MEMO

TO	Te Awarua-o-Porirua Whaitua Committee, Te Awarua-o-Porirua Project Team
FROM	Brent King, Senior Science Coordinator, Science Integration Team
DATE	June 2018
SUBJECT	Key messages from life cycle cost analysis of Te Awarua-o-Porirua Whaitua Committees' scenarios

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This memo summarises the key outputs from a 'life cycle cost' analysis in the economic modelling of the Committee's scenarios. The analysis looked at the interventions under the Committees' Improved and Water Sensitive scenarios. The existing and BAU scenarios assume there is no existing treatment or, where there is, existing treatments are not upgraded.

The costs are calculated and presented for three different groups of interventions:

1. Urban stormwater interventions – applied to both existing urban areas and greenfield and infill development areas (e.g. stormwater wetlands, raintanks and reduced impervious footprint)
2. Urban wastewater interventions (e.g. wastewater network improvements to reduce wastewater overflows)
3. Rural interventions (e.g. fencing and planting of riparian margins, space planting, retirement of erosion prone slopes)

This memo brings together the analyses undertaken for each water management unit (WMU) in the whaitua and reports on the key messages of how the scenarios may impact costs across the whole whaitua as well as how these may differ for rural vs urban land uses. Fact sheets are being prepared for each WMU to report in more detail the outputs of the analysis on the by WMU basis – examples of these have been provided to the Committee along with this memo.

What are 'life cycle costs' and how can you interpret them?

Life cycle costs are estimated based on the types of interventions used, the area to be treated and the desired level of treatment performance, over and above the costs associated with any existing or BAU interventions.

Life cycle costs are estimates of the total amount of money required to plan and build interventions (i.e. total acquisition costs) and maintain interventions (i.e. maintenance costs) over a 50 year life cycle. This allows like for like comparison of the estimated costs between scenarios with differing magnitudes and timing of expenditure. We can see the additional costs of one level of effort under one scenario relative to another level of effort under another scenario and we can relate that to the levels of water quality changes associated with each level of effort.

An illustrative example of these costs through time is shown in Figure 1 below.

