

# Akaroa Reclaimed Water Beneficial Reuse, Treatment and Disposal Options

# **FRIENDS** of Banks Peninsula

## WE WISH TO BE HEARD IN SUPPORT OF OUR SUBMISSION

Submission from: FRIENDS of Banks Peninsula Inc. PO Box 56 Duvauchelle 7545 Banks Peninsula Canterbury Email: info@friendsofbp.org.nz

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Fundamentally, what environment	t would you prefe	er Akaroa wastewater i	s discharged into?
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- Irrigation of reclaimed water to trees or pasture
- Disposal via a new outfall pipeline to the mid-harbour
- ✓ Other (please describe)

Please state your reasons why: We prefer beneficial re-use of the water in Akaroa

Please rate the options listed below with a number according to your preference, with 1 being your most
preferred option and 5 your least preferred option (please note the options below are in no particular order)

Option 1-	Irrigation	of trees	or pasture	1n	Robinsons	Bay
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Option 2 – Irrigation of trees or pasture at Pompeys Pillar

Option 3 – Irrigation of trees or pasture in Takamātua Valley, in combination with another area

- Option 4 Non-potable reuse in A karoa, in combination with another option
  - Option 5 Disposal via a new outfall pipeline to the mid-harbour
  - Other (please describe)

Please state your reasons for this ranking: Please see our submission for the options we seek in combination with Option 4

Would you be more supportive of spray irrigation of treated wastewater to pasture or drip irrigation to trees? Please state your reasons why:

See submission. This is dependent on the location.

Do you have a preference for the location of reclaimed water storage pond(s)? Please state your reasons why:

Pond site 10, covered to avoid odour and midges given proximity to residences and to avoid fouling before re-use in Akaroa.

Do you think the Council should add aspirational projects to the Akaroa wastewater scheme (e.g. fire storage ponds, providing a reticulated wastewater scheme in Takamātua Valley)? If so, which ones do you support and why?

We support aspirational projects. Please see our submission.

**Do you have any other comments? (Please use additional paper if required):** Please see our submission.

## **Executive Summary**

Water is a precious resource. Water restrictions are in force every summer in Akaroa. Its stream fed supply is under such stress that since 2014 the town has had to draw on the neighbouring Takamatua catchment to meet its water demand.

CCC has a problem it needs to address: disposal of Akaroa's wastewater.

#### What if solving this problem could reduce Akaroa's water shortage issue at the same time?

Data supplied by the Council shows there is more *demand* in Akaroa for external water use (garden watering) than all the wastewater it currently *generates*. With appropriate treatment this wastewater can be efficiently transformed to an almost drinkable standard, turning it from a problematic waste back into a valuable and much needed resource. The key to public acceptance is the highest standard of treatment. People must be convinced that the reclaimed water is 100% safe.

Akaroa's water shortage issues are only predicted to get worse. By taking a sensible step now, the Council can solve two problems at once - bring to an end the disposal of wastewater into the harbour and increase Akaroa's resilience by conserving its potable water supply.

**Friends of Banks Peninsula Inc. was established in 1990** to protect and enhance the environmental heritage of Banks Peninsula and safe-guard the environment for future generations. The society has been involved with the Akaroa Wastewater issue over many years and participated in the Akaroa Area Water Services Working Party in 2008 and the recent Akaroa Treated Wastewater Reuse Options Working Party.

This second Working Party was established by the Banks Peninsula Community Board in response to the *"Community Strategy toward an Acceptable Solution to the disposal of Akaroa Wastewater"* presented to it by Friends of Banks Peninsula on January 30, 2017. We commend the Community Board for setting up this Working Party and for its choice of Penny Carnaby as the Chair. We believe that as a result of the Working Party deliberations, solutions potentially acceptable to the community have emerged.

The consultation booklet released by the Council offers options sweeping in their breadth and potential impacts, but limited on the detail of how they would be implemented. The plethora of potential sites for storage and disposal is confusing. This submission presents an environmentally sustainable solution based on combining the options to maximise the benefits, minimise the risks, decommission the existing treatment plant at Takapūneke as soon as possible and providing the most resilient for the long term.

#### 1. The best solution is one that reclaims and beneficially re-uses the water, rather than wastes it.

- Under a *beneficial re-use* system the water is taken up by the receiving environment (be it a farm, garden watering) as it is best needed. The water is treated as a resource.
- Under a *disposal* system the water is distributed to the receiving environment to get rid of it, whether the environment needs it or not. The water is being dumped as unwanted waste.
- Beneficial use is maximised when the water is *used where it is needed most*.
- 2. This submission presents two environmentally sustainable solutions that maximise benefits and minimise risks by combining options from the consultation document, and identifies those solutions that do not meet this aim.
  - We signal to the Council that Friends of Banks Peninsula is likely to participate in the submission process to any future consent, and we hope this will be in support of a great solution.

- 3. Friends of Banks Peninsula strongly supports Option 4 Non-potable re-use in Akaroa. This forms the basis of the best solution.
  - Re-use in Akaroa puts the water where it is of most benefit to the environment and people
  - Re-use would be on a **voluntary basis**, with people taking the water because they needed and wanted it.
  - The water must be treated to the highest standard, safe for watering vegetables including salad crops.
  - By taking a lead with re-use in the public toilets and irrigating parks, the Council will demonstrate its confidence in the safety of the water, and it will serve as an incentive for the Council to maintain treatment levels at the highest standards. We recommend a public exemplar garden is developed.
  - The Council's lead will encourage other voluntary uses of the water.
- 4. Option 4 signals Council's intention to add a reticulated purple pipe (reclaimed water pipe) system through the town enabling more households and businesses to use it over time.
  - We would expect this commitment to be reflected in the Council's Long Term Plan process prior to lodging its resource consent.
  - Data in the latest Beca report indicates that *100% of current wastewater flow* could be reused in Akaroa on external uses (such as garden watering).
  - We recognise that it will take time to reticulate the whole town with a purple pipe system enabling non-potable re-use in Akaroa to absorb 100% of the water, so another method will be needed during the years of transition. Public education to discourage wasteful use of potable water use will assist with this.
  - We recommend full nitrogen removal, ultrafiltration and disinfection (e.g. chlorination) is adopted to produce water of a suitable quality for re-use without causing long-term environmental effects or limiting its suitability for re-use.
  - We signal the need for a back-up should a wet summer reduce the demand from Akaroa to the point that it doesn't use all of the supply.

# 5. Option 4 must be combined with another option to take all the water. We present two solutions for the remaining water during the transitional period:

#### Transitional outfall to Akaroa harbour

- A transitional harbour outfall frees up the most capital for investment in the Akaroa purple pipe system. Operational costs are also lowest.
- We present two alternatives for implementing a transitional harbour outfall. Both piggyback onto the purple pipe re-use infrastructure to minimise additional costs. They are:
  - New mid-harbour outfall
  - Use the existing Takapūneke outfall
- Both enable the Council to redirect budget toward installing more of the reticulated purple-pipe network, setting the Council on a path to achieve 100% re-use in the shortest timeframe

- Both enable the Takapūneke wastewater *plant* to be decommissioned as soon as the new plant is operational, but the less expensive of these alternatives retains its *outfall* pipe.
- Disadvantages of a transitional harbour outfall are that the water disposed of to the harbour during the transitional period is being wasted and Ngāi Tahu are being asked to wait longer before disposal to the harbour ends.

#### Agricultural use at Pompeys Pillar

- Support for this option is predicated on the landowners reaching an agreement with Council that is satisfactory to them.
- Managed as part of the farm, all the water will be put to a beneficial purpose from the outset, however the capital cost is higher than harbour outfall, so less funding may be available for re-use in Akaroa where the environmental and community benefit is greater.
- We recommend that all land identified as geo-technically suitable at Pompeys Pillar is included in the irrigation areas regardless of whether it is overlaid with the Outstanding Natural Landscape zone. This increases the opportunity for beneficial re-use by giving the farm greater flexibility, lowers the risk of the irrigation area failing to absorb the hydraulic and nutrient loads and, we suggest, will actually be *less* visually intrusive.
- Pumping the water over the hill means higher operating costs. The trade-off is that this option is the most rapid land-based system to set-up, and the potential to include high-altitude fire ponds may be another benefit.
- The Takapūneke plant and harbour outfall would both cease as soon as Pompeys Pillar is operational.

# 6. We do not support the remaining options in the consultation document for the following reasons:

- Disposal to Takamatua does not make beneficial use of the water. It is impractical because of the fragmented nature of the identified areas. It has high opportunity cost because it converts high value lifestyle and residential land into a low value disposal area, and negatively impacts a large number of people. It is a high-risk solution because it is proposing disposal in a valley catchment, when the ability of the peninsula soils to take up the water and nutrients is not accurately known, and the sloping terrain and proximity to waterways increases both the probability and impact of failure. The proximity to residents exacerbates the collateral damage of such a failure.
- Disposal to Robinsons Bay does not make beneficial use of the water either. In the lower valley, it too has high opportunity cost and carries the same risks as Takamatua valley. Even in the upper valley, it is a high-risk solution because of unknowns in the ability of the peninsula soils and native trees to take up the water and nutrients, the sloping terrain and proximity to waterways, and the number of residents in the vicinity.
- Pompeys Pillar as a stand-alone option may be acceptable, but would not extract the maximum benefits from the water and does nothing to solve Akaroa's water shortages.
- Permanent harbour outfall makes no beneficial use of the water, and does nothing to solve Akaroa's water shortages. It fails to address the cultural concerns of Ngāi Tahu, now or in the future.

#### 7. We present a detailed consideration of the options

- We have reviewed the latest Beca report and all the earlier technical reports, and draw attention to the many and substantial knowledge gaps and other issues identified in these documents
- We have researched land-based *disposal* systems elsewhere and are aware of a significant number of failures, principally due to nitrogen saturation and leaching. Our submission identifies that additional nitrogen removal over that proposed for the treatment plant would be necessary, and factors in the associated additional cost.
- We have researched recycling wastewater for beneficial *re-use* and find it is increasingly . used to successfully overcome water shortages, often with a mix of different components taking up to the water, driven by demand.
- We present re-evaluated cost estimates based on the combined solutions we have • presented, including our proposed variations to the details and costings of the consultation options
- We believe the cost estimates and assumptions in the consultation document should be subject to an independent peer review
- 8. Environmentally sustainable solution summary and costings Non-potable re-use in Akaroa with residual options

We believe that the following cost estimates would apply to the solutions we propose, based on the information disclosed by Council to date and therefore subject to the same + or - 30%.

Option	Estimated Cost	Combined Total
Non-potable re-use in Akaroa (includes full nitrogen removal)	\$3.5m	
Transitional mid-harbour outfall for residual	+\$4.2m	\$7.7m
Transitional Takapūneke outfall for residual	+\$1.5m	\$5.0m
Pompeys Pillar for residual	+\$12.7m	\$16.2m

## **Table of Contents**

1	Intro	oduction	1
2	Back	<pre><ground< pre=""></ground<></pre>	1
	2.1	Friends of Banks Peninsula objectives	1
	2.2	2008 Akaroa Area Water Services Working Party	2
	2.3	Consent application and decision	3
	2.4	2016 Consultation	3
	2.5	Revised study area options announced	3
	2.6	Technical Experts group	4
	2.7	Community Strategy Principles	4
	2.8	2017 Akaroa Treated Wastewater Reuse Options Working Party	5
3	Dist	inguishing between Disposal and Beneficial Re-use	5
	3.1	Potential cost savings with a Beneficial Re-use approach	6
4	Cha	llenges with land irrigation on Banks Peninsula	6
	4.1	Risk of slips and flooding	6
	4.2	Storage ponds	7
	4.3	Irrigation methods	8
	4.4	Experience elsewhere with land disposal	9
	4.5	Future climate and population trends	10
	4.6	A New Zealand first	10
5	Qua	lity and Quantity - Reducing the problem	11
	5.1	Highest Treated Water quality	11
	5.2	Minimising outflows	13
6	Ben	eficial Re-use of treated wastewater in other countries	.14
7	Envi	ronmentally sustainable solution based on Option 4 - Non-potable re-use in Akaroa	15
	7.1	Conditions	15
	7.2	Achieving 100% usage	15
	7.3	Assessment against Principles	15
	7.4	Short term implementation	.16
	7.5	Long term	.16
	7.6	Costings	16
	7.7	Residual flows	17
8	Resi	dual flow to a transitional harbour outfall for disposal	17
	8.1	Conditions	17
	8.2	Assessment against principles	18
	8.3	Short term implementation	18
	8.4	Long term	20

8.	.5	Re-e	evaluated costings	.20
8.	.6	Harl	oour outfall as a standalone option	.21
9	Res	idual	flow to Pompeys Pillar for beneficial re-use	.21
9.	.1	Con	ditions	.21
9.	.2	Asse	essment against principles	.23
9.	.3	Sho	rt term implementation	.23
9.	.4	Lon	g term	.23
9.	.5	Re-e	evaluated costings	.23
9.	.6	Con	sideration of Pompeys Pillar as a standalone option	.24
10	0	Dispos	al based options	.25
1(	0.1	Disp	osal via harbour outfall	.25
1(	0.2	Land	d-based disposal	.25
11	C	Optior	e development process	.28
12	S	Summ	ary of options	.28
13	C	Conclu	sion	.33
Арр	endi	x 1	Expert advice EcoEng	.35
Арр	endi	x 2	Assessment of options against Community Strategy Principles	.38
2.	.1	Opti	on 4 Non-potable re-use in Akaroa	.38
2.	.2	Pom	peys Pillar residual solution	.39
2.	.3	Harl	oour outfall residual solution	.39
Арр	endi	x 3	Calculating re-use potential	.41
Арр	endi	x 4	Technical matters outstanding	.43
4.	.1	Kno	wledge gaps	.43
4.	.2	Una	nswered Working Party questions	.45
4.	.3	Inad	lequate data	.45
4.	.4	Nitr	ogen removal requirements	.45
4.	.5	Ecol	Eng review advocates caution	.46
4.	.6	The	need for a peer review	.46
Арр	endi	x 5	References	.47
Арр	endi	x 6	List of names endorsing this submission	.48

## 1 Introduction

Friends of Banks Peninsula has been involved with the Akaroa Wastewater issue for many years and we agree with the Council that the disposal of Akaroa's wastewater is a complex problem with no easy answers. However we do believe that progress has been made and the Council is now poised to develop an innovative and environmentally sound solution to this long-standing problem.

This submission presents solutions we believe would be acceptable to the community and environment through appropriate implementation of the options presented in the Akaroa Reclaimed Water Beneficial Reuse, Treatment and Disposal Options Consultation booklet.

Our submission opens with an introduction to the Friends of Banks Peninsula Incorporated society, and its long-standing involvement with the issue of Akaroa's wastewater. We draw a clear distinction between *disposal* and *beneficial re-use* of treated wastewater and describe the technical challenges facing land based *disposal* given the area's topography. The acceptable solution we then propose is based first and foremost around *beneficial reuse* of the water in Akaroa for external use, principally **garden watering**, and we provide reference examples where this is already done in other places. We present two different options for disposing of the remainder of the treated water during a transition period to 100% re-use in Akaroa. We identify and discuss the advantages and disadvantages of each.

We flag that costings associated with each option will need to be re-evaluated in the acceptable solutions and have attempted to do this using the latest information provided in the Beca<sup>15</sup> report dated on March 31, 2017.

We suggest that regardless, all costings in the consultation booklet and the Beca report are subject to a rigorous peer review as many constituents of the overall options have been changing rapidly in the period immediately prior to release of the consultation document, and expertise in relevant disciplines such as ecology and commercial marketing does not appear to have been included in the project design. In particular the concept of beneficial re-use in Akaroa has only been recently introduced and the solution needs more work. We offer to assist the Council with this process.

For clarity and completeness we also identify solutions that could potentially be developed from the consultation options that we do not support.

## 2 Background

The Friends of Banks Peninsula is an incorporated society founded in 1990. It works to protect and enhance the unique environmental heritage of Banks Peninsula and safe-guard the environment for future generations, with a focus on the Akaroa area. Our involvement with the Akaroa wastewater issue for many years means that we have read and analysed in detail many technical documents and presentations that underpin the options given in the consultation document. Hence our submission is based on a thorough understanding of the issues and how potential solutions have progressed and developed over the years.

#### 2.1 Friends of Banks Peninsula objectives

The founding objectives of Friends of Banks Peninsula are to:

- Protect and enhance the environmental heritage of Banks Peninsula
- Encourage and support activities related to the maintenance and re-establishment of the flora and fauna of Banks Peninsula

- Act as an umbrella society to link individuals and small groups concerned with Banks Peninsula environmental issues
- Enable residents and visitors to become more involved in the environment and conservation of Banks Peninsula
- Work with local authorities and central Government to promote sound environmental practices

Achievements over the years include:

- Setting up the first recycling facilities in Akaroa, now managed through Christchurch City Council
- Extensive involvement with the District Plan and resource management process ensuring local environmental concerns are recognised
- Promotion of marine conservation and protection of the harbour and its wildlife and natural environment
- Many successful campaigns to protect the area from inappropriate developments including appeals to the Environment Court.

