can services be provided? For example, alternative processes, mixes of enablers, etc.</i>	<ul style="list-style-type: none"> • <i>status quo</i>...Do nothing • Assist in management of existing schemes • Purchase existing schemes • Build new local infrastructure • Send wastewater to Wanaka
Service delivery	<i>Who can help us to deliver the services? Eg in-house or out-sourced or alternative partnering arrangements.</i>	<ul style="list-style-type: none"> • In-house design • Out-sourced design • Alliancing / partnership design
Implementation	<i>When can services be delivered? Including choices about the pace of change. Eg big bang, phased, modular.</i>	<ul style="list-style-type: none"> • Deferred • Just in time (just too late) • Phased • Now, big bang
Funding	<i>How can it be funded? Including choices of funders and possible arrangements. For example, capital or operating, privately or Crown funded, user charging.</i>	<ul style="list-style-type: none"> • Targeted • Ward based • 3rd Party

Based on the initial assessment of the long-list options (by dimension), the following short-listed options were selected for further economic analysis:

- Option 0: Status quo or do nothing (retained as a baseline comparator).
- Option 1: Do minimum - Purchase an existing wastewater scheme to service the Rural Visitor Zone only.
- Option 2: Less Ambitious - Purchase existing wastewater and water supply schemes to service the Cardrona Village.
- Option 3: Intermediate – New WWTP and new water supply source and treatment to service the Cardrona Village and Mt Cardrona Station.
- Option 4: More Ambitious – Cardrona Valley Pipeline and new water supply source and treatment to service the Cardrona Village, Mt Cardrona Station and Cardrona Alpine Resort.

At the key stakeholder workshops it was evident that there was a desire for an immediate solution as well as a longer term solution. This resulted in a number of hybrid options being investigated, with the following option being considered for inclusion:

- Option 5: Hybrid – Cardrona Valley Pipeline, with purchase of existing schemes in the interim.

A summary of the long-list options assessment can be found in Appendix A.

This framework was instrumental in demonstrating that all options were being considered, which resulted in good buy-in from our key stakeholders. It also gave the team confidence that, if questioned down the track by other parties/individuals, there would be clear records of a robust and easily demonstrated process for assessing all options.

2.3.3 ECONOMIC ANALYSIS

Cost benefit analysis was used for the assessment of the short-listed options. A community perspective was applied, rather than just focusing on council costs, so that the full impact on residents and ratepayers could be assessed over the agreed 30 year analysis period.

The following benefits were identified and included in the analysis:

- Capital and operating costs avoided from the status quo (do nothing). These included significant costs for connecting to existing infrastructure or building new infrastructure (i.e. capital costs of \$12M are assumed in the do nothing option to enable development).
- The uplift in property values once the infrastructure barriers to development are removed is included as a key benefit in the analysis. This is estimated at \$25/m².
- The lost revenue from sick days is considered in the analysis.
- The residual value of long life assets is considered as a benefit in the analysis.

To make the analysis easier to follow, and to give better visibility of the individual options, the wastewater and water supply options have been separated out in the economic analysis. This helped to give everyone confidence that each component was the right decision on its own.

Table 8: Wastewater Options Cost Benefit Analysis

Wastewater Options	0	1	2	3a	3b	4	5
Description	Do Nothing	Baxter2009	SBR	SBR at MCS	SBR at MCS	CVP	Baxter/CVP
Appraisal period (years)	30	30	30	30	30	30	30
Capital costs (\$m)	12.0	1.0	7.1	8.5	10.6	9.8	10.8
Whole of Life Costs (\$m)	27.8	2.6	7.7	18.1	23.0	12.4	13.4
Cost-Benefit Analysis of (monetary benefits and costs at the Public Sector Discount Rate)							
Net Present Value of Benefits (\$m)	0.0	0.9	12.5	11.5	16.2	17.3	17.0
Net Present Costs (\$m)	14.7	1.6	7.5	11.0	13.8	10.2	9.5
Benefit Cost Ratio	0.0	0.6	1.7	1.0	1.2	1.7	1.8
Net Present Value (NPV, \$m)	-14.7	-0.6	5.0	0.5	2.5	7.0	7.5
Multi-criteria Analysis (ranking of non-monetary benefits and costs, if any)							
Objective 1	Partial	Partial	Partial	Yes	Yes	Yes	Partial
Objective 2	Partial	Partial	Yes	Yes	Yes	Yes	Yes
Objective 3	No	Partial	Partial	Yes	Yes	Yes	Yes
Objective 4	No	Partial	Partial	Yes	Yes	Yes	Yes
Costs per DE (Capex+Opex, \$k/DE)		21.8	25.1	16.3	11.3	9.8	10.7
Preferred Option:							Preferred

