APPENDIX A: INDICATIVE LCC ESTIMATES FOR THE PORIRUA WHAITUA – REPORT CARDS

What is Life Cycle Costing?

Life Cycle Costing (LCC) is the process of assessing the cost of a product over its life cycle or a portion thereof. (Australian/ New Zealand Standard 4536:1999)

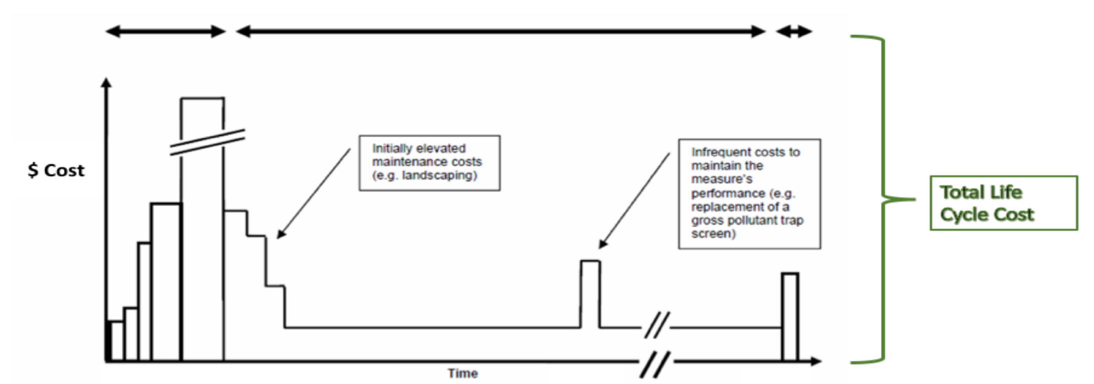
The LCC is the sum of the acquisition and ownership costs of an asset over its life cycle from design stage, manufacturing, usage, and maintenance through to disposal. It includes:

- Total Acquisition Costs: planning, design, land and construction costs; and
- Maintenance Costs: both annual maintenance and corrective maintenance costs.

LCC present the total amount of money you'd need to have today to meet that cost of building and operating the device over its lifetime. The annual amount is simply that total divided by the expected lifetime, in this case 50 years.

Why use life cycle costing?

- It gives us a **relative** comparison of **indicative costs** of one scenario against another scenario;
- It can balance performance (benefits) against cost;
- It uses a standard approach so can provide a consistent platform for discussion between parties.

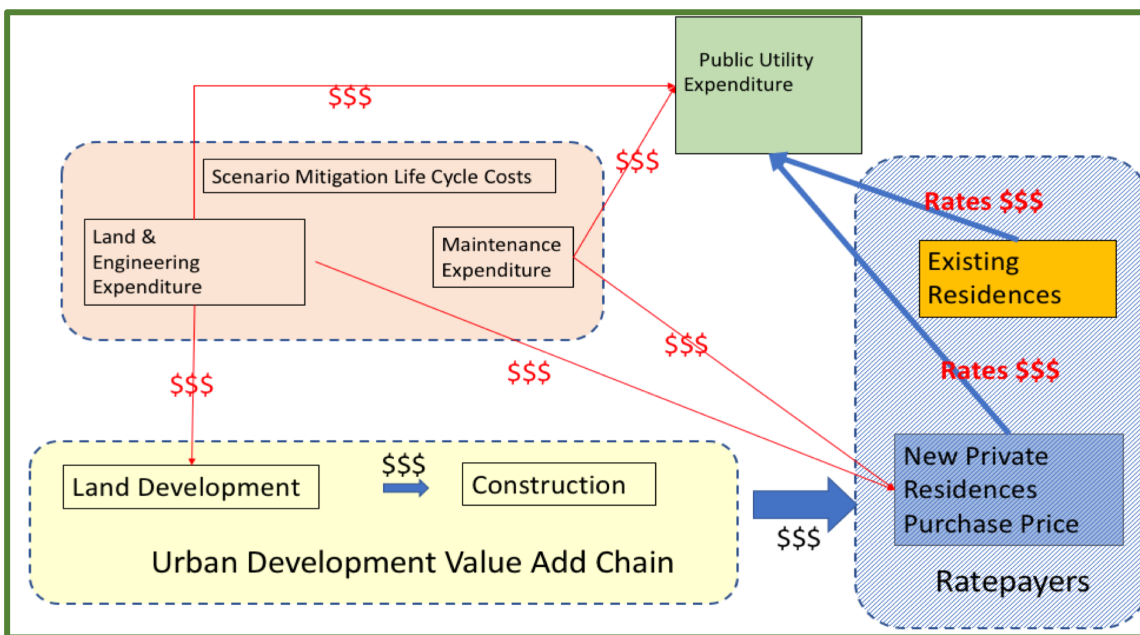


Phases in the life cycle of a stormwater practice and potentially associated costs (Taylor, 2003)

What are the limitations of life cycle costing?

- Cost data is notoriously difficult to obtain in a consistent and useful manner;
- There is inherent variability in the site design process;
- It is data intensive.

LCC makes no assumptions around the timing of implementation, funding needs, governance structures or the feasibility of options.



Understanding the costing results:

- The Porirua Whaitua Cost Aggregation Model builds on existing LCC work and is based on generating a total LCC over a 50 year analysis period (base date of 2017).
- The costs relate to best practice design of the mitigations and treatment performance, and are based on the best available cost data.
- The costs are presented as ranges from low to high to express uncertainty due to cost data gaps or large variation in costs.
- When interpreting the cost results, look for patterns and relative differences between scenario results, do not focus or use the absolute cost figure.
- The economic report cards highlight the split of costs in terms of where they fall within the value chain, i.e. whether they are developer-related costs, public utility costs or house-hold costs. In reality, all costs are borne by the private individual via "on-charging" from developers, network utility fees or rates, or everyday household costs.

NOTE:

Whilst every effort has been made to ensure the integrity of the data collected and its application through the COSTnz and UPSW models, Koru Environmental does not give any warranty as to the accuracy, completeness, currency or reliability of the information made available in the report cards and expressly disclaims (to the maximum extent permitted by law) all liability for any damage or loss resulting from the use of, or reliance on the Model or the information or graphs provided through them.

Costs presented in the report cards are based on current available information and should be read in the context of the assumptions presented. Cost information has been gathered and modelled in order to gain an understanding of the ***relative difference in cost between different solutions***, not the actual cost of each solution.

Any decision that is made after using this data must be based solely on the decision-makers own evaluation of the information available to them, their circumstances and objectives.

WHAITUA-WIDE LIFE CYCLE COSTS

ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 4,118,326	$ 6,867,817
WATER SENSITIVE	$ 11,913,248	$ 16,536,053

ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

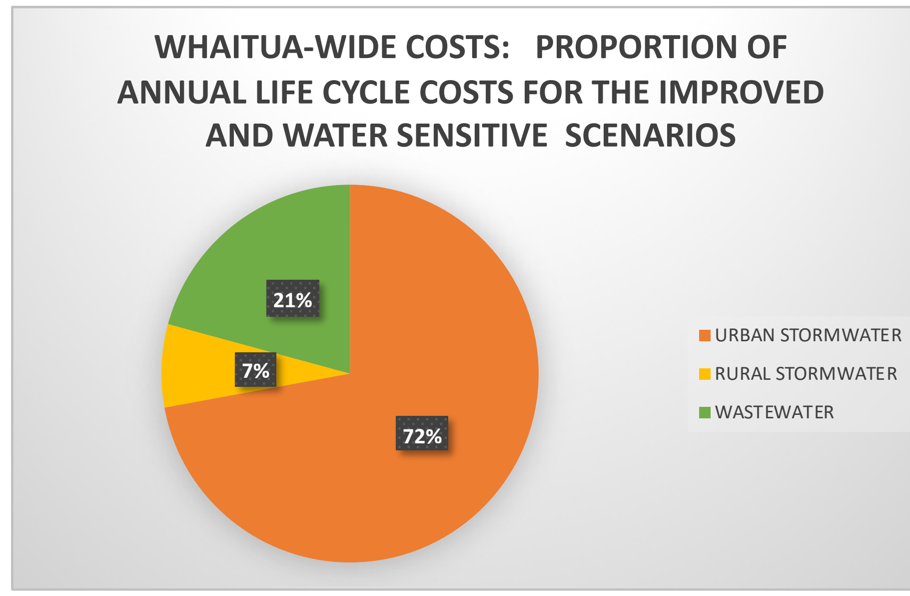
Scenario	Total LCC $/ year	% of LCC relating to loss of rural land
IMPROVED	$ 625,357	52%
WATER SENSITIVE	$ 1,226,192	70%

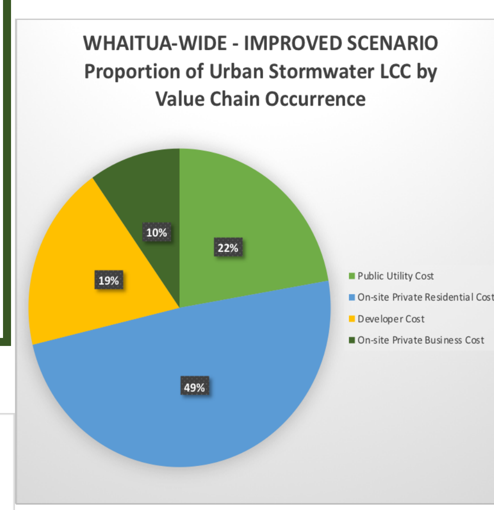
ANNUAL WASTEWATER LIFE CYCLE COSTS (over 50 years)

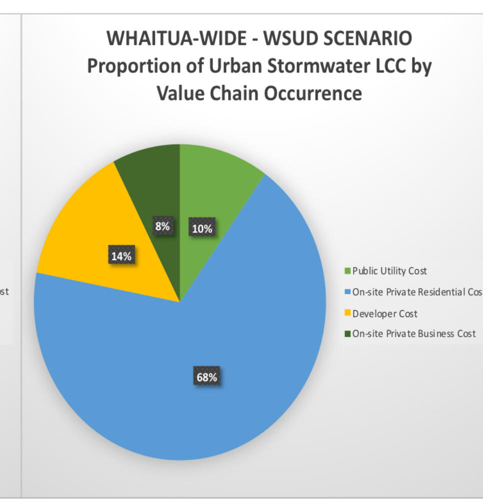
Scenario	Total LCC $/ year	
	Low	High
IMPROVED	$ 2,142,852	$ 2,619,099
WATER SENSITIVE	$ 2,180,595	$ 2,657,095

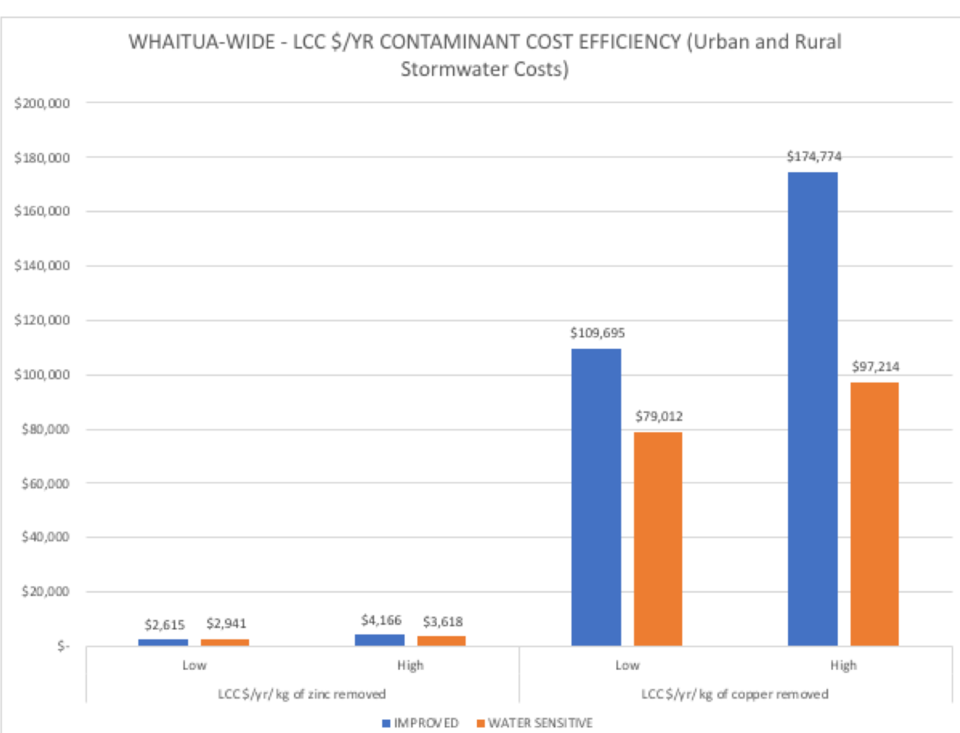
LAND USE

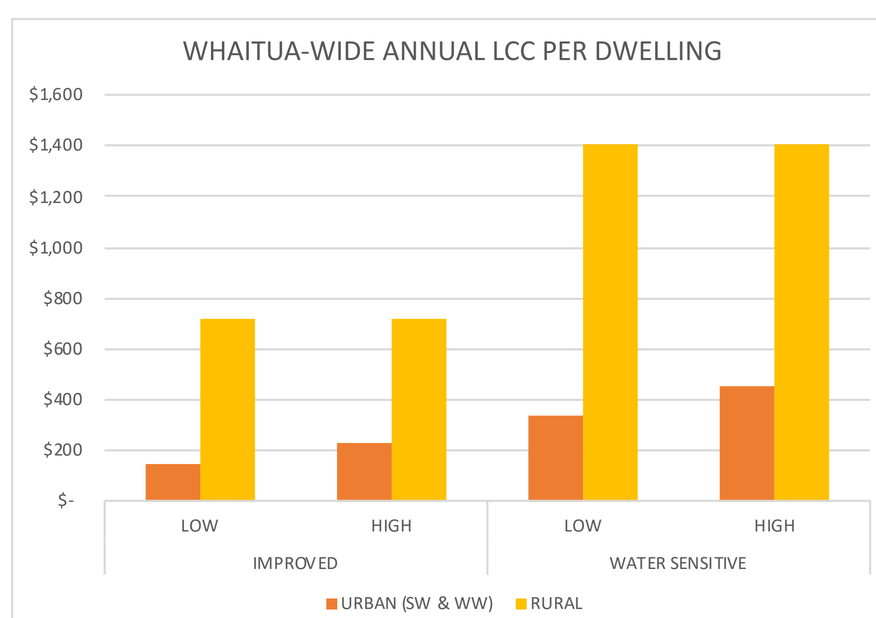
Type	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	4309	21%	31407
Additional Greenfield	637	3%	7056
Additional Infill	264	1%	4396
Existing Rural	15012	74%	870











UNDERSTANDING THE COST RESULTS:

- Life cycle costs (LCC) are development, construction and maintenance costs calculated according to Australia/ NZ Standard 4536:1999.
- Costs are **indicative estimates** and **focus should be placed on the relative difference between scenarios and trends**.
- Urban stormwater mitigation cost drivers include amount of impervious area treated, land costs and level of treatment.
- High estimates are more indicative of "infill" or "brownfields" retrofit costs, whilst low estimates are more indicative of "greenfield" costs.
- Costs of the piped network (i.e. BAU) are not included – costs presented here relate solely to the mitigations relating to the "Improved" and "WSUD" scenarios and are additional to the BAU and/ or existing scenarios.
- Wastewater costs are likely to be under-estimated as there is insufficient cost data to account for costs relating to fixing illegal cross-connections, and a "catchment-scale" cost model is unable to account for such site-specific costs.

