To: ORC Policy Team

From: Dean Olsen

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Subject: Non-consumptive takes

Name	Role	Date Completed
Dean Olsen	Author	01/05/2025
Jason Augspurger	Internal Reviewer	25/11/2024

1. Introduction

The purpose of this memo is to provide information to inform policy development regarding the management of non-consumptive takes in Otago.

In its broadest sense, "non-consumptive" is used to describe an activity where water is taken from a waterbody, used for some activity, before the same volume of water is returned to a water body, i.e. the water is not "consumed" during the activity. Usually, in a resource management context, non-consumptive takes are treated as having lower environmental impacts than a consumptive take (where water is not returned after use) because the length of the reach impacted by water abstraction is shorter. As a result, there are usually different rules for non-consumptive takes compared with consumptive takes. Using the broad definition given above, there is potential for significant adverse environmental effects to arise from non-consumptive takes in some circumstances, such as where:

- Water is not returned to the source waterway but is discharged to a different waterway. For the source waterway, the impacts of such a take would be equivalent to a consumptive take of the same magnitude.
- Water is diverted from the source water body before being discharged a long distance downstream.
- Water is diverted from the source water body into offline storage and there is a significant delay before it is discharged back to the source water body.

1.1. A proposed definition of non-consumptive takes

For the reasons above, a more restrictive definition of the term non-consumptive may be used – where a volume of water is diverted or pumped from a waterway, but that this water is returned to the source waterbody "in the vicinity of" the original take. This relies on three aspects:

1. The same amount of water is returned as is taken, and
2. The water is returned to the same water body at or near the location from which it was taken.
3. There is no significant delay between the taking and discharge of the water to the source water body.

2. Activities involving non-consumptive use of water

Water takes associated with a number of different activities may be considered to be non-consumptive, including:

- Hydro-electric power generation (e.g. run-of-river schemes without substantial storage)
- Construction or mining dewatering (e.g. mining pits, construction sites)
- Alluvial gold mining
- Gravel washing
- Amenity ponds
- Aquaculture including fish hatcheries
- Cooling water for power plants or industrial uses
- Ground- or water-sourced heat pumps

However, in some circumstances these activities may not meet the definition of non-consumptive takes given in Section 1.1. Activities that may appear to be non-consumptive but may not meet the definition given above include:

1) Some hydro-electric takes (see Section 5.3 for further discussion)
2) Water takes for snow making, where there may be a considerable lag between the water being taken and the water being released as the snow melts.

3. Key ecological considerations

The major factors affecting the magnitude of potential effects of a non-consumptive take of water on in-stream ecological values are:

- The size of the take relative to the size of the waterbody,
- The length of the reach affected, i.e. the distance between the "take" of water and the discharge of water.
- The time between the taking and the discharge of water and whether the take results in large fluctuations in flow in the receiving water body.

Activities that may be considered to be non-consumptive (e.g. hydro-electric power schemes) have the potential to have significant ecological effects. The risk of adverse effects will increase as the magnitude of the take increases relative to the size of the source water body and/or the length of residual reach increases. Activities such as hydro-peaking

3.1. Magnitude of take

Typically, the ecological effects of the non-consumptive diversion of water are addressed by setting a residual flow for the diversion reach (i.e. the reach between the take and discharge of water). The risk of adverse effects is related to the magnitude of the take relative to the size of stream (Table 1). Based on the advice of Hayes et al. (2023), in the absence of other water abstraction pressure, a non-consumptive take of up to 20% of the flow in smaller rivers (≤5 m^3/s) is anticipated to have a low risk of adverse effects, while a non-consumptive take of up to 30% of the flow in larger rivers (>5 m^3/s) is anticipated to have a low risk.

3.2. Length of diversion reach

In addition to the magnitude of the water take relative to the size of stream, the risk of adverse effects increases as the length of the reach increases (Table 1). This increase in risk reflects the spatial extent of impact (including changed habitat availability within the residual reach.), and the greater likelihood of impacts extending downstream of the residual reach (such as reduced macroinvertebrate drift from the residual reach or effects arising from impediments to fish passage.

Table 1 Risk assessment of the non-consumptive taking of water based on the magnitude of flow alteration (as a percentage of natural flows) and the length of the residual reach.

		Level of flow alteration (% of natural)					
		<10%	**10-20%**	**20-30%**	**30-40%**	**40-50%**	**>50%**
Length of residual flow (metres)	**0-50 m**	Very low	Very low	Very low	Low	Low-medium	Medium
	50-100 m	Very low	Very low	Low	Low-medium	Low-medium	Medium
	100-250 m	Very low	Low	Low-medium	Low-medium	Medium	Medium-high
	250-500 m	Very low	Low	Low-medium	Medium	Medium-high	Medium-high
	500-1000 m	Very low	Low	Low-medium	Medium	Medium-high	High
	>1000 m	Very low	Low	Low-medium	Medium	Medium-high	High

3.3. Time between the taking and discharge of water

In the absence of storage, the time lag between the taking and discharge of water is not expected to be significant, as the travel time through a penstock/pipe is typically expected to be similar to the flow through a natural channel over a similar distance and height difference.

