BEFORE THE INDEPENDENT HEARINGS PANELS APPOINTED TO HEAR AND MAKE RECOMMENDATIONS ON SUBMISSIONS AND FURTHER SUBMISSIONS ON PROPOSED CHANGE 1 TO THE REGIONAL POLICY STATEMENT FOR THE WELLINGTON REGION

IN THE MATTER	of the Resource Management Act 1991 (the Act)
	AND
IN THE MATTER	of Hearing of Submissions and Further Submissions on Proposed Change 1 to the Regional Policy Statement for the Wellington Region under Schedule 1 of the Act

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STATEMENT OF EVIDENCE OF STUART FARRANT

ON BEHALF OF WELLINGTON REGIONAL COUNCIL

TECHNICAL EVIDENCE -

[CLIMATE-RESILIENCE AND NATURE-BASED SOLUTIONS]

7 August 2023

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INTRODUCTION

1 My full name is Stuart James Edgar Farrant. I am a Principal Ecological Engineer and Water Sensitive Design practice lead at Morphum Environmental Ltd.

2 I have read the evidence and statements provided by submitters relevant to the Section 42A report on Climate Change: Climate-Resilience and Nature-Based Solutions.

3 I have prepared this statement of evidence on behalf of Wellington Regional Council (**the Council**) in respect of technical related matters arising from the submissions and further submissions on Proposed Change 1 to the Regional Policy Statement for the Wellington Region (**Change 1**).

4 Specifically, this statement of evidence relates to the matters in the Section 42A Report – Climate-Resilience and Nature-Based Solutions.

5 I am authorised to provide this evidence on behalf of the Council.

QUALIFICATIONS AND EXPERIENCE

6 My full name is Stuart James Edgar Farrant. I am a Principal Ecological Engineer and Water Sensitive Design practice lead at Morphum Environmental Ltd; and hold a Bachelor of Engineering (Natural Resources) from University of Canterbury

7 I have over 16 years' experience working in multiple aspects of freshwater management and ecological engineering. I have worked for Morphum Environmental for 9 years establishing the southern sector office (Wellington) in 2014. Prior to that, I worked for 5 years as an Ecological Engineer in Melbourne, Australia.

8 I have experience working in a range of aspects relating to three waters management, including design, technical review and auditing of constructed wetlands, vegetated stormwater treatment/conveyance systems, stream restoration and catchment planning. Specifically, I have extensive experience with the design and delivery of integrated stormwater management devices to mitigate adverse water quality effects from urban development at a range of scales.

9 I have contributed to and authored technical design guidelines for Councils/Utilities in New Zealand and Australia (including the Wellington Water 'Water Sensitive Design technical guidelines').

10 I was awarded a 2018 Winston Churchill Fellowship to travel internationally for the purposes of researching leading practice with urban water management in Europe, Scandinavia, and USA.

11 I was appointed co-chair of the Te Awarua o Porirua Whaitua committee and the Te Whanganui a Tara Whaitua technical expert group and am familiar with the local context in terms of development typologies, biophysical conditions, and ongoing national policy directions.

12 In 2020 I was appointed to the Wellington City Council Mayoral taskforce charged with investigating the current state of play with the provision of three waters services across the city and informing recommendations for changes to improve long term outcomes for the community and environment.

13 I am a member of Engineering New Zealand and Co-Chair of The Sustainability Society which is a technical interest group of Engineering New Zealand.

CODE OF CONDUCT

14 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

15 The purpose of my evidence is to provide context and background to explain the drivers for, and importance of, taking action to ensure that our natural and physical resources, including people and communities, are well placed to withstand the impacts and recover from the predicted effects of climate change. My evidence highlights the value of nature-based solutions to climate change, recognising their ability to increase resilience and/or mitigate greenhouse gas emissions, while also delivering a wide range of environmental, social, cultural, and economic co-benefits.

16 My evidence:

1. Outlines the climate change stresses/impacts that need to be anticipated and addressed when planning and constructing new development in the Wellington Region.

2. Discusses the risks for people and the environment if "Business as Usual" development continues.

3. Explains the concepts of climate-resilience and nature-based solutions and how these translate into practical measures that should be incorporated into development planning to provide for a climate-resilient future.

4. Includes examples of climate-resilience features and nature-based solutions as sought by Change 1.

BACKGROUND – CHANGE 1 PROVISIONS SEEKING CLIMATE-RESILIENCE AND NATURE-BASED SOLUTIONS

17 Change 1 includes a new Climate Change Chapter (Chapter 3.1A) that sets out the regionally significant issues and actions required to respond to climate change in the Wellington Region. The following notified Change 1 text and provisions are of particular relevance to my evidence:

The key areas of action required to address climate change are to[1]: …

3. Take adaptation action to increase the resilience of our communities, the natural and built environment to prepare for the changes that are already occurring and those that are coming down the line. Critical to this is the need to protect and restore natural ecosystems so they can continue to provide the important services that ensure clean water and air, support indigenous biodiversity and ultimately, people.

Climate Change Issue 2.

2. Climate change and the decline of ecosystem health and biodiversity are inseparably intertwined[2].

Climate change is placing significant additional pressure on species, habitats, ecosystems, and ecosystem processes, especially those that are already threatened or degraded, further reducing their resilience, and threatening their ability to persist. This, in turn, reduces the health of natural ecosystems, affecting their ability to deliver the range of ecosystem services, such as carbon sequestration, natural hazard mitigation, erosion prevention, and the provision of food and amenity, that support

[1] Change 1, page 9
[2] Change 1, page 10

our lives and livelihoods and enable mana whenua to exercise their way of being in the Te Ao Tūroa, the natural world.