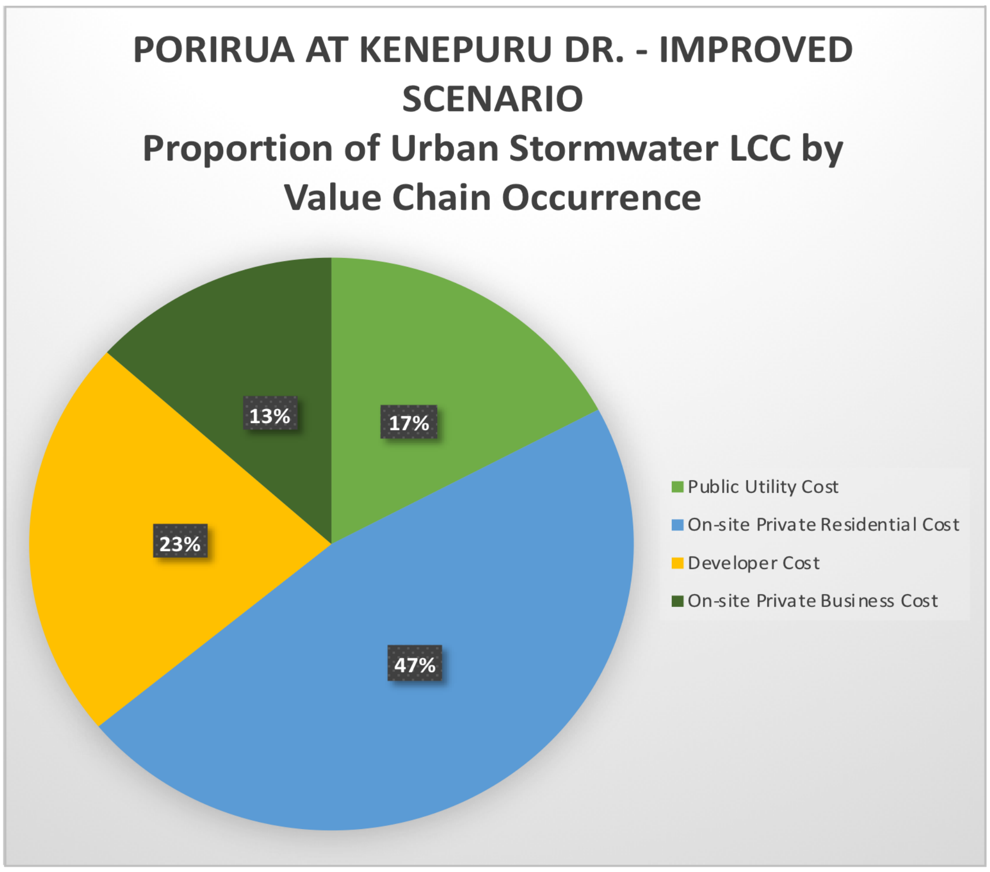
LIFE CYCLE COST REPORT CARD – PORIRUA AT KENEPURU DRIVE

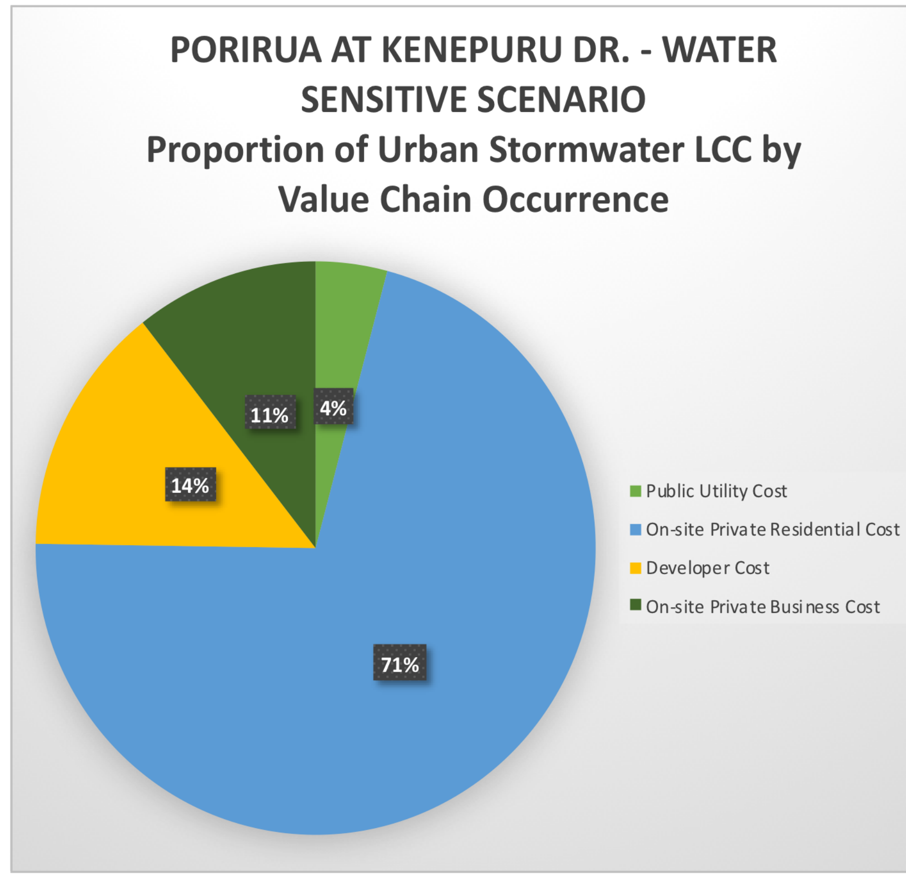
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

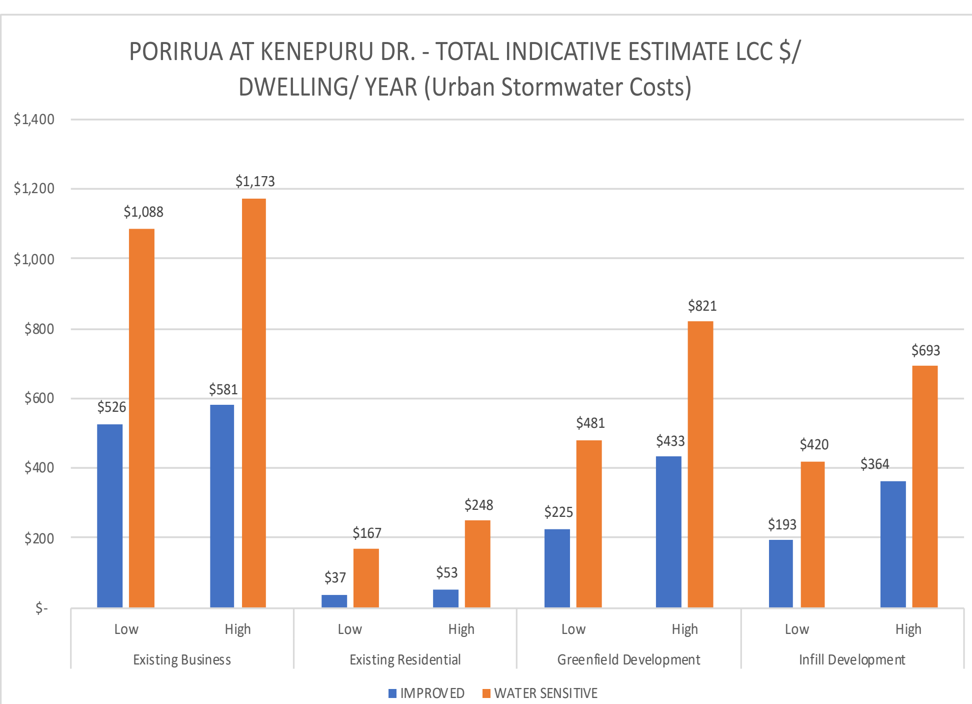
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 1,464,255	$ 2,438,160
WATER SENSITIVE	$ 4,029,071	$ 6,166,998

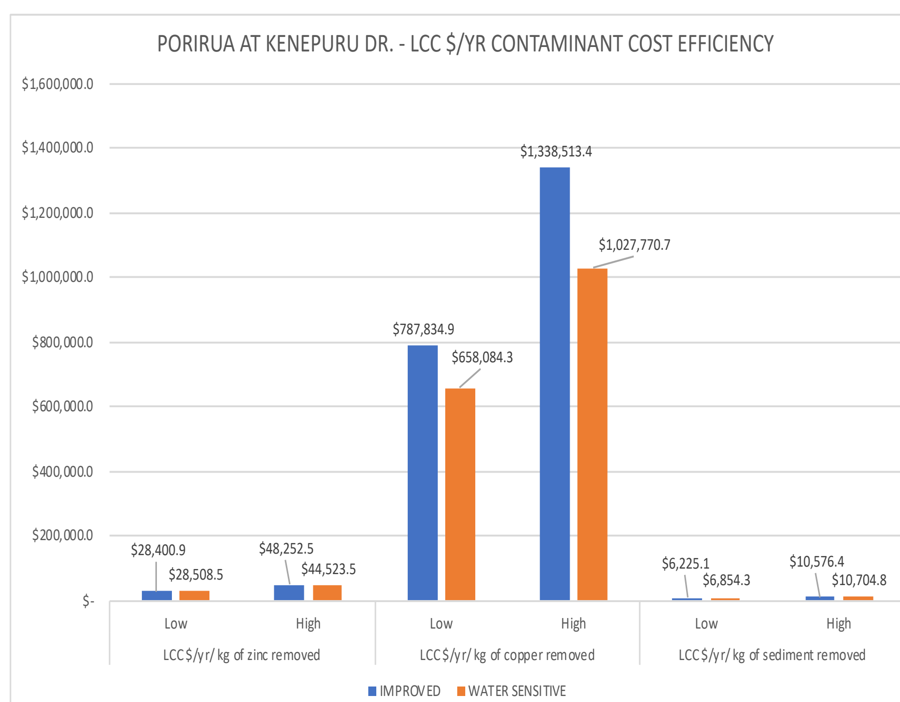
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 57,930	35%
WATER SENSITIVE	$ 134,141	67%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	1547	40%	11454
Additional Greenfield	287	7%	3237
Additional Infill	38	1%	653
Existing Rural	1980	51%	265

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 73,212,741	$ 121,908,022	$ 32,138,498	$ 60,527,427	$ 838,250	$ 1,252,665
WATER SENSITIVE	$ 201,453,531	$ 308,349,884	$ 108,383,606	$ 170,571,827	$ 1,899,386	$ 2,811,797

UNDERSTANDING THE COST RESULTS:

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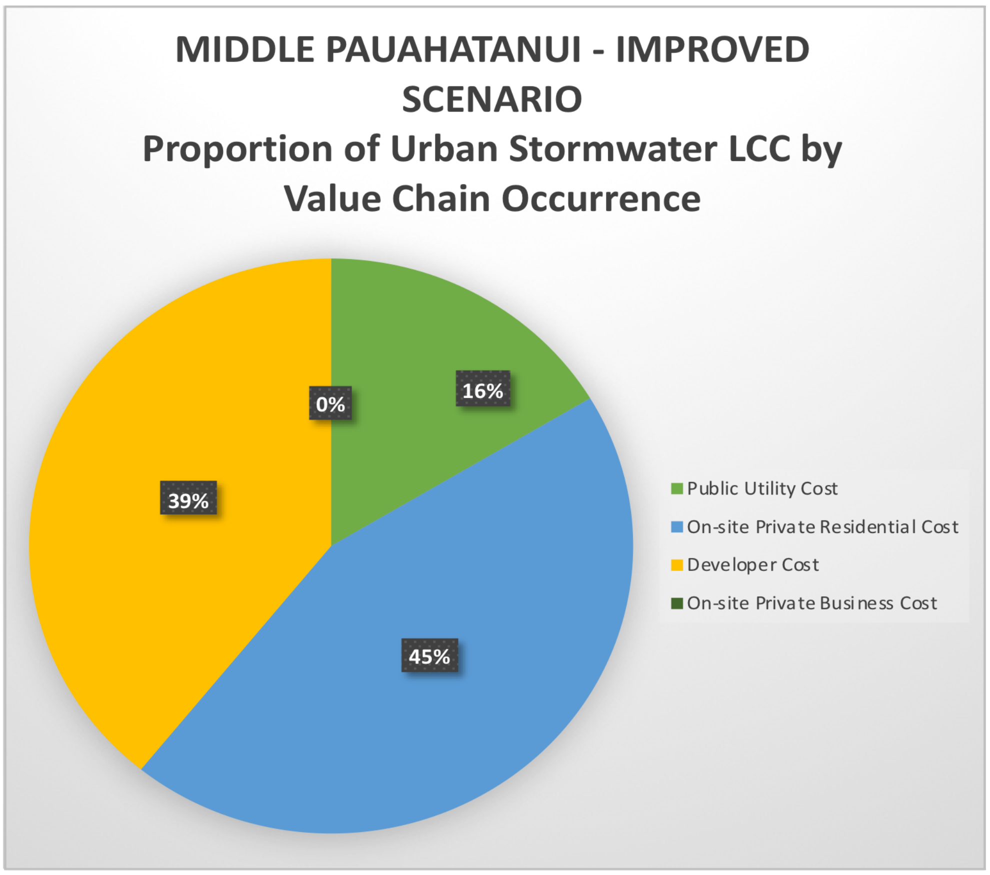
LIFE CYCLE COST REPORT CARD – PAUATAHANUI (MIDDLE REACHES)