#### 2.2 2008 Akaroa Area Water Services Working Party

Friends of Banks Peninsula actively participated in the Akaroa Area Water Services Working Party set-up in 2008.

We are part of a community with a strong desire to respect culture and heritage. We understand the cultural sensitivity of Takapūneke to Ngāi Tahu and its significance to the heritage of New Zealand. We agree that to operate a sewage treatment plant at this site is offensive. We note that it is from this shared desire to respect culture and heritage that the Akaroa wastewater issue principally arises. In the absence of such cultural and heritage issues, the relocation of the wastewater treatment plant and cessation of its associated harbour outfall would probably not be happening now.

However, through the Akaroa Area Water Services Working Party the society agreed that:

- A new plant be located away from Takapūneke Reserve
- The plant should be designed to produce wastewater that achieves the best quality possible at the time, and the membrane plant at Turangi was considered the minimum performance level acceptable.
- After much investigation into land disposal, it was found to be infeasible and hence an outfall located in mid-harbour was recommended, with the location to be chosen to maximise dilution of the wastewater. The outfall design was to facilitate extension to the ocean later if required.
- The design of the plant was to allow for beneficial re-use of the water and land irrigation would be trialled to determine parameters for better decision making.
- The cultural concerns of Ngāi Tahu would be managed by passing the water over or through land prior to harbour discharge.

The work of this first Working Party was informed by a Council-initiated feasibility study: "Akaroa Wastewater Treatment and Disposal: Wastewater Options and Risk Analysis Report"<sup>1</sup>. This report advised that irrigating **all** of the treated wastewater to land was not feasible because of the risk of instability during winter irrigation. The report concluded that a mid-harbour outflow presented the most cost-effective solution, but with the highest cultural concerns to local iwi. A "hybrid" solution irrigating some of the wastewater to land and discharging the rest via some form of land overflow

(e.g. constructed wetland similar to that constructed at the Blenheim WWTP) was also considered feasible and potentially acceptable to iwi, albeit at greater cost. For any form of land disposal the report recommended that the solution be staged such that the volume of water irrigated was increased gradually over many years and as the actual risk of instability or other adverse effects was ascertained through careful monitoring.

## 2.3 Consent application and decision

The Council's 2015 consent application to relocate the plant to the top of Old Coach Road and the outfall to a mid-harbour discharge was largely in-line with the 2008 Working Party's recommendations and as there were not matters of great concern to the Friends of Banks Peninsula and no community groups approached it, the society did not participate in the consent process. With hindsight this was unfortunate, as it meant we did not participate in the subsequent appeal of the decision to decline the harbour outfall.

The approach taken in the 2015 consent application had been one of the harbour as a permanent solution based on *disposal* of the water. Re-use was mentioned, but there was no serious commitment to follow-up with definite actions. We appreciate the Commissioner's point that the sunk cost of this harbour outfall could well dissuade future investment in a re-use approach. We believe that had the Council shown a genuine commitment to re-use the consent might have been approved as part of a transition to a longer-term solution and a "last resort" emergency outflow during prolonged wet conditions.

## 2.4 2016 Consultation

Faced with the task of investigating land-based options after the harbour outfall had been declined, the Council yet again took a *disposal* based approach. Options considered were based on finding the minimum amount of land meeting purely geo-technical considerations rather than looking for solutions based on beneficial re-use - such as the Commissioner's suggestion of setting up an irrigation scheme on a large remote farm and then on-selling it as a commercial enterprise.

Nevertheless, the approach did break new ground, in particular introducing the concept of accumulating wastewater during the winter in very large storage ponds.

In April/May 2016 the Council carried out its initial consultation exercise on a range of land-based and coastal infiltration options. We were impressed by the calibre of submissions from Takamatua residents concerned about the ability of their valley to absorb the additional water and the proximity of many residences to the areas selected for irrigation. They urged Council to adopt a higher treatment level and to re-use the water in Akaroa. What support there was for land irrigation favoured trees, but with the proviso that much further investigation and research was needed.

Harbour outfall was the most popular response to this consultation.

In the end further geo-technical work revealed that the principal area identified for disposal irrigation on the Takamatua headland was unsuitable, and the Council was forced to look for new options.

## 2.5 Revised study area options announced

New proposals were released to the public at a meeting held in the Gaiety Theatre in Akaroa in November 2016. It was disappointing that the new options did not take account of the Takamatua submitters concerns, and once again the Council chose to focus an intensive *disposal* approach, limited its consideration largely to geotechnical issues, and ruled the Akaroa catchment out of the study thereby negating the ability of Akaroa to be part of the solution to its own problem.

Friends of Banks Peninsula re-engaged with the wastewater process at this point when it was approached by community members from Robinsons Bay, deeply concerned about the impacts on their local environment. The new proposals had identified irrigation areas on many residential and

lifestyle properties in Robinsons Bay as well as Takamatua valley, with setbacks from houses and streams of only 5 metres for drip irrigation or spray irrigation within 25 metres. While the Council claimed the water would be treated to a safe standard, it also acknowledged that at times of heavy rain, infiltration of the sewage network with storm water would overwhelm the plant capacity and bypass flows with a much lower treatment standard would be released to the irrigation ponds. Furthermore, the huge ponds themselves would be located close to homes potentially ruining the amenity of the areas and drastically reducing property values of those affected. Residents were unanimous in their view that trees planted right along these valley floors, or the introduction of large areas of spray irrigation would completely change the amenity of these rustic pastoral valleys and have a major impact their lives, both properties identified for irrigation and the surrounding neighbours. The stigma associated with having the ponds and irrigation of wastewater foisted onto them was acute, and owners with properties on the market felt the direct brunt when their properties failed to sell.

#### 2.6 Technical Experts group

Friends of Banks Peninsula's first step was to seek advice from Andrew Dakers of EcoEng, a highly respected wastewater engineer whose work had underpinned the original Harrison Grierson report in 2010. His view was that before he could give such advice, he needed to engage with the Council's engineers to better understand the groundwater and soil modelling being used to develop the parameters underpinning the new options. In response the Council formed a Technical Experts group, working under an Environment Court protocol. This group reviewed technical aspects of the investigations undertaken so far, considered community concerns and identified areas requiring further investigation.

## 2.7 Community Strategy Principles

At the end of January, 2017, Friends of Banks Peninsula presented the "*Community Strategy toward an Acceptable solution to the disposal of Akaroa Wastewater*" to the Banks Peninsula Community Board. 18 residents from Takamatua valley and Robinsons Bay travelled to Lyttelton to make the delegation and a further 58 sent apologies.

The *Community Strategy* proposed working collaboratively with the Council to find a solution with broad acceptance through the application of principles to govern the selection of wastewater disposal sites, these being:

Principle A.	Wastewater treatment must be consistent and to the highest standard
Principle B.	Disposal must be in the right area, not one that externalises risks and costs onto adjoining residents, or destroys the amenity or health of the environment
Principle C.	Solution must be sustainable in the long term and robust in the event of natural disasters
Principle D.	Solution must meet Ngāi Tahu cultural values
Principle E.	Akaroa must be actively involved in the solution
Principle F.	Managed process and infrastructure
Principle G.	Ideally find a solution that makes beneficial use of the water
Principle H.	Obviate the need for compulsory purchase
Principle I.	Options put out for public consultation must be sufficiently detailed for the public to make an informed choice

## 2.8 2017 Akaroa Treated Wastewater Reuse Options Working Party

Friends of Banks Peninsula was pleased that the Banks Peninsula Community Board responded by forming the Akaroa Treated Wastewater Reuse Options Working Party, with members drawn from the Board, and affected communities and rūnanga. It was attended by technical staff and had the ability to send questions to the Technical experts group. The Working Party met seven times in a series of intense and sometimes gruelling sessions.

Friends of Banks Peninsula made two significant presentations to the Working Party asking for technical issues to be more fully addressed and presenting an alternative solution to those tabled by the Council at the time. The alternative was based on a distributed network of ponds and irrigation facilitating re-use in Akaroa.

As a result of the Working Party discussions and the support it received from the Technical Experts, Beca, PDP engineers and the Council staff working through these issues and alternatives, several significant improvements to the original proposals are now in the consultation options. These include:

- Addition of Pond Site 10 on Old Coach Road, opposite the new treatment plant site. This was agreed by all at the Working Party as the best option for the principal storage pond, as it facilitates re-use in Akaroa as well as the other options;
- Commitment by Council staff to remove the bypass flows concept and instead increase the capacity of the plant and include a pre-plant storage pond to ensure that all wastewater passes through the full treatment process;
- Engagement and negotiation with the landowners at Pompeys Pillar to work toward arrangements that work for them;
- Recognition that irrigation around residential properties is problematic and that a greater distance from residential properties is an important consideration over and above geotechnical feasibility;
- Re-evaluation of re-use in Akaroa and determining that 25% of the water could be used immediately on a combination of public toilet flushing and municipal park watering.

The latter was considered a critical step forward by Friends of Banks Peninsula. A key issue repeatedly identified by the community has been the quality of the treated wastewater. Having the Council prepared to use the water in public places demonstrates its own confidence in the water quality and provides a strong incentive to keep that quality up.

## 3 Distinguishing between Disposal and Beneficial Re-use

Throughout the submission so far, we have made a distinction between *disposal* and *beneficial re-use*. This distinction and its implications for the receiving environment, promotion of voluntary use of the water and storage requirements are important considerations in the remainder of this submission.

Soil moisture levels are the critical factor in distinguishing between land disposal and beneficial reuse of wastewater— a distinction that the consultation booklet fails to make, but one that is vital to understanding and building acceptable solutions from the options provided in the consultation.

Under a *disposal* system, the water is distributed to the receiving environment whether the environment needs it or not. The purpose of the irrigation is not to benefit the receiving environment, but to dispose of the maximum amount of water.

When the water is put to *beneficial re-use*, the level and times at which it is irrigated or used are determined by the needs of the receiving environment. For example a garden or farm paddock will be watered only when it is dry and the plants will benefit from the water, not when soils are already moist and additional water would not add benefit, or indeed could be detrimental. Toilets will only be flushed when they have been used.

#### Potential cost savings with a Beneficial Re-use approach 3.1

An advantage of beneficial re-use is that because the water is applied in a beneficial way, landowners are likely to want the water. Conversely with a disposal system landowners are unwilling to take it on a purely voluntary basis because of the level of ground saturation involved. They are forced to irrigate whether it makes sense to or not.

Because the approach taken by Council to date has been one of *disposal* costings of the options all include lease or purchase of the required land.

The inclusion of beneficial re-use in Akaroa at a very late stage in the process, and immediately prior to release of the consultation document, has meant that re-use options and the implications for land and storage costs have not been as fully considered.

Later in the submission we explore how solutions that provide a benefit to the landowner could also result in cost reductions. Furthermore, under a beneficial re-use model the risks are lower because the irrigation rate is reduced. This combination enables additional land to be considered over and above the minimum size and we note that it was this type of approach hinted at by Commissioner Collins in the decision<sup>2</sup>.

#### Long term cost spreading 3.1.1

We suggest that there are also cost implications for spreading the load over several years, sizing infrastructure according to need, and deferring some costs until later stages as needed.

#### 4 Challenges with land irrigation on Banks Peninsula

We respect that irrigation of wastewater to land meets Ngāi Tahu cultural concerns and appreciate that passing through top-soil has positive benefits for the absorption and neutralising of residues in wastewater such as viruses, provided that the top-soil is not saturated. However, expert advice confirms concerns that the topography and geology of Banks Peninsula present significant challenges to land disposal as most of the land is steep, with the volcanic bedrock coated in a layer of slip-prone loess soil. Stream gullies and ephemeral streams punctuate the slopes, testament to the huge volumes of water that cascade down to the valley floors below in heavy rain events.

#### 4.1 **Risk of slips and flooding**

Over the last 100 years every valley within the inner harbour has suffered from flooding. During extreme rain events the water cascading down the slopes swells the streams into massive torrents – the noise of boulders rolling in the creeks is a feature at such times – and the streams can break their banks. Much more serious flooding has been experienced when blockages have occurred upstream during these events either by debris washing down the stream, or by a slip. Then huge volumes of water can become trapped and release destructive flash-floods to areas below when the blockage subsequently breaches. Extreme rainfall events are often highly localised with massive cloudbursts occurring in one catchment, but not another, and with no set patterns<sup>3</sup>.

Loess soil loses its strength as it gets wetter and there is a limit to the level of moisture the soil on slopes can safely absorb before ground water mounding (a locally rising water table) exacerbates slip risks. Hence the geologically suitable areas identified by PDP have been limited to slopes of no more than 19°, with the additional restriction of slopes below irrigated areas of no more than 15°. This

latter requirement has ruled out many of the flatter headlands and ridgetops and reduced the suitable land within 10km of the treatment plant to the populated valleys of Robinsons Bay, Takamatua, and the remote headland of Pompeys Pillar on the outer coast.

## 4.2 Storage ponds

In order to cope with periods when the soil moisture levels are too high to irrigate safely, the scheme proposed for the Akaroa Wastewater land irrigation options includes large storage ponds, sized to hold most or all of the water flowing out of the treatment plant during winter. No irrigation to pasture is proposed for winter but it is considered, based on theoretical modelling, that some irrigation to trees will be possible as an established tree canopy intercepts some rain and prevents it from reaching the ground. Ponds proposed for tree irrigation are therefore somewhat smaller than those for pasture.

#### 4.2.1 Community acceptance

While they provide a solution to dealing with winter flows, the large storage ponds present one of the most difficult aspects of land-disposal. Residents have expressed concerns about the ponds breaching during earthquakes or other natural disasters and flooding areas below. The Beca reports acknowledge there could potentially be issues with odour and/or midges. The large storage ponds are likely to be visually intrusive in the landscape as they will be lined and during summer the aim is for them to be nearly empty. If visible, they will not appear as natural features. They will need to be well screened.

#### 4.2.2 Pond Overflow in prolonged wet weather

All the land options proposed are essentially closed systems. All water is to be captured and stored in the ponds and then irrigated to land. Should there be a prolonged wet period or a sequence of wet seasons, with a low take-up of water from the voluntary uses and the disposal fields becoming saturated, then the excess water must go somewhere. The consultation document states on Page 9 that all ponds will include a spillway and that if the pond capacity is exceeded the water will overflow and *"make its way to the nearest stream"*.

There is no detail on whether or how such overflows would be managed or the potential impacts on the streams, particularly if the overflow continues for some time, meaning the stream is effectively receiving all the wastewater from Akaroa until such time as the land has dried out enough to resume irrigation. Nor is there an assessment provided on whether this is compatible with Ngāi Tahu values.

This risk is somewhat mitigated by the system being designed for 2041 flow levels, and therefore including a margin above the current levels. However, we note that this also means a greater sunk cost is being incurred now, with no actual guarantee that in a series of wet seasons the system could actually cope without resorting to prolonged stream disposal.

The risk of pond overflow is one of our biggest concerns with the current closed systems proposed for land irrigation and a matter that needs further consideration, particularly given the changing climate we are now experiencing. Although Banks Peninsula is predicted to get drier overall, increased storm events and more unpredictable weather could also occur. Our solutions address the issue of pond overflow.

#### 4.2.3 Sizing

The Beca report identifies that storage volumes are indicative only and that correct sizing is critical to success. If the capacity turns out to be inadequate, they will spill to the neighbouring streams.

#### 4.2.4 Pond site 10

We agreed with the other members of the Working Party that Pond Site 10 opposite the new treatment plant site is the best option for the principal storage pond. It facilitates re-use in Akaroa and is further from residences than most of the other proposals. There is good visual separation already provided by roads and well-established stands of trees. The pond at site 10 would not

impact on views from residential properties and would already be invisible from the state highway except from high vehicles. Further screening to prevent views from these could be established quickly without shading the state highway.

However, we recognise that residents of the Old Coach Road area are likely to have concerns. Not only is the treatment plant to be located there, but now, if land disposal proceeds, also the principal pond.

We suggest that the pond should be covered at all times. This will minimise the remaining potential effects of this pond on neighbours such as odour and midges and ensure that the reclaimed water is not fouled during storage by geese or other wildlife.

The pond must be constructed to the highest engineering standards and the position of its spillway and receiving environment still needs to be identified.

#### 4.2.5 Storage implications of Beneficial Re-use

An important trade-off to recognise is that greater the percentage of the water being directed toward beneficial re-use, the greater the need for water storage. Demand will be limited to the times when the water is needed, whereas under a disposal system, the water will be irrigated until much higher parameters based around land slippage thresholds and soil moisture saturation are reached.