18 Change 1 includes a suite of new objectives, policies, and methods to provide for climate-resilience and nature-based solutions. These include objectives to achieve a low-emission and climate-resilient region (Objective CC.1) and for nature-based solutions to be an integral part of climate change mitigation and climate change adaptation (Objective CC.4). Policies CC.4 and CC.14 and Policies CC4A and CC.14A (as recommended in the Section 42A report "Climate-Resilience and Nature-Based Solutions" for Hearing Stream 3) set out the different attributes of climate-resilience that are important to address the predicted impacts of climate change in the Wellington Region. The relevant policies and methods are included in Appendix 1.

19 I have reviewed the original notified provisions, the analysis and response from the Council with respect to submissions received on this topic, and the recommended amended provisions (Appendix 1 sets out the relevant provisions as recommended to be amended in the Section 42A report: "Climate-Resilience and Nature-Based Solutions"). I support the amendments proposed and the improved clarity they provide around the complex matters related to climate-resilience and nature-based solutions.

CONTEXT AND DRIVERS FOR CLIMATE-RESILIENCE AND NATURE-BASED SOLUTIONS

20 Climate projections for future climate across the Wellington Region include increased frequency and intensity of large rainfall events interspersed with prolonged dry periods. Temperatures are projected to increase across the Wellington Region (particularly in summer/autumn) with increased maximum temperatures and increased "Hot" days (Tmax >25). Rising sea levels will affect the coastline and the ability of freshwater (natural streams and stormwater networks) to 'drain' to the sea during peak rainfall and increasing the risk of coastal erosion during storm events.

21 These climate drivers will result in increased ambient temperatures which will be exacerbated in urban areas where paved surfaces will result in the phenomena of 'urban heat islands' where the thermal mass of building material results in hotter temperatures in urban areas which are sustained for a longer period. The increased temperature of urban paved surfaces will also increase the temperature of stormwater runoff and cause fluctuations in the temperature of discharges to waterways during summer rainfall. Changes in rainfall patterns (seasonally and across years) will result in increasing frequency

and severity of droughts (and water stress), flooding and wild fires. Increased intensity of storms will bring extreme winds and storm surges which will be amplified by saturated soils and rising sea levels.

22 These climatic conditions will be experienced in a range of ways across the Region, with the form and spatial layout of urban development having a significant influence on outcomes. Flooding will increasingly threaten property and lives across the region and disrupt traffic movements with increasing frequency. It is important to recognise that potential flooding will be from both large riverine catchments during heavy, prolonged rainfall, as well as smaller localised urban catchments from short duration high intensity rainfall. More frequent heavy downpours (which do not cause flooding) will discharge contaminants to stormwater networks and receiving waterbodies and cause fluctuating flows in streams which will increase instability and scour/erosion in natural and modified streams. Periods of drought and extended wet phases will both destabilise cut and natural slopes across the region resulting in increased landslides which will damage properties, damage horizontal infrastructure and disrupt traffic. Intense wind will increase vulnerability to power network and threaten existing mature trees in proximity to buildings.

23 Unless managed appropriately, environmental modification for urban development (housing and commercial) and infrastructure causes an increased discharge of contaminants (in particular heavy metals, hydrocarbons, sediments and nutrients), increased runoff **volumes** during frequent small and moderate rainfall, increased runoff **flowrates** during less frequent large rainfall, increased air temperatures (urban heat island), increased water temperatures discharging to waterways, reduced indigenous biodiversity and a disconnect with historical ecosystems. These combined impacts will reduce the mauri of natural and modified waterways and not give effect to Te Mana o te Wai.

24 These predicted changes will impact on natural systems and urban areas where the form of development can amplify impacts. Poorly planned and designed urban development will result in outcomes which impact on human health, mana whenua values, resilience of infrastructure and ecological health. Recent events across New Zealand have clearly highlighted many of the risks that urban and rural areas face with regards to extreme rainfall events and the impact on human health, economy, and the environment.

25 Changes in already modified land, such as conversion of rural land to urban (greenfield development) and intensification of existing urban areas (brownfield development or infill), cause a change, and generally a worsening, of existing impacts through increased

impervious surfaces, further reduction in vegetation cover/biodiversity, increased vehicle usage and modification to waterways, including piping, bank lining and installation of outfall structures.

26 The use of nature-based solutions and the principles of water sensitive design provide well researched means of mitigating the potential impacts of future climate change in urban areas and can respond to a range of, often overlapping, drivers and stressors.

27 Any continuation of existing development practices, whereby development yields are maximised through widespread landform modification, combined with high intensity development, without requiring appropriate mitigation measures that address these future climate related impacts, will worsen current ecological, human health and cultural outcomes and result in considerable direct and indirect costs to rectify and or remedy in the future.

RISKS OF CONTINUING BUSINESS AS USUAL

Stormwater drivers

28 Current development practices are typically driven by a desire to optimise development yields within a given footprint. Housing typologies have in recent years evolved from being comprised almost entirely of free-standing dwellings to increasing multi-unit developments to increase yield further. Commercial development increasingly results in larger span roof areas and large areas of carparking/hardstand with a desire to optimise the 'useable' proportion of any given lot.

29 Due to the variable topography of the Wellington Region and desire to provide drive-on level access and slab on grade (a structural engineering practice using a concrete slab to provide the building foundation), residential and commercial developments often involve extensive earthworks to modify and retain land. Current development practice therefore results in extensive areas of impervious landcover (roofs, roads and hardstand), highly compacted and modified soils, minimal vegetation and disconnect from historical or remaining watercourses.

30 Discharge of urban stormwater (regardless of whether hydraulic neutrality is achieved), without appropriate management of contaminants, will contribute to reduced water quality. Contaminants (including heavy metals, sediments, nutrients, hydrocarbons and temperature) are generated by all impermeable surfaces and vary between and during rainfall events, depending on duration of dry periods between rainfall, intensity of rainfall

and landuse within catchment. Urban contaminants are both in dissolved and particulate form and are therefore readily transported to surface and ground water resources.

