BEFORE THE PROPOSED NATURAL RESOURCES PLAN HEARINGS PANEL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of Water Allocation
AND	
IN THE MATTER	of the submissions and further submissions set out in the S42a Officer Report

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STATEMENT OF PRIMARY EVIDENCE OF MIKE THOMPSON ON BEHALF OF WELLINGTON REGIONAL COUNCIL

TECHNICAL – WATER ALLOCATION: MINIMUM FLOWS AND ALLOCATION

7 August 2017

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1. INTRODUCTION

1.1 My name is Mike Thompson. I work as Senior Environmental Scientist for Wellington Regional Council. I have Bachelor of Science and Master of Science and Technology degrees from Waikato University, majoring in hydrology. I have 17 subsequent years of employment experience in hydrology and water resource assessment. A fuller account of my qualifications and experience is available in **Attachment A** of my evidence.

1.2 My evidence relates to the topic of **allocation**.

2. CODE OF CONDUCT

2.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note and that I agree to comply with the code. My evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that might alter to detract from the opinions which I express.

3. SCOPE

3.1 I have been asked to provide technical evidence in response to submissions received coded to topic **allocation** for the following specific matters:

(a) Minimum flows

(b) Core allocation

(c) Supplementary allocation

3.2 The scope of my evidence includes assessing submissions relating to the matters listed above and making recommendations about what response to the relief sought in the submission might be appropriate.

4. GENERAL BACKGROUND TO DEVELOPMENT OF MINIMUM FLOW AND ALLOCATION PROVISIONS

4.1 The broad rationale behind, and methods applied in, developing minimum flow and allocation limit provisions for the proposed Plan are described in Thompson (2015) and Thompson and Mzila (2015) and are not repeated in detail in this evidence. However, the following paragraphs summarise the main features of the overall approach, and especially changes between the existing Regional Freshwater Plan (RFP, Wellington Regional Council 1999) and the proposed Plan, considered most pertinent to the submissions received.

Minimum flows

4.2 There were minimum flow limits for 18 catchments listed in the RFP. These have all been adopted without change in the proposed Plan.

4.3 Two significant changes between the RFP and the proposed Plan have been made. Firstly, minimum flows have been included for an additional three stream catchments (Parkvale, Papawai and Otukura streams), bringing the total number of catchments with specified minimum flows to 21. Secondly, for all other catchments in the region not covered by one of the 21 catchment-specific limits, a default minimum flow policy has been included in the proposed Plan.

4.4 The basis for retaining existing minimum flows and including new minimum flow limits is discussed further in section 5 of this evidence.

Allocation

4.5 Historically, for the purposes of allocating water, Council has managed surface water (primarily rivers and streams) and groundwater as largely separate entities. Allocation limits in the RFP are listed separately for groundwater aquifers and surface water catchments, with no explicit linkage between the two.

4.6 Council now have an improved understanding of the connection between ground and surface water resources and a new

allocation framework for managing surface and groundwater in a more integrated fashion (conjunctive water management – see evidence of Dr Gyopari and Mr Hughes). One of the consequences of moving to this new framework is that the RFP allocation limits are no longer considered appropriate or workable. New allocation amounts are proposed and the reasoning and basis for these is discussed further in section 6 of this evidence.

4.7 A further change in the proposed Plan is that a new supplementary allocation policy is being introduced. Previously, supplementary flow thresholds (river flow above which water in addition to core allocation can be taken) had been set for all rivers with minimum flow thresholds. However, no supplementary allocation volume/rate limit had been set, nor was there a policy covering all other catchments in the region. The new policy is being introduced to address these perceived shortcomings and is discussed more in section 7 of this evidence.

5. MINIMUM FLOWS

Background to development of provisions

5.1 Minimum flow polices are set out in the proposed Plan in Policies P111 (general), R.P.1 (Ruamahanga whaitua), WH.P.1 (Wellington Harbour and Hutt Valley whaitua), P.P1 (Te Awarua-o-Porirua whaitua), K.P.1 (Kapiti Coast whaitua) and WC.P.1 (Wairarapa Coast whaitua). Tables 7.1, 8.1 and 10.1 in the proposed Plan also list numerical minimum flows for the Ruamahanga, Wellington Harbour and Kapiti Coast whaitua, respectively.

5.2 Minimum flows in the Regional Freshwater Plan (RFP, Wellington Regional Council, 1999), and subsequent plan changes, were derived in a number of ways, from application of a simple flow statistic to hydraulic-habitat modelling and water quality modelling. Since the RFP became operative, Council has been undertaking a review of minimum flows.

5.3 Hydraulic-habitat models predict how the quality and quantity of physical habitat will respond to changes in flow[1]. They involve a hydraulic component and a habitat component. The hydraulic modelling component predicts how water depth and velocity varies with flow at an array of points in a modelled stream reach. The habitat component involves assessing the suitability of these predicted depths and velocities (physical habitat variables) for given target species (or life stages), by comparing against criteria describing the physical habitat conditions used or preferred by the target organism (typically fish).

5.4 Ultimately, hydraulic-habitat models can be used to predict how much *habitat will be retained* for a given flow, thereby providing an explicit basis for establishing ecological/minimum flows. At the time provisions for the proposed Plan were being finalised, hydraulic-habitat model methods were widely considered to be the most scientifically defensible for ecological flow assessments (Hay 2010a).

[1] Instream Flow Incremental Methodology (IFIM) is a framework that uses hydraulic modelling (including hydraulic-habitat modelling) to predict the response of river ecosystems to incremental changes in flow. It is commonly used by Council (and throughout NZ and internationally)

5.5 Of the 18 catchments (or reaches) with minimum flows in the RFP, four have (since the RFP became operative) been subject to full flow assessment studies, including hydraulic-habitat modelling (lower Ruamahanga, Waiohine, Tauherenikau and Otaki rivers). These studies have involved a level of public consultation to establish river values. Advice and assistance from Cawthron Institute staff was sought to ensure the most appropriate science and habitat criteria were being applied in the flow setting decisions.

5.6 Three other rivers (Waingawa, Wainuiomata and Waikanae rivers) have been the subject of more generalised reviews. This involved the Cawthron Institute revisiting historical habitat survey data but applying more conservative fish habitat retention criteria in line with best practice at the time of that review.

5.7 In addition to these reviews of existing minimum flows, instream flow assessments were completed on the Papawai and Otukura streams in 2007/08 and new minimum flows established (linked to the flow monitoring site in each catchment). Both of these catchments had been identified by Council as being a high priority for establishing a flow management regime due to relative high levels of abstraction, low summer flows and high community values. The flow assessments in 2007/08 took into account stream habitat and water quality as well as recreational attributes where relevant.

5.8 Of particular note (with regard to the result of reviews undertaken) is that: existing minimum flows for the lower Ruamahanga River (8,500 L/s at Waihenga), Tauherenikau River (1,100 L/s at Gorge), lower Wainuiomata River (300 L/s at Leonard Wood Park), Waikanae River (750 L/s at Water Treatment Plant) and Waingawa River (1,100 L/s at Kaituna) were confirmed as appropriate for sustaining identified instream values. The existing minimum flows for the Waiohine River (2,300 L/s at Gorge) and Otaki River (2,550 L/s at Pukehinau) were found to be too low to sufficiently protect the habitat of fish with high flow demands (based on adult brown trout requirements). The recommended increase in minimum flow for the Waiohine

River (increased to 2,750 L/s) was relatively small but more substantial for the Otaki River (increased to 4,150 L/s).

5.9 At the time the proposed Plan was notified, minimum flow reviews had not been completed for eleven catchments/reaches, although for some of these (e.g. Mangatarere Stream), minimum flows had been adopted as RFP plan changes as late as 2004.

5.10 For the proposed Plan, a decision was made to retain existing RFP minimum flows in all cases. This included the Waiohine and Otaki rivers where the flow studies mentioned above have indicated higher limits are justified. The reason for this decision is that changes in minimum flow have a direct and immediate impact on the reliability of supply for existing water users. This change in reliability has not been explicitly considered to date as part of the minimum flow review programme. A catchment committee process (whaitua) is currently underway in the Wellington region and is considered the best forum in which to more thoroughly consider minimum flow options and justification for change. The implication of this decision with respect to ecological values for the Waiohine and Otaki rivers is discussed more in response to submissions in paragraphs 5.35 to 5.36 of this evidence.

Response to submissions on minimum flows

5.11 **Submission:** Sustainable Wairarapa Inc (s167/014) seek confirmation that provisions of the proposed Plan ensure minimum flows and allocation limits are set to safe guard the life supporting capacity of freshwater. The following paragraphs address this submission point, with particular respect to minimum flows.

5.12 There is no clear case law to help define the term ‘life supporting capacity’ in the context of setting minimum flows. I agree with Hay et al (2015) that it seems intuitive that ‘capacity’ is not just ‘capability’ (i.e. merely the presence of life) and is more about quantity (i.e. diversity and abundance of life). However, actually demonstrating the minimum flow settings that safe guard a desirable diversity and abundance of aquatic life is problematic

for a number of reasons. Foremost among these is that biological responses (which determine aquatic health) to flow are highly complex and variable between catchments and even within catchments and over time. Existing science is not able to reliably quantify the expected biological response for a given change in flow. The best science can do is provide some characterisation of the risk associated with different flow setting policies, acknowledging that ecological outcomes might be quite different for similar risk levels in different catchments.

5.13 Furthermore, there are a range of stressors (related and unrelated to water quantity) acting on rivers and streams at times when minimum flows are applied. These stressors collectively determine the quality of the environment and the health of the ecosystem. Attributing ecological outcomes to any particular management response (in this case, minimum flows) would be extremely difficult, even with expensive, specifically designed experimental catchment studies.

5.14 For the reasons just described, as well as significant monitoring data limitations[2], it is not possible to address the submission point in a quantitative or conclusive manner. Nevertheless, in the following paragraphs I seek to provide a sense of the level of instream protection being afforded by minimum flows, how this relates to identified values and what the available information tells us about levels of risk.

5.15 As previously mentioned, minimum flows afford varying levels of flow retention from river to river. Figure 1 in Attachment B shows the minimum flow as a proportion of mean annual low flow (MALF) for all catchments listed in the proposed Plan. Research in New Zealand has identified MALF as an ecologically relevant flow statistic with respect to the abundance and diversity of fish because it sets a lower limit to the physical habitat space available within timeframes meaningful to their reproductive cycles (Hay 2010a). Therefore it provides a useful baseline for considering, at a broad level, the question of whether minimum

[2] Existing monitoring programmes have largely been developed with a focus on detecting changes in water quality. Monitoring to isolate the influence of flow changes from those of water quality would be substantially more involved and expensive and have not been done to date (by GWRC or elsewhere)

flows safe guard life-supporting capacity.

5.16 For many rivers and streams (especially those with flat wide channels) the amount of flow retained (by the minimum flow) as a proportion of MALF will offer a good approximation of the amount of habitat retained as a proportion of MALF. In other words, for example, a minimum flow set to retain flow in the river equal to 90% of MALF will retain approximately 90% of the habitat available at MALF. However, the relationship is not always 1:1 and varies with river size and morphology. For example, in steep sided U-shaped channels it is common to find that 90% of habitat available at MALF can be retained with flows that are significantly lower than 90% of MALF.

5.17 As a general guide however, minimum flows of 90% of MALF (or higher) are considered ecologically conservative (e.g. Young and Hay 2017). In larger rivers, where habitat losses with declining flows are not typically as high (as a proportion of MALF) as in smaller streams, minimum flows of higher than 80% of MALF can also be considered as relatively conservative (e.g. that is, if total catchment abstraction is not excessive and abstractions are managed (i.e. reduced or suspended) according to these thresholds, the risk of those abstractions significantly reducing the life-supporting capacity (i.e. beyond naturally occurring reductions) of the waterway during times of prolonged water stress are very low.

5.18 Figure 1 shows that seven of the 21 minimum flows meet (or very nearly meet) these thresholds; they are the Mangatarere, Waingawa, Tauherenikau and Kopuaranga rivers and the Otukura and Waitohu streams. Consequently, the minimum flows in these streams can be considered ecologically conservative.

5.19 Flows were originally set in the 1980s and 1990s for the Mangatarere, Waingawa, Tauherenikau and Kopuaranga rivers using a combination of hydraulic habitat survey techniques and WAIORA[3] water quality modelling. These techniques focus on life

[3] Water Allocation Impacts on River Attributes (WAIORA) is a model developed by NIWA that, like IFIM, provides guidance on physical habitat but it also predicts other environmental responses to flow change (such as dissolved oxygen and water temperature)

supporting stream functions that have an explicit flow dependency (primarily physical habitat space, water temperature and dissolved oxygen).

5.20 The Mangatarere River has the most conservative set of minimum flow provisions in the Wellington region with abstractors being required to heavily reduce or cease take well above MALF (145% of MALF for the upper catchment and 120% for the lower catchment). This was agreed during the flow setting process in 2004 with the explicit intent of helping to "support trout habitat, fishing/spawning and aquatic ecosystems" (Greater Wellington Regional Council 2007) and to compensate, to some extent, for the high level of allocation in this catchment (see paragraph 6.25).

5.21 With respect to the Tauherenikau and Waingawa rivers, Council reviews in 2011 (Thompson 2011b and 2012a) confirmed that the existing minimum flows remain appropriate when tested against more stringent habitat retention criteria for flow-demanding fish than were applied in the original surveys.

5.22 The Otukura Stream was subject to a comprehensive Council study in 2008 (Watts 2008) from which the proposed minimum flow was derived primarily on the basis of maintaining dissolved oxygen levels appropriate to the "*long term protection of aquatic life*".

