Before the Hearings Panel
At Wellington City Council

Under ISPP of the Resource Management Act 1991

In the matter of the Proposed Wellington City District Plan

Statement of evidence of Nadia Nitsche on behalf of Wellington City Council (Hydraulics and Hydrology)

Date: 30th June 2023

INTRODUCTION:

1 My full name is Nadia Caron Nitsche. I am employed as Head of Modelling at Wellington Water Ltd (Wellington Water).

2 I have prepared this statement of evidence on behalf of the Wellington City Council (the **Council**) in respect of technical related matters arising from the submissions and further submissions on the Proposed Wellington City District Plan (the **PDP**).

3 Specifically, this statement of evidence relates to the matters in the Three Waters Chapter of the PDP.

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

QUALIFICATIONS AND EXPERIENCE

5 My qualifications are a BEng (Civil Engineering) from University of Cape Town, South Africa, and a MEng (Civil Engineering) specialising in Hydraulics and Hydrology from Stellenbosch University, South Africa.

6 I have over 20 years' experience in hydraulic, hydrological modelling and flood risk assessments. Most of this has been in New Zealand but I have several years' experience in other countries. My experience is split between consultancies and councils.

7 I am a Chartered Engineer with Engineering New Zealand and a member of the New Zealand Water and Waste Association.

Code of conduct

8 I have read the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing my evidence and will continue to comply with it

while giving oral evidence. My qualifications as an expert are set out above. Except where I state I rely on the evidence of another person, I confirm that the issues addressed in this statement of 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

9 My statement of evidence covers the following matters:

9.1 The framework that Wellington Water and Council have applied to manage flood risk.

9.2 Comments on submission points as follows:

- Submission points 339.2 and 339.3 by The Sustainability Society
- Submission 351.72 by Greater Wellington Regional Council
- Submission points 439.8, 439.15, 439.20 and FS116.2 by Survey & Spatial New Zealand Wellington Branch
- Submission 359.25 by Woolworths New Zealand
- Submission 266.53 by Wellington City Council
- Submission 318.11 by Rimu Architects

INVOLVEMENT WITH THE PROPOSED PLAN

10 My involvement with the PDP to date has comprised of the provision of technical advice to Council regarding stormwater hydraulics and hydrology to assist Council to develop fit for purpose three waters provisions. This has included managing the technical aspects of the hydrological modelling undertaken to help understand potential

stormwater mitigation in terms retention for environmental water quality impacts and hydraulic neutrality for flood detention.

OVERVIEW OF THE STORMWATER SYSTEM FUNCTION IN WELLINGTON CITY

11 The primary **existing primary stormwater system (such as pipes)** is generally designed for the smaller events. With population and the changing climate, the stormwater system is already carrying more runoff than it's designed for. Any runoff that is greater than the primary system is carried with the **secondary system** (such as overland flow paths) to the receiving environment. Development and climate change are increasing the available spare capacity of both. If the primary system is overwhelmed by higher rainfall event planning controls such as detention, retention and floor levels need to ensure there is not impact on the community. Figure 1 shows the three levers of stormwater management. The primary system (in orange) deals with the more frequent less extreme flows; the planning controls (such as hydraulic neutrality and floor levels and shown in green) deal with the more extreme rainfall events (in blue) and emergency management, insurance and community awareness then deals or prepares for the impacts of extreme rainfall.

