Summary statement of evidence : MD de Winton

My evidence relates to submerged macrophytes (easily visible plants that can grow permanently submerged) and macroalgae (multicellular alga visible to the unaided eye).

Waituna Lagoon vegetation mostly comprises two species, *R. megacarpa* and *R. polycarpa*. *Ruppia* only dominate submerged vegetation in brackish-water, coastal lagoons. This is because they are more tolerant of high and fluctuating salinity than other plants. Sediment pollen records confirm that *Ruppia* was present in Waituna Lagoon long before the artificial openings began.

Most coastal lagoons have lost their submerged vegetation, including the best known example of Te Waihora (Lake Ellesmere). I note that *Ruppia megacarpa* has the national threat designation of At Risk - Naturally Uncommon because of its limited distribution and abundance.

Waituna Lagoon is one of the few remaining, large coastal waterbodies on the mainland to regularly support *Ruppia* dominated vegetation. But it is at risk of losing macrophytes. Too many stresses can overwhelm macrophytes' ability to survive, reproduce and reestablish. Nutrient enrichment and/or high sediment loads can cause a waterbody to "flip" from a macrophyte dominated state to blooms of macroalgae or phytoplankton (meaning microscopic plants). In this state, there is insufficient light for macrophyte growth and recovery, and their ecological benefits are lost, including provision of habitat, food, shading, nutrient uptake and sediment stabilisation.

I conclude that *Ruppia* dominated submerged vegetation would be the typical natural state at Waituna Lagoon and it is valued. Loss of the *Ruppia* vegetation would leave the lagoon in a significantly more degraded state.

Vegetation surveys in Waituna Lagoon were made in summer, annually over the last 17 years. Over 45 sites were monitored lagoon-wide. Surveys have also been made in spring (over 3 years) and winter (over 2 years) at 16 sites. In my opinion, this level of monitoring provides for a robust understanding of *Ruppia* responses to lagoon opening regimes.

Ruppia was present year round, *when* environmental conditions permitted. *Ruppia* seed was present year round and seed bank viability is unlikely to be depleted over greater than 1, to 2 years or more, even if no fresh seed is added. Seed germination has been seen within the lagoon, and I would consider seedling recruitment as the way that *Ruppia* recovers after a large disturbance.

Successful summer flowering and fruiting is needed for *Ruppia* seed replenishment. The greatest summer flowering success is seen when *Ruppia* cover and height are well developed.

Macrophyte monitoring results at Waituna Lagoon are assessed against six ecological targets, as provided in Table 1 of my evidence. Four targets relate to the development of *Ruppia* species and reproductive success. One target describes macroalgae development against an upper cover limit. One target considers if the lagoon had been closed for the previous 3 months before monitoring. In my opinion, these ecological targets are relevant for assessing the wellbeing of *Ruppia* at Waituna lagoon.

Table 2 of my evidence considers if these 6 ecological targets were met during the 17 years of monitoring. In years that were not closed for three months before monitoring, only one or no ecological targets were met. This was the case for eight of the 17 monitored years.

I conclude that open lagoon conditions during the critical spring/summer season for *Ruppia* lead to poorer growth and reproduction and to greater vegetation disturbance and loss via drying, tidal currents and waterfowl grazing.

Four or more targets *were* met only in the second consecutive year of meeting that lagoon closure target. Consecutive years of favourable closed conditions during the critical spring/summer period allowed greater *Ruppia* biomass, plant height, and reproduction. Noting there have been no more than 2 consecutive years meeting the lagoon closure target during the 17 years of monitoring.

In summary, previous Resource Consents with opening trigger water levels of 1.8 to 2.2 masl did not avoid open lagoon conditions over the critical spring/summer period for *Ruppia*. Almost half of monitoring years were open during this time, leading to impacts on the *Ruppia* vegetation.

Under the 'existing environment', that is without any artificial openings, Waituna Lagoon would be closed most of the time and openings would be short. Under this scenario, water levels would be higher, the lagoon would be deeper and fresher for longer compared to artificial openings.