Finding creative ways to store the water, such as requiring voluntary users to provide storage or distributing storage into multiple micro-ponds or tanks will form part of the solutions proposed later in this submission.

#### 4.3 Irrigation methods

The consultation document proposes that water would be disposed of to land via spray irrigation to pasture or drip irrigation to trees, without giving further information on how this would be implemented or the challenges either pose in the locations proposed.

#### 4.3.1 Spray irrigation to pasture

Spray irrigation to pasture is generally used for land disposal in conjunction with a cut-and-carry regime. Pasture heavily irrigated with nutrient laden water grows quickly as the grass takes up the nitrogen and is then cut regularly to promote continued growth. This requires the land under irrigation to be suitably graded for tractors to pass over and could potentially introduce a level of farming intensification not currently experienced in the valley floors proposed for irrigation.

Spray irrigation to pasture that is grazed would either need to have more nitrogen removed at the treatment plant or be spread over a larger area, as the animals themselves are continually returning nitrogen to the ground.

There can be market restrictions on baleage from wastewater irrigated pasture and stand-down periods for stock depending on the treatment level of the wastewater.

#### 4.3.2 Drip to trees

Most land disposal systems to trees have been installed into established pine forests. As no established forests are available on land meeting the geo-technical criteria, the consultation options propose to plant a new area in native trees. There does not appear to have been an ecological assessment of the appropriate mix of species to absorb the water, the methodology for husbandry during the period of establishment, how long it would take before such trees were able to take the full irrigation load proposed, and the impact on root growth and tree health from watering during the establishment period.

Friends of Banks Peninsula understands that the Council proposes to continue using the Takapūneke treatment plant while such trees establish and only use the new treatment plant for the water that is to be irrigated onto the new trees.

We are concerned with the lack of both ecological and social assessments of the proposal to establish new native forest using irrigation. Trees subjected to watering during the period while they are being established are likely to be shallow rooted, and therefore prone to blowing over in high winds later. This tendency is exacerbated when planted on sloping ground. They are also more susceptible to fungal disease. During the establishment period, such trees will need extensive weed control and management to prevent hare damage. The management method is not discussed in the Beca report and we suspect it has been largely overlooked, and the significant costs of husbanding many hectares of newly planted trees during their establishment period is therefore omitted from the costings.

Trees planted close to property boundaries and near houses are likely to have amenity affects through shading, blocking views and dependent on the species chosen, potential increase in fire risk. The management method during establishment is also likely to have amenity affects.

#### 4.4 Experience elsewhere with land disposal

Friends of Banks Peninsula has undertaken considerable research into the success or otherwise of land-disposal systems elsewhere. We have studied the small system at Wainui across the harbour from Akaroa, and much larger systems at Rolleston, Leeston, Selwyn Huts, Ashburton, Rakaia, Methven and Rotorua.

All of these systems feature year round *disposal* irrigation either to pasture managed under a cutand-carry system or into well-established pine forests.

# No other systems require large volumes of winter storage, nor can we find any other system irrigating to native trees or newly established trees.

#### 4.4.1 Nitrogen leaching

Several other land disposal systems have encountered issues with nitrogen leaching, including Whakarewarewa (Rotorua), Leeston, Selwyn Huts and Ashburton. In all four cases the land treatment system design was intended to remove nitrogen from the wastewater through uptake via the grown vegetation, soil, and optionally a wetland, and in all the cases the system has failed to perform as designed, with the land treatment systems unable to perform within consent limits for nitrogen:

- Whakarewarewa is being closed because of nitrogen leaching into the Puarenga stream, and the wastewater will be returned to Lake Rotorua<sup>4</sup>.
- The Leeston field has already been increased in size once because of excessive nitrogen loading<sup>5</sup> but still leaches nitrogen into Tramway Drain, breaching its consent conditions.
- Selwyn Huts has never worked satisfactorily and leaches nitrogen into Lake Ellesmere<sup>6</sup>.
- Ashburton's wetland has failed resulting in excess nitrogen, blocking of irrigation equipment and regular overflows into the Ashburton river<sup>7</sup>.

The Technical Expert group has noted that nitrogen leaching is a potential issue, and that the movement of groundwater at the sites under consideration has not been fully investigated. **The risk of nitrogen leaching is essentially therefore still unknown.** 

We are concerned that the irrigation rate (and consequent nitrogen loading rate) presented in the consultation options has been based on the Wainui disposal scheme. In granting consent for the Wainui scheme the commissioner explicitly noted that the nitrogen load proposed was permissible because of a *lack* of water resource in the irrigation area. In contrast, the areas proposed for

irrigation at Takamatua and Robinsons Bay contain streams and water bores which have the potential to be directly impacted by nitrogen leaching from the irrigated land. Potential effects of nitrogen leaching include harm to sensitive whitebait spawning areas including the popular Robinsons Bay stream<sup>8</sup>.

#### 4.4.2 Field failure and growing pains

The Whakarewarewa, Leeston, Selwyn Huts and Ashburton land treatment systems have all failed to meet their design performance standards. At Whakarewarewa the Puarenga stream running through the middle of the disposal forest is now considered one of the most polluted in New Zealand, forcing the Rotorua District Council to return the discharge to Lake Rotorua despite opposition from some iwi<sup>9</sup>. Leeston's dispersal field has already been more than doubled in size and its border dyke and rapid infiltration design replaced with spraying because of nutrient buildup, yet both it and Selwyn Huts have ongoing nitrogen loading, effluent ponding and compliance breach issues, and were identified as the major priority for the Selwyn Waihora Water Management Zone committee<sup>10</sup>; Ashburton, Rakaia and Methven land treatment systems have all outgrown their designed areas, with Ashburton and Rakaia requiring a doubling in land area<sup>11</sup>; Ashburton's award-winning constructed wetland has failed, with this and other problems causing significant operational and consenting issues<sup>7</sup>.

## 4.5 Future climate and population trends

Predictions for Banks Peninsula are that it will get drier overall with stream flows expected to reduce from between 20 to 100%. Increased storm intensity and frequency is already exceeding predictions, the position of Banks Peninsula, jutting into the Pacific ocean makes it particularly vulnerable to storm damage and extreme rainfall events. The consultation booklet sets a 25 year timeframe on the new system but in practice anything built now is likely to be the basis for Akaroa wastewater disposal for a much longer period.

Population growth is another long term affect that needs to be considered. Demand for water in Akaroa is likely to increase as its resident and holiday populations grow, and land in the neighbouring valleys provide opportunity to absorb some of this growth.

Any solution put in place now should be mindful of the direction it sets for an extremely long timeframe and ensure that it is building resilience in Akaroa to face the challenges ahead of both climate change and an increasing population.

#### 4.6 A New Zealand first

The land disposal system proposed for the Akaroa wastewater would break new ground in New Zealand on several counts.

#### 4.6.1 Winter storage a first

It is the only system requiring large volumes of water to be stored over winter. This storage level itself potentially creates problems of water stagnation and subsequent release of odour. As previously discussed a potentially significant environmental issue is that water would be released to nearby streams if the storage becomes full due to a series of wet seasons, negating the ability of the land to absorb nitrogen and neutralise pathogens.

#### 4.6.2 Irrigation to native trees a first

The idea of disposal irrigation to newly established native trees is also new. Native trees generally have a lower uptake of nitrogen than pine trees, and choice of species to those having high water uptake would be essential. Kanuka, for example, which frequently appears as an example species in the reports, prefers dry feet and is not likely to respond well to watering, particularly to a disposal regime in which soil moisture levels are kept high. It is also is poor at removing nitrogen<sup>12</sup>.

A disposal system to newly planted trees will take several years to establish. Irrigation levels must be much lower before the canopy has developed and is ready to absorb rain.

We are **not recommending** that this approach is used in our submission.

#### 4.6.3 Beneficial re-use may overcome some issues

Beneficial re-use would be a New Zealand first too, but we believe that it will overcome some of the issues facing irrigation on the Banks Peninsula topography, because the water would be applied at the rate needed by the receiving environment. This means it will be spread over a wider area on an as-needed basis and is therefore likely to be at a much lower intensity of application, as informed by soil and plant conditions. The risk of saturating the ground to the point where slips or flood risk is elevated is much less than with a disposal system based on maximum hydraulic loading.

## 5 Quality and Quantity - Reducing the problem

The consultation document is silent on a number of matters that could significantly improve the quality of the wastewater and reduce the total volume. Friends of Banks Peninsula submits that these matters must form part of the solution to the Akaroa wastewater issue.

#### 5.1 Highest Treated Water quality

The wastewater quality has been identified as a fundamental issue at all community meetings run by Friends of Banks Peninsula. The higher the quality of the water, the more comfortable people feel about using it, or having it disposed of nearby to their properties. The community has consistently told us and the Council that if the water is treated to the highest standard they would be prepared to re-use it.

Hence, the Community Strategy has adopted as its first principal:

#### Principle A. Wastewater treatment must be consistent and to the highest standard

We now put forward ways in which the water quality could be treated and maintained at the highest standard.

#### 5.1.1 Capturing flows during heavy rain

During heavy rain events stormwater infiltrates the sewer pipes leading to a considerably increased volume of wastewater, potentially beyond the capacity of the treatment plant. The original intention, prior to the Working Party meetings, had been to treat this to a much lower level before disposal. The Council now proposes to capture and fully treat all of the high level flows during heavy rain. This is a critical step to achieving a consistent high standard of treatment and water quality and we commend the Council staff for taking it.

#### 5.1.2 Treatment standard

Residents are concerned about the residues that will be in the water when it exits the plant, including viruses, hormones and endocrine disrupters. The current treatment standard proposed which produces water unsuitable for use with salad crops is likely to discourage re-use by the public.

# We submit that the Council should increase the water quality standard so that it can be used to water all food crops, including salads. As elsewhere where water is re-used, the Council should put in the highest level of ultrafiltration, combined with post-treatment disinfection of any water being returned through the purple pipe network.

Concerns would be substantially mitigated if the Council does indeed re-use the water itself in public places. Not only would this inspire public confidence initially, it would also be seen as a check on keeping the Council "honest" in maintaining those standards, as it will have "skin in the game", which is not the case if all the water is shunted off to a remote out-of-sight, out-of-mind location.

We suggest that at least some of the municipal watering needs to be above ground and using the type of sprayers that people would use in domestic gardens to encourage confidence. We suggest a demonstration garden, including vegetable and salad crops.

Community members have asked for a reverse osmosis treatment system to be included in the plant. We recognise this is expensive and some other places ensure water safety by disinfection (e.g. chlorination) after filtering, the method recommended by the US-EPA<sup>23</sup>.

#### 5.1.3 Nitrogen – a critical environmental issue

The issue of nitrogen levels in the water has not been clearly addressed in the consultation document, but significantly impacts on the viability of some of the options. On Page 8 the consultation document states that *treatment plant design could be changed to achieve a total nitrogen concentration of 5 g/m<sup>3</sup> if needed to avoid adverse effects on the receiving environment, but does not give any information about whether this is planned for any of the proposed options, or what it would cost.* 

The treatment level proposed by Council includes a nitrogen concentration of 20-30g/m<sup>3</sup>. As highlighted in the consultation document, this is quite poor by today's standards (e.g. Turangi, around 7g/m<sup>3</sup>). Water NZ would only give the proposed plant a nitrogen rating of B. Even modern on-site effluent treatment systems (septic systems) such as Oasis achieve levels less than 15g/m<sup>3</sup>, the maximum allowed in the Rotorua Lakes district, for example.

As already described, nitrogen build-up in soil is emerging as a serious issue for many of the longerrunning land treatment systems. It was previously thought that large quantities of nitrogen could be removed via soil take-up and vegetation growth, but it has become clear that this is not the case<sup>4</sup>. First, it was assumed nitrogen taken up by soil would break down and be released as gas, but this does not happen to any significant degree. Second, the amount of nitrogen removed by vegetation (particularly trees) is much lower than previously thought: at Whakarewarewa the current removal by mature pine forest is *at most* 12%, and as low as zero. Another option for removing nitrogen is artificial wetlands, but these too appear to have limited effect, removing just 12% of all nitrogen applied at Whakarewarewa.

The Council proposal to irrigate to native species such as Kanuka further exacerbates the problem. Kanuka's nitrogen uptake is thought to be as low as less than 20% of applied nitrogen<sup>12</sup>, which would leave the majority accumulating in the soil until it leaches out into the nearest groundwater. Other natives do not fare much better.

#### 5.1.4 Nitrogen removal requirements

The appropriate level of nitrogen to remove at the treatment stage depends on which of the disposal options is being considered, and, in particular, whether at-risk water bodies are present.

With beneficial re-use in domestic gardens, the Council would have no control over the species being watered, so it would be prudent to err on the safe side and provide full nitrogen removal. We have made several further comments on nitrogen removal in Appendix 4.

Beca have estimated the capital cost of maximising nitrogen removal (estimated to reduce the final concentration to  $5g/m^3$ ) at an additional \$1.8 million. Given that our proposed solution for 100% reuse in Akaroa as the end result, we have included this cost for full nitrogen removal in our revised costings.

#### 5.1.5 Mitigating Plant failure with an outflow buffer tank

The environment could also suffer adverse effects if the Treatment plant itself were to experience a malfunction, and wastewater outflowing is at a lower standard than normal. It is our current understanding that such lower standard water would flow directly to the main storage pond, potentially lowering the standard of the whole volume it contains (as the bypass flows did in earlier designs).

To minimise the risk of such water polluting the pond and reducing the quality of the reclaimed water, we suggest that water is captured in a small buffer tank as it is emitted from the plant and held there until it is cleared as suitable for onward flow to the main storage pond - perhaps daily. In this way if there has been a failure of the plant and substandard water has been emitted, it can be sent back to the treatment plant for re-processing.

#### 5.1.6 Covering the pond

As stated earlier, we consider that the main storage pond should be covered to ensure that the water quality is not diminished through subsequent fouling, such as from flocks of geese.

#### 5.2 Minimising outflows

Growth of the town has meant that in recent years additional water has been piped over from Takamatua to boost the supply. All water supplied in Akaroa is treated to a potable standard, whether it is intended for potable uses or not. A reduction in the volume of potable water being used for potable uses will also lower the amount of wastewater. Combined with re-use of treated wastewater in Akaroa for non-potable uses, potable water usage and wastewater outflows could be reduced, making savings on both the the infrastructure and land area required for dealing with wastewater, and potentially reducing costs of providing the potable supply. We suggest this is examined and costed to establish what reductions would be achieved.

#### 5.2.1 Minimising Infiltration

Outflow data from the existing treatment plant indicates much less difference between winter and summer flows than would be expected given the highly seasonal nature of the Akaroa population. This suggests that there is a base level of infiltration into the sewer pipe network from groundwater.

The Council has estimated that over 300m<sup>3</sup> of potable water is lost from its potable water reticulated network every day<sup>13</sup>. This potable water loss is clearly "money down the drain", but could also be a potential source of infiltration into the sewer network, making a double cost whammy.

The other source, stormwater, has been identified by Council staff, and we are aware that efforts are in progress to reduce this infiltration and that to date they are meeting with success. All further reductions in such infiltration will reduce the costs of running the treatment plant and the volume of land disposal. We urge the Council to continue with its work to reduce stormwater infiltration, and suggest that it require all households in Akaroa to actively demonstrate that stormwater from their properties is not infiltrating the sewer network.

#### 5.2.2 Water conservation

Nowhere in the consultation booklet is the issue of water conservation mentioned. Currently Akaroa suffers from water shortages every year and essential conservation is achieved through the blunt instrument of summer watering restrictions. This year they were still in place at the start of April.

We make the following suggestions on conservation measures:

- In urban Akaroa, residents, businesses and visitors must be better informed of the consequences of wasting water and encouraged to be more responsible for water use and disposal.
- The Council should embark immediately on a programme to promote responsible water use in Akaroa and:
  - Lead the way with an audit of its own facilities including leaks and wasteful consumption at public toilet facilities
  - o Install dual flush toilets and metered taps at basins
  - Investigate the pressure of the reticulated water supply (which is unnecessarily high in some areas) and consider ways to adjust this so as to reduce water wastage.

- Provide information to residents, visitors, businesses, school, etc. on the consequences of overuse and the need to reduce water use, and ways to achieve this.
- Provide information and incentives to property owners and developers to install water efficient taps, toilets and appliances.
- Research the incidence of chemicals and harmful materials (cleaning products, microbeads, medicines, drugs, etc.) entering the waste system, and provide public education to minimise risks.

Water metering was introduced some years ago, but there have been no meaningful incentives to reduce usage such as usage based charges to recover costs of treatment, or caps imposed on free usage, and charging thereafter. These could provide the Council with powerful tools to incentivise reduction in the usage of potable water, particularly if an alternative supply for the much heavier non-potable use of garden watering was supplied, and if up-take was slower than desired.

