THE NEW PICTON HARBOUR WASTEWATER OUTFALL-A CLEAR AND EFFECTIVE SOLUTION

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ABSTRACT

The outfall pipeline from the Picton Sewage Treatment Plant, to the discharge at Kaipupu Point, was under capacity and its condition was deteriorating. The above-ground portion pipeline was considered to be an "eyesore".

Marlborough District Council and CH2MBeca (Beca), together with a Consultative Working Group (CWG), began assessing wastewater disposal options, including irrigation as well as new outfall sites in Picton Harbour and Shakespeare Bay.

An evaluation of the environmental, public health, engineering and economic implications of these options was undertaken and discussed with the CWG and other community stakeholders. A mid-harbour outfall was proposed as an environmentally sustainable and cost-effective solution.

The CWG and community were presented with the concept of a well-designed outfall, where neither bathing nor shellfish gathering would be at risk.

The outcome was that Council obtained consents with no appeals and a 35 year consent term.

The paper highlights the desirability, when consenting potentially contentious projects, of combining appropriately robust technical investigations with early and meaningful communication with key stakeholders.

The new Picton outfall is a cost-effective and sustainable solution and a key first stage in a wider strategy to improve the capacity of the Picton/Waikawa Sewerage System.

KEYWORDS

Consultative Working Group, treated wastewater, Picton Harbour outfall, Quantitative Microbial Risk Assessment

1 INTRODUCTION

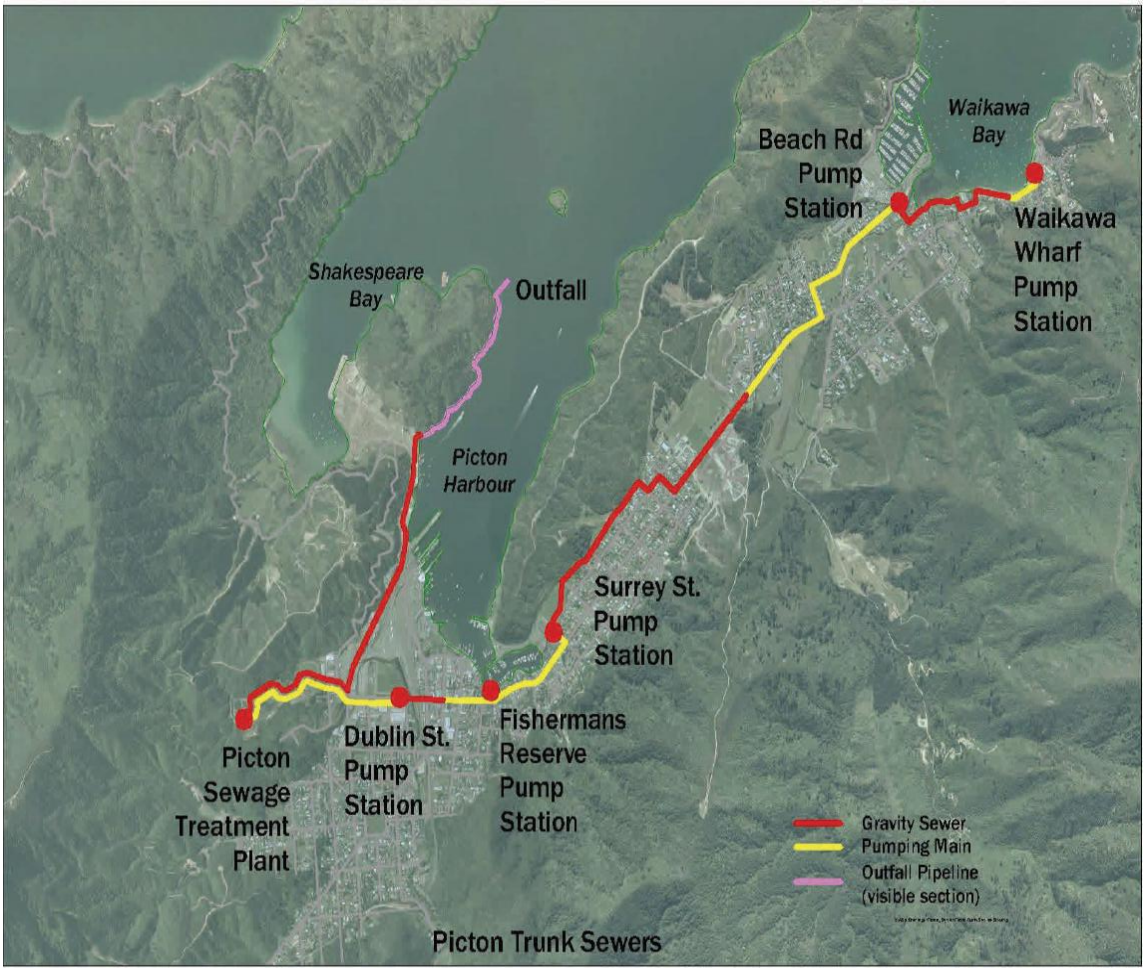
1.1 BACKGROUND

Picton is a small town located in the Marlborough District at the head of Queen Charlotte Sound. The town is subject to seasonal population fluctuations with numbers peaking to about 6,000 over the summer months due to its proximity to the Sounds and the interisland ferry terminal.