5.23 The Kopuaranga River minimum flow has not been reviewed in recent years because the existing minimum flow is in the range (80-90% of MALF) considered to be reasonably ecologically conservative and pressure on low flows from abstraction is not considered to be excessive.

5.24 Fourteen of the 21 minimum flows in Figure 1 equate to proportions of MALF that are lower than the thresholds just described in the previous paragraphs (i.e. 90% of MALF for streams and 80% of MALF for larger rivers). Minimum flows for these rivers and streams can therefore be considered less conservative, although this does not necessarily mean they are

inadequate for safe guarding life supporting capacity.

5.25 Of the fourteen rivers, seven minimum flows range from just under 70% of MALF to just under 80% of MALF. They are for the lower Wainuiomata, Waikanae, Ruamahanga and Waipoua rivers and the Papawai and Parkvale streams. In my opinion, the risk of minimum flows in these catchments significantly reducing the life supporting capacity is low, especially in the larger rivers. The following paragraphs provide more detail to support this statement.

5.26 Flows were originally set in the 1990s for the lower Wainuiomata, Waikanae, Ruamahanga and Waipoua rivers using a combination of hydraulic-habitat modelling and WAIORA water quality modelling. Since then, Council has completed reviews of varying detail on all but the Waipoua River. With regard to the lower Wainuiomata River, Hay (2011) advised Council that, although he noted some shortcomings with the original habitat survey methods and interpretation, the minimum flow he recalculated using a generalised model with more conservative habitat retention criteria was only marginally higher (7%) than the original. He questioned whether increasing the minimum flow by such a small margin would lead to any tangible ecological response. It is also noted that a difference in flow of 7% is within the error margin of a standard flow gauging.

5.27 With regard to the Waikanae River, Hay (2010b) advised Council that, while he considered the hydraulic habitat modelling an appropriate tool to use, he had misgivings about some of the original criteria used to set the minimum flow and that a closer review of the catchment was warranted. I subsequently examined a broad set of Waikanae catchment information including water quality, periphyton and fish presence/abundance data (Thompson 2012b). My conclusion was that many of the indicators of ecological health of the river are relatively favourable under the existing minimum flow and allocation regime, and that the potential benefits of an increase to the minimum flow (into the 80-90% of MALF range) would be uncertain.

5.28 A comprehensive IFIM hydraulic-habitat survey was completed on the lower Ruamahanga River in 2007 (Hay 2008). Findings confirmed that the minimum flow of 8,500 L/s at Waihenga was in line with good practice (at the time of the survey) given the fish species present and relative value of the fishery. The minimum flow for the lower Ruamahanga River is discussed in more detail in paragraphs 5.40 to 5.44.

5.29 Similarly, the Papawai Stream minimum flow was established on the basis of a Council flow study (Keenan 2009b) where two of the flow objectives were explicitly focused on life supporting capacity; the first was to protect long fin eel habitat and the second to maintain dissolved oxygen levels above aquatic ecosystem guideline thresholds. Longfin eels do not require as much habitat space as some fish species with higher flow demands (e.g. trout, torrentfish). Studies in the Waikato (described in Keenan 2009b) found that to retain about 90% of the longfin habitat available at MALF, minimum flows in the range 50-75% of MALF would be appropriate. The minimum flow for the Papawai Stream is 75% of MALF and considered suitably precautionary, especially since this stream has a deeply incised channel and reduction in flow below MALF is unlikely to cause an equivalent degree of habitat loss for longfin eel (for the reasons described in paragraph 5.16)

5.30 The rationale for the Parkvale Stream minimum flow is less ecologically-explicit. This catchment has not yet had a full flow assessment, but water abstractions have been subject to restrictions and cease take conditions for a long time. The minimum flow (100 L/s at Renalls Weir) is based on best judgement by Council officers. While it appears, at face value, to be relatively low for a small stream under high allocation and water quality stress, it is notable that mean daily flows fall below 100 L/s on an average of 43 days per summer (and therefore no take is permitted). In dry summers (e.g. 2013/14), cease take conditions can be in force on Parkvale Stream continuously for up to three months. The main point here is that, while the minimum flow is not related to an explicit ecological objective, the

frequency with which cease take conditions occur indicates that the minimum flow is likely to be providing an active safe guard during periods of highest aquatic stress.

5.31 Seven catchments have minimum flows that are substantially lower than 70% of MALF (ranging from about 30% to 50% of MALF). These are the upper Wainuiomata, Orongorongo, Hutt (upper and lower), Waiohine and Otaki rivers and the Mangaone Stream.

5.32 The Wainuiomata, Orongorongo and Hutt are municipal water supply catchments for Wellington, Hutt and Porirua cities. Minimum flows were established for these catchments on the basis of habitat quality guidelines developed by Jowett (1993) and his regional formula for Wellington rivers using available instream habitat survey data from rivers in the region. The rationale for habitat retention applied by Jowett in the 1990s has now been super-ceded by a generally more conservative approach.

5.33 The Hutt Valley and Wellington Harbour is due to begin in 2018. A comprehensive review of the efficacy of the minimum flows (and allocation limits) in all three water supply catchments is expected to be a part of the programme of work for this whaitua. In the meantime, there are several reasons why impacts on these streams are not likely to be as severe as the level of flow retention alone might initially suggest (and why I am of the opinion that the existing minimum flows are appropriate to retain in the proposed Plan).

5.34 The most significant mitigating factor, in my view, is that the reaches that are heavily impacted by the public supply water takes occur are high in the undisturbed (forested) headwaters of each catchment. As a result, the negative consequences of low minimum flows will be offset, perhaps substantially so, by other factors that are more favourable (than in many other areas of high water use in the region) towards maintaining habitat quality at low flows; for example, shading and bankside cover from overhanging vegetation, higher abundance of natural refuge

points such as pools and overhanging banks, more sustained feeding opportunities for aquatic animals and lower water temperatures (among many other favourable water quality/ecological characteristics that are typical of undisturbed headwaters). There are also likely to be fewer fish species in upper reaches due to diadromous lifecycles of most NZ fish species.

5.35 The habitat quality guidelines and regional formula developed by Jowett (1993) were also used to inform the existing minimum flows for the Otaki and Waiohine rivers. A hydraulic habitat survey (IFIM) of the Waiohine River (Keenan 2009c) and a generalised habitat study on the Otaki River (Thompson 2011a) have since indicated that the original minimum flows are unlikely to achieve ecological objectives as defined by more recent scientific consensus (for rivers with high value fisheries and flow demanding species). In the case of the Waiohine, the Keenan (2009c) study recommended an increase in the minimum flow from 2,300 L/s to 2,750 L/s was warranted to ensure an adequate level of habitat retention for adult brown trout. For the Otaki River, brown trout were also identified as a critical value and the recommended increase in minimum flow was more substantial, from 2,550 L/s to 4,120 L/s. As mentioned previously, Council decided to retain existing minimum flows in the proposed Plan for the Waiohine and Otaki rivers rather than move to the higher limits just described. The reason for this was discussed previously (paragraph 5.10) and here I will just provide my view on the ecological implication of the decision as it relates to the original submission point about life supporting capacity.

5.36 Purely based on the technical evidence available for the Waiohine River, I consider the adoption of the higher minimum flow (2,750 L/s) would be more consistent with the principle of safe guarding life supporting capacity (than the proposed Plan approach). However, there is a parallel process already underway (Ruamahanga whaitua) in which this question will be considered further and ecological risks balanced against consequences for existing water users in the catchment. Since

the concept of safe guarding life supporting capacity inherently contains an element of human judgement and preference (around what comprises desirable diversity and abundance) it seems quite appropriate and justifiable that the decision about minimum flow is deferred to the whaitua. The implications for river ecology in doing this, especially given the favourable whaitua decision-making timeframes and the relatively modest increase in minimum being considered, are probably minor.

5.37 My view is slightly different for the Otaki River. The apparent discrepancy between the existing minimum flow and that which I consider to be more justifiable is substantially greater than for the Waiohine River. In fact, the Otaki River has never fallen to the existing minimum flow (records began in 1980), indicating that, as a flow management tool, it is largely ineffectual. Furthermore, the Kapiti Coast whaitua process is not due to begin until 2020 meaning there remains a significant period of time before the merits of raising the minimum flow can be more fully considered. The mitigating factor in this catchment is that current allocation levels are low (360 L/s which equates to 9% of MALF or 18% of allocation available), much lower than in all the other allocated rivers in the region. At this level of allocation the lack of an effective minimum flow is inconsequential. I have some concern however that if the core allocation of the Otaki River is much more fully taken up over coming years (up to 1,970 L/s is available in the proposed Plan) then the ecological risks associated with the existing minimum flow could increase significantly. One way of mitigating this risk without impacting the reliability of supply of existing users would be to substantially reduce the available allocation in the proposed Plan until such a time as the question about the minimum flow has been more thoroughly tested. A nominal allocation limit equating to 15% of MALF (or 590 L/s) would, in my opinion, safe guard the river under existing minimum flow provisions.

5.38 The Mangaone Stream also appears to have a minimum flow that is so low as to be ineffectual (it has never been struck). It was set in the 1990s when limited flow record was available and has only

since been proven to be an outlier when compared to other streams around the region. The level of allocation from the Mangaone Stream is relatively modest (and limited to one abstraction consent in the lower catchment) and the ecological risk associated with the minimum flow is more a potential future one if allocation becomes fully utilised. I would therefore make a similar suggestion as for the Otaki River; that allocation be capped at current consented level (24 L/s), rather than the 45 L/s in the proposed Plan, until the minimum flow can be more thoroughly reviewed.

5.39 For all rivers and streams in the Wellington region that do not fall within one of the 21 catchments described previously, Council is proposing that a default minimum flow equating to 90% of MALF is applied. This is based on guidance in the proposed National Environmental Standard (NES) for ecological flows and water levels (Ministry for the Environment 2008). The rationale is that when this minimum flow is applied in combination with allocation levels of no more than 30% to 50% of MALF depending on river size (defaults which have also been adopted by Council – see section 6 on allocation), the overall degree of hydrological alteration at low flows is unlikely to lead to significant ecological impacts. Consequently, I consider this new default minimum flow (in combination with reasonable allocation limits) will safeguard the life supporting capacity of streams not explicitly named in the Plan, at least with regard to flow dependent potential effects.

5.40 **Submission:** Jim Hedley (s340/002) considers the minimum flow for the Ruamahanga River at Waihenga (8,500 L/s) is set too high and should be set at 7,500 L/s. A new flow recording point should also be established.

5.41 The minimum flow for the lower Ruamahanga River was reviewed by Council in 2008. Cawthron were commissioned to undertake a hydraulic habitat survey and focused on two reaches, one upstream (Morrison's Bush) of the flow control site at Waihenga and one downstream (Bentley's Beach). Consideration was given primarily to the flow preferences of identified high value fish (adult brown trout had the highest flow

demands) as well as other values such as boat passage. Cawthron's modelling suggested that a flow of 8,500 L/s in the Morrison's Bush reach would retain 90% of adult brown trout available at the MALF, and this level of habitat retention is consistent with minimum flows set elsewhere in the region and nationally in recent years given the identified values. Notwithstanding some uncertainty in the flow relationship between Morrison's Bush and Waihenga flow site, Councils best understanding is that a flow of 8,500 L/s at the former equates to a similar flow at the latter (within the margins of gauging errors) and therefore has opted to retain the existing minimum flow at Waihenga of 8,500 L/s.

5.42 Cawthron also recommended a slightly lower flow of 7,500 L/s would be sufficient to sustain values in the lower reach (Bentley's Beach). However, Council do not support lowering the minimum flow at Waihenga to this value for the following reasons. The natural low flow hydrology of the lower Ruamahanga River is very difficult to characterise with certainty due to the extent of cumulative abstraction throughout the catchment. When Cawthron undertook their survey work in 2008 they were using the best available estimates of natural MALF available at the time (including 11,800 L/sec for the lower reach). Since then, data revisions have been made and the current best estimates are higher than previous (approximately 12,600 L/sec for the lower reach). Since the minimum flows originally recommended by Cawthron are based on levels of habitat retention compared with MALF, they would increase in light of the new MALF estimate. Therefore, choosing to adopt the higher of the two original values (8,500 L/s) for the minimum flow compensates somewhat for this effect.

5.43 Also, there is a gathering body of evidence (e.g. Hayes et al 2016 and Hayes et al In Review) that suggests basing minimum flows on hydraulic habitat survey data alone may run more of a risk of underestimating actual fish flow requirements than previously thought, particularly in relatively large rivers such as the Ruamahanga with high value drift feeding fish populations. This

is also especially the case in rivers with high levels of allocation (>40% of MALF) such as the Ruamahanga. While this research cannot yet be applied to the Ruamahanga (or used explicitly in consideration of Mr Hedley's submission point), it signals, in my view, a need to be very cautious about reducing existing minimum flows.

5.44 I do acknowledge that the Ruamahanga River morphology changes noticeably in its lower reaches. Riffles, shallow runs and pools are a dominant channel feature upstream of Waihenga while downstream of this general area the morphology gradually transitions to longer deeper runs and more infrequent riffles. While I consider the minimum flow (8,500 L/s) to be appropriate for reasons discussed, I do think there could be merit (in the longer term) of Council reviewing the flow management regime in the lowest reaches of the river, especially where the low flows begin to be influenced by tides and by the movement of water to and from Lake Wairarapa. Such a review could usefully consider in more detail the transition in habitat diversity along the lower river and emerging research (discussed in the previous paragraph) as well as the potential merits of an additional flow recording station downstream of Waihenga (as sought by Mr Hedley). Based on what we know now, however, I remain of the view that the Waihenga flow control site with a minimum flow of 8,500 L/s is justified.