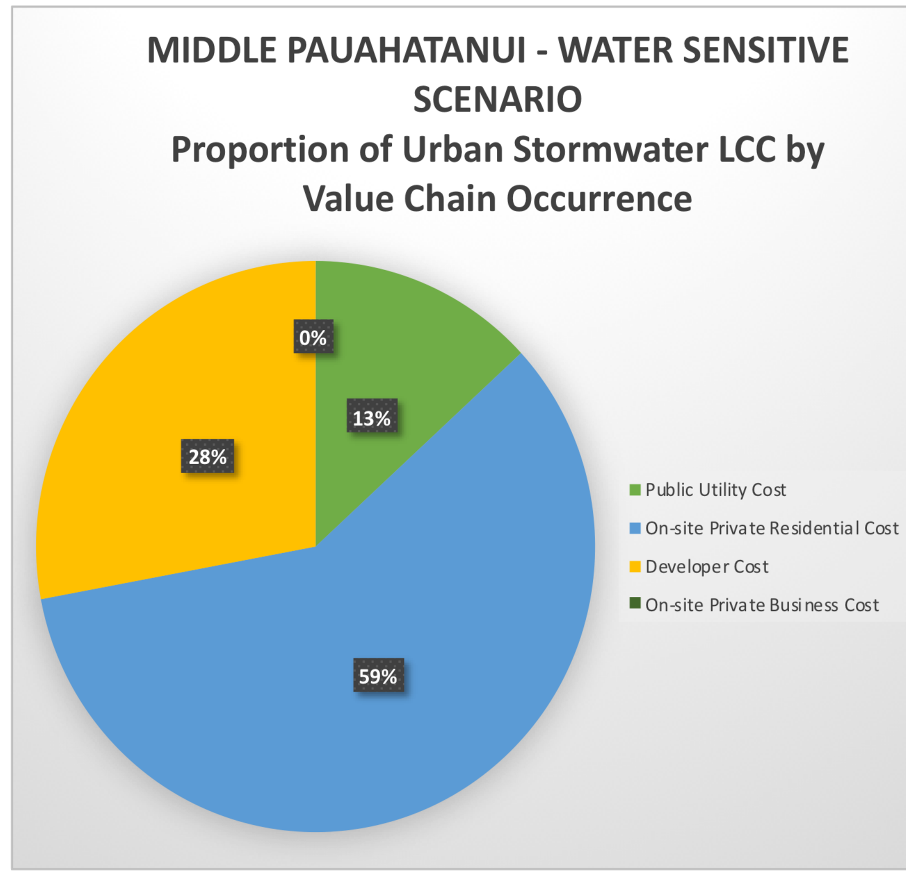
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

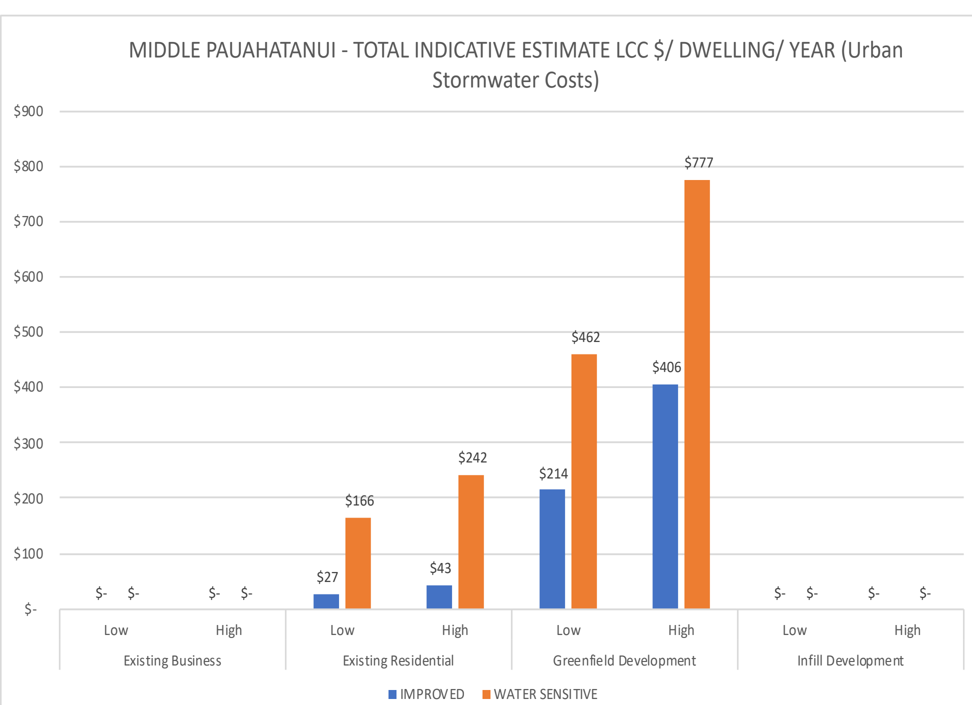
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 235,904	$ 446,447
WATER SENSITIVE	$ 508,597	$ 856,065

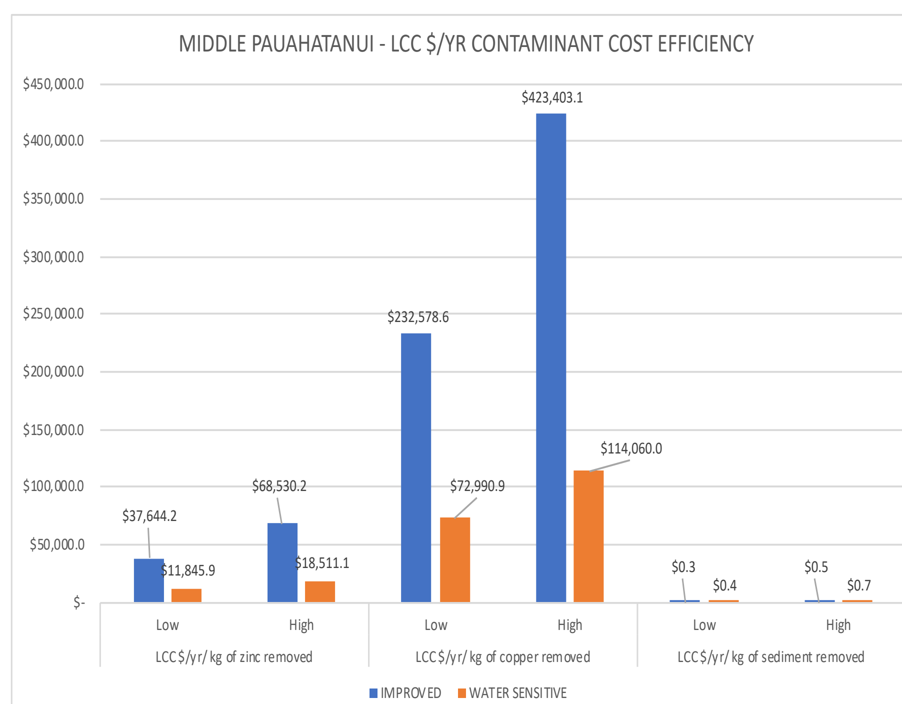
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 123,269	19%
WATER SENSITIVE	$ 313,942	64%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	25	1%	12
Additional Greenfield	85	2%	1099
Additional Infill	0	0%	0
Existing Rural	3752	97%	200

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 11,795,225	$ 22,322,365	$ 5,570,723	$ 12,191,982	$ 127,031	$ 206,743
WATER SENSITIVE	$ 25,429,841	$ 42,803,255	$ 13,767,568	$ 27,059,948	$ 238,006	$ 321,292

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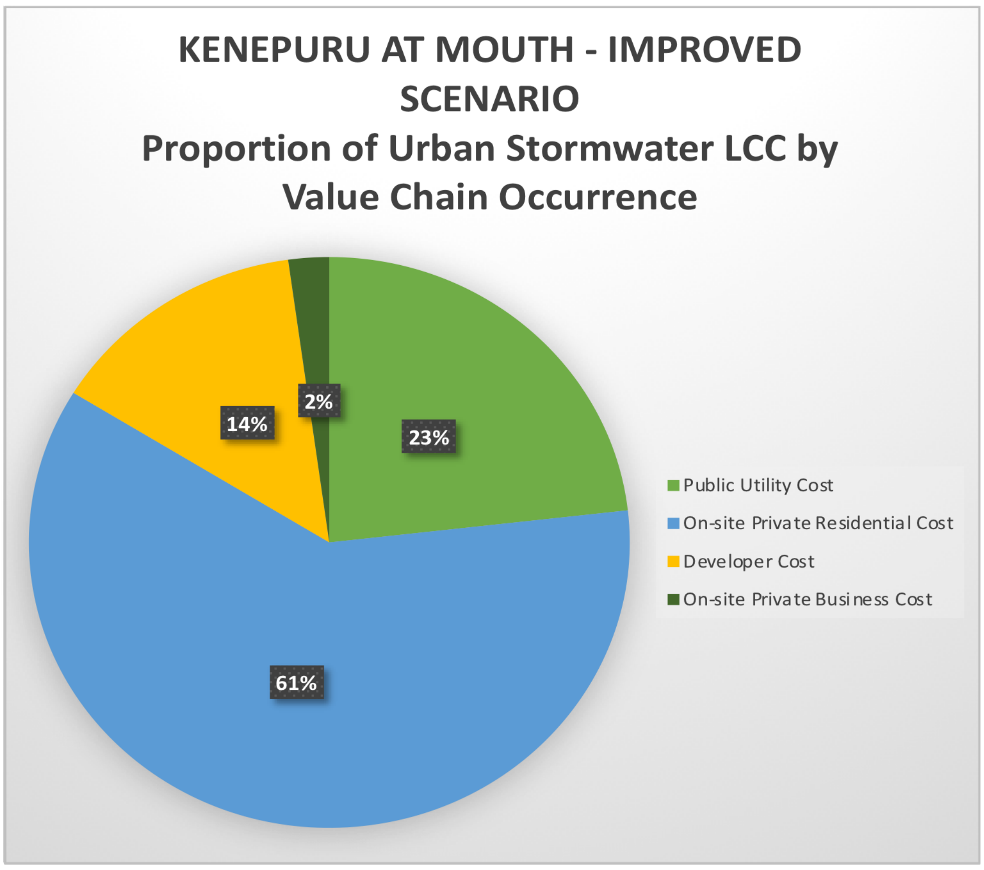
LIFE CYCLE COST REPORT CARD – KENEPURU AT MOUTH

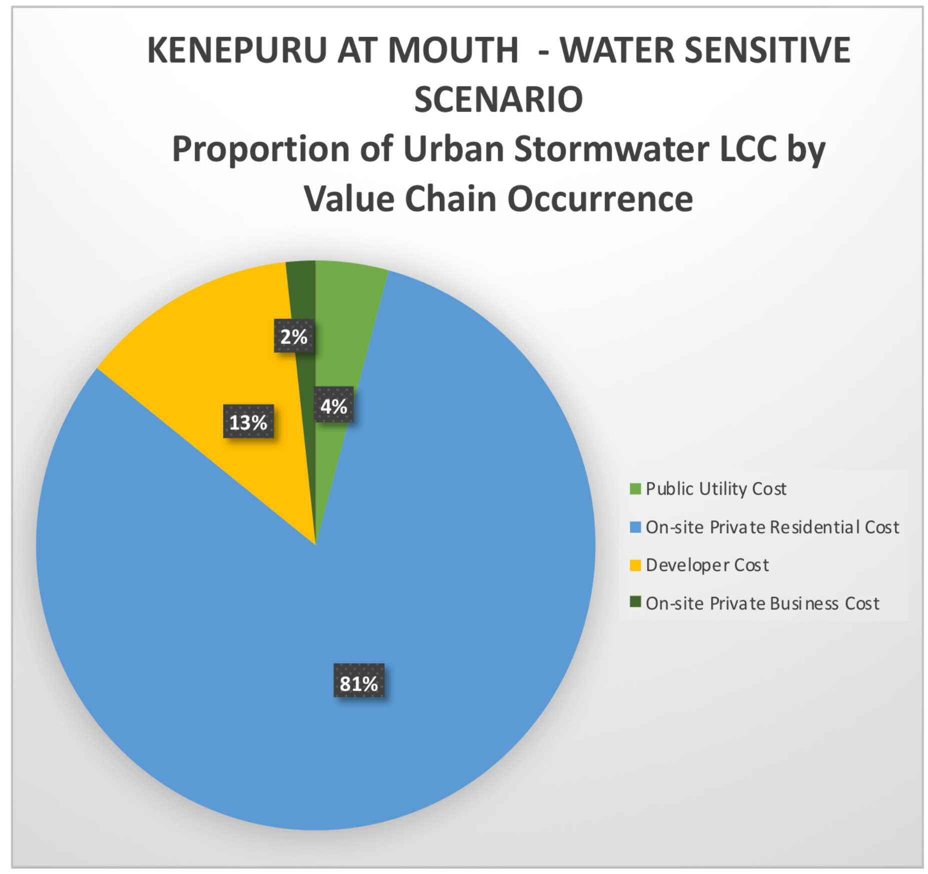
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

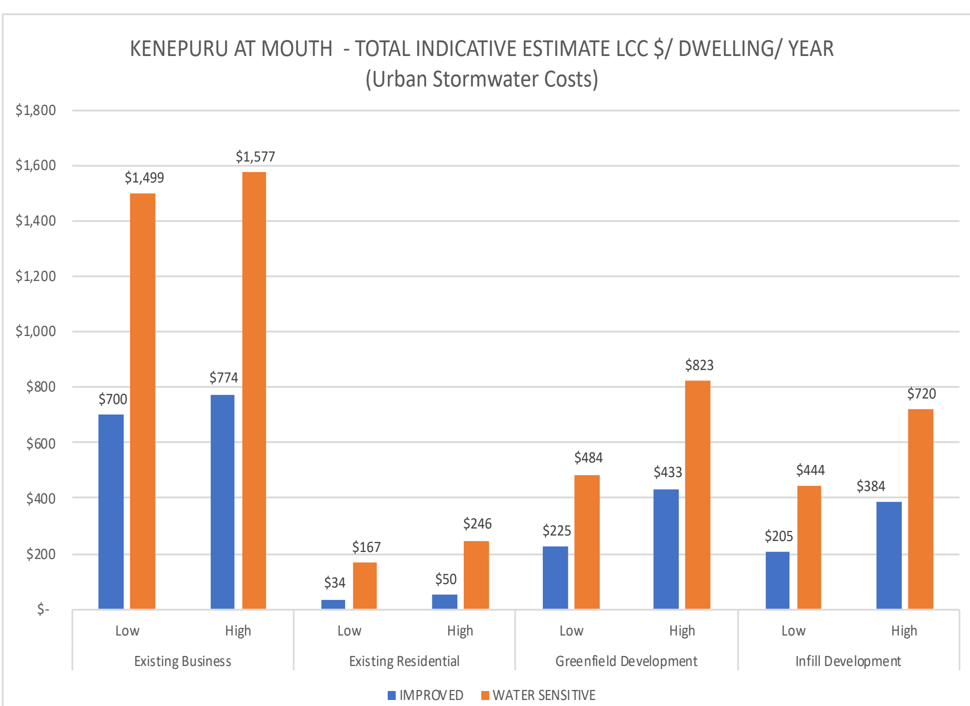
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 599,786	$ 1,047,694
WATER SENSITIVE	$ 1,763,525	$ 2,738,487

