Action Plan for Healthy Waterways
A submission to the Ministry for the Environment
on
Draft National Policy Statement for Freshwater Management
Proposed National Environmental Standards for Freshwater

30 October 2019
Trustpower Limited (Trustpower) welcomes the opportunity to provide a submission to the Ministry for the Environment ("MfE") on its Action Plan for Healthy Waterways, in particular the draft National Policy Statement on Freshwater Management ("NPS:FM") and the draft Freshwater National Environmental Standard ("NES:FM").

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Summary of views and structure of submission

1.1.1 New Zealand’s existing hydro-electricity generation infrastructure is a substantial and extremely valuable resource that makes a strong and ongoing contribution to New Zealand’s energy needs and its commitment to a low emissions economy. We fear that the freshwater package of proposals will limit the contribution that hydro-electricity generation can make to New Zealand in the future.

1.1.2 Part 1 of this submission sets out the importance of hydro-electric power generation to New Zealand, in both the short and long-term, and explains the importance of considering the appropriate regulatory context when creating a freshwater management regime.

1.1.3 In particular Trustpower considers that the package of proposals does not adequately consider:

a. The importance of hydro-electric generation including New Zealand’s broad network of existing hydro-electric power schemes, the significant benefits associated with hydro-electricity generation and the role that hydro-electricity has in transitioning to a low emissions economy.

b. The broad regulatory context that needs to be considered when setting a freshwater management regime. In particular, the contribution of sustainable energy to the energy trilemma, the importance of lifeline utilities such as electricity generators, the Government’s international commitments and the Resource Management Act.

c. The impact (both direct and consequential) on hydro-electricity generation or New Zealand’s energy system. There is a risk that these proposals will reduce the potential for future hydro-electricity generation, increase New Zealand’s carbon emissions and create loss of future opportunity. Trustpower’s independent experts estimate that the potential impacts of the draft NPS:FM on hydro electricity generation could increase total emissions by 629 kt CO2-e per annum. There is also a potential for these proposals to create an anti-competitive environment that increases the cost for consumers.

1.1.4 In Part 2 of this submission Trustpower explains its key concerns with the draft NPS:FM and proposed NES:FM and proposes appropriate solutions to address these key concerns. In particular Trustpower explains that:

a. The exceptions proposal is not well-founded and needs reconsidering. This is because it inappropriately protects specific schemes and creates an exemptions framework that is inconsistent with the principles of natural justice. It is also inconsistent with the Resource Management Act and the NPS for Renewable Electricity Generation. Trustpower therefore proposes to include all hydro-electric power schemes in the exception, or alternatively apply a more principled approach that recognises the benefits of all renewable electricity.

b. The objective and the hierarchy of obligations in the draft NPS:FM needs clarification because the hierarchy uses ambiguous terms. The importance of ‘other values’ in Appendix 1B is also unclear.

c. The approach to “current state” is problematic.

d. The suite of attributes is not fit for purpose and will create legal uncertainty. This is because there are proposed attributes that cannot be robustly, consistently and safely monitored and the approach taken creates legal uncertainty.

e. Sedimentation proposals are likely to create risks and introduce significant costs.
f. The treatment of fish passage is inconsistent and may be impractical for existing dams. This is because there are inconsistencies between the draft and proposed documents about the treatment of fish passage. There is also no feasibility or cost benefit analysis about this aspect of the draft NPS:FM.

g. The draft NPS:FM does not recognise or provide for the benefits of hydro-electricity. The value of hydro-electricity generation needs to be clearly recognised and expressed more fully.

h. Outcomes should relate to sustainable management and link to hydro-electricity generation values.

i. The definition of constructed wetlands needs clarifying because it is too broad and not supported by data.

j. The telemetry and freshwater accounting system proposed are flawed because quality telemetry data is variable and frequently not audited.

k. There are significant capacity and implementation constraints that may cause poor decisions to be made.

l. The Regulatory Impact Analysis ("RIA") offered with the consultation does not reflect the magnitude of the changes being proposed throughout the reform. The costs, risks and impacts for the electricity sector and consumers, and more broadly the economic impacts of this reform, have not been adequately assessed in the RIA.

1.1.5 To make good policy and avoid foreseeable adverse consequences, Trustpower encourages MfE to move to a Select Committee-like process or to provide an opportunity for us to engage with the Independent Advisory Panel led by Judge Sheppard.
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PART ONE: THE IMPORTANCE OF HYDRO-ELECTRIC POWER GENERATION AND CONSIDERING THE APPROPRIATE REGULATORY CONTEXT

1 Introduction

1.1 Trustpower Limited ("Trustpower") thanks the Ministry for the Environment ("MfE") for the opportunity to submit on its Action Plan for Healthy Waterways.

1.2 Trustpower’s key submission

1.2.1 Trustpower is a leading hydro-electricity generator in New Zealand. Trustpower has long expressed a desire to see responsible water quality management, however, we have concerns about the potential impacts of the Government’s recent proposals relating to freshwater management.

1.2.2 New Zealand’s existing hydro-electricity generation infrastructure is a powerful and useful resource that makes a strong and ongoing contribution to New Zealand’s commitment to reducing carbon emissions. We fear that the proposals will limit the contribution that hydro-electricity generation can make to New Zealand, particularly as it transitions to a low emission economy.

1.3 Trustpower owns the largest number of hydro-electricity generation stations in New Zealand

1.3.1 Trustpower is New Zealand’s fifth largest electricity generator and owns the largest number of hydro-electricity generation stations in New Zealand. This offers the company a unique and valuable perspective on issues affecting the hydro-electricity sector, including freshwater management.

1.3.2 Trustpower has a diverse electricity asset base. Trustpower owns 433MW of mainly hydro-electricity generation assets throughout New Zealand. The company owns 38 hydro-electric power stations across 19 individual schemes. The installed capacity of our sites varies from 0.43 to 80MW. Cumulatively our stations represent 8% of New Zealand’s hydro-electricity generation capacity.

1.3.3 The majority of our hydro-electric power stations are connected to local electricity distribution networks. We are connected to ten different companies’ networks as well as Transpower’s national grid.

1.3.4 The generation segment of Trustpower also includes metering and irrigation assets as well as Trustpower’s energy trading function. Trustpower also holds a 75% (2018: 80%) controlling interest in King Country Energy Limited, which owns an additional 54MW of hydro-electricity generation assets.

1.3.5 In the 2019 financial year, Trustpower generated 1,994GWh of electricity. This was down 11% from the previous year due to particularly low hydro inflows in the last quarter.

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1 The term scheme is the description used to indicate there may be more than one power station on a single stretch of river.
1.3.6 Trustpower’s hydro-electric power stations operate within the constraints of 429 resource consents authorising their operation and maintenance. A total of 3,520 conditions are associated with these consents of which 472 are actively managed for compliance purposes.

Figure 1: The location of Trustpower’s hydro-electric power schemes

1.4 Feedback has been constrained due to time limits

1.4.1 At the outset, Trustpower wishes to make it clear that it considers the approach to consultation on the proposals undertaken by MfE has been inadequate:

a. MfE has consulted on the draft National Policy Statement on Freshwater Management (“NPS:FM”) and the proposed Freshwater National Environmental Standard (“NES:FM”) without sufficient or relevant regulatory impact information being made available to those, like Trustpower, who will be directly and significantly affected by the proposals.
b. There is a shortfall in the quantity and quality of the economic impact analysis undertaken and, in the case of hydro-electric generators, the information relied upon by MfE for its economic impact analysis was unsuitable for this purpose (and known to be unsuitable to MfE but nevertheless, relied on).\(^2\)

c. Trustpower appreciates that MfE has extended the submissions period by two weeks. However, even with this extra time, given the quantity and complexity of the proposals Trustpower’s expert advisors have not had sufficient time to complete a full analysis of the potential consequences.

d. Our experience at the public consultation meetings Trustpower attended was that there were numerous information gaps and unanswered questions and only superficial reassurances given by officials who were there to explain the proposal.

1.5 Trustpower seeks an opportunity for its concerns to be heard

1.5.1 Trustpower encourages MfE to move to a Select Committee-like process or to provide an opportunity for us to engage with the Independent Advisory Panel led by Judge Sheppard.

1.5.2 If either of these options were available, then people can more fully share their views on this proposal and MfE would be better informed to make policy recommendations and avoid foreseeable adverse consequences.

1.5.3 Trustpower would be willing to co-ordinate a presentation with others who share the views expressed in this submission.

1.6 Trustpower’s response is informed by its experience and expert advice

1.6.1 Trustpower has set out its key concerns in this submission. We use comment boxes throughout to illustrate examples from Trustpower’s experience.

1.6.2 Throughout each section we set out proposed solutions in response to concerns raised. A complete summary of Trustpower’s submissions and relief sought is presented in Appendix A.

1.6.3 In developing this submission Trustpower has been guided by a number of independent expert advisors. Reports prepared by these experts are attached to, and should be read as part of, this submission. These reports are presented in Appendix B - D, respectively:

a. Appendix B - Ryder Consulting, “Comments on the draft 2019 National Policy Statement for Freshwater Management (NPS)”, October 2019 (Ryder Report);

b. Appendix C - Tonkin & Taylor Limited, “Letter Report on Draft NPSFM – deposited fine sediment attribute – Potential Implications for Trustpower”, October 2019 (T&T Report); and


\(^2\) As set out in section 16.5 of this submission.
2 A broad legal and policy context needs to be considered when setting a freshwater management regime

2.1 The contribution of sustainable energy must be considered when creating a freshwater management framework

2.1.1 The World Energy Council assesses a country or region’s ability to deliver equitable (or affordable), secure (or reliable) and environmentally sustainable energy to its inhabitants. This is described as the energy trilemma.

2.1.2 The key to a successful trilemma ‘score’ is by balancing these three fundamental elements of energy provisioning. A common challenge is excelling in one area but at a cost in another. This tool is widely accepted by energy professionals world-wide and is often used to guide and shape government policies – including New Zealand’s. We consider the energy trilemma is relevant to this proposal and will explain why it does not achieve the necessary balance required by the trilemma.

2.2 The essential services provided by lifeline utilities must not be undermined

2.2.1 Lifeline utilities are entities that provide essential infrastructure services to the community such as water, wastewater, transport, energy and telecommunications. Most relevantly to water, lifeline utilities include entities:

a. that generate electricity for distribution through a network or distribute electricity through a network (including hydro-electric power generators like Trustpower); and

b. that supply or distribute water to the inhabitants of a city, district or other place.

2.2.2 The Civil Defence Emergency Management Act 2002 recognises the vital role that lifeline utilities play in supporting the community during emergencies.

2.2.3 Among other matters, this Act requires every lifeline utility to take all necessary steps to undertake civil defence emergency management, perform the functions and duties required under the National Civil Defence Emergency Management Plan, ensure it is able to function to the fullest possible extent during and after an emergency, plan for functioning during and after an emergency, provide technical advice to any Civil Defence Emergency Management Group or the Director of Civil Defence Emergency Management.

2.2.4 Care needs to be taken by the Government to ensure that New Zealand’s most essential infrastructure services are not undermined by any policy, including the draft NPS:FM. As noted in 1.2.2 above, Trustpower fear the NPS:FM as drafted could undermine Trustpower’s and others, contributions to these lifeline utilities. Trustpower is concerned that has been insufficiently considered.

2.3 The Government’s commitments to establishing a low emissions economy must not be undermined

2.3.1 The Government needs to take care to ensure that the role of renewable electricity in assisting New Zealand to transition to a low emissions economy is not undermined by any policy, including the draft NPS:FM because:

a. It has made international commitments to reduce emissions;
b. Domestically, it has committed to implement emission reduction recommendations; and

c. The Zero Carbon Bill will impact future emissions.

2.3.2 **Low emissions are anticipated in international agreements.** The Paris Agreement is the new global agreement on climate change which will take effect from 2020. It was adopted by parties to the United Nations Framework on Climate Change (UNFCCC) in 12 December 2015 (and was ratified by New Zealand on 4 October 2016).

2.3.3 The Paris Agreement commits countries to take action on climate change. The purpose of the Paris Agreement is to:

a. Keep the global average temperature well below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C;

b. Strengthen the ability of countries to deal with the impacts of climate change; and

c. Make sure that financial flows support the development of low-carbon and climate-resilient economies.

2.3.4 Under the Agreement, New Zealand has committed to reduce greenhouse gas emissions by 30 percent below 2005 levels by 2030.

2.3.5 **The Government has committed to a “whole of economy” climate change work programme.** In line with New Zealand’s commitments under the Paris Agreement, in August 2018 the New Zealand Productivity Commission provided recommendations to the Government on how to transition New Zealand towards a lower emissions future. The Commission made 174 findings and 77 recommendations. The Government has agreed, or has agreed to investigate, the majority of the Commissions’ recommendations. It is committed to drive momentum on a whole of economy climate change work programme.

2.3.6 **Renewable energy is a key part of the Government’s commitments.** Transitioning to 100% renewable electricity (including through hydro-electric power generation) by 2035 is a key part of that work programme:

a. The Government has acknowledged that New Zealand already has up to 85% of electricity generated from renewable sources but demand for renewable electricity will increase to meet the needs of transport and to enable other shifts to a low-emissions economy.

b. In line with recommendations from the Interim Climate Change Committee and the findings of the Electricity Price Review, the Government is developing a policy package as part of a renewable energy strategy, which aims to accelerate the deployment of renewable electricity generation, encourage the update of renewable energy in industry energy use, and ensure fair and affordable electricity.

2.3.7 The New Zealand Energy Efficiency and Conservation Strategy 2017-2022 “Unlocking our energy productivity and renewable potential” and the New Zealand Energy Strategy 2011-2021 “Developing our energy potential” identify the same priority:

a. A key area of focus of the New Zealand Energy Strategy is developing and using more renewable resources to meet energy demand, help reduce energy-related greenhouse gas emissions, improve air quality and health, and meet the renewable electricity target. Central government’s approach is to ensure market incentives and
the regulatory framework support further investment in appropriate renewable projects by removing unnecessary regulatory barriers.

b. The NZ Energy Efficiency and Conservation Strategy focusses on leveraging New Zealand’s abundant supply of renewable energy resources to help meet New Zealand’s emissions reduction targets. The Strategy sets out the objectives, actions and targets for energy efficiency and renewable energy for the next five years and continues to support the New Zealand Energy Strategy.

2.3.8 The Climate Change Response (Zero Carbon) Amendment Bill will require further action.

The Bill was introduced to Parliament on 8 May 2019. It provides a framework for New Zealand to develop and implement climate change policies that contribute to the global effort under the Paris Agreement. The Bill sets a new emissions reduction target to:

a. reduce all greenhouse gas emissions (except biogenic methane) to net zero by 2050;

b. reduce emissions of biogenic methane within the range of 24-47 per cent below 2017 levels by 2050 including to 1- per cent below 2017 levels by 2030.

c. The Bill requires a series of emissions budgets and emissions reduction plans for the Government to work towards achieving the reduction target. It also requires the Government to develop and implement policies for climate change adaptation and mitigation. Action by the Government under the Bill will be guided by advice and monitoring by a Climate Change Commission.

2.3.9 The Bill recognises the important role of lifeline utility providers (like Trustpower) to the community:

a. The Bill empowers the Minister for Climate Change to require lifeline utility providers and other central and local government organisations to provide climate change adaptation information to the Government.

b. The information that may be required under the Bill includes the organisations’ assessment of the risks climate change poses to their functions, the organisations’ proposals and policies for adapting to climate change, and their progress towards implementing the proposals and policies.

2.4 National planning instruments must be prepared in accordance with the Resource Management Act

2.4.1 The domestic legal and policy context is also important. National planning instruments, including national policy statements and national environmental standards, must be prepared in accordance with the framework of New Zealand’s resource management legislation, the Resource Management Act 1991 (“RMA”).

2.4.2 The RMA has three underlying themes:

a. The sustainable management of natural and physical resources. Sustainable management is broader than simply protecting the environment.

b. Integrated resource management. The RMA promotes an integrated decision-making framework which means that national instruments must be clear and unambiguous and be consistent to enable compliance.

c. The management of adverse effects of activities on the environment. This requires decision-makers to take into account a range of considerations, including consideration of the effects of climate change.
2.5 The RMA requires consideration of the social and economic wellbeing of people now and in the future

2.5.1 The overriding purpose of the RMA is to promote the sustainable management of natural and physical resources. Sustainable management is broadly defined in the RMA to mean managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while –

a. sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

b. safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

c. avoiding, remedying, or mitigating any adverse effects of activities on the environment.\(^3\)

2.5.2 This definition is to be read as an integrated whole,\(^4\) without prioritising one set of effects over others. Consequently, national planning instruments prepared under the RMA are required to provide a framework for managing resources that enables people to provide for their own needs. These needs include access to electricity and the infrastructure to support its generation to support basic human health needs.

2.6 The RMA promotes the creation of clear, unambiguous and consistent national planning instruments

2.6.1 Integrated management is one of the key requirements of the RMA. To achieve an integrated approach, the RMA establishes a hierarchy of planning instruments. National Policy Statements are higher order planning documents that state objectives and policies for matters of national significance that are relevant to achieving sustainable management. Regional policy statements, regional plans and district plans must give effect to national policy statements.

2.6.2 As a result, national planning instruments and national policy statements in particular, must be clear and unambiguous. Otherwise, any inconsistencies or ambiguities will be perpetuated at a regional and local level in policy statements and plans across the country.

2.6.3 The need for clarity is reflected in the procedural principles in the RMA. These principles require decision makers to “take all practicable steps” to, use timely, efficient, consistent and cost-effective processes that are proportionate to the functions or powers being performed or exercised and ensure that policy statements and plans include only those matters relevant to the purpose of the RMA and are worded in a way that is clear and concise.\(^5\)

2.6.4 National planning instruments must similarly consider other higher order planning documents to ensure there is consistency. The RMA requires compliance with all national instruments which means the Freshwater Package prepared by the Government must be drafted to ensure that there is minimal conflict between the objectives and policies proposed in the package and existing national policy statements, such as the National Policy Statement on Renewable Electricity Generation 2011 (“NPS:REG”). Any policy on freshwater management should be developed to coordinate with and recognise existing policy on matters that affect freshwater to create integration across media. If consistency is not

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\(^3\) Resource Management Act 1991, section 5(2).

\(^4\) As set out in the Supreme Court’s decision in King Salmon.

\(^5\) RMA, section 18A.
achieved, conflicting priorities will make it difficult to implement or enforce any resulting rules that are included in regional or district plans.

2.7 The RMA requires consideration of the effects of climate change and renewable energy

2.7.1 The RMA provides a framework for managing the adverse effects of activities on the environment. Climate change is an effect specifically anticipated and referred to in the principles of the RMA. All persons exercising functions and powers under the RMA, in relation to managing the use, development and protection of natural and physical resources, shall have regard to the effects of climate change. They shall also have regard to benefits to be derived from the use and development of renewable energy.

2.7.2 The importance of renewable electricity generation from renewable electricity generation activities at any scale, including small and community generation activities, is reflected in the NPS:REG, which provides that:

a. The need to develop, operate, maintain and upgrade renewable electricity generation activities throughout New Zealand and the benefits of this generation are considered to be matters of national significance.

b. Regional policy statements and regional and district plans shall include objectives, policies and methods (including rules within plans) to provide for the development, operation, maintenance, and upgrading of new and existing hydro-electricity generation activities to the extent applicable to the region or district.

c. Decision-makers shall have regard to the fact that meeting or exceeding the New Zealand Government’s national target for the generation of electricity from renewable resources will require the significant development of renewable electricity generation activities.

2.7.3 Overall, the NPS:REG promotes a consistent approach to balancing the competing values associated with the development of renewable energy resources.

2.8 Impact analysis is essential for good policy

2.8.1 When a government agency prepares a proposal for regulatory change, such as the Freshwater Package, to present to Cabinet for approval it must be accompanied by an impact analysis of the proposal (unless an exemption applies). The purpose of an impact analysis is to ensure that policy proposals are prepared following careful and robust analysis and using a systematic and evidence-informed approach.

2.8.2 An impact analysis is summarised in a Regulatory Impact Assessment ("RIA") which must set out the agency’s best advice and must be prepared:

a. in accordance with Cabinet’s Impact Analysis Requirements set out in the Cabinet Office circular: CO(17)3: Impact Analysis Requirements;

b. following the New Zealand Treasury’s guidance on the approach that government agencies, such as MfE, should take when analysing policy options; and

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6 RMA, section 7(i).
7 RMA, section 7(j).
8 Policy E2.
9 Policy B(c).
10 A government regulatory proposal that will ultimately require creating, amending, or repealing primary or secondary legislation.
2.8.3 An RIA must define the policy or operational problem that needs to be addressed using supporting evidence, identify the policy objectives and all feasible options for addressing that problem and then analyse all material impacts and risks of proposed actions (including unintended consequences), in light of the legal context described above.

2.8.4 The detail and depth of analysis provided in a RIA must reflect the scale of the policy proposal and clearly establish why particular options have been recommended.

3 The important role of hydro-electric generation must be recognised

3.1 New Zealand has a broad network of hydro-electric power schemes

3.1.1 In New Zealand more than half of our electricity needs are generated from hydro-electric generation. Hydro-electric schemes use gravity to drive water through turbines, converting that energy into electricity.

3.1.2 Flowing water is a carbon-free energy supply. It does, however, rely on rainfall, snowmelt, and in some cases groundwater, which can be variable. Managing water resources in times of low inflows to ensure there is always a secure supply for hydro-electric generation is an important issue for New Zealand, especially as we move towards an increasingly renewable electricity system.

3.1.3 Because rainfall varies hugely across New Zealand’s hydro-electricity catchments, water storage reservoirs are important. So too is the support they receive from run-of-river schemes which also provide an important contribution in ensuring reliable electricity. In drought periods, hydro-electricity storage can be depleted and the ability to supply future energy demand can change quickly. Managing these scenarios is called managing security of electricity supply.

3.1.4 Regional planning rules and resource consent conditions also impact the ability to store water for electricity – restrictions are placed on the operating levels of hydro-electricity lakes i.e. generators cannot use all the water available in a lake and must operate within narrow water level bands – any compromise to these bands can impact energy security.

3.1.5 When enough water can be stored, hydro-electricity is reliable and consistent. However, New Zealand has relatively small water storage capacity, and water supplies can vary greatly from year to year. The storage in New Zealand’s large storage lakes (proposed for exception from the NPS:FM) typically fluctuates between approximately 1,000GWh and 5,000GWh with an average of 3,000GWh. On an annual basis these lakes generate approximately 26,000GWh which implies that they have between approximately two and ten weeks of storage, or an average of six weeks.

3.1.6 Hydro-electricity generation must continue to provide the backbone of New Zealand’s electricity system if we are to meet the goal of 100% renewable electricity generation by 2035. The sector realises there is still significant scope to develop new hydro-electricity generation in New Zealand, but as there is keen public interest in preserving our waterways,

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large projects may be difficult to establish which makes it more important to protect the current hydro-electricity asset base.

3.1.7 While the hydro-electricity system is finely balanced across the country, it can be supported by non-renewables if required. That is, if water inflows are low and the system is under pressure, alternatives such as coal, which is easily stored, can act as a substitute. Wind and solar cannot offer the same certainty.

3.2 Hydro-electricity efficiency is affected by flow rates

3.2.1 The NPS:FM provides for changes to be made to flow rates and lake levels. It is important to understand the relationship between hydro-electric power generation and pressure and machine efficiency when considering this matter.

a. Machinery used in hydro-electric power plants has efficiency characteristics that are influenced by lake range and flow. Turbine hydraulic design is optimised for a particular combination of pressure and flow. Either side of these optimised points machine efficiency starts to reduce gradually, and more water is needed to produce the same amount of electricity.

b. Any changes to flow requirements can therefore have a profound impact. Hydro-electric schemes are operated in terms of electricity output, not flow. The electricity market also requires dispatch in terms of electricity, not flow, and the Electricity System Operators compliance requirements must be met in terms of electricity (MW set points).

c. For example, when there is a combination of low discharge flow and low lake levels at Trustpower’s Matahina power station the turbines use 20-25% more water to generate the same amount of electricity than at higher flow and lake level. So, altering flow rates is likely to reduce the energy produced by hydro-electricity generation schemes.

3.3 There are significant benefits associated with hydro-electricity generation

3.3.1 The benefits of hydro-electricity generation include:

a. Strategically important economic assets when viewed at a national scale.

b. Significant assets to the environment.

c. Beneficial water management (see Box 1).

d. Recreational opportunities in local and, in some cases, national communities (see Table 1).

e. Energy security for our country.

f. Lifelines and human health needs

g. Flood attenuation.

h. Other benefits discussed elsewhere in this submission (including those in the NES:REG).

Box 1: Other positive values of hydro-electric power schemes (HEPS)
The regulation of high river flows by hydro-electric dams (i.e. storing peak flows for release during dry periods) can enhance a range of freshwater values. An example is the operation of the Cobb dam.
which overall increases the availability of flow in the Takaka River that contributes to the recharge of the aquifer, that in turn feeds the nationally important Te Waikoropupū Springs. In other words, the scheme makes water available to recharge the aquifer (via the Takaka River), keeping a more constant source of water for the springs.

Through Trustpower’s hydro-electric power schemes, a range of recreational activities are enabled. This includes recreational fishing, such as for trout, swimming, water skiing, recreations releases for kayaking and other boating activities. The table below shows the range of water based recreational activities that are provided for by the presence of the HEPS.

**Table 1**: The range of water based recreational activities provided for in a sample of Trustpower’s hydro-electric power schemes.

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Fishing</th>
<th>Swimming</th>
<th>Kayaking</th>
<th>Water Skiing</th>
<th>Boating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaimai</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motukawa</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Patea</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Branch</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Arnold</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McKays</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Coleridge</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waipori</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### 3.4 Hydro-electricity generation has a significant role in transitioning to a low emissions economy

#### 3.4.1 One additional key benefit of hydro-electric generation is ensuring our electricity generation sector has a low carbon footprint. Maintaining and enhancing existing hydro-electricity is critical for meeting international climate obligations. Hydro-electricity generation is the backbone of our energy system. It also provides the key to a sustainable energy future and achieving the Government’s target of 100% renewable electricity (including through hydro-electric generation) by 2035. Forecasts depicted in the Sapere Report (2019) also illustrate that the increase in demand from electrification of transport and industrial heat combined with removal of fossil fuel powered generation will lead to hydro-electricity becoming more important for ensuring energy security and energy equity.

#### 3.4.2 While the country needs hydro-electricity, the hydro-electricity sector needs to operate within a coordinated and supportive regulatory environment. In this context, the following considerations are particularly relevant:

a. It is important to maintain or enhance operational flexibility while enabling greater efficiencies to optimise operational output from existing investment in hydro-electricity generation infrastructure.

b. It is not only the total generation output of hydro-electricity that is highly valuable, but so too is its ability to help underpin a ‘variable generation’ future – while other
renewable energy sources are increasing (for example, solar and wind), they tend to be more variable and less manageable in output, making hydro-electricity even more important to support the future renewable energy portfolio. As noted in the Sapere report “Wind and sun cannot be stored so the combination of less fossil fuel and more of these intermittent types of generation will make hydro-electricity’s storage component more critical than under current circumstances in order to meet peaks in demand. In addition to wind, solar generation, some of the increased renewable electricity supply will come from geothermal, but this is operated as base load plant and provides no flexibility at all.”

c. The regulatory framework needs to support all forms and sizes of hydro-electric power generation from small-scale community projects to large projects. All will help the shift to a low emissions, renewable energy future.

d. Imposing unreasonable constraints on the operation of hydro-electric power schemes will result in reduced output and will be detrimental to New Zealand’s low emissions goals. Safeguarding our current and future renewable electricity generation requires policies that strongly direct the prevention of any diminution of output.

e. The flexibility of hydro-electricity generation is critical to future development of further new renewables that are either baseload or intermittent.

f. There needs to be stronger direction (and support for the hydro-electricity sector) in respect of conflicts between development of hydro-electricity generation infrastructure and policies on resources with significant values, such as use of freshwater, outstanding natural landscapes or indigenous biodiversity values.

g. There needs to be better guidance on how to address the effects of renewable electricity generation, recognising hydro-electricity generation cannot be achieved without some adverse effects.

4 The freshwater package of proposals does not adequately consider the impact on hydro-electricity generation or New Zealand’s energy system

4.1.1 Changes to regulation on freshwater management will inevitably impact on the infrastructure that relies on and operates using freshwater. However, the draft NPS:FM and draft NES:FM do not recognise or adequately address the role of hydro-electricity generation in New Zealand and its growing importance in the context of climate change.

4.2 The NPS:FM risks reducing the potential for hydro-electricity generation

4.2.1 Hydro-electricity generation is key to New Zealand’s electricity supply. In Sapere’s expert opinion that contribution is undermined by the approach taken in the draft NPS:FM:

“Hydro-electricity generation makes a vital contribution to the supply of electricity in winter. The contribution of each scheme or station depends on the characteristics of the individual scheme or station. The impact of the NPS FM will also vary between generators. Based on a high-level consideration of a sample of hydro schemes with different characteristics, we consider the range of lost winter energy supply from hydro may lie between 0% and 50% depending on the scheme and the application of the NPS FM.”

4.2.2 Losing winter energy supply from hydro-electricity infrastructure will impact on the security of New Zealand’s electricity supply. Historically, embedded generation was built for direct
supply to consumers, as early supply authorities had to install their own generating plant to initiate electricity supply to their regions. This has left a legacy of embedded generation that is valuable for security of supply. See Box 2 for an example.

4.2.3 For distributors where the demand of their network exceeds available supply by the transmission network, this distributed generation ("DG") plays a significant role in relieving congestion and ensuring demand can be met and the ‘lights stay on’ for end consumers. Not only does it defer investment needs in distribution systems, DG also contributes positively toward a distribution network’s security of supply standard, enabling them to provide a more reliable supply of electricity to the consumer.

4.2.4 Using existing DG assets is not only an optimal utilisation of resources, but also reduces the potential environmental footprint associated with establishment of new resources. It eradicates the need for construction of additional physical transmission and distribution assets to cope with increased demand. The substation and transmission towers construction process often involves the clearing of land and trees. Fewer transmission pylons means less noise disturbance and transmission interference to nearby populated areas.

Box 2: Example of hydro-electric power schemes saving costs for others and ensuring a secure supply of electricity

Trustpower’s Kaimai hydro-electric power scheme ("Kaimai") consists of four power stations in the Wairoa River catchment and has a maximum capacity of about 41MW. It is connected to PowerCo’s local distribution network in Tauranga.

The presence of Kaimai, as distributed generation, allows Tauranga’s peak demand to be met without Transpower having to upgrade transmission capacity to Tauranga or engage in alternative methods of equalising supply and demand (such as load control demand-side participation, or load shedding).

Transpower estimates that PowerCo’s network in Tauranga has a peak demand of 115MW. In its 2015 Transmission Planning Report, Transpower forecast that in 2015 Tauranga would have an annual peak demand at the grid exit point of 101MW. In addition to this 101MW delivered from the transmission network, Transpower assumes that Kaimai has a minimum generation level of 14MW.

The transmission network serving Tauranga has a winter N-1 rating of 105MW. This capacity is insufficient to serve Tauranga’s peak demand of 115MW. By injecting electricity into the Tauranga network, Kaimai makes the transmission network capable of meeting the remaining demand at the peak using existing transmission assets.

4.3 There is a risk that New Zealand’s carbon emissions are likely to increase

4.3.1 If New Zealand is going to meet its existing climate change targets or those more ambitious targets set out in the Zero Carbon Bill, a strong focus on promoting new renewable electricity generation and maximising existing renewable electricity generation output is required. Despite this need, Sapere advises that the approach taken in the draft NPS:FM will have the opposite outcome: it has the potential to reduce the contribution that existing renewable
electricity generation can make to transition the country to a low emissions economy. As a result, New Zealand’s carbon emissions are likely to increase.

