

MANGOREI HYDRO-ELECTRIC POWER SCHEME

ASSESSMENT OF EFFECTS MANAGEMENT HIERARCHY – POLICY 7 AND CLAUSE 3.24 OF THE NATIONAL POLICY STATEMENT ON FRESHWATER MANAGEMENT 2020

MARCH 2022

The table below has utilised the technical assessments that have been prepared in association with the consenting of the Mangorei Hydro-Electric Power Scheme to identify environmental effects that have the potential to be consequential to the extent and values of rivers and streams in the Waiwhakaiho River catchment. The table demonstrates the ways in which Trustpower proposes to apply the effects management hierarchy in accordance with the structure set out in the National Policy Statement on Freshwater Management 2020.

	Avoid	Minimise	Remedy	Aquatic Offsetting	Aquatic Compensation
<i>Actual and potential effects that could result in the loss of river extent and values (including cumulative effects and loss of potential value) – and on the basis that there is a functional need for the activity in that location.</i>	<i>Can the effect be avoided in a 'practicable' manner? If so, how? If not, why not?</i>	<i>Can the effect be minimised in a 'practicable' manner? If so, how? If not, why not?</i>	<i>Can the effect be remedied in a 'practicable' manner? If so, how? If not, why not?</i>	<i>If there are more than minor residual adverse effects, what aquatic offsetting is available? Is the imposition of aquatic offsetting possible? If not, why not?</i>	<i>What aquatic compensation can be provided if aquatic offsetting is not possible?</i>
<i>What residual effects will remain after the implementation of avoidance, minimisation and remediation measures?</i>					
<i>Will the residual adverse effects be more than minor?</i>					
WATER QUALITY AND AQUATIC ECOLOGY					
The potential restriction of fish passage in the Waiwhakaiho River as a result of the Waiwhakaiho Weir.	No – the Waiwhakaiho Weir is necessary to provide sufficient head / impoundment to enable the diversion of water into Lake Mangamahoe. If the weir was to be removed, or replaced with an alternative structure, this would require significant civil works in the bed of the Waiwhakaiho River and potential changes to the intake structure on the true left of the riverbank – all of which would introduce significant engineering, operational and maintenance costs (as well as the potential loss in generation output from the Mangorei HEPS and water supply for the New Plymouth District).	Yes – the existing fish pass on the true right side of the weir provides effective alternative means to ensure that fish species are able to navigate the Waiwhakaiho Weir. This pass will continue to provide effective passage provided the pass is regularly maintained to clear debris etc. The current trap and transfer programme in Lake Mangamahoe also assists in minimising the entrainment of fish in the lake as a result of downstream migration past the Waiwhakaiho Weir	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>
The continued utilisation of the fish pass, along with the trap and transfer programme, will suitably manage any fish passage at the Waiwhakaiho Weir. As such, any potential effects on fish passage are considered to be minor .					
The potential entrainment of fish species in Lake Mangamahoe as a result of the intake structure on the Waiwhakaiho River.	No – whilst the installation of a new fish screen (that is capable of stopping all fish from entering the intake / diversion tunnel) would enable the avoidance of this effect, it would not be practicable to do this as: ➤ A new intake would potentially need to be five times larger in order to maintain the existing flows into Lake Mangamahoe and not impinge fish (otherwise	Yes – the continuation and enhancement of the current trap and transfer programme in Lake Mangamahoe will continue to assist in minimising the entrainment of fish from the Waiwhakaiho River into Lake Mangamahoe.	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A - as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A - as the actual and potential adverse effects have been minimised and assessed as minor.</i>

	<p>the intake / screen would likely impact the generation of renewable electricity by the Mangorei HEPS and the supply of water to the New Plymouth District);</p> <ul style="list-style-type: none"> ➤ The screen would need to be sufficiently robust to withstand considerable forces and debris accumulation during floods, while still operating effectively to divert water and exclude fish; and ➤ The cost of construction and maintenance would be prohibitive. 				
<p>The implementation of a trap and transfer programme in Lake Mangamahoe will manage the entrainment of fish in the lake via the intake structure. With the implementation of this measure, potential effects on fish entrainment will be minor.</p>					
<p>The potential impediment of fish passage in the Mangamahoe Stream as a result of the Mangamahoe Dam.</p>	<p>No – the Mangamahoe Dam is required to provide the storage in Lake Mangamahoe for renewable electricity and water supply.</p> <p>Additionally, the presence of the New Plymouth District Council owned dam located in the lower Mangamahoe Stream, downstream of the Mangamahoe Dam presently represents a barrier to fish passage.</p>	<p>No – the implementation of a new two-way fish pass is not considered practicable given the physical nature of the catchment in which the dam is located and the likely operational / maintenance costs that such a pass would attract (and notwithstanding the existence of the lower dam owned by the District Council).</p> <p>Yes - Potential effects can, however, be minimised with the current and potentially more targeted trap and transfer programme in Lake Mangamahoe will assist in minimising potential effects on native fish.</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>
<p>The implementation of a trap and transfer programme within Lake Mangamahoe will provide appropriate effect minimisation for the entrainment of native fish in Lake Mangamahoe, such that the extent of any adverse effects will be minor.</p>					
<p>The potential for increased water temperatures in the Waiwhakaiho River resulting from the take / diversion of water from the river.</p>	<p>No – avoidance of this effect would require the take / diversion of water from the Waiwhakaiho River to not occur or the residual flow to be substantially increased. However, as water from the Waiwhakaiho River is required to facilitate hydro-electric power generation at the Mangorei Power Station (and water supply for the New Plymouth District), these options are not practicable.</p>	<p>Yes – minimisation of this effect is intended with the proposed responsive change to the flow regime in the residual reach of the Waiwhakaiho River when temperatures are high (noting that high temperatures can occur in the river irrespective of the take / diversion at the Waiwhakaiho Weir). This response involves reducing the take / diversion from the Waiwhakaiho River (and, therefore, increasing the residual flow in the river) when temperatures in the river exceed 25 degrees.</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>
<p>The proposed responsive change in the flow regime in the residual reach of the Waiwhakaiho River will minimise the potential effects of increased water temperatures in the river. With the implementation of this measure, potential effects on water temperatures in the river will be minor.</p>					

