Economic assessment

Requirements for water sensitive design for four-plus unit developments

Wellington City Council

8 February 2023

→ **The Power of Commitment**

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Three waters provisions being proposed by Wellington City Council (WCC) for all urban zones will increase requirements for on-site management of three waters. Where developments exceed four or more units, in addition to ensuring hydraulic neutrality, they will need to incorporate water sensitive design (WSD) techniques into the development plan through a resource consenting process.

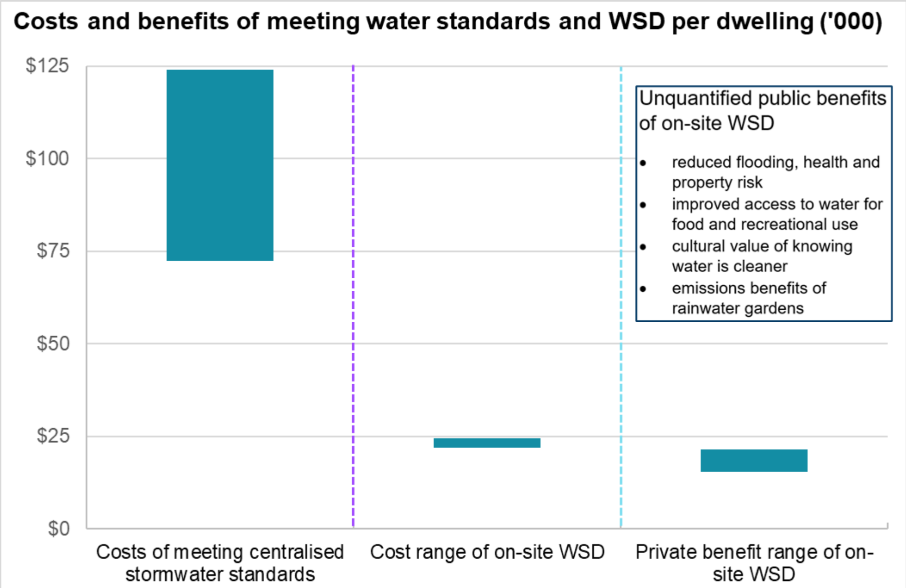
GHD was commissioned to:

- investigate the strategic economic arguments for better stormwater management on site
- provide a sense of scale of the benefits of the WSD approach to stormwater, offset against the costs of two typical solutions one might expect to see (case studies) that incorporate WSD on site.

Strategic economic argument for WSD

Development increases the quantity of stormwater run-off and reduces the quality of water entering water bodies if there is no mitigation. By the economic principle of “user pays”, those who impose this cost on the stormwater network or water bodies should pay to mitigate its effect, rather than general taxes or rates being used. The evidence demonstrates that charging the full cost of managing stormwater to development does not push house prices up; it pushes the price of land down, so there is not a strong housing affordability argument for not correctly providing for water management on-site.

Detailed economic assessment



Wellington faces a significant stormwater quantity and quality challenge. Current infrastructure is insufficient to deal with major rain events. Meanwhile, the city is expected to add 25,000 to 31,000 new dwellings over the next 30 years, placing further pressure on the stormwater system. Estimates are that to meet central government-set three waters quality standards through centralised upgrades to the stormwater system rather than on-site mitigation measures, the cost to development would be prohibitive, at between $72,000 and $124,000 ***per additional new dwelling added*** just for stormwater.

The requirement for hydraulic neutrality across all developments regardless of number of dwellings helps reduce the quantitative burden that would otherwise be imposed on the network. The requirement for WSD goes further, allowing for further management of quantities and for improving the quality of stormwater flows through on-site management. Two studies demonstrate a typical ***cost*** for WSD of between $21,800 and $24,400 per dwelling including additional resource consent-related costs. This figure is dramatically less than the cost per dwelling for new dwellings to meet the costs of three waters standards for stormwater.

Offsetting these costs are private and public ***benefits*** to properties having WSD. Estimates suggest that WSD can raise ***private*** property values by between $15,400 and $21,400 per dwelling. But arguably the main reason for implementing WSD, beyond the massive cost of a centrally managed approach to stormwater (upgraded pipes and treatment facilities) that would otherwise need to be covered by development contributions, is the ***public*** benefits of WSD that accrue beyond the development. These benefits include reduced flooding, health and property risk; improved access to water for food and recreational use; the cultural value of knowing water is cleaner; and emissions benefits of rainwater gardens. These public benefits, taken with the private benefits and the prohibitive cost of the upgrades that would otherwise be required to the stormwater network, present a compelling case for WSD.

2. Introduction and purpose of the report

Three waters provisions being proposed by Wellington City Council (WCC) for all urban zones will increase requirements for on-site management of three waters. For developments of three or fewer dwellings, hydraulic neutrality will be required. In the case of developments of four or more units, in addition to ensuring hydraulic neutrality, developments exceeding four or more units, in addition to ensuring hydraulic neutrality, will need to incorporate water sensitive design (WSD) techniques into the development plan through a resource consenting process. These techniques consider water management in parallel with the ecology of a site, best practice urban design and community values.[1]

WSD includes the integration of planning, engineering design and water management to mimic or restore natural hydrological processes. The goal is to address the quantitative and qualitative impacts of land use and development on land, water and biodiversity, and the community's aesthetic and recreational enjoyment of waterways and the coast. WSD manages stormwater at its source as one of the tools ***to control runoff and water quality***.

The policy explicitly does not limit what these techniques might be, and they may tackle water supply, management of the effects wastewater discharges and/or managing stormwater. But in the Wellington context, where stormwater management is currently a significant challenge, it is likely that WSD responses will focus on stormwater management.

GHD was commissioned to:

- investigate the strategic economic arguments for better stormwater management on site
- provide a sense of scale of the benefits of the WSD approach to stormwater, offset against the costs of two typical solutions one might expect to see (case studies) that incorporate WSD on site.

A single development of four units is unlikely to create a major stormwater impact on its own, but the principle is that every incremental addition to stormwater demand, combined with every other incremental increase, creates the stormwater challenge.