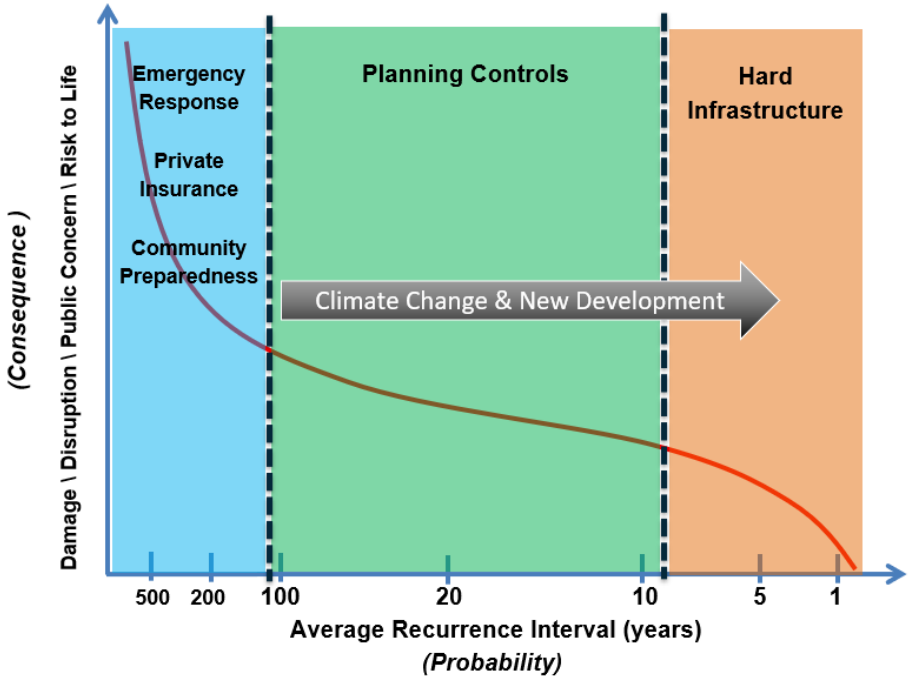

Figure 1 The three levers of stormwater management

12 It is therefore important to manage the runoff from developments to address impacts on flood hazards and environmental consequences. Figure 2 indicates three possible changes to the natural stormwater runoff through development; these include changing the primary flow, secondary and loss of natural ponding areas.

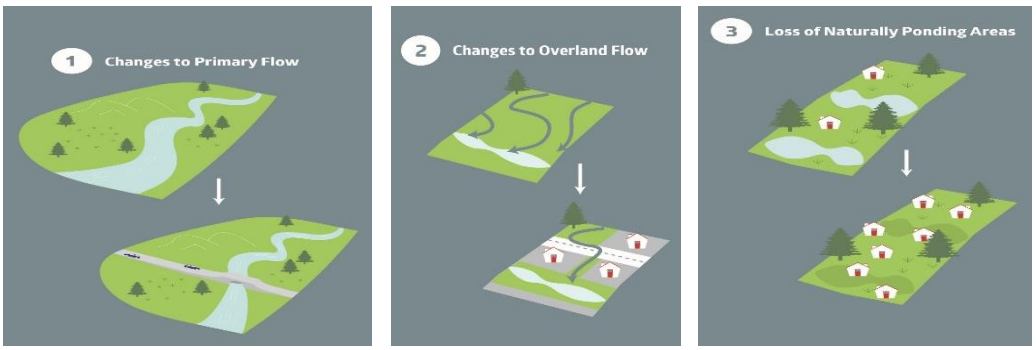

Figure 2 Changes in hydrology and hydraulics

MANAGING FLOOD HAZARD BY HYDRAULIC NEUTRALITY

13 To manage additional runoff attributed to development and control the impacts of **natural flood hazard in Wellington**, a number of matters were considered as follows:

13.1 The flooding consequences of stormwater discharges should ideally focus on managing the **higher magnitude, low-frequency flows** as they have the strongest influence on the natural hazard impacts.

13.2 Increased imperviousness from development increases storm runoff as water is unable to drain away overland. This results in **higher peak flow and greater volume of runoff**. This is especially evident in extreme flows due to high runoff.

13.3 The effectiveness of detention is best measured through design storm event – typically a 1% or 10% Annual Exceedance Probability.

13.4 The increase in peak flow can be captured in detention and held in storage and can be released at a slower stage. This means the peaks are reduced but not the volume.

13.5 Detention can bring the peak flow rates to the same stage as undeveloped sites and therefore not have a flood peak impact downstream. This is illustrated in Figure 3.