Table 9: Water Supply Options Cost Benefit Analysis

Water Supply Options	0	1	2	3
Description	Do Nothing	Purchase Village Supply	New Headwork's	Headwork's + Trunkmain
Appraisal period (years)	30	30	30	30
Capital costs (\$m)	1.6	0.4	1.1	1.5
Whole of Life Costs (\$m)	10.0	1.1	2.6	3.0
Cost-Benefit Analysis of (monetary benefits and costs at the Public Sector Discount Rate)				
Net Present Value of Benefits (\$m)	0.0	1.7	2.0	2.0
Net Present Costs (\$m)	3.8	1.0	1.7	2.0
Benefit Cost Ratio	0.0	1.6	1.2	1.0
Net Present Value (NPV, \$m)	-3.8	0.6	0.3	0.0

Multi-criteria Analysis (ranking of non-monetary benefits and costs, if any)				
<i>Objective 1</i>	Partial	Partial	Yes	Yes
<i>Objective 2</i>	Partial	Partial	Partial	Partial
<i>Objective 3</i>	N/A	N/A	N/A	N/A
<i>Objective 4</i>	No	Partial	Partial	Partial
Costs per DE (Capex+Opex, \$k/DE)		0.8	2.0	2.6
Preferred Option:		Preferred		

Many stakeholders had little understanding of the concept of net present value (NPV), therefore this was converted to a cost per dwelling equivalent, which showed the benefits of economies of scale and backed up the preferred option based on the NPV. This gave stakeholders the confidence that the NPV was identifying the preferred option.

2.3.4 THE PREFERRED OPTION

The identified preferred option involved a staged approach with the first phase including the purchase of one of the local wastewater treatment plants and disposal field along with the village water supply. This ensures that immediate action is taken to address the public health risks and remove barriers to development by improving management and enabling additional connections.

This will give QLDC and the community more time to develop and assess the second phase of the project. The preferred option for the second phase includes fully reticulating the village by gravity down to Mt Cardrona Station and pumping the wastewater from there to the Wanaka wastewater scheme, some 21.5km away.

By following a clear process to arrive at this preferred option, all stakeholders were satisfied that their needs had been considered and were reassured that progress was being made. It also gave the safety of a fall-back position should phase two of the project not get across the line.

2.4 COMMERCIAL CASE – PREPARING FOR THE POTENTIAL DEAL

Is the proposed deal commercially viable?

At this stage the commercial case has only been touched on lightly, with the key focus being on identifying the key procurement steps required. These include:

1. Negotiating sale and purchase agreements with Baxter 2009 Ltd and Cardrona Water Supply Ltd.
2. Engaging QLDC's 3 Waters operations and maintenance contractor to run these schemes once purchased.
3. Engaging professional services providers to deliver the following:
 - a. Establish investment requirements to bring existing schemes up to QLDC standards.
 - b. Concept design for the preferred solution. This includes both reticulation of the village and the Cardrona Valley Pipeline.
 - c. Legal agreements for land access issues.
 - d. Private developer agreements with Mt Cardrona Station and the Cardrona Alpine Resort need to be drawn up to agree funding and delivery options for the preferred solution.
 - e. Detailed design of the final solution.

There are significant risks around the preferred option of a 21.5km pipeline to Wanaka and further work has been identified to assess how these risks can be best apportioned between the parties involved.

2.5 FINANCIAL CASE – ASCERTAINING AFFORDABILITY AND FUNDING REQUIREMENTS

Is the proposed spend affordable?

At this stage, the financial case has simply identified the preferred funding options available to QLDC and given a worst case funding scenario to help assess affordability.