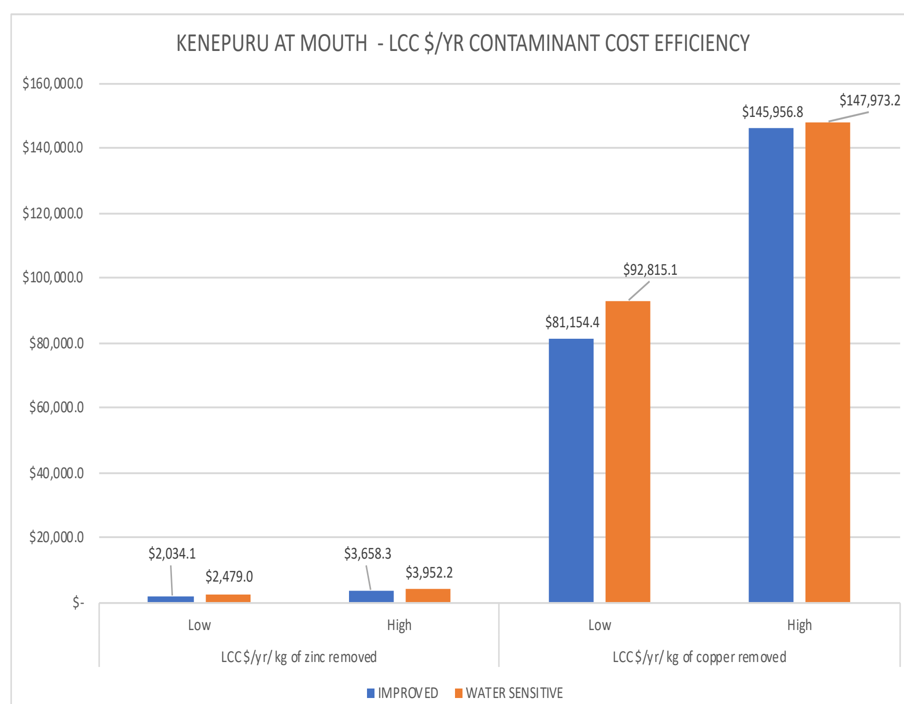
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 32,737	77%
WATER SENSITIVE	$ 54,882	83%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	713	56%	6467
Additional Greenfield	57	4%	621
Additional Infill	81	6%	1322
Existing Rural	413	33%	2

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 29,989,278	$ 52,384,697	$ 13,094,320	$ 25,546,013	$ 344,795	$ 547,728
WATER SENSITIVE	$ 88,176,259	$ 136,924,366	$ 44,159,679	$ 77,467,439	$ 898,298	$ 1,213,407

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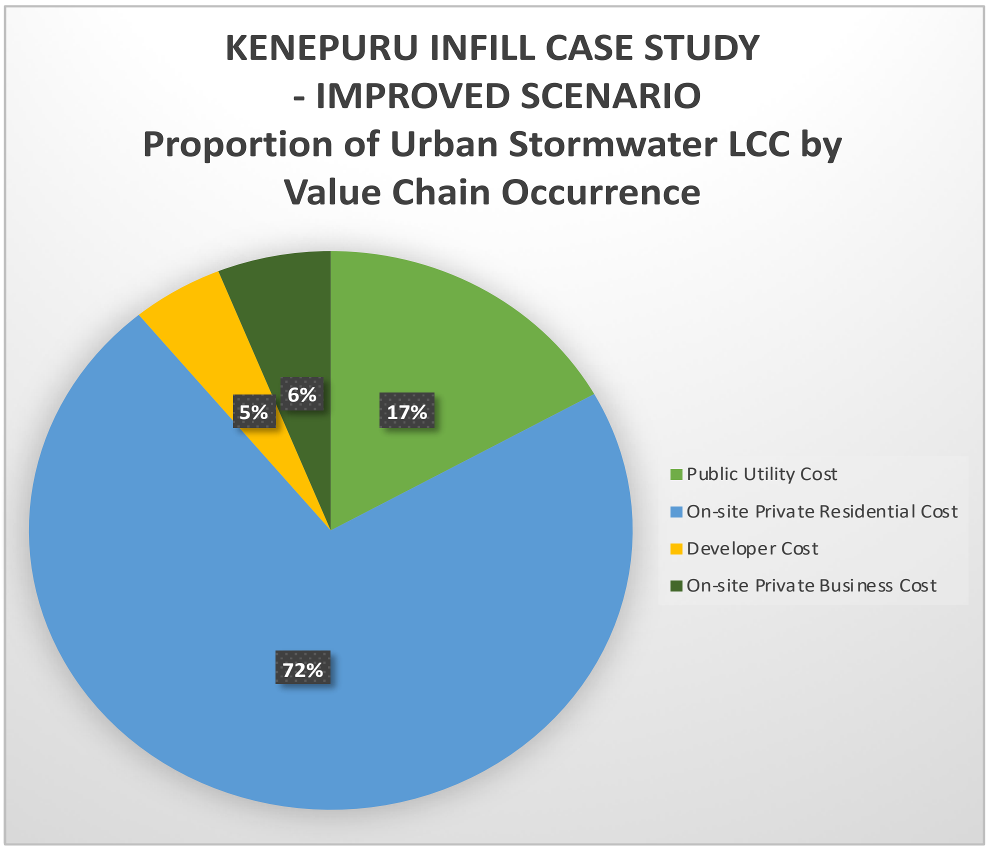
LIFE CYCLE COST REPORT CARD – KENEPURU INFILL CASE STUDY

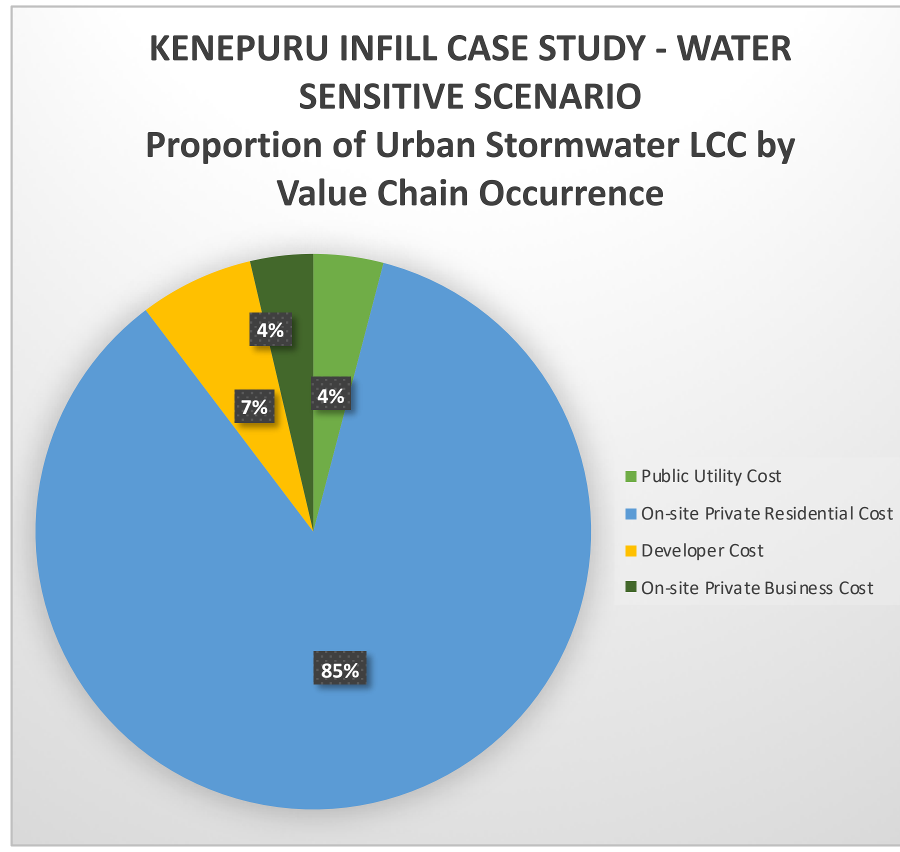
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

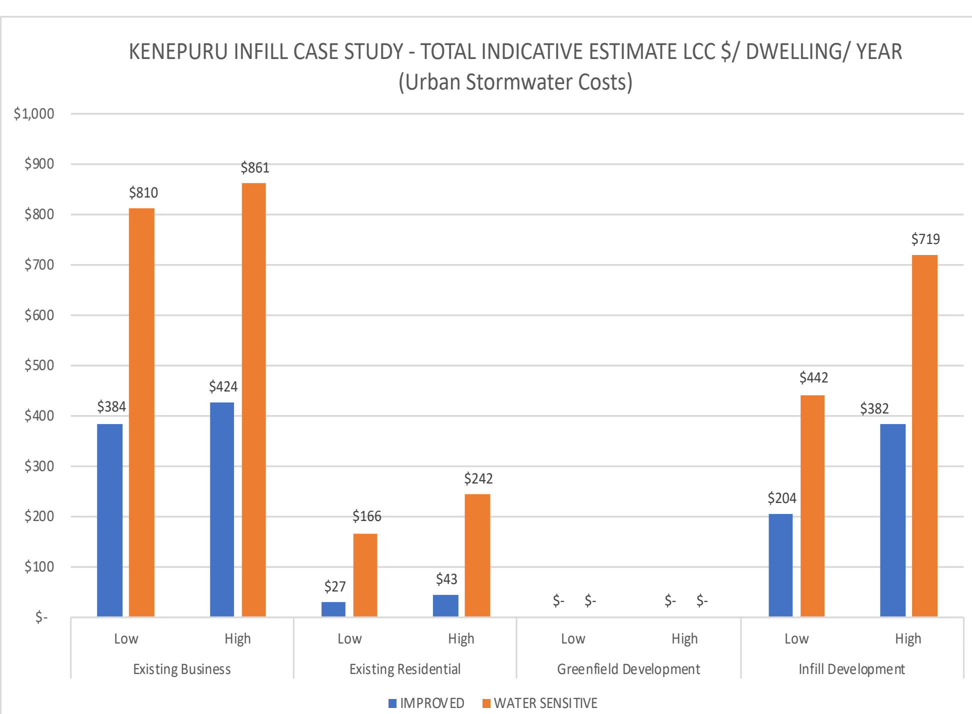
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 172,345	$ 292,016
WATER SENSITIVE	$ 635,891	$ 949,907

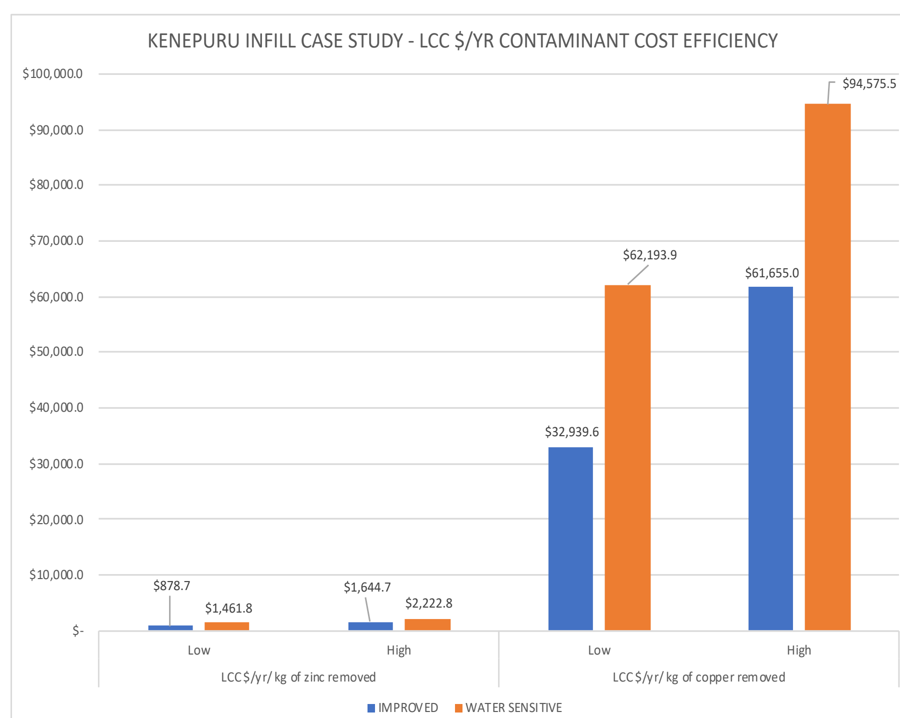
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 2,263	6%
WATER SENSITIVE	$ 21,749	84%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	316	68%	2957
Additional Greenfield	1	0%	0
Additional Infill	27	6%	452
Existing Rural	122	26%	1

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 8,617,261	$ 14,600,818	$ 3,644,461	$ 6,702,865	$ 101,486	$ 161,183
WATER SENSITIVE	$ 31,794,562	$ 47,495,363	$ 15,451,713	$ 25,212,720	$ 333,528	$ 454,748

