Attachment C: SWWTP Long Term Disposal Solution – Enhanced Treatment Options

Technical Memorandum

02 December 2025

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Project Name	Shotover WWTP Disposal Field Alternative Discharge		
Subject	Summary notes of providing additional treatment		

Executive summary

Purpose

This technical memo compares the Shotover Wastewater Treatment Plant (WWTP) with more stringent discharge standards within New Zealand (e.g. the WW discharge standard "very low dilution", and the "Pukekohe standard"). Furthermore, ballpark capital cost estimates have been prepared for an initial appraisal of higher removal efficiency of nitrogen, phosphorus and viruses.

This memo also compares discharge limits at selected treatment facilities in Australia, North America, and Europe to show how the proposed long-term limits for Shotover WWTP Option A align with these example sites.

This memo is intended to provide supplementary technical information for further discussion, and only as an interim deliverable.

Additional treatment for nutrient and virus removal

GHD assessed several options to enhance the nutrient and virus removal efficiency of the recently upgraded Shotover WWTP. Table i below presents a summary of the additional treatment alternatives evaluated, along with indicative ball park capital expenditure estimates.

Table i Additional Treatment Options – Nutrients and Virus Removal

Discharge standard target	Treatment Options	Reasons for consideration / rejection	Ballpark CAPEX ($)
Additional Nutrient Removals (to meet to "Pukekohe standard")	Reconfigure into 5 stage BNR	Not carried forward – high immediate CAPEX and major plant changes	--
Additional Nutrient Removals (to meet to "Pukekohe standard")	Reconfigure into MBR	Not carried forward – high immediate CAPEX and major plant changes	--
Additional Nutrient Removals (to meet to "Pukekohe standard")	Supplementary chemical dosing & add online ammonia analysers	Carried forward – moderate CAPEX and relatively straightforward	Chemical storage could range **$680k to $1.4 million** (accuracy range of +50%/-30%). ISE sensors are generally lower cost (~**$15k** supply only).

Discharge standard target	Treatment Options	Reasons for consideration / rejection	Ballpark CAPEX ($)
Additional Virus Removals (if QMRA requires higher order of virus removal from the WWTP)	Install high power UVs downstream of new tertiary filters	Carried forward	The cost of two UV systems (each sized for 30ML/d) could range between **$3.6 to 7.7 million** (accuracy range of +50%/-30%).
Additional Virus Removals (if QMRA requires higher order of virus removal from the WWTP)	Replace tertiary filter upgrade with membrane filtration	Not carried forward - Significantly higher cost.	The estimated total cost for the membrane filtration system is **$30 to 55 million**.

Comparison with selected WWTP overseas

See Table ii below for a comparison between the Shotover WWTP discharge limits and those of several other selected WWTP sites, which are similar in terms of their alpine locations, popularity with tourists, and/or sensitive receiving environments.

Table ii ***Comparison of Shotover WWTP proposed discharge limits (for Option A) with other few selected WWTP sites overseas***

	Shotover WWTP long term consent proposed limits	NZ WW Discharge Standard "very low dilution"	"Pukekohe Standard"	Werdholzli WWTP, Zurich	Winmalee WWTP, Sydney	Chesapeake Bay WWTPs, USA	Upper South Creek AWRC, Sydney
Relevance	Basis for comparison	The most stringent discharge standard prescribed in the law	Gold standard for WWTPs in Waikato region	Alpine location, known for pristine area and tourism	Australian example for tourism	USA example of stringent discharge standard	Recent example for potable water reuse quality
Type of WWTPs	MLE + Clarifiers Tertiary Filters & UV	--	Pukekohe – bioreactor and MBR	Primary Clarifiers, Bioreactors, Clarifiers, Ozonation, Sand Filters Sludge drying and incineration	Bioreactor Retrofitted into MBR (2021-25)	Various	WWTP followed by Advanced Water Treatment Plant (AWTP)
<u>Discharge standards</u>							
BOD5 (mg/L)	< 5 (median)	< 5 (median)	< 5 (median)	--		No info	The highly treated effluent passes through AWTP with reverse osmosis. Purified recycled water contains negligible levels of contaminants.
TSS (mg/L)	< 5 (median)	< 5 (median)	< 5 (median)	--	<5 (median)	No info	
TN (mg/L)	< 10 (median)	< 4 (median)	< 4 (median)	<8 (median)	< 3 (median)	< 8 (BNR limit) < 3 (ENR limit)	
TAN (mg/L)	< 1.5 (median)	<1 (90%tile)	< 1 (median)	--	< 0.9 (median)	No info	
TP (mg/L)	< 1.5 (median)	<0.5 (median)	< 1 (median)	<0.5 (median)	<0.1 (median)	< 0.3 (median)	
E coli	< 10 cfu/100mL (median)	<130 cfu/100mL (90th percentile)	<50 cfu/100mL (median)	--	<10 (median) as faecal coliform	No info	
Other comments	*Generally, this is in line with the various tight discharge standards in NZ and overseas. Supplementary carbon and alum dosing could lower TN and TP limits (say, 4 and 0.5 mg/L respectively), but there will incur additional OPEX.*			*The WWTP was upgraded with ozone for meeting Swiss and EU revised WW directive of 80% removal of micropollutants (13 selected species). The cost of the ozone upgrade (quaternary treatment) was part of a $50M (USD) upgrade (2016).*	*The highly treated effluent is discharged to Hawkesbury River, within a very environmental sensitive catchment of the wider Hawkesbury-Nepean catchment. This is reflected in the TN and TP limits.*	--	*The reported project cost for Stage 1 (including the pipelines) is between AUD$1 to 1.6 billion (2025).*