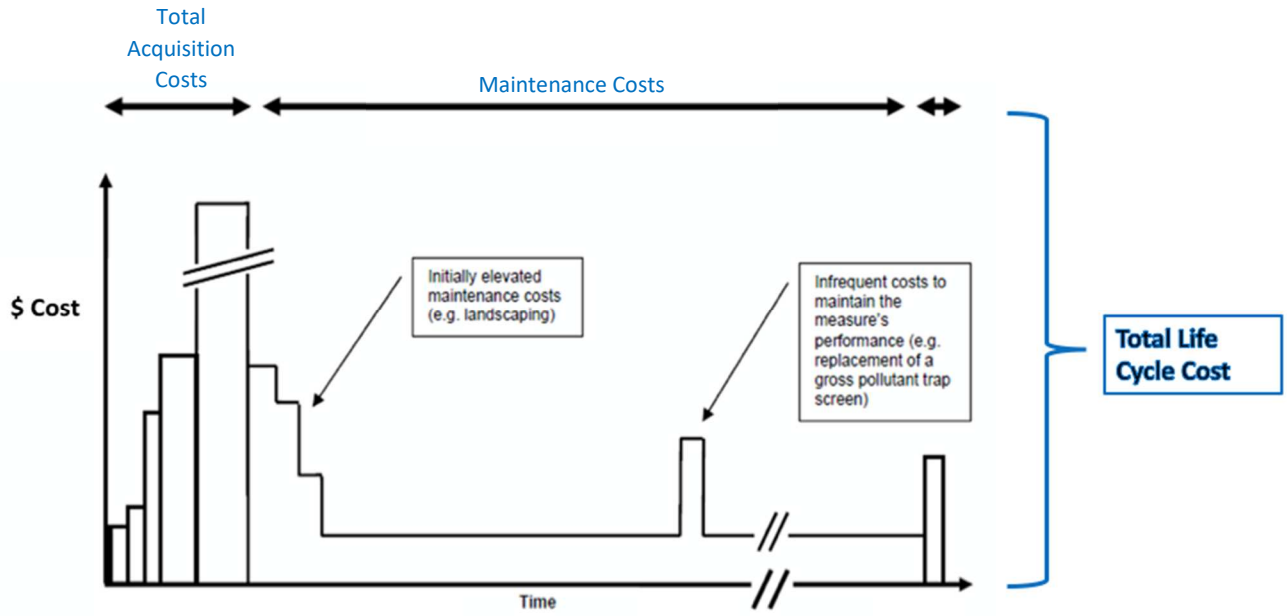


Figure 1. Example of life cycle costs over time

Like the biophysical modelling, this analysis aims to provide like for like comparison of the scenario outcomes. It does not attempt to make assumptions about the feasibility, timing or optimisation of interventions, or about financing, governance or distributions of costs for particular catchments or activities. To do so would require further information and complicate the interpretation of these results.

For this reason, care should be taken to focus on the relative differences between scenarios, and not to dwell on absolute amounts or comparisons between particular places.

1. Urban stormwater interventions

What is the cost estimate for the whole whaitua of these interventions?

The life cycle costs of urban stormwater interventions are the largest portion of costs modelled under the Committee's scenarios, with relatively little difference in costs between scenarios. Life cycle costs ranged from around $6.5-$21 million per year under the Improved scenario to $10.5-$28 million per year under the Water Sensitive scenario.

Scenario	Range of total life cycle costs $/year	
	Low	High
Improved	$6,431,000	$20,937,000
Water Sensitive	$10,563,000	$28,307,000

Table 1. Annual urban stormwater life cycle costs over 50 years for the whole whaitua, showing the low and high ends of the range of costs

Most of these costs are generated from scenario interventions in areas of greenfield and infill development. Costs associated with mitigating the impacts of greenfield development are expected to be at the lower end of that cost range while costs associated with infill development are expected to be at the higher end of the cost range. This is because land prices and the difficulty of working

within existing services and site constraints, along with increased land costs, tend to push infill and retrofit interventions towards the higher level of the cost range.

The large variability in wetland costs are a large driver in the wide range reported, particularly for the Improved scenario. The small difference between scenarios is likely due to the savings available from different approaches to land development associated with the Water Sensitive scenario, such as reduced earthworks and reduced impervious areas to treat with catchment devices.

What are the cost estimates per dwelling of these interventions?

On a per dwelling basis, additional greenfield or infill dwellings incur additional costs over the BAU in the range of $400-$1,300 per year. The analysis showed little difference in costs per dwelling between the Improved and Water Sensitive scenarios (Figure 2). By contrast, the analysis indicates that existing dwellings have relatively small increases in life cycle costs for stormwater interventions, being in the order of $10-$40 per year depending on the water management unit looked at. However, these too show little difference in costs between the scenarios.

This similarity in costs per existing dwelling is likely reflective of the relatively low level of interventions proposed in the scenarios to treat stormwater from existing dwellings in combination with the large number of existing dwellings over which the on-going public maintenance costs are spread.