Some of the benefits of WSD are hard to quantify, which makes comparison against the costs on a case-by-case basis difficult. We have adopted a Quantify Proxy Describe methodology for understanding the benefits of the provision. As the costs in the two case studies are in dollar terms, we attempt to ***quantify*** benefits in dollar terms where possible for easiest comparison. Where this is not possible, we attempt to ***proxy*** benefits, which means we present them in a numerical, non-dollar form. Finally, if it is not possible to quantify or proxy benefits, we ***describe*** them in a way that allows decision-makers to hold these in mind alongside quantified or proxied benefits as they weigh benefits and costs.

[1] Wellington Water. (2019). *Water Sensitive Design for Stormwater: Treatment Device Design Guideline*. Retrieved December 14, 2022, from WSD-for-Stormwater-Treatment-Device-Design-Guideline-December-2019.pdf (wellingtonwater.co.nz)

3. Current stormwater challenge

The stormwater network in Wellington carries 80 million cubic metres of run-off and does not have the capacity to support current stormwater levels.[2] Pluvial flooding (surface and flash flooding due to extreme rain events) is already occurring and the challenges with managing stormwater are expected to increase over time. This is due to the increased frequency of heavy rain events and sea level rise which makes it more difficult for stormwater to discharge.

Recent growth and intensification have contributed to this challenge as developments have often been designed with large areas of impervious surfaces that reduce ground permeability, causing the stormwater network to become overloaded. This impacts on overland flow paths as there is more surface water moving around the city.

Traditionally, managing stormwater has been centred around drainage; however, it is now a legal requirement for stormwater to be of better quality because surface water carries pollution such as litter, fertiliser, heavy metals and bacteria.[5] Councils are also required to manage the effects of urban development on freshwater ecosystems. Greater Wellington Regional Council advises that people avoid swimming at beaches for at least two days following heavy rainfall. Wastewater overflow also occurs in these instances and beaches are required to be closed due to pollution levels.[3]

Therefore, it is now a priority to reduce *and* filter stormwater so that it does not cause harm to existing habitats and ecosystems, or to human health. The areas in Wellington that are particularly subject to flooding as a result of increased stormwater challenges are Tawa, Johnsonville, Mount Cook, Pipitea, Te Aro, Thorndon, Wellington Central, Berhampore, Island Bay, Kilbirnie and Miramar.[4] Figure 1 signifies that existing stormwater assets are performing only at a moderate level and that maintenance is required just to provide for current levels of intensification. The replacement costs are also high, at $1.2bn, which is potentially a conservative estimate that does not account for the cost escalation that has been seen in recent times. The asset management maturity is also under review for all three waters which is further indication that there is some concern that the state of the network is not performing as the desired.

Figure 1 Breakdown of the assessment of asset data[5]

	Replacement Cost	Condition (1-5)	Performance (1-5)	Data confidence (A-E)	AM Maturity
Transport	$1.6bn	2 - Minor defects only	2 - Good minor shortcomings	A-B Minor inaccuracies (1)	Intermediate (3)
Water	$1.1bn	3 - maintenance required	2 - Good	A-B Minor inaccuracies (1)	Under review
Stormwater	$1.2bn	3 - maintenance required	3 - Moderate	A-B Minor inaccuracies (1)	Under review
Wastewater	$1.6bn	3 - Maintenance required	3 - Moderate	A-B Minor inaccuracies (1)	Under review

[2]Wellington City Council. *Tō mātou mahere ngahuru tau. Our 10-Year Plan.* Retrieved December 15, 2022, from https://wellington.govt.nz/-/media/your-council/plans-policies-and-bylaws/plans-and-policies/longtermplan/2021-31/wcc-long-term-plan-2021-31-volume-1.pdf?la=en&hash=F2462CB9DAD2300511A9D2368DDFA13ECE09B67E

[3] Stantec. (2019). *Wellington CBD Stormwater Master Planning: Prepared for Wellington Water*. Retrieved from Wellington City Council.

[4] Wellington Water. (2021). *Wellington City Council – Spatial Plan: Three Waters Assessment – Growth Catchments Mahi Table and Cost Estimates.* Retrieved December 12, 2022, from three-waters-assessment---growth-catchments-mahi-table-and-cost-estimates-march-2021.pdf (wellington.govt.nz)

[5] Wellington City Council. Tō mātou mahere ngahuru tau Our 10-Year Plan: Volume two – Long-term Plan 2021-2031. Retrieved December 22, 2022, from https://wellington.govt.nz/-/media/your-council/plans-policies-and-bylaws/plans-and-policies/longtermplan/2021-31/wcc-long-term-plan-2021-31-volume-2.pdf?la=en&hash=61DD9C557668BCCCFB7AB610578085CB609AD38

4. The strategic economic case for on-site stormwater management

Before examining the economic costs and benefits of on-site stormwater management in detail, it is prudent to consider the strategic economic case for a policy that requires increased stormwater quantities or reduced stormwater quality to be managed on the site of development or redevelopment.

In summary:

- Development increases the quantity of stormwater run-off and reduces the quality of water entering water bodies if there is no mitigation.
- By the economic principle of "user pays", those who impose this cost on the stormwater network or water bodies should pay to mitigate its effect.
- The evidence demonstrates that charging the full cost of managing stormwater to development does not push house prices up; it pushes the price of land down.
- Nevertheless, in the short-term, some developers who may have overpaid for the land on the expectation that their impacts on the environment and those around the development would be paid for by the general ratepayer may see the profitability of their development fall.

4.1 Increased stormwater run-off imposes costs

If stormwater run-off from development sites is increased because of an increase in impervious surfaces, this imposes costs on residents and businesses beyond the development site, both with regard to quantity and quality of stormwater.

Through increased site coverage via more impermeable surfaces, development adds to the ***quantity of stormwater*** needing to be managed. If stormwater capacity is sufficient to accommodate growth, the new service demand is added at little or no cost to the development site[6]. This increased demand means that capacity paid for by others (ratepayers) is used up at no cost to the development site.

Alternatively, if there are already constraints on the stormwater system, development leading to more stormwater run-off will either lead to the need to upgrade the stormwater system sooner or will lead to increased risk of flooding. These outcomes also impose costs on others who would need to fund that upgrade or would bear the consequences of increased regularity and/or scale of flooding. In the case of Wellington, we know there are already significant constraints on the stormwater system, so this alternative scenario is most likely.