5.45 **Submission:** Wellington Water Limited (s135/197) believe the minimum flow for the Hutt River at Kaitoke should be able to be reduced to 400 L/s for special circumstances.

5.46 I am aware that approval was given in 2011 (via resource consent WGN000299) for the minimum flow on the Hutt River at Kaitoke to be reduced from the existing minimum flow of 600 L/s to 400 L/s. This consent was granted for a period of three years for the express purpose of maintaining the reliability of municipal water supply while storage lakes were operating at reduced capacity for earthquake strengthening. In arriving at its decision, the hearing panel stated "*We are satisfied, on the basis of the evidence heard and subject to implementation of the ecological*

monitoring and the Low Flow Plan, that the reduced minimum flow will protect the habitat, water quality and recreational values of the Hutt River for the 3-year duration of the consent. We should emphasise that our conclusion is made on the basis that the reduced flow may occur only temporarily – that is, for brief periods over a 3-year period" (Greater Wellington Regional Council 2011). The underline emphasis at the end of the paragraph is mine as it highlights the most pertinent point in my view. The granting of the consent for reduced minimum flow in 2011 should not be viewed as justification for, or the basis of, making more permanent reductions to the Kaitoke threshold.

5.47 I do think a wide range of very useful technical information regarding effects was generated in support of the 2011 Kaitoke consent application and much of it will be directly relevant to any future consideration of the Wellington Water Limited submission point. However, the forum for that future consideration in my view is the Wellington Harbour and Hutt Valley whaitua, which is due to begin in 2018, rather than this current planning process.

5.48 **Submission:** Carterton District Council (S301/006) notes that there is no minimum flow specified for the Kaipatangata Stream and seeks clarification as to whether this is the intention.

5.49 Yes this was intentional. At the time provisions for the proposed Plan were finalised there was insufficient data with which to specify a minimum flow for the Kaipatangata Stream. Therefore, as a tributary of the lower Mangatarere Stream, the minimum flow that applies by default in the Kaipatangata Stream is 200 L/s (as measured at the Mangatarere Gorge flow site). I note that water remains available below this minimum flow for the Carterton District Council public supply take in the upper Kaipatangata Stream in accordance with Policy P111(a).

5.50 **Submission:** Porirua Harbour and Catchment Community Trust (s33/026) wants information provided on how minimum flows were decided for the Pauatahanui Inlet tributary streams.

5.51 Minimum flows for all streams in the Te Awarua-o-Porirua

whaitua, including all tributaries of the Pauatahanui Inlet, are based on the default limit of 90% of MALF. The rationale for applying these limits is explained earlier in my evidence (paragraph 5.39). MALF has been calculated for the Pauatahanui Stream (100 L/s) and Horokiri Stream (80 L/s) based on flow records collected at monitoring sites in these catchments. Any new applications for consent to abstract water from these streams (or their tributaries) will be subject to minimum flows based on these MALF values. While MALF has not been calculated for all of the other streams discharging to the inlet (due to lack of data), the same principle as just described will apply except applicants will be required to submit estimates of MALF from which minimum flow conditions will be specified using the default rule.

5.52 I further discuss proposed allocation provisions in relation to Pauatahanui Inlet in response to another submission later in my evidence (paragraphs 6.40 to 6.44).

6. ALLOCATION AMOUNTS

General background

6.1 Allocation polices of most relevance to my evidence in this section are set out in the proposed Plan in Policy P113 (general), and policies and rules R.P.2/R.R.1 (Ruamahanga whaitua), WH.P.2/WH.R.1 (Wellington Harbour and Hutt Valley whaitua), P.R.1 (Te Awarua-o-Porirua whaitua), K.P.2, K.R.1 (Kapiti Coast whaitua) and WC.R.1 (Wairarapa Coast whaitua). Tables 7.3 to 7.5, 8.2 to 8.3 and 10.2 to 10.3 in the proposed Plan also list allocation amounts for the Ruamahanga, Wellington Harbour and Kapiti Coast whaitua, respectively. The following paragraphs describe the general approach taken to developing the allocation amounts in the proposed Plan.

6.2 Core allocation limits in the Regional Freshwater Plan (RFP, Wellington Regional Council 1999) which became operative in 1999, were calculated in a variety of ways for individual rivers. Examples included simply adopting the actual rate of allocation on the date that the RFP became operative to the use of hydrological statistics to define a limit based on proportion of available low flow (e.g. 60% of the 1 in 5 year flow rate). Some high use rivers did not have allocation limits (e.g. the Hutt, Wainuiomata, Orongorongo and Waikanae rivers that supply municipal water) and there was generally little consistency in approach across the region to defining an upper limit to resource use.

6.3 More importantly, allocation limits in the 1999 RFP were set separately for groundwater (aquifer allocation limits) and surface water (core allocation) with less regard for the hydraulic connectivity between these resources than we now know to be appropriate. While some consideration was given in the 1999 RFP to incorporating the direct effects of riparian groundwater abstractions within surface water core allocation there was insufficient information at the time to more fully define the wider catchment extent of ground and surface water connectivity.

6.4 Another important weakness of the 1999 RFP with respect to

allocation limits is that it did not take specific regard of the cumulative impact of sub-catchment abstractions on parent catchment flows. The Ruamahanga River catchment is where this weakness is potentially of most significance. This catchment comprises more than a dozen sub-catchments, each with their own allocation limit but, historically, there has been no explicit regard (in the form of a limit) for the size of the impact of all abstractions in these sub-catchments once they accumulate to the main stem of the Ruamahanga River.

6.5 The allocation provisions in the proposed Plan seek to address, at least partly, some of the limitations just described. Primarily they do this, in my view, by applying a consistent lens across catchments and defining allocation amounts that are proportional to the amount of water available at low flow using a natural flow index (mean annual low flow, MALF) that is ecologically meaningful. This approach ensures that the pressures of abstraction are spatially distributed more in accordance with the capacity of rivers and streams to sustainably meet demand and that the cumulative impact of sub-catchment abstraction on parent catchments can be more carefully managed.

6.6 There remain some limitations with the proposed Plan approach to setting allocation amounts. Foremost among these in my mind is that rivers and streams have different values and respond differently to abstraction pressures. I acknowledge that the approach of using a common rule of thumb based on proportion of MALF to set allocation is not particularly sensitive to this real world variability. Ultimately, allocation amounts will be refined by whaitua committee on the basis of fuller discussions about both instream (ecological, cultural, recreational) and out of stream (abstractive) values and development of firmer catchment objectives. Until that occurs, the intent in the proposed Plan is to establish an allocation framework that is more consistent with contemporary planning requirements to broaden the application of resource limits, consider cumulative effects and be ecologically precautionary.

Response to submissions

6.7 There are several submissions that relate to the general appropriateness of, and rationale behind, the core allocation amounts in the proposed Plan. Some oppose the Council approach while others are in support. These submissions are summarised in paragraphs 6.8 to 6.10 below and then addressed collectively by my subsequent evidence.

6.8 **Submission:** Federated Farmers (S352/256) submit that "the proposed new "default" allocations are based on "partial information", or more specifically based on value judgements and assumptions made in estimating "naturalised" MALF. No rationale is presented". They oppose this approach and recommend the operative core allocations apply as in the Regional Freshwater Plan (RFP, Wellington Regional Council 1999) pending more detailed whaitua consideration. Waa rata Estate (FS1/047) support the Federated Farmers submission on this point as it is consistent with the intention to use the whaitua process to establish the framework for taking and using water.

6.9 **Submission**: Rangitane o Wairarapa (FS74/095, 96) oppose the Federated Farmers point of view and suggest minimum flows and allocations should be derived based on the best evidence available at the present time and a precautionary approach applied where there is in sufficient or uncertain information. There is some indication (in their view) that the existing RFP allocation and minimum flow standards are causing a long term adverse effect on water bodies and therefore are not consistent with the outcomes intended by the RPS, NPS-FM, objectives of the proposed Plan and the RMA.

6.10 **Submission:** The Minister of Conservation (s75/203) believes the allocation limits in Table 7.3 (of the proposed Plan) are appropriate and are based on guidance in the Proposed NES for ecological flows. (FS61/067) from the Minister of Conservation opposes keeping the current allocation limits in the Freshwater Plan as the provisions will not give effect to the RPS or the NPS-FM.

6.11 I respond firstly to the points raised in the Federated Farmers submission (paragraph 6.8). It is true that the default allocation amounts are based on “partial information”. The absence of full information and understanding when setting allocation limits is not an uncommon situation to be in. As described earlier in my evidence, biological responses to flow alteration are highly complex and spatially variable and there are a range of stressors (related and unrelated to water quantity) acting on rivers and streams at times of low flow. It is therefore normally impossible (outside of highly designed experiments) to confidently quantify the ecological consequences of different allocation amounts. We need to rely instead on understanding generalised relationships and levels of risk.

6.12 The default allocation amounts (30% of MALF for small rivers and streams and 50% of MALF for large rivers) are based on guidance from the proposed National Environmental Standard on ecological flows and water levels (Ministry for the Environment, 2008). The NES guidance in turn is based on a body of New Zealand research (summarised in Beca, 2008) that has characterized the general risks associated with exceeding certain allocation thresholds (extended duration of low flows leading to, for example, nuisance algae blooms and aquatic habitat degradation). An analysis of three rivers with quite different flow regimes (from the Otaki River with high base flow, to the Kopuaranga River with moderate base flow and the Whareama River with low base flow) described in Thompson and Mzila (2015) supported the notion of scaling the amount of water for abstraction based on river size in the Wellington region and also indicated that the 30% and 50% of MALF thresholds were generally appropriate (i.e. likely to avoid extending the duration of low flows beyond 30 days per year).

6.13 I do acknowledge that the default amounts are unlikely to be equally appropriate across catchments. For example, some of the impacts described in the previous point are less likely to be apparent (under similar levels of allocation) in the deeper U-shaped channels typical of spring fed streams than they are in

gravel bed river environments. Nevertheless, in the absence of a finer understanding about how different stream environments respond to allocation and what level of risk communities are prepared to accept, I think allocating on the basis of a common fraction of MALF based on our most up to date understanding of naturalised flows (consistent with the approach to the default allocation limits in the proposed NES) generally has a more ecologically explicit and justifiable rationale than retaining existing core allocations.

6.14 I note that Rangitane o Wairarapa generally support the Council approach due to what they consider to be indications of adverse effects related to existing allocation limits. As I mentioned earlier, quantifying cause and effect in relation to existing limits and resource use is not possible. However, I do consider that the sentiment of the Rangitane o Wairarapa assertion is supported by some observations from recent catchment studies. For example, a report on the quality of water in the Mangatarere River (Milne et al 2010) concluded that it is highly likely that abstractions are exacerbating periods of stream drying by increasing the frequency and duration of low flows and included water abstractions among a range of stressors contributing to "significant impacts on stream health". In another example, Keenan (2009b) expressed discomfort with the level of allocation in the Papawai Stream. This was based, in part, on observations of declining dissolved oxygen levels during times of low flow that were being further exacerbated by abstraction (although the ecological consequence of this was not clear). I agree with Rangitane o Wairarapa that such observations, while not conclusive, are reasonable justification for taking a more cautious approach to allocation, especially in smaller stream catchments.

6.15 Federated Farmers raise concern in their submission about the assumptions behind the naturalisation of low flows. Flow 'naturalisation' refers to the process of 'correcting' observed/measured flow to account for alterations caused by upstream abstractions, diversions or discharges. The natural flow record that results is considered a more appropriate basis (Beca

2008, Hayes et al In Review) from which to then make an assessment of allocation levels. If you do not naturalise the flow record then you risk under or over estimating true natural MALF and gaining a false impression of the extent to which allocation will modify a river from its natural hydrological state.

6.16 Natural MALF estimates used in the proposed Plan have been derived for the Ruamahanga River main stem by Thompson (2014) and for other rivers and streams throughout the region by Keenan (2009a). In addition to those reports, Appendix 3 in Thompson and Mzila (2015) provides a fuller discussion of the methods and assumptions. In the absence of long term and complete metering data of actual water use, it is not possible to quantify the full extent of 'corrections' that are needed to accurately recreate a natural flow record. However, in my opinion, the estimates that have been derived incorporate a reasonable attempt to minimise this error as much as current information allows. They do this by at least capturing the most significant abstractions and discharges and making assumptions about likely levels of resource use at times of flow measurement based on Council staff experience and metering records where available.

6.17 Although it is not possible to quantify the error in the natural MALF estimates, I undertook a sensitivity analysis of four main assumptions made when naturalising the Ruamahanga River flows (described in Thompson 2014). These assumptions related to (1) the proportion of allocated water that is actually used, (2) the proportion of water race flow that returns to the main river, (3) the extent to which historical restrictions on abstractions have been imposed and (4) the likely increase in overall water use over the 35 year period of flow record analysis. My main conclusion was that the change related to applying quite different individual assumptions was generally less than about +/- 5% of the natural MALF estimate (although, collective uncertainty may amount to more than this when the error of all assumptions are combined).

6.18 Overall, I am not aware of any evidence to suggest that the natural MALF estimates are significantly biased in one direction or another and I think they represent a reasonable basis upon

which to set allocation amounts (and are preferable to using non-naturalised MALF statistics).

6.19 Turning to the Federated Farmers submission point about retaining existing RFP core allocations rather than the default amounts in the proposed Plan. It is not clear from their submission (summarized in paragraph 6.8) whether any distinction is intended between surface water allocation and groundwater allocation. I will address both in my response since the definition of core allocation in the proposed Plan covers both.