31 Hydrological controls are measures which aim to match the predevelopment flowrates across the full spectrum of rainfall events. This requires measures to match the pre-development amount or volume of runoff from a site which represents the natural 'loss' of water from evaporation and transpiration. This is typically termed **retention** and is increasingly required for new developments by councils across Aotearoa. Discharge of urban stormwater without hydrological controls results in stormwater discharge in rainfall events which would otherwise be intercepted by vegetation and soils and results in highly fluctuating flowrates to waterways which results in instability, scour and loss of ecosystem function and indigenous biodiversity.

32 Ongoing adverse impacts on waterways due to an absence of appropriate hydrological controls (volume reduction) or water quality management results in substantial ongoing financial costs for design, consenting and construction of instream retaining structures to protect assets such as roading, utilities and private/public property. These costs are borne by councils without any ability to seek redress from private developers who have directly contributed to the downstream impacts through uncontrolled stormwater discharges. Costs of lost indigenous and taonga species and degradation of the mauri of waterways is not able to be monetised.

33 Urban development without the protection or inclusion of canopy trees and planted vegetation results in reduced indigenous biodiversity and increased ambient temperatures where paved surfaces remain unshaded. Increasing research and anecdotal evidence form recent heat waves across Europe and USA have confirmed the significance of these temperature increases, including the tendencies for urbanised areas without significant tree cover to experience significantly increased temperatures when compared to nearby green spaces and these temperatures being maintained overnight. Increasing heat waves and ambient temperatures are increasingly being directly linked to adverse human health impacts, including mortality for vulnerable populations (in particular elderly, young children and people with co-morbidities) and increased pressure on the health system. Additionally, increased surface temperatures result in elevated water temperature in stormwater runoff which impacts on indigenous fish and invertebrates which are unable to withstand rapid fluctuations. Further, increased surface temperatures results in increased generation of

contaminants from tyre wear, road wear and other sources which are mobilised in rainfall and high wind events.

34 Urban trees and vegetation are also known to intercept airbourne pollution which otherwise has potential to impact human health (through inhalation) and ecosystem health (through deposition on surfaces such as roofs which connect to waterways).

35 Urban development is often based on available 'developable' land, which considers factors such as topography, land values and location. Flood modelling has traditionally been relied on with regulated requirements to ensure habitable floor levels are protected from expected peak flood events (typically 1% Annual Exceedance Probability). Overland flow paths (often associated with infilling of the headwaters of minor tributaries) are often overlooked with potential to cause harm to property and communities in more frequent but high intensity rainfall. The development of land which optimises yield in locations where overland flows or flooding can occur remains an ongoing risk as we gain an understanding of the increasing scale of potential rainfall events which exceed the previously understood flood extents. When considered alongside the increasing incidence of coastal storm surges and rising sea levels, the existing approach to landuse planning and development in vulnerable locations reduces resilience of communities to future climate change.

36 A continuation of existing development practice will accelerate the decline in environmental and social outcomes across the Wellington Region. In particular, a continuation of "Business as Usual" will result in the following:

36.1 Ongoing loss of indigenous biodiversity in aquatic systems

36.2 Reduced quality of water in waterways, adversely impacting on recreation and mahinga kai values

36.3 Ongoing loss of terrestrial biodiversity through reducing habitat and fragmented connections or ecological corridors

36.4 Reduced resilience to future climate change, including both large shocks (floods/droughts) and changing seasonal patterns

36.5 Reduced resilience to natural disasters, such as earthquakes and landslips, which will impact water supply and drainage

36.6 Increasing urban temperatures with increased adverse health impacts

36.7 Continuing disconnect between communities and the natural environment.

Terrestrial Drivers

37 Urban development often results in the clearance of indigenous vegetation (including regenerating scrub) and continued loss of urban vegetation through intensification. This results in large areas of urban development with low vegetation coverage and high proportions of impervious cover (roads, roofs and hardstand) and highly modified ground (such as grassed lawns and heavily compacted engineered fill). These impacts are worsened on sloping sites where the prevalence of 'slab on grade' building results in extensive earthworks (cut and fill) and limited protection for existing vegetation or provision of planted trees. Lack of greenspace and mature vegetation in urban areas results in:

37.1 Increased ambient temperatures through urban heat island effects whereby unshaded surfaces heat up and contribute to an increased air temperature in urban areas as compared to undeveloped areas. Heat stress on humans (particularly the elderly and young) is increasingly recognised as a contributing factor in poor health and fatalities.

37.2 Loss of biodiversity, and in particular urban ecology, which would otherwise connect communities with the natural environment and support indigenous species to move across and through urban areas to connect remnant areas of reserve land.

37.3 Loss of shading resulting in increased energy demands to cool buildings (commercial and residential) and vehicles.

37.4 Reduction in interception of rainfall during small rain events resulting in increased stormwater volumes and flowrates.

37.5 Loss of amenity and urban greenery contributing to decline in human mental health.

NATURE-BASED SOLUTIONS

38 Nature-Based Solutions is an umbrella term that refers to the intentional use of natural ecological systems, or engineered systems that mimic natural processes, to support changes in landuse whilst ensuring the resilience of ecosystems, communities and cultural values. Nature-based solutions are defined by the ability to respond to more than one driver in a human influenced landscape and use natural systems in a manner which

provides resilience across a range of spatial and temporal scales for both chronic and acute stressors.

39 Examples of nature-based Solutions include:

39.1 Retreat and/or restricted development on floodplains and wetlands with restoration/reinstatement of riverine ecosystems and riparian landscapes to buffer storms, accommodate lowland flooding, reduce risk to infrastructure, sequester carbon and support indigenous biodiversity.

