NEW WATER SCHEME IN HISTORIC AKAROA

Raelene Stewart & Philip La Roche, CH2M Beca Ltd; Colin Currie & Steve Pink, Christchurch City Council

ABSTRACT

CH2M Beca has assisted Christchurch City Council (CCC) to upgrade the water supply system in Akaroa and Takamatua to meet the Drinking Water Standards for New Zealand (DWSNZ). Although only a small community water supply, many challenges were faced during the upgrade – during both design and construction. The project illustrates how upgrading water supplies for small communities can be both costly and complex.

Akaroa is a historic township, and its cultural values are significant for the community, iwi and Heritage New Zealand. In summer Akaroa hosts regular cruise ships which can introduce up to 3,000 visitors to the town on any one day. The original water supply system comprised six raw water sources feeding to three water treatment plants. An options study in 2009 showed that centralising on a single treatment plant was the most economic long term option for the community, and best utilised the scarce water resources. A membrane treatment process was selected for the centralised plant.

This paper outlines the options, constraints and considerations that were worked through to decide a final scheme configuration and how the project team and CCC worked with stakeholders and residents to overcome the challenges that arose during construction and commissioning.

KEYWORDS

Membrane Water Treatment Plant. Drinking Water Standards

1 INTRODUCTION

Akaroa is a small township nestled in Banks Peninsula, Canterbury. The town is an area of historic and cultural significance. The permanent population is approximately 700, however in summer this can increase to around 3,700 and on scheduled cruise ship days a further 3,000 tourists can pass through the town. The water infrastructure was ageing and the town's water treatment plants were unable to meet legislative requirements. In 2009 Christchurch City Council (CCC) embarked on a project to upgrade the scheme to meet Drinking Water Standards for NZ (DWSNZ) by 1st July 2014.

The upgrade project objectives included providing compliant water treatment and supply to Akaroa and nearby Takamatua, installing a robust system with a high level of reliability and minimal operation and maintenance requirements (because of the relative remoteness of the location), and achieving community satisfaction and acceptance.

Water resources in Akaroa are limited, peak summer demands are high due to the large visitor numbers, and these periods also typically coincide with low stream flows. Water restrictions are common as a result of the water resources being unable to meet the peak summer demand, so while assessing future water sources was outside the scope of the upgrade project, the design needed to be cognisant of water availability.

The shortage of source water was just one of many constraints that needed to be addressed during the design process. Further challenges were also encountered during construction, which was completed during 2014/2015, with commissioning in early 2015. This paper describes how the scheme progressed through design and construction and what steps were taken to overcome such challenges.

2 THE DESIGN PROCESS AND CONSTRAINTS

2.1 PROJECT OBJECTIVES

At project kick-off the following objectives for the Akaroa water supply upgrade were identified;

- Upgrade water treatment to enable full compliance with DWSNZ 2005 (revised 2008).
- Make provision for future source inclusion/expansion.
- Provide redundancy against failure of key mechanical equipment.
- Provide treated water reservoir storage to cover short term outages and ensure a minimum 30 minutes chlorine contact time is provided – taking into account the large variation in peak versus average demand.
- Automation implemented to achieve typical operator attendance of 2-3 times per week with no routine weekend visits required.
- Minimise Opex/Capex.
- Consider the need for pH correction noting that most of the older reticulation is asbestos cement and cast iron, and renewals and new reticulation typically uses uPVC.

Several of these objectives were driven by the location of the project. While CCC have locally based operators, they are required to monitor, operate and troubleshoot both water and wastewater treatment plants in the wider Banks Peninsula area and so could not be expected to spend extended periods of time attending to the upgraded scheme.

Figure 1: Extent of Akaroa Water Scheme (image courtesy of Google earth)

2.2 WATER DEMAND

The first step in the process was to establish the capacity of the scheme. Review of historical water demand records showed the peak day demand for Akaroa was approximately 1,600 m³/day. As there was unlikely to be any substantial increase in the availability of source water in the short term, and the level of restrictions that were being utilised to meet the 1,600 m³/day peak demand were workable, the present day design capacity for the current Akaroa water treatment plants was set only slightly higher at 1,800 m³/day.

The Takamatua current peak demand was 220 m³/day, and this was adopted as the present day design capacity for the Takamatua plant.