In the early 1900s, sewage generated in Picton was collected in a septic tank in Seymour Gardens near the foreshore. By 1948, population growth had resulted in increased flows such that, during wet weather, the sewage bypassed the tank directly to the nearby tidal flats. The tank was abandoned and raw sewage was discharged into the harbour at an outfall near Waitohi Wharf. The Kaipupu Point outfall was commissioned in 1968, as a result of ongoing concerns regarding the effects of the wharf discharge on public health. The discharge of comminuted ("chopped up") raw sewage through the outfall continued until the Picton Sewage Treatment Plant was commissioned in 1999.

Today, raw sewage from mainly domestic and commercial premises is collected from within Picton and nearby Waikawa Bay, and then transported via the sewer network to the treatment plant off Gravesend Place. The transport of raw sewage through trunk sewers to the treatment plant is achieved by a series of five main pump stations as shown in Figure 1.

Figure 2: Treated wastewater prior to discharge to outfall



1.2 PICTON SEWAGE TREATMENT PLANT

The Picton Sewage Treatment Plant consists of inlet screening, an extended aeration activated sludge treatment process, clarification and UV disinfection. Sludge is stabilised in two lagoons and dewatered on-site in drying beds before being stockpiled on the nearby closed landfill.

The treatment plant currently treats a dry weather flow of 22l/s and a peak wet weather flow of 110l/s.

The treatment plant has performed well since commissioning with removal efficiencies for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) consistently in the 95 to 98 per cent range. As a result, the plant produces a clear, high quality wastewater with low concentrations of the key contaminants of BOD, TSS and microorganism (faecal coliforms and enterococci). The STP reduces bacteria such as Faecal Coliforms and Enterococci by 99.999%. Potentially pathogenic (disease-causing) viruses which can be more resistant than bacteria to UV disinfection are reduced by at least 99.9% by the treatment process. This means that most other pathogens, including larger organisms such as Giardia, are removed prior to discharge.

The mainly domestic and commercial nature of the raw sewage means that concentrations of potentially toxic contaminants such as heavy metals are low. In addition, concentrations of nutrient (nitrogen and phosphorus) and fats, oil and grease are also low.

Table 2 shows the results of wastewater monitoring for key contaminants in 2012/13. Figure 2 shows the clarity of the final treated wastewater before exiting the treatment plant.

At projected population growth rates, the treatment plant will require upgrading to double the treatment capacity by around 2070. This could include the installation of a second extended aeration basin and clarifier system. Provision could be made for further biological nutrient removal if required by future consents.

Table 2 - Picton Sewage Treatment Plant treated wastewater quality 2012-13

Parameter	Reported as	Statistical basis	Result of analysis
cBOD	g/m^3	Annual median	3

Parameter	Reported as	Statistical basis	Result of analysis
TSS	g/m^3	Annual median	8
Ammoniacal Nitrogen	g/m^3	Annual median	2.9
Faecal coliforms	Number/100mls	Annual geometric mean	72
	Number/100mls	Annual 90th percentile	1010
Enterococci	Number/100mls	Annual geometric mean	26

Figure 2: Treated wastewater prior to discharge to outfall

1.3 OUTFALL DISCHARGE PRIOR TO UPGRADING

Prior to upgrading in 2012, the wastewater pipeline conveyed treated wastewater about 3 km from the treatment plant to an outfall located at Kaipupu Point (see Figure 1). From the treatment plant, to a point on the western side of the harbour, immediately north of the entrance to the Port Marlborough log yard, the pipeline was laid underground. From this point to the outfall at Kaipupu Point, the 300 mm diameter pipeline was generally laid above ground on concrete pedestal supports. Pipe material was mainly Asbestos Cement (AC), which was failing due to corrosion and damage from falling rocks. As a result, Council had replaced a number of sections of the AC pipeline with PVC pipe.

The above-ground portion of the pipeline was considered by many to be an "eyesore" and incompatible with the role of Picton as the "tourist gateway to the south" (see Figure 3). The harbour area is popular for water recreation, and is on the inter-island ferry route.

The Kaipupu Point outfall consisted of a multi-point diffuser located between 58 and 88m from the shore discharging at a depth of between 16 and 21m.