<p>The potential for increased nuisance periphyton growth in the Waiwhakaiho River resulting from the take / diversion of water from the river.</p>	<p>No – avoidance of this effect would require the take / diversion of water from the Waiwhakaiho River to not occur or the residual flow to be substantially increased (as well as the cessation of land use discharges / practices that are unrelated to the Mangorei HEPS). However, as water from the Waiwhakaiho River is required to facilitate hydro-electric power generation at the Mangorei Power Station (and water supply for the New Plymouth District), these options are not practicable.</p>	<p>Yes – minimisation of this effect is intended with the proposed responsive change in the flow regime (i.e. reducing the diversion when river flows have been low for extended periods of time to provide a flushing flow). It is also noted that nuisance periphyton growth can occur in the river irrespective of the take / diversion at the Waiwhakaiho Weir (due to land use practices etc).</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>
<p>The proposed responsive change to flow regime in the residual reach of the Waiwhakaiho River will minimise the potential contribution of the Mangorei HEPS to nuisance periphyton growths in the river. With the implementation of this measure, potential effects on the river will be minor.</p>					
<p>Potential changes to fish habitat and macroinvertebrate communities resulting from the take / diversion of water from the Waiwhakaiho River.</p>	<p>No – avoidance of this effect would require the take / diversion of water from the Waiwhakaiho River to not occur. However, as water from the Waiwhakaiho River is required to facilitate hydro-electric power generation (and water supply for the New Plymouth District), this option is not practicable.</p>	<p>Yes – minimisation of this effect can be provided with the implementation of the proposed residual flow regime, and the provision of additional flows (including flushing flows) when temperatures in the Waiwhakaiho River are high or natural freshes or have not occurred in the river over an extended period.</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as less than minor.</i></p>
<p>The proposed flow regime in the Waiwhakaiho River, including changes in response to high temperatures and the need for flushing flows, will minimise the potential loss of habitat in the river. As such, any potential effects on these values are considered to be minor.</p>					
<p>Potential changes to fish habitat in the Waiwhakaiho River downstream of the tailrace of the Mangorei Power Station resulting from flow fluctuations.</p>	<p>No – varying generation outflow from the Mangorei Power Station in order to meet electricity supply requirements results in daily fluctuations in water level and flow in the lower Waiwhakaiho River. The avoidance of any potential effects on habitat in the river would not be practicable as it would either require the power station to not operate or not generate renewable electricity when demand is highest.</p>	<p>Yes – fish are able to move in and out of the channel margins as the habitat changes and macroinvertebrates in this environment are tolerant of the conditions.</p> <p>In addition, the discharge from the Mangorei Power Station has a (slight) cooling effect on downstream water temperatures, increases dissolved oxygen levels, and is also effective in flushing nuisance periphyton growths.</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>
<p>The cooling, dissolved oxygen and flushing benefits generated by the discharge from the Mangorei Power Station will minimise changes to native fish habitat and communities in the lower section of the Waiwhakaiho River. Any potential residual effects associated with habitat changes are considered to be minor.</p>					
<p>RECREATION</p>					
<p>Potential loss of available habitat for trout fishing in the residual reach of the Waiwhakaiho Weir, and effects on whitebait species resulting from the diversion of water to Lake Mangamahoe.</p>	<p>No – avoidance of this effect would require the take / diversion of water from the Waiwhakaiho River to not occur. However, this option is not practicable as it would negate the generation of renewable electricity from the Waiwhakaiho River.</p>	<p>Yes – minimisation of potential effects on habitat for trout fishing and whitebait species can be provided with the implementation of the proposed flow regime in the Waiwhakaiho River.</p> <p>In addition, the existing fish pass at the Waiwhakaiho Weir will continue to provide effective passage for trout in the Waiwhakaiho River.</p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>	<p><i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i></p>