CCC had identified significant leakage losses in the reticulation for both areas. Following completion of repairs, leakage losses in Akaroa were estimated at 321 m^3/day and 67 m^3/day for Takamatua. There are many asbestos cement pipes still in use, and low areas in Akaroa have high reticulation pressures up to 90 m head; these factors contribute to the high level of leakage experienced. For the purposes of future demand, it was assumed that leakage losses would be no worse than existing, on a per capita basis.

Using the historical water demand records and knowledge of leakage levels, a present day capacity of 1,800 m^3/day for Akaroa and 220 m^3/day for Takamatua was confirmed. CCC required that the upgrade be designed to accommodate 2041 population predictions. This increased the peak day demand to 2,250 m^3/day for Akaroa and 300 m^3/day for Takamatua.

2.3 WATER SUPPLIES AND EXISTING TREATMENT

Water for the scheme is supplied by three stream sources and two bores in Akaroa, and one stream source in Takamatua. All the sources are subject to existing consents, which specify maximum take per day and per week. While there is sufficient consented water take to meet demand, the streams are all relatively small, and during dry periods the available flows are actually substantially less than the consented amount. Generally the bores are only used during peak periods to address this shortfall and have limited storativity which does not allow for continuous abstraction at high volumes.

The consent limits for the 6 water sources are as follows;

- Grehan Stream - 14.5 L/s
- Aylmers Stream- 19.2 L/s
- Balguerie Stream - 13.2 L/s
- Takamatua Stream - 8.7 L/s
- Aylmers Bore - 14 L/s
- Settlers Hill Bore - 4 L/s

The stream catchments are located in a mixture of pasture and bush, and stock can have access to the upper reaches of the catchments. The streams were therefore considered as requiring 4 log protozoa removal under the DWSNZ. The monitoring data used for design indicated that turbidity events were generally of short duration, with events greater than 100 NTU lasting no longer than 4 or 5 hours.

Treatment in the original scheme was undertaken in three separate sites – two plants in Akaroa to supply Akaroa and one in Takamatua to supply Takamatua residents only. All three treatment plants were conventional design consisting of settling and sand filtration. The Takamatua water treatment plant (WTP) had originally been funded and built by Takamatua residents before being taken over and modified firstly by Banks Peninsula District Council and then Christchurch City Council.

Photograph 1: Takamatua Water Treatment Plant before the Upgrade

2.4 UPGRADED SCHEME DESIGN

The design for the upgraded scheme was developed through preliminary design in 2010 and 2011, and detailed design in 2013 and 2014. The following sections summarise the main aspects of the scheme design.

2.4.1 TREATMENT REQUIREMENTS

The key treatment requirements of the upgraded scheme were:

- Treatment to provide 4 log protozoa credits for surface water
- Ability to treat a minimum raw water turbidity of 50 NTU for surface waters
- Treatment to provide iron and manganese removal for groundwater
- Chlorine dosing for disinfection and maintenance of distribution water quality
- pH correction to reduce aggressiveness (plumbosolvency) of treated water

2.4.2 TREATMENT OPTIONS

Two general options were considered – either a conventional treatment upgrade of the existing facilities or installation of membrane based plants, substantially replacing the existing plants. Also considered was whether to upgrade each existing plant, or to combine some or all of the sites.

Capex and Opex costs were estimated for each option, and the lowest cost scheme option to achieve the set objectives was found to be the option of centralising on a single treatment plant whereby raw water from Takamatua would be pumped to Akaroa for treatment, and treated water pumped back to Takamatua.

Due to changing standards, technology developments, the shorter life cycle of the more complex electrical and mechanical plant associated with treatment plants, and the higher relative Opex costs of treatment plants over time; it was thought that future unaccounted for costs would be higher for the treatment plants in comparison to

pipelines (over the lifecycle of the assets). Hence a sensitivity analysis considering the risk or likelihood of future treatment upgrades further reinforced the option of a single treatment plant being the best long term solution.

The selected option would require the installation of a raw water collection network from Takamatua to Aylmers. This network would facilitate the addition of groundwater sources that may be developed in the area, and other sources that may be added, with economic treatment at a single facility. So this option also enabled the project to meet the objective of allowing for future source development.