Prior to the commissioning of the treatment plant in 1999, successive ecological survey reports by the Cawthron Institute noted that the discharge was having a significant, if reasonably localised, effect on the benthic environment. However, since the commissioning of the treatment plant, there was a progressive recovery noted in the "health" of the benthic environment.

Figure 3: View to the west across Picton Harbour towards log yard entrance showing above-ground AC outfall pipeline (replaced PVC sections in white)

2 RATIONALE FOR UPGRADING

While the existing outfall discharge consent, which authorises the discharge of treated wastewater at Kaipupu Point did not expire until August 2011, Council recognised that the existing method of discharge was not satisfactory, because of the poor condition of the existing outfall pipeline and also because the existing pipeline had limited hydraulic capacity.

As a consequence, there was a need to upgrade the outfall as a matter of priority. In addition, an upgraded outfall was required to cater for increased flows from the upgraded Picton Sewerage System.

It was also recognised that the relatively remote Kaipupu Point outfall was constructed prior the commissioning of the treatment plant in 1999 to maximise the distance between harbour recreational users and the discharge (thereby minimising public health risk). The high quality wastewater produced by the treatment plant provided Council with the opportunity to offer the community potential cost savings by replacing the long above-ground, visually obtrusive pipeline with a shorter, non-visible, outfall, while still protecting public health and the harbour environment.

Future opportunities to reuse some of the treated wastewater around Picton were also recognised.

3 ROLE OF CONSULTATIVE WORKING GROUP

Marlborough District Council favours the Consultative Working Group (CWG) approach to obtaining key stakeholder views on proposed infrastructure projects within the district. This approach worked well during the planning for the Blenheim STP upgrading and has been adopted for the upgrading of the Picton sewerage and water supply systems. The focussed consultative approach involves the following process:

- identification of key stakeholders groups
- an invitation to these groups to select a representative(s) to attend CWG meetings
- provision of an agenda prior to meetings
- presentations on key issues by Council and specialist consultants on options for upgrading followed by the opportunity for questions and discussion
- sufficient time between meetings for CWG representatives to solicit the views of their members
- an invitation for CWG representatives to shortlist options and request further information with an expectation that ultimately a recommendation would be made to Council on a preferred upgrading option.

Membership of the CWG was broad and included Te Atiawa, Department of Conservation, District Health Board, environmental groups, a residents' association, business groups, Forest and Bird, Port Marlborough and fishing interest groups.

4 CONSIDERATION OF WASTEWATER REUSE AND DISPOSAL OPTIONS

4.1 OVERVIEW

The CWG and Council considered a number of treated wastewater reuse and disposal options at a series of meetings between 2007 and 2009 and these are summarised in Table 3.

Table 3 - Summary of Possible Wastewater Reuse and Disposal Options

Irrigation of local "green" areas such as playing fields and parks.
Non-potable reuse, e.g. for toilet flushing or boat washing
Indirect and direct potable reuse, i.e. supplementation of reservoir or water supply catchment, or direct to consumer
Irrigation of pasture or forestry (either year-round or seasonal)
Discharge to water though outfall in Picton Harbour or Shakespeare Bay

Technical studies showed that currently, there was only limited opportunity around Picton for re-using treated wastewater. While some wastewater could be applied to playing fields at Queen Charlotte College and nearby Endeavour Park, this would be seasonal, represent only a small proportion of the total Picton Sewage Treatment Plant flows and have relatively high costs. There would be some cost savings if a pipeline was installed as part of the wider Picton Sewerage upgrading project. Some opportunities may exist to reuse wastewater for boat washing, but this would likely require upgrading of the treatment plant to further reduce pathogens (eg by using membrane technology).

Larger land areas were noted as available for land application of wastewater (by irrigation) in the Speeds and Tuamarina Valleys to the south of Picton, as well as on Port Marlborough land to the west. However, year-round irrigation of wastewater was deemed unlikely to be sustainable because of climatic (high rainfall) and soil constraints (poor infiltration). Council would be required to construct very large storage dams or discharge through an outfall, when irrigation demand was low or soil moisture too high for sustainable application. Wastewater irrigation in the lower Speeds Valley was viewed as potentially incompatible with other land uses, including the current abstraction of water for supply to Picton Township. The estimated capital costs of constructing and a wastewater irrigation system, to either pasture or forestry areas, within reasonable distance of the treatment plant, would be very high (between $22-28M in 2008). There would also be high operational costs as wastewater would need to be pumped long distances over hilly areas from the STP.

4.2 DISCHARGE TO WATER

Three options for discharging treated wastewater to water were assessed as:

- New 1,100 metre submarine pipeline from opposite the log yard entrance to the existing outfall at Kaipupu Point
- New 150 metre submarine pipeline from opposite the log yard entrance to a new outfall in mid-Picton Harbour
- New pipeline from opposite the log yard entrance to a new outfall in Shakespeare Bay
- Each of these options also required the construction of a new 1,340 metre pipeline from the Dublin Street/Lagoon Road intersection along Lagoon Road to a connection point near the log yard entrance.