39.2 Integration of water sensitive design elements including raingardens, green roofs, tree pits and vegetated swales with urban development to treat stormwater, retain initial rainfall depths, connect communities with nature, increase urban ecology and provide passive cooling/insulation.

39.3 Construction of urban wetlands to treat stormwater, provide flood detention, connect communities with nature and increase urban ecology.

39.4 Increased planting of urban trees (in particular, indigenous street trees) to mitigate urban heat impacts, reduce runoff in small rainfall events, support urban ecology and improve urban amenity/greening.

39.5 Capture of rainwater (at lot or community scale) for non-potable uses to retain small rainfall depths (replicate natural flow patterns), avoid contaminant discharge, reduce demand on mains supply, connect communities with water and provide resilience to shock events (such as earthquakes).

39.6 Protection and/or reinstatement of natural urban stream channels to safely pass extreme flood flows whilst supporting urban ecology and biodiversity.

39.7 Protection of shallow aquifers and groundwater through managing the volumes to match natural groundwater recharge rates and ensuring all infiltrated water is appropriately treated.

39.8 Identifying and protecting modified overland flows paths to replicate natural ephemeral hydrology and pass peak flows with managed risk to life and property.

39.9 Management of earthworks volumes and extent through developing with the landform and utilising building typologies which are better suited to the terrain such as timber piles as opposed to slab on grade.

39.10 Municipal collection and composting of organic and biodegradable waste to enable land application to retain organic nutrients, reduce greenhouse gas emissions and improve local soils.

40 Alternatives to nature-based solutions can, in some instances, provide a similar level of service for some of the drivers but will not typically provide co-benefits and, in many instances, can result in related negative outcomes such as:

40.1 High embodied carbon in heavily engineered concrete structures

40.2 Increased lifecycle costs from mechanised or bespoke water treatment systems

40.3 Financial impacts on private/public land through engineered solutions causing worsening of conditions such as erosion on adjacent land

40.4 Financial and social impacts from large climatic events such as floods and drought

41 Nature-based solutions are therefore recognised as offering cost effective and resilient solutions to a wide range of often complex landuse related problems whilst simultaneously supporting other non-financial benefits to communities and indigenous ecosystems.

PROPOSED CHANGE 1 PROVISIONS

42 Change 1 includes a suite of provisions which aim to ensure that development and infrastructure is located, designed, and constructed in ways that provide for climate-resilience, prioritising the use of nature-based solutions, reducing the risks of future climate change impacts. The intent of these provisions is to respond to the mix of issues described in this evidence, which are anticipated should development continue in a "Business As Usual" manner.

43 Submissions received by the Council on Change 1 raise a number of points requiring clarification and reconsideration. I have read the relevant submissions and the evaluation and recommendations set out in the Section 42A Report "Climate Change: Climate-Resilience and Nature-Based Solutions" to improve the clarity and effectiveness of these provisions. In the following sections I discuss the relevant Change 1 provisions and provide my professional opinion on the appropriateness of the recommended amendments.

44 I support the definition for **Nature-Based Solutions** with amendments as recommended by Ms Guest in the Section 42A Report: "Climate Change: Climate-Resilience and Nature-Based Solutions":

"Actions to protect, enhance, or restore natural ecosystems, and the ~~incorporation of natural elements into built environments~~ use of engineered systems that mimic natural processes, to reduce *greenhouse gas emissions* and/or strengthen the resilience and well-being of ~~humans~~ people, indigenous biodiversity, and ~~the~~ natural and physical resources ~~environment~~ to the effects of climate change."

45 I consider that this captures the key outcomes sought, being the protection of existing natural systems as well as the integration of engineered solutions which mimic the required natural outcomes sought. I consider that the examples that follow the main part of the definition are useful, as they show how the concept of nature-based solutions can be implemented in practice. This evidence provides further real-world examples of the local application of nature-based solutions.

46 I support adding a definition for **climate-resilience** as recommended in the Section 42A Report: "Climate Change: Climate-Resilience and Nature-Based Solutions":

"The capacity and ability of the natural and built environment, including people, communities, businesses, infrastructure, and ecosystems, to withstand the impacts and recover from the effects of climate change, including natural hazard events'.

47 I consider that this definition captures the need for resilience to be provided across the natural, built and human environments and includes the critical elements of both withstanding climatic forces and also facilitating recovery. This final point ensures that this concept encompasses a range of events, rather than just infrequent large natural hazard scale events.

48 I support adding a definition for **Water-Sensitive Urban Design** as recommended in the Section 42A Report: "Climate Change: Climate-Resilience and Nature-Based Solutions":

The integration of planning, engineering design and water management to mimic or restore natural hydrological processes in order 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.

49 Based on my experience in the planning, design and delivery of Water Sensitive Urban Design projects, I consider that it encapsulates the principles which underpin its effective use.

50 Policy CC.4 is a key policy to ensure that district plans facilitate climate-resilient development. I consider that the amendments recommended by Ms Guest in the Section 42A Report: "Climate Change: Climate-Resilience and Nature-Based Solutions" improve the policy, with clauses (a) – (g) providing a comprehensive list of the required activities or practice to address predicted climate stressors in the Wellington Region. I consider that these provide clear direction to Territorial Authorities (and future Water Entity) on what objectives, policies and rules need to cover, without being excessively prescriptive. The amended explanation has been simplified and provides a clear description of the reason for the focus on nature-based solutions in terms of the multiple benefits they provide.

51 In my opinion, the recommendations of Ms Guest in the Section 42A Report: "Climate-Resilience and Nature-Based Solutions" to separate Policy CC.4 into two policies provides helpful clarification of the different regulatory powers and responsibilities of the regional council and territorial authorities. I consider that the additional specificity directing stormwater management in regional plans and the need to protect and enhance existing natural ecosystem function is helpful. In particular, clause (b) requires *stormwater flowrates and volumes to be managed to minimise flooding and to maintain, to the extent practicable, natural stream flow rates and volumes* which I consider to be a fundamental requirement to protect the Region's urban waterways and give effect to Te Mana o te Wai, as required by the NPS-FM.