A small cost premium, estimated at 5% on Capex costs and 10% on Opex costs, was expected for membrane treatment over conventional treatment. Other benefits and issues of membrane treatment include:

- Membrane treatment provides a more robust level of treatment, with the risk of non-conformance with DWSNZ being lower.
- Membrane treatment is a highly automated process and will typically require less site visits. Site visits 1-2 times per week can be expected, compared to 2-4 times per week.
- Membrane treatment has more complex electrical and mechanical plant, and more support from skilled technicians is required to maintain this plant.
- Recycling of wastewater using membrane technology is more readily and safely achieved using membrane technology due to the more robust barrier the membrane provides. Without recycling, conventional treatment will typically produce a slightly smaller wastewater volume (3-5% typical) compared to a membrane plant (3.5-7.5% typical).

CCC considered these benefits and issues and it was agreed that a performance requirement of achieving less than 1% by volume of waste water would be imposed in the membrane treatment plant performance specification.

2.4.3 TREATMENT DESIGN CAPACITY

The centralised treatment plant design capacity was set at a current peak day capacity of 2,000 m³/day and 2,550 m³/day for 2041 peak day capacity, as outlined in Section 2.2. The plant was designed to treat water from the six existing sources with a membrane based process including coagulation and chlorine disinfection, providing a 4 log protozoa reduction with treated water meeting the DWSNZ and capable of achieving an A grading in accordance with the Ministry of Health Grading Protocol (2003).

A new raw water tank was included in the design for the new WTP. This was to allow some buffering and mixing of the existing raw water sources, in particular when bore water was being used. The raw water tank was sized at 100 m^3.

2.4.4 PIPELINE DESIGN

Design of the pipeline was based on the use of PE100 pipes for both raw water and treated water, due to the seismic performance and fatigue resistance of PE. The design assumed installation by trenching given the large number of below ground services within the township and the possibility of volcanic rock along the route. On the longest section of the scheme, between Akaroa and Takamatua both a treated water line and a raw water line needed to be installed – it was thought for efficiency and cost these could be installed in the same trench provided minimum separation distances were still met.

NZTA required that trenchless technology be used to cross State Highways – there were a number of these crossings along the pipe route. Detailed design of these crossings was to be established between the Contractor and NZTA.

Where possible the pipe route was shown in road reserve, however within Akaroa the topography is steep and roads are often narrow, meaning that in many cases there was no option but to install in the road.

The steep topography between Takamatua and Akaroa meant that the hydraulic grade line of the raw water pipeline passed through an intermediate high point along the route. To address this issue a pressure sustaining

valve was installed downstream of the high point. This was used in conjunction with standard air release valves along the line.

2.5 GROUND CONDITIONS

The geology of Akaroa is predominantly windblown yellow-brown silt deposits with fine sand or clay known as loess. Loess is notoriously difficult to work with when wet, and can be subject to instability, under-runners resulting in slips and uneven load bearing ability. The presence of loess required special trench details (such as the use of imported backfill) so that the trenches did not become a flow path which could then create tunnel gullies adjacent to the trench. Pipelines in steep gradients were required to have regular water stops installed.

Loess soils also require that careful consideration is given to how site earthworks and stormwater and run-off are controlled. Large volume earthworks needed to be completed in stages, with appropriate temporary works to minimise the risk of erosion and collapse.

2.6 EFFECT OF CHRISTCHURCH EARTHQUAKES ON DESIGN

Just as preliminary design of the scheme was about to be delivered, the Christchurch earthquake sequence began. While this delayed delivery of the preliminary design report and threw doubt around the accuracy of cost estimates developed at preliminary design, there were few significant design changes that resulted and those that did were addressed during detailed design. The pipeline material had already been nominated as PE, which was recognised to have the best earthquake resilience, and the pump station design has been based on a previous Importance Level 4 structure designed for the Council.

Retaining walls associated with the reticulation infrastructure were affected and the project team needed to assess whether timber post walls, which were traditionally used in Banks Peninsula, could offer the same resilience as the concrete block walls being favoured by SCIRT.

CCC updated their Infrastructure Design Standards (IDS) and Construction Standard Specifications (CSS) in conjunction with lessons learned through SCIRT and the earthquakes and the tender documentation for the scheme referred to these standards.