6.20 In paragraphs 6.2 to 6.6 I set out reasons why I think it is preferable to adopt the proposed allocation amounts. For groundwater, Council's fundamental understanding of hydrogeology across the region has substantially improved in the past decade (see evidence of Dr Gyopari and Mr Hughes) such that 1999 RFP management zones (i.e. aquifer zones) and allocation limits (or "safe yields" as they have been described) are no longer considered relevant. A good illustration of the extent of change to management zone boundaries is provided in Attachment C, where Table 1b compares RFP groundwater provisions with those in the proposed Plan. Taking an example from this table, the RFP groundwater management zones of 'Fernridge', 'Upper Plain' and 'Masterton' all had individual allocation limits (Column B). Council's current understanding based on groundwater modelling is that these three zones are sufficiently hydraulically connected to one another to warrant being merged into the 'Waingawa Groundwater Zone' (Column E) with a single allocation amount (Column G). The new amount is also based on an improved understanding of 'safe yield'. The approach taken in the RFP was that all aquifer recharge was essentially considered available for allocation. By contrast, current sustainable aquifer management practice, which is reflected in the new amounts, suggests that only a portion should be. For both these reasons I am of the view that retaining the RFP groundwater allocation limits would be both practically unworkable (in terms of giving effect to the new conjunctive water framework and management zonation) as well as inconsistent

with the best available information we have on sustainable use. Dr Gyopari comments further on the points above in his evidence.

6.21 With respect to introducing the proposed Plan default river allocation amounts in favour of the RFP limits, my evidence covers two main points. Firstly, I consider the default amounts to generally have a more transparent link to likely ecological outcomes and be based on more robust low flow data (i.e. naturalised) than the RFP limits. The default amounts provide measures of hydrological alteration caused by abstraction that have been related to ecologically meaningful thresholds (Beca 2008, as described in paragraph 6.12). Secondly, the default amounts provide coverage in catchments for which current RFP limits do not exist and also provide a more equitable and, in my view, robust framework for managing cumulative effects (for reasons stated in paragraph 6.5).

6.22 In addition to mitigating the risk of abstractions causing significant harm during low flow events, the default amounts should also ensure that the alteration of flows in the low to mid-range (i.e. between MALF and median) are not excessive. There is a growing body of evidence in New Zealand and internationally (most recently summarised by Hayes et al In Review) that emphasises the importance of low to mid-range flows for river productivity (i.e. benthic invertebrate production, especially important for feeding fish).

6.23 My analysis of flow duration curves (using the NIWA EFSAP model[4]) shows that the default allocation amounts should limit the reduction in summer median flow (a commonly used surrogate metric of habitat availability to support invertebrate production, which in turn feed fish and birds) to about 10% for small rivers and streams and 20% for larger rivers. In the absence of more river specific data on values and biological responses these impacts are, in my judgement, sufficiently small to be considered acceptable and consistent with the principle of safe guarding life supporting capacity.

[4] Environmental Flows Strategic Allocation Platform, a water planning and management tool designed by NIWA to assist with water resource limit setting.

6.24 I do acknowledge that for catchments that have been subject to a higher level of planning and consultation in arriving at the existing core allocation limits (e.g,. Kopuaranga, Mangatarere) the argument for moving to default allocation amounts (i.e. that are not related to catchment-specific objectives) is less compelling. However, even for these catchments, I remain of the view that the default amounts are the better option. This is primarily because Council's understanding of natural catchment flows (discussed previously in paragraphs 6.15 to 6.18), upon which default amounts are based, has improved since the last of the existing limits were introduced to the RFP in 2007. Natural MALF estimates (described earlier) have created new and sometimes slightly different perspectives about levels of alteration caused by existing abstraction.

6.25 Secondly, the point about the importance of low to mid-range flows from the paragraph 6.22 is also pertinent here. For example, when the core allocation limits for the Mangatarere River (180 L/s in the upper catchment and 140 L/s in the lower catchment) were settled in 2007, the discussion between stakeholders and Council focused on compensating for the high levels of allocation by establishing relatively conservative minimum flows. While this was a prudent step in my view, and in line with current flow-setting practice. However, the higher minimum flows still do not prevent very substantial alteration of flows in the range between MALF and median (~50%). The default amount proposed for the Mangatarere River (110 L/s) is based on limiting allocation to 30% of MALF and is justified in my view because it better reflects more recent thinking around flow setting rationale (that is relevant to this river) and preserves low to mid-range flows to an extent that is more consistent with precautionary practice.

6.26 Tables 1 to 3 in Attachment C provide a comparison of allocation status under the existing RFP limits and the proposed Plan amounts. A key point is that once cumulative allocation from sub-catchments and groundwater are accounted for (as required under the NPS-FM) under the proposed Plan regime, the

allocation status for rivers and streams remains largely the same whether the existing limits are retained or the new amounts imposed.

6.27 A comparison of the allocation status for the Ruamahanga River catchment in Table 1a of Attachment C illustrates this point. The catchment as a whole is considered fully allocated under the new default amounts based on total cumulative allocation (8,046 L/s) exceeding 50% of MALF (7,535 L/s) in the lower Ruamahanga River (Column G). This effectively means no further water can be allocated from any upstream sub-catchments, even though, individually, several of them have allocation available (Column F).

6.28 Under the existing RFP limits regime it appears, at face value, that there is water available to allocate in almost all of the sub-catchments (Column C) as they are not constrained by a whole of catchment amount. However, once connected groundwater takes are more fully accounted for than they have been in the past (Column D) then existing sub-catchment core allocation limits (Column B) are exceeded and the allocation status is the same as under the proposed Plan regime.

6.29 Notwithstanding the point just made, I think there remains sufficient justification to introduce the new allocation amounts because they provide, in my view, a more appropriate and consistently applied representation of the level of ecological risk posed by current allocation than the existing RFP limits. I note the Minister of Conservation supports this Council approach.

6.30 **Submission:** Royal Forest and Bird Protection Society (s353/123) submit that the core allocations in Policy P113 are too high and do not give effect to the NPS-FM. In their view, the maximum allocation amounts should be set at a level which provides for ecological health (which they consider to be a significantly lower allocation than in the proposed Plan policy). Although I cannot speculate about their reasoning as the submission is not specific and does not make an alternative suggestion for allocation limits, I do not share this view. My reasoning is set out earlier in my evidence and expanded on in

the following paragraphs.

6.31 I note that the submission point relates only to rivers and streams outside of the Ruamahanga, Wellington Harbour and Kapiti Coast whaitua areas (as this is what Policy P113 is constrained to). However, since the same criteria as in P113 have been used to establish allocation amounts within whaitua areas as well, I have not limited my comments strictly to the scope of the submission.

6.32 All of the rivers in the Wellington region that meet the large river criteria (and have a meaningful allocable low flow5) arise in the central Tararua or Rimutaka ranges. They are subject to relatively frequent summer flushing flows and typically have relatively well supported summer base flows. Both of these features make these types of rivers more resilient in the face of abstraction at low flows. My analyses of flow alterations (referred to earlier in paragraph 6.12) suggest that allocation levels of 50% of MALF are unlikely to significantly exacerbate impacts from low flow events or reduce mid-range flows excessively.

6.33 It is also not the case that allocation equates to actual take. It is extremely unlikely that all abstractions in a catchment will be fully exercised concurrently for a significant and continuous period of time (as is simulated when the hydrological alteration of different levels of allocation is calculated). Previous Council water metering surveys (e.g. Baker and King, 2007) have suggested that a figure of up to about 80% of cumulative allocation rate of take (as a daily average across a catchment) might provide a more realistic view of actual flow alteration caused during prolonged periods of peak water use. With this and the previous paragraph in mind, I consider the default amounts for larger rivers to be more conservative than they might appear upon first assessment.

6.34 With respect to the default amount for smaller rivers and streams (30% of MALF), when combined with relatively conservative

[5] Only two rivers in the Wellington region that do not originate in the Tararua Range meet the large river criteria (mean flow >5,000 L/sec). These are the Whareama and Pahaoa rivers that drain the eastern Wairarapa hill country. Both of these rivers typically experience very long and extreme summer base flow recessions and have very low MALF (30-100 L/sec). Potential allocable flow is consequently minor (i.e. up to 50 L/s under the 50% of MALF rule for the Pahaoa River) and when combined with relatively conservative minimum flows (90% of MALF) is unlikely to have a significant impact on low flow characteristics (magnitude and duration of flow flows).

minimum flows, as it is in non-whaitua areas (90% of MALF), I am of the view that it offers an appropriate degree of protection to instream values. Within the whaitua areas, I note that the proposed allocation amount (based on 30% of MALF) is substantially lower than existing use in a large majority (75%) of relevant catchments.

6.35 I do acknowledge that the default amounts are not at the most ecologically conservative end of the spectrum. For example, Beca (2008) in their guidance for the proposed NES on ecological flows suggest that allocation levels of >40% of MALF should be considered a high level of allocation, irrespective of river type. However, there is no firm advice from either Beca (2008) or within subsequent NPS-FM supporting documentation about what constitutes excessive or over allocation. Notwithstanding the value-based judgements implicit in this question, I do not consider that the proposed default amounts are excessively high for the reasons just described.

6.36 **Submission:** Dairy NZ and Fonterra Co-operative Group (s316/136) support Policy R.P2 as it allows allocation to be the greater of that allocated by resource consents or the allocation limits in Tables 7.3 to 7.5 of the proposed Plan. However, they have concerns as to "how the allocation limits in these tables have been set and there is no explanation provided".

6.37 The derivation of the allocation amounts for the Ruamahanga River catchment in Tables 7.3 to 7.5 (and the other whaitua areas) is described in Thompson and Mzila (2015). In general terms, the surface water allocation amounts (Tables 7.3 and 7.4) equate to either 30% of MALF or 50% of MALF at the mouth of the relevant catchment[6] while groundwater allocation amounts are based on consideration of both the long term surface depletion effects as well as aquifer recharge. The actual derivations of individual management unit and sub-unit allocation amounts are described in more detail in Appendix 1 of Thompson and Mzila (2015).

[6] Managing the local effects of abstraction (e.g. to prevent excessive local scale stream flow depletion) is given regard to in the proposed Plan in Policy R.P.3 (within the Ruamahanga River catchment) and also as a matter of discretion in the whaitua rules regarding Take and Use of Water.

6.38 It may be helpful to illustrate by way of examples. The surface water allocation amount for the Waipoua River management sub-unit is specified in Table 7.3 (of the proposed Plan) as 145 L/s. This equates to 30% of the estimated natural MALF (490 L/s) at the confluence of the Waipoua River with the Ruamahanga River (i.e. the bottom of the Waipoua catchment). Thirty percent was chosen because mean flow in the Waipoua River is 3,600 L/sec (lower that the 5,000 L/sec threshold used to define 'large' from 'small' rivers). The estimate of natural MALF (490 L/s) was derived by Keenan (2009a) on the basis of eight concurrent low flow gauging runs in the catchment spread from the late 1970s to 2009 (adjusted to account for any significant abstractions likely to be impacting flow at the time of the gaugings). The same approach as just described was taken to deriving the allocation amounts in all other catchments.

6.39 The following is an example of how groundwater allocation amounts have been derived. Table 7.5 in the proposed Plan shows that the groundwater allocation amount in the Te Ore Ore zone is 0.48 million m^3/year. This limit was primarily based on ensuring that the predicted seasonal depletion effect was not greater than 9% of MALF for the Poterau Stream and 0.5% of MALF for the Ruamahanga River. Once the amount (0.48 million m^3/year) was identified, it was checked against the annual recharge for the zone and found to be 27% of the lower quartile. Figure 2 in Attachment B shows the large inter-annual variability in modelled recharge for the Te Ore Ore zone and that there are several occasions when at least two successive years of recharge well below the mean occur. The choice to keep groundwater allocation amount below about 30% of the lower quartile of annual recharge was made to ensure that abstraction does not outstrip recharge by a large amount during successive dry years. A similar approach to that just described was taken to deriving the allocation amounts in all groundwater management units and is explained in more detail by Dr Gyopari in his evidence.

6.40 **Submission:** Christine Stanley (s87/008) expresses concern in

her submission about the increased development in the Pauatahanui Inlet catchment leading to increased water taken from streams and reducing the flushing ability of the inlet. She submits that when setting water take limits Council need to consider the effect on the flushing ability of the inlet.

6.41 Consented water use from streams in the Pauatahanui Inlet catchment is currently quite modest, totaling about 19 L/s spread across four activities in the Pauatahanui and Horokiri Stream catchments (see map in Figure 3). This total equates to only about 10% of the combined MALF for these two streams. Other water use (e.g. by rural lifestyle blocks and for stock and domestic requirements) occurs via permitted activity rules and is not measured. Therefore, Council does not have an accurate sense of total cumulative use and how this might have changed in recent years.

6.42 A desktop modelling study (Beca 2011) estimated the magnitude of unconsented surface water use in about 40 catchments across the Wellington region based on some assumptions about the water demands associated with different property types (following a method developed for Waikato Regional Council). Unfortunately, no Pauatanhaui Inlet stream catchments were included, however, the study findings remain informative on this submission point. Unconsented use was estimated to vary significantly across the region, being highest (as a proportion of catchment low flows) in the very large, dry stock farming catchments of eastern Wairarapa. In catchments towards the west, and probably more representative of the scale of use in the Pauatahanui area, estimates of use ranged between about 1% and 5% of MALF. Even if total unconsented use was substantially more than these predictions in the Pauatahanui area, in my view it would still likely be a relatively small fraction of total summer flow flows, even when combined with consented use, and unlikely to significantly reduce total flows to the inlet.