Further, even if there is sufficient capacity to manage the volumes of stormwater, the run-off, if not dealt with adequately, can introduce further contaminants into water bodies – leachates, sediment or heavy metals for instance – leading to poorer ***quality*** water. Again, if not managed on-site, this cost is imposed on others beyond the development.

4.2 User pays: Those who impose the cost should pay

The basic economic principle of user pays states that when consumers of a good or service pay the full cost of what they consume, society allocates its limited resources most appropriately.

This somewhat complicated explanation simply means that when an inaccurate price is charged for something (either too much or too little), perverse outcomes occur. For example, by not requiring development to fully pay for its own demands on the stormwater network, we incentivise development to happen where the stormwater impacts may be severe (and the costs of mitigation may be high) because development no longer has to consider the cost to development of mitigating those costs. This is poor resource allocation because by not pricing accurately, we

[6] Current development contributions for stormwater in Wellington are $165 per equivalent household unit. Wellington City Council. (2015-16). Development Contributions Policy. Retrieved December 15, 2022, from https://wellington.govt.nz/-/media/your-council/plans-policies-and-bylaws/plans-and-policies/a-to-z/devcontributions/files/2015-16/2015-16-development-contributions-policy.pdf?la=en&hash=8ABAA3FC0E521FB07F00188892FF513D0E79A061

send the wrong signals to the market about the impacts their choices (in this case to develop without stormwater mitigation) have on society beyond the development site.

To avoid perverse outcomes, it is important that the costs imposed by development are internalised by that development. This means that the cost of dealing with stormwater quantity or quality impacts due to development should be internalised by that development.

4.3 Balancing user pays with other considerations

While the user pays principle should be adhered to as much as possible to internalise costs among those who impose them, there are a few other considerations that may lead to a slight departure from this principle.

4.3.1 Administrative efficiency

A policy that aims to ensure those who impose the cost on the stormwater system pay for that imposition must balance the administrative burden of the policy against the cost imposed on society. For instance, the cost of checking compliance and issuing resource consents may outweigh the benefits of ensuring stormwater impacts are internalised on smaller development sites. This is one consideration in the Medium Density Residential Standards (MDRS) allowing development of three dwellings on a site as of right for instance.

There may therefore be a valid argument for policy not focusing on smaller developments or those likely to have an immaterial impact on stormwater flows or quality.

4.3.2 Ability to pay

New Zealand, like many economies, has a progressive tax system. The underlying principle behind this is that those who can afford to pay more subsidise those who cannot afford to pay. In considering stormwater impacts and who pays, we may once again consider whether the costs of a policy to require more comprehensive on-site stormwater management can be borne by that development.

Every development site will be different, and the business decisions made by the developer, including how much profit they hope to make and how much they have accounted for costs, will vary. Investment in development or redevelopment activity typically involves large dollar figures, and the expected cost of the mitigation measures captured in section 5.3 would form a relatively low proportion of the overall project cost, particularly when compared to the alternative, centralised approach and costs for managing stormwater that would otherwise need to be imposed via a development contribution or similar tool.

Nevertheless, a further strength of the proposed policy in applying to developments of four or more dwellings is that it allows for the possibility that smaller developments have less capacity to share costs WSD across multiple dwellings.

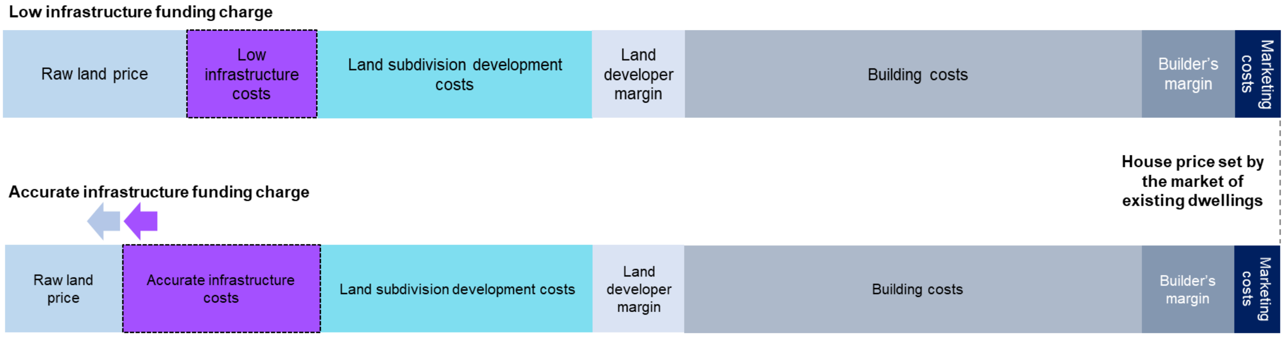
4.4 Correctly assigning infrastructure costs do not push up house prices

It is a commonly held but inaccurate belief that charging more accurately for infrastructure (such as to mitigate stormwater impacts) will significantly raise house prices.

The inaccuracy of this view is demonstrated both by theory and by case studies. We begin by considering the theory. When a new dwelling is built, it enters a market of, in the case of Wellington City, tens of thousands of existing homes. New homes delivered into this market have to compete on price with these tens of thousands of homes, and especially with other recently constructed homes. As a consequence, developers are what economics calls “price-takers”. No individual developer sets the price of a home. If they charge too much, people will simply buy somewhere else.

In determining development feasibility, therefore, the developer has to consider the price at which the developed homes will sell at the end of the project; a price set by the market. The developer then works backwards to ensure they make a profit and cover all the other inputs required to go from empty or under-used land to a new completed development. This process requires the developer to calculate infrastructure costs (including development contributions or any requirement for extra on-site infrastructure such as stormwater mitigation). What is left after covering profit and all the inputs, is a residual value the developer can pay for the undeveloped or under-developed "raw land". This process of working out the feasibility of the project is demonstrated in the top bar in Figure 2.

Figure 2 How development pricing changes when infrastructure costs rise



If the cost of servicing the land through development contributions or through on-site stormwater management rises, as shown in the second bar in Figure 2, the developer will be very limited in their ability to pass on those costs. Instead, developers will have to pay ***less*** for "raw land" if the development is to maximise its commercial viability. All things being equal (i.e. without a change in the ***quality*** of the housing delivered – see the detailed discussion later), house prices are unaffected and raw land prices fall.