The assessment of another outfall site midway between Kaipupu Point and the log yard entrance showed no distinct environmental or engineering advantages. However, construction costs would be significantly higher than at the mid Picton Harbour site. A fourth option, of installing a new above-water plastic or concrete pipeline

to Kaipupu Point, had no support from key stakeholders such as the Kaipupu Point Mainland Island Society or Department of Conservation.

Table 4 summarises the environmental and engineering issues for each option and provides a range of preliminary capital cost estimates. These estimates were based on discussions with contractors familiar with construction of pipelines and outfalls. From Table 4, it was concluded that the discharge of well-treated wastewater, at either Kaipupu Point or at the mid-Picton Harbour preferred site, would not have any significant public health or environmental effects. However, there would be substantial cost savings for the community if a shorter outfall was constructed.

The key engineering issues were identified as constructing a new pipeline along Lagoon Road, which carries significant road traffic to the InterIslander and Blue Bridge ferries, as well as providing road access to the Port Marlborough log yard in Shakespeare Bay, and the installation of the submarine pipeline and outfall in a busy harbour environment.

Table 4: Environmental and Engineering Issues and Preliminary Costs for Outfall Options

Option	Advantages	Disadvantages	Costs Range $M
Submarine pipeline to Kaipupu Point	▪ High quality discharge into deep water, well-separated from recreational areas ▪ Historical monitoring shows that effects on water quality and ecology are not significant ▪ May require less monitoring than other sites	▪ Higher ecological value area than other options ▪ More sub tidal disturbance during construction ▪ Longer construction time in busy harbour ▪ Significantly higher construction costs than other options	12.8 to 17.3
Short outfall to Mid Harbour	▪ High quality discharge into deep water, well separated from recreational areas ▪ Public health risk no greater than others sites ▪ Lower ecological values than Kaipupu Point ▪ Less sub tidal disturbance than Kaipupu Point during construction ▪ Shorter construction period than Kaipupu Point ▪ Lower construction costs than other options	▪ Possible adverse community perception ▪ Historical monitoring information not available and may require more monitoring than Kaipupu Point	6.1 to 8.8
Short outfall into Shakespeare Bay	▪ High quality discharge into deep water, well separated from recreational areas ▪ Lower environmental	▪ Less dispersive environment than other sites ▪ Possible adverse community perception ▪ Historical	

Option	Advantages	Disadvantages	Costs Range $M
	values than Kaipupu Point ▪ No significant disturbance during construction ▪ Lower construction costs than Kaipupu Point option	monitoring information not available and may require more monitoring than Kaipupu Point ▪ Construction through busy Port log yard and wharf area ▪ No substantive support from CWG or Port Marlborough	7.2 to 10.1

5 PUBLIC HEALTH EFFECTS

5.1 ASSESSMENT PROCESS

A key issue for Council was to assure the local community and other users of the Picton Harbour waters, that discharging treated wastewater at any of the short-listed sites would not result in any significant public health risks. It is now usual practice to carry out a Public Health Risk Assessment when considering the possible effects of discharging treated wastewater to waters that are used for recreational or shellfish gathering purposes. This assessment considers the increased risks of infection from accidental ingestion of viruses during swimming, or from eating raw shellfish at identified sites in the vicinity of the discharge.

The basis for using risk-based assessments is embodied in the statement by the Ministry for Environment/Ministry of Health (2003) that "*guidelines should not be directly applied to assess the microbiological quality of water that is impacted by a nearby point source discharge of treated effluent without first confirming they are appropriate… While it is correct to infer that water exceeding the guideline values poses an unacceptable health risk, the converse is not necessarily true. This is because effluent may be treated to a level where the indicator bacteria concentrations are very low, but pathogens such as viruses and protozoa may still be present at substantial concentrations …*". In other words, even though the receiving water quality as assessed by bacterial indicators meets the guidelines, the water may still not be safe for contact recreation or raw shellfish consumption due to the presence of pathogens (e.g. viruses) in the wastewater that the guideline bacterial indicator organisms do not account for.

A Quantitative Microbial Risk Assessment (QMRA) is now being increasingly adopted as a means of quantifying and comparing human health risks arising from discharge of treated wastewater. This procedure uses dose-response data for particular pathogens – rather than an indicator – alongside water users' exposures to potentially contaminated water and shellfish. This data is then used to calculate estimates of the risk of exposure to the pathogen.