Whilst considered to be non-consumptive (in the sense that the water taken will be discharged back to the original source body), hydro-electric power schemes with storage can substantially alter the hydrology of the water body by delaying the discharge of water by periods ranging from several hours to months (or even years). Even HEPS with a small amount of storage capable of short-duration storage (i.e. a few hours) can enable hydro-peaking, where water is stored during times of the day when the spot-price is low, and used to generate electricity when prices are high, resulting in flows downstream of the power station that can fluctuate markedly through the day (e.g. Figure 1). The practice of hydro-peaking can have substantial adverse environmental effects, including the creation of a varial zone (an area of the stream bed/banks that is subject to drying and re-wetting within a short time period) and rapid flow fluctuations which may result in fish stranding. Given the potential magnitude of environmental impacts arising from such activities, they require specific consideration as part of assessment of environmental effects (e.g. consideration of extent of a varial zone created by flow fluctuations, potential effect of fluctuating flows on habitat suitability in wetted channel and potential for fish strandings).

Any delay between the taking and discharge of water that exceeds the time that it would take for the exposed portions of the stream bed to start drying is likely to result in adverse ecological effects. Thus, any delay by more than a few minutes (maximum 15 minutes) has the potential for such effects.

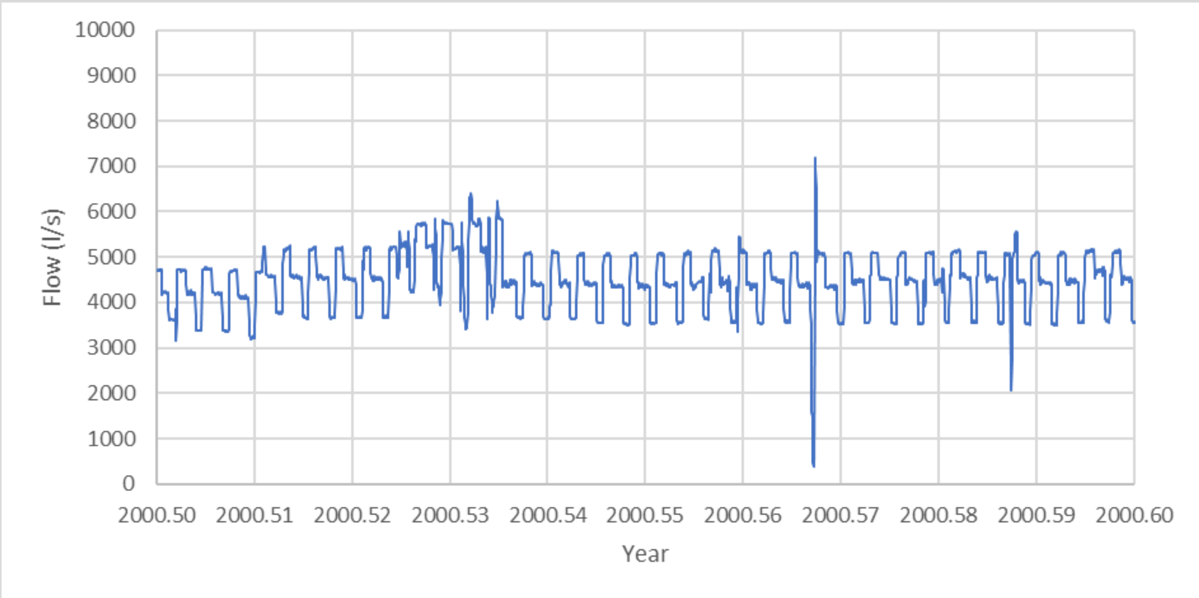

Figure 1 Observed flows in the Teviot River/Te Awa Makarara at Bridge Huts Road between 1 July and 7 August 2000.

4. Do we need more than one category of non-consumptive take?

A detailed consideration of the range of potential activities that may on first glance may appear to be non-consumptive suggest that the range and nature of such takes, the activities for which they are used and the potential effects associated with such takes suggest that a range of approaches to consenting non-consumptive takes may be required. Some takes may best be considered to be consumptive for consent processes (e.g. inter-catchment transfers), may require special consideration for water accounting purposes (see Section 5.1) or may require assessments associated with the due to the ecological risks associated with particular activities (see Sections 5.2 and 5.3).