The empirical evidence from overseas and in New Zealand supports this theoretical description. The international evidence on this trend for infrastructure costs to pass up the chain to land prices rather than down to house prices is instructive. Work done in Auckland Council's Chief Economist Unit summarising the findings of international studies shows that in almost all cases, the vast majority of costs were passed up the chain.[7]

In New Zealand, the Auckland experience is invaluable in demonstrating that the true costs of infrastructure are internalised rather than passed on into higher house prices. In its independent role, the Chief Economist Unit at Auckland Council evaluated whether that city's Rural Urban Boundary (RUB) constrained access to developable land and thus artificially inflated land prices inside the boundary, a common accusation against growth boundaries.[8] While growth boundaries can have this effect, they do not by necessity have this impact.

The key finding of the RUB study was that Auckland's growth boundary does not currently inflate land prices inside the boundary. However, a further finding was that once the true cost of infrastructure is factored into land values, it appears that land prices ***outside*** the boundary were inflated. This is likely because of speculation on land purchases just outside the boundary, where developers believe that at some point in future, development will be allowed with an ongoing infrastructure subsidy from the general ratepayer. In other words, ***developers are offering a price for raw land based on what they think they will have to pay for infrastructure***. If a clear signal is sent that development will need to pay more for infrastructure (including on-site stormwater management), raw land prices will fall, rather than house prices rising.

The implication for Wellington is that as the city signals that the true cost of development, in this case for the purposes of mitigating stormwater impacts, raw land prices will adjust to reflect the true cost of infrastructure to service new developments.

4.5 Short term impacts of the policy

Nevertheless, there can be marginal impacts on the delivery of housing in the short to medium term.

[7] See Harshal Chitale, *Unshackling growth Growth paying for itself*. 2018. https://www.aucklandcouncil.govt.nz/about-auckland-council/business-in-auckland/docsoccasionalpapers/unshackling-growth%20-%20April%202018.pdf
[8] See Shane Martin and David Norman, *An evidence based approach: Does the Rural Urban Boundary impose a price premium on land inside it?* 2020. https://www.aucklandcouncil.govt.nz/about-auckland-council/business-in-auckland/Reports/does-the-rub-impose-a-price-premium-on-land-inside-it-20-Feb-2020.pdf

4.5.1 Developers who have overpaid for land

The introduction of the requirement to better manage on-site stormwater coming at the same time as the MDRS are introduced reduces the likelihood that developers have already purchased land for development without considering the need to mitigate their stormwater run-off. Because these changes are still occurring, the pool of developers who have overpaid for land on the expectation of these costs not being internalised should be relatively small.

Still, developers who have paid a price for land that does not reflect the cost of mitigating their stormwater impacts may have overpaid. At the margins, the policy will make some developments infeasible, especially in the current market of falling land values. This is no reason not to implement the policy; perpetuating the current state because some developers have overpaid or because of cyclical weakness in the housing market will only exacerbate the stormwater challenge. There will always be some developers who overpay for land and struggle to make the development commercially viable.

4.5.2 Under-development of sites

A final consideration is whether the policy is likely to lead to under-development of sites. For instance, if a site can accommodate four or more dwellings, but a resource is required for that scale of development but not for a three-dwelling development, will developers be incentivised to develop only three dwellings? This would obviously be a sub-optimal outcome that uses land inefficiently and contradicts the concept of more compact growth closer to jobs, alternative transport choices and other amenities.

Whether developers choose to under-use the land depends primarily on:

- the costs of the resource consent process (time and money via holding costs and fees) and the cost of the solution relative to costs for a solution for a development of three dwellings.
- the increased yield from the site that a development of four or more dwellings will generate relative to a three-dwelling development.

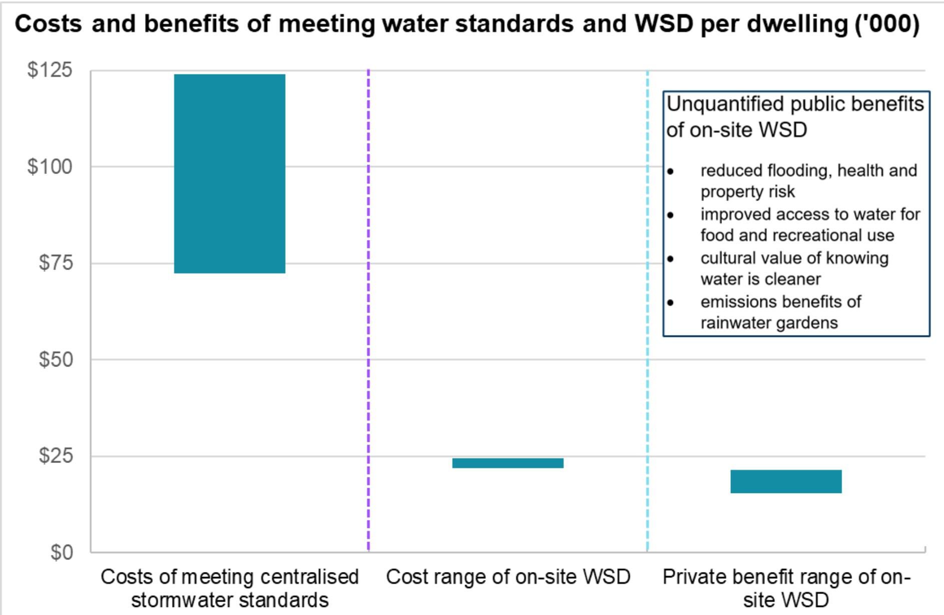
Based on the case study work dealt with below, it seems most likely that in most cases it will still make sense to develop the land as efficiently as possible (i.e. to maximum intensity). At the margins, some under-use of land may be incentivised, but this is likely to be a very small fraction of the total potential capacity of developable land.