The proposed funding arrangements are:

- To offer residents/ratepayers the choice between a lump sum contribution and a targeted rate for their contribution to the new scheme.
- Annual rates would also be payable to cover the operating, interest, depreciation and overhead costs.
- Future development (additional demand) would be charged a development contribution.

The financial analysis model and the associated methodology is preliminary and is only intended to indicate the potential funding implications. It has not allowed for any lump sum contributions or future development contributions to help offset the interest costs, other than an initial contribution from Cardrona Alpine Resort.

The financial analysis of the preferred option demonstrates that it is affordable but is very close to the assumed limits of affordability. A capital contribution of less than \$10k per dwelling equivalent is considered affordable. The estimated annual costs though are high at nearly \$2,800 per dwelling equivalent, assuming 100% debt funding.

The following opportunities have been identified to help make the solution more affordable:

- To share costs with the wider Wanaka ward.
- Defer the funding of depreciation until the initial scheme loans are repaid.
- Ensure the additional capacity provided for growth is funded by those that utilise that capacity.

It will therefore be necessary to take the final funding proposal to the community for an indication of support.

2.6 MANAGEMENT CASE – PLANNING FOR SUCCESSFUL DELIVERY

How can the proposal be delivered successfully?

At this time, the management case has focused on putting together the right team to deliver the project along with the timeline and gateways the project will need to pass through to ensure successful delivery.

Two elements are seen as key to successful delivery – the first of these is the role of the project sponsor. The Infrastructure Portfolio Councillor has been tasked with this role. It is critical to maintain continued engagement with the key stakeholders as should this engagement stall, the project will once again risk failure. The key stakeholders are ultimately the parties that will be asked to invest in the project.

The second key element is following a structured gateway process so that support is reconfirmed at each gateway before the decision to proceed is given. This should ensure that ‘wasted’ expenditure is avoided on progressing a solution that doesn’t have the support of investors.

3 CONCLUSIONS

The key observation made as a result of implementing the BBC process was that the focus on key stakeholder engagement meant everyone was well informed throughout the process and had opportunities to contribute

throughout. This was evidenced by the fact that there was no opposition to QLDC adopting the preferred solution. Other key learnings and observations are listed below:

- By taking key stakeholders ‘on the journey’, a better consensus was reached and the concern around further spending on investigating issues that had already been investigated in the past was accepted.
- Holding internal stakeholder workshops first meant that when the meeting with the key external stakeholders took place, the team worked more efficiently and had sufficient time to debate the key sticking points.
- By generating SMART (specific, measureable, achievable, relevant, time-bound) objectives it was found that the definition and evaluation of options was much clearer and easier for all stakeholders to follow and understand
- The case for change tables proved to be a very useful way of communicating to the elected representatives (‘the investors’) in a succinct way.
- The critical success factors helped to quickly drop out those options that did not align strategically, were not good value for money, were not commercially viable, and were unaffordable or unachievable.
- The long-list options assessment framework was instrumental in getting good buy-in from our key stakeholders that all options were being considered. It also gave us confidence that if we were questioned down the track by other parties/individuals we had a robust and easily demonstrated process for assessing all options.
- Even though many stakeholders had little understanding of net present value (NPV) by converting the costs to a cost per dwelling equivalent basis it showed the benefits of economies of scale and backed up the preferred option based on the NPV. This gave stakeholders the confidence that the NPV was identifying the preferred option.

The BBC process definitely helped us to arrive at a preferred option that all stakeholders were satisfied with. They had the security of knowing that we were making progress and yet still had the safety of a fall-back position should phase two of the project not get across the line. Affordability is going to be the key hurdle for this project and ongoing engagement will be critical to the ultimate success of this project.

REFERENCES

Aireys Ltd, 2012. *Wastewater Treatment Options to Serve Cardrona Village*, s.l.: s.n.

Harrison Grierson Ltd, 2015. *Cardrona Water and Wastewater Servicing Options*, s.l.: s.n.

Rationale Ltd, 2015. *Cardrona Indicative Business Case - Wastewater and Water Supply Servicing Options*, s.l.: s.n.