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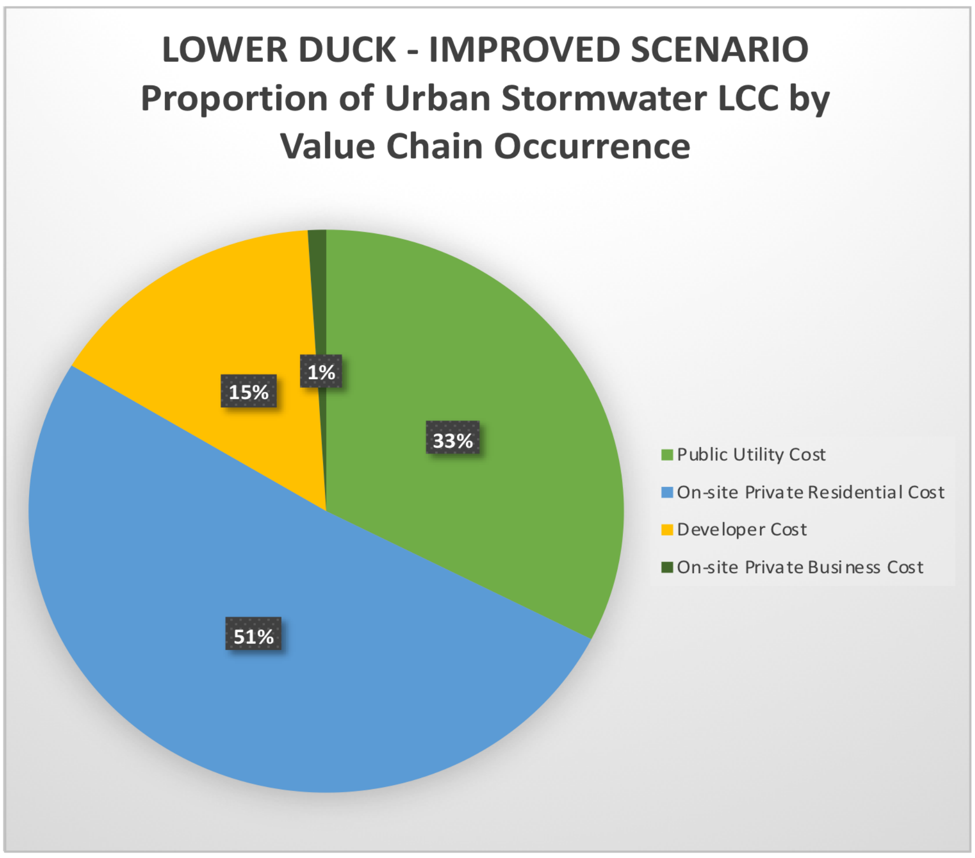
LIFE CYCLE COST REPORT CARD – LOWER DUCK CREEK (MOUTH)

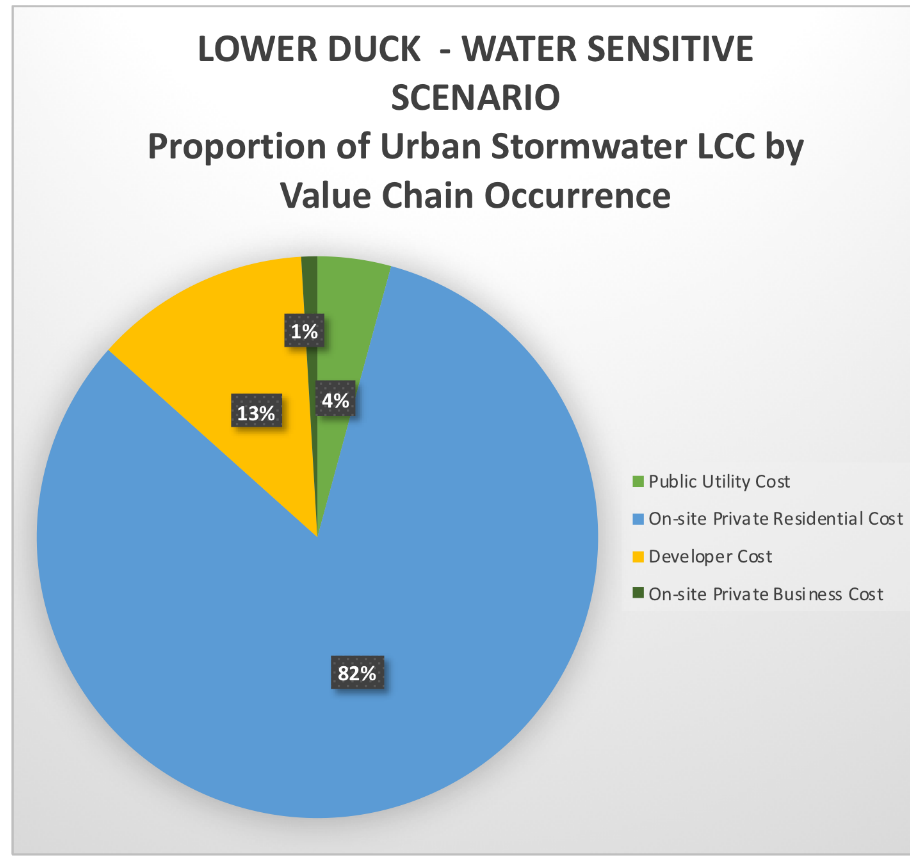
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

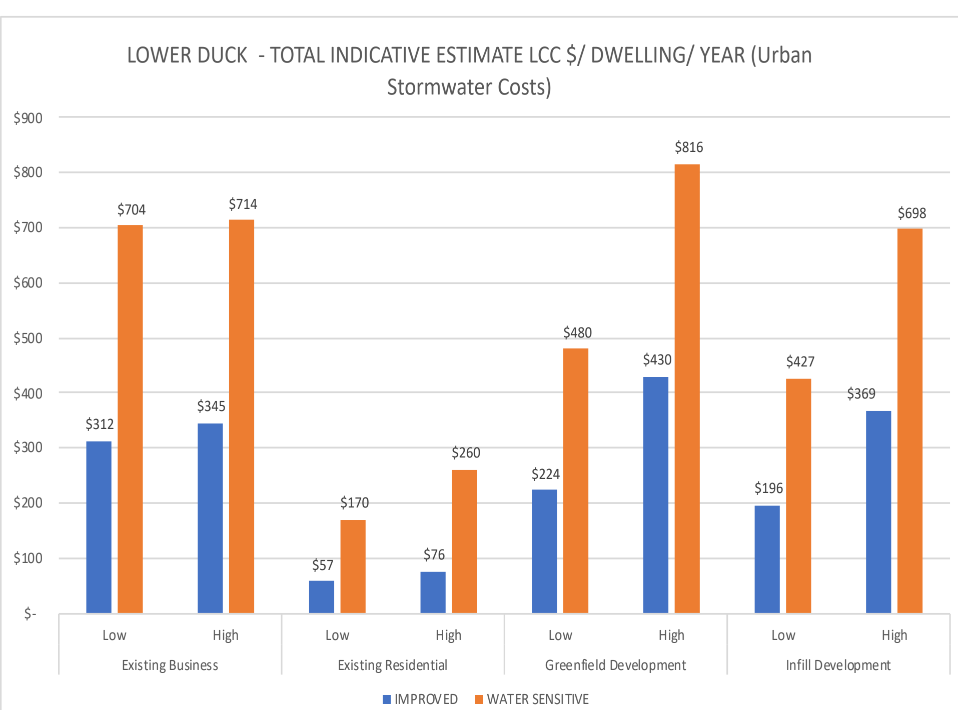
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 235,494	$ 385,036
WATER SENSITIVE	$ 593,212	$ 941,630

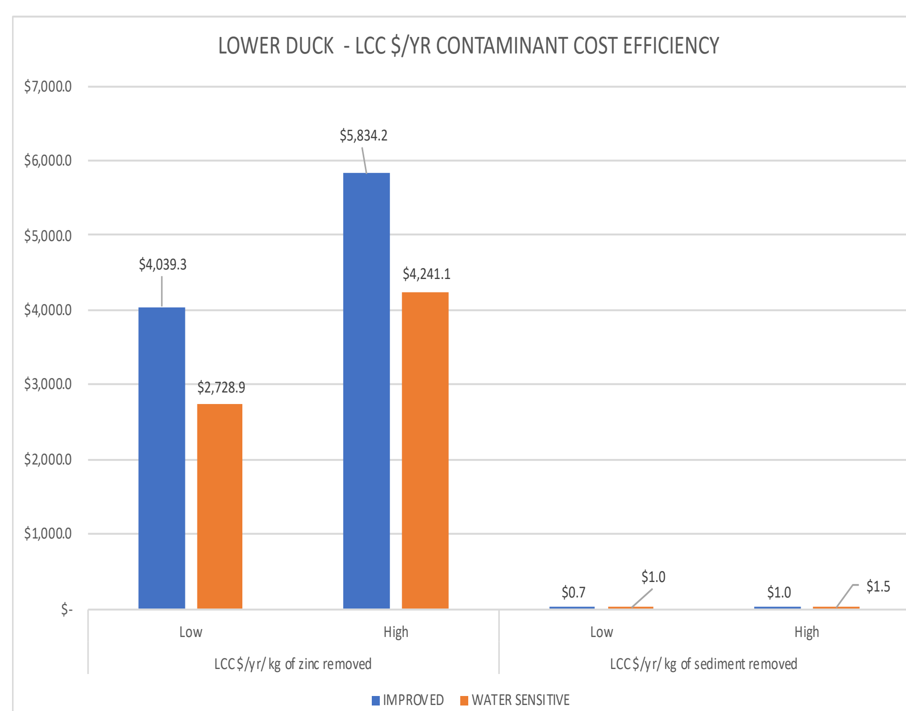
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 74,113	79%
WATER SENSITIVE	$ 97,664	80%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	268	26%	1918
Additional Greenfield	31	3%	309
Additional Infill	18	2%	301
Existing Rural	715	69%	2

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 11,774,720	$ 19,251,816	$ 5,063,304	$ 9,229,303	$ 136,968	$ 204,541
WATER SENSITIVE	$ 29,660,592	$ 47,081,482	$ 15,017,485	$ 26,742,542	$ 298,839	$ 415,080

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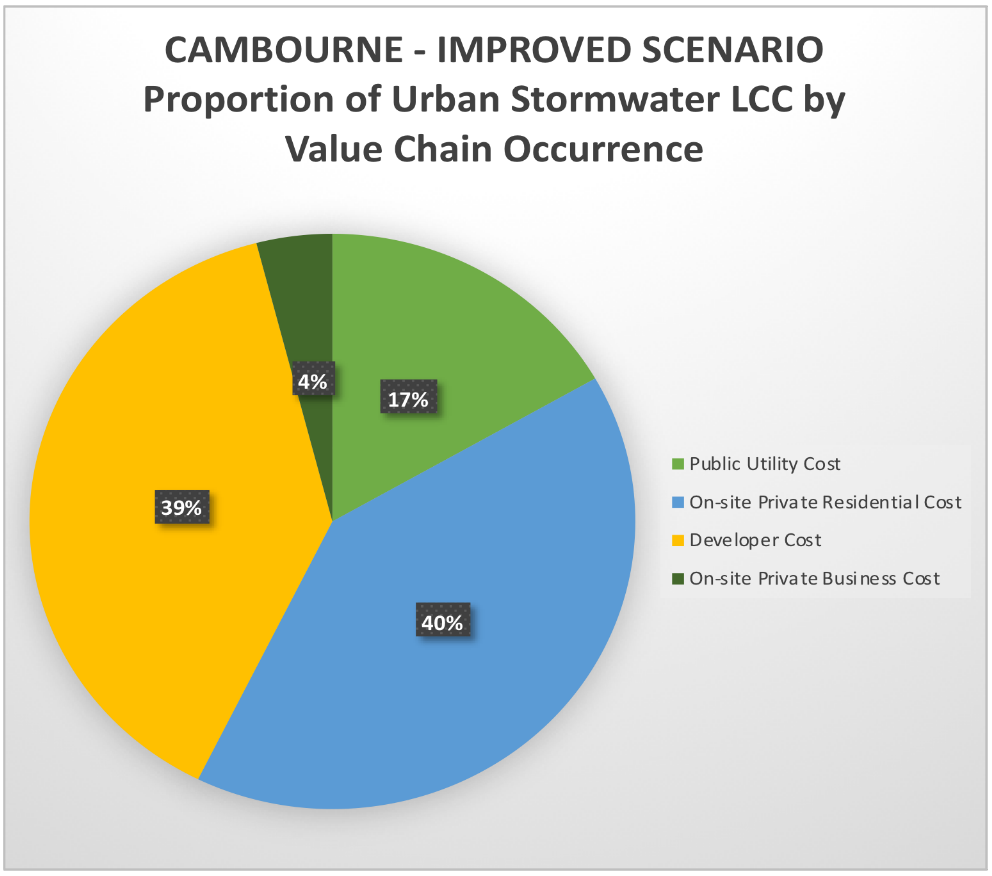
LIFE CYCLE COST REPORT CARD – CAMBOURNE GREENFIELD CASE STUDY

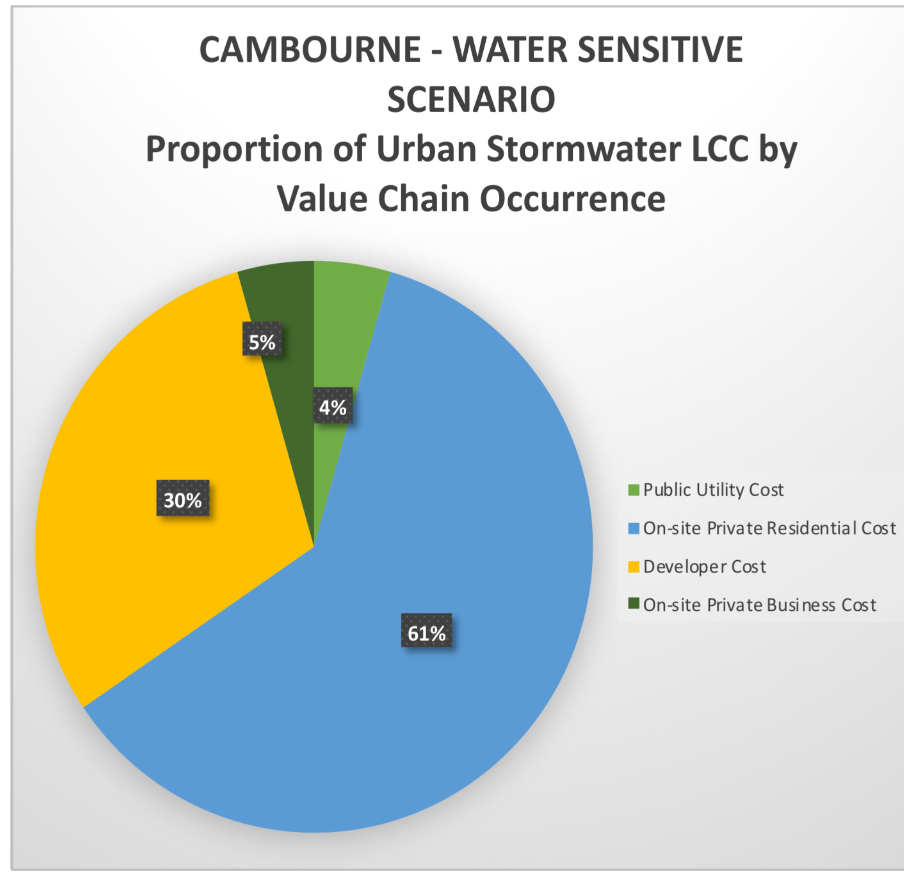
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