5.2 QMRA RESULTS FOR PICTON MID-HARBOUR DISCHARGE

Council treats wastewater at the Picton Sewage Treatment Plant with ultra violet (UV) light before discharge. This is a well-known and effective means of reducing micro-organism concentrations. A Public Health Risk Assessment was carried out by the National Institute of Water and Atmosphere (NIWA, 2009) which is a recognised specialist in the field. The statistical approach for the Picton outfall assessment used *rotavirus*, which can cause gastroenteritis in humans, as the "model" for all pathogenic organisms that may be present at times in Picton's wastewater. A conservative approach was taken by selecting a rotavirus which is relatively resistant to UV treatment and survives well in the receiving environment.

The results showed a risk profile for recognised bathing and shellfish gathering sites in the harbour-known as the Individual Infection Risk (IIR) which was then compared to World Health Organisation (WHO) guidelines.

The results of the study showed that for "normal" virus concentrations in the raw wastewater entering the treatment plant, (ie non epidemic) the risk from any of the three outfall sites was negligible at all Harbour recreational sites ("exposure" sites). The mid-Picton Harbour preferred site only exceeded the IRR for shellfish gathering at the Picton Wharf (under northerly winds) and on the western shoreline near the log yard entrance (under southerly winds). However, neither of these sites provide any realistic opportunity for shellfish gathering and are already modified by other influences such as stormwater discharges and wharf operation.

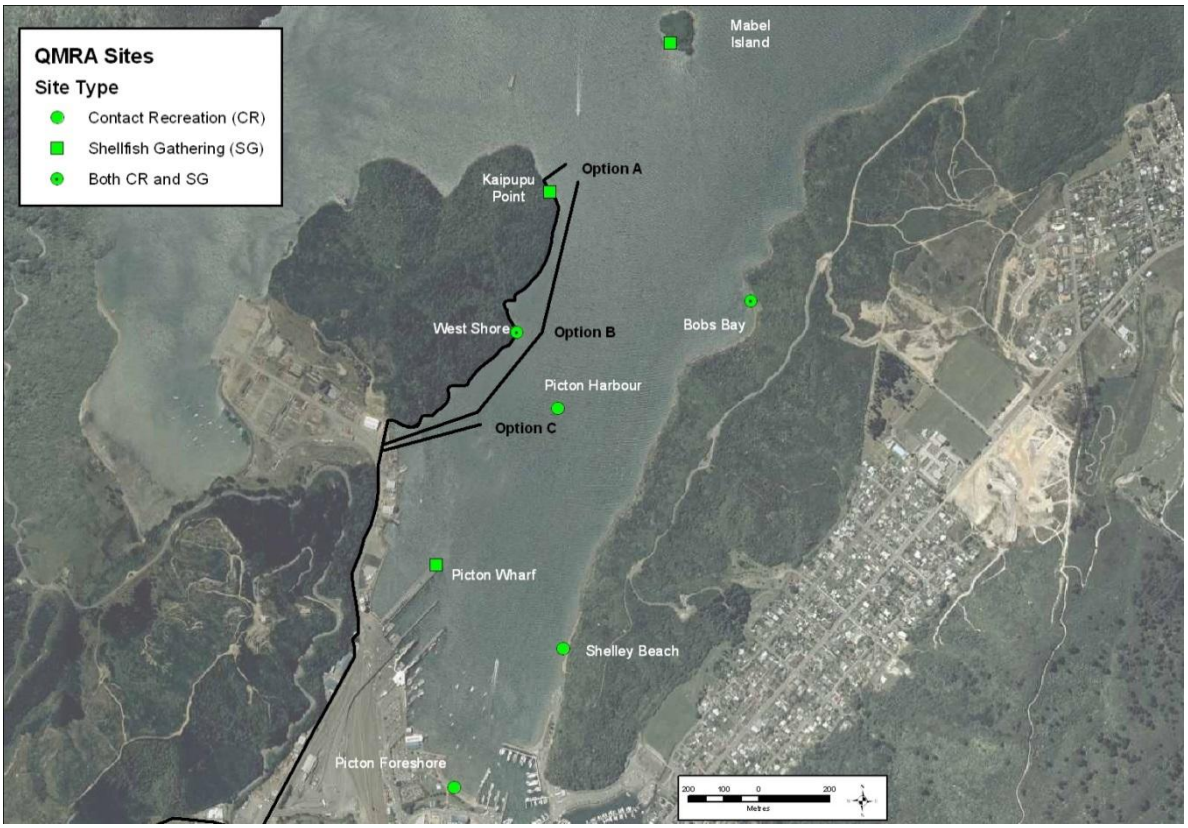
Under an "unusual" or epidemic virus inflow scenario, the risk threshold was exceeded for all three outfall sites at almost all recreational areas. However, NIWA noted that any extreme outbreak would be detected by the local medical community and measures to warn the public or limit shellfish gathering could be quickly implemented.

