JOURNEY TO SUCCESS – RAETIHI WTP UPGRADE

S. Chung (Veolia), C. Wang (Veolia), N. de Haan (Veolia), A.M. Westcott (Ruapehu District Council)

ABSTRACT

The Raetihi township water supply was contaminated in September 2013 as a result of a diesel spill incident to the Headwaters of the Makotuku River in the Tongariro National Park. The spill occurred at the Turoa ski field which is 27 kilometres away from the intake. This resulted in the drinking water supply being interrupted for 21 days while the plant and reticulation network were cleaned and a temporary supply was installed. At the time of the incident the treatment was basic with surface water abstracted into two raw water settling ponds and a chlorination system. This incident highlighted the inadequacy of preventive measures at the existing plant for the drinking-water supply scheme.

In order to achieve DWSNZ compliance as soon as possible, Ruapehu District Council (RDC) in partnership with Veolia developed and implemented an improvement programme. This secured Capital Assistance Funding from Central Government enabling a long term solution to be implemented in a high deprivation population.

In July 2018 the upgrade to the WTP was completed. Water safety and resilience of the supply are now compliant with DWSNZ.

After completion of the upgrade, the community were invited to come together for an orientation day. Posters, group tours and a live streamed Facebook presentation, followed by an edited video were all used to communicate the upgrades to the new plant, and provide feedback to the community around works completed and security of the supply.

This paper describes the approaches that RDC and Veolia have used in upgrading the Raetihi WTP to ensure water safety, achieve DWSNZ compliance, and overcome the financial and time challenges. It also provides an overview of the upgraded WTP including its performance, and lessons learnt along the journey.

KEY WORDS

Water safety, DWSNZ compliance, water treatment, partnership, community engagement, resilience

PRESENTER PROFILE

Anne-Marie Westcott: MBA, BSc; Ruapehu District Council Environmental Manager; Principal's Representative for this project.

Chunlong Wang: CPEng, IntPE(NZ), PMP; Process Engineer, Veolia; Project Manager for this project.

1. INTRODUCTION

Each morning we wake up, turn on the tap and outflows safe drinking-water. Water governs our home rituals from boiling the kettle, flushing the toilet, to washing. The first three days without water are likened to a "camping holiday", but after a week it starts wearing thin. The weather turns cold and wet and you have to journey to the water cart and the toilet at the corner of the street, the shower block is set up 25 minutes drive away, and the family washing needs to be done. There has been no major emergency but your normality has changed. The loss of water is like a death, it creates a sense of hurt, anger and disorientation.

The Raetihi water supply was contaminated in September 2013 as a result of a diesel spill 27 kilometres away from the abstraction point. The incident occurred at the Makotuku Rivers Headwater in the World Duel Heritage Tongariro National Park polluting its entire length. Raetihi's water supply was offline for 21 days until a temporary supply was established. During this time the town was supplied tankered water.

The supply's treatment was a basic system. Gravity fed surface water was abstracted into two raw water settling ponds and then treated with a chlorination system with basic SCADA. There is now a hydrocarbon sensor that monitors raw water flow. It is alarmed and there is a valve to divert the raw water back to the stream should there be any hydrocarbon detected.

The Raetihi water supply is funded from targeted rates and charges for extraordinary users. The community deprivation index of 9.1 posed a high financial burden on local ratepayers. Ruapehu District Council (RDC), in partnership with Veolia, were successful in their application for Capital Assistance Funding from the Ministry of Health. This funding was designed to help small Councils upgrade their Water Supplies to ensure compliance with the Drinking-Water Standards for New Zealand (DWSNZ). The related works included:

a) Preparation: funding application, outline plan submission, easement negotiation;
b) Planning (peer reviewed): project delivery approach development, scope and specification development;
c) Delivery (peer reviewed): design and construction of a Water Treatment Plant (WTP) with a capacity of 70 m^3/hour and 6 log protozoa removal credits; including civil works, mechanical works, electrical and automation works, commissioning and project management.

The project outcome was realised within budget and delivered on time with zero incidents. The Plant was commissioned in July 2018, the water supply consistently complies with DWSNZ.

This paper describes the three different project delivery approaches that RDC and Veolia investigated to overcome the financial and time challenges. It details the collaborative delivery approach that was adopted and provides an overview of the work that has been undertaken. This paper then explores the realisations of the chosen delivery approach and the lessons learnt along the way of this journey to success.