5. Detailed economic assessment

This report has established that Wellington already faces significant stormwater challenges and costs. It has further set out the strategic economic case – that new development imposes external costs, that those costs should be internalised by development, and that internalising infrastructure costs pushes land values down, not house prices up. Attention now turns to a more detailed analysis of the costs and benefits of incorporating WSD, within the context of the significant stormwater quantity and quality challenge that Wellington faces. This detailed economic assessment can be summarised as follows:

- The city is expected to add 25,000 to 31,000 new dwellings over the next 30 years, placing further pressure on the quantity and quality of stormwater, according to Wellington's Spatial Plan.[9]
- Estimates are that to meet Council-provisioned three waters quality standards, the cost to development would be prohibitive, at between $72,000 and $124,000 ***per additional new dwelling*** added just for stormwater.[10]
- The proposed requirement in the Proposed district plan for hydraulic neutrality across all developments regardless of number of dwellings helps reduce the ***quantitative*** burden that would otherwise be imposed on the network. The requirement for WSD goes further, allowing for ***further management of quantities*** and also for ***improving the quality*** of stormwater flows through on-site management.
- Two costed case studies demonstrate a typical cost for WSD of between $21,800 and $24,400 per dwelling including additional resource consent-related costs. This figure is dramatically less than the cost per dwelling for new dwellings to meet the government-set three waters standards for stormwater.
- The ***private benefits*** of WSD are likely to be captured in the property price. Estimates suggest that WSD could raise property values by between $15,400 and $21,400 per dwelling.
- The ***public benefits*** of WSD beyond the development include reduced flooding, health and property risk; improved access to water for food and recreational use; the cultural value of knowing water is cleaner; and emissions benefits of rainwater gardens.
- The private and benefits of WSD and the prohibitive cost of upgrades that would otherwise be required to the stormwater network, present a compelling case for WSD.

Figure 3 Comparison of costs and benefits of options for managing stormwater quantity and quality



[9] Wellington City Council. (2021). *Our City Tomorrow: Spatial Plan for Wellington City.* Retrieved December 12, 2022, from citywide-estimated-growth-distribution-figures-september-2021.pdf (wellington.govt.nz)
[10] Wellington Water. (2020). *Addendum Report – Outer Suburbs: WCC Spatial Plan – Three Waters Assessment.* Retrieved December 12, 2022, from wellington-water-three-watera-assessment---addendum-report-(2020).pdf

5.1 Future growth

According to Statistics NZ, Wellington's population is expected to grow by 50,000 to 80,000 over the next 30 years, with 25,000 to 31,000 new dwellings to be added.[11]

Work by WCC, provided by email, suggests that more than 90% of all new dwellings added across the city over the next 30 years are likely to be in developments of four or more dwellings. This implies that, without mechanisms in place to manage the quantity and quality of water on-site, the challenge to the City would be substantial.

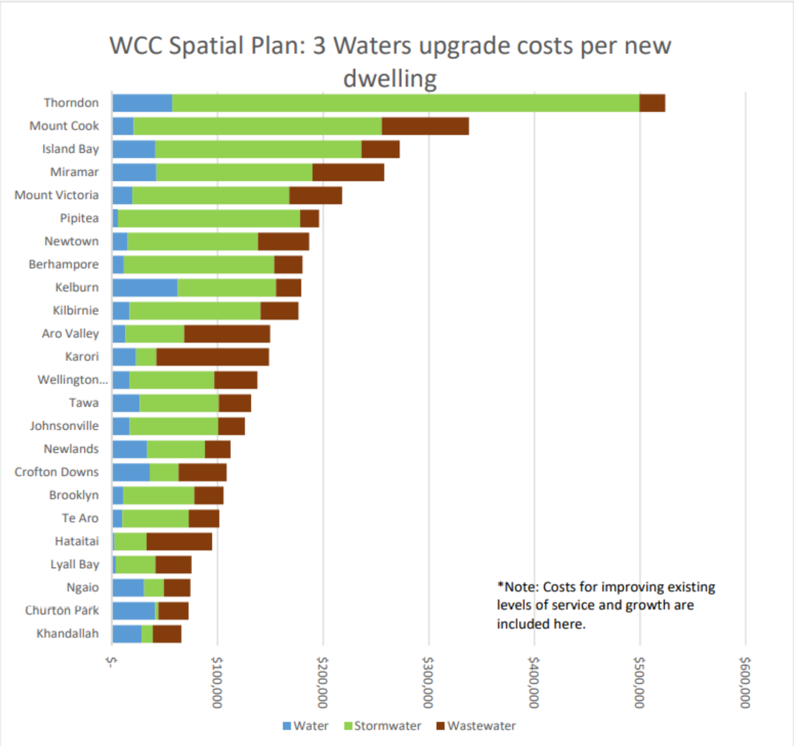
5.2 Impact of growth on water infrastructure

This growth will add considerable additional burden to the three waters network. In fact, work by Wellington Water based on anticipated growth shows that in some neighbourhoods, the cost to the stormwater network alone of the additional housing capacity will be more than $400,000 per dwelling unit if new growth is to comply with three waters standards.[12]

In total, using the midpoint of the investment estimates required across parts of the city yields an estimated investment in today's dollars of almost $4.0 billion is required to upgrade the three waters system alone.[9] Using the high end of the range, quite justifiable in today's environment of cost escalation, indicates a cost of $5.3 billion to upgrade the system to meet the demands of growth. In many cases, stormwater upgrades that would be required are a dominant share of total investment required. This range equates to between $2.2 and 3.1 billion just for stormwater services.

Dividing this cost by the total number of new dwellings estimated to be added over the next 30 years suggests an ***average cost per additional dwelling of between $72,000 and $124,000***. In the absence of alternative or on-site solutions, these costs would need to be covered by development contributions or a similar mechanism to ensure the upgrades occur.

Figure 4 Freshwater, wastewater and stormwater costs per additional unit[13]



[11] Wellington City Council. (2021). *Our City Tomorrow: Spatial Plan for Wellington City.* Retrieved December 12, 2022, from citywide-estimated-growth-distribution-figures-september-2021.pdf (wellington.govt.nz)
[12] Wellington Water. (2020). *Addendum Report – Outer Suburbs: WCC Spatial Plan – Three Waters Assessment.* Retrieved December 12, 2022, from wellington-water-three-watera-assessment---addendum-report-(2020).pdf
[13] Wellington City Council. (2021). *Our City Tomorrow: Spatial Plan for Wellington City.* Retrieved December 12, 2022, from citywide-estimated-growth-distribution-figures-september-2021.pdf (wellington.govt.nz)

Hydraulic neutrality will assist with limiting growth in demand on the network, but given the state of the network today, there is a strong argument for doing more to manage water than just hydraulic neutrality, which is what the proposed policy suggests. By understanding the cost to deliver growth and reach three waters compliant standards, the case for managing stormwater better on site becomes clearer, as set out below.