2.7 FINAL SCHEME CONFIGURATION

The final scheme, whereby water from all stream and bore sources in Akaroa, and from Takamatua Stream would be treated in a single water treatment plant at L'Aube Hill in Akaroa involved installing the following new infrastructure:

- Membrane WTP at L'Aube Hill
- 100 m^3 raw water balance tank at L'Aube Hill
- 180 OD PE raw water pipeline from Aylmers Valley to L'Aube Hill
- A dual setpoint pressure reducing valve on the Aylmers/L'Aube treated water system (joining two previously separate distribution systems)
- Raw water pump station at Takamatua
- 125 OD PE raw water pipeline from Takamatua Valley to L'Aube Hill
- 180 OD PE treated water pipeline from L'Aube Hill to Takamatua
- 250 m^3 treated water reservoir serving Takamatua
- Booster pump station to pump treated water from Akaroa to the new Takamatua reservoir

The resilience designed into the scheme included sizing the raw water line from Takamatua to L'Aube for possible future development of other streams in the area, retaining the Aylmers treated water reservoir as end of

line storage, allowing an area at the L'Aube Hill site for future raw and/or treated water reservoirs and specifying the membrane plant as able to have additional modules fitted in the future.

For cost efficiency, as many key items at each site as possible were reused – this included tanks at Takamatua and electrical and control equipment at Aylmers WTP. This of course presents its own complications in terms of timing.