5. Other considerations

5.1. Water accounting

The NPS-FM requires regional councils to operate and maintain freshwater accounting systems for water quality and water quantity (Policy 3.29). For water quantity accounting, the regional council must be able to distinguish between consumptive and non-consumptive takes, and to distinguish between takes and retakes to avoiding double counting. There are circumstances where a non-consumptive take may be considered to be consumptive from an effects perspective, but non-consumptive from a water accounting perspective, which could give rise to another category of take such as "non-allocative takes", which have potential for significant environmental effects (similar to a consumptive take of the same magnitude), but that returns the water to the source waterbody, so is processed following a similar process to a consumptive take, but that is not counted against catchment allocation (hence "non-allocative") for the purposes of water accounting.

Another circumstance that may necessitate a separate category is takes of water from one catchment, which is then discharged to a different catchment (and potentially FMU/Rohe). Examples of this are the takes operated by Manawa Energy from the upper Beaumont River catchment (lower Clutha Rohe) to the Waipōuri River (Taieri FMU). This form of inter-catchment transfer should be distinguished from those that transfer water from one catchment to another for the purpose of consumptive use (i.e. irrigation, stockwater etc.).

Such transfers may be taken from a waterway in one Rohe, discharged into a waterway in another Rohe but may eventually re-enter the source waterbody. An example is the take from Lake Dunstan at the Dairy Creek inlet (Dunstan Rohe), which is then discharged into the Manuherekia catchment (Manuherekia Rohe), but re-enters the Clutha/Mata-Au downstream of the Manuherekia confluence (Roxburgh Rohe). To complicate matters further, this take may include fractions for consumptive (e.g. for irrigation, storage, frost fighting etc.) and non-consumptive (e.g. hydro-electric power generation) purposes. This take poses a particular challenge for water accounting.

5.2. Water quality/physicochemistry

In the case of non-consumptive takes, the assumption is that the water quality/temperature is not affected by the take and discharge. If there is any change in water quality resulting from the take and/or discharge of water, this would require consideration as part of an application for a discharge permit.

5.3. Hydro-electric power schemes

Hydro-electric power generation is commonly associated with the non-consumptive use of water. Such takes may be considered non-consumptive where water is diverted from a water body into a pipe, tunnel or canal before being passed down a penstock and through a turbine before being discharged back into the source waterbody. However, whether a hydro-electric take can be considered non-consumptive or not depends on factors such as:

a) the distance the water is taken out of the water body,
b) whether it is returned to the same waterbody that it is taken,
c) whether there is a delay between water being taken and water being returned to the source waterbody,
d) whether the take is to be used for hydro-peaking where water is stored during times of the day when electricity demand (and therefore the electricity spot-price) is low, and water used to generate electricity when prices are high, resulting in flows downstream of the power station that fluctuate markedly through the day.

Table 2 presents information for a range of different hydro-electric power schemes from large power stations (e.g. Fraser River, Teviot River) through to micro-hydro power schemes. Based on the risk assessment framework presented in Table 1, the ecological risks associated with these schemes vary widely.

Table 2 Summary of non-consumptive water takes for hydro-electric power generation in Otago

Waterbody	Approximate diversion distance (m)	Max take l/s (% MALF)	7-d MALF (l/s)	Residual flow (l/s)	Substantial storage? Potential for hydropeaking?	Ecological risk
Wye Creek	980	680 (130%)	530	30	Y	High
Fraser River 1	3,200	2,000 (400%)	496	390	Y	High
Fraser River 2	4,600	2,000 (400%)	496	50	Y	High
Roaring Meg	3,500	1,541 (250%)	620	150	Y	High
Teviot River 1	7,500	6,000 (853%)	703	345	Y	High
Teviot River 2	2,400	6,000 (853%)	703	305	Y	High
Teviot River 3	1,500	6,232 (853%)	703	50	Y	High
Teviot River 4	3,200	1,359 (853%)	703	50	Y	High
Talla Burn	3,400	1,500 (526%)	285†	-	N	High
Short Burn†	1,300	61.5 (32%)	192*	50	-	High†
Ox Burn	400	1110 (150%)	~730*	20	N	High
Alpha Burn	770	25 (32%)	~79*	-	N	Medium
Waterfall Ck	200	63 (150%)	~40*	75	N	High
Unnamed Whakatipu tributary	695	80 (100%)	~80*	55	N	High
Rough Burn	600	500 (160%)	316*	50	N	High
Niger Stream	450	120 (100%)	120*	-	N	High
Nevis Burn trib†	~5000†	56 (200%)	28*	-	N	High
Church Hill Creek	~1000	28 (75%)	37*	50% flow share	N	High
Donaldsons Creek	1,900	30 (430%)	7*	10	N	High
An unnamed tributary of Dip Creek	15	60 (250%)	2*	3	N	Low-medium
West Branch Clay Bank Creek	1800	25	3*	0	N	High
Georges Creek	780	43 (55%)	78*	Visually connected	N	High
Waianakarua trib	90	10 (125%)	8*	-	N	High

* From NIWA River maps

† Discharges to a different water body to source water body.