4.4 The NPS:FM could result in real loss of future opportunity

4.4.1 Trustpower is aware that it is far more efficient to use local energy sources in local areas where possible. Using local energy sources, eliminates the “line loss” (wasted energy) that happens during transmission and distribution in the electricity delivery system. Sapare has noted that “The nature of hydro-electricity is that it has a role in New Zealand’s regional economic development because of its location. This will be pronounced as the energy transformation unfolds. We expect to see a more decentralised energy system and regional hydro schemes (plus potential augmentation) will have an important role to provide local peaking support and reduce pressure on new transmission.”

4.4.2 If smaller hydro-electric schemes are not treated as equal to other larger schemes, the negative impacts on these smaller schemes could result in real loss of future opportunity.

4.5 The draft NPS:FM will threaten New Zealand’s ability to provide for the energy trilemma

4.5.1 As outlined above, countries across the world are striving to achieve the energy trilemma (equitable, secure and environmentally sustainable energy). However, the draft NPS:FM is focused narrowly on a sub-section of environmental sustainability and its does not consider the impacts on equity and security.

4.5.2 As noted by Sapare, “any policy measures, such as proposed in the freshwater management proposal, that constrains hydro-electricity’s flexibility or volume, (where is not excepted from the NPS FM) or through the workings of the regional councils will make it much harder for New Zealand to meet its Energy Trilemma policy objectives in relation to emissions reductions, energy security and energy equity.”

4.5.3 This is because limiting flexible operation will impact security. If the draft NPS:FM reduces the output from existing hydro-electric power schemes as anticipated, this will require New Zealand to bring more expensive generation online, thus reducing affordability.

4.5.4 This approach also sets an unhealthy precedent. To decarbonise our economy, we are likely to have to choose between competing environmental concerns – for example we may have to modify some of our natural environment to build enough generation to stop using coal for industrial heat. If we focus only on a single environmental concern and do not plan systemically, we may never achieve an appropriate balance in the energy trilemma.

4.6 An anti-competitive environment and poor constitutional outcome will be created

4.6.1 The ‘exceptions’ included in Sub Part 4 of the NPS:FM risk creating an anti-competitive environment because the proposed draft framework favours specific businesses in the industry giving them an unfair advantage over competitors:

a. **This does not promote competition and innovation** by allocating costs in a way that facilitates or encourages competition for electricity, nor does it take into account long-term opportunities for innovation in those markets.

b. **This does not promote energy system reliability.** It fails to allow the efficient operation of the electricity system in ways that minimise total cost and minimise adverse events.
This does not promote efficient operation which includes:

i. signalling of long-term maintenance in hydro-electricity generation or enhancement investment costs; or

ii. costs will be incurred in a distortionary manner.

It is not rational or transparent and therefore is not enduring in a way that is broadly acceptable to stakeholders.

Capacity is not a complete measure of the relative impact on specific hydro-electricity generators. With capacity being the basis underpinning the ‘exceptions’ approach, further analysis is needed to make robust policy decisions consistent with other legal and regulatory requirements.

4.6.2 In framing legislation (and supporting regulations and policies), parliament and the New Zealand Government have a constitutional responsibility to be even handed and balanced in how citizens (including corporates) are treated. Legislation (and supporting regulations and policies) might result in different outcomes for different individuals, but that should only occur either as:

a. an intended outcome to address a specific need or inequality; or

b. a modest unintended consequential outcome because of the need to prioritise a more important or higher objective.

4.6.3 The draft NPS:FM fails that convention and chooses to favour some over others. The draft NPS:FM draws distinctions between hydro-electricity created from different waterways, when there are no sound environmental or other policy grounds to make such distinctions.

4.6.4 All hydro-electricity, whether generated in large or small schemes, makes valuable contribution to the renewable and sustainable objectives described elsewhere in this submission. Likewise, all such schemes have environmental effects that should be appropriately measured and managed.

4.6.5 The exception regime in Subpart 4, which picks winners and losers, is arbitrary and without a sound policy rationale. The only rationale that Trustpower can discern is the excepted schemes are larger, and that is a poor basis for preference. While it may be accidental, it is an unavoidable circumstance that the major beneficiaries (other than Contact Energy Limited) included in Subpart 4 are the Crown majority owned companies, Meridian Energy Limited, Genesis Energy Limited and Mercury NZ Limited.

4.6.6 The only constitutionally appropriate approach is to treat all hydro electricity generation in an even-handed manner. That can be achieved by having all of it, or none of it, subject to Subpart 4. This point is further considered in section 5 of this submission.

4.7 The proposals will lead to an increased cost to consumers

4.7.1 In October 2019 Hon Dr Megan Woods, Minister of Energy & Resources, and Fletcher Tabuteau, Under Secretary for Regional Economic Development, released a joint statement relating to proposed changes to the electricity market as part of its Electricity Price Review. Dr Woods announced that the changes proposed will create a level playing field for
smaller independent retailers, create greater transparency over the big power companies and increase competition in the market. Mr Tabuteau confirmed that:

“New Zealand First has long held a strong belief that electricity, an essential service, must be delivered to all New Zealanders at the most reasonable price that is consistent with the maintenance of a viable industry ... As a result, New Zealand’s future energy regulatory structure will provide long-term stability and incentives for business to make informed investment and purchasing decisions while ensuring that the needs of every New Zealander are met.”

4.7.2 However, this is not reflected in the freshwater package of proposals.

4.7.3 Sapare is clear that “Any costs associated with changing the operation of existing hydro-electricity generation and investment in new generation capacity will ultimately be borne by consumers”. The impact on consumers, particularly from a fairness and affordability perspective needs rigorous analysis, particularly in light of the recent Electricity Price Review. This work is currently missing from the Freshwater Package.

PART TWO: KEY CONCERNS WITH THE NPS:FM AND NES:FM

Note: the matters discussed within this section do not cover all the areas of concern to Trustpower. This section is designed to explain the rationale for the relief sought across the most critical areas only. The relief table enclosed as Appendix A includes the complete schedule.

5 The exceptions proposal is not well-founded and needs reconsidering

5.1.1 Subpart 4 of the draft NPS:FM creates an exception for six hydro-electric power schemes to the standard policy approach:

a. The six schemes are Waikato Hydro, Tongariro Power, Waikaremoana Power, Waitaki Hydro, Manapouri Power and Clutha Hydro.

b. The draft NPS:FM directs that regional councils must have regard to the importance of not adversely impacting the generation capacity, storage and operational flexibility of the six schemes when setting limits, developing action plans or making plan changes (clause 3.22(2)).

c. In addition, regional councils are empowered to set target attribute states that are below national bottom lines in respect of waterbodies or freshwater ecosystems that are adversely impacted by structures that form any part of the schemes (clause 3.22(3)). (Regional councils must still set target attributes that, to the extent possible, improve any waterbody or freshwater ecosystem affected by any scheme (clause 3.22(4)).

5.2 The exceptions framework inappropriately protects specific schemes and should be reconsidered

5.2.1 The exceptions framework is inappropriate because it lacks any compelling logic when assessed against relevant economic, environmental, energy and regulatory principles:

a. It is ill-founded. There is no reasonable basis for selecting the six schemes for protection over and above other hydro-electric power schemes.

b. No reasons (beyond the capacity of specific schemes which Sapere explains is not an appropriate criterion) have been given justifying why the six specific schemes have been selected for protection. No reason is given why the seventh largest scheme (the Rangitaiki scheme, which has output not dissimilar to Waikaremoana) is not included. Therefore there can be no confidence that there is any integrity in the decisions that have been made to protect those schemes.

c. It does not recognise the importance of storage capability. This significant weakness is identified in the Sapere report.

d. The Action for Healthy Waterways discussion document (at page 35) acknowledges that other schemes are significant in their own right but the draft NPS:FM does not apply the exception to them on the basis that a general exception would allow too many rivers and lakes to potentially be exempt from national bottom lines. This is not a fair approach and the reasoning does not justify why significant schemes should potentially be adversely affected by the draft NPS:FM. As noted in the Sapere report,
the size of a scheme is a poor proxy for hydro electricity’s role in the energy sector or contribution to CO₂ emissions reductions.¹⁴
e. The consequence of not providing an exception to the entire hydro-electricity industry from the draft NPS:FM is a potential increase in CO₂ emissions. The Sapere report explains that:¹⁵

i. There will be a material impact on hydro-electricity generation outcomes from the freshwater policy proposal if all hydro-electricity infrastructure is not included within the Subpart 4 of the NPS:FM.

ii. The replacement form of generation for lost hydro-electricity capacity and flexibility to ensure energy security is assumed to be gas-fired generation, which is the alternative form of flexible peaking capacity.

iii. Limiting the infrastructure excepted from the NPS to the six largest hydro-electric power schemes by capacity could have a material impact on emissions and New Zealand’s ability to meet its climate objectives.

iv. Sapere estimate the total increase in annual emissions associated with the changes associated with the draft NPS:FM is 629 kt CO2-e per annum. This impact has not been adequately considered by the Government.

f. As noted above, the exceptions framework favours specific businesses in the industry giving them an unfair advantage above others operating in the same industry. This creates an anti-competitive market place and is inconsistent with the Commerce Act 1986 which promotes a level playing field for businesses by preventing behaviours which is anti-competitive – that is, behaviour which reduces competition in some way.

g. Creating policy on an unprincipled basis as has been done in this case will result in equally poor and unintended consequences e.g. potentially creating an anti-competitive market place.

5.2.2 The exceptions framework is inconsistent with the principles of natural justice which requires decision-makers to act fairly, objectively and without bias, for the same reasons.

5.2.3 It is also inconsistent with the RMA and the NPS:REG:

a. It is distinctly inconsistent with section 7 (j) of the RMA. As outlined above, all persons exercising functions and powers under the RMA, in relating to managing the use, development and protection of natural and physical resources shall have particular regard to “the benefits to be derived from the use and development of renewable energy”. The draft NPS:FM takes a very narrow interpretation of its obligations under this section. It implies that the benefits are only worth recognising when the electricity generation represents a large proportion of hydro-electric generating capacity.

b. Section 7(j) benefits are set out in Policy A of the NPS:REG. There is nothing in that policy to suggest that benefits are only worth recognising if generating capacity is sufficiently large relative to the total national hydro-electric generation capacity. In reality:

¹⁴ Toby Stevenson, Vhari McWha and Sally Wyatt, Sapere “Regulatory impact analysis: providing for hydro-electricity generation infrastructure” report prepared for Trustpower, October 2019 at 3.

¹⁵ Sapere, above n 6 at 7.
i Every kilowatt hour of renewable electricity that displaces a kilowatt hour of thermally generated electricity has the same benefit in terms of NPS:REG Policy A(a).

ii Regionally distributed schemes (such as the Trustpower schemes) have direct benefit in terms of maintaining or increasing security of supply at a local, regional and national level by contributing to the diversification of the location of generation (NPS:REG Policy A(b)).

iii Both large and smaller hydro-electric power schemes use natural rather than finite resources and both avoid reliance on imported fuels for generating electricity (NPS:REG Policy A(c)).

c. The NPS:REG does not distinguish between the six largest generation hydro-electric power schemes and other schemes. The single objective of that NPS is to:

To recognise the national significance of renewable electricity generation activities by providing for the development, operation, maintenance and upgrading of new and existing renewable electricity generation activities...

Neither that objective nor any of its implementing policies determine that some renewable electricity generation activities should be “provided for” more than others.

5.2.4 The ‘selected exceptions’ approach of the draft NPS:FM is inconsistent with the clear approach promoted by the NPS:REG. This is likely to cause confusion for the future implementation of the NPS:REG because it will be unclear for regulators and other stakeholders how the priorities of the NPS:FM apply and whether the distinction between ‘first class’ larger hydro-electric power schemes and ‘second class’ schemes is intended to apply more broadly. Trustpower considers this as a risk to the maintenance of the existing level of hydro-electric generation in the country and to New Zealand’s broader goals and international commitments as discussed above.

5.3 The most appropriate approach is to include all hydro-electric power schemes in the exception

5.3.1 Trustpower considers that the most principled and straightforward solution is to dispense with the arbitrary distinction currently proposed and apply a consistent approach to all hydro-electric schemes, as is reflected in the existing NPS:REG, by allowing all existing hydro-electric power schemes in 3.22(1) of the draft NPS:FM. This approach avoids the issues outlined above and the constitutional issues highlighted in the prior section. It also recognises the importance of the whole industry as a lifeline utility and one that is heavily relied on (and needs to be supported) by the Government and all New Zealanders’ to assist New Zealand in achieving its emissions reductions targets and in transitioning to a low emissions economy. As noted in the Sapere report:

a. Hydro-electricity plays a key role in the context of Government’s climate change policy imperatives to reduce CO₂ emissions. CO₂ emissions are expected to be reduced mainly by replacing fossil fuel powered generation with renewable generation and electrifying sectors currently reliant on fossil fuels such as transport and industrial process heat.

b. Electrification will increase demand for electricity at the same time non-renewable electricity generation is displaced by renewable generation.

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*Sapere, above n 6 at 1.*
c. In combination these two developments will place greater emphasis on the role hydro-electricity plays in the economy and its ability to fulfil them.

d. Care must be taken, and appropriately robust analysis of these issues should be completed, before steps are taken that may actually compromise the ability for hydro-electricity to play its part.

5.3.2 This approach will still enable attribute states to be set above national bottom lines to improve the relevant waterbodies or freshwater ecosystems to the extent that they do not adversely impact the generation capacity, storage and operational flexibility of the industry.

5.4 Alternatively, Trustpower proposes a principled approach that recognises the benefits of all renewable electricity

5.4.1 If an exception for all is not accepted, then Trustpower suggests the following principled approach:

5.4.2 Ensure that the benefits of renewable energy are recognised by policy of the NPS:FM. We consider that the best way to do that, without expanding the purpose of the NPS:FM, is to include a policy in clause 2.2 that expressly recognises the existing hydro electricity generation value in Appendix 1B. As drafted, the direction setting policies of clause 2.2 of the draft NPS:FM do not make any express reference to the ‘human contact’ or ‘threatened species’ values (despite them being compulsory values) or to the ‘other values’ as may be set through the national objectives framework. In Trustpower’s view that is incorrect because the detailed provisions that follow in the NPS:FM should be based on the foundation of the direction setting objectives and/or policies of clause 2.2. Accordingly, we seek the following addition to clause 2.2 to ensure that the value of hydro electricity generation is recognised (where is applies) consistent with the NPS:REG and Section 7(j) of the Act.

Policy 2A

Freshwater is managed through a National Objectives Framework to recognise and provide for compulsory values and other values as may be applicable.

5.4.3 An alternative may be to integrate the above into existing Policy 2 as follows:

Policy 2

Freshwater is managed through a National Objectives Framework in order to:

a) ensure that the health and wellbeing of waterbodies and freshwater ecosystems is maintained or improved; and

b) recognise and provide for compulsory values and other values as may be applicable.

5.4.4 Ensure that regional plans describe the outcome a regional council wants to achieve for hydro-electricity generation values (where they apply). Clause 3.7(2) relating to environmental outcomes requires environmental outcomes to be described for values. In section 6 of this submission Trustpower proposes amendment to the wording of this clause to make it clear that where hydro-electricity generation infrastructure exists, it ought to be recognised as a value and have a sustainable management outcome described in respect of it. Once there is an outcome described for the hydro-electricity value present, that will be a
relevant consideration in the setting target attribute states (under clause 3.7(6) and in the setting of environmental flows and levels (under clause 3.11 (2)).

5.4.5 **More fulsomely describe the value of hydro-electricity generation in Appendix 1B.** The value of hydro-electricity generation should be more fulsomely described in Appendix 1B and the value of *hydro-electricity generation* itself specifically recognised (rather than the suitability of the water body for hydro-electricity generation based on the natural hydrological/hydraulic characteristics). This will help to align the policy expressed in the NPS:REG (to recognise benefits) with that of the draft NPS:FM. The relief Trustpower seeks to provide for a more fulsome characterisation of the value of hydro-electricity generation is outlined in detail in section 6 of this submission.

5.4.6 This proposed approach ensures that no hydroelectric power scheme is exempted from national bottom lines or from environmental flows and levels. All hydro-electricity power schemes operate on a level playing field while ensuring the outcomes associated with the existing hydro values are taken into account when making decisions that have the potential to constrain the development, operation, maintenance and upgrading of those schemes. Those outcomes and the protection they afford may well vary scheme by scheme depending on what other values are relevant.

5.4.7 Also, Trustpower seeks to amend clause 3.9 (6) to have the same subclause apply, not just to the *setting* of target attribute states but also to the *timeframes* for achieving those states. This change will also allow hydro-electricity specific environment outcomes to be taken into account in terms of when new and more stringent requirements might apply.

5.4.8 Overall, Trustpower considers that both of the options that it has set out above would be fairer, more balanced and coherent, take into account the existing NPS:REG, and objectives and direction-setting policies of the NPS:FM and existing approach of the national objectives framework.

6 **The objective and the hierarchy of obligations needs clarification**

6.1.1 The draft NPS:FM retains Te Mana o te Wai as a fundamental concept underpinning the entire NPS. However, the draft NPS:FM usefully attempts to provide greater definition to what the concept means and how it might apply in practice than is included in the current NPS:FM. Central to that is the *hierarchy of obligations* which is proposed as the single objective of the NPS:FM (clause 2.1).

6.2 **The hierarchy of obligations uses ambiguous terms and therefore will be difficult to implement**

6.2.1 The aim of the draft NPS:FM may be to provide greater clarity and to confirm, to a large extent, what has been the practice and approach for many years. At a broad level, Trustpower agrees that is useful.

6.2.2 However, at a more detailed level Trustpower questions the extent to which the incorporation of the hierarchy of obligations will work. The approach proposed in the draft
NPS:FM’s objective may not assist with what are inherently complex, multi-dimensional issues and choices that have to be made when making water management decisions.

6.2.3 While the hierarchy of obligations sets useful high-level direction, Trustpower considers that at the level of practical implementation the intended clarity provided by clause 2.1 is illusory. For example:

a. There are often multiple values and benefits deriving from water take and use (see Box 3).

b. The ‘health and wellbeing’ of water is not a defined term and, within the national objectives framework, might be argued to be the A band or the national bottom line (or anywhere in between).

c. The ‘essential health needs of people’ is open to various interpretations. There are a number of services that are essential for human health. The focus on wadeability is unduly narrow and inconsistent with other legislation. One of the most relevant lifeline utilities is the generation of electricity by water. Trustpower considers the use of electricity is a fundamental human need, where human health cannot exist in our modern society without electricity.

d. The questions always at the heart of water management decisions are ‘how much health and well-being is appropriate?’ and “how much of that decision should be influenced by the benefits to be derived from water use?”. The way the hierarchy of obligations has been drafted presents a risk to all water users because it introduces extra uncertainty in how those core questions are to be answered in each local plan.

6.2.4 Uncertainty with the hierarchy is likely to lead to considerable litigation:

a. A lack of clarity on all of these matters raises debate in each plan about how they will be addressed.

b. The strong focus on environmental matters without broad integration of social and economic considerations is likely to raise questions about the extent to which NPS:FM gives effect to Part 2 in the RMA or whether Part 2 needs further consideration, in light of the Supreme Court’s views in King Salmon.

6.2.5 To avoid extensive future legal debate Trustpower considers that clause 2 should be amended to make clear that the objective of the NPS:FM is to be read in conjunction with Part 2 of the Act.

6.2.6 To provide clarity about what the level of health and well-being to be accorded first priority we propose that sub clause a) include reference to the health and well-being as set in accordance with the national objectives framework. Elsewhere in our submission we also suggest amendments to other provisions to provide greater clarity about the second and third priorities and the role of social and economic matters.

Box 3: Hydro-electricity generation supports town drinking water supplies

Trustpower’s Mangorei HEPS in New Plymouth, McKay’s / Kaniere HEPS on the South Island’s West Coast and the Waipori HEPS all support district councils’ municipal water supply, particularly in times of water shortage. Town water supply is provided through the associated hydro storage reservoirs, with parts of the lakes dedicated to both hydro-electric generation activities and town supply needs. Hydro-electric power needs are typically taken from the upper range of a reservoir level. However, at all of these three locations there are residual flow requirements that take priority. This means that...
during low inflows when lake levels are also typically low, the requirement to meet the residual flows can compete with town supply needs. Any changes in these flow regimes by the NPS:FM could result in higher residual flows at these locations, which in turn could impact the reliability of the town supply during dry or low flow conditions. In this situation when conditions are dry there would be a quicker reduction of reservoir availability for town water supply.

Relief Sought

6.2.7 Trustpower seeks the Objective 2.1 be redrafted as follows:

2.1 Objective

The objective of this National Policy Statement is to ensure that resources are managed in accordance with Part 2 of the RMA in a way that promotes sustainable management and prioritises:

a) first, the health and wellbeing of waterbodies and freshwater ecosystems (as determined in accordance with Part 1, subpart 2); and

b) second, the essential health needs of people; and

c) third, the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and in the future.

7 The approach to “current state” is problematic

7.1.1 Clause 3.8(1) of the draft NPS:FM requires regional councils to identify the current state of each of the 23 attributes in Schedule 2A and 2B. Subclause 3.8(3) requires councils to use ‘best efforts’ where it does not have complete and scientifically robust data on which to establish current state.

7.1.2 Trustpower has two concerns with this approach to identifying current state:

a. Current state is uncertain and dynamic. There is potential for inaccurate and variable determination of current state;

b. Inadequate consideration of “load to come” and authorised effects is unreasonable.

7.2 Current state is uncertain and there is potential for inaccurate and variable determination of the current state

7.2.1 The current state is critical to the proposed water management framework because it becomes the ‘bottom line’ state that water must be managed to (unless the national bottom line set out in Appendices 2A and 2B is above the current state in which case, water quality must be improved beyond current state to the national bottom line).

7.2.2 In Trustpower’s opinion, the approach taken in the draft NPS:FM to current state reflects poor practice, is unreasonable and potentially unfair as it applies what could be highly inaccurate and subjective assessments in ways that affect the continued viability of existing lawfully established activities:

a. The data isn’t complete: Trustpower’s independent water science advisers have advised (see Appendix B) that several years of monitoring data is required to achieve a good representation of the current state. That is consistent with the draft NPS:FM’s own requirements for monitoring attributes states (as specified in
Appendices 2A and 2B) which require multiple (generally 5) years of data. Trustpower is aware that regional councils are highly unlikely to have robust monitoring data for all 23 attributes allowing them to establish current state in a scientifically reliable fashion.

b. That means that the current state, in some places and for some attributes (particularly Appendix 2B attributes,) will be estimated using ‘best efforts’. Best efforts would be different for, and guarantee no consistency between, different regional councils or individual council scientists. When robust monitoring is undertaken it may well reveal the state of an attribute to be quite different to the estimated current state despite nothing new or additional occurring in the catchment since current state was estimated.

c. **There isn’t an adequate process for a determination of current state:** Clause 3.9 refers to current state as being “determined” under clause 3.8. For a decision-making process it is very lax. There are limited indicators of what is complete or scientifically robust. The system does not provide for any input from the public on the assessment methodology, the information available, or the determination itself. There is no obligation to give reasons for determination reached or any opportunity to challenge the approach taken.

d. **It does not provide for a satisfactory benchmark:** The draft NPS:FM acknowledges inherent uncertainty in the information it is proposed to address. That is not satisfactory. In other environmental legislation the government has acknowledged the importance of having an accurate record of a benchmark. For example, pre-1990 forest land was identified well before laws were proposed in 2007 to create New Zealand’s emission trading scheme in 2008. The emissions trading scheme has obligations which relate to forest land before and after 1 January 1990. That date was selected because there was certainty of the benchmark, due to prior international agreements associated with emissions.

e. **The approach taken to identifying the current state is not consistent with how benchmarks are used in other environmental areas.** In addition to benchmarks with forestry, contaminated land liability is another environmental area where benchmarks are commonly used. They are typically undertaken when a party enters or exits land. The parties negotiating are careful to make sure the benchmark is as clear as possible as liability shifts to before and after occupation. Scope and methodology are clear and prescribed to be repeated when another party leaves. If the land is to be transferred in a hasty manner but the purchaser does not want to accept liability for historical contamination then the parties agree a set of principles that will apply and process for proceeding, including a methodology to be used to ensure a robust benchmark is created. None of that rigor is anticipated in the draft NPS:FM.

f. **The consequence of the data does not change even if the underlying data is less reliable:** It is normal to gather data for a period before any significance or reliance is placed on it. This provides both regulators and the public with the time and opportunity to locate and test the data. For example, as New Zealand’s emissions trading scheme was first established there was a requirement to record and report data before any obligations associated with that data were in force. This remains the case for agricultural emissions. However, the draft NPS:FM does not distinguish between current states identified using robust scientific data and those estimated by ‘best efforts’ (potentially no data). As far as we are aware, current states of both levels of reliability may be used (once incorporated into a regional plan and possibly
before such incorporation) to determine if change has occurred and therefore what regulatory and non-regulatory interventions need to occur. The regulatory interventions might include:

i  new rules in plans restricting or requiring reductions in takes and discharges;
ii  declining applications for new takes or discharges;
iii  declining applications for replacement consents, (or placing conditions on any consent granted for a new or replacement take or discharge); or
iv  reviewing existing consents (under section 128 of the RMA) and imposing new conditions.

7.3 The approach to “load to come” and already authorised effects is unreasonable

7.3.1 It is common for catchments to be subject to what is called “load to come”. “Load to come” includes contaminants already in the hydrological system but which are yet to find their way to surface water receiving environments. This is often the case with dissolved nutrients that travel to surface water by way of groundwater and hence are subject to groundwater lags that can range from days to decades (but are commonly several years). Sediment load caused by land slips in the upper reaches of a catchment can be of a similar nature (particularly where the rate of sediment mobilisation is dynamic).

7.3.2 Current resource users are not in control of that ‘load to come’ and hence to take action against those current resource users because the current state has changed, as a result of these legacy contaminants arriving and having impacts in surface water, would seem unreasonable.

7.3.3 Similarly, there may be lawfully granted existing consents that have not been fully implemented but could, once fully implemented, affect attribute states (i.e. be worse than a monitored current state). Trustpower itself has such a situation (see Box 4).

7.3.4 If a line is to be drawn as a benchmark to measure whether water quality has been “maintained or improved”, then Trustpower considers that the line should accommodate the effects of existing lawfully consented but unimplemented or partially implemented consents. That approach is consistent with RMA case law regarding the assessment of effects against the “existing environment”. It would also be unfair as it would result in the inefficient use of existing assets and would be inconsistent with granted resource consents.

7.3.5 If the concepts of ‘current state’ (as defined by a plan) and ‘existing environment’ (assessed at the time a consent application is made) are not aligned there is likely to be a high degree of complexity and uncertainty in future consenting processes.

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**Box 4: Unimplemented resource consents**

Trustpower’s Kaniere / McKay’s HEPS on the West Coast of the South Island, Trustpower holds both unimplemented and partially implemented resource consents to increase the water take from Lake Kaniere and the take into the McKay’s HEPS, increasing its generation capacity. Exercising these consented enhancement opportunities would see changes to the flow patterns in the Kaniere River and level fluctuations within the lake, with the potential to affect the current state in relation to periphyton and may result in changes to the scale of wetlands located on the lake margin. All of these potential affects have been assessed during the resource consent process, with mitigation measures applied where required.
At Trustpower’s Kumara HEPS also on the West Coast of the South Island, Trustpower holds consents to take up to 16 m$^3$/s of water from the Kawaka River but the current intake design limits the take to 12 m$^3$/s. Through some minor modification to the intake, without the need for any new consents, Trustpower will be able to improve the efficiency of the intake and exercise the full 16 m$^3$/s consented allocation. This has the potential to alter the current state for several attributes below the weir, like the case noted above.

7.3.6 Trustpower’s solution to these problems is as follows:

a. To require the setting of current state only in respect of attributes for which a regional council has a robust scientific record (as per the monitoring advice given in Tables 1-23 of Appendix 2A and 2B).

b. For all other attributes the obligation should be to produce an estimate of the current state.

c. An estimated state:
   i. must not be used to establish a target attribute state for an Appendix 2A attribute under clause 3.9;
   ii. may be the subject of an action plan;
   iii. must be reviewed and confirmed as soon as there is a sufficient monitoring record.

d. To require that the current state take into account consented, and likely to be implemented, activities where that would make a difference to the current state.

e. To require regional councils to consider “load to come” when setting the target attribute state (under clause 3.9 (6)) and the timeframes for setting attribute states (under clause 3.9(5)).

7.3.7 This might be achieved by the following amendments.

3.8 Identifying current attribute states

(1) Every regional council must identify the current state of each attribute for the period 30 June 2020 to 1 July 2021 (noting that water quantity does not have attributes – see clause 3.11) as either:

a. the current measured state; or
b. the current estimated state.

(1A) Every regional council must identify:

a. the current measured state by using of scientifically robust data gathered in general conformance with the monitoring requirements of Schedule 2A and 2B;

b. the current estimated state using its best efforts based on the information that is available, including partial data, local knowledge, and information obtained from other sources.

(2) The current state (whether it is measured or estimated):

a. must to the extent practicable, take in to account, the potential effect of activities that are the subject of a resource consent that have not been established or fully established at the time the assessment of current state
is made and which, when established or fully established, would have a material effect on current state;

b. need not be a single measure but may take into account natural variability and sampling error.

(3) If a regional council does not have complete and scientifically robust data on which to establish the current state of an attribute, it must use its best efforts to identify a current state using the information that is available, including partial data, local knowledge, and information obtained from other sources.

(3) Regional councils must review and replace estimated current states with measured current states as soon as practical, and in no case later than 30 June 2025.

3.9 Setting target attribute states

(1) In order to achieve the environmental outcomes described under clause 3.7, every regional council must set a target attribute state for every attribute, as at each relevant monitoring site.

(2) Every target attribute state must-

a. for attributes relating to the value Human Contact health, be above the current measured state of that attribute as determined under clause 3.8; and

b. for all other attributes identified in Appendix 2A, be at or above the current measured state of that attribute as determined under clause 3.8(1)(a); and

c. for all other attributes be at or above the current state of the attribute as determined under clause 3.8(1) or (2).

......

(6) When setting target attribute states and timeframes for achieving target attribute states, regional councils must-

a. have regard to the following:

i) the foreseeable impacts of climate change;

ii) the long-term vision set under clause 3.2;

iii) the environmental outcomes set under clause 3.7(2);

iv) the connections and existing diversions between waterbodies, including any additional contaminant load anticipated to reach a monitoring point in the future without further human influence;

v) the connection of waterbodies to coastal water; and

b. use the best information available at the time; and

c. not delay making decisions because of uncertainty about the quality or quantity of the information; and

d. take into account results or information from freshwater accounting systems; and
8 The suite of attributes is not fit for purpose and will create legal uncertainty

8.1.1 The draft NPS:FM contains a total of 23 attributes: 12 in Appendix 2A (attributes requiring limits) and 13 in Appendix 2 (attributes requiring action plans). By contrast, the existing NPS:FM contains 9 attributes.