Nutrients and sediment enter the lagoon from the catchment, it has poor water quality and is at risk of phytoplankton and/or macroalgal blooms. Opening the lagoon would disrupt phytoplankton blooms and flush nutrient rich water. This would be at the cost of also disturbing macrophytes. However, not opening the lagoon under bloom conditions means plants would be excessively shaded, impacting plant growth, reproduction and survival.

The application proposes the lagoon would be opened in the event of an algal bloom. In my opinion this provision is important to maintain a light climate for macrophyte growth. Secondary indicators in the proposed application also consider macrophyte and macroalgae status.

In my evidence, I consider predictions from hydrological modelling based on different water level triggers. My understanding is that water level triggers at 2.4 to 2.5 masl would provide more opportunity for water to recede naturally without unnecessary openings. A trigger of 2.5 masl for 7 consecutive days would reduce the frequency of lagoon openings compared to the past lagoon trigger levels of 1.8-2.2 m asl. Importantly, it would reduce the number of openings in the key spring/summer period for *Ruppia* growth.

This application proposes a transition regime over 15 years, leading up to the trigger level of 2.5 masl for 7 consecutive days. This transition regime would also provide reduced risk of opening in the key spring/summer period for *Ruppia* growth compared to the past lagoon trigger levels.

The current application would increase consecutive years of favourable closed conditions for *Ruppia* during the critical spring/summer growth period. In my opinion, and based on monitoring results, this would act to protect dominance of *Ruppia*.

Hydrological modelling indicated short periods of time at high lagoon level under the proposed consent conditions (i.e., much less than a 1 month above 2.4 m asl). Based on literature and my experience, macrophytes can survive periods of insufficient light of a longer duration. Plant welfare during high water level would be supported by a higher biomass and height expected under the proposed opening regime of the application.

I consider this application would progress the lagoon towards a more natural state, with a more stable, sustained presence of submerged vegetation, comprised of salinity tolerant plants that would be typical of healthy coastal lagoons in New Zealand.

Table 1: Description for six ecological targets to assess vegetation monitoring at Waituna Lagoon.

Ecological Target	Description
Ruppia cover	>30–60% for average % cover of *Ruppia* (and other native macrophytes)
Ruppia biomass index	>1000 average for *Ruppia* 'biomass index' (% cover × cm height)
Ruppia reproductive success	≥40% of *Ruppia* samples in a flowering or post-flowering life-stage
Status of *Ruppia megacarpa*	≥20% of the sites record *Ruppia megacarpa*
Macroalgae cover	<10% cover of benthic and epiphytic filamentous algae (macroalgae)
Lagoon Closure	Lagoon closed during *Ruppia* growing season (spring and summer), defined as the three months before monitoring

Table 2: Summary of results for six ecological targets over all monitoring years. Darker rows indicate greater numbers of targets were met.

Year	Lagoon closure	*Ruppia* cover	*Ruppia* biomass index	Macroalgae cover	*Ruppia* reproductive success	Status of *Ruppia megacarpa*	Targets met
2009	✓	×	×	✓	×	×	2
2010	✓	×	×	✓	×	✓	3
2011	×	×	×	✓	×	×	1
2012	✓	×	×	✓	✓	×	3
2013	×	×	×	×	×	×	0
2014	×	×	×	✓	×	×	1
2015	✓	×	✓	×	✓	×	3
2016	✓	✓	✓	×	✓	×	4
2017	×	×	×	×	×	×	0
2018	✓	×	✓	✓	✓	✓	5
2019	✓	✓	✓	×	✓	✓	5
2020	×	×	×	×	×	✓	1
2021	×	×	×	×	×	×	0
2022	✓	×	×	×	×	✓	2
2023	✓	✓	✓	✓	✓	✓	6
2024	×	×	×	✓	×	×	1
2025	×	×	×	×	×	×	0