#### 5.2.3 Re-use in Akaroa

The *Community Strategy* suggests that Akaroa needs to be part of the solution. This submission proposes a win-win approach with re-use of wastewater to reduce Akaroa's chronic water shortages and to cut down on the wastage of potable water. The cost of providing sufficient potable water in summer will fall and, if less water is taken, it will have positive impacts on the streams in Akaroa, where water usage places further demand on already low flows. Thus cost and environmental benefits will be reaped and people will be able to enjoy watering their gardens and other external uses without the level of restrictions currently imposed every summer.

## 6 Beneficial Re-use of treated wastewater in other countries

As fresh water becomes scarce, the world has increasingly turned to recycling as a means of increasing supply. The World Health Organization identifies the following principal driving forces for wastewater reuse<sup>19</sup>:

- increasing water scarcity and stress,
- increasing populations and related food security issues,
- increasing environmental pollution from improper wastewater disposal, and
- increasing recognition of the resource value of wastewater

Today, wastewater is reclaimed for a wide range of uses: in the US, treated wastewater has irrigated San Francisco's Golden Gate Park since 1932, and in Orange County reclaimed wastewater has recharged groundwater and prevented salt water intrusion since 1976<sup>20</sup>. A substantial proportion of wastewater is reclaimed in Spain, Italy, Germany and Greece.

Today wastewater is commonly applied to a wide variety of uses, including irrigating parks and golf courses, sporting facilities and private gardens, vehicle washing, toilet flushing, agricultural irrigation, artificial lakes and wetlands and groundwater recharging. Provided the wastewater has been suitably treated, it can even be drunk: Singapore's NEWater is treated using Reverse Osmosis and UV light to a standard that allows it to be returned directly to the drinking water reservoir<sup>21</sup>. Indirect potable re-use is fairly common in the US<sup>22</sup>.

Akaroa could be recycling its wastewater to ease pressure on its water supply. The technology is mature and widespread.

## 7 Environmentally sustainable solution based on Option 4 - Nonpotable re-use in Akaroa

We now present the solution to the disposal of wastewater that we consider would be environmentally sustainable and acceptable based on Option 4 - Non-potable re-use of the treated water in Akaroa.

We discuss the conditions that would need to form part of the solution, assess it against the Community Strategy principles and then consider the short term implementation, the long term picture and comment on the costings presented in the consultation booklet.

Although the consultation booklet identifies that Option 4 would only absorb 25% of the wastewater and must be used in conjunction with another option, we calculate that external usage (principally garden watering) would rise to 100% once a purple pipe reticulated network was in place delivering it to all the population.

We recognise that it will take time before non-potable re-use in Akaroa accounts for 100% of the treated water, so another method will be needed during the years of transition, and may also be needed as a back-up should a wet summer lessen the demand from Akaroa itself.

Hence after our assessment of Option 4, we then present two alternative solutions for the re-use or disposal of the remainder of the water during the transition period.

## 7.1 Conditions

Our support for Option 4 is based on the following conditions:

- There are no bypass flows. All wastewater is fully treated to the same high standard.
- The water is treated to a level suitable for watering of salad crops. We suggest the highest level of ultra-filtration followed by disinfection(such as chlorination).
- The bulk of the stored water is at Pond Site 10 at Old Coach road.
- Full nitrogen removal is included in this solution.
- Post-treatment flows are closely monitored and re-treated if standards are not met, rather than contaminating the stored wastewater.

In the event that Council pursues a resource consent application that includes bypass flows, large storage ponds in unacceptable locations or fails to include full nitrogen removal, it is likely the community will actively oppose such a consent.

#### 7.2 Achieving 100% usage

Our conclusion that Option 4 is the best solution is strengthened by data given in the Beca report<sup>15</sup> on Akaroa's current water usage, the estimated amount used for external activities, and the volume of wastewater currently processed. This shows that the external use is more than the entire wastewater flows in 2015 or 2016, and we are therefore confident that once the purple pipe network was reticulated throughout Akaroa all the wastewater flows could be re-used for external non-potable uses, principally watering gardens. See Appendix 3 for further detail on how we have reached this conclusion.

#### 7.3 Assessment against Principles

Re-using the wastewater in Akaroa, providing that it is carefully done, meets all the principles of the Community Strategy, as assessed in Appendix 2, although we do discuss some reservations about aspects of the proposal in the consultation booklet.

We commend the Council for showing leadership through watering public areas and showing how the water can be used for flushing toilets but suggest that a demonstration garden will also be needed. We consider that this will greatly increase confidence in the quality of the water and is likely to lead to a rapid uptake by the voluntary sector in Akaroa, particularly for garden watering over summer, and particularly if the water restrictions remain in place for residences connected only to the potable supply. The grass will indeed be greener on the other side of the fence of neighbours who have hooked up to the passing purple pipe supply!

## 7.4 Short term implementation

The consultation document suggests that the network planned initially includes all the public toilets and L'Aube Hill and Stanley Park, but gives no further information on the pipe-runs proposed. There may be an opportunity for the Council to offer domestic connections from these first pipes as they are laid and gain more uptake of the water than is currently proposed.

We do have some concerns about using the water to irrigate L'Aube Hill and Stanley Park initially. Although we recognise the watering rate is reduced and irrigation will be seasonally applied, we feel the focus should remain on putting the water where it is most needed, rather than a quasi-disposal into Akaroa parks. We suggest that it may be more prudent to lay the pipe along the main public toilet run only (ie Recreation Ground to Britomart Reserve by the main wharf) and then along Beach Road to Greens Point as far as the last house and see what uptakes can be arranged along that route. The small waterfront reserves (such as around Daly's wharf, the War memorial, the area in front of the beach and Britomart Reserve) would appear more in need of the water than the larger L'Aube Hill and Stanley Park proposed, would be cheaper to implement and have a higher visibility. The work of laying underground pipes could be tied to improvements to these tired areas as part of a general Akaroa tidy-up.

We also suggest that some above ground irrigation will be needed to truly inspire confidence in the public to spray the water on their own gardens. We strongly recommend that the Council installs a demonstration garden in a prominent area of the town as an example. This should contain both ornamental plants and vegetable crops including salads. Potential locations would be Jubilee Park at the town's entrance or near the Petanque court on the Recreation Ground. The consistent message we have received at every community meeting is that people would welcome the water for their own gardens provided they had 100% confidence that it was safe.

#### 7.5 Long term

Additional purple pipes could be laid when the streets are being dug-up for other purposes, and gradually connected to the network, and such work should be factored into the Council's long term plan.

Council will need to increase storage as take-up for this beneficial voluntary use increases. Friends of Banks Peninsula has already identified a number of potential small pond sites around Akaroa, and would envisage large tanks (such as Kliptanks – <u>www.kliptank.com</u>) or micro-ponds that are gravity fed from Pond 10 gradually being installed. These could then gravity feed back down to the purple pipe networks in adjacent streets.

## 7.6 Costings

Given that we expect full nitrogen removal to be needed for safe long term re-use in Akaroa's parks and gardens, we add an additional \$1.8m to the costs suggested for Option 4. We have not included the cost of disinfection.

#### Table 1 Non-potable use in Akaroa costing

Components	Costing
CCC capital cost estimate in consultation document	\$1.7m
Full nitrogen removal	\$1.8m
TOTAL	\$3.5m

#### 7.7 Residual flows

An alternative disposal for the remainder of the treated wastewater will be required until such time as the full 100% of wastewater flow can be re-used in Akaroa. We have discussed how this could be achieved using a purple pipe network through the residential and commercial areas of the town providing non-potable water for use in gardens and other voluntary activities. There may also be other beneficial reuse options, such as nearby horticultural reuse, ground water recharge, establishment of biodiversity reserve areas that could take up part or all of the water but have yet to emerge or be explored. Overseas examples generally show the water is used for multiple purposes and this approach maximises the likelihood that all the water is taken up on a voluntary basis and more cost effectively. We signal that we continue to work on ideas to make more use of the purple pipe water.

The next sections of this document present two alternatives for dealing with residual flows until such time as the full purple pipe system is operational and 100% reuse achieved.

## 8 Residual flow to a transitional harbour outfall for disposal

Our preferred option is to use a harbour outfall to dispose of the remainder of the water such time as Akaroa re-use reaches 100%. We present two methods that are less expensive than the one proposed in the consultation document for routing the harbour outfall pipe. These both involve using the purple pipe network to Greens Point to deliver surplus wastewater to the harbour outfall rather than starting the pipe at Childrens Bay.

Once re-use in Akaroa has reached 100%, the harbour outfall could be either decommissioned or retained to provide an emergency overflow for extended wet weather periods. We consider this preferable from an environmental perspective to overflowing into streams because nutrients and other residues will be rapidly diluted and dispersed rather than accumulating in the silt bottoms of the shallow harbour bays.

The existing treatment plant at Takapūneke could be completely decommissioned as soon as the new treatment plant was operational.

#### 8.1 Conditions

We recommend transitional harbour outfall on the basis that

- A harbour outfall is used as an interim solution only with reductions in clearly planned stages as corresponding infrastructure to facilitate re-use is implemented.
- The Council would commit and plan (through its Long Term Plan) to re-use all of the water in Akaroa on an agreed timeframe.
- All water is fully treated, no bypass flows.
- Full nitrogen removal is in place

#### 8.2 Assessment against principles

A transitional harbour outfall scores well in several aspects, and not so well on others. Based on the NIWA impact assessment report<sup>17</sup> a harbour outfall with this level of treated water would create no health, amenity or environmental issues. What is of concern is that the harbour outfall is wholly for the purpose of *disposal*, and does not make beneficial use of the water. However, we are prepared to accept this given that the harbour disposal is an interim measure only and provides the most cost-effective way to facilitate the development of re-use in Akaroa.

The principles recognise that a harbour outfall is not palatable to Ngāi Tahu as a solution, and we recognise that in putting it forward as an interim solution we are asking them to wait longer for harbour disposal to be withdrawn. However, we do this on the basis that the harbour outfall will prove less expensive than setting up an interim land irrigation system and, with the bypass flows now omitted from the overall system, it improves the water quality and safety over that proposed in the 2015 consent application.

We also see real value in retaining some form of harbour outfall because it is the most environmentally sound, robust and sustainable emergency overflow outlet should the storage become full.

#### 8.3 Short term implementation

We suggest that there are two different ways that a harbour outfall could be achieved (in conjunction with re-use) at a lower cost that the standalone and extensive underwater pipeline suggested in Option 5 in the consultation booklet. Both piggyback on the purple-pipe network, which is why we suggest it is initially laid along the Akaroa waterfront to Greens Point. Underwater pipe is much more expensive than land based pipe, and both of these options make use of the proposed purple pipe running under the road to reduce the amount of expensive underwater pipe needed.

The diagram below shows the purple pipe network running to Greens Point, and the two options. Either lay a new mid-harbour outfall starting at Greens Point, or extend the purple pipe a bit further to the site of the existing Takapūneke treatment plant and connect to the existing harbour outfall there.

#### Figure 1 Cost-effective harbour outfall options



#### New outfall from Greens Point

If the purple pipeline is run along Beach Road to Greens Point (the last house), and an underwater outfall pipe is constructed from there to the proposed mid-harbour location for outfall, the underwater component of the pipe would be approximately half the length of that proposed in the consultation document. BECA estimate an underwater pipe to be four times more expensive to build than over land, so the over land option is significantly less expensive. We consider this would go a long way toward addressing Commissioner Collin's concerns that the sunk cost of a harbour outfall would preclude investment in re-use. Under this proposal it would be less expensive and integral to that re-use.

We would be interested in whether there would be other locations for a new mid-harbour outfall that would be preferable to Ngāi Tahu over the location proposed.

#### Retain the current outfall from Takapūneke

If the purple pipe went a bit further, it could terminate at the existing treatment plant at Takapūneke and feed into the existing harbour outfall there. The plant could still be decommissioned when the new plant becomes operational; only a connection to the outfall itself would be required.

This option would be less expensive again as it would not involve new underwater piping, only a connection to the existing pipe, but does retain some infrastructure at the Takapūneke historic site, so may not be acceptable to Ngāi Tahu.

We would hope that the staged implementation of re-use in Akaroa would provide reassurance to the rūnanga that regular use of the harbour outfall for some flows was an interim measure only.

#### 8.3.1 Storage implications

The Council have identified that they could re-use 30,000m<sup>3</sup> per annum irrigating municipal parks. This is roughly the volume of wastewater that is generated between November and March, so if

irrigation takes place over that period, minimal storage would be required. This seems an acceptable level of irrigation as it works out to the equivalent of 300mm of rainfall over that entire period, which would be a beneficial level of watering to reduce the summer soil moisture deficit without impacting recreational use of the parks by making the ground excessively damp.

The large and expensive storage ponds needed principally for winter storage could be deferred until the purple pipe network had been extended to the point where demand exceeded the summer wastewater flows. The costings we give below do not include these ponds, as they would be factored in later as part of the Long Term plan to bring all of Akaroa onto the reticulated purple pipe system

This staged approach would enables the Council to spread the main costs over more years and gives it a chance to validate re-use in Akaroa before committing to large scale storage.

#### 8.4 Long term

Once experience had built up with the system, then the decision could be taken on whether to retain the transitional harbour outfall to provide the overflow mechanism should the storage ponds became full. Should the storage become full during a prolonged wet period when demand is low, the overflow would continue until land uptake started again. The water may still contain a higher level of nutrients, including nitrogen, even with full removal, than would be healthy for a stream to absorb on a long-term basis. If a discharge over several weeks or months was needed to the harbour it would be rapidly diluted in the harbour and then flushed to the open ocean, with much less impact than releasing it to a stream and from there to the shallow bays of the coastal environment, impacting on recreational use and shellfish gathering.

#### 8.5 Re-evaluated costings

The cost of providing beneficial re-use in Akaroa combined with a transitional harbour is made more economical through shared use of the purple pipeline already conveying the treated wastewater through the town to the parks and public toilets, and then extending it on land as possible through the town to either Greens Point or onto Takapūneke. The costings below reflect this. Note that they have also been adjusted to include the savings from the change to handling of bypass flows now included in the land-based options, as this saving appears to have been omitted in the consultation booklet costings for this option.

Description	Component	Cost
New mid-harbour outfall at	Beneficial re-use in Akaroa	\$3.5m
Greens Point	CCC capital cost estimate in consultation document	\$7.4m
	Saving from sharing the pipeline over land	-\$3.0m
	Bypass removal	-\$0.2m
	TOTAL	\$7.7m
Re-use existing outfall	Beneficial re-use in Akaroa	\$3.5m
	Continue pipeline to outfall	\$1.0m
	Connection	\$0.5m
	TOTAL	\$5.0m

Table 2 Beneficia	l re-use in	Akaroa	plus	harbour	outfall	costings
			P			

The more expensive of these alternatives for the beneficial re-use and a new transitional midharbour outfall is only slightly more than the \$7.4 million needed for the harbour outfall starting at Childrens Bay proposed in the consultation document. Re-using the Takapūneke existing outfall is cheaper and could free a further \$2.4 million for the initial purple pipe implementation budget. Savings have been made because of the cheaper cost of routing some of the harbour outfall pipe over land.

## 8.6 Harbour outfall as a standalone option

We are curious as to why the Council determined to start the underwater pipe run at Childrens Bay rather than taking it as far as possible by land to minimise the amount of more expensive underwater piping. If the pipe was run under land as far as possible, we suggest the base cost of the standalone harbour outfall proposed as Option 5 could fall from \$7.4m to around \$5.0m. However, as already stated, a stand-alone harbour outfall is not supported because it does not make beneficial use of the water and is offensive to Ngāi Tahu.

## 9 Residual flow to Pompeys Pillar for beneficial re-use

A second environmentally sustainable option for the residual flows in the interim is disposal to Pompeys Pillar, provided that the conditions below are met.

We submit the capital costs of the Pompeys Pillar option could be considerably lower than those presented in the consultation booklet if a *beneficial re-use* rather than *disposal* approach is taken.

We recognise that pumping the water over the hill may incur increased capital and operational costs compared with other options, but suggest that the principle benefit is the rapid establishment time enabling closure of the Takapuneke treatment plant and cessation of any harbour disposal as soon as the new plant is in place, in the shortest timeframe for any of the options. Potential additional benefits high altitude fire ponds and overflow to the open ocean rather than the harbour.

#### 9.1 Conditions

#### 9.1.1 Landowner agreement

There is only a single owner of the land required for the Pompeys Pillar option. Our support for Pompeys Pillar is predicated on the assumption that the landowner and Council reach a satisfactory agreement and that the landowner is genuinely a supportive and willing participant, and not threatened with compulsory purchase. We were concerned to learn during the early meetings of the Working Party that no such discussions had taken place, and pleased when they subsequently commenced. We understand they are ongoing during the consultation period and hope a suitable agreement can be reached before it closes. If not, we would withdraw support for this option. We have only included irrigation to pasture as an option as the landowners clearly articulated at the Working Party that trees would not be acceptable and they wish to continue pastoral farming.