APPENDIX A

Cardrona Servicing Options Long-list Options Assessment																													
Description of Option:	Scope Options (What)										Service Solution Options (How)								Service Delivery Options (Who)			Implementation Options (When)				Funding Options			
	Activity				Scale / Location						Water supply				Wastewater				SD-1			SD-2				FU-1		FU-2	
	SC-1	SC-2	SC-3	SC-4	SC-5	SC-6	SC-7	SC-8	SC-9	SC-10	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SD-1	SD-2	SD-3	IM-1	IM-2	IM-3	IM-4	FU-1	FU-2		
	Status Quo - Do Nothing	Water supply only	Wastewater only	Water supply & wastewater	Rural Visitor Zone only	Existing communal schemes only	Current "Village"	Village + M Cardrona Stn (MCS)	Village + Cardrona Alpine Resort (CAR)	Village + MCS + CAR	Assist in water supply management	Purchase water supply scheme/s	Purchase scheme/s + new water supply source	New water supply source and treatment	Assist in wastewater management	Purchase wastewater scheme/s	New wastewater treatment plant (WWTP)	Cardrona Valley Pipeline	In-house Design	Out-sourced Design	Alliancing / partnership Design	Deferred	Just in time (just too late)	Phased	Now, big bang	Targeted	Ward based	3rd party	
Investment Objectives																													
To have zero illness attributable to a communal water supply by 2016.	Partial ⁴	Yes	Partial ⁴	Yes	Partial ⁴	Yes	Yes	Yes	Yes	Yes	Partial ⁴	Partial ⁴	Yes	Yes	Partial ⁴	Partial ⁴	Partial ⁴	Partial ⁴	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Partial ¹⁰	
To have zero illness attributable to a communal wastewater scheme by 2017.	Partial ⁴	Partial ⁴	Yes	Yes	Partial ⁴	Yes	Yes	Yes	Yes	Yes	Partial ⁴	Partial ⁴	Partial ⁴	Partial ⁴	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Partial ¹⁰	
To ensure all properties have access to a legal wastewater treatment and disposal system by 2020.	No ¹	No ¹	Yes	Yes	Partial ⁴	Partial ⁴	Partial ⁴	Yes	Partial ⁴	Yes	No ¹	No ¹	No ¹	No ¹	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Partial ¹⁰	
To ensure no development, that is permitted under current zoning, is inhibited by a lack of 3-water infrastructure from 2017.	No ²	No ²	Partial ⁴	Yes	Partial ⁴	No ²	Partial ⁴	Yes	Partial ⁴	Yes	No ²	Partial ⁴	Yes	Yes	No ²	Partial ⁴	Yes	Yes	Yes	Yes	No ²	Partial	Partial	Yes	Yes	Yes	Yes	Partial ¹⁰	
Critical Success Factors (as these CSFs are crucial (not desirable) any options that score a 'no' are automatically discounted from further analysis)																													
Strategic fit and business needs - Alignment with District Plan, 30yr Infrastructure Strategy & Regional Plans	No ¹	No ¹	Partial ⁴	Yes	Partial ⁴	No ¹	Partial ⁴	Yes	Partial ⁴	Yes	No ¹	Partial ⁴	Yes	Yes	No ¹	Partial ⁴	Partial ⁴	Yes		Yes	Partial	No ¹	Yes	Yes	Partial ⁴	Yes	Partial	No ¹⁰	
Potential value for money - right solution, right time at the right price			Partial	Partial	Partial		Partial	Partial	Partial	Partial		Partial	Partial	Partial		Partial	Partial	Partial		Partial	Yes		Partial	Partial	Partial	Partial	Yes		
Supplier capacity and capability - is it a sustainable arrangement (external)			Yes	Yes	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Partial ²		Yes	Partial		Yes	Yes	Yes	Yes	Yes		
Potential affordability - are there no funding constraints			Partial	Partial	Partial		Partial	Partial	Partial	Partial		Yes	Partial	Partial		Yes	Partial	Partial		Partial	Yes		Partial	Yes	Partial	Partial	Yes		
Potential achievability - ability and skills to deliver (internal)			Partial	Partial	Yes		Yes	Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes	No	Yes	Partial		Yes	Yes	Yes	Yes	Yes		
Summary of Advantages and Disadvantages:																													
Overall Assessment:	Continued for VFM	Discount	Possible	Preferred	Possible	Discount	Possible	Preferred	Possible	Preferred	Discount	Possible	Possible	Preferred	Discount	Possible	Preferred ²	Preferred ⁴	Discount	Preferred	Possible	Discount	Possible	Preferred	Possible	Possible	Preferred	Discount	
Short-listed options:																													
Do Nothing	Status Quo - Do Nothing										Status Quo - Do Nothing								Status Quo - Do Nothing			Status Quo - Do Nothing							
Baxter2009	Wastewater - Rural Visitor Zone only										Purchase wastewater scheme/s								Out-sourced Design			Just in time (just too late)				Targeted			
Baxter2009/Benbrae and SBR	Water supply & wastewater - Village										Purchase water supply scheme/s & Purchase wastewater scheme/s								Out-sourced Design			Phased				Targeted			
SBR at Mt Cardrona Station	Water supply & wastewater - Village + MCS										New water supply source and treatment & New WWTP								Out-sourced Design			Phased				Targeted			
Cardrona Valley Pipeline	Water supply & wastewater - Village + MCS + CAR										New water supply source and treatment & Cardrona Valley Pipeline								Alliancing / partnership Design			Now, big bang				Ward based			
Notes																													
1. Baxter 2009 services more than one development. Council is best placed to co-ordinate these consent renewals, therefore this objective is not guaranteed.											1. Baxter 2009 services more than one development. Council is best placed to co-ordinate these consent renewals, therefore this objective is not guaranteed.											1. Baxter 2009 services more than one development. Council is best placed to co-ordinate these consent renewals, therefore this objective is not guaranteed.							
2. Development is currently restricted in the RVZ by a lack of 3-water infrastructure (particularly wastewater), therefore this option will not deliver on this objective.											2. Development is currently restricted in the RVZ by a lack of 3-water infrastructure (particularly wastewater), therefore this option will not deliver on this objective.											2. Development is currently restricted in the RVZ by a lack of 3-water infrastructure (particularly wastewater), therefore this option will not deliver on this objective.							