52 I consider that Policy CC.14, including the amendments recommended by Ms Guest in the Section 42A Report: "Climate Change: Climate-Resilience and Nature-Based Solutions", and new Policy CC.14A, clearly set out the key attributes and considerations to ensure that development and infrastructure provide for climate-resilience. I consider that clauses (a) – (g) provide an appropriate level of specificity and are well suited to support councils.

EXAMPLES OF NATURE BASED SOLUTIONS

53 **<u>Te Kukuwai o Toa - Urban constructed wetland</u>**

53.1 Following expensive and damaging flooding of the Porirua CBD in 2015, investigations initially looked at how to improve flood resilience but were expanded to include water quality in response to the ongoing environmental degradation of Te Awarua o Porirua. Following a city-wide options assessment and prioritisation it was recognised that the Elsdon Park site could support multiple benefits through a nature-based approach to manage water across all

rainfall events. The now completed wetland has transformed a formally underutilised sports field into a thriving and diverse constructed wetland with approximately 45,000 locally indigenous plants (over 30 species) including a mix of aquatic and terrestrial plants which would have once been present in natural wetlands around the harbour. The 1 ha wetland treats urban stormwater from the 40 ha commercial and residential catchment during small to moderate rainfall events and during larger less frequent storms provides detention of stormwater to provide protection up to the 1% AEP event. This is achieved within an urban open space that invites the community in with boardwalks, viewing areas and signage (yet to be completed) to provide education on the cultural, ecological and historical context of the site. Te Kukuwai o Toa demonstrates a nature-based solution which responds to existing landuse and is adaptive to future climate change in a fully accessible public reserve.

54 **Queen Elizabeth Park - Restored natural peat wetland**

54.1 Peat wetlands are recognised for their ability to sequester atmospheric carbon within deep saturated organic layers at and below the surface. They also support a diverse and unique biodiversity, including indigenous plants and animals. They are typically located at the lower end of catchments and are often associated with areas subject to flooding with the ability to naturally detain flood waters which are slowly released to the ground and to smaller outlet streams. Draining of peat wetlands for uses including primary production and urban development lower the shallow groundwater table resulting in release of carbon in the form of methane. Drainage also results in a loss in biodiversity with replacement by exotic pasture and opportunistic weed species. Drained natural wetlands will typically remain subject to flooding and are increasingly susceptible as the intensity and frequency of large rainfall events increases. Queen Elizabeth Park (Kāpiti) represents a large peat wetland which was previously partially drained initially for agriculture with roading and urban development on the margins, the majority of the remnant wetland areas is within Regional Park. GWRC are currently undertaking works to manipulate excavated drains to return a more natural wetland hydrology to support improved carbon sequestration, increased indigenous biodiversity and accommodate periodic flood flows. The restoration of the wetland demonstrates a nature-based solutions at a landscape scale which can support long term adaptation and mitigation at a regional scale.

55 **Floodable landscapes- Copenhagen Denmark**

55.1 Large urban flooding in 2011 across Copenhagen caused billions of dollars in damage and insurance claims. Described as a 'Cloudbust' the event was categorised as a 1 in 1000 year event (0.1% AEP) which exceeded previous design standards and overwhelmed any pre-existing flood management strategies which similarly to Aotearoa were designed to a 1% AEP LoS. These floods, and recognition that climate change was increasing the likelihood of events of similar magnitude, prompted a council led change in focus to shift towards accommodating flood flows within the urban environment as opposed to continued attempts to 'drain' peak flood flows. Through collaboration with water utilities, transport planners, parks planners, private developers/property owners and the insurance industry a city-wide strategy has been endorsed and financed to create future urban landscapes which can safely accommodate flood waters. Through initiatives such as the lowering of strategically selected roadways, creation of multi-use public spaces (such as sunken urban basketball courts) and integration of high amenity landscape design with flood detention capacity the City of Copenhagen is progressively implementing nature-based solutions at a range of scales which mimic the natural flood attenuation within low lying lands which protects people and property.

56 **Porirua Park n Ride Raingardens - Water Sensitive Urban Design**

56.1 Carparks are a source of contaminants and contribute to increased stormwater volumes and flowrates due to expansive impermeable surfaces. In 2017 GWRC undertook an expansion and redevelopment of the Porirua Railway park n ride to increase parking capacity in line with increasing patronage of public transport. As part of these works options were developed to mitigate the impact of the carparks on freshwater and the harbour and to increase resilience to future climate change. This resulted in the inclusion of two large, agglomerated raingardens which capture and treat stormwater prior to discharge to the reticulated stormwater network. These are vegetated with locally sourced indigenous vegetation and provide treatment for approximately 85% of the annual rainfall which falls on the carparks. It is noted that whilst this provides a good example of a nature-based solution in a large-scale council led project the outcomes could have readily been further improved through the planting of

canopy shade trees to reduce thermal impacts on surface and vehicles and the use of permeable pavement where appropriate.

57 **Urban street trees– Melbourne Australia**

57.1 As a city subject to intense summer heat waves, the urban centre of Melbourne recognises the ability of street trees to mitigate existing and future heat days and the intercept initial rainfall to reduce stormwater in small events which would naturally be assimilated without surface runoff. Further co-benefits such as carbon sequestration, urban biodiversity, amenity and air quality are recognised and considered in provision of street trees as part of public and private re-development. In 2012 a city-wide urban forest strategy was developed which considered the full range of benefits from increased canopy cover and supported investment in a long-term planting strategy. This council led nature-based solution considered benefits at a range of scales and recognised the need to take definitive action now to support long term adaptation to increasingly frequent heat events. Given climate projections across Wellington and the timeframe for locally indigenous canopy species to form effective canopies the opportunity to require well considered urban trees in new development and redevelopment is very well timed.