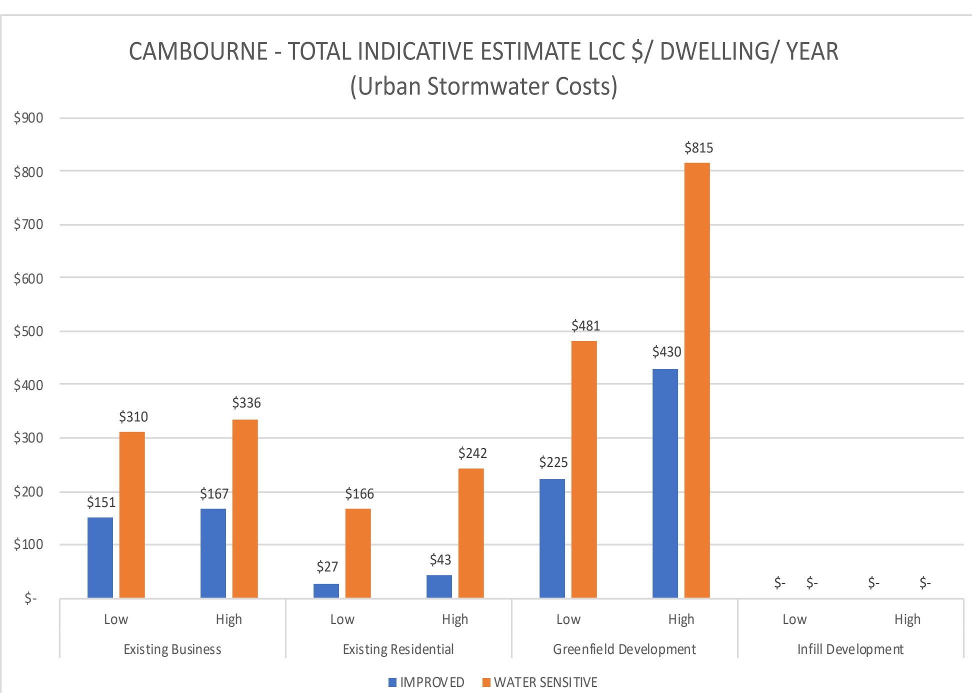
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 151,070	$ 283,158
WATER SENSITIVE	$ 325,317	$ 540,816

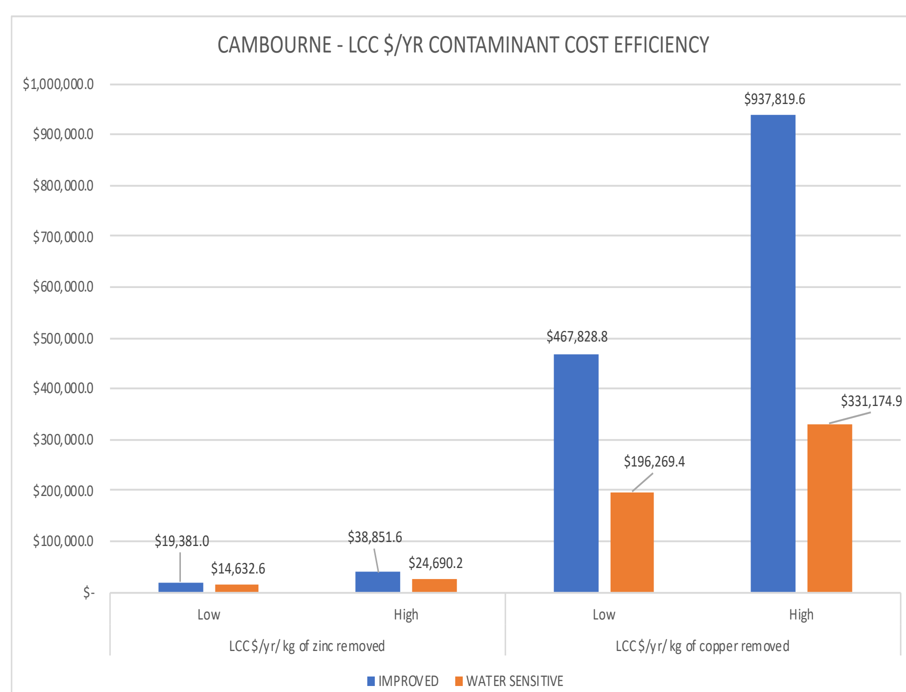
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 10,493	36%
WATER SENSITIVE	$ 30,498	70%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	11	5%	75
Additional Greenfield	54	24%	636
Additional Infill	0	0%	0
Existing Rural	159	71%	1

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 7,553,520	$ 14,157,883	$ 3,560,068	$ 7,761,871	$ 81,499	$ 130,531
WATER SENSITIVE	$ 16,265,835	$ 27,040,809	$ 8,675,036	$ 16,953,192	$ 154,914	$ 205,870

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- Costs of the piped network (i.e. BAU) are not included – costs presented here are additional to the BAU and/ or existing scenarios.

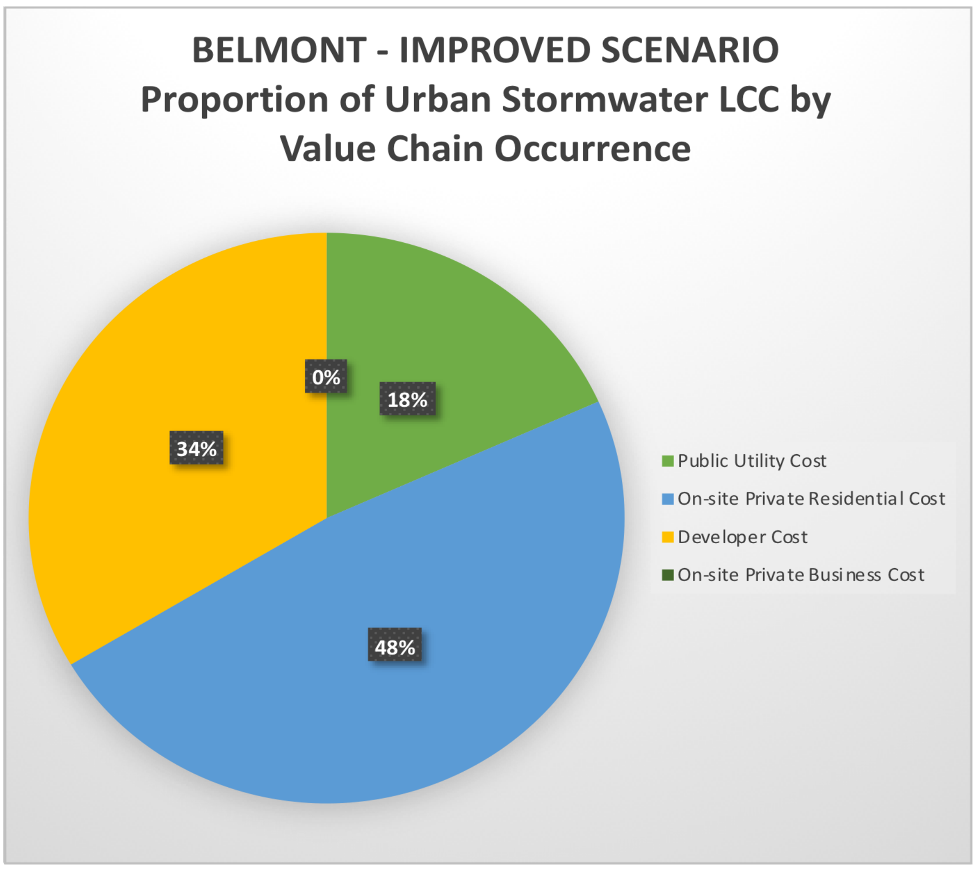
LIFE CYCLE COST REPORT CARD – BELMONT

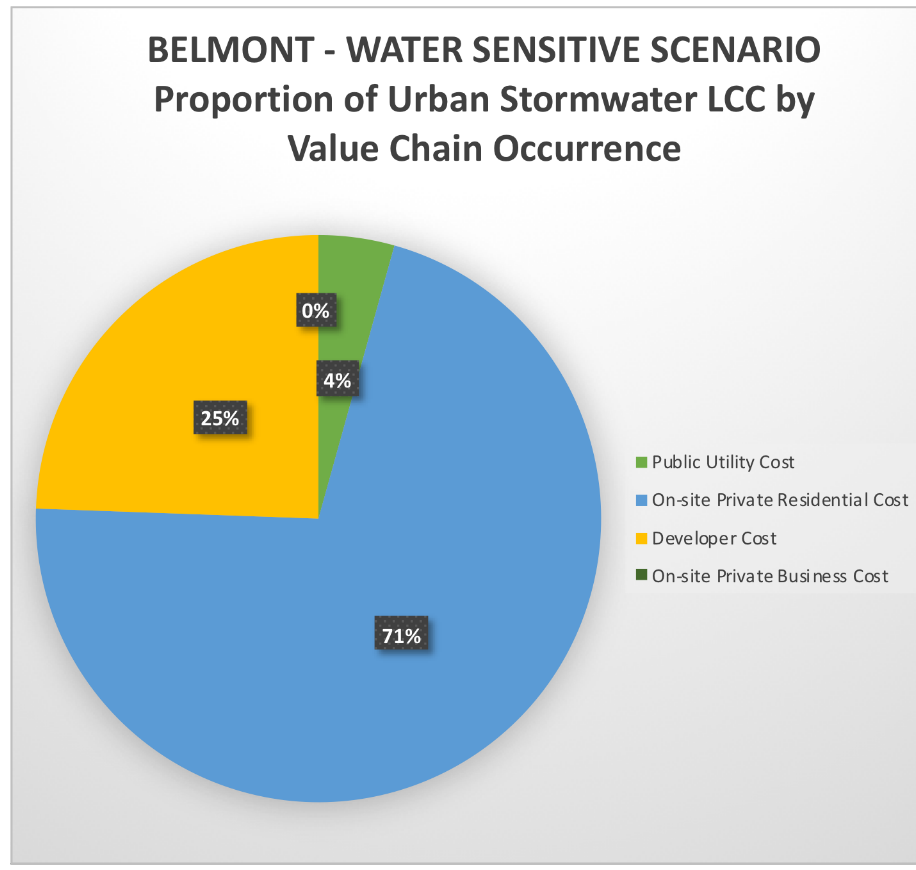
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

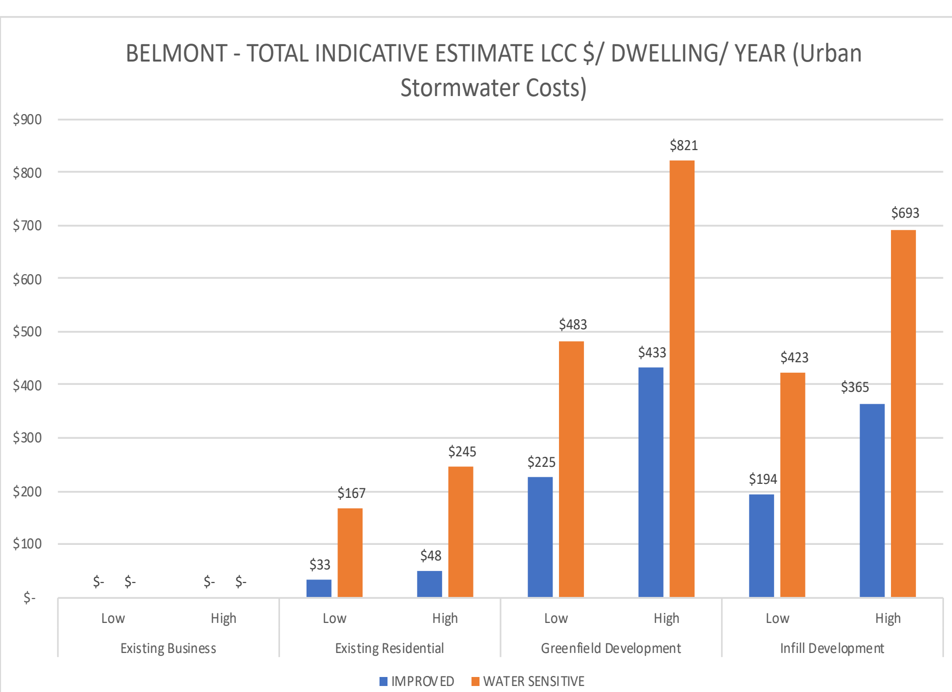
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 458,506	$ 860,657
WATER SENSITIVE	$ 1,111,694	$ 1,832,314

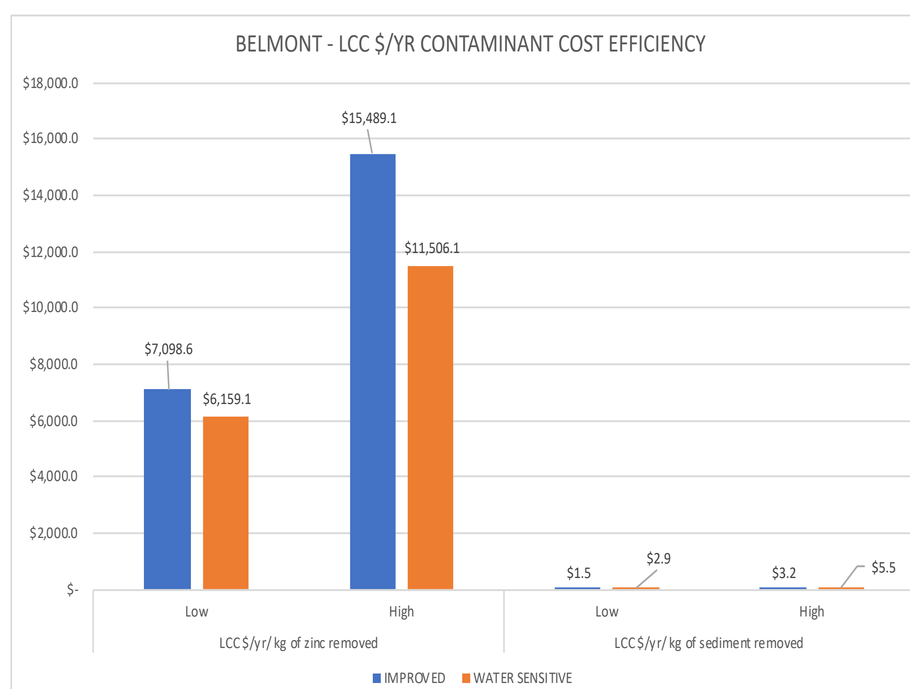
ANNUAL RURAL LIFE CYCLE COSTS (over 50 years)

Scenario	Total LCC $/ year (over 50 years)	% of LCC relating to loss of rural land
IMPROVED	$ 2,515	6%
WATER SENSITIVE	$ 3,090	10%









LANDUSE TYPE	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	135	29%	1426
Greenfield	144	31%	1621
Infill	15	3%	265
Rural	170	37%	38

URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 22,925,290	$ 43,032,832	$ 10,680,575	$ 23,108,518	$ 249,892	$ 406,619
WATER SENSITIVE	$ 55,584,697	$ 91,615,701	$ 29,328,417	$ 55,954,167	$ 535,842	$ 727,786

UNDERSTANDING THE COST RESULTS:

- Life cycle costs (LCC) are development, construction and maintenance costs calculated according to Australia/ NZ Standard 4536:1999.
- LCCs (shown in the pie and bar charts) are allocated to sequential points in the urban development value chain. Ultimately all costs would be borne by all land-use types and ratepayers.
- Costs are **indicative estimates** and **focus should be placed on the relative difference between scenarios and trends**.
- Urban mitigation cost drivers include amount of impervious area treated, land costs and level of treatment.
- High estimates are more indicative of “infill” or “brownfields” retrofit costs, whilst low estimates are more indicative of “greenfield” costs.
- Costs of the piped network (i.e. BAU) are not included – costs presented here are additional to the BAU and/ or existing scenarios.