5.2.1 Current development contributions policy

WCC's most recent Development Contributions Policy includes a stormwater component of $165 per EHU (Equivalent Housing Units) added to the network.[14] This figure is a tiny fraction of the estimated $72,000 to $124,000 in stormwater costs per additional dwelling added to the city's housing stock.

The implication is that the current fee is immaterial to the discussion of the costs and benefits of requiring WSD and better stormwater management on site. A revised Development Contributions Policy would want to consider whether there was a case for charging any stormwater Development Contributions to sites maintaining hydraulic neutrality or including WSD. In this regard, the most useful comparison for this study is the cost to ensure an adequate centralised stormwater system across Wellington ($72,000 to $124,000 per additional dwelling on average) versus the likely cost of better on-site stormwater management, which is shown to be massively lower.

5.3 Costs per dwelling from adopting WSD

Two case studies were undertaken to provide a sense of scale for what implementing WSD could cost on a per-dwelling basis for a smaller (five townhouse) development and for a larger (20 apartment) development, including any additional resource consent-related costs.

5.3.1 WSD Case Study One

Case Study One is for the development of five townhouses on a site area assumed to be 800m2, subject to site coverage rules of 50% and requiring 30% permeable surfaces. For simplicity, the site is assumed to be 40m x 20m, with ground conditions conducive to infiltration such that no subsoil drainage would be required. Note that no design has been done to size any of the WSD proposed, as agreed at commencement of this work. Proposed management of stormwater on site would include:

- Roof runoff
  - Rainwater tanks for collection of rainwater from roofs of the townhouses.
  - Tank discharges slowly overtime to a swale running the length of the site to maintain storage capacity of rainwater tank for subsequent storms.
- Runoff from rest of site
  - Porous paving for car park associated with each property infiltrates directly to ground.
  - Runoff from roads and remaining site flows overland via a buffer strip of 0.5m to the swale.

Construction costs were gathered from two resources as no single source had prices for all WSD measures proposed:

- Melbourne - Water Sensitive Urban Design Life Cycle Costing Data (data was priced in AUD for 2013)
- Auckland Unitary Plan Stormwater Management Provisions: Cost and Benefit Assessment (NZD 2013).

All prices were adjusted to 2022 prices by calculating 3.5% annual compounding inflation as per CPI Reserve Bank of New Zealand guidance. Costs in Australian dollars were then converted to New Zealand dollars using the current exchange rate (19/1/23 AS$1 = NZ$1.08). Where multiple costs were provided (high, median and low) median costs were chosen for this case study.

[14] Wellington City Council. (2015-16). Development Contributions Policy. Retrieved December 15, 2022, from https://wellington.govt.nz/-/media/your-council/plans-policies-and-bylaws/plans-and-policies/a-to-z/devcontributions/files/2015-16/2015-16-development-contributions-policy.pdf?la=en&hash=8ABAA3FC0E521FB07F00188892FF513D0E79A061

Based on this assessment the following costs were calculated:

- Construction = $30,160 (approximately $6,030 per townhouse)
- Annual maintenance = $4,080 (or approximately $820 per townhouse per year based on Economics Work Package 11: SRL1: The Urban Intervention Options Work Brief, which undertook life cycle analysis over a 50-year life span for all WSD).

Calculating a net present value ***per dwelling*** (based on the assumption of five dwellings on this site and a 4% real discount rate) yields construction and maintenance cost of $23,500 over a 50-year life span.

5.3.2 WSD Case Study Two

Case Study Two is for an 800m^2 development of 20 apartments, with 10m setback from road, underground parking and 7m access to underground parking from the road. We assume, excluding the setback, that the site is 20m x 30m. Green walls or roof are not assumed to be proposed and no need for subsoil drainage is assumed. No design has been done to size any of the WSD proposed, as agreed at commencement of this work.

Proposed management of stormwater on site is as follows:

- Roof runoff
  - Rainwater tanks for collection of rainwater from building roof. Three x 10,000L tanks are proposed to manage both he first flush and larger storm events. Underground tanks would be emptied either by plumbing into building grey water system or by discharge into the city stormwater network.
- Rain gardens proposed within the setback from the road required.
  - Rain gardens sized to use available space after 2m used for pavement and 7m gap for access to underground parking. This leaves 97.5m2 for rain gardens (split into two separate rain gardens).

Construction costs were gathered from two resources as no single source had prices for all WSD measures proposed:

- Melbourne - Water Sensitive Urban Design Life Cycle Costing Data (data was priced in AUD for 2013)
- Auckland Unitary Plan Stormwater Management Provisions: Cost and Benefit Assessment (NZD 2013).

All prices were adjusted to 2022 prices by calculating 3.5% annual compounding inflation as per CPI Reserve Bank of New Zealand guidance. Costs in Australian dollars were then converted to New Zealand dollars using the current exchange rate (19/1/23 AS$1 = NZ$1.08). Where multiple costs were provided (high, median and low) high costs were chosen for this case study as it's assumed the high-density nature of the site will incur higher costs.

Based on this assessment the following costs were calculated:

- Construction = $189,270 (around $9,500 per apartment)
- Annual maintenance = $10,750 (or approximately $540 per apartment per year based on Economics Work Package 11: SRL1: The Urban Intervention Options Work Brief, which undertook life cycle analysis over a 50-year life span for all WSD).

Calculating a net present value ***per dwelling*** (based on the assumption of 20 dwellings on this site and a 4% real discount rate) yields construction and maintenance cost of $20,900 over a 50-year life span.

5.3.3 Resource consent fees and processing time

The new rules will in fact reduce the number of developments that require resource consents. This is because developments of three dwellings or fewer will no longer require resource consents. For developments of four dwellings or more, the requirement for a resource consent will continue, now with the added WSD component. Given that these developments need a resource consent anyway, it is unlikely that the WSD requirement will add considerable cost or time delays to the consent process.

WCC's policy at the moment is to send resource consent applications out to each appropriate team – transport, landscaping, Wellington Water and so on at the same time, and then to incorporate input from each of those teams as it is developed. The additional impact on processing times and the associated cost is likely to be small.