3. Since development is being restricted by a lack of 3-water infrastructure this option is not delivering on the following objectives and enabling the current district plan zonings.											3. Since development is being restricted by a lack of 3-water infrastructure this option is not delivering on the following objectives and enabling the current district plan zonings.											3. Since development is being restricted by a lack of 3-water infrastructure this option is not delivering on the following objectives and enabling the current district plan zonings.							
Cardrona 2020 (2003) - To provide for the cost-effective reticulation of water and sewerage as the population increases and this becomes more economically viable.											Cardrona 2020 (2003) - To provide for the cost-effective reticulation of water and sewerage as the population increases and this becomes more economically viable.											Cardrona 2020 (2003) - To provide for the cost-effective reticulation of water and sewerage as the population increases and this becomes more economically viable.							
Growth Management Strategy (2007) - Infrastructure is provided in a way that supports high quality development located in the right places while adhering to the principles of sustainable development and ensuring that the environmental qualities of the district are protected.											Growth Management Strategy (2007) - Infrastructure is provided in a way that supports high quality development located in the right places while adhering to the principles of sustainable development and ensuring that the environmental qualities of the district are protected.											Growth Management Strategy (2007) - Infrastructure is provided in a way that supports high quality development located in the right places while adhering to the principles of sustainable development and ensuring that the environmental qualities of the district are protected.							
3 Waters Strategy (2011) - We will manage risk and be able to adapt to a variety of future scenarios for climate change and population growth.											3 Waters Strategy (2011) - We will manage risk and be able to adapt to a variety of future scenarios for climate change and population growth.											3 Waters Strategy (2011) - We will manage risk and be able to adapt to a variety of future scenarios for climate change and population growth.							
4. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved.											4. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved.											4. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved.							
5. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved. Especially with regard to enabling the M Cardrona Station zone.											5. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved. Especially with regard to enabling the M Cardrona Station zone.											5. This objective/CSF may be achieved under this option but council will have limited influence to ensure that it is achieved. Especially with regard to enabling the M Cardrona Station zone.							
6. At this stage it is difficult to separate these options due to the strategic advantages of the CVP being off-set by its design risk.											6. At this stage it is difficult to separate these options due to the strategic advantages of the CVP being off-set by its design risk.											6. At this stage it is difficult to separate these options due to the strategic advantages of the CVP being off-set by its design risk.							
7. There is a real risk that designers will be reluctant to take on the design risk associated with this option.											7. There is a real risk that designers will be reluctant to take on the design risk associated with this option.											7. There is a real risk that designers will be reluctant to take on the design risk associated with this option.							
8. By purchasing the schemes council can ensure spare capacity is made available to enable development. The quantum of spare capacity however is unknown.											8. By purchasing the schemes council can ensure spare capacity is made available to enable development. The quantum of spare capacity however is unknown.											8. By purchasing the schemes council can ensure spare capacity is made available to enable development. The quantum of spare capacity however is unknown.							
9. Big bang does not align with the current 3-waters strategy regarding flexibility and ability to adapt to future scenarios, i.e. no growth.											9. Big bang does not align with the current 3-waters strategy regarding flexibility and ability to adapt to future scenarios, i.e. no growth.											9. Big bang does not align with the current 3-waters strategy regarding flexibility and ability to adapt to future scenarios, i.e. no growth.							
10. By not having complete control council can not guarantee objectives will be met.											10. By not having complete control council can not guarantee objectives will be met.											10. By not having complete control council can not guarantee objectives will be met.							
11. Due to several different parties potentially being involved it would be against current funding policy to leave this to a 3rd Party.											11. Due to several different parties potentially being involved it would be against current funding policy to leave this to a 3rd Party.											11. Due to several different parties potentially being involved it would be against current funding policy to leave this to a 3rd Party.							