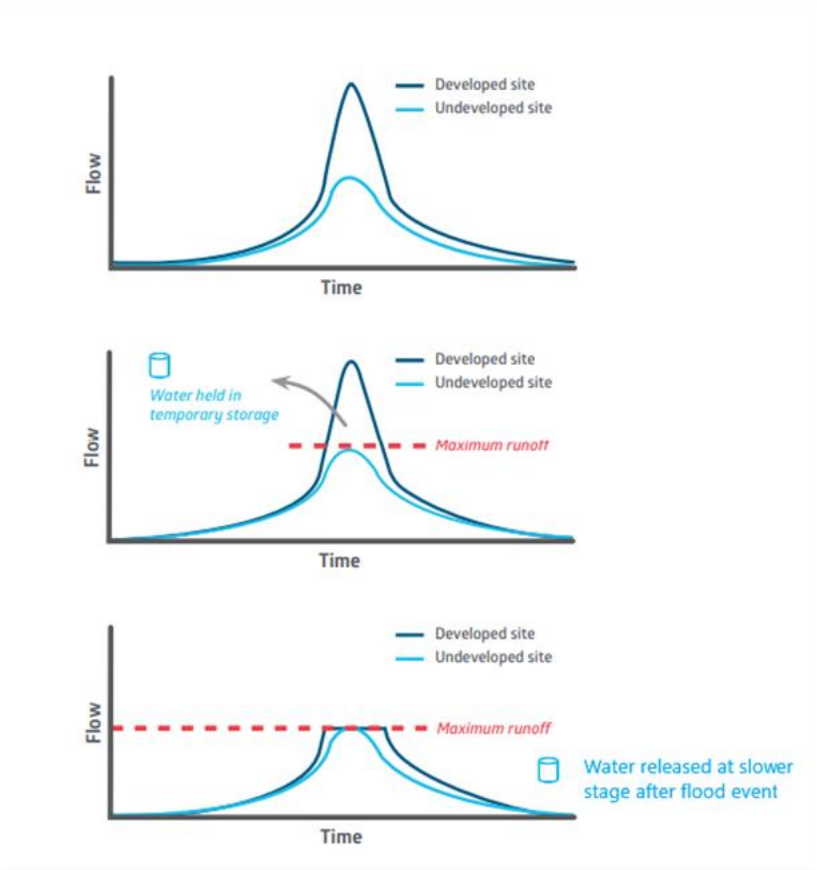

Figure 3 Changes in hydrograph before and after flood event

14 Extensive modelling has been completed to understand the impact of detention on flood hazards.

15 The process of calculating the required detention or hydraulic neutrality is captured in Figure 4.

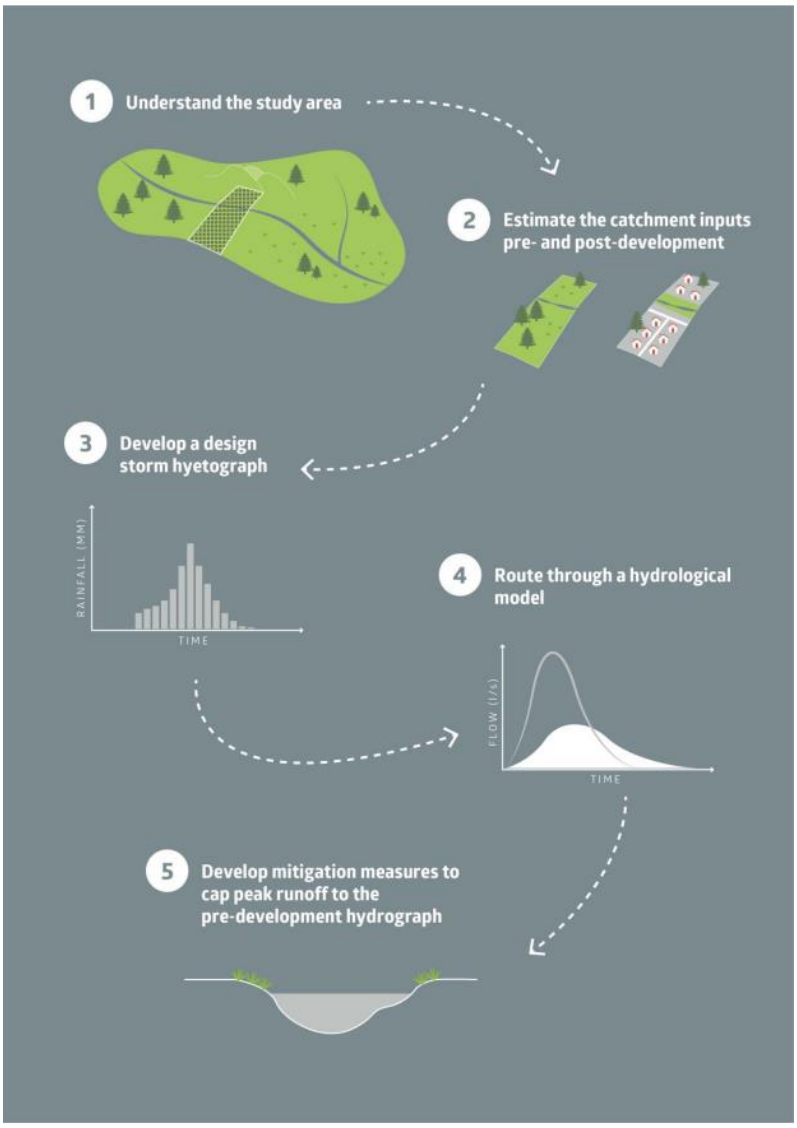

Figure 4 Required steps to estimate and manage catchment runoff from large flood events

16 A framework has been established to determine hydraulic neutrality for extreme flows and flood detention and is described in the following documents:

16.1 *Regional Standard for Water Services,* December 2021 Version 3.0

16.2 Reference Guide for Design Storm Hydrology Standardised Parameters for Hydrological Modelling, 9 April 2019

16.3 *Managing Stormwater Runoff - The use of approved solutions for hydraulic neutrality,* Version 4.