It is also noted that the QMRA produces inherently conservative results in regards to health risks because:

- The average UV dose is likely to be greater than used to determine virus reduction because of end-of-lamp and lamp fouling assumptions
- Using rotavirus in the QMRA (which is a very resistant pathogen to UV) means that it can be considered a "worst case" model for other pathogens
- The model assumes only horizontal dispersion of virus particles in the top 1 m of the water column (i.e. no vertical dispersion which will decrease concentrations further)
- The model calculates the risk of infection but not the risk of illness (of those infected, only a fraction become ill).

The exposure sites identified by key stakeholders and used in the model are shown in Figure 5.

Figure 5: Picton Harbour contact recreation and shellfish gathering 'exposure" sites



6 PREFERRED DISPOSAL OPTION

6.1 CWG RATIONALE FOR SELECTING THE MID-HARBOUR OPTION

The Consultative Working Group met on several occasions to consider wastewater disposal options and make recommendations to Council. After completion of technical work and consultation with the CWG, the Council

agreed that the preferred disposal option would be via a new mid-harbour submerged outfall located just north of the log yard entrance (see Figure 6).

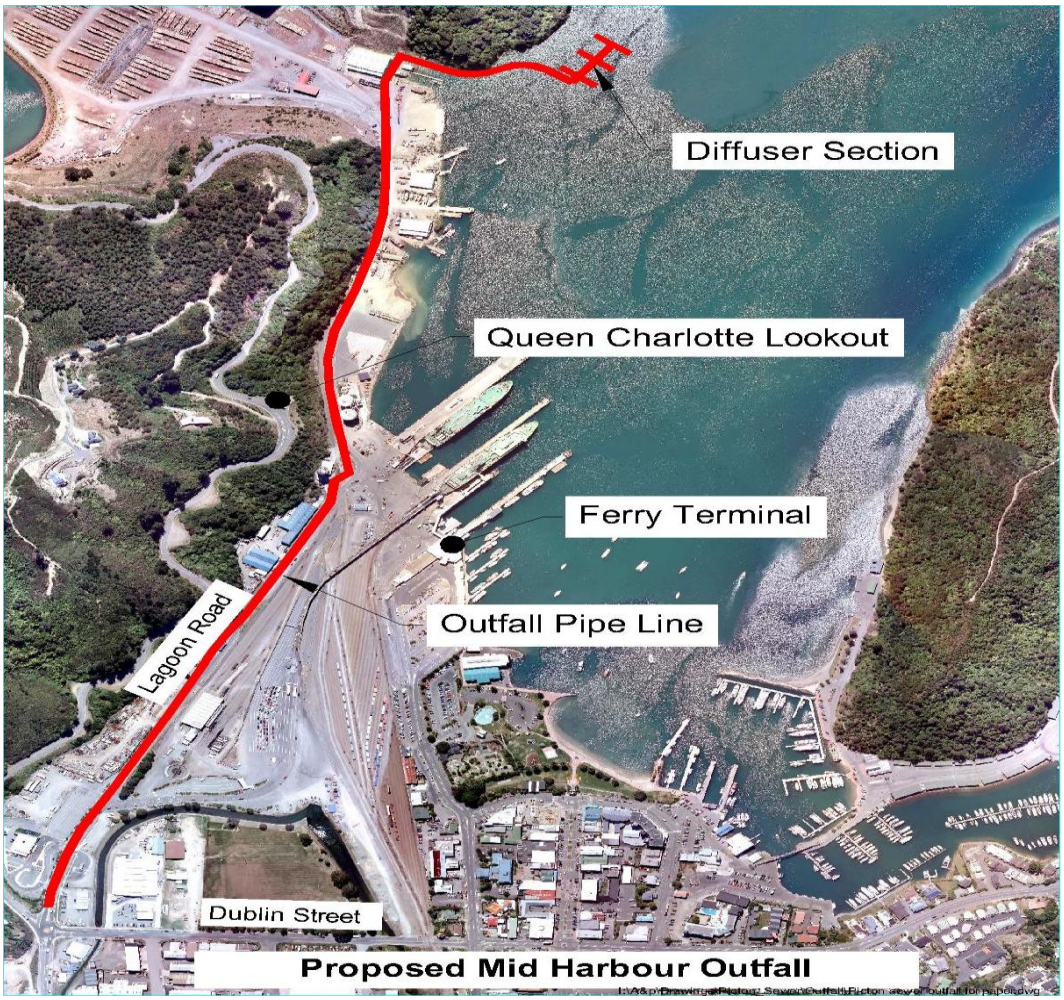
The CWG rationale for selection of this site is summarised as:

- The well-designed outfall diffuser would discharge a high quality clear wastewater into deep water (at least 13 metres) providing dilutions at average flows of greater than 230:1
- The discharge would not cause water to be unsafe for usual harbour activities
- The discharge would have no significant effects on marine organisms
- Neither swimming nor shellfish gathering are usual activities in this part of the harbour
- A short (150 metre long) submarine outfall would have significant cost savings for the community over other alternatives

Because the wastewater is well-treated, the significant separation distance to the Picton Foreshore that was required when untreated sewage was discharged, is now no longer necessary.

