Appendix 1

Comments in relation to evidence of Arthur Male

Mr Male, on behalf of Mighty River Power, commented on technical methods utilised by Horizons within the water allocation framework. These comments are addressed below in the order they are presented in the Evidence.

Mr Male's points 1 to 8 outline his qualifications etc., the evidence he has read and comments in relation to the Code of Conduct.

Mr Male's points 9 to 15 provide a summary. The points within this section are commented on in relation to the detailed content on these in the Evidence.

Mr Male's points 16 to 19 provide an overview of allocation of water by regional councils and the trends in management of water allocation. Point 20 outlines how Horizons' approach embraces every aspect of these and that "*every endeavour has been made by Horizons to keep things simple and transparent*".

Mr Male's points 21 and 22 outline his concern with the setting of minimum flows and the determination of core allocations, and his point that inequities may develop between consent holders as flows reduce to minimum flow. In particular, he is concerned that, at minimum flow, hydroelectricity schemes that operate out-of-river hydro-generation would be required to cease abstraction at low flows. Horizons officers note that this is not a technical issue in relation to the setting of core allocations and minimum flows, rather how they are used as a part of the Policy. The example raised by Mighty River Power is one that would that would relate to "new" hydroelectricity such as that which has been discussed within the community around parts of the Whangaehu River. Further, the policy framework provides for consent applications that are outside of the defined framework; however, such applications would require careful consideration of the potential adverse effects of such takes on the environment and other users.

Mr Male's points 23 to 27 address Water Management Zones (WMZs) and values. Point 23 outlines Mr Male's concern that the monitoring locations may not adequately reflect the hydrology and water quality of the WMZ. Horizons officers note that these sites provide the baseline for monitoring the cumulative outcome of the activities within the WMZs and the effect of these on the hydrology and water quality within these catchments. In this way, they form one part of a policy effectiveness and State of the Environment monitoring network. Likewise, they form part of the knowledge of the hydrology and water quality within the catchment. This knowledge is further supplemented by more detailed monitoring and reporting within these WMZs. For example, as outlined in the Supplementary Evidence of Dr Roygard (Figures 1 to 5, pages 28 to 32) and in Map 3 of Dr Roygard's s42A report (page 32).

Point 25 outlines the interest of Mighty River Power in relation to the WMZs and Sub-zones of the Whangaehu catchment. Horizons officers have, during discussions leading up to the preparation of s42A reports and supplementary evidence, requested Mighty River Power to indicate its preferred configuration for Water Management Sub-zones in the Whangaehu catchment zone. Mighty River Power did not want to pursue structural changes to the WMZs or Sub-zones. One option for setting WMZ boundaries was to set WMZs on confluences. For policy effectiveness and State of the Environment monitoring, the approach recommended to the Hearing Panel by Horizons officers is more suitable[1].

Points 28-35 of Mr Male's evidence address minimum flows and management flows. This section identifies Mr Male's issue as *"… the methods used of estimation when there is a reduced amount of data available and estimation procedures are required*". The s42A report of Mr Watson for Horizons provides information in relation to the standard methodologies that were used for this purpose. Primarily, the information used to inform the Whangaehu flow statistics is related to flow monitoring sites operated by NIWA. This has been explained in detail to representatives of Mighty River Power during discussions around the One Plan. These explanations have included identifying the records for the Whangaehu sites from the simulated natural flow series, ie. flow series that have been naturalised for the flow diverted from the Whangaehu by the Tongariro Power Scheme. These flow statistics are documented in the report by Henderson and Dietrich (2007)[2]. The flow series from which these flow statistics are generated was compiled by NIWA for Genesis Energy. The flow series and statistics were calculated by Dr Roddy Henderson, a well respected hydrologist from NIWA.