58 **Residential Rainwater Reuse – Kāpiti**

58.1 Capture of rainwater/stormwater at a lot or sub-catchment scale supports a wide range of benefits including water quality, retention and resilience. It is an especially cost effective means of mitigating the impacts of urban development and providing adaptation to future climate conditions. In 2009 KCDC adopted the requirement for all new dwellings to include lot scale rainwater capture (10,000L) to be plumbed into internal non potable demands such as toilet flushing and laundry. Whilst initially motivated by aspirations to reduce the demand on increasingly stressed municipal water supply the implementation has diverted substantial volumes of stormwater from the districts urban and natural waterways which support indigenous biodiversity, amenity and flood resilience. This use of developer funded rainwater capture and reuse in turn reduces the requirements for further stormwater treatment devices within the public realm (roads/reserves) therefore reducing the long term OPEX burden to Council. Rainwater reuse provides a readily scalable example of nature-based solutions

which can be tailored to mimic the natural undeveloped hydrology through retention whilst supporting co-benefits to reduce impacts from municipal potable water takes, connecting communities with the water 'story' and providing resilience to potable water shortages and/or outages.

59 **Urban residential intensification – Hobsonville Point Auckland**

59.1 Development of the former RNZAF land at Hobsonville Point was planned as a high yield development with performance metrics to ensure that this did not compromise social and environmental outcomes. Initially commenced prior to amalgamation, the development was subsequently supported by provisions in the Auckland Council Unitary Plan with clear requirements to manage stormwater, built form and public realm in line with national and international best practices. Largely completed the development has provided an exemplar for doing density well. Of note the development was largely unimpacted by recent intense rainfall (which exceeded 1% AEP) with flood water accommodated within landscape and limited property damage despite the intensity of rainfall in the immediate area. Extensive tree planting, restoration of coastal margins and integrated water sensitive design will continue to support ongoing improved environmental and social outcomes in coming years.

EFFECTIVE IMPLEMENTATION OF NATURE-BASED SOLUTIONS

60 The policy framework provided by Change 1 needs to be pitched at the right level to ensure that regional and district plans include an appropriate level of specificity to achieve the desired outcomes of climate-resilience and co-benefits for a range of environmental, social, and economic outcomes. The specification of technical requirements to inform the selection and/or design of nature-based solutions needs to respond to the specific functional requirement related to the proposed or existing landuse activity. These functional requirements may be triggered by changes in landuse or development at a range of scales which, in many instances, will not trigger regional consents or oversight (for example development with permitted activity status). Therefore, whilst not part of Change 1, it is important to recognise the level of specificity that needs be provided in subsequent regional and district plans, along with supporting guidance, to give effect to Change 1.

61 By way of example technical requirements/standards related to nature-based solutions could include metrics such as:

61.1 Percentage of effective pervious land on lots whereby effective pervious land includes the combination of undeveloped and vegetated land, areas of roof either in green roof or with rainwater reuse tanks and areas of paving/hardstand which connects to an appropriately designed stormwater treatment device.

61.2 Rainfall depth or water quality volume to be captured and treated for stormwater contaminants to protect urban streams, shallow groundwater and waterbodies.

61.3 Rainfall depth to be intercepted and retained (through reuse or infiltration) to match natural hydrology in freshwater and tidal streams.

61.4 Targets for mature tree canopy coverage for road corridors and car parks.

61.5 Proportion of public greenspace dedicated to functional indigenous ecosystems (this could include vegetated buffers and/or vegetated treatment devices).

61.6 Width of riparian margins to be planted in indigenous species (this could include proportion of vegetated treatment devices co-located in riparian corridors).

61.7 Net Carbon emissions to be offset taking into consideration sequestration achieved through vegetated systems and project related re-vegetation.

61.8 Annual Exceedance Probability (AEP) event to be managed to prevent downstream flooding impacts.

61.9 Proportion of impermeable landcover or public open space within urban areas

62 These metrics need to be understood by councils, land owners (including public ownership), developers and investors at the outset, to inform good design, achieve efficient and effective outcomes, and ensure that development planning can proceed without undue time or cost.

63 The inclusion of clear policy, rules, and means of compliance relating to nature-based solutions in regional and district plans is therefore an important consideration in supporting long-term sustainable development whilst meeting the intent of Change 1 and the specific performance outcomes provided, particularly in Policies CC.4 and CC.14.

CONCLUSIONS

64 Responding to pressures from existing and future urban development needs to consider the environmental, social, cultural, and economic impacts, whilst factoring in the expected

influence of climate change. A continuation of a "business-as-usual" approach to development will contribute to ongoing degradation of fresh and coastal waters, loss of biodiversity, and reduced resilience of communities and the environment to a range of climate change related outcomes, including increased exposure to natural hazards.

65 Nature-based solutions, by protecting natural systems and investing in green infrastructure, provide a means of supporting climate-resilient development, while also providing co-benefits for biodiversity, fresh and coastal waters, and alignment with Te Mana o te Wai.

66 Clarity around what the term resilient means in relation of climate change is important to ensure that councils and landowners understand the intention to support environmental and social outcomes in the short and long term. In my opinion, the definition recommended by the Section 42A Report: Climate Change: Climate-Resilience and Nature-Based Solutions 1 will achieve this and emphasises the importance of ensuring development responds to future climatic changes beyond just natural hazards.

67 Legislative and non-legislative drivers for improved urban and rural outcomes need to be supported through clear policies and rules that can facilitate the integration of nature-based solutions with urban development and can be effectively assessed through consenting.

