BEFORE THE INDEPENDENT HEARINGS PANELS APPOINTED TO HEAR AND MAKE RECOMMENDATIONS ON SUBMISSIONS AND FURTHER SUBMISSIONS ON PROPOSED PLAN CHANGE 1 TO THE NATURAL RESOURCES PLAN FOR THE WELLINGTON REGION

UNDER	the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	of Hearing of Submissions and Further Submissions on Proposed Plan Change 1 to the Natural Resources Plan for the Wellington Region under Schedule 1 of the Act

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STATEMENT OF EVIDENCE OF SUSAN JEAN TYSON IRA

ON BEHALF OF GREATER WELLINGTON REGIONAL COUNCIL

WATER QUALITY AND WATER SENSITIVE DESIGN EVIDENCE

HEARING STREAM 2 – STORMWATER

28 MARCH 2025

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INTRODUCTION

1 My full name is Susan Jean Tyson Ira. I am the Founding Director of Koru Environmental Consultants Ltd.

2 I have read the evidence and statements provided by submitters relevant to the Section 42A report on stormwater and the legal submissions relevant to this Section 42A report.

3 I have prepared this statement of evidence on behalf of Greater Wellington Regional Council (**the Council**) in respect of retrofitting of stormwater treatment into existing urban areas, a matter raised by Mr Liam Foster on behalf of Wellington Water Limited (**WWL**).

QUALIFICATIONS AND EXPERIENCE

4 I hold a Master of Science in Environmental and Geographical Science from the University of Cape Town in South Africa.

5 I have over 20 years' experience working in urban stormwater management, stormwater treatment, catchment management, water quality policy development, water quality consent review, life cycle costing of stormwater management, water sensitive urban design and green infrastructure.

6 I have specialist expertise in water quality treatment approaches, catchment management planning, water sensitive design, and green infrastructure. I came to New Zealand in 2003 and worked as a stormwater consent processing officer for the former Auckland Regional Council before becoming the manager of their stormwater consents and compliance team. In 2007 I founded Koru Environmental Consultants Ltd. During this time, I have undertaken numerous stormwater and water quality technical consent and plan change reviews for Auckland Council, Bay of Plenty Regional Council, Greater Wellington Regional Council and Environment Canterbury. I have provided training on Auckland Council and Waka Kotahi's stormwater management guidelines nationally, and have also developed and provided national training for Water New Zealand on advanced stormwater management and water sensitive design. I am one of three New Zealand based trainers to have provided training to the stormwater community for the International Certification Programme for Green Infrastructure. Other recent projects I have been involved in include:

6.1 Technical Science Lead for water quality planning for the Lake Waikare and Whangamarino Wetland on behalf of Waikato Regional Council.

6.2 One of four lead researchers on "Activating Water Sensitive Urban Design" in New Zealand jointly with NIWA, Manaaki Whenua Landcare Research and Batstone Associates for the National Science Challenge for Building Better Homes Towns and Cities.

6.3 Development of a life cycle cost model for urban stormwater quality mitigation interventions for Auckland Council's Freshwater Management Tool and providing ongoing expert advice on scenario modelling, optimisation and implementation.

6.4 Undertaking an independent review of rain garden implementation across the Auckland region on behalf of Auckland Council.

6.5 Development of life cycle cost models for the Greater Wellington Regional Council Whaitua process.

6.6 Providing water quality advice, technical consent application and compliance reviews to Greater Wellington Regional Council on the stormwater management approach and stream diversions for Transmission Gully since 2014.

CODE OF CONDUCT

7 I have read the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note 2023 (Part 9). I have complied with the Code of Conduct in preparing this evidence. My experience and qualifications are set out above. Except where I state I rely on the evidence of another person, I confirm that the issues addressed in this evidence are within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

SCOPE OF EVIDENCE

8 My evidence addresses the complexities and treatment capacities of green infrastructure when they are retrofitted into existing urban areas in response to the evidence of Mr Liam Foster on behalf of WWL.

9 My evidence should be considered together with the technical evidence of Dr Michael Greer and Mr David Walker.

RETROFITTING STORMWATER TREATMENT INTO EXISTING URBAN AREAS

10 I generally agree with Mr Foster's statement in paragraph 8.29 of his evidence which states: "*Retrofitting stormwater infrastructure into existing urban infrastructure, results in a series of compromises around the size, design and cost tend to mean that 100% performance is often not achieved*.". However, this does not mean retrofitting is not an appropriate option for stormwater treatment.

11 In many instances (but not always) the full water quality volume cannot be captured in existing urban areas because of either a lack of space or because of clashes with existing above or below ground services, meaning that a particular device ends up either being too expensive or there is simply not enough space for it.