6.43 To further investigate the submitters point I assessed patterns of total summer flow over time for the Pauatahanui and Horokiri streams, as measured quite near the bottom of each catchment

(see location of flow recorder sites in Figure 3 in Attachment B). Figure 4 shows the total measured stream flow (as a volume in m^3 for each year of record since 1975) combined for the four peak summer months of December to March when water use is expected to be highest. My interpretation of this graph is that, while summer flow volumes were relatively subdued between about 2005 and 2015 (compared with earlier parts of the record for the Pauatahanui Stream), there is no evidence of a systematic change in the pattern of annual variability or significant reduction in volumes in either catchment that is suggestive of increased abstraction (as opposed to climate drivers).

6.44 I note that the Pauatahanui Inlet is described as a "well flushed" tidal lagoon by Stevenson and Robertson (2013) and, based on the water use and flow assessment above, I do not expect that the magnitude or timing of water abstraction from tributary streams will change this status. Tides and high stream flow events are likely to be much more influence on flushing of the inlet. Nevertheless I do agree that the inlet receiving environment should be considered when setting allocation amounts and, in my opinion, the default rules that apply in the proposed Plan to all tributaries of the inlet (in particular, that the maximum allocation amount should not exceed 30% of MALF and that flushing flows are preserved under any supplementary allocation activity) are, albeit indirectly, sufficiently precautionary in this regard.

6.45 **Submission:** Wellington Water Limited (WWL) abstracts from the Hutt, Wainuiomata and Orongorongo Rivers. In their submission (s135/110, 202), WWL state that the authorised consented takes are several times the allocation amounts in the proposed Plan (Table 8.2) and that Policy WH.P2 relies heavily on Table 8.2 being correct. WWL want core allocations for Wainuiomata and Orongorongo Rivers to be 460 L/sec. They submit that the takes are managed to maintain the minimum flows specified in Table 8.1 of the proposed Plan and that the allocation amounts in Table 8.2 are default without specific assessment of environmental effects of the water taken from these rivers. There is no evidence in their view that the takes are having a detrimental impact on the

biota of the rivers. WWL request (s135/200) a footnote to Table 8.2 of the proposed Plan which acknowledges the current allocation in some rivers exceed the default values shown in the table.

6.46 The approach taken to calculating the allocation amounts for the Hutt (2,140 L/s), Wainuiomata (180 L/s) and Orongorongo (95 L/s) rivers was consistent with that applied elsewhere in the region. The allocation for the Hutt River equates to 50% of estimated natural MALF (4,275 L/s[7]) at the mouth of the river and 30% of estimated natural MALF for the Wainuiomata River (600 L/s) at the mouth and Orongorongo River (320 L/s) upper reach (based on estimates provided by Keenan, 2009). The submitter is correct that no specific assessment of environmental effects of the current allocation was undertaken in support of the application of the default limits. Rather, it was considered that, until such a time as the effects can be more thoroughly characterised, the precautionary approach is to set an allocation amount that we can be confident provides appropriate ecological safe guards.

6.47 It may well be that the allocation amounts for the Wainuiomata and Orongorongo rivers (especially) are determined through the forthcoming whaitua process to be overly conservative. In the meantime, it is my opinion that setting of the default amounts provides a yardstick of hydrological alteration that is consistent with other rivers in the region. I also note that the concern raised by the submitter about existing levels of allocation being substantially higher than the default amounts is essentially addressed by the policy that protects existing use rights.

6.48 **Submission:** Hammond Limited (s132/024) believe the allocation amount (referred to in their submission as minimum flow) in Table 7.3 of the proposed Plan should be increased in the 'Middle Ruamahanga Catchment – Papawai Stream and tributaries and Category A groundwater' management sub-unit to reflect current consented allocation.

[7] See Appendix 1 of Gyopari (2015) for a description of how MALF was derived

6.49 This submission point is similar in principle to the Wellington Water Limited submission just discussed and my response is correspondingly similar (and therefore not fully repeated here). The allocation amount for Papawai Stream sub-unit (65 L/s) has been set, in accordance with the default method for small rivers/streams, to equate to 30% of MALF. The natural MALF estimate for Papawai Stream (upstream of and, therefore, excluding Tilsons Creek) is 210 L/s. As mentioned earlier in paragraph 6.14, there has been some concern expressed in the past (Keenan 2009b) about the relatively high level of allocation in the Papawai Stream and increased risk of deleterious ecological impact it poses. With this in mind, in my view, setting an allocation amount equal to existing use in this catchment would not be consistent with a precautionary approach (although I also note here again that the concern raised by the submitter is essentially addressed anyway by the policy that protects existing use rights).

6.50 The Hammond Ltd submission has highlighted a technical matter that I recommend be addressed through the Plan Hearing. As mentioned in the previous paragraph, the proposed allocation amount (65 L/s) applies only to the Papawai Stream upstream of Tilsons Creek. However, this catchment delineation is not clearly made in the proposed Plan and supporting materials (including allocation tables) to date. There is merit in my view in re-calculating the Papawai Stream allocation amount to include Tilsons Creek (in which case it would move from 65 L/s to 105 L/s (based on a combined MALF of 350 L/s).

6.51 **Pre-hearing meeting issue:** In Stream 1 of the proposed Plan Hearing (25 May 2017), Federated Farmers expressed concern that significant changes were made to water allocations (I assume they refer to amounts) between the draft Plan and the proposed Plan.

6.52 Changes that were made to allocation amounts between the draft and proposed versions of the Plan related to corrections in flow statistics and planning matters identified by the Council staff involved in developing the allocation provisions. Tables showing

the changes in detail are appended as Attachment D to this evidence.

6.53 Overall, the actual change in the amount of water allocated was very minor (<5%) and related mostly to a refinement of flow statistics. The reasoning behind the changes in discussed in more detail in the following paragraphs.

6.54 Firstly, an error regarding how a single large consent had been accounted for in original flow naturalisation calculations for the Ruamahanga River was corrected. This resulted in revised estimates of natural MALF (from which allocation amounts are calculated), although the changes were small (between 1 and 4%, shown in Table 1 of Attachment D). A minor revision was also made to the natural MALF estimate for the Hutt River (leading to about a 1% change in the allocation amount for this river).

6.55 Secondly, Council staff came to a view that including individual allocation amounts for so many multiple reaches within catchment management units was both overly complicated to interpret (and administer) and difficult to justify due to uncertainty in extent of hydrological change between reaches. The removal of some reach allocation amounts specified in the draft Plan did not result in a reduction in the total amount of water available in each relevant catchment management sub-unit in the proposed Plan.

6.56 Thirdly, the nesting of sub-unit allocation amounts within allocation amounts for parent catchment management units (the approach taken in the draft Plan) was considered problematic in a planning sense (gives the impression of double counting). Furthermore, the draft Plan split the Ruamahanga River catchment into three discrete units (upper, middle and lower) without sufficient regard for how water allocated from upstream units would impact on downstream allocation status and reliability for users. The revisions in the proposed Plan address this by introducing a dual test; i.e. catchment sub-unit allocation amounts must be considered in conjunction with the allocation amount for

the whole of the Ruamahanga River.

6.57 Changes in the allocation amounts resulting from all of the revisions just described are shown in Tables 2 to 5 in Attachment D. As mentioned, changes in the total amount of water available were very minor (i.e. a reduction of 290 L/s equating to about 4% of allocation at the bottom of the Ruamahanga River) but the proposed Plan attempts to make it clearer where the water is available. The changes were considered necessary to both simplify the allocation framework as well as align it better with good planning principles (especially around accounting for cumulative impact).

7. SUPPLEMENTARY ALLOCATION

General background

7.1 'Supplementary allocation' refers being the water that becomes available for allocation at higher river flows in addition to that already available under 'normal' allocation (described in section 6). Supplementary allocation polices of most relevance to my evidence are set out in the proposed Plan in Policy P117 (general), and Rules R.R.1(c) (Ruamahanga whaitua), WH.R.1(c) (Wellington Harbour and Hutt Valley whaitua) and K.R.1(c) (Kapiti Coast whaitua). The following paragraphs describe the general approach taken to developing the supplementary allocation provisions in the proposed Plan.

7.2 The current Regional Freshwater Plan (RFP 1999) identifies mid-range flow thresholds for some rivers above which supplementary allocations are available. It is difficult to trace the exact basis for the numbers. Only the Mangatarere Stream threshold has explicit reasoning – to maintain optimum brown trout habitat. The other numbers are largely arbitrary and vary from river to river – some supplementary flow allocation levels are only marginally above minimum flow levels whilst others are more genuine mid-range flow thresholds. No supplementary allocation amounts are specified in the RFP, leaving this aspect of the policy open to interpretation and discretion.

7.3 For the proposed Plan, a panel of freshwater experts was assembled by the Council in 2011 to provide advice on supplementary allocation criteria. There was a consensus of opinion in that group that the data and knowledge with which to derive ecologically-explicit supplementary flow thresholds is very limited, even more so than for thresholds at low flows (for core allocation). However, they were able to agree on some key guiding principles: (1) that median flow is ecologically relevant (often viewed as providing an approximation of typical habitat conditions, and therefore carrying capacity & productivity, during flow recessions – see Hay and Kitson 2013), and (2) that preserving flushing flows (and hence a fundamental part of the natural flow regime) is important, especially for ensuring that

periphyton accrual is not encouraged by abstraction.

7.4 From these principles it was considered that supplementary allocation should only be available above median flow (i.e. so that there is no further reduction of flows in the range between MALF and median) and that the frequency of flushing flows (defined as three times median or higher) should not be altered.

7.5 The group also agreed that, in addition to the above criteria, some form of cap to the amount of flow removal above median was needed but no strong views on the size of this cap were forthcoming. Ultimately, Council decided on a maximum 50% flow removal, thereby providing equal 'share' for users and maintenance of instream values.

Response to submissions

7.6 Three submissions were received on the proposed Plan supplementary allocation provisions.

7.7 **Submission:** Fish and Game (s308/129, 133) consider supplementary allocation should only be provided for where the objectives of the Plan are achieved (relating to protecting natural character including hydrological regimes and variability, and safeguarding life-supporting capacity and recognizing and providing for contact recreation, trout habitat, indigenous fish habitat and cultural values including mahinga kai). Maintaining variable flows within rivers is also important for sustaining mauri. Fish and Game have suggested that the policy needs to be amended to be more consistent with principles above and have proposed alternative wording (see Attachment E).

7.8 **Submission:** Rangitane-o-Wairarapa (s279/148) had a very similar submission; that the supplementary take regime should be consistent with achieving objectives of the Plan and sustaining the mauri of waterways. They included reference to life supporting capacity, safe guarding mahinga kai, preserving natural character and providing for natural processes (maintaining flow variability).

7.9 **Submission:** The Minister of Conservation (s75/105) requests

that a fixed percentage limit/cap is included in the supplementary allocation policy (rather than a proportional cap) although have not elaborated further on what they think this should be.

7.10 To explore the submitter concerns a little more I have undertaken some analysis on two contrasting waterways; the Waiohine River, a large, frequently flushed river (rising within the Tararua Range) with relatively high base flows and the Papawai Stream, a small valley floor stream with relatively infrequent flushing and low base flows. For each, I have selected a typical year (July to June) and applied an abstraction regime that simulates full potential use of supplementary allocation (meeting the flushing flow criteria of the policy) but also reflects likely practical limits water users would face such as not being able to harvest during peak flows that are likely to be heavily sediment-laden. This means generally only harvesting water on flow recessions between flows of three times median and median flow.

7.11 Figure 5 in Attachment B shows a mean daily time series of natural (blue) and modified (red) flow for the Waiohine River. In the year presented (2012/13), supplementary allocation would have been available on about 135 days and, if fully exercised, would have caused a median total reduction in daily flow of 16% (and a maximum of 33%). There is no influence on the median flow or the low flow regime (e.g. increased extent/duration of low flows), nor is there any reduction in the frequency or magnitude of flushing flows. While judging the level of acceptable change to a natural flow regime is dependent on catchment specific values and objectives, my interpretation of the results for the Waiohine River is that the alteration possible under fully exercised supplementary allocation is reasonably minor. I would not expect it to compromise the values described in either the Fish and Game or Rangitane-o-Wairarapa submissions.

7.12 Figure 6 in Attachment B compares the same mean daily time series of natural and modified flow but for the Papawai Stream. The potential impact on the stream is more severe than for the Waiohine River. In the year presented (2006/07), supplementary allocation would have been available on about 150 days. Under

full allocation, the median total reduction in daily flow of 16% is about the same proportion as for the larger river but the maximum is higher at 44%. Again, there is no influence on the median flow or the low flow regime (e.g. increased extent/duration of low flows). Overall, I consider the potential level of hydrological alteration illustrated in the Papawai Stream example is quite significant, especially given the typically lower resilience of small streams to stressors (compared with larger rivers).

7.13 The points raised by submitters and the analysis just described have highlighted, in my view, a weakness in the supplementary allocation policy. When the policy was formulated it is fair to say that the focus of discussions was on larger rivers with frequent flushes and the policy was intended to be both environmentally precautionary but enabling towards flow harvesting schemes. I think it achieves this for those types of rivers. However, I think the region-wide rule also exposes smaller rivers and streams to levels of risk that are hard to justify. In this regard, I am inclined to agree with the sentiment of the Fish and Game, Rangitane-o-Wairarapa and Minister of Conservation submissions and I support the notion of amending the existing rule.

7.14 The alternative I suggest is to introduce a smaller cap to supplementary allocation available from rivers and streams with mean flow rates under 5,000 L/sec (this is consistent with the flow threshold used to distinguish between ‘large’ and ‘small’ rivers for the proposed core allocation amounts). The size of the cap suggested by Fish and Game (i.e. 10% of total flow) is reasonable in my view and I would support its incorporation in the proposed Plan.

7.15 For rivers with a mean flow exceeding 5,000 L/sec, I recommend that the current supplementary allocation cap in the proposed Plan (50% of the flow above median) is retained. The median flow threshold (above which supplementary allocation is available) should be retained for both small and large rivers/streams, as should the requirement to preserve the frequency of flushing flows that exceed three times the median flow.