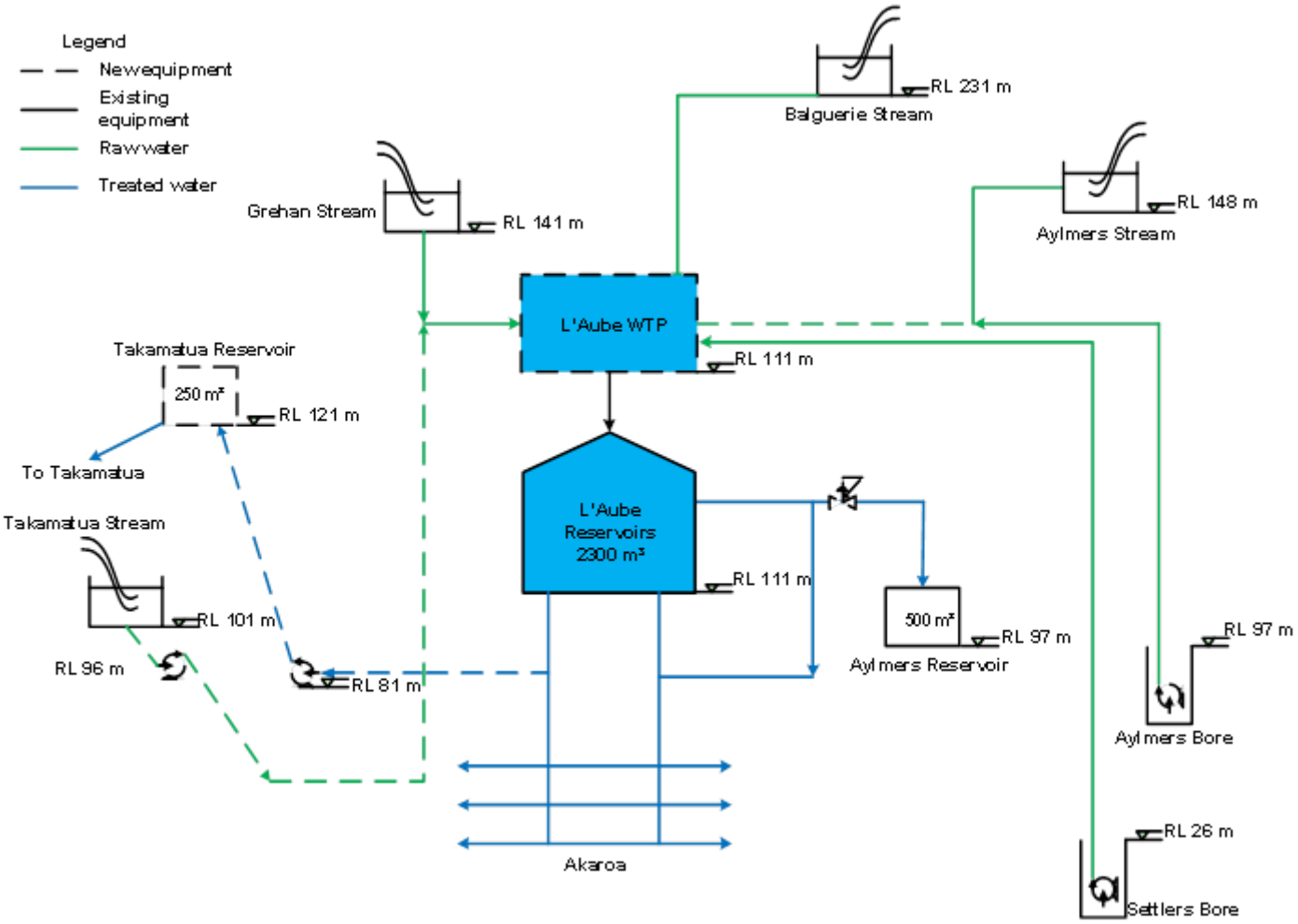

Figure 2: Schematic Diagram of Upgrade to Akaroa Water Scheme

2.8 LAND OWNERSHIP

While the existing Takamatua WTP and Aylmers WTP sites were to be repurposed and reused, new sites were required for the new Takamatua treated water reservoir and the booster pump station. Fortunately the booster pump station was able to be located on a piece of land owned by Orion and CCC was able to reach an agreement with Orion relatively easily. However the process of identifying and purchasing land for placement of the reservoir and purchasing land for the new WTP at L'Aube Hill was both time consuming and relatively expensive.

2.9 TELEMETRY AND COMMUNICATIONS

Communications between the various outstations in and around Akaroa had traditionally been carried out using radio telemetry. A repeater station at Mt Pearce was used to pass data back to CCCs Operation Control Centre located at their wastewater treatment plant at Bromley, Christchurch. However given the hilly terrain these communications were sometimes problematic, and the bandwidth was already nearing its limit.

With the introduction of new infrastructure and a greater level of automation, there was a requirement to accommodate more communications. This need, combined with the desire to have the ability for Akaroa to

effectively stand alone, independent from Bromley in the event of a loss of communications with Christchurch, resulted in a communications upgrade being included in the scope of works for the new WTP.

The communications upgrade consisted of the use of a DSL to provide a new connection between L 'Aube Hill and Bromley, and establishing a new repeater station at French Peak. Not only did this upgrade make sure that communications between the new sites on the Akaroa water scheme were at an operationally acceptable level, but it enabled CCC to future proof the communications area for several other water and wastewater upgrade projects that are to be undertaken in the coming years.

3 CONSENTING

The Takamatua WTP site, Aylmers WTP site and L'Aube Hill WTP site were all covered by existing designations and/or easements that could either be used in their current state, or extended to meet revised requirements. Although not strictly required under utility provisions, building consents were obtained for the two pump stations since these would be occasionally manned. The reservoir received an exemption from building consent requirements as it was constructed to a standard CCC reservoir design.

No consents were required or requested for the pipelines – under the District Plan utilities pipelines are considered permitted activities provided the specified conditions are complied with.

Resource consents were required for both the new reservoir and the booster pump station. While the booster pump station consent was relatively easy to obtain, visual concerns over the proposed location of the reservoir required that it be moved late in the design process. The road the reservoir was to be positioned on is considered one of the main tourist routes into Akaroa, with a further scenic route road following the hill up behind the back of the reservoir position. Council landscape architects were concerned at the possibility of the reservoir cutting into the view down into the bay for those tourists using the road behind the reservoir site.

The reservoir was moved down the hill to the bottom end of the site, the concrete panels were required to be tinted a recessive colour (which was achieved by mixing black oxide into the concrete) and the site was planted extensively after the reservoir had been constructed. The reservoir was located in a silent file area so consultation with Runanga was undertaken by CCC as part of the consenting process.

By undertaking these steps the revised reservoir location was agreed to by stakeholders and the project progressed on this basis.

Photograph 2: New Takamatua Reservoir

4 PROCUREMENT

It was decided early on to procure the upgrade in two parts – the membrane WTP as a Design Build Operate (DBO) contract, and the reticulation works (pipes, pump stations and reservoir) using a traditional detailed design, tender and construction approach. This was because CCC wanted certainty of price for a major portion of the project before committing to proceeding. Having two contracts it was recognised that the management of the interfaces would need to be tight and accurate, and that the two contractors would have to commit to working together on some aspects of the upgrade.