MANAGING ENVIRONMENTAL CONSEQUENCES BY HYDROLOGICAL CONTROLS

17 Development can have the following environmental consequences: loss of groundwater recharge, reduced base flows in streams, increased flooding, and lower water quality. Instead of channelling stormwater into pipes and drains, more natural methods of water management has benefits for the environment and economy.

18 The key considerations for managing additional runoff from development and control the impacts of **environmental consequences** are as follows:

18.1 The environmental consequences of stormwater discharges is ideally addressed through managing the lower magnitude, high-frequency flows as they have the strongest influence on the receiving environment.

18.2 Increased imperviousness resulting from development increases storm runoff because water is unable to drain away overland. This results in **increased frequency of peak flow and increased volume of runoff** at the lower rainfall events. The increased peak rainfall of lower events has the strongest influence on channel form and ecosystem health. These frequent events also are very sensitive to increases in imperviousness due to imperviousness increase. Strategies for managing impacts on the ecology, geomorphology and groundwater should seek to reduce runoff volumes, peak flow rates and the frequency that flow rates are exceeded.

18.3 The effectiveness of retention is best measured through continuous rainfall-runoff modelling, for example rainfall over a 10-year time period.

DEFINITION AND MODELLING FOR 'UNDEVELOPED STATE'

19 The proposed definition for the 'undeveloped state' is as follows*:*

> *"The modelled grassed (pastoral or urban open space) state of the site prior to urban development".*

20 This definition was developed as result of a hydrological analysis of four scenarios of catchments with different land cover and soil groups undertaken for the Wellington Region.

21 A hydrological analysis sought to understand changes in peak flow and volume, modelled runoff was compared to the following development scenarios: 1) historic state 2) pastoral or urban open space and 3) impervious state.

22 The impact of the changes to land use and soil type was compared on peak flow and flood volume for different rainfall profiles.

23 The modelling results show that the biggest difference in hydrology is from an undeveloped state to a post-development state due to the increased urban intensification.

24 The modelling has further indicated that water sensitive approaches to residential development can reduce the impacts of urbanisation for ecological impacts.

25 The modelling has indicated that the biggest impact on flows and therefore environmental consequences are from the change of pervious (pastoral or urban space) to impervious land cover.

26 On this basis, to give effect to Te Mana o te Wai, it is recommended to focus on capturing the changes from undeveloped to developed in retention and detention.

27 The modelling Wellington Water has completed to date will be used to develop a framework and technical guidance for Council to support resource consent applications for developments that trigger the requirements to assess and mitigate hydraulic and hydrological impacts and under the new district plan. The requirements for hydraulic neutrality both for detention and retention will be addressed separately.

COMMENTS ON SUBMISSIONS

28 **Submission 339.2** by The Sustainability Society requests clarification of the Three Water chapter to avoid confusion and ensure robust retention of stormwater can be achieved when mentioning peak runoff flowrates and overall stormwater volumes.

29 I concur it would be beneficial to further clarify requirements for hydraulic detention (to avoid flood hazard) and retention (to avoid environmental consequences). The intention is that Wellington Water and the Council will develop technical guidance to provide the methodology to achieve this as noted earlier.

30 **Submission 351.72** by Greater Wellington Regional Council (GW) notes that the proposed Regional Policy Statement Change 1 contains a new definition for hydrological controls which set out the requirements for managing stormwater run-off flows or volumes in relation to a site's undeveloped state (referenced in Policies FW.3 and 42). GW request that the proposed PDP hydraulic neutrality provisions 'have regard' to this approach.

31 After collaboration between GW, the Council and Wellington Water, it is proposed to amend the definition for **Undeveloped State** as noted in paragraph 19. The definition would not take existing buildings into consideration in the calculations.

32 As I have explained earlier (paragraphs 19 - 27), this will capture the biggest impacts and environmental consequences from development.

33 **Submission 439.8** by Survey & Spatial New Zealand Wellington Branch considers the discussion in the Introduction about hydraulic neutrality is forcing developments (particularly multi-unit developments) to over-compensate for stormwater discharges, and existing capacity constraints in Council infrastructure are reduced in favour of smaller developments.