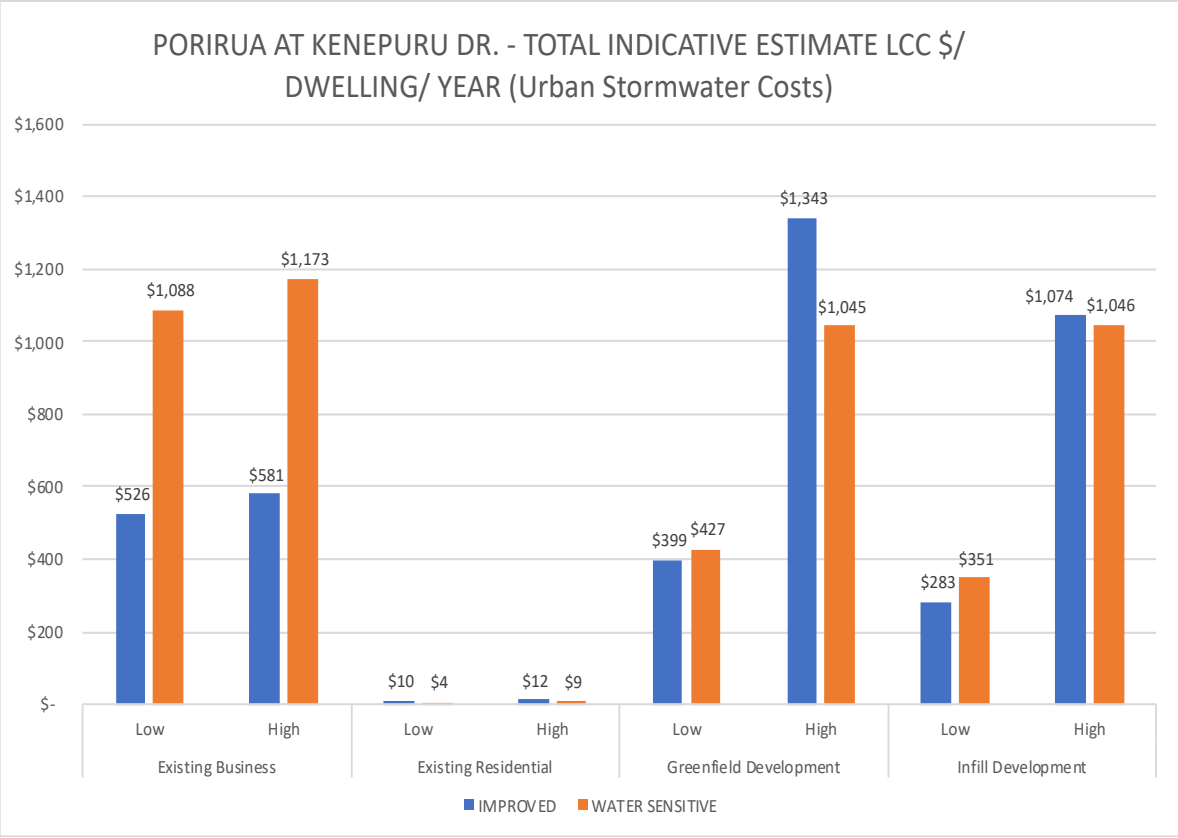


Figure 2. Estimated urban stormwater life cycle costs per dwelling for different dwelling types – Porirua at Kenepuru Drive reporting site.

What are the cost estimates for businesses of these interventions?

There is larger range in the estimated stormwater costs per business between scenarios and across different water management units for commercial and industrial areas. Depending on the WMU, Improved scenario costs per business are in the range of $200-$700 per year, and Water Sensitive scenario costs are typically double at around $300-$1600 per year.

Differences between the scenarios are expected as the Water Sensitive scenario proposes interventions to double the area treated over the Improved scenario. In addition, it includes a mix of interventions which are slightly more expensive on a unit cost basis than the Improved scenario interventions. Differences between WMUs likely reflects higher variation in the number, size and form of commercial premises in different WMUs.

Where does the cost fall within the urban development process (or value chain)?

The Improved scenario includes a large number of catchment-scale treatment devices such as stormwater treatment wetlands. These contribute to generating a higher share of total acquisition costs during the subdivision or land development phase than in the Water Sensitive scenario, and a higher share of publically (network operator) on-going maintenance costs. By contrast, the Water Sensitive scenario involves a higher proportion of lot-scale mitigation methods for residential developments which sees a higher share of private residential costs in that scenario.

These findings are illustrated in the pie charts below for the Porirua at Kenepuru Drive Reporting Unit (Figure 3).