2. BACKGROUND

2.1 OVERVIEW OF THE OLD WTP

The diagram and photos below exhibit the main components of the Raetihi water supply previous to 2013.

Figure 1: Main Components of Raetihi WTP 2013

2.2 THE IMPACT OF THE 2013 DIESEL SPILL

In late September 2013 Raetihi's water supply was contaminated as a result of a diesel spill on nearby Mt Ruapehu. Approximately 19,000 litres of diesel leaked from a storage tank into the surrounding environment. The spill had contaminated the Makotuku River. The incident interrupted the town's supply of safe drinking water for 21 days and left the community feeling extremely vulnerable and angry.

Photograph 1: Various Newspaper Photographs on the 2013 Diesel Spill

2.3 CHALLENGES FACED

The Raetihi community was identified as having a socioeconomic deprivation index of 9.1. The Deprivation Index with a value of 1 indicates that a population is in the 10 percent least deprived areas in New Zealand, and a value of 10 indicates that it is in the most deprived 10 percent of areas in New Zealand. The development of new water treatment infrastructure represented a large project which would require a significant financial injection.

Time was another challenge that Raetihi faced. The journey of returning community normality began with the short term solutions of a hydrocarbon sensor to safeguard the abstraction quality, and under bench filters. But a sustainable medium term solution was required. While this solution needed to be mindful of the impact the daily operation and maintenance costs would have on community affordability, the commencement of a substantial upgrade of the treatment plant could not be delayed any further.

3. PROJECT DELIVERY OPTIONS

There are various procurement approaches a Principal can choose for the delivery of an infrastructure project. The two prevailing conventional options for RDC to get the WTP upgrade project delivered are both consultancy centred. From here on they will be referred to as the 'traditional' approach and the 'DBO' (Design, Build Operate) approach.

Table 1: Comparative table - Traditional, DBO, and Collaborative Delivery

	Traditional (Design → Construct)	DBO (Design & Build & Operate)	Collaborative Delivery (Partnership)
NZ Contract	Consultancy agreement + Construction contract (e.g. CCCS + NZS3910)	Bespoke NZS3916 or NZS3916 + NZS3917	Existing operation & maintenance contract + NZS3916
Owners influence	Moderate	Low	Moderate
Contractors availability	Moderate to high	Low	High
Change management	Cost of change typically high	Cost of change typically high	Agile / flexible
Delivery time	Typically Long	Medium to long	Optimised due to iterative scheduling
Whole of life cost	Variable	Variable	Key focus
Operability	Variable	Typically high	Close involvement of operator

3.1 TRADITIONAL PROJECT DELIVERY APPROACH

The 'traditional' project delivery approach has four common steps.

Once funding is secured the Principal then engages a Consultant to prepare a design and a Request for Tender (RFT) package. Here the Consultant prepares documentation and drawings for process, mechanical, structural, electrical, civil and other required engineering services. Subcontractors providing additional services such as geotechnical survey and Assessment of Environmental Effects (AEE) are engaged. The RFT documentation is then composed and legal advice may be sought throughout preparation. Often the contract basis is NZS 3910:2013.

Upon completion, RFT's are released to the market where prospective Contractors respond. The Tender Evaluation team selects the recommended bidder and advises the decision makers, often the Tenders Team, of the Principal's organisation. The successful bidder is then contacted and the contract is negotiated and signed.

The next step in a traditional project delivery method is construction. The designed package is constructed by the contractor and various other specialist subcontractors. Throughout this stage the contractor is obligated to follow the original design. The Consultant will oversee the project here on behalf of the Principal.

When construction is complete, the Consultant will collaborate with the Contractor to commission the newly built facility.

3.1.1 LIMITATIONS OF THE TRADITIONAL PROJECT DELIVERY APPROACH

The entire process is lengthy with few opportunities to fast track activities. There is little capacity to omit or change any steps. Furthermore, any weaknesses identified within the contract or design is subject to variations on the scope. Market competition influences the number of parties who tender and price.

Construction contractors are not usually specialised in the broad range of multidisciplinary activities that are involved in a project such as a WTP upgrade. In areas where the Contractors feel less confident they will factor in a risk premium in the price.

In remote rural areas it can be difficult to acquire suitable (sub) contractors. Under-qualified subcontractors that may be available (e.g. domestic electricians) are not desirable for such a project. Qualified subcontractors are often based in urban centres and are not often willing to bid for a job that entails significant travel if they can secure work closer to home instead.