In point 31, Mr Male identifies two issues. The first is how mean annual low flow (MALF) statistics were generated in the absence of continuous hydrological record (this is outlined in the evidence of Mr Watson). The second point is about the application of MALF as a predictor of Instream Flow Incremental Methodology (IFIM) minimum flow. This second point is clearly documented in the evidence of Dr Roygard (s42A report; Box 11, page 48). The assertion by Mr Male that hydrological data often requires an appropriate transformation so that linear regression can be applied legitimately is an academic point when the relationships that are being used show very strong correlation coefficients. The strength of these correlations is at the very highest end of the

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1 An overview of information on the development of water management zones can be found in the evidence of Dr Roygard (s42A report, pages 16 & 17). This includes links to more detailed information.
2 This project is introduced in the s42A report of Dr Roygard; page 39, point 65.

scale (r^2 values[3] range from 0.9969 to 0.9997). The correlations are very strong without any transformation, demonstrating transformation is not required.

Mr Male's point 32 identifies that the linear regression lines are plotted with the origin forced through zero. Basically, this means that the line slope is forced to form a slope that starts from the zero point on each axis of the graph (the point zero-zero on a graph can be termed 'the origin' in graphing terms). Forcing the linear regression through the origin requires the line to be plotted through the data to start from the zero-zero point and therefore the line has the simple relationship of the value of the Y (vertical) axis equals the value on the X (horizontal) axis multiplied by a slope (or gradient). In this way, the regression equation is Y = m * X (where m is the gradient). (Note the * symbol indicates multiplied by). The alternative is to allow for an offset on either X or Y axis where the line crosses either the X or Y axis. In this way, the line is Y = m X + c (where c is the offset). Mr Male's comment in relation to this is acknowledged. He could have tested the difference between these approaches using the data provided in (Box 10, p. 47 of Dr Roygard's s42A report).

This analysis has been completed and there is no material difference between outcomes from either method of regression analysis (see Box 1 below). The relationships make very little difference to the r^2 values, particularly given the way these were then used as a part of the framework as described in paragraph 78 of Dr Roygard's s42A report. It is more appropriate to force the line through zero for the lower range values of Figure A, and the "All IFIM's" dataset Figure C. For the flows represented in Figure B the relationship shows very little difference either way; however, it is numerically lower for the relationship that is not forced through zero.

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3 *Technical Note: r^2 (*r-Squared) is a statistical term defining how well one parameter predicts another. If r^2 is 1.0 then given the value of one parameter, you can perfectly predict the value of another predictor. If r^2 is 0.0, then knowing one term doesn't not help you determine the other term at all. Basically, a higher value of r^2 means that you can better predict one term from another.

Box 1: Setting minimum flows using flow statistics and information from IFIM surveys

The following three graphs show the relationship between the one-day MALF and the minimum flow recommended by IFIM analysis based on 90% of habitat retention for the recommended species at MALF. This information has been used to revise the approach around setting minimum flows based on flow statistics (Scenario 5)

Figure A: MALF as a predictor of IFIM recommended flows for the flow range where MALF <=0.275 m³/s

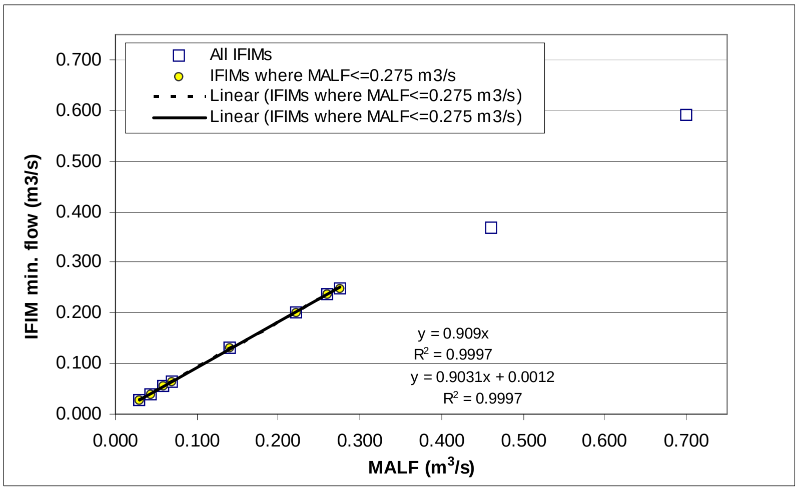


Figure B: MALF as a predictor of IFIM recommended flows for the flow range where MALF is 0.460 to 3.7 m³/s