8.1.2 Attributes have significant implications for decisions on management of water resources:

   a. A target attribute state must be identified for every attribute (clause 3.9 (1))
   b. Limits on resource use must be included in regional plans to achieve target attribute states for Appendix 2A attributes (clause 3.10 (1)).
   c. Actions plans must be prepared for achieving target attribute states for Appendix 2B attributes (clause 3.10 (2)).
   d. Monitoring methods for monitoring progress towards target attribute states must be established (and must include measures of health of indigenous flora and fauna and mātauranga Māori) (clause 3.13 (1))
   e. An action plan must be prepared if there is a decline in any attribute state (clause 3.14 (1))
   f. Accounting systems must account for loads and concentrations of contaminants relevant to target attributes states to (amongst other things) ascertain if there is over-allocation (clause 3.20 (2)).
   g. There must be reporting of monitoring results and assessment of whether target attribute states are being achieved.
   h. Perhaps most importantly, the definition of ‘over-allocated’ means that the exceedance of any target attribute state renders a water body (or that part of a water body above a monitoring site) over-allocated. Over-allocation is something that a regional council must phase out (if it exists) or avoid.

8.1.3 In light of their critical role it is essential that attributes:

   a. be ‘fit for purpose’ (ie. provide a meaningful and reliable basis for determining what effects may be occurring in-stream and if, and what, management decisions are required); and
   b. are able to be robustly, consistently and safely monitored.

8.1.4 Trustpower is concerned that several attributes do not appropriately meet these criteria.

8.2 There are attributes that are not fit for purpose and which cannot be robustly, consistently and safely monitored

8.2.1 Trustpower’s science and monitoring experts have identified problems with monitoring proposed attributes and questioned whether they are all fit for purpose (see Appendix B). Trustpower considers that in many cases the suite of attributes is too ambitious and/or in respect of some proposed attributes, premature (because the merits and workability of some
of the newer and more novel attributes are have not been fully tested). Based on that advice we seek the following:

a. Table 2 – Periphyton (Trophic state)- Rivers. This should apply to wadeable rivers and streams in the same way that, for example, Table 14 (Macroinvertebrates) applies specifically to wadeable streams and rivers.

b. That the following tables be removed:
   - Table 5 – Dissolved inorganic nitrogen;
   - Table 6 – Dissolved reactive phosphorus;
   - Table 10 – Suspended fine sediment;
   - Table 14 – Macroinvertebrates (ASPM);
   - Table 15 – Fish;
   - Table 16 – Submerged plants (natives);
   - Table 17 – Submerged plants (invasive species);
   - Table 18 – Deposited fine sediment;
   - Table 19 – Dissolved oxygen in rivers;
   - Table 20 – Lake-bottom dissolved oxygen;
   - Table 21 – Mid-hypolimnetic dissolved oxygen;
   - Table 22 – Ecosystem metabolism.

8.2.2 The rationale behind these recommendations is set out in Appendix A.

8.3 The approach taken to Appendix 2A and 2B attributes creates legal uncertainty

8.3.1 There are two different approaches taken in the policy framework with respect to attributes and target attribute states. The draft NPS:FM:

a. Requires Appendix 2A attributes to be implemented through a regulatory (limit setting) approach.

b. Allows Appendix 2B attributes to be addressed through an action plan (that may be non-regulatory).

c. The definition of ‘over-allocation’ does not distinguish between these two types of target attribute state. The duty to phase out and ‘avoid’ over-allocation in Policy 10 therefore applies to both Appendix 2A and Appendix 2B attributes.

8.3.2 This approach creates legal uncertainty as to the weight to be given in consenting processes, for example, to over-allocation in relation to an Appendix 2B attribute. This uncertainty is particularly important to resolve if the full suite of Appendix 2B attributes proposed in the draft NPS:FM is retained. Conceivably, an Appendix 2B attribute could act as a veto on a
consent application if it was shown that the bottom line was exceeded and the activity for which consent was sought could contribute to further exceedances.

8.3.3 We consider that Appendix 2A ought to be specifically and exclusively identified as applicable to allocation decisions because it is more certain; it includes specific metrics.

Relief Sought

8.3.4 In addition to seeking the modification of deletion of the attributes listed above, Trustpower seeks the following amendment to the definition of ‘over-allocation’.

*over-allocation*, in relation to both the quantity and quality of water, is the situation where the water-

a) has been allocated to users beyond a limit on resource use or a take limit; or

b) is being used to a point where one or more target attribute states for an attribute identified in Appendix 2A is not being met.

9 Sedimentation proposals are likely to create risks and introduce costs

9.1.1 The draft NPS:FM seeks to better manage sediment by use of a suspended sediment (turbidity) (Appendix 2A) attribute and a deposited sediment (Appendix 2B) attribute.

9.1.2 Trustpower acknowledges that sediment is a major stressor of ecological health. It can also be a major cost on hydro-electric power schemes. Sediment, as a result of natural processes and poor land use/forestry practices, can infill hydro-electric storage lakes and canals causing a range of operational issues including reducing storage and hence operational flexibility, necessitating dredging, damaging turbines and encouraging macrophyte growth. Trustpower has significant experience with these issues (see Box 5 below).

9.1.3 Hydro-electric power schemes do not cause sedimentation but they do impact sediment transport. The draft NPS:FM therefore presents a complex picture for such schemes and the impacts of the proposals are difficult to predict and to assess.

9.2 The approach to sedimentation is likely to create risks and introduce costs

9.2.1 Trustpower supports initiatives that will reduce the accelerated erosion and associated sedimentation caused by poor practices in farming and forestry in hydro-electricity catchments (both above and below storage lakes).

9.2.2 However, the approach to sedimentation in the draft NPS:FM is likely to create risks for and introduce costs to hydro-electric power schemes. These include:

a. Increased difficulty in gaining resource consent to remove (dredge) sediments from reservoirs or for the sluicing/flushing of sediment. If these are not achieved then hydro-electric power schemes will be less effective.

b. Increased requirements to manage flows to manage downstream sediment. If this happens then there are potentially negative implications for storage levels and operational flexibility.

c. Other potential impacts set out in the T&T Report included as Appendix C.
9.2.3 Trustpower considers that these risks can, and should, be expressly managed in the NPS:FM alongside management of land use activities to reduce sedimentation. This is particularly helpful clarification if the sediment attributes in Appendix 2A are retained (despite the issues raised elsewhere in this submission).

Box 5: Sediment impacts on equipment

Trustpower has a diverse portfolio of hydro-electric power schemes, which span various types of catchments, geology and surrounding land uses.

For hydro-electric power schemes that are located in and around the Southern Alps, these are impacted by naturally derived gravels. The sediment load can be very high and very destructive, and Trustpower spends considerable time manipulating and deflecting gravel material in an effort to reduce the impact the material has on generation assets.

Excessive sediment in water erodes the hydro turbine blades causing excessive erosion and wear, requiring significant maintenance and early replacement of turbine blades. Schemes affected by this are the Coleridge, Montalto and Highbank HEPS all located in Canterbury, and Wahapo HEPS on the West Coast. Trustpower also experiences significant gravel baseload at Waihopai HEPS in Marlborough.

For other hydro-electric power schemes, the influx of sediment is largely driven by the surrounding land uses. These are primarily plantation forestry and pastoral farming. These sediments tend to be finer in nature, and often suspended in the water column, and are difficult to manage. Schemes affected in this manner include Matahina HEPS, Wheao HEPS and Hinemaiaia HEPS (all located in the Bay of Plenty / central North Island area), and the Mangorei HEPS in Taranaki, the Esk HEPS in Hawkes Bay, and the Branch HEPS in Marlborough. Often the land surrounding these schemes are naturally more susceptible to erosion, but with current land uses, this erosion is exacerbated and is particularly evident during and following weather events.

While Trustpower is realistic in that operating and maintaining a hydro-electric power scheme will entail some level of sediment management and associated maintenance costs, it is the increasing frequency and the additional logistical issues these works bring, that raises concerns for Trustpower. Dredging sediment from hydro storage ponds means lost generation, land disposal challenges (including finding suitable land nearby), consent costs, trucking cartage costs, fish salvage requirements and health and safety concerns.

In the Wairau River catchment (Marlborough), it has been observed that the amount of fine suspended sediment coming down the Branch River has been consistently increasing over the last 10 years. In addition, recent harvesting of plantation forestry exposed land adjacent to the head pond, increased direct sediment run off from this hillside. To date the costs for managing and remediying these impacts have fallen to hydro operators and the environment.

Trustpower recently dredged the Argyle head pond to restore its capacity. To do this, Trustpower had to cease generation in the scheme for a number or weeks, dewater the scheme and storage head pond, and undertake fish salvage (mostly trout which are released into this pond by Fish and Game for recreational fishing). In addition, Trustpower must find suitable land to dispose of this sediment too, which needs to be nearby to reduce the need to trucking sediment long distances. This disposal requires a land use consent, as sediment volumes exceed permitted activity limits.

The most recent dredging of the Argyle head pond took 5 weeks, removed 15,000 m$^3$ of sediment (1500 truck loads), with a cost of $130,000.
Relief sought

9.2.4 As a minimum, Trustpower seeks the following amendment to Policy 13 of the NPS:FM:

Policy 13: People and communities are enabled to provide for their social, economic, and cultural wellbeing while managing freshwater in a manner consistent with Te Mana o te Wai and as required by as reflected through the application of the national objectives framework, and other requirements of this National Policy Statement, and other national policy statements.

9.2.5 The relief sought in relation to how the hydro value is described will address in part the issue raised above.

9.2.6 Clear and direct reference to the NPS:REG or to the benefits of renewable electricity generation (or climate change mitigation) in the NPS:FM so that it is certain that the benefits of renewable electricity generation will be relevant considerations in consenting processes to maintain and restore hydro generating capacity (notwithstanding some effects such as the temporary mobilisation of sediment).

9.2.7 Explicit acknowledgement in the NPS:FM of a principle that existing consent holders should not, through consent review or conditions on the granting of replacement consents, have to take responsibility for managing effects and issues that have arisen since the consent was first granted as a result others’ actions. This would address the issue that arises when land use change and/or intensification downstream of a hydro-electric dam leads to exceedance of sediment target attribute states and expectations are raised that the issue should be
managed by modifying hydro flows in ways that reduce hydro-electric power generation and flexibility.

10 The treatment of fish passage is inconsistent and may be impractical for existing dams

10.1.1 Clause 3.17 of the draft NPS:FM requires regional councils to address fish passage in their regional plans:

a. Regional plans must ensure that regard is had to a range of matters when considering a consent for an in-stream structure (Clause 3.17(3)). Those matters all relate to fish passage and to the extent to which there is provision for a new mandatory ‘aquatic life objective’.

b. Regional councils must establish and implement ‘work programmes’ to improve the extent to which existing structures achieve the aquatic life objectives for fish. Details of what such a programme must include are specified. Records of instream structures must be collected and published by councils.

c. Part 2 (subpart 3) of the draft NES:FM regulates activities that may affect fish passage (culverts, weirs and passive flap gates), making activities either permitted (subject to conditions) or discretionary activities (subject to conditions), or in the case of non-passive flood gates, non-complying activities. Those constructing a dam, fords, or non-passive flood gate are required to a range of information to the regional councils after construction.

10.1.2 Trustpower has two key concerns with the approach to fish passage:

a. That there are inconsistences in the freshwater package about the treatment of fish passage; and

b. There is no feasibility or cost benefit analysis related to fish passage.

10.2 There are inconsistencies between the various draft documents about the treatment of fish passage

10.2.1 Trustpower is concerned with the level of ambiguity created through inconsistencies between the draft NPS:FM, the draft NES:FM and the ‘action for healthy waterways’ discussion document relating to fish passage.

10.2.2 There is uncertainty about whether or not the documents relate only to new structures:

a. Clause 19 of the draft NPS-FW notes that the ‘subpart applies only in respect of structures constructed after the commencement date’. That suggests that structures existing as at that date do not need to apply for retrospective consent under the NES, nor have the specified matters apply at the time a replacement consent is sought.

b. Clause 3.17(1)-(6) of the NPS-FW does not set out any limitation on applicability of the policies to only new structures. In fact, clauses 3.17(4)-(6) appear to seek to address fish passage issues associated with existing structures.

c. It is not clear that whether the ‘work programme’ required by clauses 3.17 (4)-(6) is intended to cover non-regulatory as well as regulatory interventions.
We are also concerned about the potential for inappropriate guidance to be applied to weirs and dams higher than 4m:

a. The ‘action for healthy waterways’ discussion document introduces ambiguity around the application of the draft NPS:FM and NES:FM relating to fish passage. On page 43 the document states ‘We propose to require regional councils to provide for fish passage in line with these guidelines, both in plan-making and consenting, and in imposing design requirements on some types of new in-stream structures less than four metres high...’.

b. The draft NES:FM includes no such height limitation – except in respect of weirs as permitted activities. Regulation 22(2) (discretionary activity for weirs) appears to apply to weirs of all heights. Similarly, clause 3.24 appears to apply to all dams, not just those over 4m.

c. Clauses 3.17(1)-(6) of the draft NPS:FM include no qualification as to their application only to structures less than 4m. The note at the end of draft NPS:FM subpart 3.17 refers to the New Zealand Fish Passage Guidelines for structures up to 4 metres as being a useful tool to help manage fish passage.

Without clear direction in the body of subpart 3.17 that the guidance applies only to structures up to 4 metres problems and confusion will arise. That is because:

a. The guidelines referred to are not designed to apply to structures over 4 metres high.

b. Managing fish passage for structures greater than 4 metres is much more complicated, hence why this guideline has not yet been developed.

c. In many cases, the effects of restricted fish passage by hydro-electric power schemes have been mitigated through the consents process under the RMA. This may be in a form of compensation where physical structures have been considered inappropriate. These approaches can have added benefits for fisheries management over all (See Box 6). The draft NPS:FM does not appear to provide for managing fish passage through compensatory means such as trap and transfer or where it is being met through consenting mechanisms available under RMA.

Box 6: Hydro-electricity infrastructure supports collection of fisheries data

In many of Trustpower’s hydro-electric power schemes, alternative means of fish passage are provided. A common method is trap and transfer, where indigenous fish are caught and released at a suitable location past the scheme, which can be either upstream or downstream depending on the objectives of the trap and transfer.

At our Matahina and Patea HEPS native fish trapping programmes collect essential fisheries information relating to the full range of native migratory fish species. Through the fisheries permit process information such as size, sex, species, weight, numbers and distribution are collected and fed into the national database. This information is important in understanding the state of New Zealand’s fisheries particularly in relation to threatened tuna species. Our programme at the Patea HEPS won the Taranaki Regional Council Environmental Leadership in Business award in 2017 for or trapping and successfully transferring migrating native fish and increasing biodiversity in the headwaters of the Patea catchment. Trustpower staff trap and transfer migrating native fish from the base of the Patea power station to the headwaters above Lake Rotorangi. Around one and a half million young longfin and shortfin eels and 13,000 juvenile whitebait were successfully transferred in the year to June 2016.
10.3 There is no feasibility or cost benefit analysis related to fish passage

10.3.1 Trustpower has a broad concern about the potential cost that might be imposed on hydro-electricity generators at the time a replacement consent is sought (or a review of a consent is required).

10.3.2 Flow requirements to enable upstream and downstream fish passage as well as potential exclusion measures (screening of intakes) would have potential impacts on flow requirements and capital costs. In some situations, unimpeded fish passage will not be possible/practicable.

10.3.3 Based on cost estimates for large-scale screening of irrigation schemes, if full exclusion is required, then modern screening systems are likely to cost ~$0.5million per m$^3$/s for each intake.

10.3.4 The CAPEX cost to provide unimpeded fish passage and screening at four of Trustpower’s hydro-electric power schemes has been estimated to be $54.5M - $66M. Trustpower has an additional 15 schemes, therefore the total cost is likely to be significantly higher. The cost benefits and alternatives to this work ought to be taken into account in any decision-making.

10.3.5 We are not aware that the impact assessment work to date has provided any detailed analysis of these costs.

Box 7: Examples of potential scheme-specific issues with fish passage

**Cobb hydro-electric power scheme**

Full unimpeded fish passage up the Cobb River and over the dam would be extremely challenging to facilitate. The river is very steep and filled in places with large boulders. Fish passage is therefore likely to be practically limited to native species suited to alpine environments. Existing springs, and tributaries augment flow in the Cobb River as it moves downstream of the dam. It is therefore unlikely that flow releases, over and above any imposed residual flow through the draft NPS:FM, would improve the practicality of achieving fish passage. This was recognised during the last re-consenting process for this scheme with compensatory arrangement put in place in the form of an environmental fund to mitigate residual effects.

**Hinemaiaia hydro-electric power scheme**

The Hinemaiaia hydro-electric power scheme is comprised of three dams.

Trustpower investigated a fish passage system prior to adopting the current ‘trap-n-transfer’ programme. Those investigations concluded that a fish passage system in this location would not be suitable for a wide range of species and would be unusable for periods after significant flood events. Consequently, it might not meet compliance requirements.

The CAPEX cost of providing fish passage at two of the dams (HA & HB) is expected to be approximately $2M. The practicality at the third dam (HC) is questionable due to the lack of space to create a fish pass and the likelihood that an alternative mechanical lift would likely be damaged or destroyed during each large flood.

Downstream passage would potentially require screening at an estimated cost (based on the $0.5M per m$^3$/s) of $14M over the full scheme.

The feasibility of screens at HC is highly uncertain given the constrained site.
**Wheao hydro-electric power scheme**

Additional physical structures (conveyance structures and screens to reduce entrainment) would be needed to enable fish passage and an appropriate flow (up and downstream) of the existing weirs and intakes.

The cost of a fish passage structure is expected to cost between $0.5 to 1.0M. The cost of screening is difficult to determine. However, if full exclusion is required, then the total cost is expected to be approximately $1.7M.

Establishing appropriate flows for fish passage (and interconnectivity between the river and bypass structure) may be challenging below the Rangitaiki weir, where the river enters a narrow gorge. There are also downstream barriers that would need to be considered in deciding whether fish passage is even necessary.

**Relief sought**

10.3.6 Amend clause 3.17 of the draft NPS:FM to include the following additional subclause:

(7) Nothing in clause 3.17 shall require regional councils to impose conditions on the consents of any hydro-electricity dam constructed before the commencement date of this document requiring modification to existing structures to enable fish passage, except to the extent that such dams already operate fish passage facilities.

10.3.7 Amend the information note at the end of clause 3.17 to read as follows:

The following is a useful tool to help with managing fish passage in respect of structures less than 4 metres in height.

**11 The value of hydro-electricity generation needs to be clearly recognised**

11.1 The draft NPS:FM does not recognise or provide for the benefits of hydro-electricity

11.1.1 Despite the diverse and highly significant values of hydro-electric power generation, the draft NPS:FM:

a. **Provides little recognition of the benefits** of existing hydro-electricity and the modified (but still highly valued) freshwater outcomes they provide or the fact that the industry relies on access to water to operate.

b. **Undermines the operation of hydro-electric power schemes.** The National Objectives Framework works to prioritise values such that in the event of any conflict between an attribute state required achieve different environment outcomes the most stringent must always apply (clause 3.9 (7)). What that means in practice is that a value like the compulsory ecosystem health value (and its associated outcomes) ‘trumps’ all other values and the target attribute state that achieves the desired level of ecosystem health must always apply - irrespective of the impact that might have on the ability to maintain other values such as hydro. In other words, there is a deliberate asymmetry in the way the NOF, and associated provisions, work. This means that having hydro-electric power generation identified as a value may not have any meaningful effect on a regional council’s water management decisions. Accordingly, there is unlikely to be any consideration of the benefits to be gained from existing hydro-electric generation assets.
11.2 The value of hydro-electricity generation needs to be expressed more fully

11.2.1 As set out in Part 1 of this submission, hydro-electricity generation has significant benefits. Recognition of hydro-electricity generation as a value could, and should, protect hydro-electric power generation from the effects of activities that might undermine or frustrate the maintenance of that value. A good example would be control and land use and management practices in a hydro-electricity catchment to minimise the loss of sediment and debris flow into storage lakes and intake structures.

11.2.2 As currently drafted the description of the hydro-electric power generation value focuses on the suitability of a freshwater management unit for hydro-electricity generation (in the sense of having the right hydrological characteristics). It does not recognise that the presence of an existing hydro-electric power scheme brings benefits to local and national communities in terms of recreational opportunities, meeting the nation’s electricity needs and climate change mitigation obligations.

11.2.3 The draft NPS:FM (clause 3.7 (3)) provides for ‘components’ of values to be individually recognised and proposes 5 biophysical components for the ecosystem health value. Trustpower supports the identification of ‘components’ of values and considers these could assist councils in their understanding of the hydro-electric power generation value.

Relief sought

11.2.4 Amend the description of the hydro-electric power value in Appendix 1B as follows:

**Hydro-electric power generation**

The freshwater management unit is either:

- The location of an existing hydro-electric power scheme; and/or

- Suitable for hydro-electric power generation because the water quality and quantity and the physical qualities of the freshwater management unit, including hydraulic gradient and flow rate, can provide for hydro-electric power generation.

There are 4 components that contribute to the hydro-electric power generation value and it is necessary that all of them are managed. They are:

- The quality of the inflow to storage hydro lakes and reservoirs in terms of the low levels of anthropogenic contributions of sediment and forest debris.

- The characteristics of existing infrastructure and the ability of the infrastructure in terms of its capacity, reliability, output and operational flexibility to generate electricity.

- The recreational potential of storage lakes.

- Any coincidental sustainable management benefits of existing schemes in terms of maintaining any compulsory national value.

12 Outcomes need to link to hydro-electricity generation values

12.1.1 Clause 3.7 of the draft NPS:FM requires regional councils to:

a. identify values for each FMU (3.7(1)) and:
b. for FMU, waterbody or freshwater ecosystem describe the environmental outcomes that it wants to achieve for all identified values (ie. compulsory values and any other values and components the council identifies (3.7(2)).

12.1.2 Trustpower recognises outcomes as being at the heart of the NPS:FM planning framework.

a. They must be had regard to when setting target attributes states (Clause 3.9(6)).

b. Environmental flows and levels must be developed on the basis of them (Clause 3.11(3)).

c. They must be taken into account when take limits are identified (3.12(3)).

12.2 Outcomes for hydro-electricity generation must be identified

12.2.1 Accordingly, Trustpower considers that an outcome must be clearly identified for the hydro-electricity generation values because:

a. To give the identification of hydro-electricity values any purpose and meaning, it is essential that regional councils describe the outcomes wanted for that hydro-electricity value.

b. The proposed wording appears to provide absolute discretion for hydro-electricity values to not be identified, or, if they are identified, for a regional council to decide not to describe an outcome it wants to achieve in relation to such value. We note, of course, that while we focus on the hydro-electricity value as an ‘other value’, the same potential arises in respect all the values listed in Appendix 1B.

c. Whether the values in Appendix 1B of the NPS:FM exist is a matter of fact: they are either present (and therefore apply) or they are not (in which case they do not apply). In some cases, research and consultation will be required to ascertain that fact. In other cases, such as with the presence of hydro-electric power schemes, the existence of the value is plain and obvious. No exercise of discretion is required.

12.2.2 Trustpower also suggests that the description of an outcome must be informed by the national objectives as expressed in the NPS:FM and in other relevant NPSs. To do otherwise would be to ‘silo’ objective setting which would not be consistent with the principle of integrated management and would undermine the achievement of other national policy objectives.

12.3 Outcomes should relate to sustainable management

12.3.1 Until there is substantive reform of the RMA, its purpose remains as sustainable management. For consistency with the purpose and Part 2 of the RMA we consider it is more appropriate that outcomes be identified as sustainable management outcomes.

Relief Sought

12.3.2 Make the following amendments to clause 3.7.

3.7 Identifying values and environmental outcomes
(1) Every regional council must identify the values that apply to each FMU, as follows:
   a) the compulsory values as set out in Appendix 1A;
   b) any of the other values set out in Appendix 1B that the council considers applies;
   c) any other value as the council considers, after consultation with its community and tangata whenua, applies.
(2) For each FMU, or for individual waterbodies or freshwater ecosystems within an FMU, the regional council must describe the environmental outcomes that it wants to achieve for:
   a) the value Ecosystem Health, and each of its components; and
   b) the values Human Contact Health, and each of its components; and
   c) the value[s] [Mahinga kai or Tangata Whenua Value and] Threatened Species; and
   d) the values of Appendix 1B and any other components that apply,
   e) any other values and any other components the council identifies.

(2A) In describing the outcomes in accordance with (2) above, every regional council shall have regard to the objective of this, and any other relevant, national policy statement.

Definitions
Environmental Outcome means a sustainable management environmental outcome for an FMU, or for individual waterbody or freshwater ecosystems that is described as required by to be achieved for the values identified in clause 3.7.

13 The definition of constructed wetlands needs clarifying

13.1.1 In and around Trustpower’s hydro-electric power schemes throughout New Zealand there are numerous areas that may potentially be identified as wetlands.

13.1.2 The challenge with hydro-electric power schemes and wetlands, is that there is a constant fluctuation in water levels of varying durations (such as daily fluctuations to monthly and inter-seasonal fluctuations). These fluctuations in water levels, often pseudo-replicate that of a natural wetland environment, and encourage wetland species (both plant and animals) to inhabit these artificial wetland areas.

13.2 The definition of wetlands is too broad and not supported by data

13.2.1 Trustpower is concerned about the wetland provisions proposed in the draft NPS:FM and the new NES:FM because:
   a. While Trustpower is generally supportive of restoration of degraded natural wetlands, it is concerned that undue restrictions may be placed on its operations to support a wetland that has only established in an area due to the presence of a hydro-electric power scheme.
   b. Not all regional councils have undertaken an identification and mapping exercise of wetlands in their regions (and probably no council has done so to the resolution of 500m²). We are therefore uncertain whether any natural or ‘constructed’ (artificial) wetland is present in the vicinity of our hydro-electric power schemes. Even in areas where an identification and mapping exercise has been undertaken, this has been a desktop exercise only and has not necessarily been ‘ground-truthed’.
   c. Where a wetland is located or has established in association with a hydro-electric power scheme, these wetlands have adapted to, and modified their structure and composition in response to level and flow fluctuations resulting from the operation of that hydro-electric power scheme. Accordingly, such wetlands should be considered within the definition of a ‘constructed wetland’.
13.2.2 The examples in **Box 9** of where wetlands have been identified in and around Trustpower’s hydro-electric power schemes demonstrate the varied nature of data held by regional councils where wetlands are concerned. Due to resources and cost, councils typically identify wetlands using desktop-based methods which result in significant inaccuracies in relation to wetland states (both natural or constructed). Removing these inaccuracies will require significant cost and resource.

**Box 9: Wetlands and hydro-electric power schemes**

Examples of wetlands in and around Trustpower’s schemes

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**West Coast Regional Council**: Mapped wetlands, with schedule 1 being ‘significant wetlands’ and schedule 2 being all other wetlands. Here, the map shows schedule 2 wetlands around the margin of Lake Kapitea and the Kumara Reservoir, both are used for storage as part of the Kumara Hydro Electric Power Scheme.
Trustpower is concerned that the proposed wetland provision could limit the Waipori HEPS’s operational flexibility to provide a steady flow state for this wetland. The Waipori HEPS plays an important role in flood management for the Taieri Plains as would the two wetlands downstream.
Canterbury Regional Council: Wetlands in the Canterbury region have been identified using aerial imagery, with only a limited number having undergone ground surveys. The wetlands identified in dark blue have been identified by aerial imagery and have not been included in any regional or district plans. Here, potential wetlands have been identified around the eastern end of Lake Coleridge. These may be subject to fluctuating water levels depending on the intra-seasonal storage of water within this hydro-electric storage lake. This has not been ground truthed with landowners and is likely to contain errors and cause confusion.
Taranaki Regional Council: An artificially constructed pond has been incorrectly classified as a ‘freshwater wetland’. This pond is a sediment distilling pond, where water taken from the Manganui River is retained in this pond for a period of time, allowing sediment to settle out before the water is conveyed in a race to the power station.

Relief sought

13.2.3 Amend the definition of ‘constructed wetlands’ as follows.

**Constructed wetland** means a wetland established or constructed by artificial means that:

a) supports an ecosystem of plants that are suited to wet conditions; and

b) is established or constructed for a specific purpose in a place where a natural wetland does not already exist; or

c) establishes as a consequence of an impoundment structure.

14 The telemetry and freshwater accounting system proposed are flawed

14.1.1 Trustpower is concerned about the relationship of the requirement for universal telemetry and ‘real time’, 15 minute reporting of water takes (through an amendment to the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 (as discussed
at section 5.12 of the discussion document), and the requirement for a freshwater accounting system under clause 3.20 of the draft NPS:FM.

14.2 The quality of telemetry data is variable and frequently not audited

14.2.1 In Trustpower’s experience there are many variables that can impact the accuracy of a real time database for water quantity, let alone water quality.

a. Real time data shows recorded values at that given moment in time as measured by instruments on site. This data is often referred to as ‘provisional’ or ‘raw’ data. This means that the data has not been checked or audited. Provisional data has not been checked for any inaccuracies or errors that can occur, for example if an instrument is damaged the data may not be reliable. It is impractical to expect (even with considerable resource) that real-time data can be used to produce accurate and meaningful decisions without quality checks. See Box 10 for an example.

b. Currently some councils only provide live information for a selection of hydrological sites. This is usually limited to sites that have stable cross sections and regular physical checks able to be carried out. It is our experience that councils choose to only show data for sites that they know are checked and therefore data is likely to be more accurate. Councils purposefully do not include certain sites on their database which they are less confident with data accuracy. This lack of data confidence is often due to factors beyond the control of the council such as difficulty with access to regularly check instrument calibration, lack of resourcing and environmental volatility of the resource being monitored.

c. It is common for councils to provide disclaimers in relation to the accuracy of data provided to the public. Clause 3.20 of NPS:FM does not provide any clarity on how data accuracy is to be managed and suggests that a database ought to include all sites. This is a concern for councils and the public as councils will have to show all sites regardless of how confident they are in the data.

14.2.2 Trustpower is concerned that:

a. Telemetry data might be treated as better quality data than it actually is and may result in poorly informed freshwater accounting and management decision-making.

b. There is lack of clarity around what the NPS:FM is seeking to achieve in relation to the accounting system.

c. Poor decisions and wrong assumptions may be made by councils and the public in reliance on a database.

d. Not including a standardised method for maintaining a database, as suggested in clause 3.20, will lead to differing results across regions. Costs associated with achieving this could be significant. Currently each council will have their interpretation and preferred method of presenting the data. This also means that the requirements for monitoring are not necessarily consistent across the country. This can create inefficiencies where a water user works across several regions, and a lack of consistency will make it difficult to identify differences among the state of water quality across different regions.

e. From experience in extreme weather events (e.g. Edgecumbe floods) Trustpower would be concerned about reliance on un-audited data for compliance purposes.
Box 10: Practical limitations with accounting system

Physical limits exist in managing the accuracy of data and instrument failures. Trustpower specifies the fault response times in the service provider contracts. Timeframes exist for the following: Fault response (instrument issues), the updating of Operational Ratings, provision of compliance data, gaugings and reporting timeframes. In some cases, it just isn’t physically possible to maintain an accurate live data system as it may take a minimum of a day to respond to a fault to investigate an issue. If an instrument replacement is required there will be a lead time to obtain this and the set this up. If a site has been affected by flooding it may no longer be stable enough for flow monitoring and scoping a replacement site can take a lengthy period. With a live database or more visibility of data there tends to be more pressure to ensure data faults are corrected promptly. This would be a big strain on resources within councils and service providers.

Level and flow instrumentation need to be maintained and calibrated frequently to have any confidence in measurements. Due to the nature of rivers, a rating may change frequently due to many natural factors (such as floods or erosion), and certain activities in or around the area. Some sites will require significantly more measurements to maintain a level to flow relationship while other sites may be more stable and experience less changes. This means that the effort involved to supply a complete dataset will differ significantly between sites.

15 There are significant capacity and implementation constraints

15.1.1 Trustpower considers the Essential Freshwater Reform package is hugely ambitious, particularly in the time frames proposed.