#### 9.1.2 Irrigation to pasture

Irrigation to pasture is a *beneficial re-use* because the wastewater is being put to productive use. Pasture irrigation could begin immediately on completion of construction. There is no need to wait for several years for trees to establish, or for shelter belts to grow, since irrigation could commence far from any boundaries. All the wastewater could therefore be put to productive use from the outset, provided there is sufficient land included in the scheme to support irrigation at the appropriate rate for grazing. The plant at Takapūneke and its associated harbour outfall could therefore be decommissioned as soon as the Pompey's Pillar irrigation is set up, and this would be potentially achievable by 2020 when the existing Takapūneke consent expires.

#### 9.1.3 Extending the proposed area

We challenge the Council's assumption that much of the land identified as geo-technically suitable should be excluded on the grounds of the Outstanding Natural Landscape overlay and suggest that inclusion of these areas would *lessen* impact on the landscape and increase the potential for beneficial re-use rather than disposal.

Farming is a permitted activity in the Rural zone and Pompeys Pillar is currently subject to pastoral farming. The land, both inside and outside the Outstanding Natural Landscape zone, exhibits a variety of colours depending on the crops being grown or level of grazing. Adding irrigation to parts of the farm would be no different. The Outstanding Natural Landscape area of the farm property is only visible from that property or the open ocean. Disposal irrigation on the minimum area in the centre of the property as identified in the consultation document is likely to lead to an increase in visibility as this area will be a brighter green patch in the middle of the headland. Extending the area for watering to the entire 90ha identified as geotechnically suitable will result in lower levels of watering, and a similar patchwork of colours to that the property currently exhibits. The recent aerial imagery of Pompeys Pillar shows the patchwork of different colours as a result of farming activities, *including in the outstanding natural character overlay area*.

Figure 2 Pompeys Pillar showing Outstanding Natural Landscape overlay boundary. Areas on the coastal side of the line are within the overlay



#### 9.1.4 Use of Pond Site 10

We assume that Pond Site 10 would be used for the principal storage since Pompeys Pillar is now an interim solution. We suggest that use of Pond Site 10 combined with re-use in Akaroa will reduce the amount of water to be pumped and therefore the costings of Pompeys Pillar in the combined option would be lower than those given in the consultation booklet based on its use as a standalone option. Pond Site 10 provides a large amount of buffering (as compared with proposals that did not include a pond at the plant) meaning that the wastewater only needs to be pumped to Pompeys Pillar at the average flow rate, not the maximum flow rate included in the current costings. The pumps and pipes do not need to be able to deal with peak flows and this may allow pump infrastructure to be reduced.

#### 9.1.5 Fire ponds

We also see the potential to add much needed high level fire ponds as a side benefit of pumping water over the hill, and suggest that the capital cost of such ponds is sourced from another budget. The benefit of such ponds to this scheme is that they could be used as intermediaries enroute to Pompeys Pillar allowing the pipe run to be broken into stages and providing greater resilience. The incoming pipe would deliver water to the pond, the outgoing pipe take it away. The ponds would therefore remain full or near full at all times. They would not form part of the overall storage capacity. However, from a pond perspective, the stored water would be kept fresh and therefore minimise the risk of odour that could be likely with static fire ponds.

#### 9.1.6 Cultural considerations

We are aware that Te Rūnanga o Koukourārata is carrying out a cultural assessment of the area. We note that no sites have been identified in the replacement Christchurch District Plan to which Ngāi

Tahu was a principal submitter. We are confident that should the cultural assessment indicate that there are specific areas of cultural significance, these would be either small areas or of relatively low significance and could be worked around given the greater benefit to Ngāi Tahu cultural concerns of the overall scheme obviating the need for a harbour discharge.

#### 9.1.7 Potential to provide ocean outfall for overflows

As noted earlier, under the current options, ponds would overflow during a prolonged wet period to the nearest stream, leading to a direct mixing of waters without the wastewater having first passed through the land. This would apply anywhere that land disposal is proposed. The difference at Pompeys Pillar is that such streams flow to the open ocean rather than the harbour. It would be for Ngāi Tahu to establish whether this was preferable culturally to such mixed stream water flowing to Akaroa harbour. Potentially the overflow could be contained in a pipe taken over the cliff, so that no water mixing took place until the outer coast is reached.

## 9.2 Assessment against principles

An assessment against the principles is given in Appendix 2. Pompeys Pillar scores well on all counts provided that the landowner is agreeable to the proposals. We would particularly welcome the use of the water to improve the productivity of the farm and the involvement of the farmer in managing this optimally.

#### 9.3 Short term implementation

All the residual water not used in Akaroa could be pumped to Pompeys Pillar and used on the farm, and provided that the area is sufficiently large, done so in a beneficial way.

Therefore, initial re-use in Akaroa as proposed in Option 4, combined with irrigation of the farm at Pompeys Pillar, could be implemented at once.

The Takapūneke plant and its associated outfall could be closed immediately, ceasing any further discharge of treated wastewater to Akaroa Harbour.

#### 9.4 Long term

In the longer term usage of Pompeys Pillar would phase out as uptake from Akaroa increased.

Given the high sunk cost, it is likely that if this option were to proceed, the farm would need to guarantee to take the balance of the wastewater should wet weather limit up-take in Akaroa in perpetuity.

#### 9.5 Re-evaluated costings

Given these assumptions and the potential benefits they bring, we urge the Council to re-evaluate the costings for Pompeys Pillar.

The costings for this option are based on the same assumptions as the other land disposal options, i.e.:

- Purchase of the required land, and
- Disposal to the minimum land area

Changing the approach from disposal to beneficial re-use by the existing landowner could alter both of these assumptions. Because the wastewater now becomes beneficial to the farming operation, there is no reason to believe the land would need to be purchased. Entering into other arrangements, such as leasing, is common in other schemes<sup>14</sup>. This would save the purchase cost, and the treated wastewater would confer a benefit upon the receiving farm as the water itself adds substantial value by increasing the pasture/feedstock growing season. The Council may need to underwrite the risk that in the future stock produced on this farm met with market resistance.

Because the land would continue to be farmed, the area irrigated does not need to be minimised. The entire area available (including coastal area) is potentially three times the minimum area identified by Beca as required. Using a larger area has the following advantages:

- Spreading the irrigation over a larger area would reduce the saturation level of the soil, allowing irrigation to continue for longer into wet weather, with a potential reduction in storage pond volume required.
- The original engineering study commissioned by the Council<sup>1</sup> recognised the difficulty of the Banks Peninsula soils and terrain, and recommended a "staged" approach whereby land disposal is initially carried out at a lower rate and monitored for several years, progressively increasing the rate if conditions allowed. However, by increasing the application area, the risks are immediately reduced, potentially obviating the need for staging irrigation, combined with re-use in Akaroa to further reduce the immediate water volume. This means the initial application rate could be as little as 25% of the design rate or less, giving the farm owner much greater flexibility over where and when the water is applied, making this a beneficial re-use solution, rather than disposal

The revised cost estimate for Pompeys Pillar, when combined with beneficial re-use in Akaroa, is:

Component	Total cost
Beneficial re-use in Akaroa	\$3.5m
Pompeys Pillar – estimate in consultation booklet	\$13.7m
Revised estimate with land purchase cost removed on the basis of a beneficial re-use	\$12.7
TOTAL	\$16.2m

#### Table 3 Beneficial re-use in Akaroa plus Pompeys Pillar costings

#### 9.6 Consideration of Pompeys Pillar as a standalone option

Pompeys Pillar is the only land-disposal option presented that could stand alone as a beneficial reuse solution. If so, we believe it could be done at a reduced cost than that suggested in the consultation booklet. Nitrogen is a valuable resource for the farm provided it is not applied at an excessive rate. If the land area used included the entire 90ha, then this would allow a heavier nitrogen loading in the wastewater. The nitrogen retained in the wastewater would be used on the farm at an appropriate rate to grow more grass for grazing, rather than having it extracted at the plant. The lack of impacted waterways at the Pompeys Pillar site means this option would carry relatively low risk. Beca have advised that the Treatment plant could be "de-tuned" leaving more nitrogen in the effluent, with a potential saving of \$2-3m<sup>15</sup>. The revised costing for the Pompeys Pillar option standalone would therefore be:

#### Table 4 Pompeys Pillar standalone option costing

Component	Total cost
Pompeys Pillar – estimate in consultation booklet	\$13.7m
Revised estimate with land purchase cost removed on the basis of a beneficial re-use	\$12.7m
WWTP de-tuning	-\$2.0 - \$3.0m
TOTAL	\$9.7m - \$10.7m

While we do not advocate this solution because it reduces the benefit obtained from the water compared with re-use in Akaroa, we would consider it to be an acceptable solution. We do not consider that ultrafiltration or disinfection would be required either if the water was only used for farming purposes.

## 10 Disposal based options

For clarity we now identify potential solutions based on the consultation options which are not supported. The fundamental criterion applied is:

Any proposal based around disposal, whether to the harbour or to land, is not supported as a solution because the precious resource of water is being wasted instead of used.

#### 10.1 Disposal via harbour outfall

We see no harm to the environmental health of the harbour from disposal of highly treated wastewater via a harbour outfall, particularly if bypass flows are removed. However it completely wastes a scarce resource and makes no attempt to alleviate Ngāi Tahu's cultural concerns. Hence we have not proposed it as a suitable solution.

#### 10.2 Land-based disposal

The remaining land based options in the consultation (irrigation to trees or pasture at Takamatua or Robinsons Bay) are also *disposal* options. They seek to use the minimum land area to dispose of the wastewater, rather than using when and where it is beneficial.

#### 10.2.1 Spray irrigation

Spray irrigation to pasture in these areas might be presented as a beneficial use, but the high application rates and requirement to take the water are based on disposal rather than farming use thresholds. Given the large number of land owners involved it would be impractical to extend the irrigation over a greater area such as we propose for Pompeys Pillar. The limited areas proposed for irrigation would be too small to remove the nutrients through pastoral farming so they would need to be removed additional cost. Cut-and-carry management is normally practiced to export the nutrients that would otherwise accumulate in the soil. This would be impractical on much of the hilly slopes of the Takamatua and Robinsons Bay valleys, and only possible on the flat valley floors. Here it would impose the highest negative impact on amenity, both from the irrigation itself and the shelter belts proposed around these areas, and the number of multiple parcels make the economics highly questionable.

#### 10.2.2 Trees are not beneficial use

Re-establishment of native forest is presented as a potential benefit of these solutions. While we welcome an increase in biodiversity, irrigation is not needed to achieve this and is likely to have negative effects on the resilience of native forest established under this regime.

Native forest regenerates rapidly on Banks Peninsula *without* additional watering as soon as stock pressure is removed. As demonstrated in the example below, native forest is re-establishing itself rapidly in Takamatua and Robinsons Bay wherever land is retired or lightly grazed.

#### Figure 3 Natural regeneration of native forest



Robinsons Bay c. 1980

Robinsons Bay c. 2017

The native forest that establishes naturally is inherently suited to its environment. Trees that establish naturally must put down strong and long roots in their search for water. By contrast introduced plants subject to intensive irrigation with water containing elevated nutrient levels are likely to be shallow rooted. They will be prone to blowing over in storms and more susceptible to fungal diseases due to a poorer root structure. We do not therefore class use of the water to establish native forest as a beneficial use, *particularly* when the plan is to do it on the smallest land area possible.

#### 10.2.3 Land-based disposal poses an elevated risk

The disposal-based irrigation solutions presented in the consultation document seek to use the minimum amount of land feasible and maximise the application rate. They elevate the risk of ground water mounding and subsequent slips and flooding. We are concerned that **irrigation with the application rates proposed for disposal of water**, whether spray or drip, into any peninsula valley catchment would carry high risk because the peninsula soils and topology are so challenging. Intensive disposal elevates the potential for nitrogen leaching to streams, and increases risks of slips and flooding to downstream properties.

#### 10.2.4 Inadequate buffer zones

The buffer zones proposed in the consultation booklet are wholly inadequate and the proximity of the irrigation and ponds to homes is out of line with other disposal schemes in New Zealand. Under the system proposed here, people could have trees grown within 5 metres of their house, blocking sun and views, or spray irrigation within 25m with attendant spray drift in windy weather, or alternatively large shelter belts creating issues with shading, blocking views and drastically altering the existing landscape character. The following table describes the actual distances to residences of other land treatment systems in New Zealand:

#### Table 5 Buffer distances elsewhere in New Zealand

Scheme	Туре	Actual distance to residence
Wainui	Drip to trees	300m of existing mature pine forest stands between the irrigation area and nearest dwelling
Leeston	Spray	50m to boundary; 100m to nearest external dwelling; with mature shelter belts in place
Ashburton	Spray	500m to nearest external dwelling (farm paddocks in between); mature shelter belt
Rotorua	Spray to trees	At least 1km of forestry operation between sprayed areas and nearest dwelling

To add insult to injury, the buffers proposed around properties and homes suggested in the consultation booklet are smaller than those proposed around the outstanding natural landscape overlay at remote Pompeys Pillar.

#### 10.2.5 Amenity and community impact

Rather than water being applied where it is wanted and welcomed, disposal into neighbouring valleys takes a problem from one community, and instead of solving it, imposes it on another. Residents of these neighbouring valleys already bear the cost and management of their own sewage disposal through the septic tank systems on their own properties, they would gain no benefits from these proposals. Instead they would now have the wastewater from another community foisted onto them with impacts on their amenity, livelihoods and property values.

These valleys are people's homes. The areas earmarked by the Council for ponds or irrigation are their gardens or the small, domestic paddocks around their homes. To state that the amenity values of the surrounding area are not significantly affected is fatuous. Should either of these proposals come to pass, the valleys of Robinsons Bay and Takamatua would be changed forever. Instead of being blessed with open views and sunlight, these areas could be covered by dense forest entirely surrounding homes to within 5 metres of property boundaries, or even imposed on people's own back yards, or subject to spraying as though they were desolate dairy paddocks.

The Takamatua and Robinsons Bay valleys are attractive areas to live, and contain flat, fertile land suited to smallholdings and agriculture. Converting these valleys to irrigation disposal areas is a waste of such useful and valuable land.

Should the Council apply for resource consent based on either of the valley disposal options, the Friends of Banks Peninsula would lodge a submission in opposition.

#### 10.2.6 Upper Robinsons Bay

We have considered the option of disposal to upper Robinsons Bay. As discussed at the Working Party, this would be less objectionable from an amenity perspective than irrigation to the valley floor, particularly if there were mitigation and community compensation measures included to give the community reassurance against flooding and slips, enable public access to monitor activities and providing a public benefits. However, we consider there are too many unanswered technical questions and it carries too high a risk for it to be recommended as a land based option for the residual water flows at this stage.

As alluded to earlier, establishment of land based irrigation using native trees, as is proposed for upper Robinsons Bay, would take several years. The expert technical advice we have received is that this is such an experimental concept that it should be further staged to enable monitoring of the trees and the soil with a gradual introduction as actual conditions on the ground dictate. **This would** 

not only absorb sunk cost over time, but would prolong the period before land uses, whether in Akaroa or upper Robinsons Bay could absorb all of the wastewater and replace the harbour outfall. The investment would be being made into a land-based disposal system at best in parallel to the installation of the purple pipe network in Akaroa, without conveying any benefit as it would not yet be able to take up the residual wastewater during the establishment period. This is the very time when the transitional uptake is most needed if harbour outfall is to cease. By the time the trees were ready to take the full amount of water, the Council could have been well on the way to having the beneficial re-use system established in Akaroa rather than a disposal system in Robinsons Bay that would eventually become defunct.

We have therefore assessed this option as carrying a significantly higher risk for considerably less benefit than our supported solutions.

## 11 Option development process

People are hugely concerned about the impacts on their cherished valleys and their individual property values, and shocked that the Council could even consider such solutions as forced irrigation around their homes. It does not make sense to involve multiple residential blocks in a compulsorily imposed wastewater disposal scheme.

Takamatua residents affected have lived with the stress of this for over a year; Robinsons Bay for over 6 months. Compulsory purchase has been threatened at every meeting, and the consultation booklet reaffirms this threat. A similar lack of respect has been shown toward the landowner of Pompeys Pillar.

That the options in the consultation document still include large storage ponds and disposal irrigation on private properties despite residents' concerns and the wishes of the Working Party continues the offence. It does nothing to build confidence in the Council or draw people to supporting the project – quite the opposite – it has the effect of driving a potential voluntary market away. The more the Council attempts to foist the water onto some people, the less it appeals to others and the more suspicion is generated.