12 To explain this further, and as taken from a report I wrote in 2022 for Tauranga City Council (Ira and Roa, 2023):

13 *"In many instances, underground utilities are provided as the main reason for not being able to retrofit stormwater treatment on existing roads. However, their presence merely presents a challenge and need not prevent stormwater treatment. The USEPA green streets design manual (2021) provides guidance to designers on overcoming obstacles relating to existing services. The manual states that, depending on the site, designers have the ability to avoid, coexist with, modify or replace utilities during the design process."* (Figure 1).

14 *"The USEPA (2021) advise that, whilst in some cases and depending on the site, the obstacles may be too difficult or costly to overcome and there may be the need to replace utilities. This is not an ideal solution and should be considered a last resort. In other cases, workarounds are possible and key steps to eliminate problems include (p4-5 USEPA, 2021):*

- *Placing all utility vaults outside the 'wet' zone of the stormwater feature where possible;*
- *Lining the practice along curbs or next to utility trenches with a thin, impermeable geotextile or liner to prevent migration of infiltrated stormwater;*
- *Constructing a deeper than conventional curb profile to physically separate roadbed subgrade or utility lines from the stormwater feature;*

- *Installing a clay or other impermeable plug within the utility treat to inhibit movement of stormwater within the trench line."*

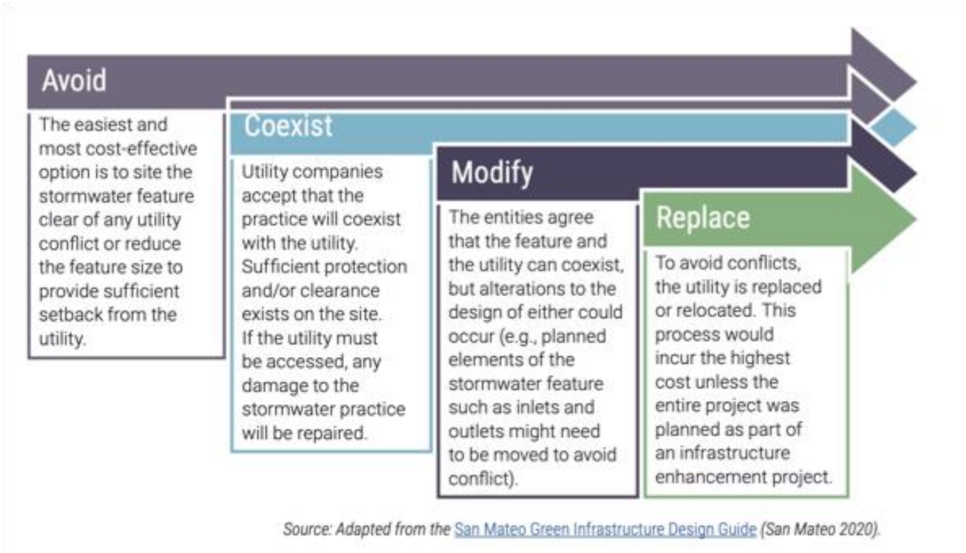

Figure 1: Options for accommodating utilities during a green infrastructure retrofit project (US EPA, 2021)

15 *"Ideally, the aim of retrofitting stormwater treatment onto existing roads should be to avoid or coexist with existing services. In reality, this is often not possible and more than likely the design of the stormwater treatment practice may need to be modified so that it can coexist with existing services. Designers therefore need to find innovative ways to facilitate these retrofits. With respect to rain gardens, for example:*

- *the depth of filter media could be reduced: this might mean that the media layer is thinner leading to reduced stormwater treatment as the "best practicable option";*
- *the area of the rain garden could be increased to make up for a thinner media layer;*
- *the construction depth could be increased locally to account for existing services;*
- *not include a concrete base on the rain garden to allow for access to infrastructure that is beneath the rain garden;*
- *allow pipelines to pass through the rain garden by altering the end wall design."* (Figure 2)