15.2 Capacity and capability constraints may cause poor decisions to be made

15.2.1 The reform raises significant issues about whether the current ‘system’ has the capacity and capability to implement the reforms. This includes the following concerns:

a. Regional councils as the primary regulators may not have the resources to undertake the work adequately which will lead to increased costs for others.

b. The expectation that businesses need to respond to these plan changes in addition to other regulatory change while continuing to undertake normal operations, especially when they operate across different regions. Trustpower operates across nine different regions. We understand that all regions will be required to notify new plans (or changes to existing plans) to ensure compliance with the new NPS:FM by 2023 for them to be made operative by 2025 as required. We are not confident that the capability will be available for Trustpower to participate effectively in that many processes in such a compressed timeframe. The rate of change and draw on resources is unprecedented. The need to increase our own internal resourcing to respond, will likely be difficult in a market already constrained by a planning and policy skills shortage.

c. The national capability in water management (and related disciplines) is limited. All interested parties – regulators and the regulated - tend to compete for capability from the same pool of expertise and experience. While that expertise can be grown over time it cannot be instantly expanded without risk of loss of quality. In our view the wider science, modelling, planning, engineering and general consulting sectors do not have capacity to implement the reforms or to assist affected parties to participate in an informed and effective manner in plan-making processes.
d. There is a real risk that meeting the timeframes proposed for plan-making (including, in particular, setting target attributes states and limits), preparing action plans and establishing monitoring programmes can only be achieved by sacrificing engagement with communities and affected parties and/or by reducing the depth of analysis and evaluation that supports plan development. In short, quality and durability may be sacrificed for speed.

15.2.2 Trustpower considers those outcomes would represent a retrograde step in water management.

Relief sought

15.2.3 For those reasons, Trustpower seeks amendments to Part 4 of the draft NPS:FM. Such amendments would:

a. Allow for progressive implementation of the NPS:FM by providing for the staging and sequencing of plan reviews needed to give effect to the NPS:FM. That might be undertaken on the basis of risks to freshwater outcomes (i.e. regions, or catchments, at high risk would be prioritised for the earliest action with those regions of catchments being allowed longer before reviews are required); and

b. Confirm that action plans may be developed progressively over time and need not be available at the time regional plans are notified.

16 The costs, risks and impacts were not adequately considered in the RIA

16.1.1 MfE published a RIA to accompany the Freshwater Package. While it is acknowledged that the RIA was prepared as an interim analysis, Trustpower considers that the analysis it provides is not adequate to justify the associated recommendations which are now reflected in the proposed wording of the draft NPS:FM and NES:FM.

16.1.2 Trustpower engaged Sapere to evaluate the RIA, in particular in relation to Appendix 10: providing for hydro-electricity generation. Sapere’s report is in Appendix D and it highlights the following issues.

16.2 The RIA does not clearly define the problem and assess its magnitude with reference to the status quo

16.2.1 As set out above, a RIA must define the policy or operational problem that needs addressing, with reference to the status quo.

16.2.2 The Interim Climate Change Committee’s recommendation that the Government ensure the value of existing hydro-electricity generation to New Zealand’s climate change objectives be given sufficient weight when decisions about freshwater are made, including by strengthening and clarifying national direction on making trade-offs between hydro generation and freshwater objectives across national policy statements. However, this is not recognised in the RIA prepared for the Freshwater Package. It does not provide a clear definition of the problem that explains and assesses the conflict in these freshwater initiatives and the Government’s existing climate objectives (that form part of the status quo).

16.2.3 A proposed policy measure that constrains the flexibility or volume of New Zealand’s hydro-electricity capacity (whether by being excluded from subpart 4 or through the workings of
regional councils to follow the NPS:FM), will make it harder to meet the Energy Trilemma (explained above), which Sapare has called “a glaring example of a lack of joined up thinking and shortcomings in the analysis relating to those other policy objectives.”

16.3 The RIA does not clearly show why six hydro-electric power schemes were given preference in the exceptions over other schemes

16.3.1 The detail and depth of analysis of the options is not commensurate with the magnitude of the problem and size of the potential impacts.

16.3.2 There is an incomplete explanation of the rationale for the options selected.

16.4 The RIA does not evaluate the key impacts of the proposals on hydro-electric power schemes, including the loss of generation

16.4.1 The RIA does not analyse all material impacts and risks of proposed actions (including unintended consequences) which are explained above. It lacks the depth necessary to accurately recognise the size of the potential impacts of constraining hydro-electricity generation infrastructure. Hydro-electricity generation is becoming increasingly important in the context of climate change policy imperatives that focus on the need to reduce emissions which will drive increasing demand for electricity and force New Zealand to reduce its reliance on non-renewable electricity generation, however:

a. There is no analysis of the attributes of hydro-electricity generation infrastructure that are important for delivering on the Government’s other policies.

b. There is no analysis of the costs, risks and outcomes of not listing infrastructure within the exception.

c. It does not recognise that a minimum level of flexibility must be retained to manage energy adequacy. The presence of hydro is one of the reasons why capacity has been well served in New Zealand. Although highly flexible, hydro-electricity is insufficient by itself to meet peak demand requirements in winter months and is supplemented with other forms of renewable energy (including geothermal and thermal). The job of a flexible plant is not only to meet the changing levels of demand but to respond to short-term variations of intermittent generation and medium-term variations in hydro inflows. Plants that fulfil this role effectively make use of fuel storage. As the system reduces emissions by reducing thermal plant, it needs to ensure that the new fuel mix has sufficient flexibility to perform the role that thermal currently performs in responding to changing demand.

16.5 The RIA’s assessment of the impacts on hydro-electricity generation is based on out-of-date and insufficient data

16.5.1 The RIA issued as part of the consultation documents, refers the reader to the 2015 Halliburton report with respect to flow alterations on electricity generation. The study models possible outcomes for hydro-electricity generation in eight scenarios. At the time it was produced, the hydro-electricity generation sector was concerned that the Halliburton report may be mis-used, and therefore a preface was included stating the study should not be used for any other purposes. The report preface states: “The results are generated from a simulation of the New Zealand electricity system, are subject to limitations and need to be

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Sapare Report, at page 7.
interpreted with care ... This study should not be used for any other purposes.” The scenarios modelled did not reflect policy intentions at the time (or now).

16.5.2 It is Trustpower’s view that it is not appropriate to rely on this 2015 report to consider impacts under a new set of circumstances and different NPS:FM. Sapere note that “The Haliburton report sampled only a few schemes and considered the impact of changed water allocation on wholesale prices which doesn’t address the contribution hydro makes to energy security, climate change goals and energy equity. It assumes that gas and diesel generation is available as peaking capacity, both in plant that was available at the time but has now been decommissioned and the assumed generation build. This assumed generation mix naturally results in the conclusion of the report that absolute volumes of hydro generation are important, but timing is not. This conclusion suggests that size of generator is a key indicator of the expected benefit in terms of climate change goals which misses the point.”

16.5.3 It also cannot give appropriate guidance because it is limited to consideration of the Waitaki, Clutha, Tongariro, Waikato and Waikaremoana schemes and not others, like Manapouri.

16.5.4 Overall, the RIA is inadequate which has led to a package of proposals that reflects a lack of coherent joined up thinking around national values and priorities of freshwater. As outlined above, the resulting draft NPS:FM and NES:FM will have significant negative consequences for hydro-electric power schemes across New Zealand. As a result, Trustpower has gone to significant effort to offer solutions to the issues it has identified and would welcome the opportunity to participate further, including by providing further explanation to the Independent Advisory Panel.
Appendix A: Detailed submission
Trustpower’s Detailed Submission on the National Policy Statement for Freshwater Management

Given the extent of material open for consultation in this Essential Freshwater package, Trustpower has only made a submission on the aspects it does not fully agree with and where it seeks amendments. Those provisions which Trustpower supports or are not of interest to Trustpower have not been commented on.

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<td>1.5 Fundamental concept – Te Mana o te Wai</td>
<td>Conditionally support</td>
<td>Trustpower supports the continued inclusion of Te Mana o te Wai in the NPS:FM. Trustpower is concerned about the uncertainty that surrounds this concept and how it will be implemented. However, Trustpower accepts that this could be addressed at a regional level.</td>
<td>Trustpower seeks the following relief: 1. That it be recognised in the NPS:FM that regional councils will be open to modifying these matters as part of the development of each regional plan.</td>
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<td>1.6 Definitions – Natural Wetland</td>
<td>Support with amendments</td>
<td>Trustpower considers for ease of use of the NPS:FM, it would be useful to have the definition of natural wetland included in this section, rather than a cross-reference to another section of the NPS:FM. Trustpower also considers a minor amendment is needed to this definition, to reflect Trustpower’s submission below on the definition of inland wetlands which Trustpower considers is superfluous. A consequential amendment is required to differentiate coastal wetlands from natural inland wetlands.</td>
<td>Trustpower seeks the following relief: 1. Amend the definition as follows: natural inland wetland has the meaning in clause 3.15 means a wetland as defined in the Act (regardless of whether it is dominated by indigenous or exotic vegetation), except that it does not include: a) wet pasture or paddocks where water temporarily ponds after rain in places dominated by pasture, or that contain patches of exotic sedge or rush species; or b) constructed wetlands; or</td>
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| 1.6 Definitions – Outstanding Waterbody       | Support with amendments | Trustpower supports the continued inclusion of a definition of outstanding waterbody, however it remains concerned about the uncertainty and lack of guidance about what characteristics a waterbody must exhibit to be considered ‘outstanding’. | Trustpower seeks the following relief:  
1. Provide more clarity and guidance to regional councils on the characteristics a waterbody needs to exhibit in order to be considered outstanding.  
2. Any consequential amendments required. |
| 1.6 Definitions – new definition for Essential Human Health Needs | Support | Trustpower considers that it is necessary to have the term ‘essential human health needs’ defined because the proposed NPS:F:M uses the phrases “human needs” (1.5), “essential needs of people” (1.5) and “essential health needs of people” (2.1 and 3.12) and includes a compulsory value for human contact. However, there is no clarification about what these phrases should mean and what considerations they provide for. | Trustpower seeks the following relief:  
1. Include a new definition as follows:  
   Essential Human Health Needs:  
   means providing for essential human health needs. It includes providing for the health of water for consumption, its ability to sustain life and grow food, and essential lifeline utilities (defined in the Civil Defence Emergency Management Act 2002).  
2. That the term Essential Human Health Needs, replace the similar phrases such as the “essential needs of people” or “essential health needs of people are used throughout the NPS:F:M. |
| 1.6 Definitions – Over-allocation             | Support with amendments | For the reasons set out in Trustpower’s submission in section 8 above, Trustpower considers that an | Trustpower seeks the following relief: |


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| Amendment is required to the definition of over allocation in the NPS:FM. | 1. Amend the definition as follows: **over-allocation**, in relation to both the quantity and quality of water, is the situation where the water-  
a) has been allocated to users beyond a limit on resource use or a take limit; or  
b) is being used to a point where one or more target attribute states for an attribute identified in Appendix 2A is not being met. |
| 2.1 Objective | Support with amendments | For the reasons set out in Trustpower’s submission in section 6 above, Trustpower is concerned with the objective of the NPS:FM. The approach is not consistent with the purpose of the Resource Management Act (**RMA**) (to promote the sustainable management of natural and physical resources) and unduly prioritises the health and wellbeing of the natural environment. | Trustpower seeks the following relief:  
1. Amend the objective as follows:  
The objective of this National Policy Statement is to ensure that resources are managed in accordance with Part 2 of the RMA in a way that promotes sustainable management and prioritises:  
a) first, the health and wellbeing of waterbodies and freshwater ecosystems (as determined in accordance with Part 1, subpart 2); and  
b) the essential health needs of people; and  
c) third, the ability of people and communities to provide for their social, economic and cultural wellbeing, now and in the future.  
3. Any consequential amendments required. |
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| 2.2 Policies | Oppose   | For the reasons set out in Trustpower’s submission in section 5 above, Trustpower considers the approach to setting policies is incorrect because the detailed provisions that follow in the NPS:FM should be based on a foundation that would logically be found in the direction setting objectives and/or policies of Clause 2.1 and/or 2.2. Therefore, reference to ‘other values’ is required in the policies. Trustpower also opposes policy 11 because it needs amending to align with the New Zealand Coastal Policy Statement 2010, and similarly considers Policy 13 needs amending to align with the RMA and its purpose (section 5). | Trustpower seeks the following relief:  
1) Insert as Policy 2A:  
Policy 2A: Freshwater is managed through a National Objectives Framework to recognise and provide for compulsory values and other values as may be applicable.  
2) Alternatively, insert as Policy 2:  
Policy 2: Freshwater is managed through a national objectives framework, in order to:  
(a) ensure that the health and wellbeing of waterbodies and freshwater ecosystems is maintained or improved; and  
(b) recognise and provide for compulsory values and other values as may be applicable.  
3) Amend Policy 11 as follows:  
Policy 11: The significant habitats of indigenous freshwater species are protected safeguarded.  
4) Amend Policy 13 as follows:  
Policy 13: People and communities are enabled to provide for their social, economic and cultural wellbeing while managing freshwater in a manner consistent with Te Mana o te Wai and as required as reflected through the application of the national objectives framework, and other |
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<td>requirements of this National Policy Statement, and other national policy statements.</td>
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<td>3.2 Te Mana o te Wai</td>
<td>Conditionally support</td>
<td>As noted at 1.5 above, Trustpower has concerns about the practical implications of incorporating Te Mana o te Wai from a social, cultural, economic and environmental perspective. The potential outcomes from using this concept (and matauranga Maori more broadly) in the NPS:FM cannot currently be assessed because it is not defined or explained. However, Trustpower considers that this could be addressed at a regional level.</td>
<td>Trustpower seeks the relief set out at 1.5 above.</td>
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<td>3.4 Integrated Management</td>
<td>Support with amendments</td>
<td>Trustpower is generally supportive of the provisions outlined in the Integrated Management policy. However, given that the phrase ‘sensitive receiving environment’ plays an important role in this policy, it is important to have this term defined.</td>
<td>Trustpower seeks the following relief: 1. Include a definition of ‘sensitive receiving environment’ in section 1.6 Definitions. 2. Any consequential amendments required.</td>
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<tr>
<td>3.6 Identifying FMUs and monitoring sites</td>
<td>Support with amendments</td>
<td>As a consequence of Trustpower’s submission on the definition of natural and inland wetlands, an amendment is required to reflect the terminology.</td>
<td>Trustpower seeks the following relief: 1. Amend clause 3 e) as follows: e) natural inland wetlands 2. Any consequential amendments required.</td>
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| 3.7 Identifying values and environmental outcomes | Support with amendments  | Compulsory values  
Trustpower considers that the compulsory value for Human Contact should be broadened to include services of health provided by lifeline utilities.  
As noted below (in relation to Appendix 1A – Human Contact), the value should also reflect other human health uses such as being suitable for consumption, being suitable to use to grow food, and allow the essential wellbeing of people to be provided for.  
Other values  
For the reasons set out in Trustpower’s submission in section 12 above, it considers that it is unreasonable that it is discretionary whether the hydro generation value will apply when a hydro-electric power scheme exists in an FMU. Trustpower is concerned that this does not provide hydro-electric power generation suppliers with sufficient certainty that hydro-electric power schemes will be recognised when regional councils are determining the relevant values that apply in any particular catchment. | Trustpower seeks the following relief:  
1. Amend Policy 3.7 as follows:  
3.7 Identifying values and environmental outcomes  
(1) …  
b) any of the other values set out in Appendix 1B that the council considers applies:  
…  
(2) For each FMU, or for individual waterbodies or freshwater ecosystems within an FMU, the regional council must describe the environmental outcomes that it wants to achieve for:  
…  
b) the value Human Contact Health,  
…  
d) the values of Appendix 1B and any other components that apply.  
e) any other values and any other components the council identifies.  
(2A) In describing the outcomes in accordance with subsection (2) above, every regional council shall have regard to the objective of this, and any other relevant, national policy statement. |
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<tr>
<td>3.8 Identifying current attributes states</td>
<td>Oppose</td>
<td>For the reasons set out in section 7 of Trustpower’s submission above, Trustpower considers that there are a number of practical and scientific concerns associated with the approach taken and considers that the current framework for identifying the current state is unreasonable, unfair and unlikely to lead to good sustainable management outcomes. Trustpower considers that there is a need for a regional council to be able to refine the attribute state as additional and more accurate information becomes available over time.</td>
<td>Trustpower seeks the following relief: 1. Amend clause 3.8 as follows: (1) Every regional council must identify the current state of each attribute for the period 30 June 2020 to 1 July 2021 (noting that water quality does not have attributes – see clause 3.11) as either: a) the current measured state; or b) the current estimated state. (1A) Every regional council must identify: a) the current measured state by using scientifically robust data gathered in general conformance with the monitoring requirements of Schedule 2A and 2B;</td>
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<td>b) the current estimated state using its best efforts based on the information that is available, including partial data, local knowledge, and information obtained from other sources.</td>
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<td>(2) The current state (whether it is measured or estimated):</td>
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<td>a) must to the extent practicable, take into account, the potential effect of activities that are the subject of a resource consent that have been not been established or fully established at the time the assessment of the current state is made and which, when established or fully established, would have a material effect on the current state.</td>
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<td>b) need not be a single measure but may take into account natural variability and sampling error.</td>
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<td>(3) If a regional council does not have complete and scientifically robust data on which to establish the current state of an attribute, it must use its best efforts to identify a current state using the information that is available, including partial data, local knowledge, and information obtain.</td>
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<td>(3) Regional councils must review and replace estimated current states with measured current states as soon as practical, and in no case later than 30 June 2025.</td>
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| 3.9 Setting Target Attribute States | Support with amendments | As set out in section 7 of Trustpower’s submission above, Trustpower considers that this clause requires amendment to ensure consistency with its proposed amendments to clause 3.7 and 3.8, and to ensure there is consideration of “load to come” and authorised effects. | Trustpower seeks the following relief:  
1. Amend clause 1) and 2) as follows:  
   (1) In order to achieve the environmental outcomes described under clause 3.7, every regional council must set a target attribute state for every attribute, as at each relevant monitoring site.  
   (2) Every target attribute state must-  
      a) for attributes relating to the value Human Contact Health, be above the current measured state of that attribute as determined under clause 3.8; and  
      b) for all other attributes identified in Appendix 2A, be at or above the current measured state of that attribute as determined under clause 3.8(1)(a); and  
      c) for all other attributes be at or above the current state of the attribute as determined under clause 3.8(1) or (2). |
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<td>2. Amend clause 6) as follows:</td>
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<td>(6) When setting target attribute states, <strong>and</strong> <strong>timeframes for achieving target attribute states</strong>, regional councils must:</td>
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<td>a) have regard to the following:</td>
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<td>i. the foreseeable impacts of climate change;</td>
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<td>ii. the long-term vision set under clause 3.2;</td>
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<td>iii. the <strong>environmental</strong> outcomes set under clause 3.7(2);</td>
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<td>iv. the connections <strong>and existing diversions</strong> between waterbodies, <strong>including any additional contaminant load anticipated to reach a monitoring point in the future without further human influence</strong>.</td>
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<td>v. the connection of waterbodies and coastal water; <strong>and</strong></td>
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<td>b) use the best information available at the time; and</td>
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<td>c) not delay making decisions because of uncertainty about the quality or quantity of the information; and</td>
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<td>d) take into account results or information from freshwater accounting systems; and</td>
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<td>3.10 Identifying limits on resource use and preparing action plans</td>
<td>Oppose</td>
<td>Trustpower is unclear what weight action plans will have. Action plans are not compulsory for all attributes. Trustpower therefore considers that these should sit outside of the RMA framework and specific regional plans, in the way other strategies or management plans do. This would provide clarity that they do not have the same status as plans or resource consents and would ensure that there is consistency across regions.</td>
<td>Trustpower seeks the following relief: 1. Amend clause 6 as follows: 6) Action plans shall be may be published either by including them in a separately from regional plans or by being published separately. 2. Any consequential amendments required.</td>
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<td>3.11 Setting environmental flows and levels</td>
<td>Support with amendments</td>
<td>Trustpower generally support the environmental flows and level setting process, however, is concerned that there is no direction for regional councils to ensure that this process does not have an adverse impact on a hydro-electric power scheme and it does not recognise that the ‘current state’ may be altered over time. To ensure a schemes operational flexibility and generation capacity is maintained, policy support is required.</td>
<td>Trustpower seeks the following relief: 1. Insert a new clause 4) as follows: 4) When setting environmental flows and levels, regional councils must have particular regard to the importance of not adversely impacting the generation capacity, storage and operational flexibility of a hydro-electric power scheme. 2. Or alternatively, 4) When setting environmental flows and levels, regional councils must have particular regard to the importance of not adversely impacting lifeline</td>
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<td>3.12 Identifying take limits</td>
<td>Support with amendments</td>
<td>As discussed in policy 3.9, Trustpower is concerned with lack of recognition of water that is diverted from one water body to another, a common aspect of a hydro-electricity power scheme. Trustpower also considers that acknowledgement of existing takes for nationally and regionally significant infrastructure and activities is needed (i.e. for both municipal use and hydro-electricity generation).</td>
<td>Trustpower seeks the following relief: 1. Amend clause 3 as follows: 3) Take limits must be identified at levels that: a) provide for flow or level variability that meets the needs of the relevant waterbody and connected waterbodies, and their associated ecosystems; and b) safeguard ecosystem health from the effects of the take limit on the frequency and duration of lowered flows or levels; and c) provide for the lifecycle needs of aquatic life; and d) provide for essential human health needs; and e) take into account existing diversions of water between waterbodies; and f) take into account the environmental outcomes applying to the relevant waterbodies and any connected waterbodies (such as aquifers and downstream surface utilities (as defined in the Civil Defence Emergency Management Act 2002). 3. Renumber existing clause 4) to clause 5). 4. Any consequential amendments required.</td>
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<td>3.13 – Monitoring</td>
<td>Support with amendments</td>
<td>Clause 2(b) provides that every regional council must establish methods for monitoring progress and these methods must include matārunga Maori. Trustpower does not oppose the inclusion of matārunga Maori methods, however, Trustpower is highly concerned that this clause lacks sufficient clarify. Trustpower is unable to comment on what this will provide or the effects it will have because there is no information provided on matārunga methods, and how they will interrelate with the western science methods contained in Appendix 2A and 2B. Trustpower therefore considers it necessary that these methods include matārunga Maori provided it is practicable.</td>
<td>Trustpower seeks the following relief: 1. Amend clause (2) as follows: (2) The methods must include, where practicable; 2. Any consequential amendments required.</td>
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<tr>
<td>3.15 – Inland wetlands – Definition of Constructed Wetland</td>
<td>Support with amendments</td>
<td>Trustpower considers that further clarification is required to make clear that this definition it is not intended to capture areas that may exhibit wetland characteristics but are in existence as a result of artificial means. This includes impoundment structures such as a weir, flood control gates or a dam, which may initiate water levels fluctuations that in turn allow wetland vegetation species to establish.</td>
<td>Trustpower seeks the following relief: 1. Amend the definition as follows: Constructed wetland means a wetland established or constructed by artificial means that: a) supports and ecosystem of plants that are suited to wet conditions; and</td>
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| 3.15 Inland wetlands – Definition of Effects Management hierarchy | Support with amendments | The effects management hierarchy reflects current planning practice, whereby you ‘step through’ a process when assessing and addressing effects of an activity. It is determined which effects can be avoided, before moving through to consider those that can be remedied and then mitigated. Trustpower considers that, as drafted, it is unclear when consideration of offsetting and compensation is available. As the RMA is not a ‘nil effects statute’ the ability to undertake offsetting and/or compensation needs to be clear. Otherwise, the ability to use offsetting and/or compensation may be somehow curtailed. | Trustpower seeks the following relief:
1. Amend the definition as follows:
   - **effects management hierarchy** means an approach to managing the adverse effects of subdivision, use, and development that requires that:
     - **significant** adverse effects are avoided where **practicable** possible; and
     - **significant** adverse effects that cannot be **demonstrably** avoided are remedied where **practicable** possible; and
     - **significant** adverse effects that cannot be **demonstrably** remedied are mitigated; and
     - in relation to any **significant residual** adverse effects that cannot be avoided, remedied, or mitigated:
       - **offsetting** is considered by a regional council if proposed **by an applicant**; and |
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| 3.15 – Inland wetlands – Definition of inland wetland | Oppose | Trustpower considers that the definition of inland wetland creates confusion and uncertainty because it contradicts what is provided under the heading and the use of the term ‘inland wetland’ in earlier provisions in the NPS:FM. | Trustpower seeks the following relief:  
1. Delete the definition as follows:  
Inland wetland means any wetland that is not a coastal wetland, but does not include geothermal wetlands  
2. Any consequential amendments required. |
| 3.15 – Inland wetlands – Definition of Natural Wetland | Support with amendments | Trustpower considers a minor amended to this definition is needed, as per the submission point on the definition of inland wetlands which Trustpower considers is superfluous. There is also a consequential amendment in that a new clause d) is needed to differentiate coastal wetlands from natural inland wetlands. | Trustpower seeks the following relief:  
1. Amend the definition as follows:  
natural inland wetland has the meaning in clause 3.15  
means a wetland as defined in the Act (regardless of whether it is dominated by indigenous or exotic vegetation), except that it does not include:  
a) wet pasture or paddocks where water temporarily ponds after rain in places dominated by pasture, or that contain patches of exotic sedge or rush species; or  
b) constructed wetlands; or  
c) geothermal wetlands; or |
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| 3.15 Inland wetlands - Definitions | Oppose | Trustpower opposes the inclusion of a definition for net gain and net loss at this time, as it is understood this definition is still being developed in relation to the development of the National Policy Statement for Indigenous Biodiversity. Trustpower considers it may be appropriate to include at a later date.                                                                 | Trustpower seeks the following relief:  
1. Delete the definition of net gain and net loss.  
2. Any consequential amendments required.                                                                                                                                                                                                                       |
| 3.16 Streams | Support with amendments | Trustpower is concerned that this provision may in inadvertently be applied to existing diversions of streams, or existing culverts within streams, and in particular how this may be managed at the time an existing consent is renewed.                                                                 | Trustpower seeks the following relief:  
1. Amend clause 4) as follows:  
4) Every regional council must make or change its regional policy statement and plans to ensure that the following do not result in a net loss in the extent or ecosystem health of a stream:  
   a) any new permanently diverting diversion of a stream;  
   b) any new culverting a stream, where that is allowed and as far as practicable.  
2. Any consequential amendments required.                                                                                                                                                                                                                  |
| 3.17 – Fish passage – Clause 3 | Support with amendments | For the reasons set out in Trustpower’s submission in section 7 above, Trustpower is concerned about the ambiguity and inconsistency in approach to                                                                                                                                                                                                 | Trustpower seeks the following relief:  
1. Include a new clause (7) as follows:                                                                                                                                                                                                                                                                                       |
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<td>3.22 – Exceptions for large hydro schemes</td>
<td>Oppose</td>
<td>Trustpower opposes the proposed exemption for six hydro-schemes for the reasons set out in part 5 of its submission above.</td>
<td>Trustpower seeks the following relief: 1. Amend Policy 3.22 as follows: 3.22 Exception for Large Special Considerations for Hydro-Electric Power Schemes 1) This section applies to all hydro-electric power schemes that are either connected to the national grid or a distribution network. The following 6 hydro-electricity generation schemes (referred to as Schemes): Waikato Hydro Scheme; Tongariro Power Scheme; Waikaremoana Power Scheme;</td>
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<td>fish passage regulation and is concerned that this will affect existing hydro-generation facilities.</td>
<td>(7) Nothing in clause 3.17 shall require regional councils to impose conditions on the consents of any hydro-electricity dam constructed before the commencement date of this document requiring modification to existing structures to enable fish passage, except to the extent that such dams already operate fish passage facilities.</td>
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<td>Waitaki Hydro Scheme;</td>
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<td>Manapouri Power Scheme;</td>
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<td>Clutha Hydro Scheme.</td>
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<td>2) When setting limits or developing action plans, and when making plan changes required by this National Policy Statement, regional councils must have regard to the importance of not adversely impacting the generation capacity, storage and operational flexibility of a Scheme.</td>
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<td>3) Regional councils may accordingly set target attribute states that are below national bottom lines in respect of waterbodies or freshwater ecosystems that are adversely impacted by structures or fluctuation in water levels in waterbodies that form part of any Schemes, to the extent of such an impact.</td>
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<td>4) Despite subclause (3), regional councils must still set target attributes states that, to the extent possible, improve any waterbody or freshwater ecosystem affected by any Scheme.</td>
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<td>5) Subclause (1) only applies to structures that were first operational as part of any Scheme's operational on or before 1 August 2019, including any subsequent maintenance, repair, upgrade for seismic strengthening, flood mitigation or generation optimisation purposes, or like for like replacement works.</td>
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<td>3.23 Exceptions for naturally occurring processes</td>
<td>Support as proposed</td>
<td>Trustpower supports the inclusion of an exception for naturally occurring processes. For instance, in Taranaki, naturally occurring landslide events on Mt Taranaki are still contributing to current water quality more than two decades on from the event.</td>
<td>Trustpower seeks the following relief: 1. The exceptions for naturally occurring processes are retained as proposed.</td>
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<td>3.24 Transitional exception</td>
<td>Support as proposed</td>
<td>As discussed in section 4.1 of the submission, Trustpower supports the inclusion of transitional exceptions.</td>
<td>Trustpower seeks the following relief: 1. The transitional exceptions are retained as proposed.</td>
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<tr>
<td>4.1 Timing</td>
<td>Oppose</td>
<td>Trustpower is concerned that the proposed timeframe in the subclause (2) does not provide sufficient time for regional councils across New Zealand to collect the data necessary to appreciate the conditions of the freshwater environment in all catchments. This information is vital for setting appropriate target attribute states to achieve outcomes and will influence limits set on resource use and action plans imposed under the NPS:FM.</td>
<td>Trustpower seeks the following relief: 1. Trustpower seeks the relief set out at 3.8 above, to recognise that less reliance should be placed on poor quality information.</td>
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## Trustpower’s Detailed Submission on the Appendices and Attributes of the NPS:FM

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<td>APPENDIX 1A: COMPULSORY VALUES</td>
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<tr>
<td>1 Human Contact</td>
<td>Oppose</td>
<td>Trustpower considers that the value for Human Contact should be amended and expanded to incorporate the concept of human health. This value should focus on water quality being healthy enough to provide for a range of human health activities, including swimming and recreation. The value should also reflect other human health uses such as being suitable for consumption, being suitable to use to grow food, and allow the essential wellbeing of people to be provided for. This includes acknowledging water as an essential lifeline utility, and recognising the importance its use to generate electricity, which is also an essential lifeline utility.</td>
<td>Trustpower seeks the following relief: 1. Amend the value for Human Contact as follows: Human contact Health This refers to the extent to which waterbodies in an FMU can provide for essential human health needs. It includes the health of water for consumption, its ability to sustain life and grow food, and for essential lifeline utilities (defined in the Civil Defence Emergency Management Act 2002). Human health also supports people being able to connect with the water through a range of activities such as swimming, waka, boating, fishing, mahinga kai and water skiing, in a range of different flows. Matters to take into account... 2. Any consequential amendments required.</td>
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<td>4 Possible Mahinga Kai or Tangata Whenua Value</td>
<td>Support with amendments</td>
<td>Trustpower supports the inclusion of a compulsory values for Mahinga Kai. Trustpower supports the inclusion of the first option for describing Mahinga kai, as it is directly related to freshwater management (both quality</td>
<td>Trustpower seeks the following relief: 1. Amend the value for Mahinga Kai as follows: Mahinga kai – Kai are safe to harvest and eat.</td>
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and quantity), is comprehensive, and clearly articulates the value in a way that is easy to interpret and understand. However, Trustpower does not support the reference of transfer of knowledge on the preparation, storage and cooking of kai, as that is outside of the control of a regional council, and they could not achieve this.