1. Introduction

This technical memo summarises our response on the following queries raised in a teleconference on the 14th November between Queenstown Lakes District Council (QLDC) and GHD:

a. To provide further information on including additional nutrient and virus removals at Shotover WWTP:
   i. Nutrient removals – to match the highest treated effluent quality standards currently achieved in Aotearoa, such as the Pukekohe WWTP standards
   ii. Virus Removals – the use of membrane filtration instead of tertiary filters, or otherwise installing larger UV reactors
b. To provide high level commentary and description on other wastewater treatment facilities overseas which service similar tourist and alpine townships.

1.1 Purpose of this memorandum

This technical memo is intended as a preliminary assessment of providing higher wastewater treatment standards than what has been proposed in the Short List Options Report. This memo will assist QLDC staff in preparation for the upcoming Shotover WWTP Disposal meeting scheduled for 8th December. The meeting will occur with QLDC councillors and other public attendees.

This technical memorandum is provided as an interim communication under our agreement with QLDC. It is provided to foster discussion in relation to technical matters associated with the project and the intended purpose, and should not be relied upon as final technical deliverables, especially the cost estimates. More technical evaluation and assessments are necessary.

1.2 Scope and limitations

Scope of this technical memo:

- Description of likely additional treatment processes/augmentation to achieve higher removals of nutrients (nitrogen and phosphorus) and virus
- High level review of other wastewater treatment facilities in terms of plant configuration and discharge standards, servicing similar tourist and alpine townships.

This technical memorandum has been prepared by GHD for Queenstown Lakes District Council. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

Accessibility of documents

If this Technical Memorandum is required to be accessible in any other format this can be provided by GHD upon request and at an additional cost if necessary.

GHD has prepared rough order cost estimates set out in section 2 of this report using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD based on conceptual sizing and information available at the time of report writing. The construction cost of infrastructure is subject to wide fluctuation and cost escalation.

The Cost Estimate has been prepared for the purpose of showing indicative cost range of potential additional treatment and must not be used for any other purpose. If any of these options is selected to add to the preferred option, further investigations and concept/preliminary design will be undertaken to develop the preliminary cost estimates for the purpose of project budget planning.

2. Additional treatment opportunities at Shotover WWTP

This section describes the possible additional treatment processes to enhance the Shotover WWTP in terms of nutrient and virus removals.

2.1 Nutrients removal

Shotover current situation

The second Modified Ludzack-Ettinger (MLE) reactor and clarifier, at Shotover WWTP, was commissioned in October 2025, which has significantly improved the discharge quality particularly in terms of total ammoniacal nitrogen (TAN), total nitrogen (TN) and total phosphorus (TP). The MLE upgrade was designed to achieve an average TN limit of 10 mg/L and an average TP limit of 8 mg/L, based off the original land-based discharge consent. In recent years, several wastewater treatment plants were designed to achieve more stringent discharge standards, one of those is Pukekohe WWTP, and similar discharge limits have since adopted into a number of Waikato based WWTPs.