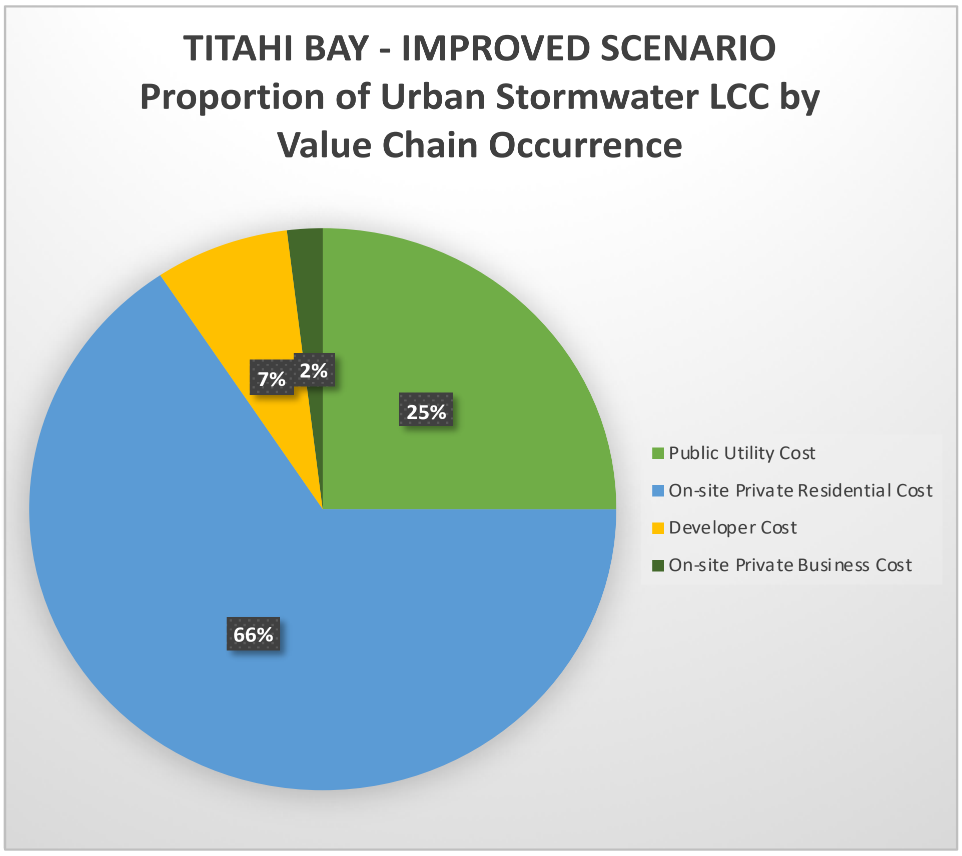
LIFE CYCLE COST REPORT CARD – TITAHI BAY

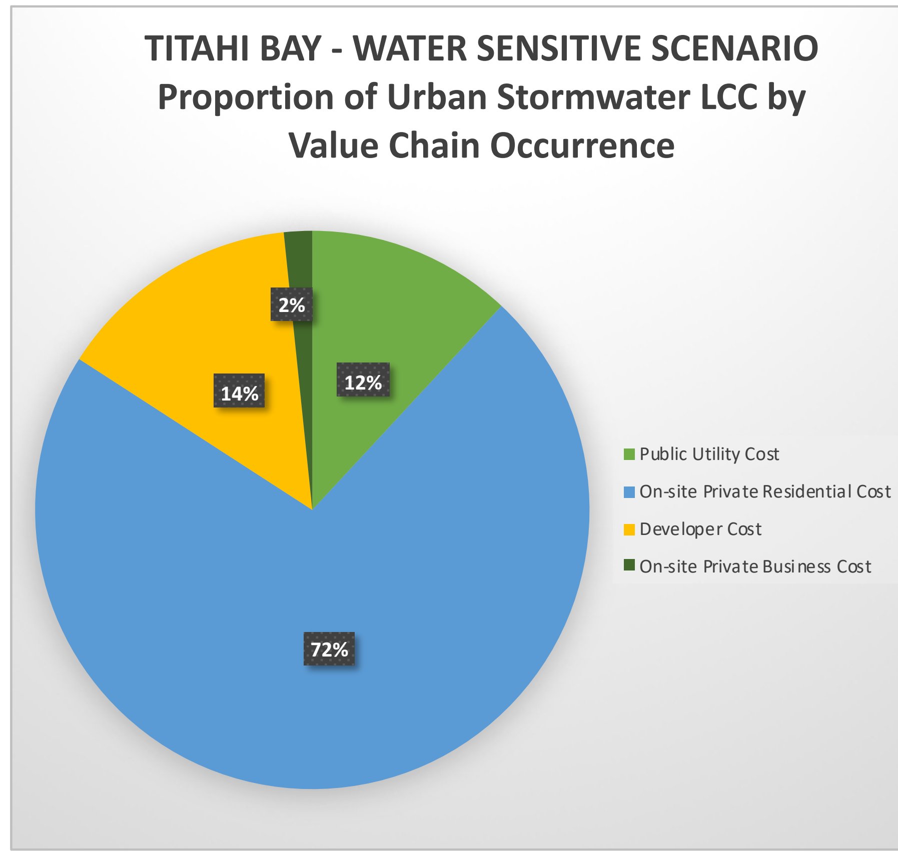
ANNUAL URBAN STORMWATER LIFE CYCLE COSTS (over 50 years)

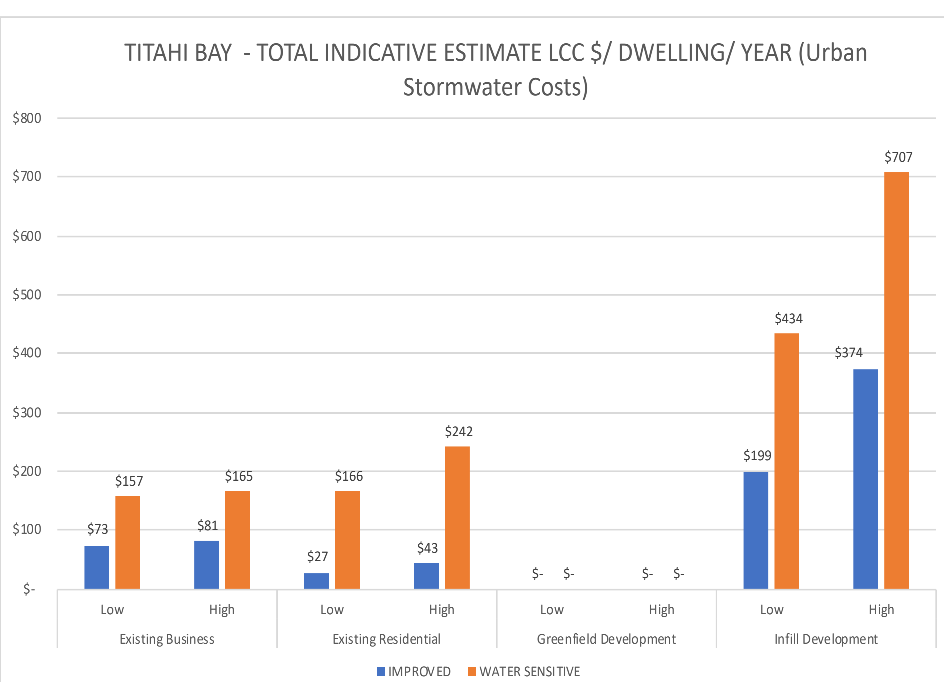
Scenario	Total LCC$/ year	
	Low	High
IMPROVED	$ 69,618	$ 126,851
WATER SENSITIVE	$ 183,132	$ 287,988

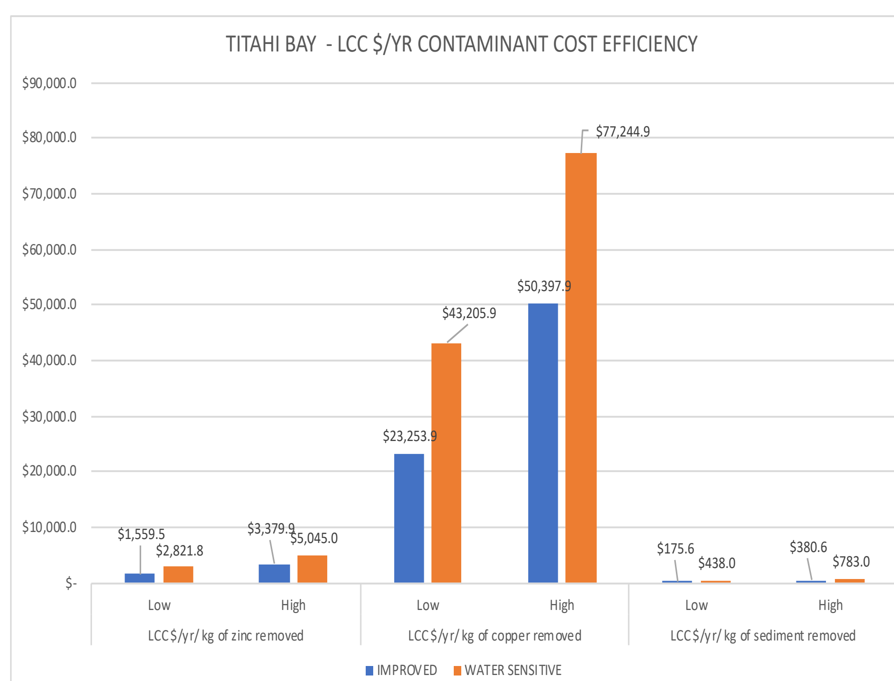
LAND USE

Type	Landuse		Dwellings
	Area (ha)	Area (%)	
Existing Urban	12	40%	393
Greenfield	0	2%	0
Infill	18	58%	300
Rural	0	0%	0