APPENDIX B

Cardrona Wastewater and Water Supply Servicing Options

Strategic Case: Investment Objectives and Case for Change	
Objective 1:	To have zero illness attributable to a communal water supply by 2016.
Existing arrangements	Two private bores located in the centre of village. Main community supply has a new chlorine dosing pump and UV unit installed. The UV unit is not an accredited system with the NZDWS.
Business Needs	A secure water supply source and treatment solution that significantly reduces the risk of future outbreaks.
Scope	A core requirement is to improve the existing treatment and management to comply with NZDWS. A more desirable solution would also include finding a more secure water supply source.
Objective 2:	To have zero illness attributable to a communal wastewater scheme by 2020.
Existing arrangements	Three private treatment plants and disposal fields located in and around the village. Baxter2009 is acting as a community supply. The remainder of the village are operating on septic tanks. Cardrona Alpine Resort is keen to get their wastewater off the mountain.
Business Needs	Wastewater disposal that does not pose a significant risk to public health.
Scope	A core requirement is to improve the existing treatment and disposal systems. A more desirable solution would include consolidating the number of plants and disposal fields and locating these away from any potable water takes.
Objective 3:	To ensure all properties have access to a legal wastewater treatment and disposal system by 2020.
Existing arrangements	The Hotel's consent expires in 2016 and Baxter2009's consent expires in 2019. The remainder of the village are operating on septic tanks. Cardrona Alpine Resort currently have a 5 year consent for wastewater disposal.
Business Needs	Consented wastewater disposal systems for existing/future communities.
Scope	A core requirement is to service the existing community. A more desirable solution would include consolidating the number of plants and disposal fields and incorporating the wider Cardrona Valley
Objective 4:	To ensure no development, that is permitted under current zoning, is inhibited by a lack of 3-water infrastructure from 2017.
Existing arrangements	Under current Rural Visitor Zone rules there is no minimum lot size but lack of access to a community wastewater scheme means developments are limited through having to provide wastewater treatment and disposal solutions.
Business needs	Access to suitable 3-waters infrastructure for all residential and visitor zoned land that enables the zone to be fully developed.
Scope	A core requirement is to service the existing Rural Visitor Zone. A more desirable solution would include both the Mt Cardrona Special Zone and the Cardrona Alpine Resort.