68 In my opinion, the policy framework in Change 1 establishes clear requirements about the outcomes and performance to be achieved by future land use activities/developments and will enable local authorities to develop specific metrics where nature-based solutions are the optimal means of supporting a suite of environmental, cultural, and social outcomes which are resilient to climate and affordable over a realistic timeframe.

69 Stronger policies and rules are required in both regional and district plans if future development is to avoid ongoing loss of freshwater values, biodiversity, and cultural values/aspirations. I consider that Change 1 sets out the appropriate requirements for future plans to directly respond with specific metrics to support climate resilience and improved ecological outcomes from development.

7 August 2023

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MORPHUM ENVIRONMENTAL

Appendix 1:

Climate Change: Climate-resilience and Nature-Based Solutions topic - recommended amendments to proposed provisions

Objective CC.1 [3]

~~By 2050, t~~The Wellington Region is a low-emission and *climate-resilient* region, where climate change mitigation and climate change adaptation are an integral part of:

(a) sustainable air, land, freshwater, and coastal management,

(b) well-functioning urban areas ~~environments~~ and rural areas, and

(c) the ~~well~~ planning ~~ed~~ and delivery of infrastructure.

Objective CC.4: *Nature-based solutions* are an integral part of *climate change mitigation* and *climate change adaptation*, improving the health and resilience of people, indigenous biodiversity, and ~~the~~ natural and physical resources ~~environment~~.

Objective CC.7[4]**:**

People and businesses understand ~~what~~ the current and future effects of climate change and how this may impact them ~~means for their future~~ and are actively involved in ~~planning and implementing~~ appropriate mitigation and adaptation responses.

Definition: **nature-based solutions -**

~~A~~ctions to protect, enhance, or restore natural ecosystems, and the ~~incorporation of natural elements into built environments~~ use of engineered systems that mimic natural processes, to reduce *greenhouse gas emissions* and/or strengthen the resilience and well-being of ~~humans~~ people, indigenous biodiversity, and ~~the~~ natural and physical resources ~~environment~~ to the effects of climate change.

Note, ~~E~~examples include:

Reducing greenhouse gas emissions (climate change mitigation):

- planting forests to sequester carbon
- ~~protecting~~ maintaining peatland to retain carbon stores

Increasing resilience (climate change adaptation):

a. *providing resilience for people*
   - planting street trees to ~~provide relief from high temperatures~~ reduce urban heat
   - restoring coastal dunelands to provide increased resilience to the damaging effects of storm~~s~~ surges linked to sea level rise
   - leaving space for rivers to undertake their natural movement and accommodate increased floodwaters
   - the use of *water-sensitive urban design* principles and methods, such as rain gardens to manage contaminants and reduce stormwater runoff in urban areas
   - retaining wetlands and planting swales on farmland to slow runoff, reduce flood peaks, retain base flows, and protect water quality

b. *providing resilience for ecosystems and species*
   - restoring indigenous forest to a healthy state to increase its resilience to increased climate extremes

[3] Changes recommended in the S42A Report: Climate Change - General

[4] Changes recommended in the S42A Report: Climate Change - General

- leaving space for estuarine ecosystems, such as salt marshes, to retreat inland in response to sea level rise.

Climate-resilience/Climate-resilient/ Resilience and Resilient (in relation to climate change or natural hazards) –
The capacity and ability of natural and physical resources, including people, communities, businesses, infrastructure, and ecosystems, to withstand the impacts and recover from the effects of climate change, including natural hazard events.

water-sensitive urban design – The integration of planning, engineering design and water management to mimic or restore natural hydrological processes in order 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. Water sensitive urban design manages stormwater at its source as one of the tools to control runoff and water quality. The terms low impact design, low impact urban design and water-sensitive design are often used synonymously with water-sensitive urban design.

Policy CC.4: Climate-resilient development ~~urban areas~~ – district ~~and regional~~ plans

District ~~and regional~~ plans shall include objectives, policies, rules and methods to ~~provide for climate-resilient urban areas by providing for actions and initiatives described in Policy CC.14 which support delivering the characteristics and qualities of well-functioning urban environments.~~ require development and infrastructure to be located, designed, and constructed in ways that provide for *climate-resilience*, prioritising the use of *nature-based solutions,* including by, as appropriate to the activity:

(a) requiring provision of urban green space, particularly canopy trees, to reduce urban heat and reduce stormwater flowrates:
   i. prioritising the use of appropriate indigenous species, and
   ii. working towards achieving a target of 10 percent *tree canopy cover* at a suburb-scale by 2030, and 30 percent cover by 2050,

(b) requiring application of *water-sensitive urban design* principles, hydrological controls, and other methods to improve water quality, overall environmental quality, minimise flooding and maintain, to the extent practicable, natural stream flows,

(c) requiring methods to increase water resilience, including harvesting of water at a domestic and/or community-scale for non-potable uses (for example by requiring rain tanks, rainwater re-use tanks, and setting targets for urban roof area rainwater collection),

(d) requiring that significant adverse effects on the *climate change mitigation*, *climate change adaptation* and *climate-resilience* functions and values of an ecosystem shall be avoided, and other adverse effects on these functions and values shall be avoided, minimised, or remedied,

(e) promoting efficient use of water and energy in buildings and infrastructure, and

(f) promoting appropriate design of buildings and infrastructure so they are able to withstand the predicted future higher temperatures, intensity and duration of rainfall and wind over their anticipated life span.

Explanation

Policy CC.4 directs ~~regional and~~ district plans to include ~~relevant~~ provisions to provide for *climate-resilient* development and infrastructure ~~urban areas~~. The policy seeks that priority be given to the use of *nature-based solutions*, recognising the multiple-benefits they can provide for people and nature. It also seeks to manage any adverse effects of activities on the climate change functions and values of ecosystems.