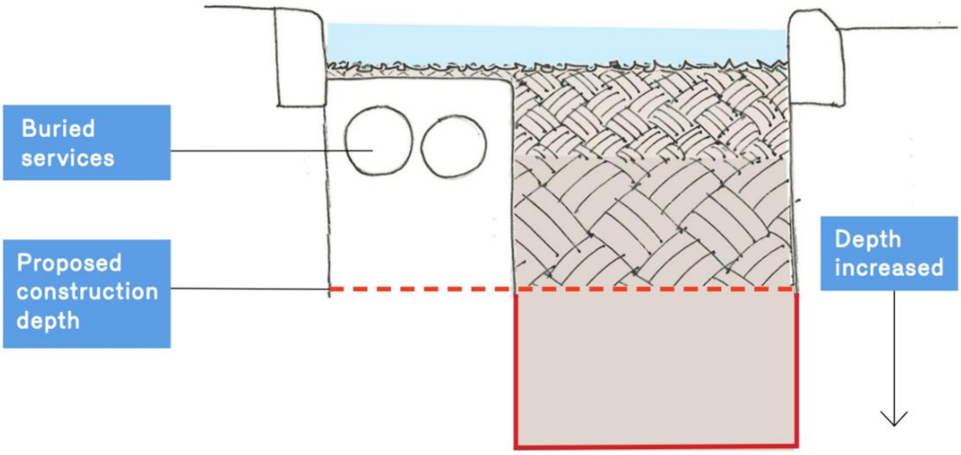

Figure 2: Cross section illustrating how the construction depth of a rain garden can be increased locally to account for existing services (Urban Design London, undated)

16 *In areas where space is constrained, tree pits could be used instead of rain gardens, as has been successfully implemented in Stockholme (Alvem and Embrén, 2014).*

17 *For either tree pits or rain gardens, 'bulb-outs' can also be created where the tree pit or rain garden is used as a traffic calming device within the carriageway."* (Figure 3)

Figure 3: A tree pit as a 'bulb-out' within the road carriageway (Embrén et al., 2009)

18 Based on this research, and my expert opinion, I agree that retrofitting stormwater devices into existing urban areas often leads to compromises in the level of water quality treatment.

19 The challenge for this planning process is being able to estimate or calculate what the likely reduction in performance would be, as the constraints will be very site specific and are often only identified at a detailed design stage.

20 In existing urban areas where space is limited and/or constraints are present, undersized rain gardens, swales or wetlands could be considered as they will still offer stormwater treatment benefits.

21 With respect to retrofitting rain gardens, Luell, et al. (2011) evaluated the ability of an undersized bioretention (rain garden) device to provide treatment for highway runoff and found that outflow contaminant loads from a large and small bioretention cell were not significantly different from one another for any of the examined pollutants (TSS, TP and TN). They concluded that the small bioretention devices' relative performance provides support for retrofitting undersized systems in urbanized areas where there is insufficient space available for conventional full-sized stormwater treatment systems. Whilst long-term performance of the bioretention devices was not examined as part of this study, the authors of this study infer that smaller cells will likely have a shorter functional life (which may therefore result in increased maintenance frequencies) due to limited media for the removal of certain pollutants. Based on my life cycle costing work which I have undertaken nationally in New Zealand, I would agree with this assessment (Ira and Simcock, 2019).

22 Houle et al. (2017) found similar results when they monitored 2 undersized bioretention systems in New Hampshire, USA from 2013 – 2015. Despite being undersized, the authors found that sediment and metal removals for both systems were high, with a median removal efficiency 86% for both total suspended solids (**TSS**) and total zinc (**TZn**).

23 A New Zealand example of performance for undersized stormwater treatment devices is presented in Figure 4 below, which provides an indication of treatment efficiency, expressed as a percentage of total suspended solids removal, where 75% (corresponding to 100% of water quality volume) is the target removal for a compliant device (source: ARC TP10 2003, Table 3.1).

Table 3-1 Relative levels of removal efficiency	
Practice Volume	Efficiency
150% of WQV	82%
100% of WQV	75%
75% of WQV	70%
50% of WQV	60%
25% of WQV	50%
10% of WQV	40%
5% of WQV	30%

Figure 4: Example of treatment efficiency for a range of device sizes (Source: ARC TP10 2003)

24 The key outcome of these studies is that smaller rain gardens, which may be the result of an adaptive design situation where rain garden size or depth has to be reduced due to local site constraints, can still provide a high level of stormwater treatment and important stormwater function. This outcome applies to other types of green infrastructure, such as swales and wetlands.

25 Additionally, even if the water quality treatment functions of undersized rain gardens are reduced, the additional benefits that they provide (such as carbon sequestration, linking green corridors, reducing the urban heat island effect, increasing biodiversity) means that they are likely to achieve greater value and more benefits across a range of council and network operator outcomes than grey treatment infrastructure.

CONCLUSIONS

26 As in any retrofit situation, the implementation of green infrastructure stormwater practices, such as rain gardens, swales or wetlands, in established urban areas can be disruptive and technically challenging. Additionally, some of their treatment function may be compromised by lack of space and clashes with existing services. However, with innovative design, these devices can come close to meeting the environmental objectives and targets in PC1 in relation to the reduction of contaminants in stormwater. Furthermore they can offer advantages and opportunities that go beyond the stormwater function, and which, in my opinion, outweigh the constraints and challenges.

DATE: 28 MARCH 2025

SUSAN JEAN TYSON IRA

DIRECTOR, KORU ENVIRONMENTAL

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