Finally, separate parties and segmented projects can produce issues surrounding ownership. The Principal will have lower control on both the design, and the operation and maintenance. With multiple work interfaces requiring robust

design specification and scope division, there is also lack of flexibility on iterative improvement throughout the project process.

3.2 DBO PROJECT DELIVERY

A DBO delivery approach is often chosen for somewhat larger projects where the Principal wants to create a vested interest of the construction party to deliver a facility that is optimised for operational efficiency.

Following funding approval, the Principal engages a Consultant to prepare a design and an RFT package. In the case of a DBO the Consultant prepares a Front End Engineering (FEED) package which is lighter than a full design and leaves considerable freedom of interpretation for the Contractor. Subcontractors providing additional services such as geotechnical survey and Assessment of Environmental Effects (AEE) are engaged to supply information outside of the Consultants skillset. The Consultant then prepares RFT documentation for which legal advice will be required.

Prior to the release to market there is often an Expression of Interest round which allows prospective contractors to pre-qualify and / or team up with one another to 'complement' each other's skillset. Upon the RFT release to market a significant response period must be taken into account which is longer than in case of a traditional delivery approach. The reason for this is the broader scope of work which requires longer to price up and respond to. The Tender Evaluation team selects the recommended bidder and advises the decision makers of the Principal's organisation. The successful bidder is then contacted and the contract is negotiated and signed.

Detail design commences using the FEED documentation. Input is provided from the operational team which allows operational optimisation of the design. Engineering documents are delivered piecemeal to the Principals and / or their Consultant for feedback and approval. Procurement of the Contractors will often be fast-tracked for elements of the design which are time sensitive.

The Consultant will oversee the project here on behalf of the Principal.

When construction is complete, commissioning of the newly built facility is often left to the DBO party with little involvement of the Consultant.

3.2.1 LIMITATIONS OF THE DBO DELIVERY APPROACH

Although there is the ability to fast-track some aspects of the project, the procurement process can be extensive, drawing out the entire operation. Utilising this delivery method enables the Principal to take a 'hands off' approach to the project. The Principal has to commit themselves to an operational contract for a number of years, but has little to do with the delivery process. If there is already an operational contract in place this can restrict the timing for DBO projects.

The DBO model requires the preparation of the Principal's Requirements to cover the design basis, scope and performance requirements. However, the workload is smaller in comparison to the involvement in the traditional delivery approach.

Whilst the DBO delivery approach can allow for a diverse range of disciplines (civil, process, electrical, automation, and coordination with existing operation contractors), the total contract value of the Raetihi WTP project is small in scale which is unattractive to the typical DBO contractors.

3.3 COLLABORATIVE DELIVERY APPROACH

RDC and Veolia have worked together since 2002 with a long-standing 3 waters delivery arrangement. Veolia operates 7 water and 8 wastewater schemes within the Ruapehu District.

The granted $1.5 million subsidy and the imposed timeline ruled out the use of a traditional delivery approach. As the existing operator Veolia understood the funding constraints and RDC's requirements.

Although the subsidy was lower than requested, Veolia believed it could be done with an additional financial injection by RDC. Veolia has an engineering team providing design, technical support, and project management services to the operation & maintenance contract. A partnership delivery approach was developed to utilise the experience of RDC, Veolia's operation & maintenance team, and Veolia's engineering team to deliver this complex engineering project.

4. REALISATIONS OF THE COLLABORATIVE DELIVERY

4.1 COLLABORATIVE DELIVERY PROCESS

4.1.1 FUNDING APPLICATION

Ministry of Health requires four reports to accompany the drinking water subsidy application: Preliminary Design, Optimisation, Water Supply Sustainability and budget. As the existing operator of the Raetihi WTP Veolia had extensive experience with its operation capacity and limitations. Combining this with RDC's local and legislative knowledge, the separate inputs were complementary in the assembly of the application.

4.1.2 DESIGN

All of the process, mechanical, electrical, control and automation designs were completed by Veolia's engineering team.

The design concepts that were considered include: status quo of gravity abstraction with either a conventional or membrane treatment; or ground water abstraction and treatment. These were reviewed with the Community and Councillors who opted for a gravity abstraction with conventional treatment having the lowest whole-of-life cost.