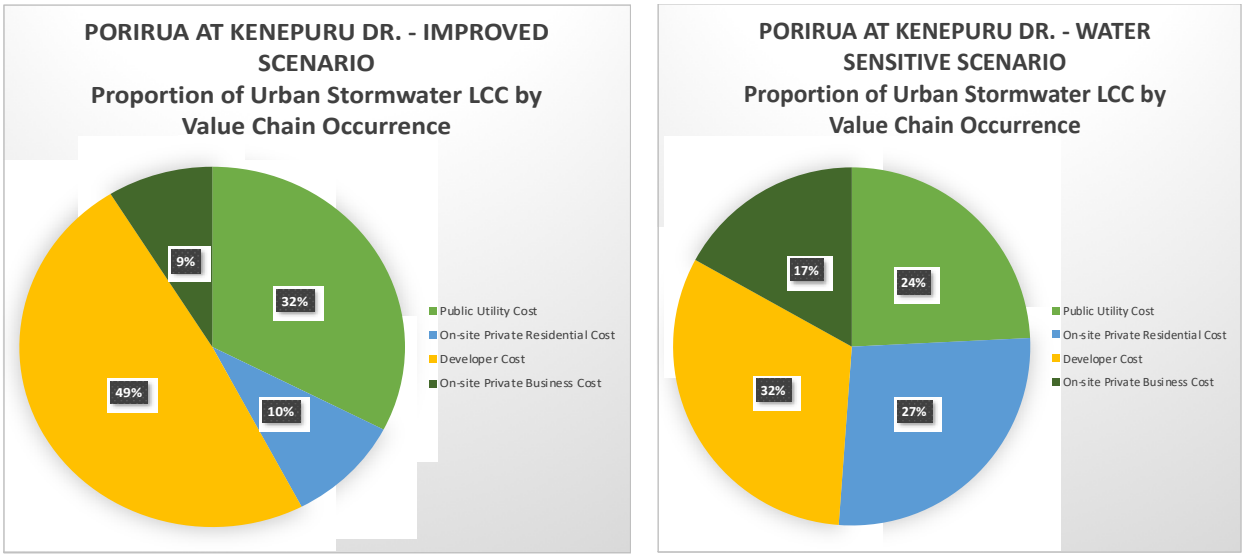


Figure 3. Proportion of urban stormwater life cycle costs generated by parts of the development and maintenance of interventions – Porirua at Kenepuru Drive reporting site.

Which scenario is more cost efficient?

When looking at the estimated life cycle costs per year by the amount of contaminant load (zinc, copper and sediment) removed, the Water Sensitive scenario is more cost effective than the Improved scenario. That is, the bundle of interventions in the Water Sensitive scenario tends to remove more contaminants for every dollar spent. An example of this pattern is shown in Figure 4 below for the analysis undertaken in the Porirua Stream WMU.