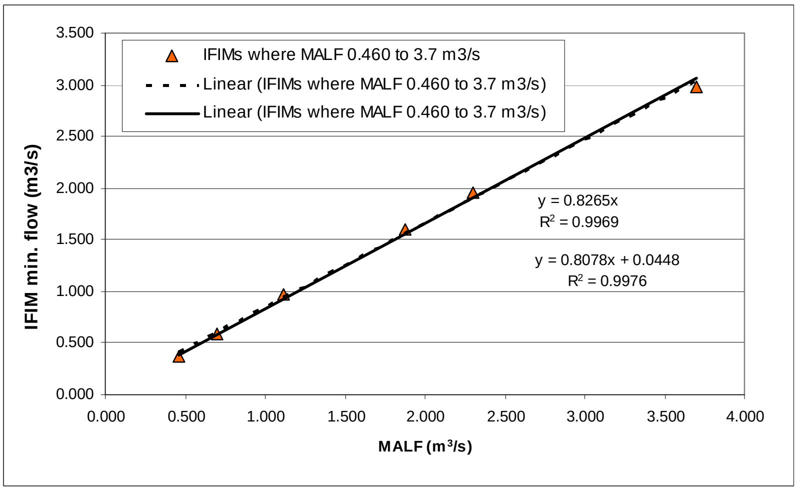
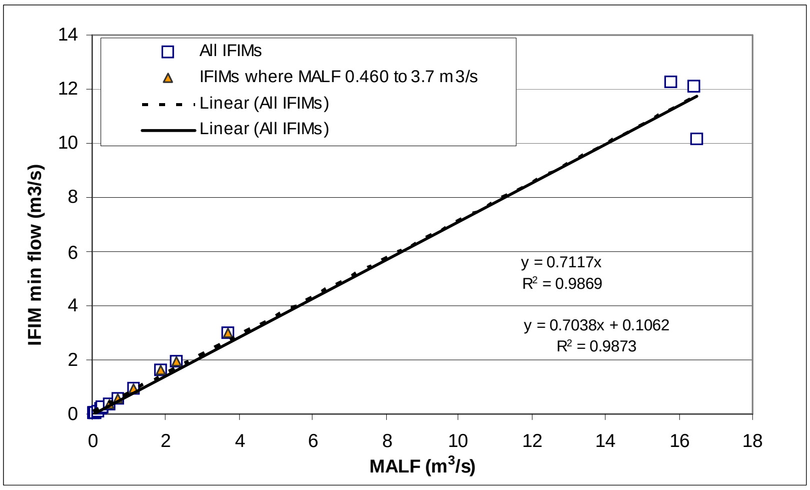


Figure C: MALF as a predictor of IFIM recommended flows for the flow range where MALF is 0.030 to 16.5 m³/s



The summary of the information in Mr Male's points 28 to 35 is provided in point 35 and raises issues of uncertainty with the setting of minimum flows and allocation limits. Horizons officers note that this could be compared to the methodologies used in other regions and proposed nationally via the National Environmental Standards (NES) for ecological flow setting. Mr Male has commented on how Horizons' approach compares to these in his paragraph 20 (see the note relating to this above). However, in point 35 he overlooks how Horizons' approach has sought to reduce the uncertainty with adoption of such approaches. For example, Horizons' methodology uses a more detailed method of setting minimum flows (IFIM[4] as a methodology to predict what these methods would predict based on flow statistics). By comparison, the proposed NES approach uses historic flow methods and does not utilise more advanced flow setting methodologies to inform the selection of the appropriate flow statistic for the 'default method'.

In terms of setting allocation limits, Horizons' approach has sought to reduce uncertainty by seeking to quantify the frequency of restrictions under the proposed water allocation framework (the combination of minimum flow and core allocation limits). These calculations are shown throughout the evidence of Ms Hurndell. Further analysis has been done to compare how the minimum flows and allocation limits would relate to 'default methods' under the proposed NES framework. Comments on this analysis are provided in the s42A evidence of Dr Roygard (page 54-58). The proposed NES approach for setting minimum flows has not presented analysis of the frequency of the minimum flows to demonstrate the likely outcome for users and the environment.