Need to Invest

- There was an outbreak of acute gastroenteritis at Cardrona late in Aug/Sep 2012 involving 53 recognised cases.
 - Two water supplies were found to contain the same *Norovirus* strain as that detected in faecal specimens from cases.
 - Environmental sampling found evidence of *Norovirus* in the surface discharge from at least one wastewater system and also the Cardrona River downstream of the village.
 - There is evidence that the contamination from sewerage has been occurring for some time.
 - There was a large outbreak in 2006 at the Cardrona Alpine Resort, also caused by *Norovirus* contamination of the water supply.

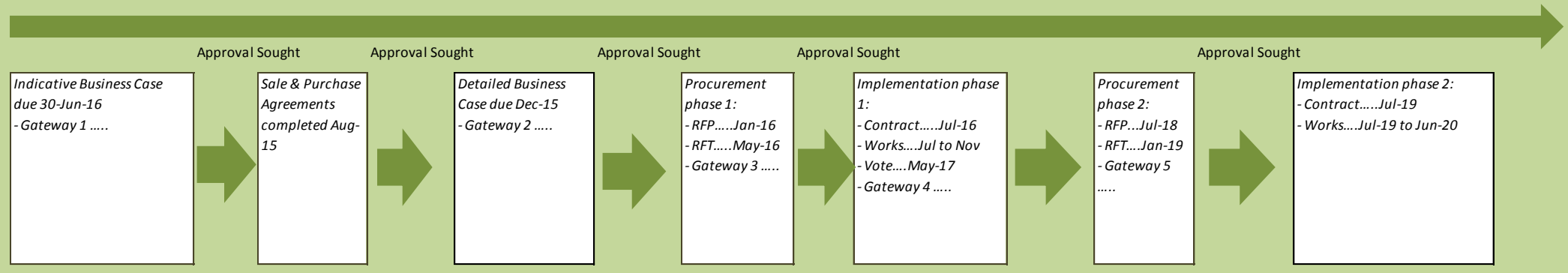
Strategic Context

Health Act 1956 - to improve, promote, and protect public health within its district. To cause all proper steps to be taken to secure the abatement of any nuisance, or any conditions likely to be injurious to health.
 LGA 2002 - assess, from a public health perspective, the adequacy of water and other sanitary services available to communities. Growth Management Strategy (2007) - Infrastructure is provided in a way that supports high quality development located in the right places while adhering to the principles of sustainable development and ensuring that the environmental qualities of the district are protected.
 Cardrona 2020 (2003) - To provide cost-effective reticulation of water and sewerage as the population increases and this becomes more economically viable.

Economic Case: Determine Potential Value for Money							
Wastewater Options	0	1	2	3a	3b	4	5
Description	Do Nothing	Baxter2009	SBR	SBR at MCS	SBR at MCS	CVP	Baxter/CVP
Appraisal period (years)	30	30	30	30	30	30	30
Capital costs (\$m)	12.0	1.0	7.1	8.5	10.6	9.8	10.8
Whole of Life Costs (\$m)	27.8	2.6	7.7	18.1	23.0	12.4	13.4
Cost-Benefit Analysis of (monetary benefits and costs at the Public Sector Discount Rate)							
Net Present Value of Benefits (\$m)	0.0	0.9	12.5	11.5	16.2	17.3	17.0
Net Present Costs (\$m)	14.7	1.6	7.5	11.0	13.8	10.2	9.5
Benefit Cost Ratio	0.0	0.6	1.7	1.0	1.2	1.7	1.8
Net Present Value (NPV, \$m)	-14.7	-0.6	5.0	0.5	2.5	7.0	7.5
Multi-criteria Analysis (ranking of non-monetary benefits and costs, if any)							
Objective 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Objective 2	Partial	Partial	Yes	Yes	Yes	Yes	Yes
Objective 3	No	Partial	Partial	Yes	Yes	Yes	Yes
Objective 4	No	Partial	Partial	Yes	Yes	Yes	Yes
Costs per DE (Capex+Opex, \$k/DE)		21.8	25.1	16.3	11.3	9.8	10.7
Preferred Option:							Preferred
The Preferred Option: (Wastewater Option 5 - Baxter/CVP) + (Water Supply Option 1 - Purchase Village Supply)							
Is to purchase the Baxter2009 WWTP as soon as possible and progress the development of the Cardrona Valley Pipeline ready for construction in 2019/20. It delivers on all objectives and satisfies those that wish to have immediate action but avoids the costly upgrades for as long as possible. Value for money is confirmed as it has the highest NPV and the second lowest costs per dwelling equivalent. Purchasing the village water supply will help deliver on all objectives over time (once wastewater disposal is removed from the village), satisfies those that wish to have immediate action and avoids the costly upgrades of finding a new water source.							
Water Supply Options	0	1	2	3			
Description	Do Nothing	Purchase Village Supply	New Bore Supply	Supply + Reticulation			
Whole of Life Costs (\$m)	10.0	1.1	2.6	3.0			
Net Present Value (NPV, \$m)	-3.8	0.6	0.3	0.0			
Commercial Case:							
The procurement strategy is to negotiate sale and purchase agreements with Baxter2009 and Cardrona Water Supply Limited, engage QLDC's 3-waters operations and maintenance contractor to run these schemes and use professional services providers to further develop the preferred solution.							