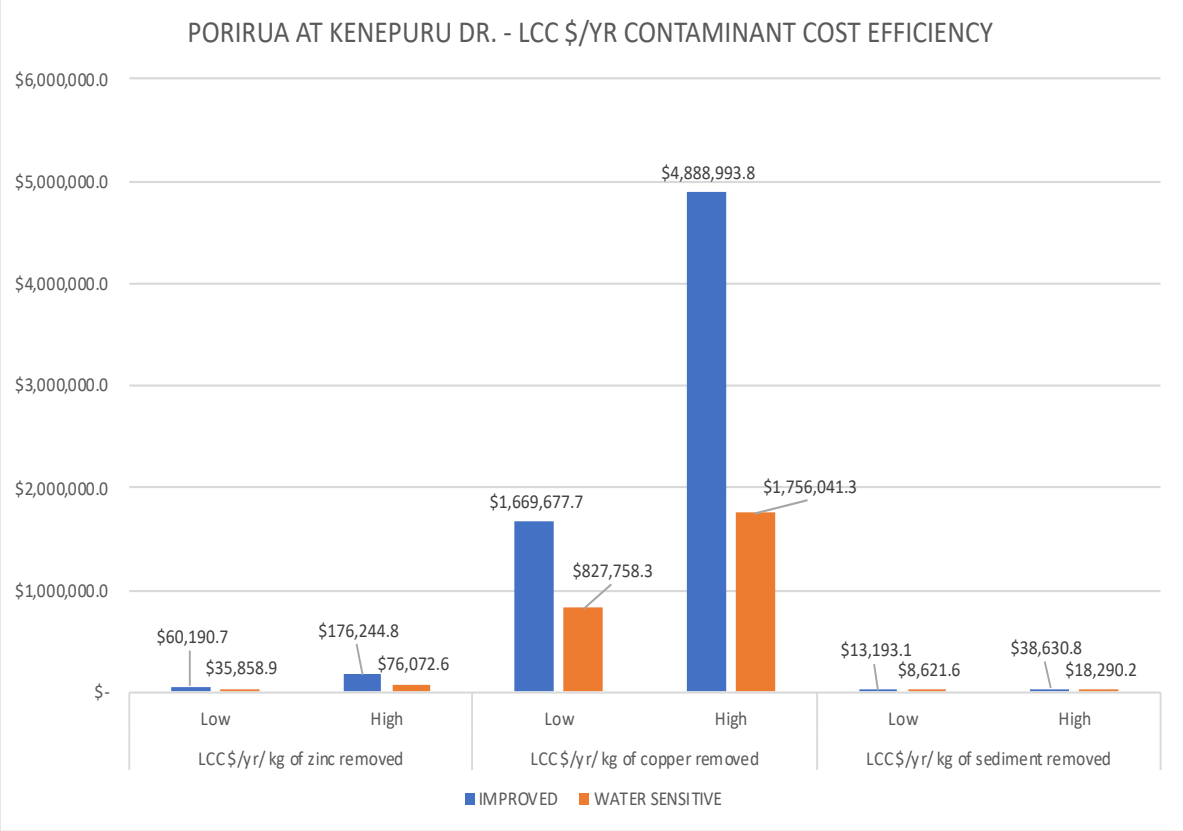


Figure 4. Urban stormwater life cycle costs per kilogram of contaminant removed – Porirua at Kenepuru Drive reporting site.

How do the scenarios affect the cost of owning a property?

As described above, both the Improved and Water Sensitive scenarios will lead to increased costs resulting from urban stormwater treatment mitigations.

An international literature search highlights that the adoption of stormwater interventions may also lead to a property price premium, particularly for properties bordering or in close proximity to larger scale interventions like wetlands. The size of this premium is highly variable, with a range of results reporting average increases between 3% and 8%. However, a lack of on-going maintenance can cause property values to decrease in the longer-term.

The implications of these findings is that increased stormwater treatment could potentially add to the costs of holding a property, through both increasing the purchase price and the cost of implementing and maintaining interventions either privately or publically.

While not directly comparable to the additional lifecycle costs, the current costs of holding a property (either ownership or rental) give some context to the additional costs estimated in this analysis. The

estimated range of holding costs for a mid-value property is in the order of $22,000 to $39,000 per year for dwellings in Porirua and Wellington cities.

The additional lifecycle costs for stormwater interventions for additional residential dwellings are in the range of $400-$1,300 per dwelling per year, or an additional 1-6% of the current costs of holding a property. These additional costs and price premium may increase the initial purchase price and holding costs for those that purchase them.

The relatively low level of interventions proposed in the scenarios to treat stormwater from existing dwellings suggests there will be potentially less influence on the holding and purchase cost of existing properties.

2. Urban wastewater interventions

The wastewater improvement cost estimates cover the improvements of the wastewater network that aim to reduce overflows and upgrades to the treatment plant. These improvements are estimated at around $2.1 to $2.7 million per year for both scenarios, or around $50-$60 per dwelling per year over and above existing wastewater costs (currently $385 per residential dwelling per year for Porirua City ratepayers).