This work assumes that the additional evaluation requires up to four more hours of staff time at Wellington Water and WCC, both currently charged at $201.50 per hour. At a minimum number of dwellings per site of four, the ***maximum direct cost per dwelling is therefore $201.50***.

We further assume an extra five days of elapsed time (one working week) for the consent to be issued because of the need to review WSD although this is likely to occur concurrently with other elements. To err on the side of conservatism, we assume a Weighted Average Cost of Capital (WACC) of 12%. We assume the full cost of the land for a development and 10% of the budget for construction is spent prior to resource consent being received. This latter assumption is again quite conservative and will likely over-estimate the cost of the extra time needed to approve the WSD approach.

Recently listed property in Wellington City greater than 600 square metres in size and without a recently built dwelling was surveyed on trademe.co.nz. This provided a sample of likely candidates for development or redevelopment. We were able to estimate the likely number of new dwellings per site using sites that were for sale with resource consents for a certain number of dwellings to help calibrate our estimates. Twelve such properties had potential for approximately 115 new dwellings at an average asking price per potential dwelling of around $245,000 for the cost of the land. We therefore assume this full $***245,000 per dwelling has been spent on land*** before resource consent is granted.

WCC was able to further provide us with a list of building consents over the last six years to November 2022. We isolated developments of four or more dwellings and summed up the full costs of each building project where multi-stage consents were issued. We then filtered these results to eliminate ones with manifestly incorrect entries for the value of construction (those below $150,000 per dwelling for multi-unit developments, and those above $1.5 million per unit). We also only used properties that received building consents after January 2021 so that the price per dwelling was more up to date than using the six-year period. These assumptions yielded a list of 492 dwellings with an average consented value of $369,551. As mentioned above, we assumed that 10% of this cost is incurred before the resource consent is granted, for a ***previously incurred construction cost of $36,955***.

Summing the land cost per unit of $245,000 and the assumed pre-consent incurred construction cost of $36,955 and applying a WACC of 12% over five days of a 240-day working week yields a total cost of $705 per dwelling in additional holding costs due to a five-day delay in resource consenting.

Taken with the extra processing fees, the total additional ***cost per dwelling of the resource consent process for WSD is estimated at just over $900***.

5.4 Benefits

Benefits from WSD accrue both to the property owner within the development, and to other residents beyond the development. These can be grouped as private and public benefits respectively. The value of ***private benefits***, such as improved visual amenity, lower risk of properties in the development flooding and subsequent damage and health impacts, will tend to be captured in the sales price of the property. The value of ***public benefits***, such as reduced risk of flooding to properties outside the development, reduced contamination of water, or delayed costs for upgrading water infrastructure due to development, is not. These public benefits, because they do not accrue to the property where WSD is included, are not captured in the sale price of those properties.

5.4.1 Private benefit to property owners

This report has already demonstrated that when development is required to contribute the full cost of the infrastructure required for it not to impose on others, those costs tend to flow up to land values rather than down to house prices. Yet the literature demonstrates that adding features to a property that people value does increase the value of the property. These differentiated properties sell at a price premium because they offer an additional amenity that buyers value.

At the same time as developers will try to pass the cost of WSD requirements up the value chain, they will be producing a better-quality product for which they will likely be able to charge more. This is an important nuance in the earlier discussion on developers being price-takers. Even if they cannot pass the full cost up the chain (notwithstanding the empirical evidence provided earlier that suggests they can), they are likely to be able to recoup the costs of a better product through a better sales price.

A literature review undertaken by Greater Wellington Regional Council suggests that properties that incorporate WSD sell at a premium because owners see value in the water quality and green space that typically accompany this design approach.[15] The literature review indicates that the range of the premium for properties near green space in New Zealand ranges between 5% and 7%. It is hard to generalise from these results to a benefit for an individual, specific site in Wellington where WSD is incorporated, and where the scale of that WSD is not always the same. However, the estimate for green space provides a useful starting point for thinking about how much value on-site, natural ways of managing water quantity and quality (including through rain gardens) may add to a property. To err on the side of conservatism, we estimate the benefit to private properties at one-third of these percentages, or a 1.7% to 2.3% premium for properties with WSD.

The Wellington City median house price as of November 2022 was $920,000.[16] WSD is likely to be used on higher-density developments, where the typology is likely to be townhouses. This may lead some to the conclusion that the median price of these properties would be lower than the overall median. However, townhouse developments are most feasible where land values are high, so it is likely that new intensive development will occur on land that ensures the overall property value is at least the city-wide median value.

Based on the percentages assumed to be added to properties by WSD, we can estimate the value uplift of developments that include WSD at between $15,400 and $21,400 per dwelling based on this city wide median price assumption. The more intense the development typology, the more value the presence of green space on-site that also functions as WSD will have.

5.4.2 Public benefits

In addition to the private benefits, there are also a number of public benefits that result from the inclusion of WSD. Arguably, these are the main reasons to implement WSD, such that costs of development do not accrue to those beyond the development. However, they are also much harder to meaningfully express in dollar terms. Nevertheless, as already pointed out, these are genuine benefits of significant scale that should always be held in mind along with quantified benefits and costs.

Reduced flooding, health and property risk

With the adoption of WSD, the Wellington region is likely to experience reduced flooding in local areas compared to the counterfactual. By decreasing runoff that usually carries pollutants, WSD also improves water quality of stormwater and, therefore, streams and harbours. Streambanks are also at less risk of erosion, which protects fish and aquatic animals. Less pollution in stormwater means better health outcomes as people are less vulnerable to the effects of contaminated water. “By protecting the health and well-being of our freshwater we protect the health and well-being of our people and environments” (p.1).[17]

Natural hazards such as flooding cost New Zealanders millions of dollars a year.[18] For instance, the Wellington floods in July 2021 led to $18m in insurance claims according to the Insurance Council of New Zealand (ICNZ). The financial costs associated with flooding at a 1% AEP (Annual Exceedance Probability) were estimated at $87m in the Wellington CBD Stormwater Master Planning (2019)[19] document. This is a large sum and only reflects