8. CONCLUSIONS

8.1 In my evidence I have set out the technical background to the development of minimum flows and allocation amounts (including supplementary allocation) in the Greater Wellington Regional Council's proposed Natural Resources Plan. I have then responded to specific submitter points on these topic areas and made recommendations for potential amendments where appropriate.

8.2 Submissions on minimum flows sought reassurance that the flows have been set appropriately. I have explained the basis for the minimum flows catchment by catchment as well as the default rule where this applies. While levels of protection vary between rivers, my overall conclusion is that the minimum flows are providing a reasonable safe guard of life supporting capacity. This conclusion has been shaped in part for some catchments by the knowledge that the whaitua (community decision-making body) process is already underway in the Wellington region. Minimum flows will be more fully examined during this process.

8.3 In two catchments on the Kapiti Coast (Mangaone Stream and Otaki River), I have suggested that the risk associated with minimum flows should be mitigated in advance of the whaitua process being completed. This is because the minimum flows are relatively low and the Kapiti Coast whaitua process will be one of the later ones to get underway. In both cases, due to only modest current allocation levels, the risk associated with the minimum flows can be achieved by capping allocation at (or just above) existing use (rather than increasing the minimum flow and impacting on the reliability of existing users).

8.4 In responding to submissions that are opposed to the Council proposals for allocation amounts, or sought clarification of how the amounts have been derived, I have explained the methods and rationale. I have concluded that the proposed allocation amounts are suitably precautionary, more aligned (than in the past) with good practice for managing cumulative effects and should, in my view, guard against abstractions causing excessive impact to river ecosystems. I have acknowledged that the

allocation amounts are not given full effect in the proposed Plan due to the policy protecting existing user rights. However I remain of the view that there is merit in introducing the proposed amounts to provide a regionally consistent measure of allocation stress with a more explicit ecological rationale than existing limits.

8.5 With respect to supplementary allocation, several submitters expressed some concern about whether the proposed policy and rules were sufficiently precautionary. Having undertaken further analysis in response to these submissions I have come to the view that some smaller rivers/stream could be exposed to higher levels of flow alteration under fully exercised supplementary allocation than anticipated (by the proposed Plan). I therefore agree with submitters that some relief is justified and have recommended an alternative policy that draws a distinction between large rivers and small rivers/streams and applies a reduced allocation cap to the latter.

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Attachment A
Qualifications and experience

Qualifications:

Master of Science (and Technology). 1997. University of Waikato, New Zealand.

Bachelor of Science (Earth Science). 1995. University of Waikato, New Zealand.

Experience:

2010-present

Greater Wellington Regional Council. *Senior Environmental Scientist – Hydrology.*

2004-2010

Ministry for the Environment. *Senior Analyst (Freshwater) – Monitoring and Reporting.*

2001-2004

Hydro-logic Ltd (Environmental Consultancy, UK). *Senior Hydrologist.*

1998-2000

Waikato Regional Council. *Environmental Monitoring Officer (Hydrology).*

Attachment B
Figures

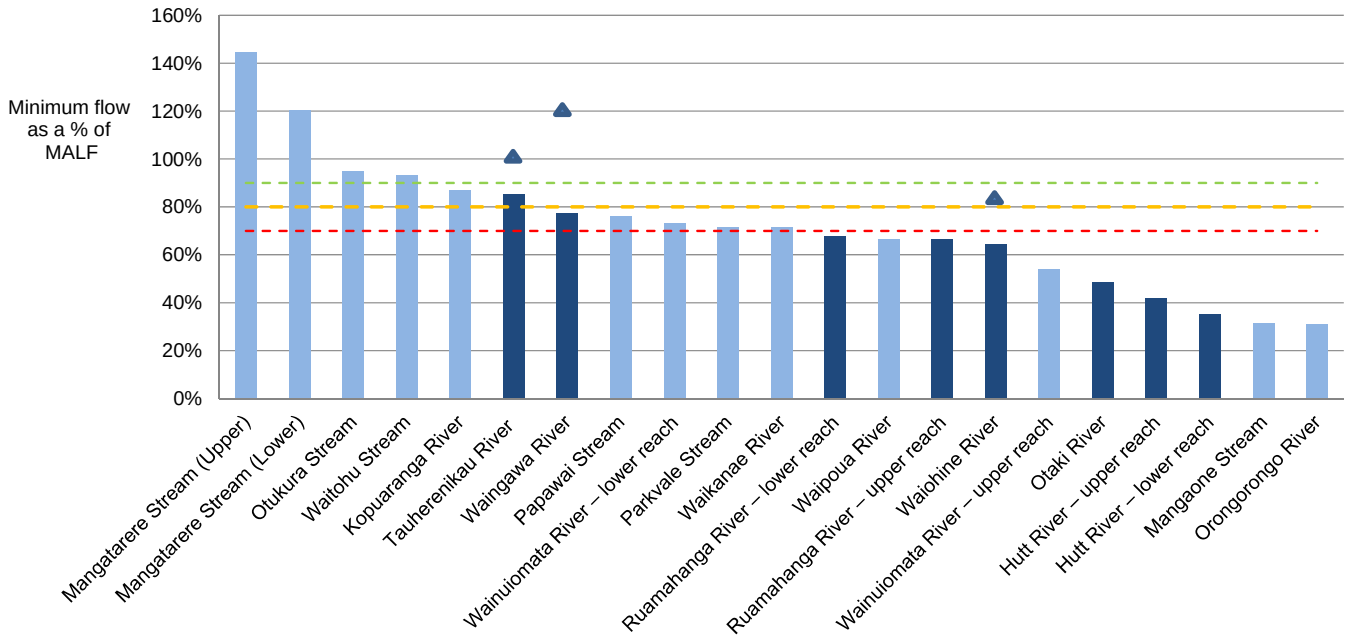

Figure 1: Comparison of minimum flows for rivers and reaches with minimum flows listed in the proposed Plan. The minimum flow is shown as a proportion of mean annual low flow (MALF). Dark blue bars indicate 'large' rivers (i.e. mean flow > 5 m^3/sec) and pale blue bars are 'small' rivers or streams (i.e. mean flow < 5 m^3/sec). The horizontal green line represents a flow equating to 90% of MALF and the orange and red lines 80% and 70% of MALF, respectively. Note that three rivers – the Tauherenikau, Waingawa and Waiohine – that have substantial public water supply takes (deemed as 'essential use'), also have flow thresholds higher than the minimum flow at which point 'non-essential' surface water takes (e.g. for irrigation) are required to cease. These thresholds are shown as the blue triangles.

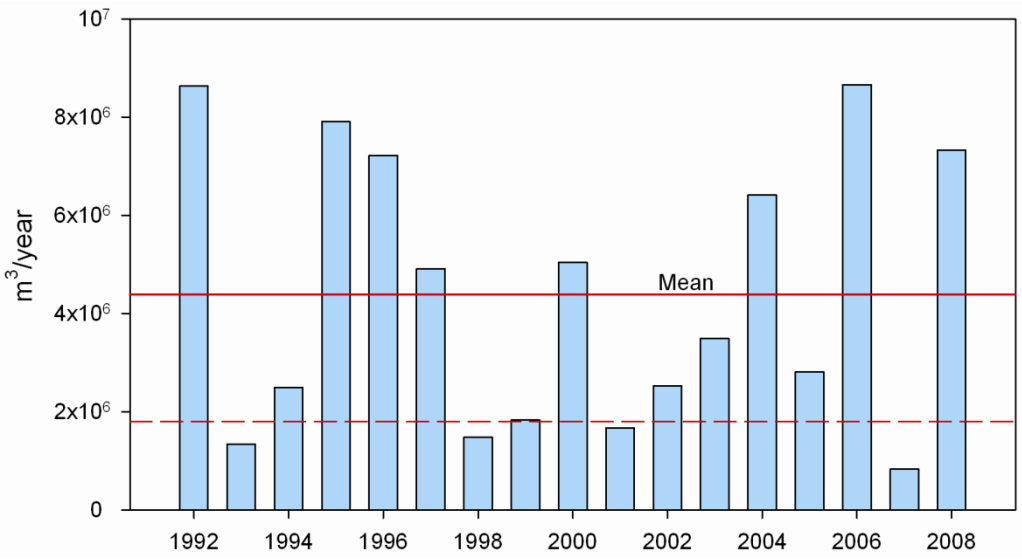

Figure 2: Modelled annual rainfall recharge for the Te Ore Ore zone in the Upper Valley catchment between 1992 and 2008. A mean (average) recharge of 4.4 x 10^6 m^3/year is indicated as is the lower quartile value of 1.8 x 10^6 m^3/year (dashed line).

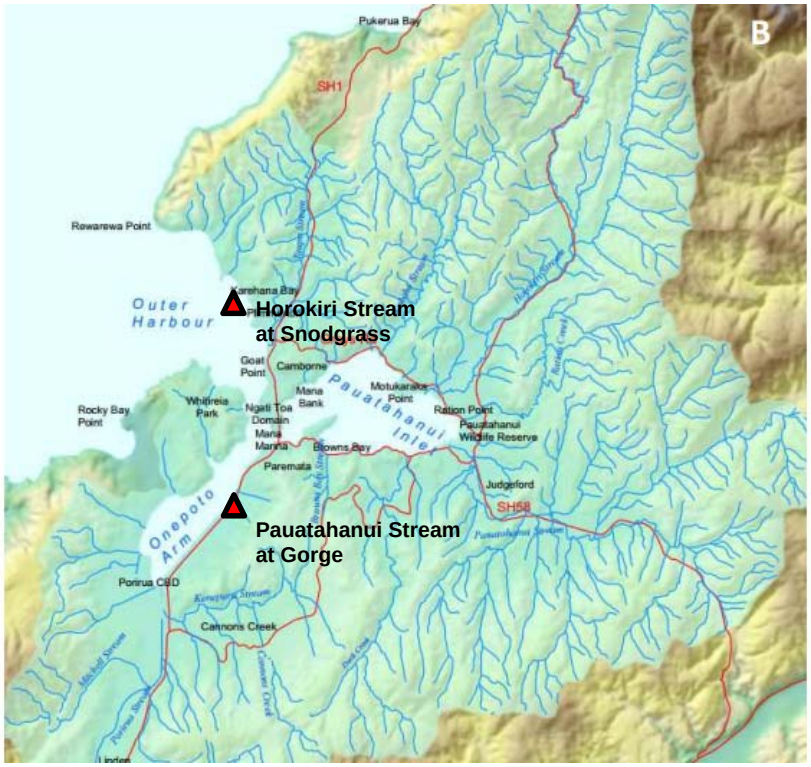

Figure 3: Map of Pauatahanui Inlet and tributary streams. The flow recorder sites on the Pauatahanui and Horokiri streams are marked with by the triangles.

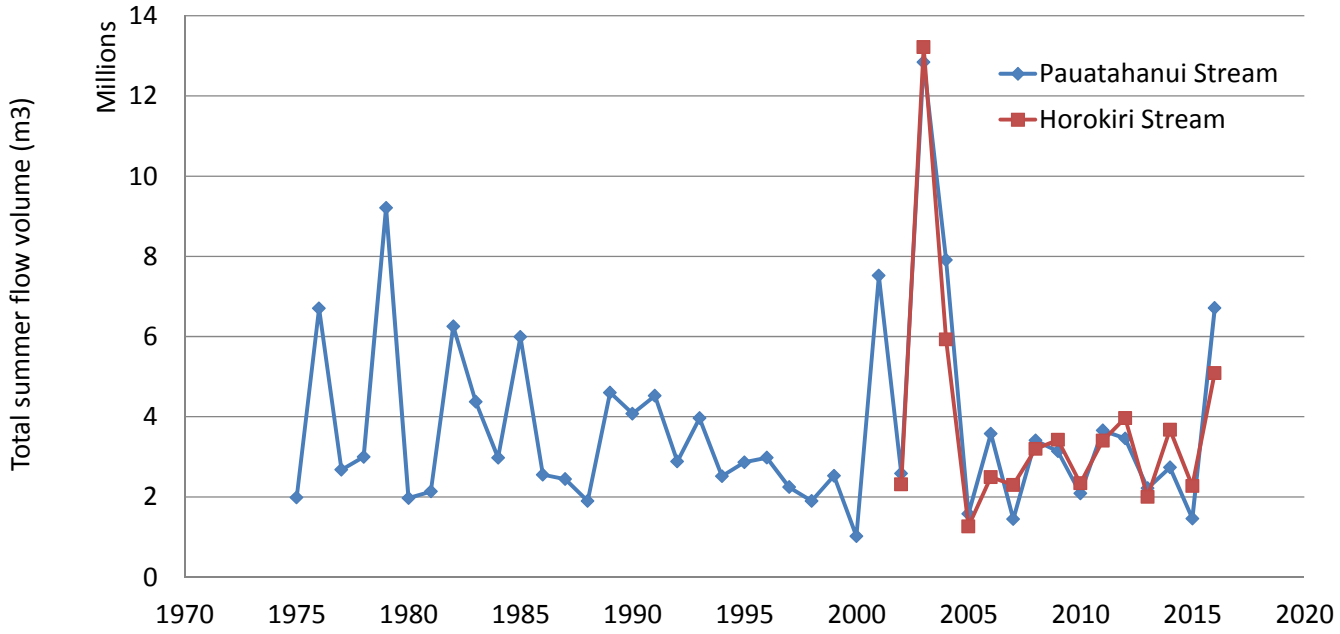

Figure 4: Total summer flow volume (combined for the months Dec to Mar inclusive) measured in the lower Pauatahanui and Horokiri stream catchments at the 'Gorge' and 'Snodgrass' recorder sites, respectively. Horokiri Stream flow measurement only began in 2002.