There was some concern that given the huge amount of infrastructure work going on in and around Christchurch associated with the earthquakes, there would be limited interest from contractors in the Akaroa upgrade. Although only around 75km and 1 ¼ hours travel time from Christchurch, all materials, including essential materials such as backfill and asphalt, need to come from Christchurch and the majority of spoil needs to be taken back to Christchurch, due to limited consented dump sites. This makes the project more complex and costly than a Christchurch based job. An Expression of Interest (EOI) step was undertaken for both contracts, and the interest received was significant, including an offering from an Australian company.

Three tenderers were shortlisted for each contract and after the tender period Fulton Hogan were successful in securing the DBO WTP contract and Hawkins Infrastructure won the Reticulation Contract. Consideration was given at tender stage to combining the contracts and award to one contractor, if the economics and technical merits of the contractors allowed for some advantage to Council. However, after due consideration of the proposals and relative technical merits of construction expertise, the tender evaluation resulted in the contracts being awarded to the two separate contractors.

5 CONSTRUCTION CHALLENGES AND OPPORTUNITIES

The construction phase of the project had many interesting challenges and opportunities are described in the following sections.

5.1 INTERFACING WITH RESIDENTS

Many residents of Akaroa and Takamatua feel strongly about the historic and aesthetic value of the townships. CCC recognized the importance of keeping residents informed of the project design and progress throughout the life of the project. Updates were given to the local community board and newsletters outlining progress were issued during the construction works.

The contractors worked closely with local businesses – trying to use local sub-contractors as much as possible and staying in regular contact with public interface facilities such as the Fire Service, the local garage, the Council's local service centre and the tourist information centre. The contractors used standard CCC start work notices to inform residents of forthcoming work, and letter drops of shut-off notices to advise when water lines needing to be shut off temporarily to complete a connection.

Some complaints were received during the construction phase – the project team worked to deal with these as quickly as possible. Complaints were around pits that had been backfilled but not sealed for a time (due to the availability of asphalt and roading contractors), perceived damage to private property (which was generally road reserve) and traffic issues such as reduced access to some roads and properties during parts of the work and contract works impinging on the road. Although there was one incident involving a local who drove into a drill pit in a section of road that had been closed off, the works were constructed without too many detrimental effects on local residents.

5.2 EFFECT OF CRUISE SHIPS AND TOURIST SEASON

Cruise ship visits are a crucial part of the Akaroa tourist season that result in an extra 2,000 to 3,000 people coming through the town on any one day. Many of the cruise ship visitors board buses and head straight out of Akaroa to Christchurch. While the WTP site remained largely immune to this influx, the reticulation works had to be carefully scheduled around cruise ship days. CCC closely monitored traffic management on the main roads and the contractor was required to backfill pits and minimise the impact of traffic management to coincide with cruise ship dates. This was sometimes challenging due to the availability of materials for making good the roads, and the need to backfill and seal pits that would later be reopened to complete the works.

On days when the cruise ships were in town not only was there additional traffic, but there were numerous tourists walking down, across and in the middle of roads. The contractors dealt with this with a great deal of patience and flexibility.

5.3 USE OF TRENCHLESS TECHNOLOGY

The original design for the scheme was based on pipe installation by open cut trenching. However it had been noted from aerial photographs showing property boundaries that many of the properties in Akaroa encroached severely on the road reserve that was intended to be used for pipelaying. To go through the process of dealing with each property owner to try and relocate fences and gardens for trenching would have been difficult, time consuming and problematic. Despite the risks associated with identifying underground services, the Contractor took the initiative to pursue installation by trenchless technology.

The very narrow streets in and around Akaroa are full of both current and unused services. Many of these are not well documented – either not shown on plans, or shown in incorrect positions. While the Contractor made every effort to positively identify services by potholing and using service providers to come out and mark positions, there were a number of service strikes that occurred. Despite this, the decision to use directional drilling in the township significantly reduced negative impact on the residents that would have come from the mess and disruption caused by open cut trenching either in road reserve or through existing roads. This helped the project to be viewed in a more positive light by those living and working in the area.

In some areas, due to the presence of river rock, trenching had to be used, and in one location rock breaking equipment was required. However most of the new pipe was able to be installed by trenchless methods and this project has collected detailed as-built information that can be added to the council's GIS system to help future

projects. For these works there was significant time and cost involved in identifying, avoiding and repairing services that was able to be offset by directional drilling efficiencies.