The Council must work to turn this negativity around if any land disposal option involving large numbers of people is to be accepted. Friends of Banks Peninsula has participated in 10 community meetings since the proposals were first identified in October 2016 and at every meeting the public have stressed that treating the water to the highest standard is key to acceptance of land based disposal anywhere around people and homes.

## 12 Summary of options

The solutions supported in this submission are based on the adoption of non-potable re-use in Akaroa as the primary instrument to absorb Akaroa's wastewater whilst maximising environmental and community benefit. We have given two alternatives for the re-use or disposal of the remainder of the water while a reticulated purple-pipe system is gradually installed in the town. These: are to continue with a harbour outfall, using either a new pipe from Greens Point or the existing pipe at Takapūneke, or to send the water to Pompeys Pillar for use on the farm.

All are based on the conditions of:

- All water is fully treated, there are no bypass flows during heavy rain conditions.
- The water is treated to a standard suitable for watering salad crops. We have recommended ultrafiltration followed by disinfection such as chlorination.

- The outflow from the treatment plant is captured and tested before it is released to the main storage pond to enable re-treatment in case of sub-standard water being emitted.
- Maximum nitrogen removal is included at the plant.
- Principal storage is at Pond site 10.
- Council taking the lead in using the water to irrigate public areas in Akaroa, flush public toilets and install a demonstration garden including ornamental and edible plants.
- A commitment is made in the Long Term Plan and through consent conditions to install a purple pipe network through Akaroa over time, and Akaroa residents incentivised to use it.
- Water conservation measures are introduced into Akaroa.
- Stormwater infiltration work continues to reduce flows.

The following tables summarise both the solutions we have proposed and the solutions we do not support. We summarise the advantages and disadvantages of each, give the revised costings, and whether harbour outfall is discontinued and if so, over what timeframe.

#### Table 6 Summary of solutions supported

Option	Closure of Takapūneke	Harbour outfall	Cost in consultation	Estimated Revised Cost	Advantages and Disadvantages
Beneficial re-use + mid-harbour outfall	Immediate closure of treatment plant and its outfall	New harbour outfall constructed, but use diminishes to overflow only over time	\$9.1m	\$7.7m	Advantages:Low up-front cost optionProvides best solution to overflow in prolonged wet periodsMinimal environmental impactsBest option for long term resilience, retains a harbour outfall for emergency useDisadvantages:Does not immediately address Ngāi Tahu cultural concerns
Beneficial re-use + current (Takapūneke ) outfall	Immediate closure of treatment plant, but retention of its outfall	Existing harbour outfall retained but use diminishes to overflow only over time	No comparable costings included in consultation document	\$5.0m	Advantages:Lowest up-front cost, least investment in eventually redundant infrastructureRetains a harbour outfall for emergency useDisadvantages:Lower quality solution for residual flow and eventually overflow compared to mid-harbour outfallDoes not immediately address Ngāi Tahu cultural concerns and retains some infrastructure at Takapūneke
Beneficial reuse + Pompeys Pillar	Immediate closure of treatment plant and its outfall	No	\$15.4m	\$16.2m	Advantages:Allows immediate start, with all wastewater being used beneficially from the outset.Addresses Ngāi Tahu cultural concernsImmediately removes all treated wastewater from Akaroa HarbourCould provide optional extras such as high level fire ponds and overflow to ocean in prolonged wet periodsDisadvantages:High sunk cost reduces the incentive to re-use all of the wastewater in Akaroa over time

Table 2 Summary of solutions not supported

Option	Closure of Takapūneke	Harbour outfall	Cost in consultation	Estimated Revised Cost	Advantages and Disadvantages
Pompeys Pillar - standalone	Immediate closure of treatment plant and its outfall	No	\$13.7m	\$9.7m- \$10.7m	Advantages Immediately removes all treated wastewater flows from Akaroa Harbour Beneficial use for farming Could provide optional extras such as high level fire ponds and overflow to ocean in prolonged wet periods Disadvantages Does not address Akaroa's water shortages, benefits of re-use are not maximised More expensive
Mid-harbour outfall	Immediate closure of treatment plant and its outfall	Yes – in perpetuity for all flows	\$7.4m	\$5.0m	Advantages         Least expensive option         Minimal environmental and amenity impact         Disadvantages         Does not make any use of the water         Does not meet Ngāi Tahu's cultural concerns
Beneficial re- use in Akaroa + Upper Robinsons Bay	Takapuneke retained until all flows can be absorbed by Akaroa or trees at Upper Robinsons	Retained until trees established in Robinsons Bay – at least 5-6 years. More if a prudent staged approach is taken	\$8.3m	\$10.6m	Advantages Single willing seller Disadvantages Long implementation time while trees establish. Takapuneke treatment plant and harbour outfall retained during this period High risk – irrigation to native trees is not used elsewhere Elevated risk of flooding, slips and nitrogen leaching to Robinsons stream Investment in tree establishment and irrigation at Robinsons Bay reduces the incentive to re-use the wastewater in Akaroa. Relatively high sunk cost once all water being re-used in Akaroa. Overflow during prolonged wet periods once harbour outfall ceases would be to either Grehan Stream or Robinsons stream

Option	Closure of Takapūneke	Harbour outfall	Cost in consultation	Estimated Revised Cost	Advantages and Disadvantages
Takamatua or Lower Robinsons Bay valley floor	Takapūneke retained until all flows can be absorbed by trees in these valleys or shelter belts established	Retained a minimum of 5-6 years for native tree or shelter belt establishment and preferably considerably longer for a staged approach as recommended	\$6.6m-\$8.4m	\$8.4m- \$10.2m	Advantages None Disadvantages Multiple land parcels required. Lack of willing sellers and community resistance Severe amenity effects on residents in the valley from surrounding in forest or cut-and-carry operations Longer implementation time; Takapūneke plant and harbour outfall needed until native trees or shelter belts established No beneficial use of the water;- disposal only. Does not address Akaroa's water shortages Highest risk of flooding and nutrient leaching Overflow during prolonged wet periods would be to valley stream (and then to harbour)
Upper Robinsons Bay - standalone	Takapūneke retained until all flows can be absorbed by trees	Delayed by a minimum of 5-6 years for tree establishment. More if a prudent staged approach is taken	\$6.6m	\$8.4m	AdvantagesSingle willing sellerPotential less amenity impact than Valley floor options provided appropriately developedDisadvantagesLong implementation time while trees establish. Takapūneke treatment plant and harbour outfall retained during this periodHigh risk – irrigation to native trees is not used elsewhereElevated risk of flooding, slips and nitrogen leaching to Robinsons streamOverflow during prolonged wet periods would be to either Grehan Stream or Robinsons Bay stream

## **13 Conclusion**

Communities have been shocked by the proposals produced by Council and the way in which the process has been conducted to date. Friends of Banks Peninsula has worked hard to listen to these communities and to find a way forward that deals with their concerns and their desire to see the Akaroa wastewater treated to the highest possible quality so that it can be put to beneficial use where it is most needed.

We respect and acknowledge the work of the Banks Peninsula Community Board in recognising the seriousness of the issue and setting up the Working Party, and we commend the able chairmanship provided by Penny Carnaby. This submission builds on the progress made by the Working Party through listening to community and Ngāi Tahu concerns in a respectful and constructive way and in treating community input and local skills and knowledge as something to be harnessed. As a result of that progress made, beneficial re-use of the water in Akaroa has been included in the consultation.

The solutions we have proposed are based on Option 4 - Non-potable re-use in Akaroa. They are aimed at maximising long term benefit, minimising risk, and providing Akaroa with the greatest resilience long term to balance the challenge of the dwindling water supply predicted by the change to a drier climate with increased demand from a growing population.

Beneficial non-potable re-use is still uncommon in New Zealand, but it is widely practiced overseas and the technology to treat the water to a sufficiently high standard and deliver it to businesses and residences with a purple pipe network is mature. In contrast, intensive land disposal has a recent and chequered history in New Zealand and, given the unique challenges posed by Banks Peninsula's topography and poorly draining loess soils, we believe this to be a much riskier option, that does not deliver the long-term benefits of recycling the water in Akaroa.

We have taken into account that the root of all proposals is to reduce the offence to Ngāi Tahu caused by the existing treatment plant at the culturally significant site of Takapūneke and to withdraw from the culturally offensive practice of mixing water that has passed through humans into the harbour without first passing through land.

Our preferred solution is to combine the Non-potable re-use in Akaroa with transitional harbour outfall. We believe this will lead to the best environmental outcome in the long term. It comes with a lower price tag, and much less capital sunk up-front in a residual disposal that will gradually become redundant for regular use. We recommend that the outfall is retained to provide the most environmentally sound way of dealing with overflow should a prolonged sequence of wet weather temporarily preclude land based use.

However, we recognise that this will necessitate the culturally offensive practice of mixing waters to continue not only for a longer period during implementation but also in the long term for emergency use. Hence we have also included a solution with beneficial re-use at the remote farm of Pompeys Pillar. This solution would enable the harbour outfall to be discontinued immediately upon implementation, but has a higher up-front and overall cost, and therefore a greater financial disincentive to phase in additional purple pipe reticulation in Akaroa. Emergency overflow would be to streams, or potentially to the ocean. These factors combined mean it may be of higher cultural but lower environmental benefit in the end.

We have also identified the solutions that are not acceptable. These are based on the disposal rather than the beneficial re-use of the water, have high impacts on the communities neighbouring Akaroa and a long implementation period during which both the treatment plant at Takapūneke and its harbour outfall would be retained. Should the Council continue to progress solutions that are

environmentally and socially unacceptable to the resource consent stage, we signal that we would submit in opposition and fully participate in the process.

We implore the Council to select a solution that has community support and make better use of public money through building Akaroa's resilience based on a co-operative approach rather than on legal expenses fighting its own ratepayers. We implore the Council to further investigate the implications of Option 4 – Non-potable re-use in Akaroa, as it has only been introduced to the consultation mix near the end of the research and design process, and to now examine how it could be staged in and costed effectively through the Council's long term plan in conjunction with any resource consent application based upon it.

If the Council selects a solution based on beneficial re-use in Akaroa and with a residual disposal method that is acceptable to Friends of Banks Peninsula, we would expect to further engage in a constructive manner to ensure that solution provided an exemplar for communities elsewhere in New Zealand or even overseas. We trust that the Council finds this submission constructive and helpful in assisting it to determine the next stage of the Akaroa Wastewater process.

We believe that Akaroa is now positioned to lead New Zealand with a beneficial re-use system that would best position it to face the challenges of climate change ahead, improve the health of its streams and potentially end summer water restrictions in the town. We urge Christchurch City Council to demonstrate that it treats its water resources and its communities, both tangata whenua and pākehā, with the greatest of respect and projects a 100% Pure image at its top tourist town.

## Appendix 1 Expert advice EcoEng



63 Bowenvale Avenue, Christchurch, New Zealand Ph (64) (3) 942 7954 Mobile: (64) 021 533386

Email: <u>andrew@ecoeng.co.nz</u> Website: <u>www.ecoeng.co.nz</u>

## Memorandum

6 April 2017

#### To: Friends of Banks Peninsula From: Andrew Dakers Subject: Akaroa Wastewater Land Application Proposal

Attention Sue

This letter is in response to a letter from members of Robinsons Bay community requesting statement from me on the risks of year round land based wastewater application on the Banks Peninsula.

Banks Peninsula soils, topography, geology, land use and catchment configurations make large scale yearround wastewater land application of treated domestic wastewater, very technically challenging, with potential for high risks with respect to:

- Public, and private health
- Land and water based ecosystem integrity,
- Cultural and social values of the local affected communities and individual land owners
- Affected land values and
- Unacceptable economic burden to present and future rate payers.

My reasoning for stating the above follows.

- The upper soils are generally poorly draining loess soils, often with compacted pans and other anomalies that further restrict the vertical movement of applied water. These soils overlay bed rock. (Note: The Pattle Delamor Partners soils reports have noted significant shallow red and grey mottling at relatively shallow depths, indicating significant seasonally saturated soils over many years).
- The topography is highly variable, steep in parts, with geological structures giving rise to slope stability risks, both in terms of mass earth movement and shallow erosion (some areas of dispersive soils).
- Within the Akaroa Harbour catchment there are many surface streams and water courses draining into the harbour. Some of these steams and receiving harbour bays are used for recreational purposes as well as supporting biodiversity and are potentially at risk.

The above factors make both large scale year round irrigation of treated wastewater and provision of large affordable storage facilities significantly more challenging than many other sites.

This does not mean that treated wastewater cannot not be safely applied to Banks Peninsula land areas at certain times in the year without significant risk. It does mean that should such a proposal be adopted it would be wise to proceed with caution, careful monitoring and in sensible stages, perhaps over many years to provide knowledge for the unknowns referred to later. **The ultimate goal may be to achieve year-round** 

**land application of all treated wastewater from the new Akaroa WWTP**. I know of no other similar yearround large scale wastewater land application system in NZ on similar soils and topography that has been operating successfully for a substantive period at design load. This proposal is essentially a first for NZ.

The latest consultation document, CIT0630 Final 2, lists 5 options:

- 1. Irrigation of trees or pasture at Robinsons Bay
- 2. Irrigation of trees or pasture at Pompeys Pillar
- 3. Irrigation of trees or pasture at Takamatua Valley in combination with another area
- 4. Non-potable reuse in Akaroa in combination with another option
- 5. Disposal via a new outfall pipeline to the mid-harbour

The same draft document made it clear that Options 1,2 and 3 are to be year-round irrigation to land. The consultation document does not seek submissions any options that are a combination of land application and harbour discharge, even as a staged development option.

A staged combined land/harbour discharge option, after full scale advanced treatment, is likely to result in an immediate and significant step towards long term protection of the harbour ecosystem, with minimal risk to land based ecosystems (and embedded human communities) both in terms of ecological sciences, harbour water quality and protecting and enhancing the mauri (life force) of the harbour. This may not fully satisfy the immediate expectations of Ngāi Tahu, but it likely to be the most pragmatic and optimal compromise that will enable life to resume for Banks Peninsula residents with minimal cultural, public health and environmental risks and without unacceptable economic burden to affected rate payers. Furthermore, a staged combined land/harbour discharge option will require significantly less storage.

What do I mean by staged combined land/harbour discharge option?

- a. Install the new advanced treatment plant essentially as consented (i.e. a new full capacity treatment plant)
- b. Upgrade Akaroa sewer network over an acceptable time period to achieve significant reductions in I&I
- c. Install land application for summer period when soils and vegetation is most receptive to the application of treated wastewater to land and discharge to the harbour for periods when land and vegetation is not receptive to land application.
- d. Allow appropriate harbour discharge, perhaps via a low cost wetland or infiltration gallery, for times when the land is not safely receptive to land application
- e. Implement (c) and (d) in stages to increase discharge to land and reduce discharge to the harbour over time as knowledge with respect to safe land application is gained.

It is acknowledged that a previous consultation document noted that *options involving a coastal infiltration* gallery located at the end of the Takamatua Peninsula .... were not acceptable to Ngāi Tahu.

The staged combined land/harbour discharge option would seem to me to be an eminently sensible compromise, given the current high degree of uncertainty and risk for the year-round irrigation option.

<u>In summary</u>, the reasons I believe an option of (staged) combined land/harbour discharge post advanced treatment should be considered more seriously are:

• Banks Peninsula soils, topography/geology, land use, catchment configurations and settlement structures make year round irrigation of treated wastewater a high geotech, public health, environmental, social/cultural and economic risk. There is no similar long-standing large scale year-round land based wastewater irrigation system in NZ to model options 1 to 3 by.

- There are a number significant technical knowledge gaps. Staged development of combined land/harbour discharge option will provide not only more time but also feedback monitoring data. The current knowledge gaps include:
  - The actual (rather than theoretical) site specific down slope risk in relation to different hydraulic loading rates
  - $\circ$   $\;$  The site specific effect of tree roots on slope stability
  - Once a specific site has been chosen a more detailed site specific water balance modeling may be required – to take into account additional input variables such interflow, and output variables such as deep percolation (LTAR), evapotranspiration, interception, and maybe other factors. At the moment modeling variables are unrefined due to sparse specific field data and lack of local specifics and knowledge.
  - Long term site specific nutrient uptake coefficients (especially for trees) and nutrient pathways for Banks Peninsula soils require refining and modeling.
  - Climate change science continues to be improving and likely impacts (especially extreme events) becoming more predictable.

Yours faithfully

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Andrew Dakers Director and Principal Engineer

## Appendix 2 Assessment of options against Community Strategy Principles

Each of the Acceptable Options is assessed against the relevant Principles in the Community Strategy. (Excludes A,E and H assessed in the main text as apply to all options)

#### 2.1 Option 4 Non-potable re-use in Akaroa

# Principle B - Disposal must be in the right area, not one that externalises risks and costs onto adjoining residents, or destroys the amenity or health of the environment

We consider that if the Council is prepared to take a lead and irrigate the water into the public reserves, a demonstration garden and the public toilets, then our concerns about risks to health would be addressed.