Veolia's engineering team had substantial knowledge of the existing infrastructure (power supply, site conditions, raw water conditions, reusable assets, process bottlenecks, etc.). It would have taken a 'new' party a considerable amount of time to gather and digest the information on the plant. Thus RDC avoided running the risk of delays or potential suboptimal design / solution with this approach.

Veolia's operations team had the greatest interest in the operability of the WTP. Their expectations and know-how were well incorporated into the Safety in Design, HAZOP, and construction activities which subsequently led to the design of an operator friendly WTP.

4.1.3 PROCUREMENT

The procurement model involved the split of the total physical delivery into five separate subcontractor packages: Geotechnical investigation; Construction of the new access road and site preparation; Civil design and construction of the WTP building, including foundations; Power supply upgrade; and Mechanical installation. The opportunity was taken to improve other aspects such as backflow prevention, new treated water falling main, and site security.

The construction of the new access road and site preparation were managed by RDC. Veolia managed the other subcontractor packages, allowing them to organize several subcontractors whilst being solely responsible for the project.

Veolia's global agreement framework was used in procuring materials (e.g. equipment, valves and instruments, etc.) and monetary savings were beneficial to RDC.

4.1.4 CONSTRUCTION

Construction of the new Raetihi WTP commenced in October 2017 and was completed in July 2018.

Excluding the five subcontracted packages, all other construction activities (e.g. electrical installation, programming, relocation of existing assets, underground pipe installation, and commissioning, etc.) were completed by Veolia's in-house teams.

Veolia had a full time construction manager supervising the construction activities, and enforcing the health & safety policies. RDC and Veolia jointly audited the health and safety performance of Contractors on a quarterly basis.

4.1.5 PEER REVIEW

RDC engaged an independent Engineer, together with an Engineer's Representative, to peer-review the design completed by Veolia, audit the installation, and witness the performance testing. This was for quality control and due diligence purposes.

A peer review was conducted in the early stages of the project and at predefined HOLD points later on. DWSNZ compliance, water safety, reliability and operability were checked by The Engineers Representative to ensure that budget and performance outcomes would be met.

The contract based on NZS 3916:2013 was checked by Morrison Low to ensure there was independence, transparency and robustness around contracting.

4.1.6 COMMUNITY ENGAGEMENT

The project team worked hard to remove the community's feeling of vulnerability and have remained transparent throughout the entire process.

The locals were informed through the release of Situation Reports during the 2013 emergency to the public. These reports were distributed through a local reporter within the community, an independent Facebook page, and using a local radio announcer to keep the locals informed. Ongoing engagement and communication throughout the design and construction period is detailed in section 4.2.1.

An orientation day was held at the new Raetihi WTP for the community to come together. This included a karakia by Uenuku kaumatua, and a tape was cut by Mayor Don Cameron with Aiden Gilbert, Chair of Ueneku Charitable Trust. The day was a great success and those who attended had the opportunity to experience their new plant and meet those involved in the build and daily operation of the new water treatment facility.

4.2 BENEFITS OF A COLLABORATIVE DELIVERY APPROACH

There were a number of areas where the collaborative approach proved beneficial for all parties.

4.2.1 EFFECTIVE COMMUNICATION

The open communication channel between Veolia and RDC in this approach built a strong platform for effective stakeholder involvement. In the planning phase of the project RDC held community and councillor meetings to discuss all the available options. Frequent communication with the local iwi, Veolia Health and Safety representatives, Community Boards and other stakeholders was facilitated throughout the project. Through this channel Veolia representatives had the ability to hear the concerns of the councillors and the community first-hand. This proved to be beneficial to Veolia's response time and accountability throughout the project.

Constant communication in this collaborative delivery also ensured that RDC – as the client – was well informed of any updates or changes made to the project in real time.

4.2.2 ENSURING VALUE FOR MONEY

The collaborative delivery approach enabled flexibility in scope changes and iterative improvements to maximise the value of ratepayers' money. This was critical for the small town's budget. The final project cost was just over $2.4 million.

4.2.3 ENSURING OPERABILITY

With the close engagement of the operations team in all stages of the delivery the plant's operability was optimised. Some of the practical features that were installed include tepid water safety shower and eyewash station including alarming, hot water shower facility, and remote access to the PLC programme for performance diagnosis.