A key part of the upgrade would also be the removal of the highly visual above-water pipeline to Kaipupu Point.

Figure 6: Location of mid-harbour outfall near entrance to log yard



6.2 IWI POSITION

Council recognised that gaining iwi acceptance for a new outfall was an important consideration. As a result, separate meetings were held with Te Atiawa through the consultation process where the results of technical studies were presented and discussed.

Following this interaction, Te Atiawa noted in a written statement to Council that "*while the discharge of human effluent into water goes against the grain of Maori tikanga"* it appreciated:

- *"The current and proposed sewage situation are infinitely better than previous practice of raw sewage discharge relatively close to Picton*
- *The extra cost and logistics involved in the Kaipupu Point discharge compared with mid-harbour outfall*
- *The fact Council and the local community (as a small ratepayer base) need to strike a realistic balance between environmental and financial concerns"*

Te Atiawa accepted the mid-harbour option as the proposed discharge location on the basis that providing the discharge is treated to a very high standard and is regularly and strictly monitored, with reports on its performance forwarded to Te Atiawa.

If problems do arise with the mid-harbour site, Te Atiawa would wish to have the Kaipupu Point site re-considered.

This pragmatic position adopted by Iwi provided a strong platform for Council's decision-making.

6.3 OTHER CONSULTATION

In addition to consultation with the CWG and iwi, Council also met independently with other key stakeholders including Port Marlborough, Harbourmaster, ferry operators, Department of Conservation, Kaipupu Point Mainland Island Society, and businesses in proximity to the outfall.

An article on progress with the work was published in the Marlborough Express, together with a community information update to local ratepayers. Further details on the proposal were made available from Council's Picton Service Centre, and also placed on the Council website.

All of these interactions and communications proved invaluable during the decision-making and consenting processes.

7 SUCCESSFUL OUTCOMES

The outcome of the outfall "optioneering" and consultation phases was the preparation of an Assessment of Environmental Effects (CH2MBeca, 2010) and consents application. A smooth consenting process followed with only 2 submitters (iwi and one member of the public (no institutional submitters) and no appeals. A 35 year consent was subsequently granted with monitoring conditions appropriate to the scale and effects of the outfall discharge. Because of the high quality of the treated wastewater, there is a strong emphasis on maintaining treatment plant performance and monitoring of the discharge. Environmental monitoring is kept to an appropriate minimum with emphasis on regular benthic surveys (at 2 years and then at 5 yearly intervals), yearly outfall inspections and a one-off confirmation of the performance of the diffuser.

The outfall pipeline and diffuser work was completed in December 2012 without significant disruption to other road or harbour users at a cost of $3.7M. This represents a "win-win" for Council and the community with substantial cost savings without compromising the public health or environmental values of the harbour. Indeed, the removal of the above-ground pipeline and the Kaipupu Point outfall and diffuser, provides an environmental and recreational benefit to harbour users.

The results in the latest Annual Monitoring Report required by the consent, show that quality of the wastewater discharged from the Picton STP is well within consent limits. No effects from the discharge have been observed within or outside the mixing zone specified by the consent.

Cawthron has since verified that the outfall diffuser is operating according to design requirements by use of a dye release study to confirm dilution.

8 PICTON SEWERAGE UPGRADING

The consenting of the new outfall is a key first stage in the overall upgrading of the Picton Sewerage System.

Currently, wet weather flows in excess of the capacity of the existing sewers and pump stations, overflow to surface waterways which then flow into Picton Harbour and Waikawa Bay. Council is implementing a staged upgrading of the sewerage system which will reduce the incidence of overflows to waterways and the coastal marine area.

Part of this upgrading work will involve pumping flows, in excess of the capacity of the treatment plant, from the Dublin Street Pump Station to a Bypass Treatment Facility. This will significantly reduce both the solids and micro-organism concentrations before discharge to the new outfall.

The reduction of the shoreline overflows will significantly reduce the health risks at several popular Picton and Waikawa Bay beaches.