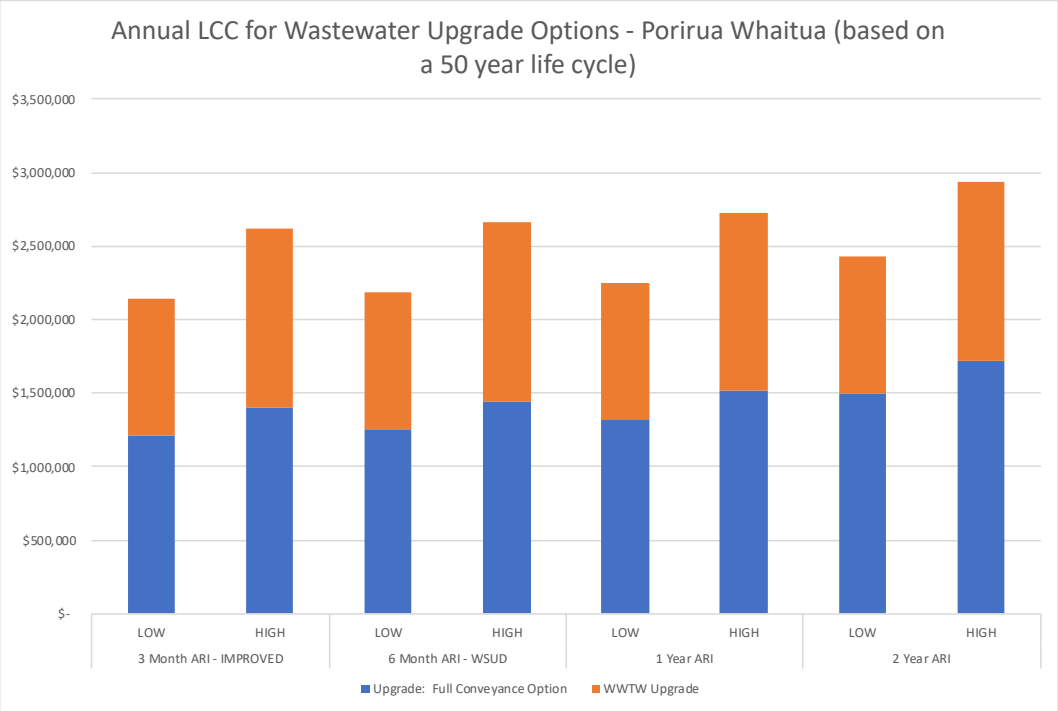
This analysis has used the costs associated with the 'Conveyance' option from Wellington Water's network improvement planning. The Conveyance option aims to increase the capacity of the network and treatment plant capacity to handle all wastewater within the network for different sized storms. This translates to the two scenarios:

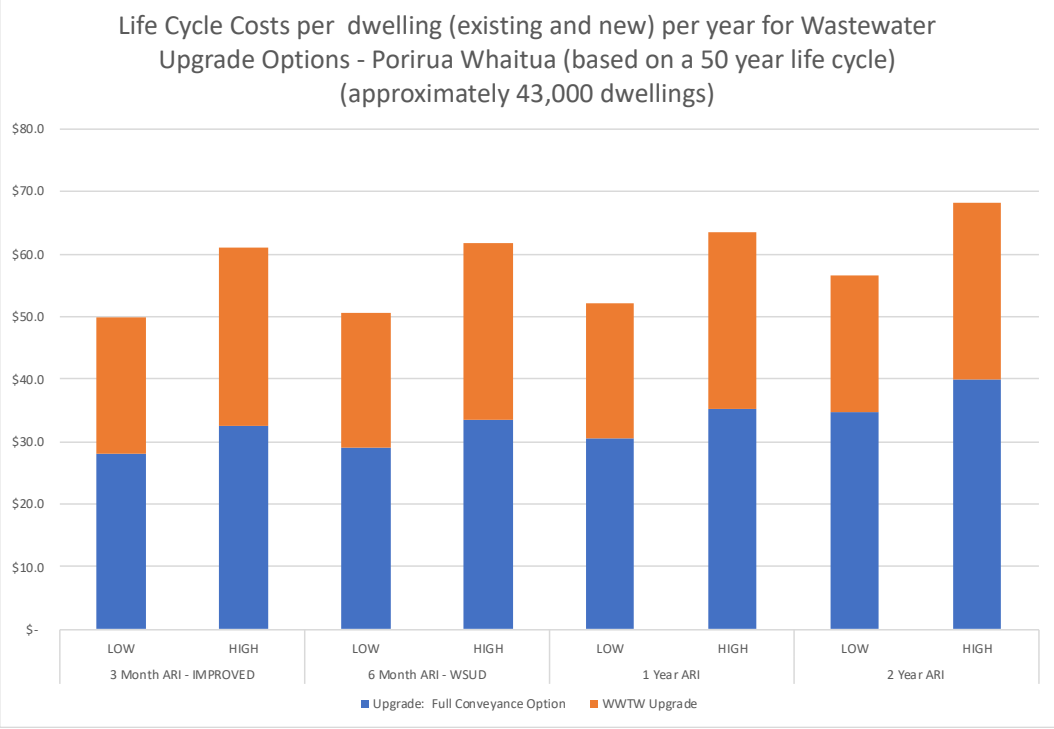
- A '3 month ARI' option designed for the size of storm expected, on average, 4 times per year and approximately corresponds to a design capacity that delivers 4 overflows per year (Improved scenario)
- A '6 month ARI' option designed for the size of storm expected, on average, 2 times per year and approximately corresponds to a design capacity that delivers 2 overflows per year (Water Sensitive scenario)

There is still some uncertainty as to whether these interventions and associated costs get us to the levels represented in the scenarios or not. Wellington Water are continuing to refine both the potential network changes and associated costs at present. However, this is the best information currently available to illustrate magnitude of cost for different levels of improvements to the wastewater network.

Costs of improvements to the wastewater network to improve leaking pipes and cross connections are uncertain and could not be evaluated in these estimates.

The costs estimated through this analysis largely fall to the network operator, in this case Wellington Water. Costs would be passed through to ratepayers following the agreements of the city councils with Wellington Water and the rating policies of the respective councils.





Figures 5 and 6. Wastewater life cycle costs per year and per dwelling – whole Whaitua[1].

[1] These graphs include two further levels of design improvements analysed by Wellington Water. 1 Year ARI is designed for the size of storm expected, on average, once per year and 2 Year ARI is designed for the size of storm expected, on average, every second year.

3. Rural interventions

Information for the analysis of costs of the scenario interventions on the rural sector was generated based on statistical data from Beef and Lamb NZ, and through a series of workshops and interviews with stakeholders in the rural community. Based on this information and in consultation with the rural stakeholder, unit costs used in the scenario analysis were generated for each mitigation technique (riparian fencing and planting, pole planting and retirement) (Table 2).

Table 2: Summary of per unit mitigation costs

Mitigation	Basis	Unit cost	Metric	Area applied to
Stream fencing	Fencing one side to exclude sheep and larger animals, flat slope	$20	$/linear m	Sheep and beef, lifestyle not currently fenced
Planting 5m strip	Cost of planting one side of a stream	$25	$/linear m	Sheep and beef, lifestyle not currently fenced
Land retired with 5m buffer strip	From value of retired land	$5.35	$/linear m	Sheep and beef, lifestyle not currently fenced
Planting 10m buffer	Cost of planting one side of a stream	$50	$/linear m	Sheep and beef, lifestyle not currently fenced
Land retired with 5m buffer strip	From value of retired land	$10.70	$/linear m	Sheep and beef, lifestyle not currently fenced
Annual maintenance	All fenced areas	$2.50	$/linear m	Sheep and beef, lifestyle not currently fenced
Pole planting	Cost of planting poplars 15 stems/ha (average for all of 6e land)	$7.50	$/ha	6e sheep and beef, lifestyle
Retirement ($/ha capital costs)	20th percentile of QV per ha values	$10,700	$/ha	6e, 7e, 8e sheep and beef, lifestyle
Fencing of retired areas	Cost of excluding sheep and large animals on steep land, 50% of perimeter/ha from affected GIS polygons	$2,100/ha for 6e, $1400/ha for 7e, 8	$/ha	6e, 7e, 8e sheep and beef, lifestyle