Refer to Table 1 below for comparing with recent MLE clarifier effluent results, the newly released Wastewater discharge standard for “very low dilution” and the “Pukekohe WWTP standard”.

Table 1 Recent MLE clarifier effluent results, and the Pukekohe WWTP effluent standard

Parameters (as median, unless stated specifically)	Shotover WWTP clarifier effluent results (2023 to 2025 data)[1]	NZ WW discharge standard “very low dilution”	“Pukekohe WWTP” effluent standard
TAN (mg/L)	0.1 (as median) 2 (as 90%ile)	- 1 (as 90%tile)	1 (as median) 2.3 (as 90%tile)
TN (mg/L)	6.7 (as median)	4 (as median)	4 (as median)[2]
TP (mg/L)	0.9 (as median)	0.5 (as median)	1 (as median)[2]
Biological oxygen demand (BOD_5) (mg/L)	6.0 (as median)	5 (as median)	5 (as median)
Total suspended solids (TSS) (mg/L)	8 (as median)	5 (as median)	5 (as median)

Notes:

1) MLE Clarifier results from Sept 23 to Oct 25 excluding samples related to process upsets in Nov 23 to Jan 24, and July and Aug 2024.

2) Pukekohe WWTP consent TN and TP limits are based on mass load limits, the concentration values in the table are derived based on future forecasted wastewater flows.

Possible plant augmentation

For the scenario where Shotover WWTP is to be further improved to meet the “Pukekohe WWTP” standard, there are a number of potential improvements/augmentation options:

1. **Reconfiguration of MLE bioreactor into a 5 stage BNR set-up:** This option would be expensive and disruptive to the existing reactors, so it will not be discussed in subsequent sections of this memo. In this option, the final aerobic zone is re-configured as post-anoxic and re-aeration zones (requiring new internal walls) with some modifications to the swing zone and the first aerobic zone.
2. **Reconfiguration of MLE bioreactor and secondary clarifier into a Membrane Bioreactor Process:** This option is considered to be very expensive and disruptive to the existing bioreactors, so it will not be discussed in subsequent sections of this memo. In this option, the secondary clarifiers are be re-purposed as storm storage or storm flow treatment. A new MBR tank (21m long x 16m wide, derived from a recent MBR design project with DuPont MBR modules) would handle the required flow range (10 to 60 ML/d). The final aerobic zone is re-configured as post-anoxic and re-aeration zones

(requiring new internal walls), with some modifications to the swing zone and the first aerobic zone. Nonetheless, the re-configured bioreactor with MBR trains could possibly be able to handle the biological loads beyond the current 2048 design, negating the need of construction the third MLE reactor and secondary clarifier.

3. **Supplementary carbon dosing:** Acetic acid (and potentially a sucrose solution) could be dosed within the MLE zone to provide a readily available carbon source for denitrification.

   Data from Shotover WWTP (2023 to 2025) showed that the COD/TN ratio is 10:1 and the BOD_5/TN ratio is approximately 5:1 with a range between 6:1 (90%ile) and 4:1 (20%ile). This is typically considered favourable for denitrification. As such, adding extra carbon may not be necessary. However, if a BOD deficiency were to be identified, it would be necessary to consider supplementary carbon dosing.

   i. In a scenario with a deficiency of 12 mg BOD/L, based on applying a BOD_5:TN ratio of 4:1 to reduce the current MLE clarifier effluent TN from 6.7 to 4 mg/L. The estimated acetic acid dosage is approximately 680 L/day, or a monthly consumption of 19,000 L. The chemicals could be stored in one 20 m^3 tanks to provide 1 month of storage capacity.

4. **Supplementary alum dosing:** Alum dosing can reduce the total phosphorus (TP) concentrations in the effluent. Shotover monitoring results indicate that an average of 0.9 mg/L of TP is leaving the clarifier (based off 2023 to 2025 data). If dosing is performed to further reduce the TP, to say 0.4 mg/L, it is estimated that for the 2060 flows, a max dose rate of 406 L/d of alum would be required. For this dosage, a storage volume of at least 15 m^3 would be necessary to provide one month of chemical storage on site.

   It is important to note that the alum dosing process will generate additional sludge as a by-product. The increase of waste sludge volume would be handled by the existing sludge management (WAS tanks and centrifuges) as part of the overall plant operations.