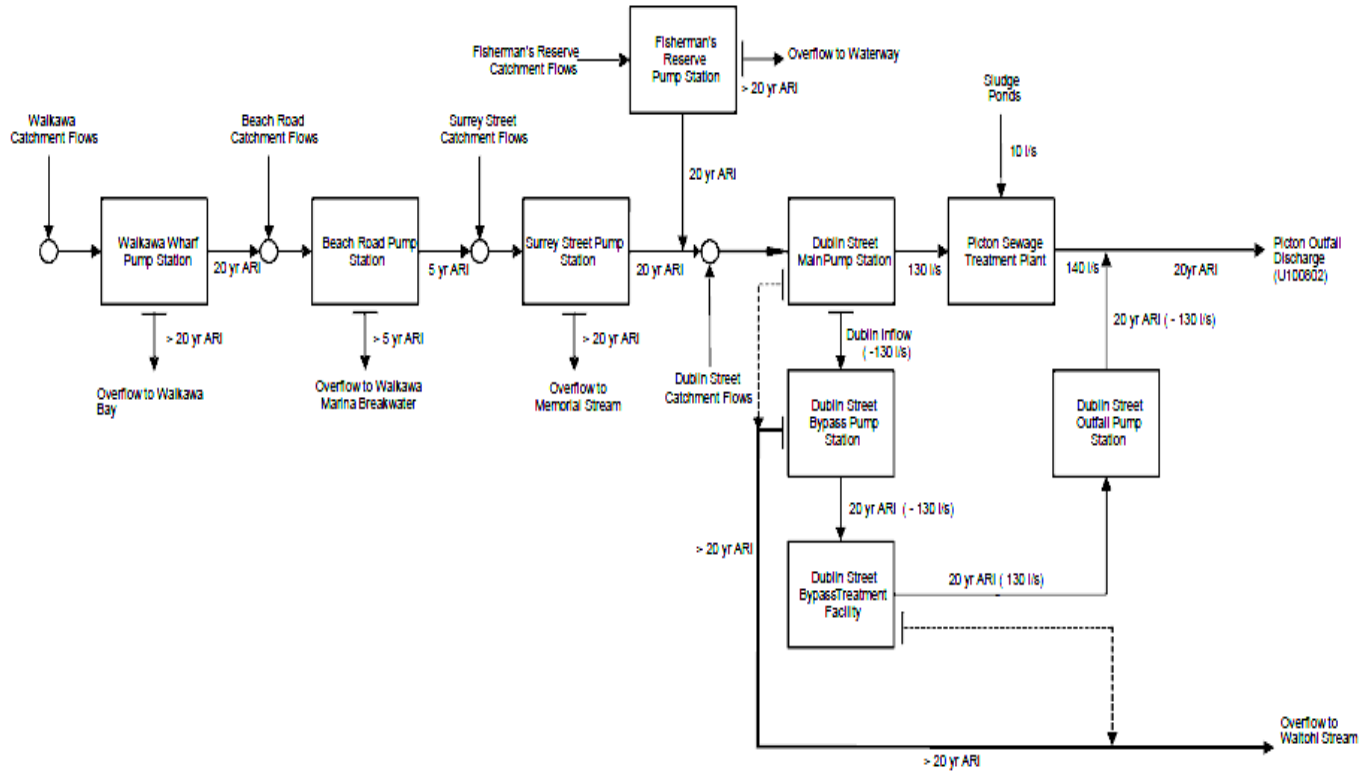
Council has now obtained consents for Stages 2 to 4 of the works which will include upgrading or replacement of five pump stations, the construction of the Bypass Treatment Facility at the Dublin Street Pump Station, and replacement of most of the trunk sewer between the Waikawa and Dublin Street Pump Stations.

Council successfully used the CWG approach to obtain wider community views during the options assessment and consenting of the sewerage upgrading project. Again, the outcomes were positive with 35 year overflow consents confirmed without any significant opposition.

The upgrading work, which is expected to be completed in 2019, will reduce the duration, frequency and volumes of overflows, further reduce public health risk, improve coastal water quality, increase system capacity and provide for the future growth of Picton and Waikawa.

A schematic of the proposed Picton Sewerage Upgrade is shown in Figure 7.

Figure 7: Process schematic of proposed Picton Sewerage Upgrade



9 CONCLUSIONS

The successful outcome of the Picton treated wastewater outfall project reinforces the following:

- While initial public perception may be adverse when dealing with potentially contentious projects such as outfalls, this can be altered with good technical information and appropriate consultation.
- A willingness to consult through the project with representative Community Working Groups, key stakeholders and the wider public was the key to good decision-making for the project.

- The preparation of robust, technically defensible information that addresses the key issues and is delivered to stakeholders in a meaningful way is essential for a desirable consenting outcome. The desirability of using the results of tools such as the QMRA process for public health risk assessment is particularly noteworthy. This tool provides a better assessment of the risks due to the presence of pathogens (e.g. viruses) in the wastewater that are accounted for by monitoring guideline bacterial indicator organisms.

10 REFERENCES

- CH2M Beca (2009); Picton Sewage Treatment Plant Pipeline and Outfall-Application for Resource Consents and Assessment of Environmental Effects
- Ministry for Environment/Ministry of Health (2003); Bacteriological Water Quality Guidelines for Marine and Freshwater Recreational Areas
- NIWA Ltd (2009); Calculating Risks Associated with Future Discharge of Treated Effluent from the Picton STP; NIWA Report HAM 2009-054