4.3 THE NEW RAETIHI WTP

One of the principal project drivers was to achieve compliance with DWSNZ. The Raetihi WTP excels in achieving these standards. The necessary upgrade of all treatment infrastructure has also ensured that the risks of future contamination are mitigated against. The plant itself is relatively conventional with the exception of a few innovative applications:

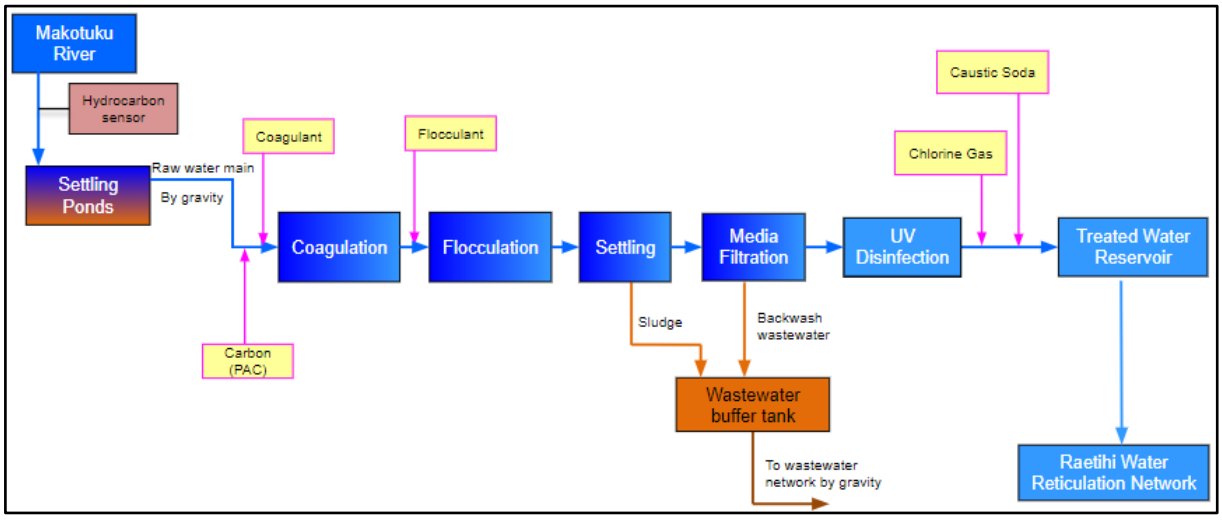
- Partially recirculating the settled sludge from the settler to the raw water inlet to improve performance for treating the 'low turbidity, low temperature, but rich in natural organic matter' water;
- A wastewater buffer tank with level monitoring and automatic outlet valve to reduce the peak load to the wastewater scheme; and
- Remote access to the PLC and SCADA server is in place so the automation & SCADA engineer can perform diagnosis and optimise programming remotely.

The upgraded Raetihi WTP processes include:

- Raw water settling (2 ponds),
- Powdered activated carbon dosing,
- Coagulation (1 static mixer),
- Flocculation (2 mechanical flocculation chambers),
- Sedimentation (1 lamella settler),
- Filtration (2 dual-media filters),
- UV disinfection (2 UV units, duty / standby),
- Chlorination (with chlorine gas), and
- Final pH correction (with caustic soda)