5. **Installation of ammonia analysers in aeration zones:** Ammonia analysers have been employed in many Australian wastewater treatment plants to assist aeration control. Several NZ WWTPs are now fitted with online ammonia sensors for aeration control. There are generally two types of ammonia online instruments, ISE sensors (with working principles similar to a pH/ORP probe), and wet chemistry analysers. ISE sensors are generally lower cost (~$15k supply only) but with limited accuracy when TAN level is < 1mg/L. Hence, for achieving consistent MLE clarifier ammonia level of <0.5 mg/L, wet chemistry analysers are more suitable in such applications. The wet chemistry analysers are in the range of $50 to 60k each (supply only).

Ball park capital cost estimate for alum and carbon dosing

Based on the above storage requirements for chemical dosing and ammonia analyser addition, a rough order capital cost estimate has been performed. The following key assumptions and data sources were used in the preparation of the chemical dosing storage cost estimate:

- The cost estimates are high level estimates (a Class 5 estimate) with $\pm$ 50% accuracy. A design is necessary to update the cost estimate for the purpose of budget planning.
- A previous quotation from Chemfeed for a Self-Bunded HDPE Chemical Storage Tank (dated 2022) was utilised as the baseline for storage tank costs. To reflect price changes, a 9% inflation adjustment was applied, covering the period from 2022 to 2025.
- Other items such as chemical delivery pad, chemical dosing skids and mechanical & electrical installations are based on either previous quotes/estimates or as a percentage of the upgrade works.
- The alum dosing requirements were determined based on TP concentrations measured in effluent leaving the clarifier, using monitoring data collected between 2023 and 2025.
- Requirements for carbon dosing (acetic acid) were established using influent characteristics of the Shotover WWTP, using monitoring data collected between 2023 and 2025.
- Storage allowances for chemicals were sized to provide at least one month of on-site storage.

- Two ammonia analysers installed in the aeration zones (1 per reactor, exact location TBA) to optimise aeration control.
- Preliminary and general costs, margins, and overheads were assumed at 35% of the total estimated costs.
- Design and MSQA costs were assumed at 15% of the total estimated costs.
- A contingency allowance of 30% was included in the overall estimate to account for potential uncertainties.

The total cost for the chemical storage components, including a 15 m^3 tank for alum storage, a 15 m^3 tank for acetic acid storage, as well as provisions for storage & delivery pads and dosing skids, is $430k.

With the inclusion of overheads, design input, MSQA, and contingencies, the total estimated cost is **$680k to $1.4M** (accuracy range of +50%/-30%).

2.2 Additional virus removal

Current situation

QLDC recently conducted virus testing, which showed live virus in the plant discharge. It is normal to have residual virus in the plant discharge. However, additional virus removal for the treatment plant may be required following the Quantitative Microbial Risk Assessment (QMRA).

Possible plant augmentation

There are two potential improvements/augmentations that can be added to the Shotover WWTP:

1. **Installing purpose-built UV reactors downstream of proposed pile cloth media tertiary filters:** Additional UV disinfection downstream of the pile cloth tertiary will further reduce the viruses and other pathogens in the effluent. For achieving a 2-log virus removal target, the required UV dose will be in the order of 100 mJ/cm^2, roughly three times to normal UV disinfection necessary for E coli inactivation. For Shotover WWTP, two Trojan Flex200/144 reactors (with 120 lamps in operation and 24 lamps on standby) could achieve this target. Xylem is an alternative UV supplier to Trojan.
2. **Installing tertiary membrane filtration (ultrafiltration) instead of pile cloth media tertiary filters:** Ultrafiltration(UF) membranes offer a physical barrier to pathogens, including viruses. Membrane filtration can lower TSS in the permeate to less than 2 mg/L, which is the detection limit. It typically removes viruses by about 1.5 to 2 log, making its virus removal efficiency roughly equal to or slightly less than that of dedicated UV treatment. The main advantage is that the output will be almost completely free of solids. However, membrane filtration requires much higher capital investment compared to tertiary filters and UV systems specifically designed for virus removal, and may also need coagulant dosing.

Ball park capital cost estimates for UV treatment and membrane ultrafiltration

High level cost estimates have been done for both additional UV and tertiary membrane UF for the Shotover 2060 flows. As part of these estimates, the following assumptions were made.

– Cost estimates are ball park estimates (Class 5 estimate) with +/-50% accuracy. A design is necessary to update this cost estimate for the purpose of budget planning.