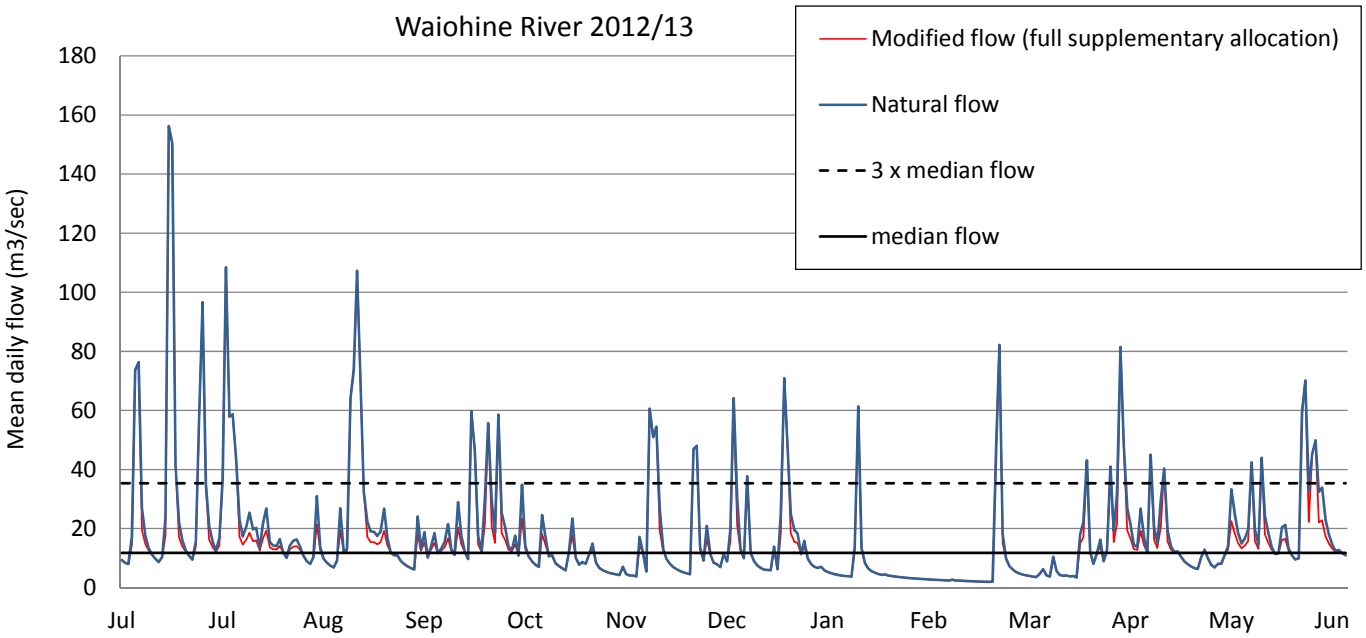

Figure 5: Comparison of natural mean daily flow in the Waiohine River (July 2012 to June 2013) with simulated flow under fully exercised supplementary allocation.

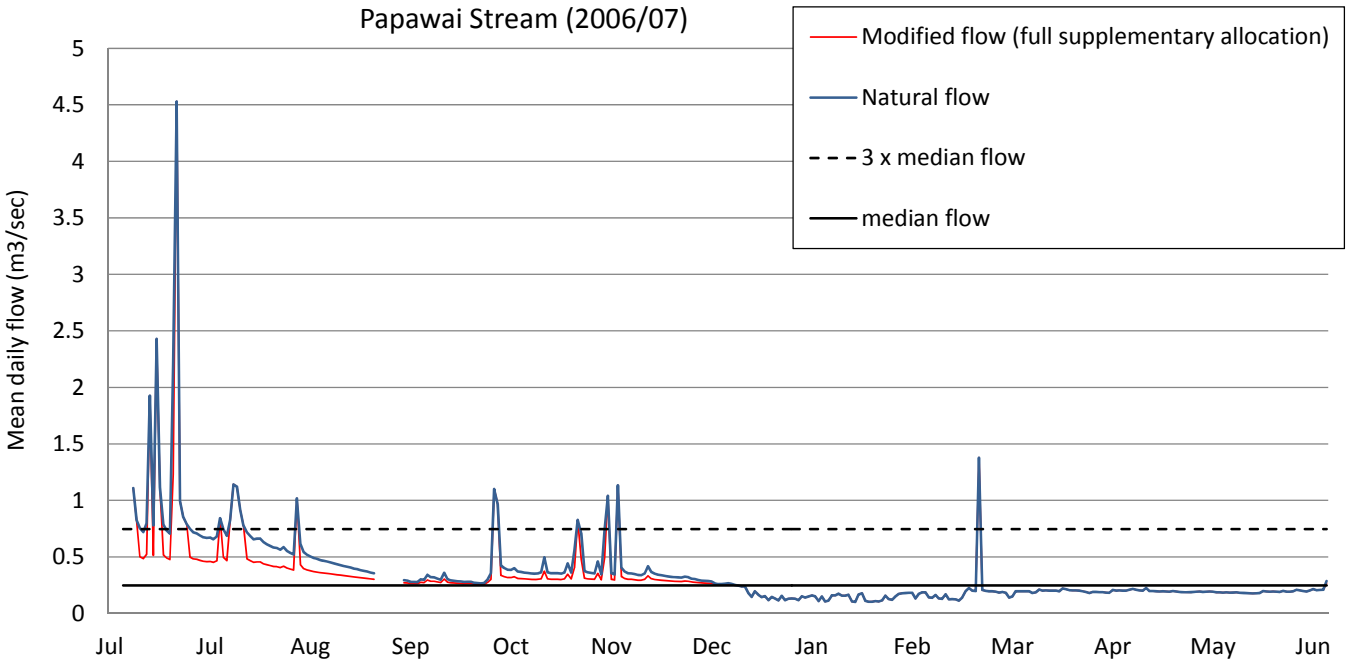

Figure 6: Comparison of natural mean daily flow in the Papawai Stream (July 2006 to June 2007) with simulated flow under fully exercised supplementary allocation.

Attachment C
Comparison of allocation amounts in the existing RFP with those in the proposed plan

Table 1a: Ruamahanga River and Lake Wairarapa catchment surface water allocation

Allocation status of surface water under existing RFP provisions and PNRP provisions **February 2016**

River	Existing RFP provisions			PNRP provisions			
	COLUMN A *Surface water allocation (L/s)* [as calculated under the RFP – i.e. excluding connected groundwater]	COLUMN B *Core or capped allocation limit (L/s)*	COLUMN C *Allocation status* [Column A/Column B]	COLUMN D *Current allocation (L/s)* [including all connected groundwater]	COLUMN E *Allocation amount[2] (L/s)*	COLUMN F *Catchment management sub-unit status* [Column D/Column E]	COLUMN G *Catchment management unit status*
RUAMAHANGA RIVER	**No provision**			**8046**	**7535**	**N/A**	**100% allocated**
Kopuaranga River	125	125	100% allocated	150	180	83% allocated	
Waipoua River	65	90	72% allocated	129	145	89% allocated	
Makoura Stream[1]	26	40	65% allocated	Not in PNRP			
Waingawa River	1036	1040	100% allocated	1197	920	100% allocated	
Upper Ruamahanga River	672	800	84% allocated	954	1200	80% allocated	
Parkvale Stream[1]	115	160	72% allocated	151	40	100% allocated	
Booths Creek[1]	97	100	97% allocated	109	25	100% allocated	
Mangatarere Stream	176 (upper)	180 (upper)	98% allocated	473	110	100% allocated	
	127 (lower)	140 (lower)	90% allocated				
Taueru River[1]	41	50	82% allocated	Not in PNRP			
Makahakaha Stream[1]	18	50	36% allocated	Not in PNRP			
Waiohine River	731	740	99% allocated	1004	1590	63% allocated	
Papawai Stream[1]	120	200	60% allocated	340	105	100% allocated	
Middle Ruamahanga River	See Upper Ruamahanga River above			975	1240	79% allocated	
Huangarua River	No provision			92	110	84% allocated	
Lower Ruamahanga River	1069	1500	71% allocated	2447	1475	100% allocated	

River	Existing RFP provisions			PNRP provisions			
	COLUMN A *Surface water allocation (L/s)* [as calculated under the RFP – i.e. excluding connected groundwater]	COLUMN B *Core or capped allocation limit (L/s)*	COLUMN C *Allocation status* [Column A/Column B]	COLUMN D *Current allocation (L/s)* [including all connected groundwater]	COLUMN E *Core allocation amount[2] (L/s)*	COLUMN F *Catchment management sub-unit status* [Column D/Column E]	COLUMN G *Catchment management unit status*
LAKE WAIRARAPA	**No provision**			**1799**	**1800**	**N/A**	**100% allocated**
Otukura Stream[1]	46	60	77% allocated	140	30	100% allocated	
Dock Creek[1]	212	210	100% allocated	Not in draft NRP recommendations			
Tauherenikau River	210	405	52% allocated	233	410	57% allocated	
Lake Wairarapa				1426	N/A	N/A	N/A

[1]These limits are capped allocation limits where potential over allocation was identified through a change to the RFP in May 2009. Since that time some consents have been surrendered or reduced during consent renewal.

[2] Large rivers – 50% of 7 day MALF allocated. Small rivers – 30% of 7 day MALF allocated

Note: There is no allocation amount (L/s) in the PNRP for water takes below the confluence with Lake Wairarapa outflow.

Table 1b: Ruamahanga River and Lake Wairarapa catchment groundwater allocation

Allocation status of groundwater under existing RFP provisions and PNRP provisions **February 2016**

Existing RFP provisions					**PNRP provisions** (under the conjunctive management framework)					
Existing zone name	COLUMN A *Current allocation (Mm^3/year)*	COLUMN B *RFP allocation limit (Mm^3/year)*	*Allocation status* COLUMN C *All aquifers*	COLUMN D *Deep aquifers*	COLUMN E *New zone name*	COLUMN F *Current allocation Category C (Mm^3/year)*	COLUMN G *PNRP allocation amount Category C (Mm^3/year)*	COLUMN H *Category A (Surface water)*	COLUMN I *Category B (Surface and/or groundwater)*	COLUMN J *Category C (Groundwater)*
Opaki	0.05	2.3	<50 % allocated		Upper Ruamahanga	0.572	3.55	100% allocated	Category B takes are assessed on a case by case basis. Each take is then split between Category C (groundwater) or Cat A (surface water)	<50% allocated
Upper Opaki	0.566	4.5	<50 % allocated							
Rathkeale	1.781	3.0	59% allocated							
Te Ore Ore	1.223 (shallow) 2.908 (deep)	3 (shallow) 4.5 (deep)	<50 % allocated	65% allocated	Te Ore Ore	0.813	0.48	100% allocated		100% allocated
Fernridge	0	1.5	<50 % allocated		Waingawa	0.695	1.90	100% allocated		<50% allocated
Upper Plain	3.32	17.0	<50 % allocated							
Masterton	0.219 (shallow) 0.027 (deep)	3.2 (shallow) 2.3 (deep)	<50 % allocated	<50 % allocated						
Fern Hill	0.99	4.7	<50 % allocated		Fernhill-Tiffen	0.972	1.2	No Cat A		81% allocated
Middle Ruamahanga	7.051 (shallow) 1.734 (deep)	7.3 (shallow) 2.2 (deep)	96% allocated	79% allocated	Middle Ruamahanga	No Cat C		100% allocated		No Cat C
Parkvale	1.166 (shallow) 2.357 (deep)	3.5 (shallow) 2.62 (deep)	<50 % allocated	90% allocated	Parkvale	0.340 (shallow)	0.35	No Cat A		97% allocated
						2.162 (deep)	1.55	No Cat A		100% allocated
East Taratahi	0.01 (shallow) 0.14 (deep)	14 (shallow) 1.7 (deep)	<50 % allocated	<50 % allocated	Taratahi	0.427	1.4	No Cat A		<50 % allocated
West Taratahi	0.482	5.3	<50 % allocated							
Mangatarere	1.148	7.6	<50 % allocated		Mangatarere	2.548	2.3	100% allocated		100% allocated
Matarawa	0.241	10.0	<50 % allocated							
Carterton	2.576	3.9	66% allocated							
Hodders	1.133	4.0	<50 % allocated							
Greytown	3.344	20	<50 % allocated		Waiohine	No Cat C		100% allocated		No Cat C
Ahikouka	2.265	3.3	69% allocated							
Woodside	0.094	16	<50 % allocated		Tauherenikau	5.002	6.6	100% allocated		76% allocated
Moroa	0.172	0.7	<50 % allocated							
Battersea	1.848	2.4	77% allocated							
Tauherenikau	4.242	20.0	<50 % allocated							
South Featherston	1.889	5.3	<50 % allocated							