Mr Male's comments in points 36 to 41 relate to the setting of core allocation limits and surety of supply. Horizons officers note the setting of core allocation limits has (where possible) included an analysis of the impact of these on frequency of low flows. This information is presented transparently throughout the evidence of Ms Hurndell. The approach was to define the minimum flow then determine the core allocation limits. To some extent the analysis is subjective. The approach did take into account existing allocation as, through whatever form of consenting process[5], water has been allocated to that current level in the catchment and there is associated reliance and infrastructure around that water being available. The minimum flows recommended within the Proposed One Plan generally align closely with those generated and implemented via previous water allocation decisions within the Region[6], including the implementation of the recommended water allocation framework via consents from work such as Water Resource Assessments. There is a high level of implementation (ie. inclusion in consent conditions) of the minimum flows from these studies within the catchments. The recommended POP core allocation limits do not always provide for the current level of allocation, for example, the Raparapawai Sub-Zone.

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4 Instream flow incremental methodology (see the s42A report of Dr Roygard; paragraph 62, page 38).
5 Refer to Dr Roygard's s42A report; paragraph 75, page 45.
6 Refer to Dr Roygard's s42A report Section 4.7.2.1 (page 36& 37) & paragraph 80 (page 47).

Mr Male's points 42 to 44 relate to water use, efficiency and net take position. Point 42 is factually incorrect in the statement that "*the potential impact of water allocation from irrigation has not been considered in detail*". The reason this is incorrect is that Horizons' approach has been to set limits for core allocations (which is the primary part of the allocation regime from which irrigation water is currently abstracted from). Further, as described above, Horizons has set out to quantify the frequency by which this level of allocation will increase the frequency of the occurrence of minimum flows. It is acknowledged this doesn't relate only to irrigation, but also relates to the sum of all allocation up to the level of the core allocation limit, ie. it includes consented takes for water supply, industry, etc. Mr Male also comments on the impacts of stock water, permitted allocations and the non-consumptive nature of hydroelectricity. Horizons officers' comments in relation to this are contained in a separate section of this report.

Mr Male addresses water quality in points 45 and 46. These points are noted.

Mr Male addresses groundwater in points 47 to 50. These comments include reference to the area of interest to Mighty River Power: the Whangaehu (point 49). Consequently, the reply is placed in that context also. Mr Male suggests that allocating 5% of the annual rainfall to groundwater will potentially have a significant impact on hydroelectricity generation in the Whangaehu catchment. At a general level this may be the case. However, the 5% of annual rainfall criteria is a conservative approach to groundwater allocation compared to the default allocation limits suggested in the proposed NES for ecological flows. Further, in the Whangaehu, the potential to abstract groundwater is far greater in the coastal part of the Whangaehu[7]. That for the most part, groundwater eventually joins a river and provides a significant portion of the river flow, as suggested by Mr Male, is debatable in the Whangaehu system. In general terms, the highest potential for groundwater surface water interaction in the Whangaehu system is in the downstream WMZs. This is also the area with the highest potential for groundwater development. Rock in the upper catchment is largely impermeable and will not likely yield significant quantities of water for large scale irrigation. Following Mr Male's logic regarding the groundwater/surface water interaction, it is noted that rivers are known to recharge groundwater systems. In such situations, where a theoretical mid-catchment hydroelectricity scheme diverts a significant proportion of the flow from the river channel for a significant distance of the river, eg. in the order of 10 km or 20 km, then there is potential for the recharge of the groundwater resource to be influenced.

Mr Male's points 51 to 53 discuss supplementary allocations, primarily identifying a perceived risk that these would alter the volume of water available for storage systems downstream of such

[7] Dr Roygard's s42A report: Map 2, page 28 provides a map of current location of the few groundwater takes in this catchment.

takes. Policy 15-10, as currently proposed, provides some controls on cumulative impact of supplementary takes via the impacts on the natural flow regime. Consideration could be given to whether the wording is strong enough in the policy to provide control of the effect of cumulative supplementary takes on other supplementary takes, other users and the environment.

In conclusion, Mr Male raised several technical comments about the water allocation framework. We have considered these and recommend no changes to the surface water allocation framework from technical perspective. The one change that that could be considered is the policy wording around supplementary allocation giving more consideration to cumulative effects of supplementary takes on other supplementary takes, other legitimate users and the environment.