– UV system costing is based off a preliminary quotation supplied by Trojan in Nov 2025 for two units of Flex200/144 reactor (With 120 lamps operation / 24 lamps on standby or added in future dates). This is capable of handling a maximum flow of 2,500 m^3/hr (~60 ML/d, approximately predicted peak discharge volume in 2060). Space for a third reactor will be allowed for N+1 redundancy at peak wet weather flow or future flow (beyond 2060). Trojan advised that a detailed quote should be sought following a concept/preliminary design to confirm the UV model selection and obtain the firm budgetary quote.

- Other items such as concrete plinth, mechanical & electrical installations are based on a percentage of the upgrade works.
- Membrane filtration is based off a preliminary advice supplied by Masons in Nov 2025. Masons provided this based off a 60MLD Membrane filtration submerged system (supplied by DuPont Memcor (Australia) Pty Ltd). Masons advised that a detailed quote should be sought following a concept/preliminary design to confirm the membrane filtration system sizing for a firm budgetary quote by them or other membrane vendors.
- The membrane system estimate also includes additional items, ranging from earthwork reclamation, safety showers, handrails, membrane feed pipes, manifolds, discharge manifolds, and backwash pipes. The costs were calculated using ALTA's rates from the Short List Cost Estimate and then adjusted accordingly and added to the membrane system cost.
- A contingency allowance of 30% was included in the overall estimate to account for potential uncertainties.
- Preliminary and general costs, margins, and overheads were assumed at 35% of the total estimated costs.

The vendor's indicative cost of two UV systems (each sized for 30ML/d) is $2.4 million. Including mechanical, electrical, civil costs, preliminary and general items, plus contingency, the total cost for the UV, covering both systems could range between **$3.6 to 7.7 million** (accuracy range of +50%/-30%).

The vendor's indicative cost for the membrane system with the additional items is $24 million. Including Contractor's preliminary and general items, project contingency, the total cost for the membrane filtration amounts to **$30 to 55 million**.

3. Comparison of other WWTPs overseas

This section compares the Shotover WWTP treatment process and discharges to several selected treatment facilities overseas.

- Werdholzli WWTP, Zurich, Switzerland
- Winmalee WWTP, Sydney (at the foothill of Blue Mountains)
- WWTPs in Chesapeake Bay, USA
- Upper South Creek WWTP, Sydney

A comparison table for the discharge standard can be found in Table ii.

Werdholzli WWTP, Zurich, Switzerland

This example shares similarities to the Shotover WWTP in terms of its location type (mountain / alpine) and discharge environment (water).

The Werdhölzli WWTP is the largest wastewater treatment plant in Switzerland, serving 434,000 people (Wastewater Digest, 2025), and to put in context has more than 4x the flow of Shotover WWTP during its peak season.

The existing treatment process comprises primary clarifiers, secondary biological treatment reactors, clarifiers, followed by ozonation and sand filtration prior to discharge to the Limmat River. Based on the information available, the plant complies with the European Union revised Urban Wastewater Treatment Directive. The total nitrogen and total phosphorus limits are similar to the proposed draft long term consent limits for Shotover WWTP, as median TN of 8 mg/L and TP of 0.5 mg/L respectively for treatment plants with tertiary treatment and a connected population great than 150,000 EP.

Moreover, Swiss legislation (effective 2016) requires wastewater treatment plants serving a population of 5,000 or more must be equipped now with a new treatment stage which ensures that up to 80% of pre-selected micropollutants are removed. In response to the legislation, a major upgrade was performed which included the installation of eight Wedeco SMOevo ozone systems at Werdhölzli WWTP. The reported upgrade cost USD$50M. (Wastewater Digest, 2025)

Sludge management in the Werdhölzli WWTP undergoes sludge thickening, two stage anaerobic digestion followed by mechanical dewatering. The dewatered sludge is then thermally dried prior to incineration, and ash is then disposed offsite.

The new EU Urban Wastewater Treatment Directive requires all WWTPs > 100,000 EP to be fitted with targeted micropollutant removal steps by the end of 2035 (Wasser 3.0, 2023). The implementation of this will incur a significant cost to the EU member countries. Several countries are more advanced than others, such as Switzerland, Netherlands, Belgium, Germany, Austria, and France. The two common technologies are ozonation (common in Switzerland) and activated carbon (powdered or granular). Several major pilot studies are being undertaken to optimise the design and the robustness of different more established and innovative processes. If Shotover WWTP is to be fitted with quaternary treatment for micropollutant removals, a very comprehensive study with pilot studies should be first undertaken, and lessons from other countries and pilot studies should be incorporated to avoid the same mistakes.