Trustpower does not support the inclusion of a compulsory values for tangata whenua, as this value is broader than freshwater management, and includes aspects such as ‘traditional customs’ which are outside of a councils ability to influence or control (in so far as a regional council cannot control or force a customary practice to be undertaken, but they can ensure the water is of a suitable quality that means food gathered from it is safe to eat).

Mahinga kai generally refers to indigenous freshwater species that have traditionally been used as food, tools, or other resources. It also refers to the places those species are found and to the act of catching them. Mahinga kai provide food for the people of the rohe and these sites give an indication of the overall health of the water. For this value, kai would be safe to harvest and eat. Transfer of knowledge would occur about the preparation, storage and cooking of kai. In freshwater management units that are used for providing mahinga kai, the desired species are plentiful enough for long-term harvest and the range of desired species is present across all life stages.

Mahinga kai – Kei te ora te mauri (the mauri of the place is intact).

For this value, freshwater resources would be available and able to be used for customary use. In freshwater management units that are valued for providing mahinga kai, resources would be available for use, customary practices able to be exercised to the extent desired, and tikanga and preferred methods are able to be practised.

2. Any consequential amendments required.

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<th>Appendix 1B: Other values that must be considered</th>
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<td>Hydro-electric power generation</td>
<td>Oppose</td>
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<tr>
<td>For the reasons set out in Trustpower’s submission above, Trustpower considers that the hydro-</td>
<td>Trustpower seeks the following relief:</td>
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1. Amend the value for hydro-electric power generation as follows

**Hydro-electric power generation** – The freshwater management unit is suitable for hydro-electric power generation. 

either:

- The location of an existing hydro-electric power generation scheme; and/or
- Suitable for hydro-electric power generation because the water quality and quantity and the physical qualities of the freshwater management unit, including hydraulic gradient and flow rate, can provide for hydro-electric power generation.

There are four components that contribute to the hydro-electric power generation. They are:

- The quality of the inflow to storage hydro lakes and reservoirs in terms of the low levels of anthropogenic contributions of sediment and forest debris.
- The characteristics of existing infrastructure and the ability of the infrastructure in terms of its capacity, output and operational flexibility to generation electricity.
- The recreational potential of storage lakes.
- Any coincidental sustainable management benefits of existing schemes in terms of maintaining any compulsory national value.
<table>
<thead>
<tr>
<th>Appendix 2A: Attributes requiring Limits</th>
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<tbody>
<tr>
<td><strong>Table 2 – Periphyton</strong> <em>(Trophic state)</em></td>
<td><strong>Support with amendments</strong></td>
</tr>
<tr>
<td>Trustpower notes that in the current NPS:FM, this attribute states that a minimum record length for grading a site based on periphyton (chl-a) is three years. However, the proposed 2019 version states that numeric attribute states must be derived from the rolling median of monthly monitoring over five years. Trustpower is unsure how this will work given the attribute states depend on the % of exceedances above stated values. Trustpower also considers that this attribute should only apply to wadeable rivers, as it requires physical access to the riverbed to collect samples. The periphyton sampling process involves wading into the river, bending over to reach the riverbed, and collecting a rock to carry back to the riverbank. To achieve this, the river needs to be wadeable, which is typically taken to be 60 cm deep or less. The requirement to collect samples monthly in a non-wadeable river would also represent a significant health and safety issue for staff undertaking this monitoring (i.e. as they would have to physically enter rivers during times of high flows).</td>
<td></td>
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</table>
| Trustpower seeks the following relief:  
1. Amend the following:  
   - Freshwater Body Type: **Wadeable** rivers  
2. Amend Table 2 as follows:  
   - Classes are streams and rivers defined according to types in the River Environment Classification system (REC). Numeric attribute states must be derived from the rolling median of monthly monitoring over five years a minimum record length of three years, based on a monthly monitoring regime.  
2. Any consequential amendments required. |
| **Table 7 – Ammonia** *(Toxicity)* | **Support with amendments** |
| This attribute currently applies to both rivers and lakes, however in the proposed table, it only applies to rivers. |
| Trustpower seeks the following relief:  
1. Have Table 7 apply to both rivers and lakes. |
| Table 9 – Dissolved Oxygen | Oppose | Trustpower consider that this must be an oversight, given the usefulness of measuring Ammonia to assist it in determining water quality. Trustpower notes that this is the only attribute with a limit that applies below a point source. However, there is no guidance on whether this applies to all point source discharges, which are numerous in every region. Criteria for the size of the discharge and the water quality of the discharge is also not identified, and some point source discharges may not exert an oxygen demand on the receiving water. Further there is not guidance where below the point source the dissolved oxygen is to be measured. Trustpower considers that suitable mixing needs to be included in this attribute. | Trustpower seeks the following relief: 1. Delete Table 9, or 2. Alternatively, amend Table 9 as follows: **Measurements of dissolved oxygen should be taken at a location below the point source which allows for suitable mixing of the discharge with the receiving water to occur.** A regional council may determine whether monitoring of dissolved oxygen below a point source discharge is required, based on the potential effects of that discharge, and whether an impact on oxygen demand is likely to occur. The seven day mean minimum is the mean value of 7 consecutive daily minimum values. The one day mean minimum is the lowest daily minimum across the whole summer period. 3. Any consequential amendments required. |
| Table 10 – Suspended fine sediment | Oppose | Trustpower is concerned with the inclusion of suspended fine sediment, and the potential logistical impacts of undertaking this monitoring on rivers and streams within a region. Trustpower is also concerned with using turbidity as the measurement tool, given the inherent issues associated with turbidity loggers. Trustpower also considered if a suspended fine sediment attribute | Trustpower seeks the following relief: 1. Delete Table 10 2. Any consequential amendments required. |
were to be included, it should be based on suspended sediment concentrations, and that clarity would be a more appropriate method.

<table>
<thead>
<tr>
<th>Appendix 2B: Attributes requiring action plans</th>
<th>Trustpower seeks the following relief:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 14 – Macroinvertebrates (2 of 2)</strong></td>
<td>1. Delete Table 14</td>
</tr>
<tr>
<td>Oppose</td>
<td>2. Any consequential amendments required.</td>
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<tr>
<td>Trustpower considers this to be an unusual</td>
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<tr>
<td>method, requiring a 5 years average, based</td>
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<td>on annual sampling. Trustpower understands it</td>
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<td>will take a long time for Councils to</td>
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<tr>
<td>establish a baseline attribute state.</td>
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<td>Further it is also possible that a water</td>
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<td>body could meet one attribute state (for</td>
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<td>instance Table 13) but not the other (this</td>
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<tr>
<td>table). Trustpower also considers that this</td>
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<td>method is not sufficiently tested as being</td>
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<tr>
<td>suitable for inclusion as a national attribute for macroinvertebrate community health.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Table 15 – Fish (rivers)</strong></th>
<th>Oppose</th>
<th>Trustpower opposed the inclusion of the Fish index of biotic integrity (F-IBI) attribute for a variety of reasons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBI compares the fish species</td>
<td></td>
<td>Trustpower understands the F-IBI approach could do with more testing before it can be rolled out as a nation-wide freshwater attribute. There is no guidance as to what expected F-IBI scores should be in each region are, but presumably the proposed attribute bands are based on the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trustpower seeks the following relief: 1. Delete Table 15. 2. Any consequential amendments required.</td>
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</tbody>
</table>
Fish monitoring associated with the F-IBI attribute is expected to be a resource intensive work programme for regional councils. The attribute specifies up to three sampling methods that can be used (electric fishing, spot lighting and trapping).

Trustpower understands that each method requires at least two experienced and qualified freshwater ecologists. The specified method to be used requires 150 metres of river or stream length to be surveyed. It takes considerable time to survey this length particularly in wide rivers. Spot lighting for fish must be undertaken in the dark, which raises health and safety issues and additional resourcing for being outside of normal work hours.

Therefore, Trustpower considers that it is premature to introduce this attribute at this time and seeks its deletion.

| Table 16 – Submerged plants (natives) | Oppose | Trustpower is concerned with the inclusion of submerged plants as an attribute. It is a very intensive monitoring method, where scuba divers and boats are typically required. To implement a |

|  |

|  |

Trustpower seeks the following relief:
1. Delete Table 16
2. Any consequential amendments required

monitoring regime across a region will be logistical challenging and expensive. In addition, Trustpower considers it will be very difficult to manage lakes which are below the national bottom line.

| Table 17 – Submerged plants (invasive species) | Oppose | As above, Trustpower is concerned with the inclusion of submerged plants as an attribute. It is a very intensive monitoring method, where scuba divers and boats are typically required. To implement a monitoring regime across a region will be logistical challenging and expensive. It is also unclear why this attribute has been included. As there would be very few lakes that only contain native species, and so most lakes would require annual monitoring. In addition, Trustpower considers it will be very difficult to manage lakes which are below the national bottom line. | Trustpower seeks the following relief: 1. Delete Table 17 2. Any consequential amendments required |

| Table 18 – Deposited fine sediment | Oppose | Trustpower considers that while deposited sediment may be an important attribute to measure, the current proposal and its associated methods in Appendix 2C is scientifically lacking. Rather Trustpower considers this could possibly be included as a compulsory monitoring attribute, as was done for MCI in the 2017 revision of the NPS:FM. | Trustpower seeks the following relief: 1. Delete Table 18 2. Any consequential amendments required. |

| Table 19 – Dissolved oxygen (Rivers) | Oppose | Trustpower does not support the inclusion of dissolved oxygen monitoring in rivers. Trustpower queries whether dissolved oxygen monitoring of rivers is necessary as a universal water quality attribute when other indicators of | Trustpower seeks the following relief: 1. Delete Table 19 2. Any consequential amendments required |
| Table 20 – Lake-bottom dissolved oxygen | Oppose | Lakes formed for the purpose of hydro-electricity generation are more prone to having low dissolved oxygen levels. This is due to these lakes being largely formed in a valley, which are typically very long and narrow lakes, and are often very deep. The steep sided terrain limits wind movement, and typically hydro lakes have very poor natural circulation within them. As hydro lakes play an important function in the hydro schemes, it is important that these unique characteristics are recognised and provided for within the attributes framework. | Trustpower seeks the following relief:  
1. Delete Table 20.  
2. Any consequential amendments required |
| Table 21 - Mid-hypolimnetic dissolved oxygen | Oppose | For the same reasons as discussed above for Table 20. | Trustpower seeks the following relief:  
1. Delete Table 21. |
| Table 22 – Ecosystem metabolism | Oppose | Trustpower questions the need for this monitoring requirement, and in particular questions what this attribute may tell you about the health of a waterbody that other attributes are not. | Trustpower seeks the following relief:  
1. Delete Table 22.  
2. Any consequential amendments required |
| Table 23 – E.coli for primary contact sites | Support with amendments | Trustpower considers that regional councils need the ability to determine that some sites are not suitable for recreation for health and safety reasons. For instance, here there may be large water intakes or discharges that induce flows and | Trustpower seeks the following relief:  
1. Amend Table 23 as follows:  
Regional councils have the ability to determine a site is not suitable for primary contact due to the |
eddies within a water body, that make swimming dangerous, and increase the risk of drowning.

presence of infrastructure or other health and safety factors which may increase the risk of drowning.

2. Any consequential amendments required

### Appendix 2C: Sediment Classification Tables

| Table 1, 2 and 3 – REC groups for both classification | Oppose | As Trustpower has sought deletion of the associated Tables in the attributes (Suspended and Deposited Sediment), there is no longer a need for this appendix to be included. Trustpower’s main concerns with this appendix is with Table 3 and the variables that were omitted, being Land-cover, Network Position, and Valley landform. These are all important variables that are needed to be able to accurately classify a river environment and go some way to allow for the vast variability between river environments in New Zealand to be classified. Omitting three of these variables without sound scientific reasoning makes the attributes particularly difficult to implement. | Trustpower seeks the following relief: 1. Delete Appendix 2C 2. Any consequential amendments required. |
Trustpower’s Detailed Submission on the National Environmental Standard for Freshwater

Given the extent of material open for consultation in this Essential Freshwater package, Trustpower has only made a submission on the aspects it does not fully agree with and where it seeks amendments. Those provisions which Trustpower supports or are not of interest to Trustpower have not been commented on.

<table>
<thead>
<tr>
<th>PROVISION</th>
<th>POSITION</th>
<th>REASON FOR SUBMISSION</th>
<th>REQUESTED RELIEF</th>
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</thead>
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<tr>
<td><strong>Part 2, Subpart 1 – Wetlands</strong></td>
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</table>
| 4 Definitions for subpart 1 Constructed wetland | Support with amendments | As per the earlier submission point of section 3.15 of the NPS:FM, Trustpower considers that further clarification is required to make clear that this definition it is not intended to capture areas that may exhibit wetland characteristics but are in existence as a result of artificial means. This includes impoundment structures such as a weir, flood control gates or a dam, which may initiate water levels fluctuations that in turn allow wetland vegetation species to establish. | **Constructed wetland** means a wetland established or constructed by artificial means that:

a) supports and ecosystem of plants that are suited to wet conditions; and

b) is established or constructed for a specific purpose in a place where a natural wetland does not already exist; or

c) establishes as a consequence of an impoundment structure. |
| 4 Definitions for subpart 1 Nationally significant infrastructure ("NSI") | Oppose | Trustpower considers that the current proposal to exclude hydro-electric power schemes ("HEPS") from the definition of renewable electricity generation facilities ("REG") is not well-justified:

- It nullifies the provisions of the NPS:FM (which recognise and provide for REG and HEPS);
- It does not recognise the importance of HEPS in creating a low emissions economy; and
- It does not recognise the importance of all lifeline utilities. Instead, an ad hoc approach has been taken to choosing NSI which means | Trustpower seeks the following relief:

1. amend clause c) of the definition of nationally significant infrastructure as follows:

*Nationally significant infrastructure means “lifeline utilities” as defined in the Civil Defence Emergency Management Act 2002.*

2. In the alternative, amend clause c) of the definition of nationally significant infrastructure as follows:
that a disconnect is created between this definition and the definition of NSI in other legislation.

For the above reasons, Trustpower considers that the definition of NSI should be broader to encompass all NSI that New Zealand relies on including HEPS.

| 6 Standard conditions for nationally significant infrastructure | Support with amendment | Trustpower generally supports the standard conditions applicable to NSI however, in clause a) Trustpower considers that offsetting should be limited to the significant residual effects, as opposed to residual effects at any scale, to ensure that the condition is reasonable. | Trustpower seeks the following relief:
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<tr>
<td></td>
<td></td>
<td>1. Amend clause a) of the standard conditions for nationally significant infrastructure as follows:</td>
<td>1. Amend clause a) of the standard conditions for nationally significant infrastructure as follows:</td>
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<tr>
<td></td>
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<td>a) to the extent that the adverse effects on a natural wetland cannot be avoided, remedied, or mitigated, any significant residual adverse effects on the natural wetlands must be offset to achieve a net gain;</td>
<td>a) to the extent that the adverse effects on a natural wetland cannot be avoided, remedied, or mitigated, any significant residual adverse effects on the natural wetlands must be offset to achieve a net gain;</td>
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<td></td>
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<td>2. Any consequential amendments required.</td>
<td>2. Any consequential amendments required.</td>
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</table>
| 12 Earth disturbance for drainage – discretionary activities | Support with amendment | Trustpower is concerned with this rule that does not provide for existing hydro schemes in the event that earthworks for drainage may need to be undertaken. | Trustpower seeks the following relief:
1. Amend Rule 12 as follows:
   ...
(3) Engaging in earth disturbance for drainage in or within 100m of any part of a natural wetland is a discretionary activity if it is undertaken:
   a) for:
      i. public flood control or drainage, or
      ii. building, maintaining, or operating any new or existing nationally significant infrastructure; and or
      iii. for the purpose of meeting or maintaining the operational needs of an existing hydro-electric power scheme; and
   ...
2. Any consequential amendments required |

| 13 Earth disturbance for drainage – discretionary activities | Support with amendment | As per the submission point on Rule 12 above, a consequential amendment is required to Rule 13. | Trustpower seeks the following relief:
1. Amend Rule 13 as follows:
   Engaging in earth disturbance for drainage within 100m of any part of a natural wetland is a non-complying activity if:
   a) the work is done for anything other than:
      i. restoring the natural wetland to its natural hydrological regime; or
      i. public flood control or drainage, or
| Subpart 2 – River bed infilling | | | 2. Any consequential amendments required |
|-------------------------------|------------------|-----------------------------------------------------------------|
| 18 Infilling bed of river | Support with amendment | Trustpower supports this provision provided that the relief sought in relation to the definition of NSI is accepted. In the event that relief if not accepted, than provisions for existing hydro schemes needs to be provided. |
| | | Trustpower seeks the following relief: 1. Amend Rule 18 (1) to include a new clause c) as follows: c) for the purpose of maintaining, or meeting the operational needs of an existing hydro-electric power scheme. 2. Renumber existing clause c) and d) to d) and e). 3. Any consequential amendments required |

| Subpart 3 – Fish passage | | | |
|----------------------------|------------------|-----------------------------------------------------------------|
| 20 Definitions for subpart 3 | Oppose | Trustpower is concerned that there is no definition for “fish passage” included in this definitions section, and that only the reference to “fish passage structure” is provided as an inferred means for providing fish passage. Further Trustpower considers that a whole range of instream and out of stream or manual |
| | | Trustpower seeks the following relief: 1. Provide a new definition as follows: Fish passage for the purposes of this section, fish passage is deemed to be provided where: a) a fish passage structure is provided as part of an instream structure; or |
assistance needs to be considered as part of providing ‘fish passage’.

For instance, Trustpower regularly uses trap and transfer as a method for providing fish passage through its HEPS where other methods are not practicable or feasible from an engineering perspective.

Trustpower notes that this method can provide additional benefits over and above “fish passage structures”, in terms of scientific knowledge and pest management. For example, a trap and transfer methodology provide opportunities to identify, survey and manage desirable and undesirable species (such as euthanising them) in the waterbodies.

Trustpower further notes that the future matauranga based attributes may be based around diversity and abundance of taonga species, and that the trap and transfer method will assist in the implementation and monitoring of these types of attributes. Trustpower notes that a trap and transfer methodology is prescribed with the NZ Fish Passage Guidelines prepared by the Department of Conservation and best practice would be to align the NPS:FM to this document.

2) Any consequential amendments required

| 24 Dams, fords, and non-passive flap gates | Oppose | Trustpower is concerned that the Rule in its current form does not provide clarity around whether an existing or dam structures need to provide fish passage or not. For example: | Trustpower seeks the following relief:
1. Redraft the rule as follows:
   Every person who constructs a new dam, ford, or non-passive flap gate must provide the following

b) an alternative bypass structure (such as fish ramps, fish ropes or ladders) which facilitates fish passage in the vicinity of the instream structure is provided; or

c) alternative methods such as the manual trapping and transfer of fish upstream or downstream of the structure can be undertaken.
to the relevant regional council, within 20 working days of the construction being completed:

a) the standard fish passage structure information for all new structures less than 4m in height; and

b) for new fords, at least drop height, substrate, width, length, material, and the presence of any culverts; or

c) for new dams, at least height, whether a spillway is present, and whether a fish pass is present; or

d) for new non-passive flap gates, at least the number of flap gates, dimensions, material, and whether any culverts are present.

2. Any consequential amendments required
Appendix B - D: Expert reports
Dear [Personal details removed]

Comments on the draft 2019 National Policy Statement for Freshwater Management (NPS)

You have asked us to comment on several aspects of the draft 2019 NPS. We set out our comments below.

(1) Attribute appropriateness and the practicality of measuring them

From our collective experience of monitoring lakes, rivers and streams throughout New Zealand, we consider that a number of the attributes included within either Appendix 2A or 2B of the draft NPS-FM document are problematical for a variety of reasons.

Table 1  Phytoplankton (Trophic state) - Lakes

Attribute monitoring in lakes can be problematic because lake sampling is fraught with difficulties associated with achieving representativeness. The selection of appropriate sampling sites in terms of reflecting wider lake water quality and the practicality of sampling large standing water bodies safely are key in obtaining useful data.

In terms of sampling methodology, we are aware of at least three different lake sampling methods in the Canterbury region alone. Environment Canterbury use a helicopter to collect water samples for its State of the Environment monitoring of lakes. The consent holder associated with the Opuha Dam and Lake Opuha undertakes lake shoreline sampling (by wading), while consent holders in the Mackenzie basin use boats to collect lake water samples as a requirement of their consent conditions. Water depth and wind direction and strength can affect the distribution of phytoplankton (e.g. phytoplankton may collect in bays as a result of wind action). Environment Canterbury staff acknowledge that sampling Canterbury high country lakes during the winter months poses a number of logistical and health and safety issues (Clarke 2015\(^1\)). Consequently, they consider that their lake sampling program is a pragmatic approach to lake monitoring in Canterbury. This includes the use of a helicopter and sampling only in the months December to April. Table 2 of the draft NPS assumes monthly or quarterly sampling.

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Comparing data from different methodologies has potential to produce questionable results. Clarke (2014) found that analysis of historical Lake Benmore water quality monitoring results obtained by NIWA and Environment Canterbury revealed significant differences between the two datasets, thought to be due to differences in sampling locations. The attribute tables in Appendix 2A do not specify the methodology to be deployed for nutrient and phytoplankton sampling in lakes, however, it is widely accepted that depth-integrated samples should be collected from the epilimnion. This requires specialised sampling equipment and a boat, which poses issues around health and safety, as highlighted above by Environment Canterbury.

Further, some lakes in some regions are rarely sampled by regional councils and so current state for these waters is largely unknown, certainly with respect to the attributes in the draft NPS document. For example, the water quality and ecology of Lake Mahinerangi, a large hydro-electric lake in Otago, is not monitored by the regional council. West Coast Regional Council monitor only two lakes in their region, but no hydro-electric lakes/reservoirs operated by Trustpower (i.e., Lake Wahapo, Lake Kaniere).

We understand that Tasman District Council does not monitor lakes on a regular basis and so understanding current state would be challenging for lakes in that district (e.g., Cobb Reservoir which is a Trustpower dam in the Takaka River catchment).

Table 2  Periphyton (Trophic state) - Rivers

The requirement to monitor periphyton (chlorophyll-\(a\)) monthly in rivers (Table 2) presents a health and safety risk, particularly because no distinction is made between wadeable and un-wadeable rivers. Unlike the other ‘attributes requiring limits’, which can all be monitored by the collection of a water sample without entering the water (e.g., dissolved reactive phosphorus), periphyton must be monitored by physically wading into the river. The periphyton sampling process involves wading into the river, bending over to reach the river bed, and collecting a rock to carry back to the river bank. To achieve this, the river needs to be wadeable, which is typically taken to be 60 cm deep or less. If most of the river is deeper than 60 cm periphyton sampling is restricted to the river margins (if possible at all) and therefore not representative of the entire river. Similarly, periphyton sampling may be constrained only to times when the river is low and therefore not representative of typical conditions. In contrast, the ‘attributes requiring action plans’ that involve physically wading into a river to collect a sample (i.e. macroinvertebrates, fish, deposited fine sediment) all appropriately apply to wadeable streams and rivers only.

Table 15  Fish (Rivers)

The proposed attribute unit for fish is the Fish Index of Biotic Integrity (F-IBI). F-IBI compares the fish species found at a site with those expected to be present, with these expectations based on the actual data available. We consider the F-IBI approach could do with more testing before it can be rolled out as a nation-wide freshwater attribute. There is no guidance as to what expected F-IBI scores should be in each region are, but presumably the proposed attribute bands are based on the national data discussed in the Joy and Death (2004) paper. However, subsequent work by Joy (2010) in the Southland region has demonstrated the importance of developing F-IBI scores based on site-specific data.

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on regional rather than national data. Southland pastoral sites were found to have higher F-IBI scores than native forest sites, in contrast to what was found nationally by Joy and Death (2004). McIlrath et al. (2013) stated that there is a clear need to understand why this is occurring as it may have implications for other sites around New Zealand.

In their paper about the development of the F-IBI, Joy and Death (2004) also noted that further knowledge was needed about the accuracy of the F-IBI in comparison to other river assessment systems. We are not aware of this information having been collected, and therefore we are not confident about the appropriateness of the F-IBI for inclusion as a national attribute for freshwater. We also note that in their report on scoring indicators for impacts on freshwater biodiversity and ecosystem processes of rivers and streams, prepared for the Ministry for the Environment, Storey et al. (2018) concluded that the F-IBI is developed but ‘with issues’, including the need to account for sampling bias and natural processes, and to determine the ‘pressures’ that drive F-IBI and/or its 12 individual components.

Fish monitoring associated with the Table 15 attribute will be a resource hungry work programme for councils. The table specifies up to three sampling methods that can be used (electric fishing, spot lighting and trapping). In our experience, each method requires at least two experienced and qualified freshwater ecologists. The specified method to be used requires 150 metres of river or stream length to be surveyed. It takes considerable time to survey this length particularly in wide rivers. Spot lighting for fish has to be undertaken in the dark, which raises health and safety issues and additional resourcing for being outside of normal work hours.

Practical issues, such as gear maintenance and equipment calibration, need to be ongoing and regular in order to produce reliable and accurate data. It is from our personal experience that even with owning two compliant electric fishing machines and associated equipment, they require frequent repairs and testing. A NIWA Kainga electric fishing machine costs approximately $10,000 and requires frequent servicing and repair work.

Any equipment used in South Island rivers in particular has to be thoroughly cleaned immediately after surveying each site to prevent the spread of Didymo and other potentially invasive species (e.g., Lagarosiphon). This takes time to complete and so the number of sites that can be surveyed in a day is limited.

Table 19 Dissolved oxygen (rivers)

We anticipate considerable logistical issues associated with dissolved oxygen (DO) monitoring of rivers. Seven-day continuous monitoring required under Table 19 will require DO loggers to be deployed at sites throughout a region. Loggers will have to be retrieved after seven days for data download. DO loggers are expensive (approximately $5,000 for a D-Opto logger) and even if a set of loggers were purchased and deployed around the region on a rotating basis, the resourcing associated with this type of work would be considerable. Issues associated with damage and loss of equipment due to flooding and vandalism are constant. The need for regular calibration in order to produce reliable data is also a critical factor in the use of DO loggers. We question whether DO monitoring of rivers is necessary as a universal water quality attribute when other indicators of

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ecosystem health are proposed in the draft NPS (i.e., nutrients, macroinvertebrates, periphyton and phytoplankton).

**Table 20 (Lake-bottom dissolved oxygen) and Table 21 (Mid-hypolimnetic dissolved oxygen)**

DO monitoring in lakes poses a number of issues. Table 20 requires measured or estimated annual DO minimum is to be assessed less than 1m above the sediment surface at the deepest part of the lake using either continuous monitoring sensors or discrete DO profiles (monitoring of temperature is also required to be informative, although not specified).

Continuous monitoring would be challenging. Finding the deepest part of the lake and then deploying continuous monitoring equipment would be resource intensive and require robust equipment particularly in very deep lakes. For example, the Lake Hawea hydro lake in Otago has a depth of 392 metres, therefore a minimum cable length of 391 metres would be required.

DO monitoring below point source discharges is also likely to be a resource-hungry requirement. There is no guidance on whether this applies to all point source discharges, of which there are many in most regions. Criteria for the size of the discharge and the water quality of the discharge is not identified. Some point source discharges may not exert an oxygen demand on the receiving water. As noted above, accurate DO loggers are relatively expensive pieces of equipment and require calibration and maintenance.

(2) **Timeframes for improvement**

You have asked what might be reasonable in terms of timeframes to observe improvements following an action associated with, for example, having to meet or better a national bottom line. We note that section 3.9(4) of the draft NPS document states:

*Every target attribute state must:
* specify a timeframe for achieving the target attribute state*

We consider that appropriate timeframes (or more correctly, achievable timeframes) for meeting a particular attribute state in catchments with hydro-electric development would ideally be set taking local characteristics into account. A number of obvious variables will come into play here, including the following:

- **Location of site.** A water body located further upstream in a catchment is subject to less external influences that one located further downstream. The downstream waterbody receives inputs from a larger catchment and, potentially, a wider range of hydrological and land use influences.

- **The scale of the catchment.** For similar reasons to the first bullet point, water bodies with larger catchments are likely to require longer periods of time to respond due to the scale of change that may be required in a large catchment.

- **The type and intensity of land use within the catchment and physical characteristics such as the presence of lakes and wetlands that may influence downstream water quality through attenuation and treatment of water quality contaminants.**
The type of freshwater attribute and its responsiveness to change within the catchment. For example, inputs of *E. coli* and phosphorus to rivers and lakes are primarily by overland flow, and so their entry to surface water can be a relatively quick process. In contrast, nitrate is soluble and can travel through to the underlying groundwater system. From there, it may take months to decades to appear in downstream surface waters, depending on the nature of the geology. Some biological attributes, such as periphyton, can respond almost immediately to a change in flow, and macroinvertebrate communities can respond to changes in benthic conditions within weeks to months.

Most regional planning documents we are aware of specify timeframes such as five and ten years for meeting water quality targets. While these are arbitrary lengths of times, they do provide some acknowledgement that time is required for change to occur. For example, Schedule 15 of the Otago Regional Water Plan includes Table 15.2 which contains receiving water numerical limits and targets for achieving good quality water. Various sub-catchments within the region have timeframes ranging from March 2012 to March 2025 to achieve targets for specific contaminants.

Clearly, some waterbodies will require many years, even decades to improve water quality and ecosystem health. Some hydro lakes, such as Trustpower’s Lake Matahina, are heavily infested with invasive pest plants. The bed is 97% covered in invasive species and below the proposed national bottom line of 90%. Being able to manage this lake to enable the national bottom line to be met would require huge resource and at this stage there is little hope it would maintain that improved state. Manging invasive plant species in lakes is very challenging and setting timeframes for meeting bottom lines would appear inappropriate given the extent of invasion, the limited methods for control, and likely impact on other more desirable elements of the ecosystem (e.g., loss of fish habitat). We note that considerable cost, time and effort has been spent on ‘managing’ the introduced weed *Lagarosphon* in Lake Dunstan, with limited success.

### (3) Current State

While ‘current state’ seems a simple enough concept, in reality it is difficult to determine as in our experience it is often highly dependent on the timeframe over which an attribute is assessed. As scientists, we would normally expect that defining the current state of water quality takes the following into account:

1. the date or period of time when ‘current’ is deemed to have occurred; and
2. the period over which sufficient monitoring data has been collected in order to provide a robust assessment of individual water quality attributes.

For (i), we would normally expect the definition of ‘current’ to be agreed through the planning process associated with the development of the plan document. For example, if a proposed plan was notified on a specific date, the current state may be that date or some date earlier, depending on how the plan was drafted. We assume setting a current state date is akin to drawing a line in the sand and establishing a benchmark against which future state(s) can be measured against.

For (ii), this is a matter that has more relevance to us as scientists, however it requires scientists and planners to communicate over the need to define current state at a particular date and to factor in an appropriate period of time leading up to that date sufficient for monitoring purposes and providing data representative of water quality conditions.

Sufficient time to collect and present water quality data that is representative of the current state can
take several years to achieve, particularly if the data is to stand up to scrutiny. For example, in the case of periphyton trophic in rivers (biomass expressed as chlorophyll-a mg/m²), Table 2 of Appendix 2A of the draft 2019 NPS-FW states:

“Numeric attribute states must be derived from the rolling median of monthly monitoring over five years.”