However, we have some doubt as to whether the areas suggested for watering in the consultation booklet are sensible. The reserves discussed for the watering at the Working Party were Akaroa's waterfront reserves, the Recreation Ground, the area near Daly's wharf, the grassy area adjacent to the main beach and the Britomart Reserve near the main wharf. All these areas are adjacent to public toilets and all are suffering from heavy over-use and looking very dry and tired. All these areas are flat and incur heavy usage, and we had assumed watering would be done with underground piping in the smaller reserves as is usual on golf courses.

The Consultation document however now describes irrigating L'Aube Hill and Stanley Park and we do have concerns about both of these. L'Aube Hill is steep, and mainly forested with Kanuka, a species as already described that does not like wet feet. We would therefore be interested to see the watering level proposed for this reserve before being reassured that it would be suitable both geotechnically and for the plants. There is significant infrastructure below the reserve including St Patrick's church.

Stanley Park may be intrinsically more suitable for irrigation as it is currently largely pasture, maintained by grazing and mowing, although there are also stands of kanuka. Stanley Park has a Reserve Management Committee, and we trust that their views have been sought before putting this concept into the public domain. Irrigation will cause greater grass growth and this may cause management issues or require a higher stock level.

We would be sympathetic if neighbours to Pond Site 10 were concerned, but note that it appears to be 225m from the nearest residential unit (the uppermost of Akaroa Cottages) from which it is very well screened by vegetation on both sides of State Highway 75

#### Principle C-Solution must be sustainable in the long term and robust in the event of natural disasters

We consider that a solution based on re-use of the water in Akaroa township makes a substantial contribution toward the sustainability of the town by reducing its demand for potable water.

Option 4 makes a start on this, and a promise of more to come in the future.....

The Pond at site 10 would need to be engineered to the highest standard. We would expect the Council to hold liability insurance to cover any eventuality such as collapse and any impact on neighbours below – principally the Akaroa Cottages

#### Principle D - Solution must meet Ngāi Tahu cultural values

We understand from Ngāi Tahu members of the Working Party that reuse in Akaroa is acceptable to them.

We are also aware that re-use carries with it the chance that water used for outdoor purposes could make its way to a stream and then the harbour without passing through land. We suggest a pragmatic approach is taken to this. Where possible, such as at the main boat-wash, such water will be captured and sent to the Treatment Plant. Otherwise it will make its way to the streams as do many other contaminants from urban environments. Measures such a riparian planting should be encouraged along waterways to minimise and mitigate all forms of run-off, and we suggest that the Council work with the Zone Committee and others to carry out this planting along all the streams, prioritising those at risk of treated water run-off.

#### Principle E - Managed process and infrastructure

Further information needs to be provided, and Friends of Banks Peninsula is happy to contribute to the design and implementation.

#### Principle F - Ideally find a solution that makes beneficial use of the water

The consultation identifies that Option 4 is the start of plans to create a purple pipe network throughout Akaroa. Data presented by Council and the final Working Party meeting suggested that it would be possible for 100% of the water to be re-used in Akaroa, and the Working Party agreed that re-use in Akaroa is desirable. We consider re-use in Akaroa would be the most beneficial as this is where it is most needed.

#### Principle G - Obviate the need for compulsory purchase

Re-use in Akaroa would be entirely voluntary on private property, and we assume that the Council's calculations behind the 25% use in reserves and public toilets was based on a beneficial level of watering.

No compulsory purchase would be needed for this option.

## 2.2 Pompeys Pillar residual solution

# Principle B - Disposal must be in the right area, not one that externalises risks and costs onto adjoining residents, or destroys the amenity or health of the environment

Our support for Pompeys Pillar is based on the Council reaching a contractual agreement with the landowners that they are happy with, with no threat of compulsory purchase.

#### Principle C-Solution must be sustainable in the long term and robust in the event of natural disasters

Pompeys Pillar scores less well on this, in that there are pumping costs, and one member of the Working Party was concerned that the long pipe would be more vulnerable in the event of a natural disaster. We agree with this, but note that if the end intention is to develop 100% re-use in Akaroa over time, then perhaps of more importance is to consider what value would be left in the residual infrastructure once irrigation at Pompeys Pillar ceased. Could it, for example, provide an outlet in the event of a succession for wet seasons?

#### Principle D - Solution must meet Ngāi Tahu cultural values

We understand from Ngāi Tahu members of the Working Party that re-use in Pompeys Pillar is acceptable to them, subject to the findings of the cultural assessment.

#### Principle E - Managed process and infrastructure

An advantage of this system would be if the farming family managed the infrastructure at the Pompeys Pillar end, and particularly if the area of the farm used and pond storage was sufficient that they could manage the water to maximise its beneficial use and minimise the need for disposal.

#### Principle F - Ideally find a solution that makes beneficial use of the water

The water and nutrients it contains would be used to improve the productivity of the farm. This should be taken into account in the whole of life costings, and a fair deal struck from both sides.

#### Principle G - Obviate the need for compulsory purchase

We would not support this option if it relies on compulsory purchase for the property.

#### 2.3 Harbour outfall residual solution

# Principle B - Disposal must be in the right area, not one that externalises risks and costs onto adjoining residents, or destroys the amenity or health of the environment

The water quality emitting from the treatment plant would now be a considerably higher quality than that proposed in the original application for harbour discharge, because the bypass flows are captured and a very high standard required for the purple pipe re-use in Akaroa. We note that the risk to shellfish identified earlier was largely due to bypass flows. If the water was suitable to irrigate salad crops that are directly watered, we cannot see that it can have an effect on shellfish when it has been much further diluted in the harbour.

Water disposed to the centre of the harbour would be rapidly diluted by the receiving environment and flushed out with the tide. The area proposed is well-away from swimming beaches and on the ocean floor.

#### Principle C-Solution must be sustainable in the long term and robust in the event of natural disasters

A harbour outfall properly installed would be robust and resilient. The sustainability criteria would be met if Harbour outfall was part of a re-use package and may provide the safest and most sustainable way to deal with overflow in the event of several wet seasons overwhelming the pond capacity.

#### Principle D - Solution must meet Ngāi Tahu cultural values

Harbour outfall does not meet the Ngāi Tahu cultural values, but we ask for consideration as to whether it is acceptable as an interim measure.

#### Principle E - Managed process and infrastructure

Probably easily managed. CCC has experience of harbour outfall already, Bromley has ocean outfall.

#### Principle F - Ideally find a solution that makes beneficial use of the water

Harbour disposal does not make beneficial use.

#### Principle G - Obviate the need for compulsory purchase

No compulsory purchase involved.

## Appendix 3 Calculating re-use potential

The following diagram is supplied in the Beca report. It gives metered water volumes based on the current flows but wastewater flows based on 2041 projects. Our annotations in red give the current flows.



- Municipal re-use identified in the Beca report is 33,000m<sup>3</sup>. This is 25% of 2041 wastewater design flows and 40% of 2015 actual flows.
- A significant proportion of Akaroa's potable water is used outside by households, chiefly garden watering, as identified in a 2003 Lincoln study<sup>18</sup> and more recently calculated by Council staff at 97,000m<sup>3 15</sup>.
- The calculation is made by comparing the total amount of potable water flowing into properties as measured by water meters, and the total amount of wastewater arriving at the treatment plant, less an estimate of stormwater infiltration. The difference is essentially water people have taken through their metered supply but not put down the sewer i.e. used externally for activities such as garden watering or washing cars.
- The 97,000m<sup>3</sup>, combined with municipal demand of 33,000m<sup>3</sup>, gives a total demand of 130,000m<sup>3</sup>, which easily exceeds both the 2015 and 2016 wastewater annual flows of 79,000m<sup>3</sup> and 76,000m<sup>3</sup> respectively, and almost meets the 2041 design flow of 138,000m<sup>3</sup>. Using the maximum current flows from the past

five years (rather than projected flows), this external use may in fact be as high as 130,000m<sup>3</sup> which, combined with the municipal demand gives 163,000m<sup>3</sup>, and would easily use all of the supply.

- The demand for garden watering is currently "throttled" every year by water restrictions; there would be no such restrictions on the "purple water" so private demand could be significantly higher.
- From this we infer that demand for non-potable re-use is likely to be enough to meet the entire wastewater flows anticipated by 2041.

## Appendix 4 Technical matters outstanding

We draw attention to the many matters where technical information is still outstanding.

### 4.1 Knowledge gaps

#### Beca identified gaps

In their latest report<sup>15</sup>, Beca acknowledge the following areas as requiring further investigation, and as potential sources of risk. These statements support the view that there are still fundamental knowledge gaps and uncertainties around the long-term effects and risks from the anticipated hydraulic and nutrient loads, as well as other aspects:

- The need for agricultural soil tests to determine current nutrient state and appropriate measures to maximise growth of trees or pasture to maximise nutrient and water uptake, i.e. both the water and nutrient uptake aren't accurately known. (p8)
- Storage volume remains indicative (p9)
- Risk of midge nuisance is currently unknown (p36)
- Uncertainty around WWTP effluent quality parameters because the final WWTP solution has not been selected (p37). Further, Beca indicate the difference between design and actual performance and that the design parameters represent a "worst case". However, for nitrogen removal their example (Motueka) performs *worse* in practice than the design value (24g/m3 vs 20). (p38)
- Potential for localised erosion points where groundwater exits the ground such as banks of water courses and other slopes (p49). Bank collapse is a flood risk for areas with residences downstream such as Robinsons Bay and Takamatua. For 11 Sawmill Rd, risk of local river bank instability identified, and movement of silt slopes may be expected to occur following heavy rain or seismic activity (p50). (Frequency and intensity of high rainfall events is predicted to increase with climate change.)
- Long-term-acceptance rate (LTAR) and nutrient uptake still needs to be determined (page 50)
- Higher risk of drainage to groundwater in Robinsons Bay and Takamatua acknowledged but not quantified (p65)
- Further work required (p78)
  - Completion of Overseer analysis of potential nitrogen leaching for each scheme option
  - Completion of the soil water balance for irrigation to trees as recommended by the Technical Experts Group.

#### Additional issues found in the Beca report

In addition to the issues raised by Beca in their report (March 2017), there are other statements made that require a closer analysis:

• Re restoring the *mauri* of the water by elimination of wastewater (page 1): the land-based treatment options all require an "overflow" for when the ponds are full and irrigation is unable to proceed. With the exception of Pompeys Pillar, where this overflow would be discharged to the open ocean (via the nearest stream valley), the overflow would enter the harbour at its head, and would therefore have the maximum impact on the *mauri* of the harbour. In contrast, a mid-harbour discharge places the wastewater further down the harbour and in deeper water, where it is rapidly flushed out to sea on the outgoing tide. From an environmental and public health point of view, discharging wastewater containing nutrients and other contaminants into the shallow harbour bays will have the effect of concentrating those nutrients and contaminants in the silt on the bottom, as is thought to be the case from the Duvauchelle outfall, which affects Robinsons Bay<sup>16</sup>. This is also true of any nutrients and contaminants that leach from the disposal areas into local streams.

- 25m buffers to streams and the coast to minimise nutrient leaching (page 12): almost all of the
  proposed irrigation areas are on hillslopes, so both leaching and runoff would be expected to flow
  downhill to the nearest waterway. A 25m buffer is unlikely to be sufficient. We note that additional
  buffering does not appear to have ever been considered as a remedy to nitrogen leaching at
  Whakarewarewa.
- Duvauchelle golf course was excluded because it is earmarked for Duvauchelle's water (page 18). The golf course is approximately 40ha of trees and lawn, most of which appears to meet slope requirements. Since the population serviced by Duvauchelle is much smaller than Akaroa it is possible the golf course could use the water from both via sub-surface irrigation. There is also another 10ha of farmland directly behind the golf course of suitable slope with the majority of this at a considerable distance from dwellings, should expansion be required. The golf course is public land, and the cost of the extra pipeline would be offset by saving on land purchase.
- Nitrogen load calculation of less than 70kg/ha (page 20): the design median nitrogen concentration is 20g/m3; at 138,000m3 per annum over 27 ha this equates to 102kg/ha, and 114kg/ha for 25 ha (trees).
- Tonkin and Taylor slope hazard susceptibility maps were used to exclude erosion zones (page 22), but these do not cover all of the area identified for Robinsons Bay. The areas that are mapped show significant local instability on land similar to the unmapped areas proposed (e.g. on the 11 Sawmill Rd property). This suggests further geotechnical assessment is still required, and that the same visual assessment used by Tonkin and Taylor would likely identify areas of local instability on this additional land.
- High Natural Character and Outstanding Natural Landscape areas (page 22): excluding these areas for irrigation to pasture makes no sense when the proposed activity has the same visual amenity effects as farm irrigation (which is a permitted activity), and the area is already visually modified by farming activities in the overlay areas. There is also no justification given for the 50m setback. Pompeys Pillar land available is closer to 90 ha if these areas are included.
- BOD load for the pond (page 35): an upper limit of 30-40kg/ha/day is recommended, but then the higher value of 40 is selected. If the more conservative value of 30kg/ha/day is selected, Beca's modelling shows this being regularly exceeded. Given the speculative nature of the modelling, the risk of odour cannot therefore be said with certainty to be low.
- Pond risks (page 36): no thought given to wildlife fouling the water, e.g. Canada geese, as has happened for large ponds in other parts of Canterbury such as Oxford. The pond will be a stagnant water body over winter, increasing the risk of odour and nitrogen build-up from bird faeces.
- Reverse Osmosis (page 41): the report suggests it has no use but does not consider its part in beneficial re-use in Akaroa. Under a combined re-use and land disposal solution the RO plant could be located in Akaroa. The retentate (a much lower volume potentially 10-15%) could then be disposed of on land giving a much lower water application rate (land area may still need to be large to take the nutrient and contaminant load), making a lot more areas viable because the instability risk would be negligible. Also, RO is not simply an additional cost: if used the WWTP would be reconfigured to suit. Also, RO removes nitrogen so further nitrogen removal may not be required, depending on where the retentate would be disposed of.
- Robinsons Bay BH1 near the coast (page 52): this shows shallow groundwater that is tidally influenced, making it probably unsuitable.

#### **Technical Working Group**

The second Joint Statement issued by the Technical Working Group confirms several of the knowledge gaps, including:

- Review of LTAR required (3.2)
- Soil scientist to review assumptions, may require further soil testing (3.4)
- Appropriateness of buffers assessment for site-specific risks needed (4.3)

- Groundwater movement not fully investigated and requires further monitoring to determine risk of nitrogen leaching (4.5)
- Impact of climate change on rainfall patterns and associated storage requirements (4.7)

## 4.2 Unanswered Working Party questions

The Working Party raised questions various aspects of the proposed solutions, which were directed to the Technical Working Group. The following questions remain unsatisfactorily answered:

- What application rate would result in no ground water mounding?
- What slope would be safe if lower water levels (e.g. half that currently proposed) were to be used? What would be safe if there is already well-established bush on the slopes?
- An assessment of soil nitrogen issues taking into account the poor experiences at other land disposal places such as Rotorua, Leeston and Selwyn Huts. How is nitrogen saturation to be avoided in a Peninsula land disposal?
- Investigate the assertion that the Medical officer of health would not allow wastewater to be irrigated behind Akaroa. We have seen no evidence from drinking water standards that this could not be done provided the water collected was then properly treated and/or applied sufficiently far from water intakes. It is our understanding that the assertion relates to returning the treated wastewater to the Akaroa drinking water catchment, which does not preclude using or disposing of it in areas that don't impact on the town drinking water supply.
- Technical group to investigate and give serious consideration to the concept of a distributed network introduced in stages.

#### 4.3 Inadequate data

The investigations undertaken to date have been carried out over a short time frame that limits the data collected. Further, there are issues with the type and quality of data gathered:

- Soil sampling and infiltration testing has been carried out over a single summer only. Soil moisture levels influence infiltration rate, and these vary significantly with the seasons, as observed between September and January during the investigations. The infiltration rate for the rest of the year has not been established.
- Core samples taken during investigation often contained "no recovery" gaps (Beca report Appendix M). In one case (BH2 Robinsons Bay valley), more than 1m of the core sample was missing, and BH6 (Takamatua upper valley) has two major missing sections of 0.77m and 0.6m.
- A Lincoln University investigation into irrigating native tree species will have been running for less than two years when it reports to this investigation. This is insufficient to determine long-term effects on both the trees and the receiving environment. Further, the juvenile trees are planted closely together in rows with grass in between, which does not reflect either the planting pattern that will be used or the long-term conditions; in particular, the on nutrient uptake of the (mowed) grass will dwarf that of the young trees (confirmed in an email from Brett Robinson)
- A Lincoln University investigation into the application of wastewater to pasture is using lysimeters to measure nutrient uptake in pasture. This is not an accurate reflection of what will occur *in situ*, and will not accurately reflect the effect of the build-up of nutrients and contaminants in the soil because the soil samples are being allowed to freely drain rather than build up (high) moisture content levels. No information has yet been released regarding the direct measurement of nitrogen build-up in the soil.