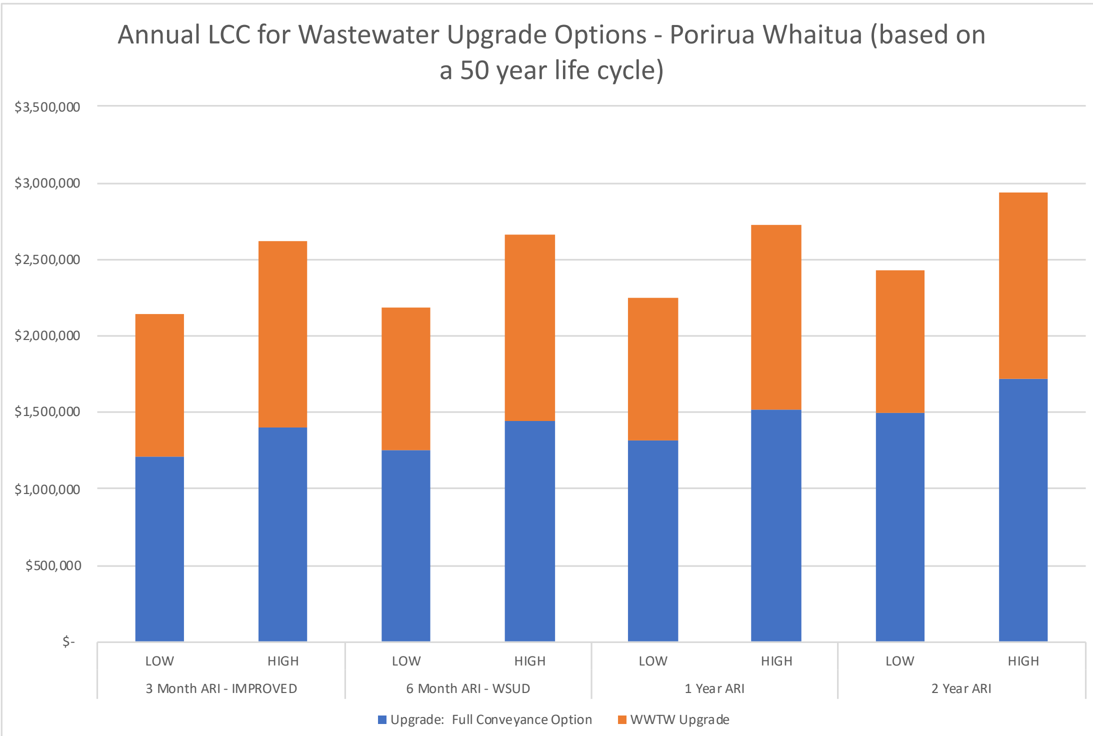


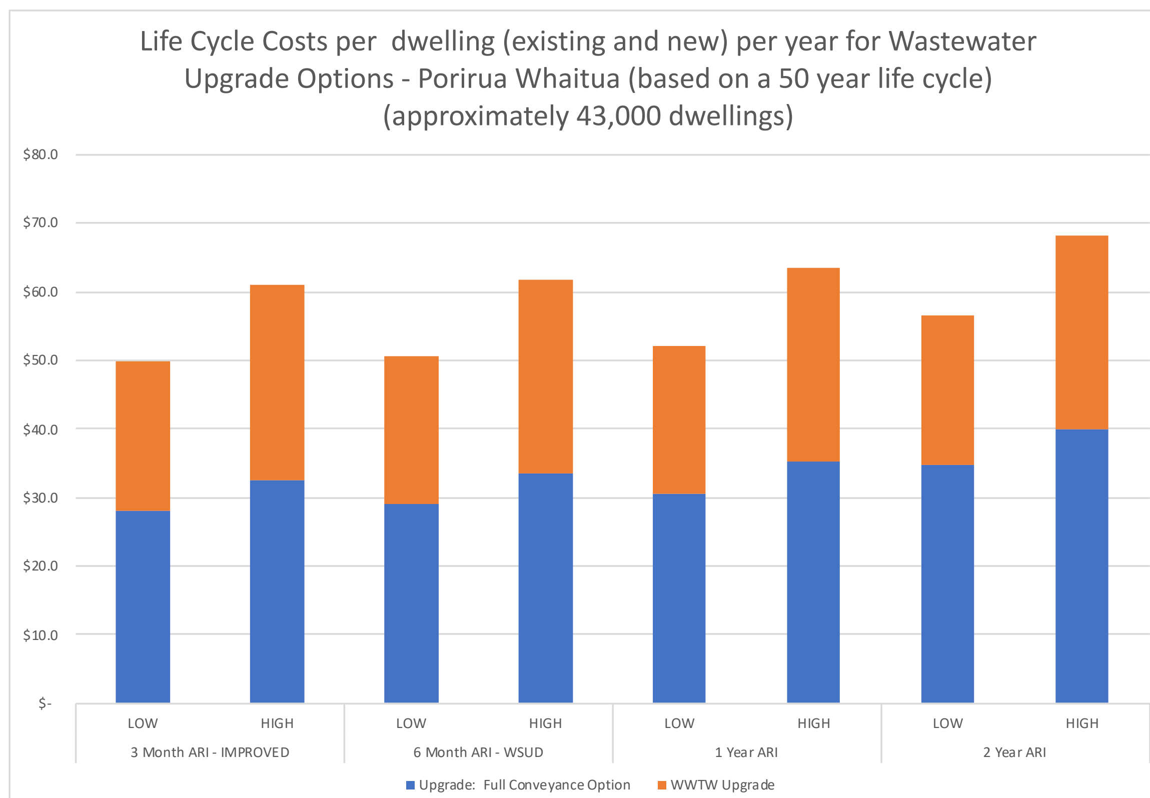
URBAN STORMWATER SCENARIO	TOTAL LCC (OVER 50 YEARS)		ACQUISITION COSTS		YEARLY MC	
	Low	High	Low	High	Low	High
IMPROVED	$ 3,480,895	$ 6,342,572	$ 1,519,640	$ 3,089,000	$ 40,026	$ 66,399
WATER SENSITIVE	$ 9,156,583	$ 14,399,377	$ 4,634,703	$ 8,613,435	$ 92,283	$ 118,080

UNDERSTANDING THE COST RESULTS:

- Life cycle costs (LCC) are development, construction and maintenance costs calculated according to Australia/ NZ Standard 4536:1999.
- LCCs (shown in the pie and bar charts) are allocated to sequential points in the urban development value chain. Ultimately all costs would be borne by all land-use types and ratepayers.
- Costs are **indicative estimates** and **focus should be placed on the relative difference between scenarios and trends**.
- Urban mitigation cost drivers include amount of impervious area treated, land costs and level of treatment.
- High estimates are more indicative of “infill” or “brownfields” retrofit costs, whilst low estimates are more indicative of “greenfield” costs.
- Costs of the piped network (i.e. BAU) are not included – costs presented here are additional to the BAU and/ or existing scenarios.

WASTEWATER LIFE CYCLE COST SUMMARY



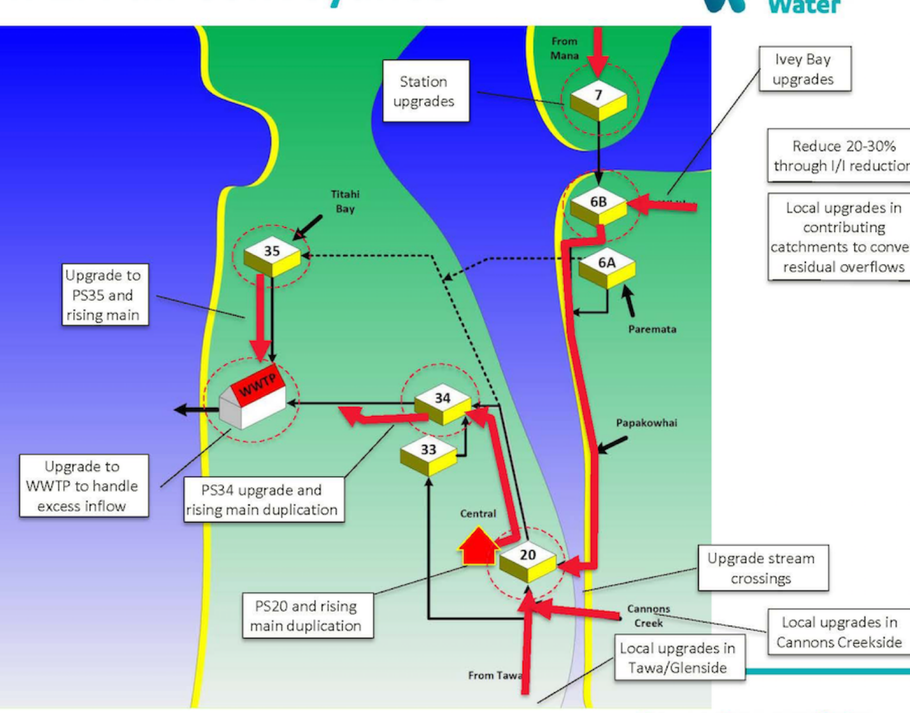


UNDERSTANDING THE COST RESULTS:

- The 3 month ARI level of service equates to approximately 4 overflows per year (improved scenario)
- The 6 month ARI level of service equates to approximately 2 overflows per year (WSUD scenario)
- Costs have only been provided for the "Full Conveyance" option and potential upgrades to the treatment plant. Costs for the treatment plant upgrade are additional to Option 1.
- Wastewater costs are likely to be under-estimated as there is insufficient cost data to account for costs relating to fixing illegal cross-connections, and a "catchment scale" LCC model is unable to account for such site-specific costs.
- Life cycle costs are development, construction and maintenance costs calculated according to Australia/ NZ Standard 4536:1999.
- Costs are **indicative estimates** and **focus should be placed on the relative difference between scenarios and trends**.
- Costs for each of the above scenarios are additional to (i.e. over and above) existing wastewater charges and rates.
- Construction Costs: generated from cost estimates provided by Wellington Water. These estimates are draft and are currently being refined and updated.
- Maintenance Costs: generated annual maintenance costs are based on recommended engineering experience of 4-5% of the mechanical and electrical capital cost and 1-2% of the civil asset cost.

Option 1: Full Conveyance

Wellington Water



Our water, our future.

PROPERTY PRICE NARRATIVE - SUMMARY

Effects of stormwater interventions/ mitigations on property prices are generally dependent on:

- the type of stormwater mitigation device,
- the combination of different types of devices used in series, and
- the level of maintenance.

Property price effects broadly operate across two scales, namely the property scale and the catchment scale. The most immediate scale is a property locality effect (i.e. how close the stormwater mitigation device is to the individual property), whilst the catchment/ wider scale relates to a liveability effect for a suburb or catchment. These wider catchment effects can be seen as an aggregation or interaction of the smaller effects around the individual devices.

An international literature review was undertaken to further understand these effects and obtain information on key learnings around the relationship between property prices and stormwater inventions.

Some of the **key learnings** from the 74 studies investigated are as follows:

- The literature shows a consistent increase in house prices in close proximity to green infrastructure/spaces world-wide, however, the quantum of this increase varies significantly between countries.
- There is a moderate to strong trend that houses which border on green space have higher values than properties which are further away. The majority of studies investigate this "proximity" effect up to about 200m from the green area, whilst some investigate it as far as up to 600m away.
- The literature demonstrates that houses which border on green space have higher values than property which is further away.
- The effect of views, especially where water is involved, leads to the highest increase in property values.
- Larger-scale urban parks and natural areas (e.g. stormwater wetlands) tend to have a higher effect on house value than small-scale green areas.
- Bush and riparian replanting on rural properties increase property values and are maximized when 40% of the property area is occupied by native vegetation.
- There is a clear trend that poor quality green areas lead to a decrease in property values.
- Negative effects on property values include green areas located in areas of high crime rates.
- Lack of on-going maintenance can cause property values to decrease in the long term.

RESULTS

- an average increase in house prices of 3.05% for those houses in close proximity to green space in the USA;
- studies in the UK and Europe show an average increase of 4.93%;
- Australia shows a 7.92% average increase;
- New Zealand studies demonstrate a 6.04% average increase;
- an increase in the purchase and rental costs of apartments in close proximity to open space;
- an average increase in property prices in close proximity to ponds/ wetlands of 6.5%;
- an average increase in property prices in close proximity to at source WSUD devices of 4%;
- an average increase in property prices in close proximity to stream restoration/ daylighting sites of 7.8%.

CAUTION: results are *very* site specific and the quantum of change to property prices should **not** be transferred to other locations.

NOTE: The Australian and New Zealand property price literature is likely to be more relevant to the Porirua Whaitua situation than other overseas studies due to the similar geo-political environment.

Relevance of this study for the Porirua Whaitua project is that there is likely to be a difference in property prices between "existing", "BAU", "Improved" and "WSUD" scenarios. This difference will be related to:

- the lack of "green infrastructure" within the "existing" and "BAU" scenarios;
- the greening effect that is common to wetlands is the focus of the "Improved" scenario;
- the greening effect of both wetlands and at source green infrastructure (e.g. bioretention) which we get at both the local and suburb scale within the "WSUD" scenario.
- increases in property prices as a result of rain tanks (in both the "Improved" and "WSUD" scenarios) as a result of additional capital (asset) value to the property.

Sydney Case Study (Polyakov, M., Iftekhar, S., and Fogarty, J. 2013. The amenity value of water sensitive urban infrastructures: A case study on rain gardens. Poster Presentation)		Results suggest that construction of rain gardens at street intersections increase values of neighbourhood properties: • by approx. 6% within 50m from an intersection with a rain garden; • by approx. 4% within 50 – 100m from an intersection with a rain garden.
Perth Stream Restoration Case Study (Polyakov, M., Fogarty, J., Zhang, F., Pandit, P. and Pannell, D.J. 2017. The value of restoring urban drains to living streams)		Homes within 200m of the stream restoration site increased in value by 4.7% of single family homes once the stream was fully restored and established. The study recommends that network operators and local councils could then use the difference in the increase in the rateable value of the properties to fund ongoing maintenance.

ECONOMICS – TAKE HOME MESSAGES

WHAITUA-WIDE COSTS

- Urban stormwater mitigation costs are the largest portion of modelled costs, with most of those generated from areas of greenfield and infill development. These ranged from around $4.1 – $6.9 million per year for the improved scenario and $11.9 – $16.5 million for the water sensitive.
- Overall, the rural costs due to loss of productive rural land are high.

URBAN STORMWATER

- Costs are indicative estimates of LCCs – relative difference between scenarios.
- The difference in costs between the 'improved' and 'water sensitive' are reflective of the fact that at source mitigation in the 'water sensitive scenario is effectively double that applied in the 'improved' scenario.
- Use high-end of cost range estimate for infill and retrofit situations. Land prices (and availability) and the difficulty of working within existing services and site constraints will drive costs.
- Use low-end of cost range estimate for greenfield situations.
- 'Improved' scenario models a higher share of public (on-going maintenance costs)and developer (total acquisition costs) expenditure from catchment scale methods (wetlands).
- 'Water sensitive' scenario includes a 16% 'avoided cost' land development saving : this saving results from a different approach to development, and leads to reduced earthworks, reduced piping costs and reduced impervious surfaces.
- 'Water sensitive' scenario models higher shares of privately borne costs from the higher use of lot scale mitigation (rain tanks/ permeable paving) and on-site mitigation for commercial and industrial properties.
- A higher portion of the cost burden lies with the private dwellings and the public utility/ council for infill development.
- The per dwelling costs should be treated with caution since they are influenced by the number of existing dwellings as well as the proposed dwellings. In reality, decisions about spending sit with local government, and it is likely that the existing properties will not need to "fit the bill" for new development. However, some general conclusions about the indicate cost estimates can be made. For businesses and private dwellings, the water sensitive scenario is approximately double the cost of the improved scenario. This result is expected since the water sensitive scenario proposes interventions to double the area treated and attenuated over the improved scenario. In addition, the business dwellings include a mix of interventions which are slightly more expensive on a unit cost basis than the improved interventions.
- When investigating the life cycle costs on the basis of $/kg contaminant removed, the "Water Sensitive" scenario is more cost effective than the "Improved" scenario on a Whaitua-wide scale for urban metals. Costs of removing copper are very high, and therefore opportunities for source control could be investigated to reduce the incoming contaminant load.
- The increased costs resulting from increased stormwater treatment and attenuation under the 'improved' and 'water sensitive' scenarios lead to a potential 1% - 4% increase in property holding costs.

RURAL STORMWATER

- 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. Furthermore, the cost of the loss of production on rural land as a result of land lost to retirement and riparian planting increases significantly in the water sensitive scenario over the improved scenario. The percentage of the LCC which relates to losses from land production costs is approximately 25% higher in the water sensitive scenario than in the improved scenario on a whaitua-wide basis.

WASTEWATER

- There is not a great deal of difference between the 'improved' and 'water sensitive' scenario costs for wastewater, and it is likely that the differences are within the error margins of the model. Maintenance costs for wastewater are based on engineering experience – no actual cost data was available.
- Wastewater costs are likely to be under-estimated as there is insufficient cost data to account for costs relating to fixing illegal cross-connections, and a "catchment-scale" cost model is unable to account for such site-specific costs.

PROPERTY PRICES

- In general, the literature shows a consistent increase in house prices in close proximity to green infrastructure/spaces world-wide, however, the quantum of this increase varies significantly between countries. Based on this literature (approximately 74 studies) one could expect that there is likely to be a difference in property prices between "existing", "BAU", "Improved" and "Water Sensitive" scenarios. Lack of on-going maintenance can cause property values to decrease in the long term.