Table 1b continued

Existing RFP provisions					**PNRP provisions** (under the conjunctive management framework)					
Existing zone name	COLUMN A ***Current allocation (Mm³/year)***	COLUMN B ***RFP allocation limit (Mm³/year)***	***Allocation status*** COLUMN C ***All aquifers***	COLUMN D ***Deep aquifers***	COLUMN E ***New zone name***	COLUMN F ***Current allocation Category C (Mm³/year)***	COLUMN G ***PNRP allocation amount Category C (Mm³/year)***	COLUMN H ***Category A (Surface water)***	COLUMN I ***Category B (Surface and/or groundwater)***	COLUMN J ***Category C (Groundwater)***
Lower Valley - Whangaehu	0.129	0.5	<50 % allocated		Lake	6.35	6.75	No Cat A		94% allocated
Lower Valley - Aquifer 2	11.38	13.5	84 % allocated							
Lower Valley - Aquifer 3	4.032	7.7	52 % allocated							
Tawaha	8.841	11	80% allocated		Lower Ruamahanga	No Cat C		100% allocated		No Cat C
Riverside	4.068	3.9	100% allocated		Moiki	No Cat C		100% allocated		No Cat C
Martinborough Western Terraces	0.851	1.38	62% allocated		Martinborough	0.979	0.8	No Cat A		100% allocated
Martinborough Eastern Terraces	0.284	0.42	68% allocated							
Huangarua	0.311 (shallow) 1.292 (deep)	0.9 (shallow) 1.2 (deep)	<50 % allocated	100% allocated	Huangarua	0.650	0.65	100% allocated		100% allocated
Pirinoa Terraces	0	18.1	<50 % allocated		Dry River	0.428	0.650	No Cat A		66% allocated
Lower Valley - Tauanui	0.280	0.8	<50 % allocated		Onoke	2.1	2.1	Allocation status unknown		100% allocated
Lower Valley - Turanganui	0.964	1.1	88% allocated							

Table 2a: Hutt Valley and Wellington Harbour catchments surface water allocation

Allocation status of surface water under existing RFP provisions and PNRP provisions **February 2016**

Catchment management units	Existing RFP provisions			PNRP provisions		
	COLUMN A *Surface water allocation (L/s)* [as calculated under the RFP – i.e. excluding connected groundwater]	COLUMN B *Core or capped allocation limit (L/s)*	COLUMN C *Allocation status* [Column A/Column B]	COLUMN D *Current allocation (L/s)* [including all connected groundwater]	COLUMN E *Allocation amount[2] (L/s)*	COLUMN F *Catchment management sub-unit status* [Column D/Column E]
Te Awa Kairangi / Hutt River	1850 [upper reach]	n/a[1]	n/a[1]	2427	2140	100% allocated
	66 [lower reach]	300	<50% allocated			
Wainuiomata River	1095 [upper reach]	n/a[1]	n/a[1]	1136	180	100% allocated
	33 [lower reach]	65	51% allocated			
Orongorongo River	1132	n/a[1]	n/a[1]	1132	95	100% allocated

[1] No core allocation limit specified in RFP for these reaches so existing allocation status cannot be defined

[2] Large rivers – 50% of 7 day MALF allocated. Small rivers – 30% of 7 day MALF allocated

Table 2b: Hutt Valley and Wellington Harbour catchments surface water allocation

Allocation status of groundwater under existing RFP provisions and PNRP provisions **February 2016**

Existing RFP provisions and allocation status					PNRP provisions (under the conjunctive management framework)				
Existing zone name	COLUMN A *Current allocation (Mm^3/year)*	COLUMN B *RFP allocation limit (Mm^3/year)*	*Allocation status* COLUMN C *All aquifers[1]*	COLUMN D *Deep aquifers*	COLUMN E *New zone name*	COLUMN F *Current allocation Category B/C (Mm^3/year)*	COLUMN G *PNRP allocation amount Category B/C (Mm^3/year)*	*Allocation status* COLUMN H *Category A*	COLUMN I *Category B/C*
Upper Hutt	0.34	26.90	<50% allocated	n/a	Upper Hutt	0.31	0.77	100% allocated	<50% allocated
Lower Hutt	32.03	33.00	97% allocated	n/a	Lower Hutt	32.03	36.50	100% allocated	88% allocated
Mangaroa	0	18.40	<50% allocated	n/a	Not in the new framework. Groundwater use from these aquifers is so minor that they have not been listed in the PNRP.				
Pakuratahi	0	5.90	<50% allocated	n/a					
Akatarawa	0.01	3.60	<50% allocated	n/a					
Wainuiomata	0.01	3.00	<50% allocated	n/a					

[1] Status descriptions apply to all aquifers in the zone unless a deep aquifer unit has been described separately in the adjacent column (Column D)

Table 3a: Kapiti Coast catchments surface water allocation

Allocation status of surface water under existing RFP provisions and PNRP provisions **February 2016**

Catchment management units	Existing RFP provisions			PNRP provisions		
	COLUMN A ***Surface water allocation (L/s)*** [as calculated under the RFP – i.e. excluding connected groundwater]	COLUMN B ***Core or capped allocation limit (L/s)***	COLUMN C ***Allocation status*** [Column A/Column B]	COLUMN D ***Current allocation (L/s)*** [including all connected groundwater]	COLUMN E ***Allocation amount[2] (L/s)***	COLUMN F ***Catchment management sub-unit status*** [Column D/Column E]
Waitohu Stream	0	57	<50% allocated	7.5	45	<50% allocated
Otaki River	110	2120	<50% allocated	361	1970	<50% allocated
Mangaone Stream	24	25	96% allocated	24	45	53% allocated
Waikanae River	463	n/a[1]	n/a[1]	494	220	100% allocated

[1] No core allocation limit specified in RFP for these reaches so existing allocation status cannot be defined

[2] Large rivers – 50% of 7 day MALF allocated. Small rivers – 30% of 7 day MALF allocated

Table 3b:Kapiti Coast groundwater allocation

Allocation status of groundwater under existing RFP provisions and PNRP provisions **February 2016**

Existing RFP provisions and allocation status					PNRP recommendations and allocation status				
Existing zone name	COLUMN A ***Current allocation (Mm^3/year)***	COLUMN B ***RFP allocation limit (Mm^3/year)***	***Allocation status*** COLUMN C ***All aquifers[1]***	COLUMN D ***Deep aquifers***	COLUMN E ***New zone name***	COLUMN F ***Current allocation Category B/C (Mm^3/year)***	COLUMN G ***PNRP allocation amount Category B/C (Mm3/year)***	**Allocation status** COLUMN H ***Category A***	COLUMN I ***Category B/C***
Waitohu	2.99	6.40	<50% allocated	n/a	Waitohu	0.28	1.08	Waitohu Category A = <50% allocated	Waitohu Category C = <50% allocated
Otaki	4.13	11.30	<50% allocated	n/a				Otaki Category A = <50% allocated	Otaki Category C = <50% allocated
Hautere	0.62	6.70	<50% allocated	n/a	Te Horo	1.21	1.62	No Category A	75% allocated
Coastal	0.47	6.80	<50% allocated	n/a					
Waikanae	2.83	10.70	<50% allocated	n/a	Waikanae	2.45	2.70	100% allocated	91% allocated
Raumati/Paekakariki	0.80	4.80	<50% allocated	n/a	Raumati	0.94	1.229	No Category A	76% allocated

[1] Status descriptions apply to all aquifers in the zone unless a deep aquifer unit has been described separately in the adjacent column (to the right)

Attachment D
Changes in allocation amounts between draft and proposed plan

Table 1: Changes to estimated naturalised MALF for locations on the Ruamahanga River as a result of updating the resource consent database since the DNRP was released.

Management node[1]	Name[2]	7d MALF (L/s) Original estimate	7d MALF (L/s) Revised estimate
Ruamahanga 1	U/S Kopuaranga River confluence	1,980	1,985
Ruamahanga 2	Carrolls	2,770	2,800
Ruamahanga 3	Wardells	3,840	3,605
End of Upper Valley sub-catchment	*No equivalent site*	5,560	5,325
Ruamahanga 4	Gladstone Bridge	7,340	7,170
Ruamahanga 5	U/S Waiohine River confluence	8,160	8,025
End of Middle Valley sub-catchment	*No equivalent site*	12,060	11,935
Ruamahanga 6	Waihenga	12,880	12,565
Ruamahanga 7 and 8 End of Middle Valley sub-catch	Otaraia	14,780	15,065

[1] These node points correspond to the management points listed in the Draft Natural Resources Plan (GWRC 2014), although only the grey highlighted rows are being carried through to the PNRP

[2] GWRC Hilltop database archive name given to the gauging location corresponding to, or most closely associated with, the management node

Table 2: Surface water allocation amounts for rivers and directly connected groundwater in the Upper Ruamahanga River catchment.

River and groundwater management unit	Surface water allocation amounts (L/s)		Explanation for change
	DNRP	PNRP	
Kopuaranga River	180	180	No change
Waipoua River	65 [upper]	145	Change to single amount (maximum of the two previous)
	145 [lower]		
Waingawa River	920 [upper]	920	Change to single amount (maximum of the two previous)
	860 [lower]		
Upper Ruamahanga River	990 [reach 1]	n/a	Removed these multiple reaches
	1,385 [reach 2]		
	1,920 [reach 3]		
Upper Ruamahanga River sub-catchment management unit	2,780	1,200	This change incorporates a slight change to MALF (based on revisions in Table 1) but mainly results from subtraction of the other amounts listed in this table so as to form a discrete unit amount[1].

[1] Note that the new number is derived from subtracting all upstream discrete unit MALFs from the revised Upper Ruamahanga River MALF (5,325 L/s) and then multiplying the resultant value by 0.5 (allocation = 50% of MALF for a large river). It does not simply equate to the Upper Ruamahanga River amount minus the upstream amounts because many of the upstream unit amounts are based on a multiplier of 0.3 (for the smaller rivers).

Table 3: Surface water allocation amounts for rivers and directly connected groundwater in the Middle Ruamahanga River catchment.

River and groundwater management unit	Surface water allocation amounts (L/s)		Explanation for change
	DNRP	PNRP	
Parkvale Stream	40	40	No change
Booths Creek	25	25	No change
Mangatarere River	40 [upper] 110 [lower]	110	Change to single amount (maximum of the two previous)
Waiohine River	1140 [upper] 1775 [lower]	1,590	Change to single amount (maximum of the two previous) but also subtraction of the Mangatarere catchment amount[1]
Papawai Stream	65	65	No change
Middle Ruamahanga River	3,670 [reach 4] 4,080 [reach 5]	n/a	Removed these multiple reaches
Middle Ruamahanga River sub-catchment management unit	6,030	1,240	This change incorporates a slight change to MALF (based on revisions in Table 1) but mainly results from subtraction of the other amounts listed in this table and the previous table (Upper Ruamahanga) so as to form a discrete unit amount[2].

[1] Note that the new number is derived from subtracting the Mangatarere MALF (370 L/s) from the Waiohine MALF (3,550 L/s) and then multiplying the resultant value by 0.5 (allocation = 50% of MALF for a large river). It does not simply equate to the Waiohine amount minus the Mangatarere amount because the allocation amount for the Mangatarere is based on a multiplier of 0.3 (being a small river).

[2] Note that the new number is derived from subtracting all upstream discrete unit MALFs from the revised Middle Ruamahanga River MALF (11,935 L/s) and then multiplying the resultant value by 0.5 (allocation = 50% of MALF for a large river). It does not simply equate to the Middle Ruamahanga River amount minus the upstream amounts because many of the upstream unit amounts are based on a multiplier of 0.3 (for the smaller rivers).

Table 4: Surface water allocation amounts for rivers and directly connected groundwater in the Lower Ruamahanga River catchment.

River and groundwater management unit	Surface water allocation amounts (L/s)		Explanation for change
	DNRP	PNRP	
Otukura Stream	30	30	No change
Tauherenikau River	410 [upper]	410	Change to single amount (maximum of the two previous)
	155 [lower]		
Lake Wairarapa	600	n/a	Removed as unnecessary (covered within total lake amount of 1,800 L/s – next row)
Lake Wairarapa sub-catchment management unit	1,800	1,800	No change
Huangarua River	110	110	No change
Lower Ruamahanga River	6,440 [reach 6]	n/a	Removed these multiple reaches
	7,390 [reach 7]		
Lower Ruamahanga River sub-catchment management unit	7,390	1,475	This change incorporates a slight change to MALF (based on revisions in Table 1) but mainly results from subtraction of the other amounts listed in this table and the previous table (Upper Ruamahanga) so as to form a discrete unit amount.
TOTAL RUAMAHANGA RIVER CATCHMENT	**7,390**	**7,535**	Slight change due to recalculation of MALF (see revisions in Table 1)

[1] Note that the new number is derived from subtracting all upstream discrete unit MALFs from the revised Lower Ruamahanga River MALF (15,065 L/s) and then multiplying the resultant value by 0.5 (allocation = 50% of MALF for a large river). It does not simply equate to the Lower Ruamahanga River amount minus the upstream amounts because many of the upstream unit amounts are based on a multiplier of 0.3 (for the smaller rivers).

Table 5: Surface water allocation amounts for rivers and directly connected groundwater in the Wellington Harbour and Hutt Valley whaitua.

River and groundwater management unit	Surface water allocation amounts (L/s)		Explanation for change
	DNRP	PNRP	
Hutt River	720 [upper] 2,115 [middle]	2,140	Change to single amount (maximum of the two previous with slight correction incorporated)
Wainuiomata River	55 [upper] 180 [middle]	180	Change to single amount (maximum of the two previous)
Orongorongo	95	95	No change

Attachment E
Alternative wording proposed by fish and game council nz for supplementary water allocation

Supplementary water^ allocation

In addition to the core allocations, a supplementary allocation from rivers^ may be provided:

(a) *in circumstances where water^ is only taken when the river^ flow is greater than the median flow, and the total amount of water^ taken by way of a supplementary allocation does not exceed 10% of the actual flow in the river^ at the time of abstraction, and*

(b) *in circumstances where it can be shown that the supplementary allocation will not:*

(i) *increase the frequency or duration of minimum flows*

(ii) *lead to a significant departure from the natural flow regime, including the magnitude of the median flow and the frequency of flushing flows*

(iii) *cause any adverse effects that are more than minor on the freshwater environment including ecosystem health, freshwater fish, and Mahinga Kai and Maori values;*

(iv) *limit the ability of anyone to take water under a core allocation*