34 Managing the effects of stormwater runoff from development requires a multi-faceted approach, including Council's own programmed upgrades. In my view the District Plan provides a critical tool to control the effects of the use and development of land for purposes of avoidance or mitigation of natural hazards and prevention or mitigation of any adverse effects of the development, or subdivision.

35 As noted earlier, Wellington Water and the Council will provide a framework that enables the requirements for hydraulic neutrality for both detention and retention to be separately addressed.

36 **Submission 339.3** by the Sustainability Society seek an amendment to the Three Water chapter to include a rule requiring a retention depth metric for future development at all scales. They state that retention of stormwater to manage stormwater volumes to *"avoid flashy rainfall runoff requires an initial depth of rainfall to be captured and not allowed to discharge as stormwater. Where soils allow, this can be via infiltration but in Wellington is likely to require rainwater harvest and reuse to reduce volume which is fundamental to mimic natural losses*

from vegetation and undeveloped soils. In other jurisdictions this retention depth generally varies from 5 - 10 mm."

37 Wellington Water and the Council agree that there is a need for provisions for rainwater harvest (retention). However, the necessary technical guidance is not yet available as the basis to implement this. The proposed technical framework (referred to in paragraph 27) will outline how to mimic the natural losses into the soil following rainfall to minimise the impact on the environment. Once the guidance is complete, corresponding changes will likely need to be incorporated into the District Plan via a Plan Change.

38 **Submission 359.25** by Woolworths New Zealand seeks an amendment of THW-P5 to remove reference to an ''undeveloped state' and replace it with 'pre-developed state' as they believed the former is overly onerous. They note that the matters of discretion at Rule THW-R6.2 include an assessment against "*the extent to which the development incorporates stormwater management techniques or controls to mitigate any increase in pre-development peak stormwater runoff*" and as such it is considered that pre-development state is the appropriate baseline against which to assess effects in this regard.

39 After collaboration between GW, the Council and Wellington Water the definition for **Undeveloped State** has been included as outlined noted in paragraph 19.

40 **Submission 439.15 and 439.20** by Survey & Spatial New Zealand Wellington Branch considers hydraulic neutrality should refer to the current disposition of a site.

41 The modelling does not support this approach. It showed that to minimise the environmental impact on the receiving environment from increased urbanisation, it is more effective to manage additional

stormwater runoff from increases in imperviousness from the undeveloped state to the developed state.

42 **Submission 266.53** by Wellington City Council requests clarification needed for the undeveloped state.

43 As noted earlier, it is proposed that the definition for **Undeveloped State** is amended as outlined in paragraph 19.

44 **Submission 318.11** by Rimu Architects request that the definition of 'Hydraulic Neutrality' be amended. They state that the proposed definition's use of 'site in an undeveloped state' does not equate to the 'pre-development' used here except for greenfield sites.

45 The Regional Standard for Water Services section 4.4.2.1 states that detention should be designed to limit the peak discharge from the development to not greater to the existing peak discharge from pre-development. Pre-development is not defined in the PNP but hydrologically implies the *modelled grassed (pastoral or urban open space) state of the site prior to urban development*.

46 It is proposed to amend THW-P5 (Hydraulic neutrality) to require new subdivision and development to be designed, constructed and maintained to sustainably manage the volume and rate of discharge of stormwater to the receiving environment so that the rate of offsite stormwater discharge is reduced as far as practicable to be at or below the modelled peak flow and volume for each site in its undeveloped state.

47 **Submission FS116.2** by Survey & Spatial New Zealand Wellington Branch states that the use of the term "undeveloped state" suggests that the stormwater runoff from any existing buildings is to be ignored, and that the site be considered as though it was a vacant greenfield site. The submission states that this definition is contradictory to the

Regional Standard for Water Services and that the definition should refer to the site in it's current state at the time of an application for development.

48 In response, it is proposed to amend the definition for **Undeveloped State** as outlined in paragraph 19.

49 The Regional Standard for Water Services section 4.2.11 states that for environmental water quality any development work needs to include an evaluation of the post-development stormwater effects on the upstream and downstream existing and residential properties.

50 The Regional Standard for Water Services section 4.4.2.1 states that detention should be designed to limit the peak discharge from the development to not greater to the existing peak discharge from pre-development.

51 The definition therefore does not contradict the Regional Standard of Water Services for environmental water quality retention or detention.

Nadia Nitsche

Date: 26/06/2023