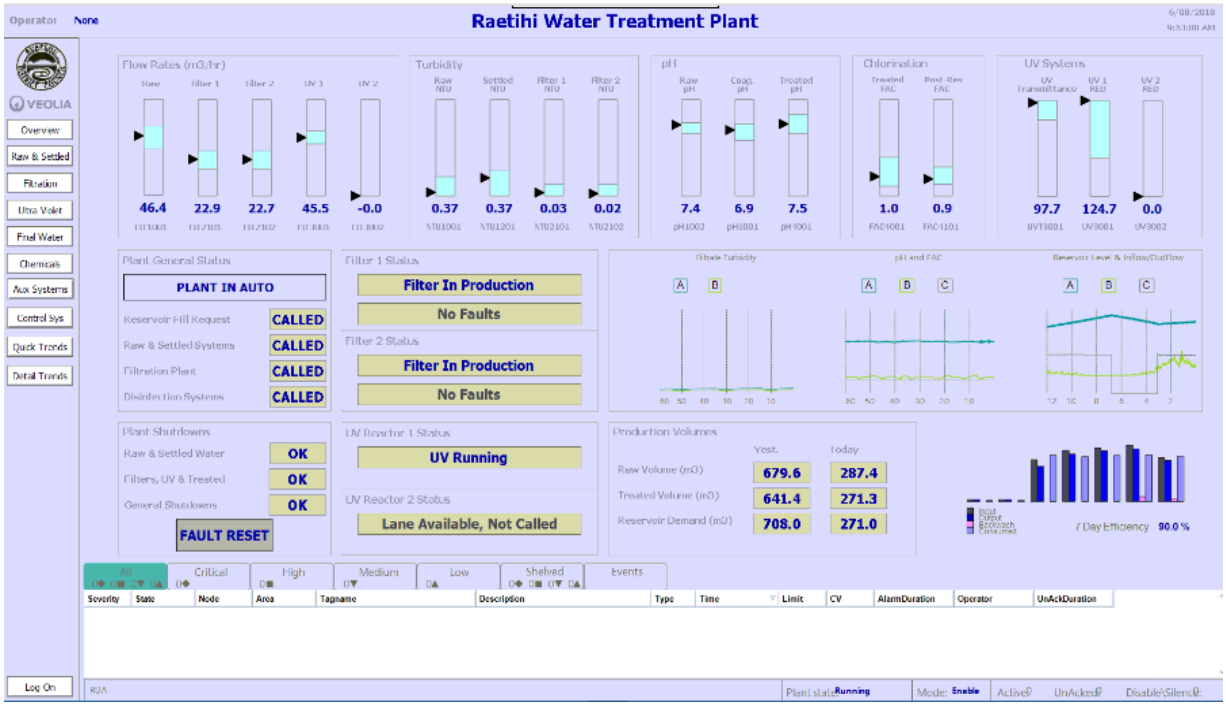
The diagram below shows the configuration of the upgraded Raetihi water supply including the new WTP.

Figure 2: Schematic of New Raetihi WTP process



The Raetihi WTP is capable of achieving 6 log credits for protozoa removal with a capacity of 70 m^3/hour. The filtered water turbidity is typically < 0.1 NTU, and UVT is > 95%. The treated water quality is now consistently compliant with DWSNZ. One of the SCADA screens is pictured below.

Figure 3: SCADA Screen for Raetihi WTP



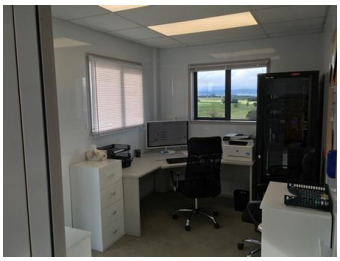
The photos below show some of the key components of the new WTP.

Photograph 2: Various Photographs of the New Raetihi WTP


Aerial View of WTP Site


WTP Main Building


Main Corridor Inside Building


Site Office & SCADA Station


Flocculator & Settler


Media Filters

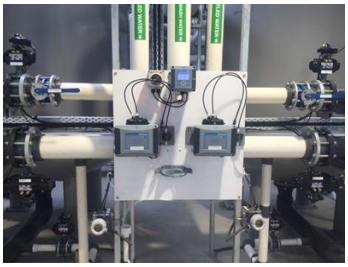

Chemical Injection Points


Chemical Systems


Wastewater Buffer Tank


Flow Meters


Instrument Board 1


Filtered Water Turbidity Meters


Motor Control Centre


VSD Station


Community Open Day

5. CONCLUSION

The diesel spill incident highlighted how difficult it was to recover from a contamination event with the existing water treatment infrastructure in Raetihi. Short term solutions, such as the hydrocarbon sensor and underbench filters, were employed to minimise the negative effects of the contamination. The entire WTP was upgraded and additional improvements were made to the supply as a medium term solution. The upgrade of these facilities posed a financial challenge to the community, but with the subsidy granted by the Ministry of Health a new WTP became more attainable.

RDC considered two conventional project delivery options for the upgrade; 'traditional' and 'DBO'; and a collaborative delivery with their longstanding WTP operators. The limitations of the conventional options were not suitable to meet the objectives of this project and thus, the collaborative delivery approach was employed.

The collaborative project delivery applied by RDC and Veolia has enabled RDC to overcome substantial financial and time challenges. The approach proved to be cost-effective, improve plant operability, enable effective communication between stakeholders, and ensure the flexibility of scope changes.

The new Raetihi WTP has been upgraded from a 3-step water filtration and processing plant to a 9-step one that now consistently achieves DWSNZ compliance. The project's outcome has exceeded the expectations of the Raetihi community and restored their trust in the drinking water process.

ACKNOWLEDGEMENTS

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