~~For the purposes of this policy, climate-resilient urban areas mean urban environments that have the ability to withstand:~~

~~• Increased temperatures and urban heat island~~

~~• Increased intensity of rainfall and urban flooding and increased discharge of urban contaminants~~

~~• Droughts and urban water scarcity and security~~

~~• Increased intensity of wind, cold spells, landslides, fire, and air pollution~~

~~The policy is directly associated with Policy CC.14 which provides further direction on actions and initiatives to provide for climate resilient urban areas.~~

It is noted that other policies of this RPS also provide for actions and initiatives to deliver *climate-resilient* infrastructure and development ~~urban areas~~, including Policy FW.3.

Policy CC.4A: Climate-resilient development – regional plans

Regional plans shall include objectives, policies, rules and methods to require development and infrastructure to be located, designed, and constructed in ways that provide for *climate-resilience*, prioritising the use of *nature-based solutions*, including by, as appropriate to the activity:

(a) requiring the application of *water-sensitive urban design* principles and methods to improve water quality and overall environmental quality, including by requiring stormwater contaminants to be avoided or minimised in discharges to the stormwater network or to water,
(b) requiring stormwater flowrates and volumes to be managed to minimise flooding and to maintain, to the extent practicable, natural stream flow rates and volumes, and
(c) requiring significant adverse effects on the *climate change mitigation*, *climate change adaptation* and *climate-resilience* functions and values of an ecosystem be avoided, and other adverse effects on these functions and values be avoided, minimised, or remedied.

Explanation

Policy CC.4A directs regional plans to include provisions to provide for *climate-resilient* development and infrastructure. The policy seeks that priority be given to the use *of nature-based solutions*, recognising the multiple-benefits they can provide for people and nature. It also seeks to manage any adverse effects of activities on the climate change functions and values of ecosystems.

It is noted that other policies of this RPS also provide for actions and initiatives to deliver *climate-resilient* infrastructure and development, including Policy FW.14.

Policy CC.14: Climate-resilient development ~~urban areas~~ – district and city council consideration

When considering an application for a resource consent, notice of requirement, or a change, variation or review of a district ~~or regional~~ plan, seek that development and infrastructure is located, designed and constructed in ways that provide for *climate-resilience*, ~~provide for actions and initiatives, particularly~~ prioritising the use of *nature-based solutions*~~, that contribute to climate-resilient urban areas~~ including by, as appropriate to the activity:

(a) ~~maintaining, enhancing, restoring, and/or creating urban green~~ space ~~at a range of spatial scales to provide urban cooling, including~~, providing urban green space, particularly canopy trees, to reduce urban heat and reduce stormwater flowrates:
    i. prioritising the use of appropriate indigenous species, and
    ii. working towards achieving a target of 10 percent *tree canopy cover* at a suburb-scale by 2030, and 30 percent cover by 2050,

(b) the application of *water-sensitive urban design* principles, hydrological controls, and other methods to ~~integrate natural water systems into built form and landscapes,to reduce flooding,~~ improve water quality and overall environmental quality, minimise flooding and maintain, to the extent practicable, natural stream flows,

(c) methods to increase water resilience, including by requiring harvesting of water at a domestic and/or ~~capturing, storing, and recycling water at a~~ community-scale for non-potable uses (for example by requiring rain tanks, rainwater re-use tanks, and setting targets for urban roof area rainwater collection),

(d) ~~protecting, enhancing, or restoring natural ecosystems to strengthen the resilience of communities to the impacts of natural hazards and the effects of climate change,~~ avoiding significant adverse effects on the *climate change mitigation*, *climate change adaptation* and *climate-resilience* functions and values of an ecosystem, and avoiding, minimising, or remedying other adverse effects on these functions and values,

(e) ~~providing for~~ promoting efficient use of water and energy in buildings and infrastructure, and

(f) promoting appropriate design of buildings and infrastructure ~~that~~ so they are able to withstand the predicted future higher temperatures, intensity and duration of rainfall and wind over their anticipated life span.

Explanation
Climate change, combined with population growth and housing intensification, is increasingly challenging the resilience and well-being of urban communities and natural ecosystems, with increasing exposure to natural hazards, and increasing pressure on water supply, wastewater and stormwater infrastructure, and the health of natural ecosystems.

This policy identifies the key attributes required to ensure that development and infrastructure provides for ~~develop~~ *climate-resilience* ~~in urban areas~~ and requires district ~~and regional~~ councils to take all opportunities to provide for actions and initiatives, particularly nature-based solutions, that will prepare our ~~urban~~ communities for the changes to come.

Policy CC.14A: Climate-resilient development – regional council consideration

When considering an application for a resource consent, or a change, variation, or review of a regional plan, seek that development and infrastructure is located, designed, and constructed in ways that are *climate-resilient*, prioritising the use of *nature-based solutions*, including by, as appropriate to the activity:

(a) the application of *water-sensitive urban design* principles and methods to improve water quality and overall environmental quality, including by avoiding or minimising stormwater contaminants in discharges to the stormwater network or to water,
(b) managing stormwater flowrates and volumes to minimise flooding and to maintain, to the extent practicable, natural stream flows, and
(c) avoiding significant adverse effects on the *climate change mitigation*, *climate change adaptation* and *climate-resilience* functions and values of an ecosystem and avoiding, minimising, or remedying other adverse effects on these functions and values.

Explanation
Climate change, combined with population growth and housing intensification, is increasingly challenging the resilience and well-being of urban communities and natural ecosystems, with increasing exposure to natural hazards, and increasing pressure on water supply, wastewater and stormwater infrastructure, and the health of natural ecosystems.

This policy identifies the key attributes required to ensure that development and infrastructure provides for *climate-resilience* and requires the regional council to take all opportunities to provide for actions and initiatives, particularly nature-based solutions, that will prepare our communities for the changes to come.

It is noted that other policies of this RPS also provide regulatory requirements to deliver climate-resilient infrastructure and development, including Policies 14 and 42.