Financial Case: Financial Costing		
(\$000)	2016/17	Total 10yrs
Capital Expenses	\$ 1,438	\$ 11,231
Operating Expenses	\$ 106	\$ 1,135
Total Revenue	\$ -	\$ 4,600
Capital Funding Required	\$ 1,438	\$ 6,631
Operating Funding Required	\$ 284	\$ 5,905
Operating (\$/DE)	\$ 1,978	\$ 16,262
Affordability and Funding:		
The financial analysis of the preferred option demonstrates that it is affordable but is very close to the assumed limits of affordability. It will therefore be necessary to take the final funding proposal to the community for an indication of support		

Management Case:
2015



Plan for Successful Delivery:
 With the uncertainty of growth and the risk of not reaching agreement with key funding contributors, it is proposed to follow a structured gateway process to ensure the decision to proceed is carefully considered at each gateway.

APPENDIX C

Cardrona Wastewater Options, Flow Assumptions

CURRENT

	Est. Pop	Total - RVZ+RG		Rural Visitor Zone (RVZ)		Rural General (RG)	
		PDWF m3/d	Flow/capita l/c/d	Est. Pop	PDWF m3/d	Est. Pop	PDWF m3/d
Cardrona Village							
Baxter	53	13	248				
Benbrae	75	14	185				
Hotel	60	11	180				
Other	66	13	202				
	254	51	201	236	47	18	4

Flow/capita 200 l/c/d
Occupancy rate 3.5 persons/dwelling

FUTURE

New phase

		6 dwellings/year																					
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
Option 1 Village (RVZ only)	Dwelling equivalents	67	73	80	86	92	99	105	111	117	124	130	136	143	149	155	161	168	174	180	187	193	
	Population equivalents	235	257	279	301	323	345	367	389	411	433	455	477	499	521	543	565	587	609	631	653	675	
	PDWF, m ³ /d	47	51	56	60	65	69	73	78	82	87	91	95	100	104	109	113	117	122	126	131	135	
		7 dwellings/year										7 dwellings/year							7 dwellings/year				
Option 2 Village (RVZ +RG)	Dwelling equivalents	73	80	87	94	100	107	114	121	129	136	143	150	157	164	171	179	186	193	200	207	214	
	Population equivalents	256	280	304	327	351	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	
	PDWF, m ³ /d	51	56	61	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	
		25 dwellings/year															24 dwellings/year						
Option 3a Village + MCS + RG	Dwelling equivalents	96	121	146	171	196	221	246	272	297	322	347	372	397	421	446	470	494	519	543	567	591	
	Population equivalents	335	423	511	599	687	775	863	950	1038	1126	1214	1302	1390	1475	1560	1645	1730	1815	1900	1985	2070	
	PDWF, m ³ /d	67	85	102	120	137	155	173	190	208	225	243	260	278	295	312	329	346	363	380	397	414	
		6 m ³ /d/year										13 m ³ /d/year											
Option 3b & 4 Village + MCS + CAR + RG	PDWF, m ³ /d	131	137	143	149	155	161	167	172	178	184	190	196	202	215	228	241	254	267	280	293	306	
	PDWF, m ³ /d	198	222	245	269	292	316	339	363	386	410	433	457	480	510	540	570	600	630	660	690	720	