5.4 HERITAGE CONSIDERATIONS

Heritage NZ has a register of significant historic features across New Zealand, including numerous features in Akaroa. On this register were three bridges that the new pipelines needed to cross, so the design proposal for taking the pipelines across the bridge was presented to Heritage NZ for their acceptance. The proposed design consisted of an encasement pipe along the outside of the bridge. Heritage NZ objected to this proposal on the basis of aesthetic effects on the historic structure and a revised proposal to run the pipes under the seal across the deck of the bridge was agreed.

Photograph 3: Historic Bridge Along Akaroa Pipe Route

However during this interaction with Heritage NZ they advised that they considered the whole of Akaroa to be an archaeological site and so, despite the fact the pipelines were being installed in road reserve and generally below existing road, the project needed to apply to Heritage NZ for an archaeological authority. An archaeological authority gives permission to undertake work that may affect an archaeological site. An archaeological site is defined in the Heritage New Zealand Pouhere Taonga Act 2014 as "any place in New Zealand (including buildings, structures or shipwrecks) that was associated with pre-1900 human activity, where there is evidence relating to the history of New Zealand that can be investigated using archaeological methods."

Heritage NZ had established a simplified and streamlined process to consider work that affects archaeological sites under the Canterbury Earthquake Response and Recovery Act 2011, however Banks Peninsula falls outside the area covered by this process. As part of the application for archaeological authority, an archaeologist was engaged by CCC to undertake a desktop assessment of the likelihood of encountering finds on the proposed pipeline route and pump station, reservoir and WTP sites associated with the water upgrade.

The application for an archaeological authority also triggers the need to consult with iwi to gain their view on the proposed installation and the possible effect this will have on areas of significance to them. An assessment of the Maori values of the archaeological site and the effect of the proposed activity on those values must form part of the application. As the project did not fall within a known silent file area, specific consultation had not been undertaken with iwi prior to this.

Heritage NZ gave a lot of guidance with applying for the application, but there was very little in the way of previous information in their database with regard to Akaroa. Therefore they decided to err on the side of caution and require that all remaining areas of works be monitored. There is a compulsory 15 day standown time once the authority is granted; this time is to allow for any appeals on the authority. As construction works had already started this resulted in significant delay and cost to the project.

Any time excavations such as drill pits or earthworks for structures were undertaken, a Heritage NZ approved archaeologist was required on site to monitor the works. Several interesting historical finds were encountered, mainly within the township – these consisted of items such as iron grills, bottle bases and porcelain fragments, sections of old cobble walls and the location of an old footbridge. Upon finding items of interest, work would be halted and the archaeologist would photograph and record the findings. This resulted in work being stopped for several days, multiple times during the works.

5.5 CONSTRAINTS AROUND TIMING

Ideally the construction works would be staged to allow earthworks and pipe-laying to be carried out during the dryer summer months as loess soils are difficult to work with when wet and there is the added complication of run-off and erosion control during rain events. However given other constraints such as trying to minimise disruption during tourist season and cruise ship season, and needing to undertake works interfacing with the treatment plants during the winter months when demand is lower, earthworks did end up having to be conducted during times when the weather was not conducive to easy or clean working.

As the upgrade was to an existing scheme, and the existing scheme needed to remain operational throughout the works and changeover, there were further operational constraints. The existing L'Aube treatment plant needed to remain operational while the new L'Aube Water Treatment Plant was constructed. The contractor managed this by installing commissioning valves on all the raw water inlet lines so these could be changed between the new plant and the existing plant during commissioning and proving. A temporary bypass line for putting treated water from the new plant into the existing treated water reservoir was also used until the new plant was proved – allowing the possibility of quickly reverting to the existing plant if any issues were encountered.

The new L'Aube Hill Water Treatment Plant, Takamatua Booster Pump Station and Takamatua Reservoir had to be commissioned and able to supply treated water to Takamatua before the existing Takamatua water treatment plant could be decommissioned and converted to a raw water pump station. However there was still a need to get Takamatua stream water to the new WTP during the proving period so the plant could be shown able to run on all sources. All these constraints were able to be managed without disruption to residents supply.

6 COMMISSIONING AND OPERATION

For various reasons the construction programme for the scheme was extended, resulting in commissioning occurring early in 2015 right over the peak tourist and visitor season, and with water supplies at very low levels.