#### 4.4 Nitrogen removal requirements

• If irrigation to pasture at Pompeys Pillar is used, over a 27ha area as proposed, then the proposed nitrogen level emitting from the plant is appropriate,, giving an average annual load of 102kg/ha, with no at risk water bodies present. However, if all of the land identified as geotechnically suitable

were to included, this would more than triple the land available for irrigation, enabling a much lower application rate. We calculate that at this rate of application the WWTP could be "de-tuned" because the higher nitrogen concentration (a maximum of 60g/m<sup>3</sup>) spread over the larger area equates to the same per-hectare load. The cost saving identified by Beca would be \$2-\$3 million it this additional land was included and the plant de-tuned<sup>15</sup>.

- For irrigation to either trees or pasture in Robinsons Bay and Takamatua, there is risk of nitrogen leaching from the irrigated area into shallow groundwater and streams. We note that the nitrogen load per hectare planned would be similar to that applied at Whakarewarewa, which saturated the soil with nitrogen over the first five years, and has been leaching out to the local waterway ever since. For these options it would therefore be prudent to apply the full nitrogen removal.
- For beneficial re-use in Akaroa, it would be prudent to apply the full nitrogen removal to minimise the risk of nitrogen saturation and leaching
- For harbour outfall, we assume the proposed level is acceptable given the rapid dilution that occurs. We have no opinion on whether "de-tuning" would be appropriate, however we note that water flowing to the harbour from the existing Takapūneke treatment plant has a higher nitrogen concentration than that proposed (approximately 28g/m3 compared to 20g/m<sup>3</sup> for the proposed plant), and there have been no reported environmental effects as a result<sup>17</sup>.
- Hence we suggest the costings of the options listed in the Consultation booklet should be adjusted as follows to achieve the optimal cost/benefit for nitrogen loading.

Option	Variation	Cost impact
Pompeys Pillar (pasture)	De-tune WWTP	-\$2-3m
Robinsons Bay/Takamatua (trees or pasture)	Full nitrogen removal	+\$1.8m
Beneficial re-use in Akaroa	Full nitrogen removal	+1.8m
Harbour outfall	No change	\$0

## 4.5 EcoEng review advocates caution

Andrew Dakers from EcoEng has been involved in the process for many years, most recently as a member of the Technical Working Group. He has advised Friends of Banks Peninsula that in his opinion caution is required before implement a "first for New Zealand" on the difficult topography of Banks Peninsula. He identifies substantial knowledge gaps, including:

- Site-specific down slope risk in relation to hydraulic loading rate
- Site-specific effect of tree roots on slope stability
- Detailed site-specific water balance modelling
- Long-term site-specific nutrient uptake coefficients and nutrient pathways
- Climate change likely impacts (especially extreme events)

#### 4.6 The need for a peer review

The issues raised in this section highlight the need for the information produced to date to be peer reviewed to assess the details, risks, and overall suitability of approach. Whilst we are sure the parties involved to-date are acting professionally, nonetheless they have a history of involvement with large sewage treatment and disposal projects that may be unconsciously directing how the investigation has proceeded. Peer review by an independent party with appropriate expertise but from outside the sewage treatment and disposal field is recommended to identify where the investigation may have missed opportunities and risks.

#### Appendix 5 References

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- 21. NEWater Technology, Singapore Public Utilities Board web resource, https://www.pub.gov.sg/Documents/NEWater%20Technology.pdf
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Appendix 6 List of names endorsing this submission

FRIENDS OF BANKS PENINSULA INC

MISSION IN RELATION TO

#### AKAROA RECLAIMED WATER BENEFICIAL RE-USE TREATMENT AND DISPOSAL OPTIONS

We hereby endorse the submission of Friends of Banks Peninsula Inc responding to the Akaroa Reclaimed Water Beneficial Reuse, Treatment and Disposal Options consultation released by Christchurch City Council in April 2017 and agree to our names being listed in the submission. (Addresses and contact details redacted).

Name	Address	Contact	Endorse through	Date received
Brent Martin			Contributing author	12 April 17
Suky Thompson			Contributing author	12 April 2017
Averil Parthonnau d			Web form	16 April 2017
Kevin Parthonnau d			Web form	16 April 2017
Fiona Turner			Verbal request	16 April 2017
Sandra Hicks			Web form	16 April 2017
Patsy Turner			Web form	16 April 2017
Josephine Cataliotti			Web form	16 April 2017
Monique Connell			Web form	16 April 2017
Stephanie Connell			Web form	16 April 2017
Suzanne Church			Web form	16 April 2017
Craig Church			Web form	16 April 2017
Andrew Bax			Web form	17 April

		2017
Anthea Penny	Web form	17 April 2017
Brent George	Web form	17 April 2017
Jacqui	Web form	17 April 2017
George		
David Brailsford	Web form	17 April 2017
Jan Cook	Web form	17 April 2017
Garth Tiffen	Web form	17 April 2017
Page Lawson	Web form	17 April 2017
Josie Martin	Web form	17 April 2017
Linda McLachlan	Web form	17 April 2017
Ian Pavitt	Web form	17 April 2017
Liz Daish	Web form	17 April 2017
Helen Briggs	Web form	17 April 2017
Emeritus Professor Helen Leach	Web form	17 April 2017
Georgie Oborne	Handwritten request	17 April 2017
Mike Oborne	Handwritten request	17 April 2017
Sarah Ford	Web form	17 April 2017
Richard Troughton	Web form	17 April 2017
Lorraine Owen	Web form	17 April 2017

Benoit Navarron	Web form	17 April 17
John Wright	Web form	17 April 17
Cherilynn Wright	Web form	17 April 17
Mary Farrell	Web form	18 April 17
Noel Kelly	Web form	18 April 17
Dick Fernyhough	Web form	18 April 17
Graeme Raxworthy & family	Web Form	18 April 17
Lorraine Raxworthy	Web form	18 April 17
Ross Pettersson	Web form	18 April 17
Chris Pottinger	Web Form	18 April 17
Tracey Pottinger	Web form	18 A;pril 17
Chris Moore	Web form	19 April 17
Annette Moore	Web form	19 April 17
Shaun Huddleston	Web form	19 April 17
Brian Eves	Web form	19 April 17
Beverley Reeves	Web form	18 April 17
Thomas Eves	Web form	20 April 17
Michael Browne	Web form	20 April 17
Mary Browne	Web form	20 April 17
Stuart Jeffrey	Web form	20 April 17
David Williams	Web form	20 April 17
Dianne	Web Form	20 April 17

Carson		
Katherine Fraser	Web Form	20 April 17
David Williams	Web Form	20 April 17
Richard Lovett	Web Form	21 April 17
Sue Lovett	Web Form	21 April 17
Mr. Gerald Davison	Web Form	21 April 17
Chris Muirhead	Web Form	21 April 17
Marion Graham Pat Lyons	Web Form	21 April 17
Wayne	Web Form	21 April 17
Sceats	Web Form	21 April 17
Tichborne Guy	Web Form	21 April 17
Tichborne Ben Tichborno	Web Form	21 April 17
Lizi Reese	Web Form	21 April 17
Michael Schlumpf	Web Form	21 April 17
Jeremy Carson	Web Form	21 April 17
Denise Wren	Web Form	21 April 17
Lea Hullett	Web Form	22 April 17

Jeanette Emmerson	Web Form	22 April 17
Selwyn Watkins	Web Form	22 April 17
Barbara Watkins	Web Form	22 April 17
Derek Marr	Web Form	22 April 17
Shireen May Helps	Web Form	22 April 17
Francis Helps	Web Form	22 April 17
Mr. Renan cataliotti	Web Form	22 April 17
Rosie Davidson	Web Form	22 April 17
Bryan Tichborne	Web Form	22 April 17
Nancy Tichborne	Web Form	22 April 17
Canalda max	Web Form	22 April 17
Contamine Matthieu	Web Form	22 April 17
Johannah Curwood	Web Form	15 April 17
Pauline Sitter	Web Form	22 April 17
Geraldine Guillemot- Peacock	Web Form	22 April 17
Russell Peacock	Web Form	22 April 17
Flore Mas	Web Form	22 April 17
Amanda Gauntlett	Web Form	22 April 17
Robert Perry	Web Form	22 April 17
Prue Hawkey	Web Form	22 April 17
Maria Bryan	Web Form	23 April 17

Helene Grimaud	Web Form	23 April 17
Mark Wren	Web Form	23 April 17
Hannah Gauntlett	Web Form	23 April 17
Martin Maquire	Verbal endorsement	23 April 17
Ad Sintenie	Web Form	23 April 17
Hollie Hollander	Web Form	23 April 17
Harvey Taylor	Web Form	23 April 17
Lyndsey Rhodes	Web Form	23 April 17
Dot Milne	Web Form	23 April 17
Kathleen Liberty	Web Form	23 April 17
Doig Smith	Web Form	23 April 17
Andrea Smith	Web Form	23 April 17
A.D Murrie	Web Form	23 April 17
Gabriel Calcutt	Web Form	23 April 17
Jamie Palmer	Web Form	23 April 17
Joanna Church	Web Form	23 April 17
Niamh Roche	Web Form	23 April 17
Julian Calcutt	Web Form	23 April 17
Katrina Calcutt	Web Form	23 April 17
Gloria Calcutt	Web Form	23 April 17
Stephen Lelievre	Web Form	23 April 17
Annette Lelievre	Web Form	23 April 17

Cynthia Muir	Web Form	23 April 17
Brent Schluz	Web Form	23 April 17
Chris Shearer	Web Form	23 April 17
Karen Watson	Web Form	23 April 17
Andrea Louisson	Web Form	23 April 17
Tracy Foley	Web Form	23 April 17
Paul MacFarlane	Web Form	23 April 17
Pip MacFarlane	Web Form	23 April 17
Giles Foley	Web Form	24 April 17
Lil Foley	Web Form	24 April 17
Michael Carson	Web Form	24 April 17
Anabel Wilson	Web Form	24 April 17
Lee Robinson	Web Form	24 April 17
Rebecca Barnett	Web Form	24 April 17
Andrew Smith	Web Form	24 April 17
Annie Maillard	Web Form	24 April 17
Jeremy Buchanan	Web Form	24 April 17
Fran Anderson	Web Form	24 April 17
Tony Muir	Web Form	24 April 17
Kerry Little	Web Form	24 April 17
Leanne M Hastie	Web Form	24 April 17

JOHN	Web Form	24 April 17
THOMSON		
Joanna Hase	Web Form	24 April 17
Marian Robinson	Web Form	24 April 17
Doug Hood	Web Form	24 April 17
Sara Parks	Web Form	24 April 17
Bruce Gauntlett	email	24 April 17
Anne Patterson	Verbal request	24 April 17
Toby Smith	Web Form	24 April 17
Annabella Fleri Soler Smith	Web Form	24 April 17
Garry Moore	Web Form	24 April 17
Catherine Ross	Web Form	24 April 17
Geoff Harris	Web Form	24 April 17
Grant Robertson	Web Form	24 April 17
Tony Mason	Web Form	24 April 17
Frank Coppens	Web Form	24 April 17
Brendan Glover	Web Form	25 April 17
Marion Glover	Web Form	25 April 17
Murray Smith	Web Form	25 April 17
Elizabeth Bain	Web Form	25 April 17
R E Stronach	Web Form	25 April 17
Susan Bruce	Web Form	25 April 17
John Higgins	Web Form	25 April 17

Gavin Shepherd	Web Form	25 April 17
Sonia Shepherd	Web Form	25 April 17
Neil Barnett	Web Form	25 April 17
Gregory Wilson	Web Form	25 April 17
Matthew Gray	Web Form	25 April 17
Grant Horner	Web Form	26 April 17
Bronwyn Horner	Web Form	26 April 17
Peter Steel	Web Form	26 April 17
Ross Shepherd	Web Form	26 April 17
Rob Allen	Web Form	26 April 17
Kosei Ono	Web Form	26 April 17
Pip Mason	Web Form	26 April 17
Emilie Plaetevoet	Web Form	26 April 17
John Baker	Web Form	26 April 17
Kate Robinson	Web Form	26 April 17
Robin Ball	Web Form	26 April 17
Andrea Moore	Web Form	26 April 17
Janna Robinson	Web Form	26 April 17
Eloise Ono	Web Form	26 April 17
Kate Casey	Web Form	26 April 17

Warren Casey	Web Form	26 April 17
David Fleming	Web Form	26 April 17
Wendy Fleming	Web Form	26 April 17
Karen Buchanan	Web Form	26 April 17
Kity Bryce	Web Form	26 April 17
Tony Bryce	Web Form	26 April 17
Kirstin McNabb	Web Form	26 April 17
Sara Black	Web Form	26 April 17
Donna Heenan	Web Form	26 April 17
Robert Steel	Web Form	26 April 17
Clive Weir	Web Form	26 April 17
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Frances	Web Form	26 April 17
Frances Baylis	Web Form	26 April 17
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Mary Pauwels	Web Form	27 April 17
Patricia Dart	Web Form	27 April 17
Marie Rhodes	Web Form	27 April 17
Tony Rhodes	Web Form	27 April 17
Ramon Farmer	Web Form	27 April 17
Pamela Fisher	Web Form	27 April 17
Tom Brennan	Web Form	28 April 17
Gary Willis	Web Form	28 April 17
Joanne Willis	Web Form	28 April 17
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Russell Turner	Verbal request	28 April 17
Sarah Anderson	Web Form	28 April 17
Julia Waghorn	Web Form	28 April 17
Paddy Stronach	Web Form	28 April 17
Lynne Lambert	Web Form	28 April 17
Peter Lambert	Web Form	28 April 17
Dawn Pearson	Web Form	28 April 17
Margaret Smith	Web Form	28 April 17
Kate Haley	Web Form	28 April 17
Chris Walker	Web Form	28 April 17
Sarah Abbott	Web Form	29 April 17
Sylvia McAslan	Web Form	29 April 17

Catherine Anderson	Web Form	29 April 17
Norman Anderson	Web Form	29 April 17
Brigid Rennell	Web Form	29 April 17
Julie Jennings	Web Form	29 April 17
Sally Cates	Web Form	29 April 17
Wirt Cates	Web Form	29 April 17
David Clark	Web Form	29 April 17
Prue Clark	Web Form	29 April 17
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Juliet Newman	Web Form	29 April 17
Mary Trevella	Web Form	29 April 17
Cameron Trevella	Web Form	29 April 17
Jessica	Web Form	29 April 17
Jan Wallace	Web Form	29 April 17
Jayne Abbott	Web Form	29 April 17
Bill Abbott	Web Form	29 April 17
Jeremy Moore	Web Form	29 April 17
Cathy Smith	Web Form	29 April 17
Alyson Molan	Web Form	29 April 17
Sarah Cook	Web Form	30 April 17

Mike Lawson	Verbal request	30 April 17
Julia Swanwick	Verbal request	30 April 17
Nayland Smith	Web Form and verbal	30 April 17
Tessa Fenton	Verbal request	30 April 17
Jackie Fenton	Verbal request	30 April 17
Hugh Martin	Web Form	30 April 17
Jenney Manks	Web Form	30 April 17
David Manks	Web Form	30 April 17
Marjorie den Hollander Cook	Web Form	30 April 17
Roger Hovenden	Web Form	30 April 17
Mary Hovenden	Web Form	30 April 17
Elise Cailleau	Web Form	1 May 17
Gill Bedford	Web Form	1 May 17
Corrie Gardner	Web Form	1 May 17
David Beattie	Web Form	1 May 17
Julie-Ann Beattie	Web Form	1 May 17
Hayley Fisher	Web Form	2 May 17
Deb Haylock	Web Form	2 May 17
Bryan Haylock	Web Form	2 May 17
Sarah Fisher	Web Form	2 May 17
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Archer McLeay	Web Form	5 May 17
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Jennifer Meares	Web Form	5 May 17
Ian PAVITT	Web Form	6 May 17
Johannah Curwood	Web Form	15 April 17
Dawn Pearson	Web Form	6 May 17
Jo Rolley	Web Form	6 May 17
David Zwartz	Web Form	7 May 17
Fiona Waghorn	Web Form	7 May 17
Marlin Robertson	Web Form	7 May 17
Andrew Bax	Web Form	7 May 17
Elizabeth Bain	Web Form	8 May 17
Ross Pettersson	Web Form	10 May 17
Jane Scribner	Web Form	10 May 17
Valerie Elaine Taylor	Web Form	14 May 17