[15] Koru Environmental Consultants Ltd. (2017). *Effects of water sensitive design solutions and green space on property values: A literature review.* Greater Wellington Regional Council, Te Awarua-o-Porirua Collaborative Modelling Project.
[16] Real Estate Institute of New Zealand. (2022). Monthly Property Report. Retrieved December 21, 2022, from https://static1.squarespace.com/static/5ce1fd700bf20400017d3a30/t/6396a642f0375c4b69a2570c/1670817558900/REINZ+Monthly+Property+Report+-+November.pdf
[17] Ministry for the Environment - Manatū Mō Te Taiao & Ministry for Primary Industries - Manatū Atu Matua. (2022). *Te Mana o te Wai Factsheet*. Retrieved December 23, 2022, from Essential Freshwater Te Mana o te Wai factsheet (environment.govt.nz)
[18] Insurance Council of New Zealand. (2021). Cost of natural disasters. Retrieved December 15, 2022, from https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters/#:~:text=New%20Zealand%20has%20experienced%20more%20than%20150%20severe,hazards%20cost%20New%20Zealanders%20millions%20of%20dollars.%20
[19] Stantec. (2019). Wellington CBD Stormwater Master Planning: Prepared for Wellington Water. Retrieved December 19, 2022, from Wellington City Council.

costs to the Wellington CBD area. WSD would help ensure properties and their contents would be more protected from flood damage, so fewer home repairs would be necessary, and insurance claims would be avoided.[20]

But these purely financial costs do not take into consideration the intangible social costs of flooding. The cost of flooding extends beyond insurance claims as it impacts livelihood due to disruption, serious injuries or fatalities. Reduced flooding minimises the risk of death and injury to human and animal life, environmental impacts, loss of cultural heritage, and emotional trauma that in extreme instances leads to family violence, alcohol misuse and crime.

Improved access to water – food and recreational use

It is important to maintain freshwater bodies as they provide access to water for drinking, cooking and sanitation purposes. Māori in particular value water for its *mauri* and for *mahinga kai*. Water security is crucial for achieving sustainable and comprehensive growth.[21]

WSD is likely to improve recreational value of rivers and lakes by acting as a filter for nutrients like nitrogen from fertilisers that are degrading of the water bodies.[15] Being able to use water recreationally supports a healthier lifestyle. Access to cleaner water for these purposes also has an ***option value***. This refers to the benefit conferred upon people by having the option to use clean water, even if they do not use it.[22]

Greater cultural value of knowing water is cleaner

Te Mana o te Wai is part of the National Policy Statement for Freshwater and describes the vital importance of water. Healthy waterways are important for cultural practices such as exercising *ahikaroa* and *kaitiakitanga*.[23]

Clean water is an integral part of life satisfaction and happiness as clean water plays an important role across many cultural traditions.[24] Māori consider water to be the source or foundation of all life. Knowing that water is clean provides people with a sense of safety in health and in water security, as well as confidence in leaders managing these water bodies.

In economic terms, there is a 'bequeath benefit' associated with clean water as this is likely to provide benefits for future generations. Bequeath value is the value that current generations place on improving, or at least maintaining, water quality for future generations. Implementing WSD provides value in the sense that it preserves water bodies for generations to come.

Emissions benefits of rainwater gardens

Rain gardens are constructed with shallow depressions in the ground and deep-rooted native and non-native adaptive plants and grasses. They collect rainwater that runs from rooftops or on lawns and soaks up some of the water acting as a filter for pollutants.[17]

This WSD technique adds to the carbon sequestration capacity of the property value as well, which is recognised as a key technique to remove carbon from the earth's atmosphere. Rain gardens have been proven to sequester up to 0.310kg of cardon dioxide per m^2 per year in southeast Australia,[25] 0.208kg per m^2 per year in New

[20] Science Direct. (2022). *Flood Damage.* Retrieved December 21, 2022, from https://www.sciencedirect.com/topics/engineering/flood-damage#:~:text=2.5%20Flood%20Damage-,Flood%20damage%20is%20defined%20as%20all%20the%20varieties%20of%20harm,Messner%20%26%20Meyer%2C%202006**)**

[21] Mishra, B. K., Kumar, P., Saraswat, C., Chakraborty, S., & Gautam, A. (2021). Water security in a changing environment: Concept, challenges and solutions. Water, 13(4), 490.

[22] Science Direct. (1999-2021). Option Value. Retrieved January 12, 2022, from https://www.sciencedirect.com/topics/social-sciences/option-value

[23] Ministry for the Environment — Manatū Mō Te Taiao. (2021). Sources and impacts of freshwater pollution. Retrieved December 21, 2022, from https://environment.govt.nz/facts-and-science/freshwater/sources-and-impacts-of-pollution-of-freshwater/

[24] United Nations Educational, Scientific and Cultural Organisation. (2022). *UN World Water Development Report 2021: Cultural values of water*. Retrieved December 21, 2022, from https://www.unesco.org/reports/wwdr/2021/en/cultural-values-water

[25] Kavehei, E., Jenkins, G. A., Lemckert, C., & Adame, M. F. (2019). Carbon stocks and sequestration of stormwater bioretention/biofiltration basins. Ecological Engineering,138, 227 – 236.

Hampshire and 0.356kg per m^2 in Pennsylvania,[26] and produce 30-90% fewer emissions than standard stormwater management alternatives.[27]

5.5 Conclusion on costs and benefits of WSD

Adopting a centralised approach to managing stormwater quality and quantity would prove prohibitively expensive. An alternative must be sought. Case studies, quantification of potential private benefits, and proxying and describing potential public benefits, demonstrate that WSD offers the opportunity to achieve these outcomes without massive increases in development contributions for stormwater that would otherwise be required.

[26] Sawosik, B. (2022). Blue carbon characteristics in stormwater bioretention systems [Master's Thesis, University of New Hampshire]. University of New Hampshire Scholar's Repository. Retrieved from https://scholars.unh.edu/thesis/1573
[27] Simon Fraser University – ACT (Adaptation to Climate Change Team). (n.d.). Low carbon resilience case study: city of North Vancouver rain gardens. Retrieved December 23, 2022, from https://act-adapt.org/wp-content/uploads/2018/12/2.5.1._lcr_best_practices_web-1.pdf

6. Limitations

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Accessibility of documents

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

6.1 Assumptions

This report has relied on source documents from Wellington City Council and the rigour of these reports has not been separately reviewed. The data used for the calculations throughout this document has not been reinterrogated.

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