The same monitoring approach is required for Table 5 (Dissolved inorganic nitrogen) and Table 6 (Dissolved reactive phosphorus).

For Table 11 (Escherichia coli (E. coli)) the following monitoring approach is stated:

“Attribute state should be determined by using a minimum of 60 samples over a maximum of 5 years, collected on a regular basis regardless of weather and flow conditions.”.

And for Table 12 (Cyanobacteria (Planktonic)):

“The 80th percentile must be calculated using a minimum of 12 samples collected over 3 years. 30 samples collected over 3 years is recommended.”

Therefore, if a proposed plan was notified on 30 June 2019, and current state was deemed to be a period of time immediately leading up to the plan notification date, the various water quality attributes in the plan would indicate that the current state should ideally be assessed over the period July 2014 to June 2019, assuming the attribute examples above are proposed in the plan.

Sample timing is also an important factor, as alluded to in the above examples, and this can vary greatly between water quality attributes. For example, dissolved oxygen in a river typically changes quite widely throughout the course of a 24 hour period, and so determining the DO current state based on an instantaneous reading would most likely not be representative of the typical DO level in the waterbody over a 24 hour period. Periphyton biomass is typically greater over the warmer months of the year. If sampling was only undertaken in the cooler months of the year to determine current state, this would likely produce an unrealistic picture of periphyton biomass in that river. Finally, as well as seasonal influences, climatic patterns can vary from year to year (e.g., rainfall, temperature and solar radiation) and these can influence levels of water quality parameters in surface waters as well as biological responses (e.g., periphyton biomass and macroinvertebrate community health). So, to account for these natural variations, sampling to determine current state is usually undertaken over a period of time to reduce the risk of data aberrations influencing the current state assessment.

The fact that there potentially may be upward or downward trends in water quality state over the time period when current state is being assessed is something that cannot be avoided.

Clause 3.8 of the draft NPS document deals with current state.

3.8 Identifying current attribute states
(1) Every regional council must identify the current state of each attribute (noting that water quantity does not have attributes – see clause 3.11).
(2) The current state need not be a single measure but may take into account natural variability and sampling error.
(3) If a regional council does not have complete and scientifically robust data on which to establish the current state of an attribute, it must use its best efforts to identify a current state using the information that is available, including partial data, local knowledge, and information obtained from other sources.
Subclauses (1) and (2) are reasonable, however subclause (3) appears very open-ended as to how this could be interpreted and does not provide a large degree of confidence in identifying current state when faced with relatively little information. It would be preferable in our opinion that this clause provided a more prescriptive scientific approach to gathering information when it is lacking.

It is highly unlikely that regional councils have data sets sufficiently robust to meet monitoring requirements for all attribute states presented in Appendix 2A and 2B of the 2019 draft NPS-FW. That leads to the issue of what level of pragmatic monitoring is justifiable for identifying current attribute states. This issue is canvased in the MFE publication ‘Draft Guide to Monitoring’ (MFE 2017⁷), however in our opinion no useful solutions are offered. We recommend that if a proposed attribute has not been monitored over the appropriate current state period, or that the monitoring over this period is deemed inadequate to meet a reasonable ‘fit for purpose’ test of scientific robustness, then that attribute does not qualify for Appendix 2A status, but rather defaults to an information gathering programme consistent with the monitoring requirements appropriate to individual attributes.

Notwithstanding the above recommendation, in our opinion, some of the additional attributes listed in Appendix 2A and 2B of the draft 2019 NPS-FM are not necessary or have a number of issues associated with monitoring or proposed attribute bands, as discussed above under section 1 for some attributes. We have summarised our comments and recommendations for retention or removal of proposed attributes in the table below.

### Draft NPS-FW (2019). Comments on Attribute monitoring to determine current state and recommendations for their retention or removal in Appendix 2A and 2B.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Limits or Action Plans</th>
<th>Specified Monitoring period and number of samples required to assess attribute state</th>
<th>Recommendation for retain or remove attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phytoplankton (Trophic state)</td>
<td>L</td>
<td>Not stated, but refers to an annual median and an annual maximum concentration.</td>
<td>Retain. Important and well researched lake attribute/indicator that responds to nutrients. However, can be difficult to collect representative samples efficiently and safely for some lakes.</td>
</tr>
<tr>
<td>Total Nitrogen (Trophic state)</td>
<td>L</td>
<td>Not stated, but refers to an annual median concentration.</td>
<td>Retain. Important and well researched water quality attribute that affects lake phytoplankton biomass.</td>
</tr>
<tr>
<td>Total Phosphorus (Trophic state)</td>
<td>L</td>
<td>Not stated, but refers to an annual median concentration.</td>
<td>Retain. Important and well researched water quality attribute that affects lake phytoplankton biomass.</td>
</tr>
<tr>
<td>Periphyton (Trophic state)</td>
<td>L</td>
<td>Rolling median of monthly monitoring over five years.</td>
<td>Retain. Important and well researched river attribute/indicator that responds to nutrients. However, can be difficult to sample in some rivers safely and at times other than low flow conditions.</td>
</tr>
<tr>
<td>Ammonia (toxicity)</td>
<td>L</td>
<td>Not stated, but refers to an annual median and an annual maximum concentration.</td>
<td>Retain. Important and well researched attribute that is linked to ecosystem health in lakes and rivers.</td>
</tr>
<tr>
<td>Nitrate (Toxicity)</td>
<td>L</td>
<td>Not stated, but refers to an annual median and an annual 95th percentile concentration.</td>
<td>Retain. Important and well researched attribute that is linked to ecosystem health in lakes and rivers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Limits or Action Plans</th>
<th>Specified Monitoring period and number of samples required to assess attribute state</th>
<th>Recommendation for retain or remove attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved oxygen</td>
<td>L</td>
<td>‘1-day mean minimum’ and ‘1-day minimum’, both over summer period: 1 Nov – 30 Apr</td>
<td>Remove. Applies to rivers below point sources only. More appropriately addressed under resource consent conditions. No mention of mixing zones.</td>
</tr>
<tr>
<td><em>Escherichia coli</em> (<em>E. coli</em>)</td>
<td>L</td>
<td>A minimum of 60 samples over a maximum of 5 years, collected on a regular basis regardless of weather and flow conditions.</td>
<td>Retain. Important attribute/indicator of suitability for swimming and food gathering.</td>
</tr>
<tr>
<td>Cyanobacteria – Planktonic</td>
<td>L</td>
<td>The 80th percentile must be calculated using a minimum of 12 samples collected over 3 years. 30 samples collected over 3 years is recommended.</td>
<td>Retain. Important attribute/indicator of suitability for contact recreation, food gathering and general ecosystem health.</td>
</tr>
<tr>
<td>Dissolved inorganic nitrogen</td>
<td>L</td>
<td>Rolling median of monthly monitoring over five years.</td>
<td>Remove. While an important river attribute that affects periphyton biomass in hard bottom rivers, not confident that the bands can be universally applied across NZ. Other factors such as flood frequency, shading and temperature affect periphyton accrual, and these vary from catchment to catchment. Arguably a redundant attribute if the periphyton attribute for rivers and the ammonia and nitrate toxicity attributes are retained. Certainly, should be monitored (as would be the case if ammonia and nitrate toxicity attributes are retained).</td>
</tr>
<tr>
<td>Dissolved reactive phosphorus</td>
<td>L</td>
<td>Rolling median of monthly monitoring over five years.</td>
<td>Remove. While an important river attribute that affects periphyton biomass in hard bottom rivers (DRP is often the nutrient limiting periphyton growth in NZ streams and rivers), not confident that the proposed bands can be universally applied across NZ. Other factors such as flood frequency, shading and temperature affect periphyton accrual, and these vary from catchment to catchment. Arguably a redundant attribute if the periphyton attribute for rivers is retained. Certainly, should be monitored.</td>
</tr>
<tr>
<td>Suspended fine sediment</td>
<td>L</td>
<td>The minimum record length for grading a site is two years of at least monthly samples (at least 24 samples).</td>
<td>Remove. Question the appropriateness of using turbidity as a surrogate for suspended sediment concentration. Turbidity loggers have issues associated with comparisons with other instruments. More appropriate to use clarity.</td>
</tr>
<tr>
<td>Macroinvertebrates (1 of 2)</td>
<td>AP</td>
<td>Current state calculated as the five-year rolling average score. Annual samples taken between December and March (inclusive).</td>
<td>Retain. Important and well researched indicator of river ecosystem health, but use only for wadeable hard bottom streams.</td>
</tr>
<tr>
<td>Macroinvertebrates (2 of 2)</td>
<td>AP</td>
<td>Current state calculated as the five-year rolling average score. Annual samples taken between December and March (inclusive).</td>
<td>Remove. Although not additional resourcing required for this attribute (other than spreadsheet calculations and assessments), considered not sufficiently tested as a suitable national attribute for macroinvertebrate community health.</td>
</tr>
<tr>
<td>Fish</td>
<td>AP</td>
<td>Determined by at least annual sampling between December and</td>
<td>Remove. Not sufficiently tested as a suitable national attribute for freshwater</td>
</tr>
</tbody>
</table>


### Attributes

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Limits or Action Plans</th>
<th>Specified Monitoring period and number of samples required to assess attribute state</th>
<th>Recommendation for retain or remove attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submerged plants (natives)</td>
<td>AP</td>
<td>March (inclusive). Numeric Attribute State is an average, but the minimum number of (annual) samples to be averaged is not stated.</td>
<td>fish and indication of some issues with particular catchments. Would require considerable council resources to be undertaken as per recommended sampling protocols. Macroinvertebrate and periphyton monitoring can provide sufficient indicators of river health.</td>
</tr>
<tr>
<td>Submerged plants (invasive species)</td>
<td>AP</td>
<td>Monitoring to be conducted at least once every three years. Not clear whether assessment of the attribute states is against annual values or is average on (say) three years.</td>
<td>Remove. Question the ability to influence plant cover without adversely affecting other components of the lake ecosystem.</td>
</tr>
<tr>
<td>Deposited fine sediment</td>
<td>AP</td>
<td>The minimum record length for grading a site is 24 samples taken over 2 years of monthly monitoring, or longer for sites where flow conditions only permit monthly monitoring seasonally.</td>
<td>Remove. Although an important attribute in rivers, question whether the attribute bands have been sufficiently tested for use and whether monitoring would be sensitive enough to detect band changes.</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>AP</td>
<td>Seven-day continuous dissolved oxygen monitoring to be collected at least once during summer (December to March inclusive).</td>
<td>Remove. Other proposed attributes sufficient to assess river ecosystem health (i.e., macroinvertebrates, periphyton). Logistically challenging and expensive to undertake throughout a region and gather good quality data.</td>
</tr>
<tr>
<td>Lake-bottom dissolved oxygen</td>
<td>AP</td>
<td>Not stated.</td>
<td>Remove. DO monitoring in lakes poses a number of issues. Logistically challenging and expensive to undertake. Significant health and safety issues Continuous monitoring would be challenging.</td>
</tr>
<tr>
<td>Mid-hypolimnetic dissolved oxygen</td>
<td>AP</td>
<td>Not stated, but attribute state to be measured using either continuous monitoring sensors or discrete DO profiles.</td>
<td>Remove. DO monitoring in lakes poses a number of issues. Logistically challenging and expensive to undertake. Significant health and safety issues Continuous monitoring would be challenging.</td>
</tr>
<tr>
<td>Ecosystem metabolism</td>
<td>AP</td>
<td>Derived from at least seven days of continuous dissolved oxygen monitoring to be collected at least once during summer (December to March inclusive), using a stated method in a reference.</td>
<td>Remove. Not sufficiently tested as a suitable national attribute for river ecosystem health. DO monitoring poses a number of issues, as noted above.</td>
</tr>
<tr>
<td><em>Escherichia coli</em> (E. coli)</td>
<td>AP</td>
<td>Not stated.</td>
<td>Retain. But ensure consistently with <em>E. coli</em> attribute in Table 11.</td>
</tr>
</tbody>
</table>

#### (4) Current State vs Consented State

We understand that there may be situations where Trustpower’s current operations are not exercising the full extent of their consented allocation. This raises the question as to whether a change to the receiving environment current state (i.e., a change in attribute state) could potentially occur as result
of an operational change that did not require a change of consent.

We consider that, potentially, it would be possible for a change in the operation of a hydro scheme (although still within its consented operational footprint) to cause a change in the current state. For example, Trustpower’s West Coast Kaniere HEPS has consents that enable it to reduce the downstream residual flow (that to our knowledge has not been exercised yet). Such an action could potentially result in an increase in downstream periphyton biomass which in turn could change the character of the macroinvertebrate community.

A hypothetical example could be a condition of consent that enabled a sluicing operation at a dam to discharge sediment-laden water to the downstream environment. Although the sluicing action may have never been exercised, doing so at some point in the future may cause a conspicuous change in deposited sediment downstream such that it would cause the national bottom line in proposed Table 18 (Deposited fine sediment) to be no longer met.

Please let us know if you require any further information.

Yours sincerely,

Personal details removed

Environmental Scientist & Director

Ryder Environmental Limited

Personal details removed

Environmental Scientist & Associate

Ryder Environmental Limited
Trustpower Ltd

Attention: Personal

Dear Personal

Draft NPS FM- deposited fine sediment attribute
Potential implications to Trustpower

Trustpower Ltd (Trustpower) asked Tonkin & Taylor Ltd (T+T) to provide advice/comment on the Draft NPS FM deposited fine sediment attribute to support their submission to the Ministry for the Environment (MfE). T+T have previously provided advice to the Generator Group on the MfE sediment attribute proposal, prior to draft NPS FM being released (T+T 2019). The findings from the preliminary assessment conducted by T+T have been incorporated throughout this letter where applicable.

This short letter report outlines our specific concerns on the deposited fine sediment attribute as it currently stands in the Draft NPS FM (Section 1), it provides a worked example of how the deposited fine sediment metric may be applied to a Trustpower Scheme (Section 2), and provides a recommendation to Trustpower on how it may want to provide its submission on this attribute.

1 Background

At present, Trustpower only collect sediment data as required by existing resource consent conditions, and generally only in areas where sediment or sediment related ‘issues’ have been identified. Generally, the sediment data that Trustpower collects is TSS, SSC or visual clarity (black disc), but occasionally Trustpower are required to assess changes in sediment depth within hydro-lakes or other receiving environments (generally through bathymetric survey).

Regional Council’s similarly only collect TSS or visual clarity in rivers around New Zealand, and deposited fine sediment is generally not monitored. In addition, the Science and Technical Advisory Group (STAG) acknowledge that “Councils currently do not require maintenance of specific, region-wide in-stream sediment thresholds to provide for overall ecosystem health”.

T+T consider that deposited fine sediment is an issue in streams throughout New Zealand, and is contributing to the decline of ecosystem health. However, we have some questions/comments about the way the deposited fine sediment metric is being applied in the Draft NPS FM.
2 Comments/questions on the attribute

We question if the deposited fine sediment attributes are a true reflection of what can be achieved in any given river, seeing as the current thresholds are based on sparse long-term monitoring data. This necessitated the use of modelling techniques to establish a reference state. It was acknowledged in Clapcott and Goodwin (2017) that regional verification of modelled reference states will need to be undertaken. In addition, the Science and Technical Advisory Group (STAG) acknowledge that urgent work is required to develop an understanding of ‘source to sea’ sediment transport, the potential impacts of catchment derived sediment on receiving environments, and the relationship between catchment sediment loads and receiving environment impacts.

To try and capture the variability of sediment within New Zealand’s rivers, the River Environment Classification (REC) was used to classify rivers into 12 river types called Sediment State Classes (SSCs) in the Draft NPS FM. This classification technique used three of the six REC parameters available, those being climate, topography (source of flow) and geology. The other three parameters not included in the classification process were land-cover, network position or valley landform (Table 2.1).

Table 2.1: The six parameters of the REC. Only Climate, Topography and geology was used in the development of the SSCs.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Processes being described by this classification level</th>
<th>Physical characteristics that are discriminated at this level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Climate influences precipitation (how much rain an area receives), the amount of evapotranspiration occurring in the catchment, and the air temperature and the amount of sunshine the river receives, which together influence heating and cooling of water.</td>
<td>Seasonality of flow and thermal regime. High and low flow frequencies. Very broad discrimination of water chemistry (quality).</td>
</tr>
<tr>
<td>Topography</td>
<td>Catchment topography strongly influences how precipitation is stored (due to snow pack and lakes) and released from a catchment as well as erosion and transport of sediment. Topography also influences small-scale climate variation within a catchment.</td>
<td>Further (more specific) discrimination of the seasonality of the flow and thermal regimes, frequency of high flows. General discrimination of sediment transport regimes.</td>
</tr>
<tr>
<td>Geology</td>
<td>Catchment geology influences rates of erosion and chemical weathering of underlying rocks including nutrient release. Catchment geology influences aspects of hydrology, including groundwater storage and release (i.e. base flow conditions)</td>
<td>The Geology level discriminates low flow magnitude, sediment supply, water chemistry (e.g. inorganic nutrient status, pH and dissolved and suspended inorganic matter) and channel substrate.</td>
</tr>
<tr>
<td>Land-Cover</td>
<td>Catchment land cover influences surficial erosion of soil, supply of soil derived water column constituents during rainfall and surface runoff including nutrients and sediments</td>
<td>The land cover level further discriminates the frequency and duration of low flow and water chemistry including total nutrients and organic matter.</td>
</tr>
<tr>
<td>Network-Position</td>
<td>Attenuation of many fluxes (e.g. flow, sediment) by catchment storage</td>
<td>Flux of sediment, water, and hydrochemicals. Distribution of flow ratios. Flood intensity.</td>
</tr>
<tr>
<td>Valley-Landform</td>
<td>Local hydraulic processes of erosion and deposition.</td>
<td>Valley-Landform influences channel shape and thus, hydraulic conditions (water velocity and depth), bank-full discharge, habitat volume, local flood power, sediment size range, and riparian conditions. The exact characteristics are, in part, determined by the higher order factors.</td>
</tr>
</tbody>
</table>
The network position and valley-landform parameters in the REC were specifically designed to deal with the spatial and temporal variability of flow and sediment transport/delivery.

The description of the network position in the REC user manual is as follows:

“Network-Position describes processes involved in transport down the network. In headwater streams, the network has very little storage capacity and there is a short delay in flood flows or material moving down the network. However, in main stems the network upstream has appreciable storage capacity. This storage affects movement of water and materials, effectively delaying and smoothing sharp spikes in flow and transported material such as sediment and chemical constituents.”

The description of the valley landform parameter in the REC is as follows:

“Valley-Landform, describes hydraulic process, essentially processes involved in in-channel erosion and deposition of sediment. These processes lead to differences in channel characteristics. Where the valley slope is high, erosion dominates, resulting in coarse substrate (bed material). Where the valley slope is low, deposition dominates and fine sediments are deposited. Hence this lowest level of the classification discriminates channels that are broad, shallow and gravel or cobble bottomed with swift moving water from those channels that are deep with slow moving water and muddy bottoms.”

If the SSC process in the deposited fine sediment attribute uses only three REC parameters (climate, topography, geology), is this sufficient to subdivide the catchments of New Zealand into regions with different sediment supply and retention characteristics? We can’t easily find the rationale to support the decision to only include these three parameters when other REC parameters (such as network position and valley-landform) also play a significant role in sediment source and retention characteristics.

The REC alone may not be sufficient to capture the variability in sediment transport across a range of temporal scales. The inclusion of specific catchment flood responses and valley confinement (eg the ability for floodplain storage of sediment) could be additional non-REC parameters that provide more clarity on deposited fine sediment states. For example, climate (specifically rainfall) is often not correlated well to flow (the driver of sediment generation and transport) in volcanic soils where there is high permeability and aquifer storage. This is the case in the Bay of Plenty, where rainfall is rapidly absorbed through the pumice soils and stored in aquifers, resulting in a dampened flood response, regardless of the size of the rainfall event. This means that sediment transport will not correlate well with rainfall.

The REC alone may not be sufficient at capturing the variability in sediment loads following large ‘events’, and the time it may take for the sediment to move through the system. For example, some rivers in Taranaki still show elevated sediment levels 15 years after a large landslide in the headwaters. Processes such as this, would potentially lead to rivers occupying lower attribute state classes for deposited fine sediment for up to 20 years post event.

Based on the above, the SSCs as presented in the draft NPS-FM may not take into account the variability of fine grained sediment supply within a single river over different timescales, the potential effects of large magnitude events (such as large floods or landslides) and the expected or demonstrated recovery timeframes from these events. The STAG acknowledge that there is a ‘major need’ to conduct further research on event based sediment loading.

The classification of SSCs means that a single river may have multiple reference states and attribute thresholds for deposited fine sediment. Based on data in Franklin et al (2019), the Waiwhakaiho River has three SSC classes (SSC2, SSC12 and SSC6).
This raises a two main questions:

- What will it mean for determining current attribute states in a catchment, if single waterways in the same catchment have multiple SSCs? Are the few monitoring sites within an FMU meant to be ‘representative’ of the catchment?
- How might Regional Councils address catchments with different SSCs in the required action plans? Would the action plans relate to the whole FMU, or to individual sub-catchments within each FMU (that may contain more similar SSCs)?

The attribute state thresholds between the different bands are very specific and fall into a narrow range, and there is an acknowledgement of a 5-10% measurement error. For example, attribute state band A for SSC6 is <30% cover, while band B is <38% and band C is <45%. There is 8% difference in coverage between band A and B, and 6% between B and C, meaning that with the acknowledged error margin a site could realistically fit into any one of these attribute states.

- Would it lead to better environmental outcomes, if the deposited sediment attribute was included in the NPS FM as a compulsory monitoring attribute to build a more appropriate dataset from which to develop attribute states, especially as previous researches involved in the development of the deposited fine sediment attribute have indicated this may be required?

The deposited fine sediment attributes are based on a ‘reference state’ that has been modelled. From our observations of stream and rivers around NZ, there are regional patterns of effects of changes in hydrology (such as dams, weirs, water diversions, or surface water abstraction) on sediment cover. Generally where water is being abstracted, diverted or impounded, there is the potential for more fine sediment to accumulate downstream of these take points, or upstream of the impediments.

- Does the REC sufficiently incorporate all hydro-power infrastructure? For example, Lake Mangamahoe (which was constructed in the 1920’s) is not incorporated into the REC, and the REC stream line does not correspond to a watercourse.
- There is a risk that Trustpower’s generation capacity, storage and operational flexibility may be affected if their allocated residual flow volumes are deemed to be contributing to an increase in deposited fine sediment. This is an issue that all hydro electric generators would face, yet only the effects of this on six schemes have been recognised through exceptions in the proposed NPS FM.

STAG’s assertion that “The levels of suspended and deposited fine sediment in rivers and streams have reached ecological tipping points in many parts of New Zealand”, is in contrast to the modelled predicted state which suggests only 16% of rivers will exceed the national bottom line for deposited fine sediment. In addition, the discussion document refers to deposited fine sediment within estuaries as the primary driver for addressing deposited fine sediment in rivers. The contradiction between these suggests further research into deposited fine sediment in New Zealand rivers, and the correlation with degradation in estuaries is required.

We know that a lack of mobile sediment (often fines, but not always) also has detrimental impacts on ecological health, with loss of spawning habitat (especially for smelt and some salmonids) and links to increased bank erosion. In many instances, Trustpower infrastructure will be capturing and storing sediment, preventing downstream sediment transport. In addition, some Trustpower infrastructure (such as in the Kaimai Scheme) are unable to release sediment into downstream reaches.

- The deposited fine sediment attribute in the Draft NPS FM is focussing on the degradation of ecological function in waterways resulting from excessive sediment. The degradation of ecological function in New Zealand waterways in the absence of deposited sediment hasn’t
have been analysed. This could have unintended consequences, that could lead to further degradation of waterways in New Zealand. Understanding this relationship through the collection of monthly deposited fine sediment data, coupled with annual MCI data will help to better understand the relationship between deposited fine sediment and biotic response.

3 Examples of how the attribute may apply to Trustpower Scheme waterways

The first step to understanding how the NPS FM deposited fine sediment attributes will effect Trustpower, is to identify what Sediment State Classification (SSC) is relevant to the waterways in the schemes. For the Mangorei Scheme in Taranaki, the Waiwhakaiho River has three SSC categories, SSC2 in the headwaters, SSC12 on the ring plain, and SSC6 from downstream of the confluence with the Taruawakanga Stream.

The Mangamahoe Stream is classified as SSC6, and Lake Mangamahoe (which forms part of the Mangorei Scheme) is not identified or recognised as present in the current REC layer (Table 3.1). The channel downstream of the dam outlet has not been classified, but based the current REC classification of Mangamahoe Stream, and it being downstream of lake Mangamahoe, it’s assumed to be classified as SSC8 (Table 3.1).

Table 3.1: A high level assessment of the SSC based on the REC climate, topography and geology parameters and NPS FM deposited fine attribute sediment bands applicable to the Mangorei Scheme.

<table>
<thead>
<tr>
<th>SSC</th>
<th>Catchment</th>
<th>Predicted reference state for the SSC (from MfE primer)</th>
<th>A band</th>
<th>B band</th>
<th>C band</th>
<th>D band/National bottom line</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Waiwhakaiho headwaters</td>
<td>4%</td>
<td>&lt;9%</td>
<td>&lt;15%</td>
<td>&lt;21%</td>
<td>&gt;21%</td>
</tr>
<tr>
<td>12</td>
<td>Waiwhakaiho</td>
<td>20%</td>
<td>&lt;27%</td>
<td>&lt;36%</td>
<td>&lt;45%</td>
<td>&gt;45%</td>
</tr>
<tr>
<td>6</td>
<td>Mangamahoe/Waiwhakaiho</td>
<td>22%</td>
<td>&lt;30%</td>
<td>&lt;38%</td>
<td>&lt;46%</td>
<td>&gt;46%</td>
</tr>
<tr>
<td>8</td>
<td>Mangamahoe downstream of dam (assumed)</td>
<td>13%</td>
<td>&lt;22%</td>
<td>&lt;33%</td>
<td>&lt;45%</td>
<td>&gt;45%</td>
</tr>
</tbody>
</table>

Both Taranaki Regional Council (TRC) monitoring sites upstream of the Waiwhakaiho Tunnel in the Waiwhakaiho River are situated within SSC12. Neither monitoring site is located within a run, and will therefore not be suitable for monitoring deposited fine sediment as required by the sediment assessment protocols (Clapcott et al. 2011).

The TRC monitoring site downstream of the Mangorei power station is on the Waiwhakaiho River, downstream of Lake Mangamahoe (and the Mangamahoe Stream catchment) and is classified as SSC6. This monitoring site is also not located in a run and will not be suitable for monitoring deposited fine sediment.

There is an expected 2% increase in predicted reference state deposited fine sediment cover between the TRC monitoring sites upstream (SSC12) and downstream of Lake Mangamahoe (SSC6), and a 1% difference in the deposited fine sediment cover for the national bottom line between the two sites. There is an 18% difference between the A band and the national bottom line for SSC12 and 16% difference between the A band and the national bottom line for SSC6. This means, if the error margin (of between 5% and 10% on any one measurement) is taken into account, the sites could fall into almost any of the attribute state bands for either SSC.

We compared the SSC predicted reference states for each of the SSCs in the relevant contributing waterways within the Mangorei Scheme to the modelled predicted contemporary state for each of
the NZREACH segments provided in Clapcott et al (2017) and available on the MfE data portal (Table 3.2). The results suggest that all potential monitoring sites that would be relevant to Trustpower would sit within the A band for deposited fine sediment for the relevant SSC. The exception to this appears to be the site below the Lake Mangamahoe dam spillway/outlet channel. However, as this reach sits below Lake Mangamahoe, it is unlikely to have a large supply of fine grained sediment, and so we believe the predicted contemporary state is incorrect for this NZREACH segment.

While predicted reference states have been modelled for the different SSCs, it is T+T’s view that further data is needed to better support the modelled reference state. As this data has not been collected by TRC or Trustpower to date, TRC will need to collect two years of monthly deposited fine sediment data (along with annual monitoring of MCI to understand the biological response to deposited fine sediment) using the method outlined in Clapcott et al (2011). Based on the inconsistencies with the results presented in Table 3.2, we suggest that two years of monthly data would be regarded as the bare minimum needed to determine this baseline condition.

Table 3.2: Comparison of predicted reference state for SSC, predicted contemporary state for each NZREACH segment (from Clapcott et al 2017) and the applicable NPS FM deposited fine sediment attribute band

<table>
<thead>
<tr>
<th>SSC</th>
<th>TRC monitoring site</th>
<th>NZREACH Id</th>
<th>Predicted reference state</th>
<th>Predicted contemporary state</th>
<th>NPS FM Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Waiwhakaiho headwaters</td>
<td>6005479</td>
<td>20%</td>
<td>8.6%</td>
<td>A</td>
</tr>
<tr>
<td>12</td>
<td>Waiwhakaiho at SH3 (US of Lake Mangamahoe)</td>
<td>6004135</td>
<td>20%</td>
<td>6.9%</td>
<td>A</td>
</tr>
<tr>
<td>12</td>
<td>Waiwhakaiho DS of inlet structure</td>
<td>6003632</td>
<td>20%</td>
<td>5.9%</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>Waiwhakaiho at SH3 (DS of Lake Mangamahoe)</td>
<td>6003415</td>
<td>22%</td>
<td>7.7%</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>Mangamahoe (US of Lake Mangamahoe)</td>
<td>6003948</td>
<td>22%</td>
<td>13.8%</td>
<td>A</td>
</tr>
<tr>
<td>6</td>
<td>Mangamahoe (at Lake Mangamahoe)</td>
<td>6003642</td>
<td>22%</td>
<td>14%</td>
<td>A</td>
</tr>
<tr>
<td>N/A but assumed to be 8</td>
<td>Mangamahoe downstream of dam (assumed)</td>
<td>6003626</td>
<td>22%</td>
<td>78.4%</td>
<td>D</td>
</tr>
</tbody>
</table>

The Mangorei scheme poses some interesting challenges in regards to the interpretation of the deposited fine sediment attribute in the draft NPS FM.

As far as the SSC is concerned, the Mangorei scheme diverts water from the Waiwhakaiho River (SSC12) into the Mangamahoe Stream (SSC6). In the development of any action plan, Trustpower should ensure that the Regional Council reclassify the SSCs appropriately, so that Lake Mangamahoe is incorporated, and the reach downstream is acknowledged as being ‘lake fed’ putting it into SSC8 (as discussed above). This would mean Trustpower is not unduly required to ensure Lake Mangamahoe (essentially a sediment trap) meets the deposited fine sediment attribute thresholds (Lake Mangamahoe will not require deposited fine sediment monitoring as it’s not considered a wadeable river), and the reaches downstream of Lake Mangamahoe will become SSC8 (refer to Table 3.1).
However, as is typical of hydro-lakes, a fine grained sediment delta has formed at the head of Lake Mangamahoe, and this section of stream is considered wadeable. Based on our site observations in February 2019, this reach may not meet the national bottom line for deposited fine sediment.

Taranaki rivers are quite responsive to small changes in climate, which effect sediment loads and recovery timeframes from large rainfall events. For example, some research from TRC (2011) suggest that in the period between 1994 and 2007 there was an increase in frequency of landslides on Mt Taranaki. This lead to largescale increases in deposited sediment within the bed of various rivers. Further research showed it took approximately 15 years for this material to 'flush' through the upper part of the system (within the steep slopes of Mt Taranaki). It would be expected that this sediment will be subsequently deposited in downstream reaches (near Trustpower infrastructure) and will likely take longer to flush through (more than 15 years from the date of the event), due to the lowered sediment transport capacity associated with flatter river grades. This could result in the Waiwhakaiho River being put into lower attribute state bands for a period of 20+ years, which trigger the Regional Council to investigate or manage sediment appropriately to ‘maintain or improve’ deposited fine sediment levels. This could have flow on effects for Trustpower, especially in regards to residual flow provisions.