What is the cost estimate for the whole whaitua of these interventions?

The total life cycle cost for mitigation in rural catchments, including land retirement, is $31 million for the Improved scenario, and $61 million for the Water Sensitive scenario. The LCC/year are $625,000 for Improved and $1,226,000 for Water Sensitive. A significant proportion of this cost (52% for Improved and 70% for Water Sensitive) is related to the land costs associated with riparian planting and retirement rather than the expenditure of putting in these interventions (e.g. fencing or pole planting).

What are the cost estimates per dwelling of these interventions?

While the rural mitigations represent a smaller portion of the intervention costs than the urban mitigations at a Whaitua scale, they can be expensive at a local scale if they were to fall solely on the individual rural property owners. This may be likely in the rural environment where there is large variation in the size and extent of treatments required based on the characteristics of a particular property.

Following the assumptions of where rural mitigations are applied, approximately one third of rural properties around Pauatahanui Inlet incur no costs. For those properties that do need to apply mitigations, the median cost[2] in different catchments ranges between less than $1000 and $7,000 in the Improved scenario, and between $3000 to $21,000 for the Water Sensitive scenario.

Costs are more significant for the top 10% of properties. In the Pauatahanui catchment, 10% of those rural properties where mitigation is required incur costs of approximately $40,000 or greater in the Improved scenario, and $115,000 in the Water Sensitive scenario. In the Horokiri catchment, 10% of rural properties where mitigation is required incur costs in excess of approximately $296,000 under the Improved scenario and $440,000 under the Water Sensitive.

These figures suggest a strong skewing in the incidence of the rural costs. For example with the water sensitive scenario in the Horokiri 7% of the ratepayers overall (approximately 6 – 7 properties) will experience costs in excess of 35% of the total cost of land used for retirement and riparian planting. There is a likelihood that these costs could cause hardship to individuals, particularly where large proportions of a productive property are to be retired or taken out for riparian planting, and where fencing and planting costs are large relative to the size and returns from the property.

Which scenario is more cost efficient?

The Water Sensitive scenario provides improvements in *E. coli* and sediment from rural properties over the Improved scenario. However it appears that there are diminishing returns from the additional retired land and riparian buffers in the Water Sensitive scenario.

In the Pauatahanui WMU, which is 97% rural, the Water Sensitive scenario produces further improvements over the Improved scenario of around 35% reduction in *E. coli* concentrations and 13% reduction sediment loads. However, rural costs increase by around 150% between the two scenarios. For the Horokiri WMU, which is 99% rural, the Water Sensitive scenario reduces *E. coli* concentrations by around 33% more than the Improved scenario and reduces sediment load by a further 1%. The rural costs increase by 30% between the two scenarios.

Although there are some confounding effects, these results suggests that the increase in costs for these primarily rural catchments under the Water Sensitive scenario is sometimes matched with increased *E. coli* reductions, but may not be matched by an increase in sediment removal. It is likely that these results for the primarily rural catchments are reflective of the differences between the two scenarios across the rural area.

[2] Note these approximate the potential acquisition costs for establishing the intervention and the value of retired land associated with the intervention. This differs from the life cycle costs used throughout the rest of the analysis (which also includes maintenance costs over time), but is helpful to illustrate the potential distributions of costs across different properties in the Whaitua.