During the summer period (December - April) CCC are required to record weekly measurements of the stream flows prior to taking water to the new WTP. These measurements showed that the 2014/15 summer weather was the driest on record. The stream flows were the worst ever seen - from the beginning of January to April, all three streams in Akaroa had average flows between 5 and 8 L/s (less than 50% of consented flow). The following water restrictions were put into force to help reduce water consumption;

- 6.12.2014 - Level 1 (use of hoses/sprinklers/irrigation alternate days only)
- 31.12.2014 - Level 2 (hand held hoses anytime, but irrigation/sprinklers not permitted at any time)

Despite these further challenges, the new L'Aube Hill WTP was successfully commissioned and has been operating to supply since 28th February 2015. Takamatua township was changed over to treated water supply from Akaroa in May 2015 and the Takamatua WTP site was converted to a pump station shortly after. Water restrictions were lifted in Akaroa at Easter. Since then there have been a number of extreme weather events with high turbidity levels in the raw water that the scheme has coped well with.

Feedback from residents to date is that they think the water has lost the chlorine smell/taste it used to have, and is much more pleasant to drink. No complaints about the quality of the drinking water have been received during commissioning and the trial operation period.

The extended commissioning and trial operation period (CCC elected to abandon the Operational component of the DBO contract) proved beneficial in terms of allowing more time for operator training and experience. The City Care operators that are responsible for operation of the new WTP on behalf of CCC had worked on conventional treatment plants in the area for many years. The transition from operation of largely manual conventional plants to highly automated membrane treatment has required the operators to undergo a steep learning curve. Membrane plants require more process optimisation and the operators need to take the time to monitor and understand how the plant reacts to different water combinations.

Photograph 4: New L'Aube Hill Membrane Plant

7 CONCLUSIONS AND LESSONS LEARNED

This interesting, complex and sometimes challenging project resulted in a number of lessons learned for the project team. The first being the level of cost involved in upgrading what is a relatively small community water supply scheme. The final construction cost of the upgrade was approximately $10 million – equating to around

$18,000 per household based on current permanent population, or $8,000 per household based on current peak/holiday population.

In this case there were multiple factors that contributed to the high costs including;

- Requirements for land purchase within a semi-urban/lifestyle area
- The need to transport key materials and equipment over the hill from Christchurch to Akaroa to construct the project, and to take spoil back to Christchurch as there were no local consented dumpsites.
- The effect of the Christchurch earthquakes, which pushed prices up and reduced the availability of sub-contractors, equipment and materials such as asphalt.
- The need for an archaeological authority, archaeological monitoring and to stop work to document archaeological features.
- The importance of minimising the visual impact of the works and new infrastructure.
- The need to work around peak tourist times and cruise ship days.
- Working in an historic township with narrow streets and limited documentation of existing below ground services.
- Extreme weather events combined with the prevalence of loess soils.

Working closely with key stakeholders such as the Akaroa and Takamatua residents, local iwi and Heritage NZ was key to successful implementation of the scheme. The project suffered from learning of the need for an archaeological authority only once construction was underway. In future Heritage NZ will be consulted early in the design process. The Akaroa Community Board were consulted at various stages during the project from planning through to implementation, however this interaction was somewhat sporadic. More regular consultation with the Community Board before and during construction would have been of benefit.

Although it may be time consuming and more expensive to gather good as-built and archaeological information on the work areas during construction, in the long term this effort will pay off for future projects completed in the area.

While it was originally intended to install the new pipelines by open cut trenching, the initiative the Contractor took to utilise directional drilling, despite the complexities of unidentified or mis-located underground services, resulted in much less disruption to locals and the ability to minimise impact on traffic and surrounding properties.

And finally the move from operation of largely manual conventional treatment plants to highly automated membrane treatment requires a change in mind-set and approach from the operational team that does not happen overnight. Long term the membrane plant offers CCC more robust treatment and because of the high level of automation will eventually require less site visits, however in the initial stages of optimization and familiarization a high level of operator attendance may be required.

Despite all the challenges, the Akaroa Water Supply Upgrade was an interesting and rewarding project in a great location. CCC believes that considering the complexity of the project and the constraints when having to work in some difficult areas, the project has been very successful.

Photograph 5: Another Beautiful Day Constructing in Akaroa

ACKNOWLEDGEMENTS

We acknowledge input from archaeological monitoring reports by Jeremy Habberfield-Short of Under Over Archaeology, and from guidance information produced by Heritage NZ.