There is the opportunity for Regional Councils to set different attribute thresholds if they can be proven appropriate due to ‘natural processes’, e.g. having the potential to have occurred before human settlement. An example of how this could be applied, is in Taranaki where the slopes of Mt Taranaki are still in their remnant, pre-human state, it could be argued that these decadal sediment cycles are ‘natural’. Therefore, any prolonged elevated sediment levels occurring as a result from a landslide in an area in its ‘natural state’ would be identified as a ‘natural process’. Therefore any increase in deposited fine sediment would not constitute a decline in condition, but rather natural variability.

Finally, water diversions/water takes that reduce the frequency of peak flows of flushing flows in the source river may also result in an increase in fine grained sediment accumulation in the source river. There are two potential effects of this:

1. Minimum flows are insufficient to transport fine grained sediment past the take point into downstream reaches (resulting in deposition of fine sediment upstream of the take), and
2. Minimum flows are sufficient to transport fine grained sediment only, and not larger clasts, past the take point (resulting in an increase in deposition downstream of the take).

The assumption that deposited fine sediment would increase in wadeable sections of the river network upstream and downstream of take points would need to be tested in some of Trustpower’s schemes. Wheao, Mangorei and Kaimai schemes would potentially be affected by this phenomenon. This would involve undertaking an assessment of deposited fine sediment cover upstream and downstream of various take points over an extended period of low flow (when only the minimum/residual flows are maintained in the source river). The results would be compared to the draft NPS FM reference and attribute states for the appropriate SSC.

The recommended sampling method for deposited fines sediment is in Clapcott et al. (2011). The recommended sediment protocol for state of the environment reporting recommends a bankside visual estimate of % sediment, Wolman pebble count for substrate composition and the Quorer methods to assess the effects on interstitial spaces. The suite of recommended monitoring methods takes approximately an hour per site, with three sites recommended to get a more accurate measure of deposited fine sediment. For health and safety reasons, sampling will need to be undertaken by two people. The NPS FM requires sampling to be undertaken monthly. While Regional Councils will most likely do this at existing State of the Environment monitoring locations, for Trustpower to assess deposited fine sediment trends within their schemes, an assessment (as
described above) would need to be undertaken upstream and downstream of weirs, dams or take points, across all their sites in New Zealand. This is likely to be a resource heavy undertaking.

The NPS FM requires maintenance or improvement of existing conditions, and as such it would need to be determined if Trustpower infrastructure was contributing to any increase in deposited fine sediment. Existing resource consents conditions (such as residual flow provisions) and potential operation constraints could be reviewed to see if there is an opportunity to improve condition (potentially through sediment flushing) under the existing operating regime. As the downstream reaches are likely to have restricted sediment loads due to the presence of dams or other infrastructure, the flushing of sediment may result in a change from baseline condition, but not a deviation from pre-impoundment ‘natural state’. However, flushing of sediment may have other ecological effects.

4 Conclusion

In summary, we believe that it is premature to include deposited fine sediment as an attribute that requires an action plan to be developed, and suggest it is included as a compulsory monitoring attribute, as was done for MCI in the 2017 NPS FM. This will require the collection of at least two years of monthly deposited fine sediment data, coupled with annual MCI data, to support the development of deposited fine sediment attribute states and reference states that are potentially more reliable than those at present. Additional geomorphic considerations (as discussed below) could help to provide better context to the attributes, and will help to address the natural variation in sediment loads for certain river types and how this relates to SSCs.

The STAG were undecided on whether deposited sediment should be included as an attribute or monitoring plan requirement. In addition, Some STAG members believe there is an “urgent requirement for national guidance to councils on how to track sediment source, determine sediment loads and model/map deposited sediment”. We support STAGs recommendation in this regards.

We also suggest further work is undertaken to iron out the inconsistencies in the SSC, or further research provided to justify the existing SSC classifications. The STAG recommended undertaking “research into physical habitat (geomorphology), including the application of existing tools, for characterising and identifying changes to physical habitats at the national scale, and potentially incorporating these tools into national direction”. We agree with STAG’s recommendations and also suggest investigating the inclusion of additional REC parameters (network-position and valley landform) into the SCC classification as a good starting point.

Additional research could be undertaken to investigate the impact of large magnitude events on deposited fine sediment in rivers, and the potential recovery timeframes before deposited fine sediment levels are back to the pre-event state. At present, the very precise sediment attribute states do not allow for this kind of event driven variability over long timeframes. There is a real challenge for Regional Councils to investigate and determine these naturally occurring processes that incorporate effects of extreme events based on two years of data, and the REC doesn’t take this variability and naturally occurring processes into account. The development or inclusion of a geomorphic framework could help Regional Councils identify and characterise ‘natural processes’ as they relate to sediment, within a catchment.
5 Applicability

This report has been prepared for the exclusive use of our client Trustpower Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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Project Director

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Taranaki Regional Council 2011: Aggradation in rivers and streams of the Taranaki Ring Plain.

Review of proposed NPS FM and associated RIA: potential hydro-electricity generation impacts

Report prepared for Trustpower

October 2019
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Executive summary

The Government recently released a discussion document that proposed a suite of policy changes intended to stop further degradation of New Zealand’s freshwater resources and reverse past damage to those resources, waterways and ecosystems (Ministry for the Environment, 2019c). The Government has also released a proposed National Policy Statement – Freshwater (NPS FM). We have reviewed the regulatory impact analysis (RIA) that accompanied that proposal, focusing on the criteria used to assess the options and the analysis in Appendix 10: providing for hydro-electricity generation infrastructure. (Ministry for the Environment, 2019d).

The proposed NPS FM Subpart 4 provides for exceptions from the water quality provisions of the NPS FM for the six largest schemes by capacity.¹ This policy allows the regional council to choose initially to set a freshwater objective below the specified national bottom line in order to preserve the benefits of the listed hydro-electricity generation infrastructure. Where hydro-electricity generation infrastructure is not excepted from the NPS FM the national bottom line for freshwater quality may alter the availability of water for hydro-electricity generation from the outset.

The rationale for the inequitable treatment of hydro-electricity generators by capacity is not clear. In effect, a two-tier approach is created. We have analysed the potential impacts of the NPS FM on the electricity system, highlighting the overall scale of the increase in emissions associated with the altering the operation of hydro-electricity generation, and the disproportionate impact on smaller generators that are not in the list of exceptions in the proposal.

Hydro-electricity generation plays a key role in New Zealand’s electricity system. The Energy Trilemma framework² provides a way of thinking about the policy demands placed on the energy system. All Governments including New Zealand’s require the energy system to deliver a balance between energy security, energy equity and environmental sustainability (i.e. mitigating and avoiding potential environmental harm and climate change impacts). Hydro-electricity is currently the only renewable energy source that has a storage component so it is critical for resource adequacy and security of supply in the electricity system.

Hydro-electricity also plays a key role in the context of Government’s climate change policy imperatives to reduce CO₂ emissions. CO₂ emissions are expected to be reduced mainly by replacing fossil fuel powered generation with renewable generation and electrifying sectors currently reliant on fossil fuels such as transport and industrial process heat. Electrification will increase demand for electricity at the same time non-renewable electricity generation is displaced by renewable generation. In combination these two developments will place greater emphasis on the role hydro-electricity plays in the economy and its ability to fulfil them. Care must be taken, and appropriately

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¹ This is equivalent to including the six largest schemes by capacity in Appendix 3 of the current NPS FM. The Action for healthy waterways discussion document and accompanying Interim Regulatory Impact Analysis for Consultation: Essential Freshwater Part 1 and Part 2 refer to the mechanism to achieve the exception in this way.

² The World Energy Council assesses 128 countries annually for their effort in achieving, and balance between policy goals of energy security, sustainability environment and energy equity policy.
robust analysis of these issues should be completed, before steps are taken that may compromise the ability for hydro-electricity to play its part.

The proposed treatment of hydro-electricity in the NPS FM does not objectively trade-off freshwater management outcomes against the contribution hydro-electricity generation makes to energy security, energy equity and CO₂ emission reductions.

There is no consideration of which hydro-electricity generators are in locations where there are freshwater quality concerns, nor of the connection between the operations of the generator and water quality outcomes. This means that we cannot know whether a given exception is the lowest cost way (in terms of accepting lower freshwater quality) of maximising the benefits of hydro-electricity generation infrastructure to the energy system and climate policy outcomes.

New Zealand is embarking on a pathway to zero CO₂ emissions by 2050 supported by legislation. Recent modelling shows that electrification of transport and industrial process heat forms a crucial role in the decarbonisation of the energy sector (New Zealand Productivity Commission, 2018) (Interim Climate Change Committee, 2019). It also shows electrification will be supported by expansion of renewable geothermal, solar and wind capacity. Geothermal is operated near-continuously at full capacity (baseload) so it doesn’t contribute to resource adequacy – the ability to store energy and shift it through time.¹ Wind and solar are not able to be stored in a meaningful (cost effective) way at present. Hydro capacity is not expected to be increased significantly so resource adequacy with greater demand and relatively more supply from non-storable renewables becomes more challenging. The impact of the NPS FM proposal will limit existing hydro-electricity generation capacity and flexibility thereby compromising the ability of hydro-electricity generation infrastructure to provide resource adequacy when it is needed more, not less, in the role of supporting a low emissions future. Given hydro’s role there needs to be caution in designing policy frameworks for one purpose that could work against those trends and the accompanying policy imperatives.

Transpower’s Te Mauri Hiko paper and the PCE’s Hydroelectricity or wild rivers? also highlight the regional benefits of hydro. By their very nature all hydro, including those that are not proposed to be included in the exceptions framework, may prove to be an important part of the energy transition in terms of risk management and resilience of distributed generation to local economies.

The detail and depth of analysis of the options proposed by MfE with respect to the impact on hydro-electricity generation as a result of the proposed reforms is not commensurate with the magnitude of the challenges in the electricity sector and the size of the potential impacts. This is directly counter to The Treasury’s guidance on RIA. There is no assessment or acknowledgment of the extent to which freshwater policy objectives and climate change objectives are in conflict – to what extent and where hydro-electricity generation infrastructure is contributing to freshwater quality problems and how potential national bottom lines will limit the operation of this infrastructure in dimensions relevant to energy security and therefore New Zealand’s ability to meet government’s climate change objectives. There is no evidence for the assumption that “balance” between the objectives is achieved by the differential treatment of the six largest hydro-electricity generation schemes.

¹ See Appendix A: Role and scale of hydro for a detailed explanation of resource adequacy and its importance.
The development of the options and the accompanying analysis should demonstrate that hydro-electricity’s full role has been assessed. The proposal advocates for alignment across Government initiatives and other NPSs and yet there is little analysis of the provisions of the NPS Renewable Electricity Generation and the Zero Carbon Bill compared with the NPS FM. Placing constraints on all or any existing hydro generation through the NPS FM will lead to:

- compromised security of supply by reducing the flexibility from hydro-electricity
- greater reliance on fossil fuels for system security than would otherwise be the case (flexibility in normal years and, additionally, hydro firming in dry years)
- less support for other renewables (e.g. wind and solar) especially in light the increased need for support from renewables with storage capability
- less progress towards reducing CO2 emissions
- a direct economic cost to consumers as a result of reducing generation output from the facilities and reducing their ability to be flexible when stored hydro-electricity should be available to meet demand

Our simplified analysis suggests that there could be a material impact on hydro-electricity generation outcomes from the freshwater policy proposal. The replacement form of generation for lost hydro-electricity capacity and flexibility to ensure energy security is assumed to be gas-fired generation, which is the alternative form of flexible peaking capacity. This means that limiting the operation of existing hydro-electricity generation schemes could have a material impact on emissions and New Zealand’s ability to meet its climate objectives. We have analysed the possible effects of adopting a Q5 7DLF minimum residual flow to meet water quality objectives across the hydro-electricity generation fleet. The magnitude of the impact on hydro-electricity generation associated with each scheme or station will depend on its individual characteristics. Diversion schemes (where residual flow is not diverted and therefore is lost to the scheme) are much more sensitive to the imposition of an increase in residual flows than in-river schemes.

Based on some simple assumptions about the average loss of energy from different types of schemes from increasing the minimum residual flow in this way to meet water quality objectives, we estimate that there could be an increase in emissions of 192kt CO2-e per annum associated with restrictions on non-excepted schemes. Because the NPS FM does not appear to provide exception from minimum flow requirements for the larger schemes, we estimated the emissions increase associated with a loss of 5% of winter energy from excepted schemes also. The total increase in emissions from the proposed NPS FM is an estimated 629kt CO2-e per annum. While our analysis was high level and based on extrapolated data this demonstrates that more careful analysis of the proposal is required. While the non-excepted schemes comprise 11% of capacity, imposing water flow changes has a disproportionate effect on their operations. More than 30% of the estimated impact on emissions is associated with smaller hydro-electricity generators. The results are shown in Table 1.

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4 Q5 7DLF is the average flow that occurs over the lowest seven consecutive days in a five year period. See Appendix B: Impact of changed water quality requirements on smaller hydro-electric generators (Lilley) for a discussion of this approach.
Our intention in doing this simple analysis is to illustrate the scale of the negative impact on emissions. We have also done this to demonstrate the sort of analysis we would expect to be carried out in a fulsome way for this proposal given the scale of the potential impact of it. The Haliburton analysis that is relied on by MfE does not achieve this and did not set out to assess issues presented the current proposal (Haliburton, 2015).

Any investment in new generation that is required to replace lost hydro capacity will come with costs that will be met by electricity consumers. While we have not estimated the scale of this increase in electricity costs, we note that it is converse to the outcome sought in the recent Electricity Price Review (EPR). The EPR sought to address the need identified by the Government for electricity prices to be fair and affordable (Electricity Price Review, 2019).

Table 1 The estimated increase in annual emissions associated with lower winter energy available from hydro electricity generation infrastructure

<table>
<thead>
<tr>
<th></th>
<th>All hydro</th>
<th>Non-expected hydro</th>
<th>Non-expected as percent of all hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>5,429 MW</td>
<td>577 MW</td>
<td>11%</td>
</tr>
<tr>
<td>Lost winter energy</td>
<td>930 GWh</td>
<td>284 GWh</td>
<td>31%</td>
</tr>
<tr>
<td>Increase in emissions</td>
<td>629 kt CO\textsubscript{2}-e</td>
<td>192 kt CO\textsubscript{2}-e</td>
<td>31%</td>
</tr>
</tbody>
</table>

In summary, the key shortcomings of the analysis in our opinion are:

1. **Inadequate definition of the problem the NPS FM is expected to solve.** The problem definition contained in the RIA is confused and inadequate for the analysis of its impact on hydro-electricity. It does not adequately explain the link between hydro-electricity generation and freshwater quality on the one hand and hydro-electricity generation and climate policy on the other.

2. **The rationale for the cut off point for the exceptions is incomplete.** No analysis is provided to support the differentiation between hydro schemes excepted and those not. Size of scheme is a poor proxy for hydro-electricity’s role in the energy sector or contribution to CO\textsubscript{2} emissions reductions. Our analysis suggests that in excess of 30% of the increase in emissions will come from the fuel source (gas) that is used to replace the lost generation from existing smaller generators that currently make up approximately 11% of capacity.

3. **Insufficient detail in the analysis of the proposal that is provided.** The analysis contains inconsistencies between the qualitative scores and the definitions of the criteria.

4. **Misplaced reliance on the Haliburton analysis.** The Haliburton analysis was prepared for a different purpose (to assess the impact on wholesale pricing in an era when fossil fuels could be relied on to backfill), using a different sample of schemes. It is outdated, is not comprehensive and does not reflect the move to a low emissions policy environment. Nor was it supported by the hydro sector at the time.

5. **Failure to fully recognise the role hydro-electricity plays in our electricity sector.** Hydro electricity is a key contributor to the three limbs of the trilemma facing government policy:
equity, security and environmental goals. Any move to undermine or constrain those roles should take those impacts into account fully but this key impact from constraining hydro is effectively ignored.

6. **Inadequate account taken of Government policies operating in parallel.** Government is pursuing decarbonisation of the economy through the NPS REG and Zero Carbon Bill. This will lead to greater electrification, higher electricity demand, less support for system security and, therefore greater reliance on hydroelectricity. This should be fully factored into the analysis of the proposed NPS FM.

7. **Limiting water use for electricity generation increases CO₂ emissions.** Our analysis shows an estimated total increase in emissions associated with limiting the operation of existing hydro-electricity generation infrastructure based on the NPS FM of 629 kt CO₂-e each year. This illustrates the scale of the negative impact.

8. **Restricting the operation of existing electricity infrastructure will increase electricity costs to consumers.** The costs associated with changing the operation of existing hydro-electricity generation and investing in replacement generation infrastructure will ultimately be borne by consumers. The analysis does not inquire into this aspect of the proposal despite the recent focus of the Government’s EPR on ensuring fair and affordable electricity prices.

9. **Departure from the ICCC recommendation.** The increasingly important role of hydroelectricity in the New Zealand energy system was explicitly identified in the interim Climate Change Committee’s Recommendation 4 in relation to the Zero Carbon Bill. The Committee recommends that the Government ensures the value of existing hydro generation to New Zealand’s climate change objectives is given sufficient weight when decisions about freshwater are made.

Given the potential effects of the proposal we would like to see:

- A clear problem definition that explains and assesses the conflict between freshwater on the one hand and hydro electricity’s role in system security and climate objectives on the other.
- Analysis commensurate with the size of the potential impacts constraining hydro generation would have on the contribution of hydro-electricity generation to all Government policies especially considering the expected increase in electricity demand that will result from New Zealand climate change policy.
Introduction

The government recently released a discussion document and draft NPS FM that propose a suite of policy changes intended to stop further degradation of New Zealand’s freshwater resources and reverse past damage to those resources, waterways and ecosystems (Ministry for the Environment, 2019c). We have been asked to provide an opinion on the quality of the regulatory impact analysis (RIA) in the Essential Freshwater Policy Package. (Ministry for the Environment, 2019c) In particular, we have reviewed the analysis in Appendix 10: providing for hydro-electricity generation infrastructure. (Ministry for the Environment, 2019d)

In our report, we describe what high quality regulatory impact analysis looks like and the additions and amendments we recommend the Ministry for the Environment (MfE) makes prior to the analysis being finalised.

While we acknowledge that the RIA is an interim analysis and the consultation is intended to inform more detailed analysis, in our opinion the analysis is not of sufficient depth and detail to allow the public or hydro operators to understand the potential impacts, nor is it satisfactory given the magnitude of the problem and potential impacts of the policies proposed.

In particular, we rely on hydro-electricity to fulfil some crucial roles in our energy sector and our ambitions for reducing CO2 emissions in response to the challenge of global warming. Our reliance on hydro-electricity for those roles will increase significantly. We address the shortcomings in the analysis accompanying the proposal, we expand on hydro-electricity’s key roles and explain how those roles will become more important going forward.
The proposal lacks balance

Climate change policy and technological change will increase demand for electricity in New Zealand. Hydro-electricity generation plays a key role in our future electricity system by providing flexibility to meet peak demand requirements and contributing significantly to the overall volume of generation. The policy proposal would establish national bottom lines in certain attributes or dimensions of freshwater quality. These national bottom lines would be achieved by regional councils making changes to the use of water resources in some catchments (or freshwater management units, FMUs). These changes may include changes to the operation of existing hydro-electricity generation infrastructure.

The changes will inevitably affect the contribution of hydro-electricity generation to energy security, and therefore New Zealand’s ability to meet the government’s climate objectives. The Government has several clear policies that rely on, or impact on, all the national hydro-electricity output especially the ability to store energy and use it when electricity demand requires it to be used. None of these policies, including this proposed NPS FM can be considered without taking all policies into account with the same level of analysis and some balance between the policy goals.

In this section, we discuss the so-called Energy Trilemma and the importance of hydro-electricity generation in New Zealand to our success in managing it.

WEC Energy Trilemma

Throughout the world, energy supply and demand are undergoing an unprecedented energy transition, from a system based on carbon-intensive fossil fuels to a system based on low carbon, renewable energy. This transition is driven by the twin imperatives of mitigating climate change and generating economic prosperity. The World Energy Council (WEC) recognises the value of adopting a whole energy systems approach in providing the benefits of sustainable energy to all. This energy transition is a connected policy challenge – success involves managing the three core dimensions; Energy Security, Energy Equity and the Environmental Sustainability of Energy Systems throughout the transition process.

WEC’s World Energy Trilemma Index, provides an objective rating of national energy system performance across these three Trilemma dimensions. WEC has created the Trilemma Index to support an informed dialogue about improving energy policy to achieve energy sustainability, by providing decision-makers with information on countries’ relative performance.

New Zealand currently ranks 10th out of 128 countries and is the only country outside Europe in the top 10. It achieves this grade by virtue of its balance in the three limbs. Each is served by New Zealand’s hydro-electric generation. New Zealand Ministers for Energy and Resources and Climate Change often mention what a huge contribution hydro-electricity makes to our Energy Trilemma generally and climate change efforts specifically.
In the context of the Trilemma, the Environmental Sustainability limb represents the transition of a country’s energy system towards avoiding and mitigating potential environmental harm and climate change impacts.

New Zealand is very aware of and proud of the contribution hydro-electricity makes to our emissions profile, energy security and energy equity policy objectives. The proposal regarding freshwater quality focuses on the physical environment as distinct from our CO$_2$ emissions profile in the Environmental sustainability limb of the Trilemma.

We also note that electrification of many activities, especially transport and industrial process heat will contribute to New Zealand’s emissions reductions aspirations through to 2050 but that will require more generation capacity. At the same time fossil fuel generation which is relied on for energy security is required to decline to meet climate objectives. A great deal of the renewable electricity generation that will replace fossil fuel and augment our electricity supply is expected to come from wind and solar power. Wind and sun cannot be stored so the combination of less fossil fuel and more of these intermittent types of generation will make hydro-electricity’s storage component more critical than under current circumstances in order to meet peaks in demand. In addition to wind, solar generation, some of the increased renewable electricity supply will come from geothermal, but this is operated as base load plant and provides no flexibility at all.

The likely contribution from wind in the electrification of the economy and expansion of generation sources is illustrated in the chart below. This is taken from the report, ‘Low emissions economy’ (New Zealand Productivity Commission, 2018). It shows that in each of six modelled scenarios (BEC 2050, Vivid and MBIE) geothermal and wind power play a significant role.
These forecasts illustrate that the increase in demand from electrification of transport and industrial heat combined with removal of fossil fuel powered generation will lead to hydro-electricity becoming more important for ensuring energy security and energy equity as New Zealand pursues its CO₂ emissions goals.

The increasingly important role of hydroelectricity in the New Zealand energy system was explicitly identified in the interim Climate Change Committee’s Recommendation 4 in relation to the Climate Change Response (Zero Carbon) Amendment Bill (Interim Climate Change Committee, 2019):

The Committee recommends that the Government ensures the value of existing hydro generation to New Zealand’s climate change objectives is given sufficient weight when decisions about freshwater are made, including by:


  b. Working collaboratively with iwi/Māori to co-design solutions so that rights and interests in freshwater are resolved within the context of the Māori-Crown partnership.

Any policy measures, such as proposed in the freshwater management proposal, that constrains hydro-electricity’s flexibility or volume, (where is not excepted from the NPS FM) or through the workings of the regional councils will make it much harder for New Zealand to meet its Energy Trilemma policy objectives in relation to emissions reductions, energy security and energy equity. This would be a glaring example of a lack of joined up thinking and shortcomings in the analysis relating to those other policy objectives.
Shortcomings with the evaluation

We have reviewed the regulatory impact analysis (RIA) in the Essential Freshwater Policy Package. (Ministry for the Environment, 2019c) In particular, we have reviewed the analysis in Appendix 10: providing for hydro-electricity generation infrastructure. (Ministry for the Environment, 2019d). we find that there are some short comings in the approach the Ministry for the Environment (MFE) has taken.

Best practice impact analysis

Good Impact Analysis is essentially just robust policy development within a transparent framework. (The Treasury, 2017, p. 3)

The New Zealand Treasury provides guidance on the approach Government agencies such as MFE should take when analysing policy options such as the proposals set out in the Action for healthy waters to stop further degradation and reverse past damage of freshwater resources, waterways and ecosystems.

Treasury set out the elements of the regulatory impact analysis framework and we consider the proposal and accompanying analysis against each of these in more detail in this section:

- Describe the status quo or counterfactual
- Define the problem and assess its magnitude
- Define the objectives
- Identify the full range of feasible options
- Analyse the options
- Consult
- Recommendations

Describe the status quo or counterfactual

The status quo appears to be mis-specified in Action for healthy waters. It is described as ‘no infrastructure is listed in Appendix 3’ (referred to as “providing exceptions” in Subpart 4 of the draft proposed NPS FM), but does not acknowledge the full implications of doing so. The analysis in the RIA still refers to the mechanism of including the excepted schemes in Appendix 3 (which has been replaced by the Subpart 4 exception for large hydro schemes). Were that the case under the status quo, the transitional exceptions in Policy CA4 would be available to councils with existing hydro-electricity generation infrastructure. This would mean that Option C is really the status quo.

It is somewhat unhelpful that the RIA and the NPS FM are not consistent. However it would appear that Policy CA4 has been replaced by the transitional exception in section 3.24 of Subpart 4. In this case, Councils are still able to make a case-by-case assessment of setting a standard below a national bottom line in a waterway because of the impact of existing infrastructure. These exceptions are transitional in the sense that individually they have a limited duration, but there does not appear to be a limit on the timeframe over which the policy is available.
The status quo should also describe relevant decisions that have already been taken. In this instance the government has made a range of decisions in relation to renewable electricity generation (NPS-REG) and climate policy (Zero carbon Bill) that are relevant to the analysis. These policies should be described and the potential conflict with the counterfactual highlighted.

**Define the problem and assess its magnitude**

The problem with the status quo mechanism assessed in the RIA in the discussion document relates to a lack of certainty and high transaction costs\(^5\) giving rise to a risk of unintended consequences. Those unintended consequences would be that existing hydro-electricity generation infrastructure is limited in its operation resulting in an inability to contribute to legislated climate change goals and reduced energy security.

The magnitude of the problem is dependent on two key factors

- The extent to which existing hydro-electricity generation infrastructure reduces freshwater quality in the dimensions targeted by the NPS FM.
- The extent to which the constraints likely to be imposed on existing infrastructure as a result of the NPS FM will reduce the volume and flexibility of hydro-electricity generation.

There is no attempt in the analysis to assess the magnitude of the existing problem beyond a comment that the impact of a loss of flexibility is “far less pronounced” than an absolute loss of hydro-electricity generation output. (Ministry for the Environment, 2019d, p. 211) This comment is based on analysis undertaken in 2015 for the MfE. (Haliburton, 2015)

The Haliburton analysis was prepared for a different purpose (related to water allocation not quality), is outdated, is not comprehensive and does not reflect the move to a low emissions policy environment.

The Haliburton report sampled only a few schemes and considered the impact of changed water allocation on wholesale prices which doesn’t address the contribution hydro makes to energy security, climate change goals and energy equity. It assumes that gas and diesel generation is available as peaking capacity, both in plant that was available at the time but has now been decommissioned and the assumed generation build. This assumed generation mix naturally results in the conclusion of the report that absolute volumes of hydro generation are important, but timing is not. This conclusion suggests that size of generator is a key indicator of the expected benefit in terms of climate change goals which misses the point.

An electricity system that has no thermal peaking in a normal year will rely on hydro storage (i.e. flexibility) to provide peaking capacity which cannot be provided by other renewables (such as intermittent wind, solar or base-load geothermal). This means that while size of generator is

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\(^5\) The term transaction costs in economics means the costs associated with exchange of goods or services and costs incurred in overcoming market imperfections. In the scenario assessed in the RIA these are the costs for non-excepted hydro generators associated with negotiating concessions with the council.
important, hydro’s storage capacity and flexibility (ability to contribute during periods of peak demand) should be a critical part of assessing the magnitude of the problem associated with relying on Policy CA4 (or the exceptions framework) under the current NPS FM.

In a dry year, all volumes will be important to achieve a reliable electricity supply. This means that while large generation systems are valuable by virtue of their size, smaller systems with flexibility also have value.

It is not clear to what extent the six largest hydro-electricity generation schemes in the excepted category represent a risk to freshwater quality or more importantly the greatest benefit to climate change policy or other Government policy objectives in terms of maintaining their existing operations. For example, the seventh largest (and other) hydro-electricity scheme is not identified, nor is the rationale for its exclusion. We understand the seventh largest is the Rangitaiki scheme, with output not dissimilar to Waikaremoana which is included in the six schemes excepted. The break point does not necessarily relate to storage capability either given the low managed storage capacity of the Clutha scheme.

The Haliburton report does not look beyond the Waitaki, Clutha, Tongariro, Waikato and Waikaremoana schemes, so even if it were not outdated in terms of the policy and generation environment, it can give no guidance on the importance of any other schemes or generation stations. The scenarios modelled did not reflect policy intentions at the time (or now). (Haliburton, 2015, p. iii)

Define the objectives

A well-formed RIA includes a statement of the objectives of the reform so it is clear what the analysis is testing. The analysis accompanying the proposal defines the objectives in at least two ways. First:

- The desired outcome is that regional councils are able to secure the benefits derived from existing infrastructure (including but not confined to hydro-electricity) and can balance national and regional benefits while working towards achieving environmental outcomes over time.

- The primary benefits derived from hydro-electricity generation infrastructure are security of New Zealand’s electricity supply, and renewable energy generation. (Ministry for the Environment, 2019d, p. 209)

And (under the heading “options objectives”):

- Ensure that ambiguity is resolved. Strike an appropriate and sustainable balance between the competing interests of New Zealand’s climate change obligations and the maintenance and improvement of freshwater quality and ecosystem health around New Zealand. (Ministry for the Environment, 2019d, p. 209)

These objectives are different, a point that is important when assessing the options. The first prioritises the benefits of existing infrastructure, while the second calls for a “balance”.
If the second “balanced” objective is adopted, then it is not established in the analysis whether these objectives are in fact competing, or where or to what extent. While we recognise that it would be beyond the resources available to a regulatory impact analysis to assess this at an individual catchment or freshwater management unit (FMU) level there is limited high level description. For example:

- How many catchments or FMUs that have hydro generation are below the national bottom line?
- What are the features of hydro generation that are most likely to affect freshwater quality and ecosystem health? What hydro generators have those features?
- In a low emissions environment (and given relevant climate policy), what is the role of hydro generation in the electricity system?
- How does this role conflict (or not) with freshwater quality and ecosystem health? (What features of hydro generation are important to climate policy and to what extent are these the same as the features that impact on freshwater quality and ecosystem health) To what extent will restricting hydro therefore improve freshwater quality and limit the ability to meet climate change objectives?
- How will New Zealanders know that an appropriate and sustainable balance between the objectives has been achieved? There is no description of the current status, no clear weighting of the objectives, nor of how the trade-offs will be assessed.

**Identify the full range of feasible options**

Two options are identified (based on our assessment that the third option, C is actually the counterfactual or status quo):*

- B1: Include the six largest hydro-electricity schemes by generating capacity in Appendix 3
- B2: Include all hydro-electricity generation infrastructure in Appendix 3

Clearly this is not the full range of options. Setting aside our questions about whether generating capacity is the only relevant criterion, there is no explanation of why the appropriate number of schemes is six.

For example, an additional option could have been included in the analysis that expressly recognises the role hydro has to play in providing a secure electricity system and in supporting the climate change agenda.