Winmalee WWTP, Sydney NSW

This example provides a reference from Australia, for a comparable tourist location plant which is discharging into a very environmentally sensitive catchment (Hawkesbury-Nepean catchment).

Winmalee WWTP is located at the foothill of the Blue Mountains ranges. The current connected population is 80,280 EP (based on COD loads), with an average dry weather flow of 16.6 ML/d. The average wastewater flow is comparable to the Shotover WWTP. The treated effluent is discharged into the Hawkesbury River, within a very environmental sensitive catchment of the wider Hawkesbury-Nepean catchment. In 2015, NSW Environmental Protection Agency (EPA) initiated a Pollution Reduction Programme, which required Sydney Water to reduce the amount of nutrients released for a number of their WWTPs. Winmalee WWTP was one of them, and a major upgrade project (AUD$50M) was initiated in 2021 to convert the original plant into a MBR treatment, which was due for completion by July 2025. (Downer, 2024)

Compared to Shotover WWTP and the Pukekohe discharge standard, the Winmalee WWTP is subjected to a set of similar discharge standards, median TAN of 0.9 mg/L, median TN of 3 mg/L and median TP <0.1 mg/L. It is noted that the TP limit is more stringent, potentially reflecting the need of protecting the downstream Hawkesbury-Nepean receiving environment, and the warmer climate relevant to mitigate against onset of algal blooms in the river.

WWTPs in Chesapeake Bay USA

This example provides a reference from North America, where a region is susceptible to nutrient loads from the WWTP discharges, which is not the case for Shotover WWTP and the downstream Kawarau River. However, the Chesapeake Bay region has been referenced by others to tightening their respective stringent discharge limits.

The Chesapeake Bay region is located in the Mid-Atlantic. USA has been working to reduce their nutrient flows from hundreds of WWTPs across the region that discharge into rivers, streams, and Chesapeake Bay. As part of that process, in 2005 the Chesapeake Bay region introduced a permitting process to restrict the discharge of nitrogen and phosphorus from WWTPs. Due to this, the WWTPs are being upgraded with nutrient reduction technology. These upgrades include biological treatment systems which consist of:

(a) Biological nutrient removal (BNR), reducing TN to 8 mg/L; and

(b) Enhanced nutrient removal (ENR), reducing TN to 3 mg/L and TP to 0.3 mg/L.

The TP limit in the latter category is likely to require coagulant dosing, which would add higher operating cost through chemical consumables and sludge volume for disposal.

Upper South Creek AWRC , Sydney

The Upper South Creek Advanced Water Recycling Centre (AWRC) and the connected pipelines are under construction. The AWRC comprises a new wastewater treatment plant with biosolids sludge digestion, with the treated effluent passing through an advanced water treatment plant (AWTP). The advanced water treatment process is based on reverse osmosis to produce a drinkable water quality, suitable for discharging back to Nepean Water and Warragamba River for environmental flow.

The Stage 1 upgrade will provide 35 ML/day of treatment capacity with an ultimate capacity of 70 ML/day, expected to be complete in 2025. The reported construction cost including the new WWTP, the AWTP and the connecting pipelines is estimated between $1 to 1.6 billion (AUD). In addition to the treatment plant construction, there are also four new major infrastructure assets:

a. A pipeline for releasing excess treated water from the USCAWRC to the Nepean River;
b. A pipeline for releasing excess treated water and wet weather flows from the USCAWRC to South Creek;
c. An extension of the pipeline from the Nepean River to the Warragamba River for environmental flow; and
d. A new pipeline from the USCAWRC to Sydney Water's existing wastewater infrastructure network to discharge brine to the Northhead WWTP.

This example provides a reference point of a recent project that takes the wastewater treatment to a quality comparable to drinking water / potable reuse. However, the same AWTP technology (reverse osmosis based) is unlikely to be viable for the Shotover WWTP, due to Shotover WWTP location away from ocean for bring disposal. A different AWTP approach would be needed, e.g. carbon-based advanced treatment using technology such as ozone, biological filters and activated carbon, or ion-exchange based advanced treatment.

4. References

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