	The proposed flow regime in the residual reach of the Waiwhakaiho River, and the continued use and maintenance of the existing fish pass at the Waiwhakaiho Weir, will minimise changes to available habitat for trout and whitebait fishing – such that any potential recreational effects on the river are considered to be minor .				
Potential hazard effects for kayaking associated with the location of the Waiwhakaiho Weir.	Yes – kayakers respond to high river flows and freshes through all seasons. At these flows the residual reach, weir and diversion structures are not impediments. Additional signage upstream of the Waiwhakaiho Weir will also alert kayakers to the presence of the weir.	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>
Any potential adverse effects can be avoided .					
Potential loss of available habitat for trout fishing in the Waiwhakaiho River resulting from flow variability from the Mangorei Power Station.	No – avoidance of this effect would require the take / diversion of water from the Waiwhakaiho River, and the associated discharge via the Mangorei Power Station to not occur. However, this option is not practicable as it would negate the generation of renewable electricity from the Waiwhakaiho River.	Yes – trout are able to move in and out of the channel margins as the habitat changes and macroinvertebrates in this environment are tolerant of the conditions. In addition, the discharge from the Mangorei Power Station has a (slight) cooling effect on downstream water temperatures, increases dissolved oxygen levels, and is also effective in flushing nuisance periphyton growths	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>
The cooling, dissolved oxygen and flushing benefits generated by the discharge from the Mangorei Power Station will minimise changes to native fish habitat and communities in the lower section of the Waiwhakaiho River. Any potential residual effects associated with habitat changes are considered to be minor .					
NATURAL CHARACTER, LANDSCAPE AND VISUAL EFFECTS					
Potential natural character, landscape and visual effects of the Waiwhakaiho Weir and the associated take / diversion of water to Lake Mangamahoe.	No – avoidance of this potential effect would require the take / diversion of water to Lake Mangamahoe to not occur, or for the diversion weir to be replaced with an alternative structure. If the weir was to be removed, or replaced with an alternative structure, this would require significant civil works in the bed of the Waiwhakaiho River and potential changes to the intake structure on the true left of the riverbank – all of which would introduce significant engineering, operational and maintenance costs (as well as the potential loss in generation output from the Mangorei HEPS and water supply for the New Plymouth District).	Yes – minimisation of this effect can be provided with the proposed flow regime (including ceasing the take at high flows) in the Waiwhakaiho River and by the fact that the weir structure is not dominant within the immediate river landscape.	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>
The effect of the existing weir in the landscape is minimised by the level of modification in the wider landscape (which has occurred over approximately 90 years), as well as the proposed flow regime in the Waiwhakaiho River. As such, and taking into account the integration of the existing structures in the wider environment the potential natural character, landscape and visual effects are considered to be minor .					
Potential natural character, landscape and visual effects of the Mangamahoe Dam on the lower Mangamahoe Stream.	No – the Mangamahoe Dam is required to provide the storage in Lake Mangamahoe – which is	In part – the visual amenity effects on the Mangamahoe Stream are minimised by the limited catchment	Yes – the scale and form of the dam structure is remedied by the landscape quality and amenity of	<i>N/A – as the actual and potential adverse effects have been minimised and remedied, and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and remedied, and assessed as minor.</i>

	necessary in order to generate renewable electricity and provide drinking water supply to New Plymouth. The creation of the lake also provides significant amenity benefits to the community.	to this waterbody and the seepage flows the stream receives from Lake Mangamahoe.	the lake, and its wide public use and enjoyment.		
The proposed seepage flows and lake environment that has been created will minimise and remediate the natural character and visual amenity effects associated with the Mangorei HEPS. As such, any potential adverse effects are, overall, considered to be minor .					
Potential natural character, landscape and visual effects associated with the discharge of water from the Mangorei Power Station to the Waiwhakaiho River.	No – the avoidance of any potential adverse effects on the Waiwhakaiho River would not be practicable as it would require the Mangorei Power Station to not generate renewable electricity.	Yes – minimisation of this effect is provided by the consent conditions requiring residual flows in the Waiwhakaiho River and a continuous generation flow release into the Waiwhakaiho River at the tailrace of at least 950 litres / second between 8:00 am and 6:00 pm each day.	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>	<i>N/A – as the actual and potential adverse effects have been minimised and assessed as minor.</i>
The requirement to provide residual flows in the Waiwhakaiho River and a continuous discharge from the power station during the day will minimise potential natural character and visual amenity effects in the lower river. Any potential effects are considered to be minor .					
HYDROLOGICAL FUNCTIONING (SEDIMENTATION)					
Potential loss of sediment transport in the Waiwhakaiho River associated with the weir and take / diversion regime in the river.	Yes – the existing weir and the proposed take / diversion regime do not adversely affect sediment transport in the river system.	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>	<i>N/A – as the actual and potential adverse effects have been avoided.</i>
Any potential adverse effects can be avoided .					