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*Reference to inclusion in Appendix 3 of the current NPS FM is the equivalent to the exception proposed in the draft proposed NPS FM but the Appendix 3 language is used in the discussion document and accompanying Interim Regulatory Impact Analysis*
Analyse the options

We acknowledge that this is an interim analysis however the detail and depth of analysis of the options is clearly not commensurate with the magnitude of the problem and size of the potential impacts. (The Treasury, 2017, p. 11)

The criteria used are consistent across all twenty policies assessed. There is nothing inherently wrong with that, but we note that the way that the criteria are defined and the way that they are applied or assessed are not always consistent. For example the ‘fairness’ criterion refers to equitable treatment of stakeholders and option B1, which explicitly treats some stakeholders more favourably than others, is assessed as neutral against this criterion.

**Fairness**: The option treats all stakeholders (rural, urban, future and current generations) equitably. The costs fall on those that contribute to the problem and not other parties (i.e., on central or local government) (Ministry for the Environment, 2019d, p. 4)

**Option B1: Fairness 0** Meets both climate and water objectives, though provides unequal treatment of generators. (Ministry for the Environment, 2019d, p. 213)

It is also our view that the application of the criteria between the options is not objective. For example, “effectiveness” is defined as “The option provides a solution to the problem. The problem has been completely addressed.” (Ministry for the Environment, 2019d, p. 4) The problem relates to loss of hydro-electricity generation capacity and flexibility and therefore impact on climate policy objectives due to mandatory freshwater national bottom lines. If the objective is to maintain the benefits from existing infrastructure then option B2 which encompasses all such infrastructure is likely to be more effective. If the objective is a balance between freshwater objectives and the benefits of existing hydro-electricity generation infrastructure (to climate change objectives), then more analysis of the trade-offs and weights applied to the two objectives is required to determine where an appropriate balance lies.
Key impact of constraining hydro ignored

The NPS FM and hydro generation loss

There are a number of attributes of a hydro scheme that determine the volume and timing of generation availability. These attributes can be either physical (naturally occurring or constructed as part of the station or system) or imposed by regulation (such as consents). These include:

- Natural inflows
- Diverted flows into a station
- Storage capacity
- Residual flows, which may go through a station or around it depending on the design of the system
- Flood management
- Discharge constraints, the amount of water that must be discharged from a station
- Ramping rates, which relate to the rate of change of water flows
- Peaking limits, the number of times a day (or other period) the inflow to the station can rise and fall
- Flushing flows and other requirements around managing sediment
- Recreational releases

Flows may be restricted to manage the environment (for example enabling fish passage) or to enable other users' needs. Restrictions on flows can indirectly limit the volume of generation by changing the operating efficiency of the turbines and increase wear on the turbines. Restrictions on flows and ramp rates can have a material effect on energy security and the cost of electricity. In Appendix A, we provide an explanation of the role hydro plays in energy security.

The implementation of the NPS FM could result in changes in the volume and timing of generation available from hydro schemes. For those schemes that are included in Appendix 3 (or the exceptions framework) the relevant consenting authority can explicitly make trade-offs between generation availability and the impact on freshwater outcomes consistent with the NPS FM. No such trade-offs are available for those excluded from Appendix 3.

The nature of hydro-electricity is that it has a role in New Zealand’s regional economic development because of its location. This will be pronounced as the energy transformation unfolds. We expect to see a more decentralised energy system and regional hydro schemes (plus potential augmentation) will have an important role to provide local peaking support and reduce pressure on new transmission.

Alterating water use for electricity generation increases emissions

The analysis in this section illustrates that there is a non-zero, and potentially material, impact on emissions associated with limiting the operation of existing hydro-electricity generation. It also
demonstrates that capacity is not a complete measure of the role of hydro-electricity generation in the electricity system or of its contribution to reducing emissions. As such, capacity is a poor criterion for selecting which generators to except from the NPS FM.

We estimate the increase in annual emissions associated with limiting water use for hydro-electricity generation in order to meet freshwater objectives to be 629 kt CO$_2$e. This represents an increase in emissions from public electricity and heat production of 1.9% compared to 2017 emissions and is equivalent to an increase in total net emissions of 1.1% compared to 2017. Of this increase in emissions, around 30% arises from changes in the operation of non-excepted hydro-electricity generators.

While the analysis is based on some simplifications, it demonstrates that there is significant value in undertaking additional analysis, preferably at scheme or FMU level, to determine the impact of the NPS FM on hydro-electricity generators, energy security and therefore emissions.

**Approach to the analysis**

Our analysis is based on estimating the impact on winter energy security of limiting existing hydro-electricity generation to meet water quality objectives, and assuming that the shortfall will be met by gas-fired generation.

The proposed NPS FM Subpart 4 provides for exceptions from the provisions of the NPS FM for the six largest schemes by capacity. The effect of this is that regional councils would be able to choose to phase in progress on the targeted attribute states without formal exceptions (i.e. they would be able to choose to set very long-term attribute states). This may reduce the initial impact of the NPS FM on these schemes. Other hydro-electricity generation infrastructure that is not excepted from the NPS FM may be affected immediately.

On the basis that the NPS FM provisions may affect all hydro-electricity generation, albeit on different timeframes, we have included both the excepted and non-excepted infrastructure in our analysis. Our analysis is intended to highlight the scale of the increase in emissions associated with altering water use for existing hydro-electricity generation infrastructure. It is also intended to demonstrate the sort of analysis we expect in the regulatory impact analysis.

We acknowledge that not all hydro-electricity generation infrastructure is in an FMU where existing water quality is below the national bottom line for an attribute or attributes. However this information is not provided by the MfE analysis and we have not been able to explicitly assess it. Also, not all existing hydro-electricity generation infrastructure contributes to freshwater quality degradation. Again, the extent of this contribution is not assessed by MfE. As a result of this absence of information, we have applied our mid-point estimates to all existing infrastructure. We acknowledge that this is a simplification and recommend MfE undertake the analysis to identify these differences.
Winter Energy Margin benchmark

Transpower completes an annual assessment of electricity security of supply (Transpower, 2019). Transpower provides several indicators for security of supply in the medium term (ten years). The Winter Energy Margin (WEM) indicates the extent to which there is likely to be sufficient generation to meet winter energy demand. It is calculated as the sum of expected winter energy supply in gigawatt-hours (GWh) divided by the expected winter energy demand, expressed as a percentage. The higher the WEM the less likely that there will be an electricity shortage. The security of supply standard states that the WEM for New Zealand should be 14% to 16%, that is that available generation should exceed expected demand by a margin of 14% to 16%. If the WEM is below this level, the implication is that new investment in generation would efficiently increase reliability. A separate WEM is calculated for the South Island to recognise the reliance on the HVDC link during winter.

In their most recent assessment, Transpower notes that to meet security standards for the NZ WEM for 2025, assuming a medium rate of demand growth, new winter generation of 400-500GWh is needed (Transpower, 2019, p. 11). An additional 1,200-1,300GWh is required by 2028.

Reduction in hydro’s contribution to the WEM

Hydro-electricity generation makes a vital contribution to the supply of electricity in winter. The contribution of each scheme or station depends on the characteristics of the individual scheme or station. The impact of the NPS FM will also vary between generators. Based on the expert advice of Peter Lilley about the likely impact of changes to residual flow releases on hydro schemes with different characteristics, we consider the range of lost winter energy supply from hydro may lie between 0% and 50% depending on the scheme and the application of the NPS FM. As noted in Peter Lilley’s report, this impact is based on adopting Q5 7DLF as a default residual flow release requirement to meet water quality thresholds. There may be additional requirements specific to individual schemes; these are not quantified.

In its assessment, Transpower sets out the individual contribution of larger assets to the WEM, we understand that smaller assets are also included, though some are reflected in (net) expected demand. We have assumed that, relative to their capacity, hydro assets that are not listed individually contribute to the WEM in the same proportion as the assets that are listed.

We obtained data on the capacity of hydro assets that are not specifically listed by Transpower from Trustpower and the Independent Electricity Generators Association. We have included 114.25MW of other non-excepted hydro generation, which we have assumed currently supplies 238GWh of winter energy.

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7 The Winter Energy Margin (WEM) is a security measure established by Transpower in its role of System operator and the margin to be deployed is formalised in the Electricity Industry Code by the Electricity Authority. It is discussed further in Appendix A.

8 See Appendix B: Impact of changed water quality requirements on smaller hydro-electric generators (Lilley).

9 Q5 7DLF is the average flow that occurs over the lowest seven consecutive days in a five year period.
Gas-fired thermal generation is the alternative

We have assumed that winter energy availability lost from hydro-electricity generation would be made up by new gas-fired thermal generation because that is the alternative form of generation that would support the resource adequacy requirement of maintaining a secure system at all times. The emissions factor for new gas generation depends on a variety of factors: we have conservatively adopted an assumption of 400 t CO$_2$-e per GWh.$^{10}$

Scheme characteristics are important

Hydro-electricity generation can be described as either in-river, where there is a dam and generation in a river, or diversion, where some river flow is diverted away from the river to a remote station. Approximately 60% of the annual average generation output of the non-excepted hydro-electricity generation is from diversion schemes. Diversion schemes are relatively more sensitive to changes in residual flow requirements, since the residual flow cannot be diverted and is therefore lost to the scheme. Diversion intakes are typically constrained in terms of capacity which means that they are not able to access higher flows. If minimum flows were increased to Q5 7DLF to meet water quality objectives then a diversion scheme could face a reduction in annual average generation of 25% to 50%. By comparison, an in-river scheme is likely to experience a less severe impact, albeit with some reductions in efficiency and a loss of flexibility. We have assumed a typical loss of 0% to 10% for in-river schemes.

Based on the relative output from these types of schemes we have estimated a mid-point impact on non-excepted hydro-electricity generators of 25% of annual generation.$^{11}$ We have assumed that the contribution of these hydro-electricity generators to the WEM would also reduce by 25%.

Based on the estimated capacity of gas-fired generation required to replace this winter energy availability (69MW) and the associated annual generation of a gas-fired generator of that size, we have estimated a total increase in emissions of 192,157 t CO$_2$-e associated with the loss of winter energy from non-excepted hydro-electricity generation.

The exclusion of the larger capacity generators means that they may initially experience less impact if the relevant regional council chooses to set very long-term goals for attribute states. Nonetheless, they may still be affected albeit possibly on a different timeframe. We expect the average effect on these larger schemes to be proportionately less than the average smaller generator. To demonstrate, we have adopted the mid-point for in-river schemes of an estimated loss of 5% of winter energy as typical of these larger schemes. Combining this estimate with our earlier results, we estimate that the total impact on emissions from limiting the operation of hydro-electricity generators would be

$^{10}$ This is based on an assessment of the heat rate of existing gas generators (Parsons Brinckerhoff, 2012) which implies an emissions factor of between 385 t CO$_2$-e per GWh (TCC and E3P) and 567 t CO$_2$-e per GWh (Huntly gas). While the level of emissions determined by assuming 400 t CO$_2$-e per GWh may therefore be somewhat conservative, the relative proportions associated with generation losses would not change with a different assumption.

$^{11}$ This figure is derived from the information in Appendix B: Impact of changed water quality requirements on smaller hydro-electric generators (Lilley).
approximately 629 kt CO$_2$-e. In excess of 30% of this increase is associated with the impact of the NPS FM on smaller non-excepted generators.

These results are shown in Table 2.

Table 2 The estimated increase in emissions associated with lower winter energy available from hydro-electricity generation

<table>
<thead>
<tr>
<th></th>
<th>All hydro</th>
<th>Non-excepted hydro</th>
<th>Non-excepted as percent of all hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>5,429 MW</td>
<td>577 MW</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Lost winter energy</strong></td>
<td>930 GWh</td>
<td>284 GWh</td>
<td>31%</td>
</tr>
<tr>
<td><strong>Increase in emissions</strong></td>
<td>629 kt CO$_2$-e</td>
<td>192 kt CO$_2$-e</td>
<td>31%</td>
</tr>
<tr>
<td><strong>Increase in emissions from public electricity and heat production, 2017</strong></td>
<td>1.9%</td>
<td>0.6%</td>
<td></td>
</tr>
</tbody>
</table>

The impact of lost winter energy generation from existing hydro-electricity generation infrastructure is equivalent to an increase in total net emissions for New Zealand of approximately 1.1% compared to 2017 (Ministry for the Environment, 2019a).

Any costs associated with changing the operation of existing hydro-electricity generation and investment in new generation capacity will ultimately be borne by consumers. While we have not quantified this aspect of the proposal, we note that it would be converse to the outcome sought by the Government for electricity prices to be fair and affordable in the recent Electricity Price Review.

The regulatory analysis should address the potential conflict with this policy objective.


Appendix A: Role and scale of hydro

NZ has 5000 MW of hydroelectric capacity. Under the current collection of consents that are in force hydro meets:

- 73% of April - Sept energy demand
- 59% of annual national energy demand (5-year average)
- 71% of annual renewable generation used to meet energy demand (5-year average)

Hydro has an essential role delivering energy security, environmental sustainability (especially New Zealand’s contribution to reducing global CO₂ emissions) and energy equity as a low short-run marginal cost (SRMC) provider of electricity.

The transformation of the economy through a focus on climate change and the transformation now underway in the electricity sector will lead to greater complexity. In the process of pursuing changes to water governance that impact on hydroelectricity care should be taken:

a) Need caution in designing policy frameworks that could counter or hinder attainment of an already uncertain path. Change initiatives should be approached with rigorous cost-benefit tests, and consider in detail the consequential effects on other sectors, i.e. hydro.

b) Flexibility is important for supporting a transition to variable sources (wind & solar). We are going to need more flexibility not less.

Figure 3 shows installed hydroelectricity generation stations larger than 5 MW. The cut-off for generation that is not excepted in the preferred option B1 is the Waikaremoana scheme (138MW). The map illustrates that the generation on the Rangitaiki is of a similar capacity (121MW). The reason for the distinction is opaque. The Waikaremoana hydro-electric power development in northern Hawke’s Bay consists of three power stations fed from the Lake Waikaremoana. The Tuai, Piripaua and Kaitawa power stations were completed between 1929 and 1948. Schemes on the Rangitaiki River consist of the Matahina Power Scheme (1967), Wheao (1982) and Flaxy (1982). All six power stations on the Rangitaiki River and below Lake Waikaremoana contribute to the benefits New Zealand enjoys from its hydro assets especially given these two schemes are in the North Island.

This illustrates the arbitrary nature of what is proposed to excepted from the NPS FM and the absence of an assessment of the relative impacts on freshwater quality and climate policy of the difference in treatment.

The following sections on Resource Adequacy, Winter Capacity Margin and Energy Adequacy and the Winter Energy Margin are extracts from ‘Transitioning to zero net emissions by 2050: moving to a very low-emissions electricity system in New Zealand’ (Sapere Research Group, 2018).
Figure 3 Installed hydroelectricity generation. Each dot represents a power station larger than 5 MW

Source (Parliamentary Commissioner for the Environment, 2012)
Resource adequacy

In New Zealand and, in the context of the Energy Trilemma it is common to talk about security of supply. However, the true issue for New Zealand is better described as resource adequacy. Resource adequacy has two broad dimensions:

- meeting the highest instantaneous demand from the system (capacity adequacy)
- the ability to meet demand over a period of time (energy adequacy). Energy adequacy is commonly thought of as dry year risk but very much includes flexibility to meet demand at all times and in all conditions.

Due to the intermittency of renewable fuels, both dimensions must consider scenarios not only of high demand but also low levels of hydro, wind and solar. It also must consider the sufficiency of underlying thermal fuel arrangements. This raises several points that we take into account in reaching our conclusions:

1. Energy adequacy requires flexibility from the system as from one time period to the next, generation from intermittent fuels and demand is changing. This manifests in the short term from wind and solar, but also in the medium term as a result of the pattern of inflows over the year being uncertain, variable, and, on average, anti-correlated with demand. Due to the dominance of hydro, New Zealand is particularly affected by significant variations in inflows caused by changes in the weather.

2. The flexibility of plant output has historically been underpinned by flexibility in underlying fuel contracts, as well as the ability to store fuel in the form of gas reservoirs, coal stockpiles and hydro reservoirs. Resource adequacy is the collective impact of the constraints on those contracts and storage facilities.

3. Looking out to 2050 we expect batteries and demand response will play a significant role in providing this flexibility. However, both these are ‘energy limited’ in the sense that they are likely to only provide a short-term response, rather than the medium-term requirement arising from the confluence of seasonal demand and inflows.

4. Irrespective of the degree to which emissions are reduced through investment in renewables, a minimum level of flexibility must be retained to manage energy adequacy. The periodicity and uncertainty in this flexibility service drives the economics of investment in flexibility providers. Plant retained purely to manage extreme hydro shortfalls may only operate very infrequently and require underlying fuel contracts or storage facilities that are commercially challenging.

The time dimension is an important aspect of resource adequacy. The energy supply a plant may be able to achieve in any given half hour is different to what it could provide over a prolonged period. For intermittent fuels, such as wind, their contribution to energy adequacy is much higher than for capacity adequacy. Over time, wind is relatively dependable and gas plants are assumed to be able to run at near capacity (should they be required), even though in “normal” hydrological years, this would not be the case.

We note that solar without accompanying battery storage does not provide any capacity adequacy (insofar as New Zealand remains a winter peaking system) due to peak demand in New Zealand.
occuring during winter nights. In fact, if the large installed capacity of solar on the system is not paired with battery storage that reinforces the need for flexible, responsive capacity in the system, as the hour-to-hour swings in solar output at this level of penetration would be significant.

Further, average national hydro inflows and solar production are highly correlated with each other and both are actually not well correlated with the pattern of demand over the year. The correlation between national inflows and demand is shown in Figure 4.

**Figure 4 Average National Inflows vs National Electricity Demand.**

![Graph showing average national inflows vs national electricity demand](image)

**Source:** EMI, Sapere Analysis

Individual inflow years are unlikely to reflect the pattern of “average” inflows and can be quite volatile from month to month and season to season. But hydro owners will make decisions with this general trend in mind. The way the supply side of the market collectively manage this is a combination of:

a) Using hydro reservoirs to “shift” some of the summer inflows to winter.

b) Relying on discretionary (thermal) plant, which may not be used much in summer, to supplement supply in winter (sometimes referred to as hydro firming).

Figure 4 suggests that a reservoir storage capacity of approximately 2,000GWh would be sufficient to manage this issue today in an average hydrological year, i.e. to provide a profile of hydro generation which matched the profile of demand. Since New Zealand has a national storage capacity of approximately 4,000GWh, this appears to be feasible within current storage constraints.

However, reservoir management is substantially more complex than indicated by this analysis. Firstly, as demand grows through to 2050, the absolute level of shifting required to be done by hydro storage – even in an average generation year, let alone a dry year – increases commensurately. As time progresses, the 4,000GWh of storage capacity may become less effective at managing the annual demand profile, unless the growth in generation comes from flexible sources (e.g., thermal).

Secondly, inflow patterns invariably never match the average (orange) line in the figure above, and, thirdly, reservoir managers do not know the future; hence their storage behaviour prior to winter will be based on a risk-adjusted expectation of the future.
The balance between (a) and (b) - ultimately coordinated through the wholesale price\(^{12}\) - is (partly) reflective of hydro owner’s storage at any point in time, and their expectations about the near future,\(^{13}\) particularly with respect to inflows.

**Winter Capacity Margin**

Under the Security of Supply Forecasting and Information Policy (SOSFIP), the System Operator publishes annually a “Winter Capacity Margin” forecast for 10 years into the future, across a range of scenarios.

**Figure 5 Contribution to capacity margins by fuel source**

Source: Sapere based on Transpower (2017) data

The dominance of hydro in the capacity margin calculation is obvious, although, while highly flexible, it is insufficient by itself to meet peak demand requirements and must be supplemented with thermal and geothermal generation. But the presence of significant hydro is one of the reasons why, in recent history, the capacity dimension of resource adequacy has been well served in New Zealand.

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\(^{12}\) We note that the market has done this coordination successfully, through some very dry sequences, since the market reforms introduced in 2009.

\(^{13}\) These expectations are communicated to the market through the hydro owner’s “water value”, implicitly embedded in their market offer each half hour.
Energy Adequacy and the Winter Energy Margin

The importance of maintaining sufficient flexible generation to reliably respond to different medium-term hydrological outcomes is embodied in the "Winter Energy Margin". The WEM is a planning standard, as distinct from the hydro risk curves\textsuperscript{14} (or its predecessor the "minzone") which are aimed at monitoring current storage levels and the near-term risk that this implies for the system.

The WEM is effectively the same as the WCM, except that it is defined by an energy requirement for a specific period (a 6 month period from 1st April through 30th September). Hydro contribution to WEM is determined by mean inflows and expected storage as at 1st April\textsuperscript{15}, while for other fuels, it is a measure of the dependable energy they can contribute over this 6 month period (Figure 6).

However, we note that the WEM standard presumes that owners of thermal plant have sufficient fuel available to allow them to generate at the “dependable” level presumed by the WEM calculation, as detailed below. In reality, the dependability of this generation level is highly dependent on the underlying fuel situation, whether it be a coal stockpile,

**Figure 6 - WEM Calculations by fuel type, 2017**

The time dimension is an important aspect of the WEM. The energy supply a plant may be able to achieve in any given half hour is different to what it could provide over a prolonged period. For intermittent fuels, such as wind, their contribution to WEM (on a load factor basis) is much higher than for the WCM. Over time, wind is relatively dependable (Figure 7) and gas plants are assumed to be able to run at near capacity (should they be required), despite the fact that in “normal” hydrological years, this would not be the case.

\textsuperscript{14} Hydro risk curves describe the probability of emptying hydro reservoirs for a given storage level at any point in time. See [https://www.transpower.co.nz/system-operator/security-supply/hydro-risk-curves](https://www.transpower.co.nz/system-operator/security-supply/hydro-risk-curves)

The WEM itself is expressed as a percentage of surplus dependable generation over forecast demand for the 6 month period (rather than an absolute GWh amount). It is defined separately for the South Island (reflecting the importance of South Island storage) as well as for New Zealand as a whole. The Electricity Authority’s most recent amendments to the standard states that a national WEM of between 14%–17% is optimal and 26%–30% is optimal for the SI. These margins, over and above expected demand, allow for the chance that hydro inflows (or starting storage) deviate significantly below their mean values. However, the margin does not allow for insufficient thermal fuel.

Figure 8 shows that the small excess in the current WEM margin is eroded over the period 2017–2019, and by 2021 (even prior to the Huntly decommissioning decision) WEM falls beneath its optimal range even if high probable generation projects are built.

The WCM and WEM standards were developed by the former Electricity Commission, and formed part of the Reserve Energy scheme, which was terminated in 2010. While the Authority made some minor amendments in 2013, they remain in the same form as developed by the Commission, with an amended role as part of security of supply monitoring, and “are intended to provide market participants and other stakeholders with information about future security of supply risks and investment opportunities.” (Authority, 2012)
Flexibility and responsiveness

Hydro plants that are paired with storage reservoirs (referred to as stored hydro) are flexible and responsive (to different degrees) and can reliably operate at different levels over the short-term (days-weeks). Figure 9 shows that the output of all hydro increases as demand increases; its volatility is a combination of the presence of run-of-river schemes, and it is acting (along with thermal) to offset the volatility of wind.

Figure 9 - Hydro output during top 10% demand periods of 2016.

Source: Sapere

However, hydro fuel (precipitation and snow melt) is quite volatile over the medium term (months). Given the relatively small size of New Zealand’s hydro reservoirs, their ability to “smooth” their production over the year is quite limited. This is shown in the different patterns of hydro production over the year in 2016 (where national inflows were close to average) and 2017 (where there was low inflows between June and August, when demand is high).

Figure 10 - Monthly national hydro output, 2016 v 2017.

Source: EMI data and Sapere analysis
Even putting aside the prospect of low inflow periods, average national hydro inflows are actually not well correlated with the pattern of demand over the year.

Figure 11 and Figure 12 below illustrates two very different thermal profiles (2016 and 2017), highlighting that, during the dry 2017 year, having thermal “headroom” available to the market played a fundamental role in maintaining resource adequacy.

**Figure 11 - 2016 Thermal Production by month**

In 2016, thermal generation was concentrated earlier in the year, helping the hydro reservoirs store water for the (yet unknown) winter demand and inflows. As inflows turned out to be relatively normal, the conservative storage approach from the hydro operators meant more water was available for late winter and spring, and thermal plant was able to back off. 2017 was quite a different story, with very little thermal required in summer (due to high inflows), but then a substantial amount required from May – August due to one of the worst hydro inflow sequences ever observed.

While 2017 is an example of the “dry year” challenge New Zealand faces, the 2016 profile is illustrative of the reservoir operators managing inflow risk. Even though a year does not turn out to be a “dry

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Note we have excluded Huntly Unit 5 from this graph, as it runs primarily in a baseload role.
year”, reservoir managers still need to take account of the risk that future inflows are low, especially during the high demand winter period. This causes them to operate conservatively until the state of the weather is more certain.

More generally, the relationship between hydro inflows and thermal plant over the last 20 years is shown in Figure 13. This illustrates the key role that thermal has played in managing hydro inflow variations over the inter-annual time dimension.

**Figure 13 - year-on-year variations in national hydro and thermal generation**

Finally, from an energy adequacy perspective, solar generation’s energy profile over the year adds to the winter inadequacy issue created by hydro inflows i.e. solar’s production is at its lowest during the high-demand winter period. Both the capacity and energy adequacy effects are illustrated in Figure 14.

**Figure 14 Annual and daily solar profiles.**

**Source:** NIWA data, Sapere analysis

Summarising this section, the job the overall system has to do is to meet the varying profile of demand over time, while some of the underlying generation fuel is also varying. The discussion above highlights that stored hydro is both a form of generation which can flexibly respond to short-term variations in intermittent generation (and demand), and a source of fuel uncertainty over the medium term.
It follows that the job of flexible plant is not only to meet the changing levels of demand over the year, but also to respond to the short-term variations of intermittent generation, and medium term variations in hydro inflows. Plants that fulfil this role effectively make use of fuel storage – whether it be a coal stockpile, a flexible gas contract, a gas storage facility, a battery, or a hydro reservoir – to shift their output reliably between hours, days, weeks, months and years. We draw attention to the substantial variation in year-to-year output from thermal plant, which is only made possible through having discretionary fuel supplies. Their ability to perform this critical “swing” system role is both enabled by, and constrained by, the storage “capacity” (which includes the flexibility inherent in gas contracts) and the plant characteristics, which determine how quickly it can reliably respond to the need. For example, open-cycle gas turbines will be able to respond much quicker to changing system conditions than combined-cycle gas plant. Some hydro plant will be quicker still. All of these factors need to be carefully and reliably coordinated in order to maintain minute-by-minute system reliability.

No system with varying demand and intermittent generation can escape the need for storage (either of fuel, or of electricity). Some storage is only needed within a day (e.g., from overnight to day-time peak periods), or, as shown above for hydro, some storage is needed to ‘move’ generation over many months (and years). As the system reduces emissions by reducing thermal plant, it needs to ensure that the new fuel mix has sufficient flexibility to perform the role that thermal currently performs, i.e. responding to changing demand and intermittent generation.
Appendix B: Impact of changed water quality requirements on smaller hydro-electric generators

Addendum to NPS Impact Assessment

The following provides additional assessment undertaken on the potential impacts of water quality threshold requirements from the proposed changes to the NPS-FM. The purpose of this further assessment is to quantify the potential impact on the fleet of smaller hydro-electric schemes in New Zealand and in particular, what this looks like for an “average” scheme.

There are 71 hydro schemes that, under the proposal NPS-FM, would not qualify for exemption in meeting water quality thresholds. These represent approximately 10% of the total national hydro-capacity. These can be broadly categorised as “In-river” or “Diversion” schemes.

In-River Schemes typically consist of a dam in the main river with a generation station at or in the near vicinity of the dam. Flow is predominately retained within the river but may be detained for periods through storage operations.

Diversion Schemes abstract water from the source (river, lake) and convey this via man-made structures to a generation station remote from the original source. The station may or may not release water back to the original river, either way there will be a reach of the river where flow is reduced by the amount abstracted. Diversion schemes also often abstract from multiple sources.

Of the 71 hydro schemes not eligible for exemption, 33 are considered In-river schemes and 38 are Diversion schemes. When their collective capacity (MW) under each of these categories is considered, In-River are on average slightly smaller (average capacity = 7.4MW) and Diversion schemes slightly larger (average capacity = 8.4MW).

In-River schemes typically have a capacity factor\(^1\) between 40% and 50% as they are optimised to generate from the variable inflow and what storage capacity they may include. Diversion Schemes typically have a slightly higher capacity factor of between 50 and 60% as they are optimised to balance the cost of the diversion system vs generation capacity.

From these average generation capacities (MW), and typical capacity factors, the energy production (GWh) for an “average scheme” can be derived.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Average Capacity (MW)</th>
<th>Typical Capacity Factor (mid point used)</th>
<th>Average Generation (GWh/pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-River</td>
<td>33</td>
<td>7.4</td>
<td>45%</td>
<td>30</td>
</tr>
<tr>
<td>Diversion</td>
<td>38</td>
<td>8.4</td>
<td>55%</td>
<td>40</td>
</tr>
</tbody>
</table>

Potential Impact

In line with the assessment of individual schemes, a QS 7DLF has been adopted as a default residual flow release requirement to meet water quality thresholds. It is noted that additional releases may be required to address specific water quality thresholds. These, however, will be bespoke to

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\(^1\) Taken from the "Station's List 2012". It is known that a few small hydro-schemes are not included on this list but this is not expected to influence the assessment outcomes.

\(^2\) The Capacity Factor of a scheme is defined as the ratio between; the average output of the scheme vs its installed capacity.
individual schemes and hence are beyond this assessment to quantify. The level of impact derived is therefore considered to represent a realistic quantum but will underestimate the impact at some schemes.

**In-river schemes.** Because flow released from an In-River scheme re-joins the river at or near the dam they are typically less directly impacted by increased residual flow or other types of releases for water quality reasons. This is because this flow can still typically be utilised for generation. There is however often a negative impact on efficiency as the generation machines are being used at low output where efficiency is poor. This would equate to up to a 10% reduction in energy or even more in extreme cases. A more typical impact would be around 5%.

The greater impact on In-river schemes is the loss of flexibility. With more water released, typically continuously, to meet water quality (or quantity) thresholds, less is then available to be stored and used flexibly to meet demand or support energy production from other sources, particularly uncontrolled renewables. From an examination of a few In-river schemes this impact could be in the range of 25-50% loss in flexible energy.

**Diversion Schemes.** In comparison to In-River Schemes, Diversion schemes are very sensitive to residual flows. Water retained in the river for residual flow requirements is then not diverted into the scheme and hence is lost to generation. A compounding impact is that increased residual flow takes away the most reliable portion of inflow as it is available from the source the vast majority of the time. Hence, as well as a reduction in energy output, there is a significant reduction in the ability to effectively place the energy produced to match demand or support alternative energy sources.

The Diversion Schemes assessed indicated a loss in energy of between 25 and 50% and as noted this is also the most reliable energy currently available from these schemes.

<table>
<thead>
<tr>
<th>Category</th>
<th>Average Generation (GWh.pa)</th>
<th>Loss per Scheme (GWh.pa)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-River Diversion</td>
<td>30</td>
<td>Up to 3</td>
<td>Also reduced flexibility</td>
</tr>
<tr>
<td>Diversion</td>
<td>40</td>
<td>10 to 20</td>
<td>Loss of most reliable energy</td>
</tr>
</tbody>
</table>

Addendum Prepared 23, Oct 2019

By Personal details removed

Report Date 23 Oct 2019
References


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