Taylor. Planning

Periodic opening of Waituna Lagoon to maintain and restore ecological health and cultural values of the lagoon ecosystem

Response to Requests for Further Information

Te Rūnanga o Awarua, Department of Conservation Te Papa Atawhai and Environment Southland

23 June 2025

Supporting clients to solve their resource management challenges.

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1. Introduction

This addendum assessment responds to the requests for further information provided by the resource consent processing officer Danielle Petricevich dated 3 June 2025 and 5 June 2025, following a Council peer review of the application in accordance with s92(2) of the RMA.

1.1 Appendices

The addendum is supported by the following information:

Appendix A – S92(2) peer review and email requests for associated information

These set out the requests from the resource consent processing officer regarding erosion and sediment, the coastal marine area, avifauna effects, fringing wetlands, monitoring, lagoon opening effects, and effects from proposed changes to conditions.

Appendix B – Avifauna Response

This supports the response in Section 2.3 of this addendum. It provides a response to the request for additional information relating to avifauna effects regarding foraging habitat and breeding birds.

Appendix C - Draft Updated Conditions of Consent

This supports the response in Section 2.4 of this addendum regarding consent monitoring. The updated conditions require a Monitoring Plan to the parameters and frequency of monitoring.

Appendix D – Draft Monitoring Plan

A draft Monitoring Plan to respond to the processing officers request regarding the implementation of monitoring via a monitoring plan that is required by the conditions (as updated in **Appendix C**).

Appendix E – Fringing Weland Response

This supports the response in Section 2.5 of this addendum. It provides a response regarding potential effects of lagoon openings on fringing wetland vegetation

communities.

Appendix F – Advice on application of 2.4m or 2.5m trigger level for transitional lagoon opening

This supports the response in Section 2.7 of this addendum regarding the applicant's proposed changes to the transitional levels. It provides a summary of the analysis undertaken to inform the changes to conditions.

Appendix G: Summary of changes to conditions made in May 2025

This includes summary of the changes and a copy of the changes made to the proposed consent conditions in May 2025.

2 Information Response

2.1 Erosion and Sedimentation

Information Requested

A review of a summary of the submissions on the application revealed that submitters are concerned about the adverse effects of erosion and sedimentation associated with extended closure of the lagoon (i.e., not the activity for which consents are being applied), which will likely result in longer and more frequent periods of inundation. The proposed opening of the lagoon will reduce water levels and, therefore, it is considered unlikely that there would be an adverse effect associated with the opening of the lagoon on erosion and sedimentation.

***However, we note that the potential for erosion and sedimentation effects has not been considered by the application and more information in this regard could improve understanding of the potential erosion risks created by the proposed opening regime**.*

Response

Response provided by Ash Rabel, Acting Science Investigations & Operations Manager, Environment Southland

Sediment inputs to coastal lakes, wetlands, and estuaries, from erosion and other catchment inputs, is a significant issue in New Zealand. The predominant source of sediment to the coastal receiving environments is from catchment inflows, in addition to marine sediments that may ingress (e.g. during lagoon opening events).

One indicator of sediment are the changes in total suspended solids (TSS) within Waituna Lagoon, as monitored by Environment Southland's State of the Environment programme. While this is not a direct measure of erosion in the Lagoon, it can give information to the amount of suspended sediment mobilised in the system.

Figure 1 provides a plot of available TSS data for Waituna Lagoon from the four sites monitored by Environment Southland, alongside monitoring from Waituna Creek. Figure 1 indicates there are typically lower TSS concentrations during prolonged closed phases (e.g. May 2022-January 2024), excepting when a high cyanobacterial growth period occurred (December 2023-January 2024).

During open periods TSS concentrations are higher, as there is more particulate matter in the water column, which, does not appear to be derived from Waituna tributaries (noting no available data for Carran Creek). This suggests that the change in TSS is from another source within the lagoon, due to resuspension of settled sediment, or from the coastal waters (e.g. marine snow or sand).

The tributaries to Waituna Lagoon (e.g. Waituna Creek) however will provide an ongoing supply of sediment to the lagoon, and during high flow events the load of sediment is expected to increase. Therefore, one of the main sources of sediment, influenced by land use change in the catchment, is the yield during high rainfall/flow events.

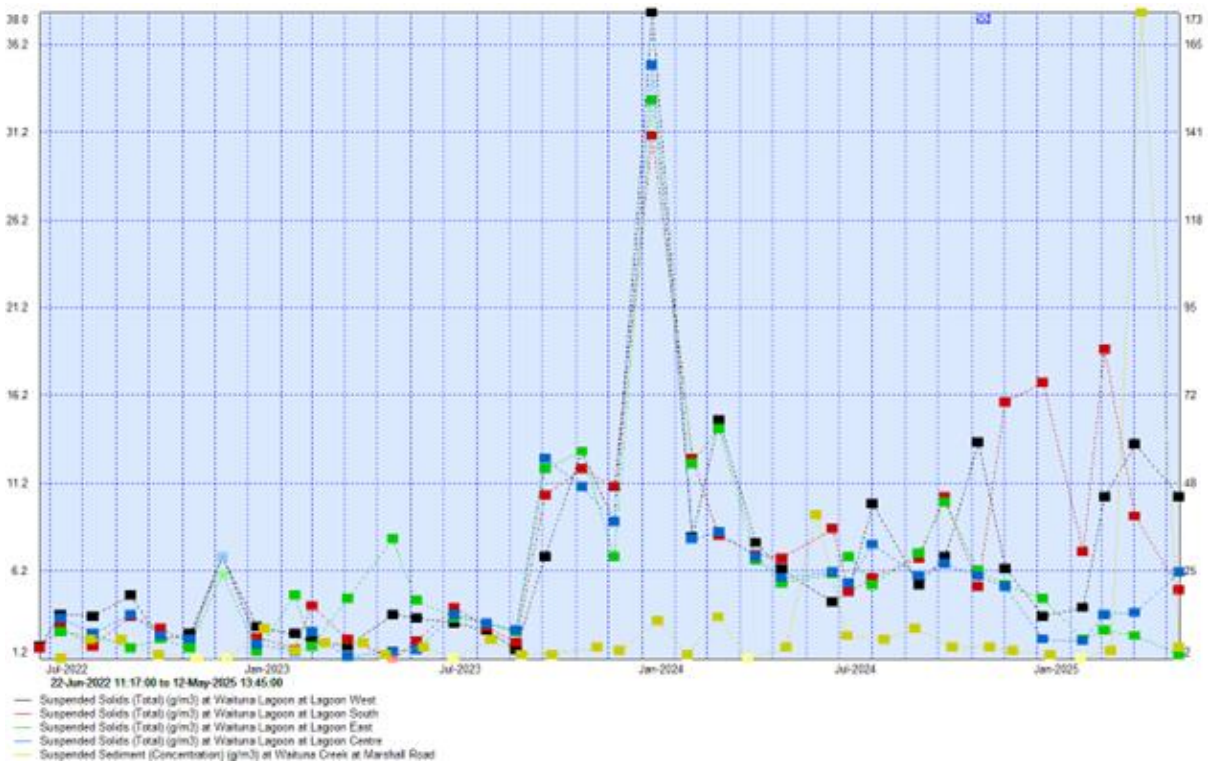

Figure 1: TSS concentration (g/m3) as measured across Environment Southland's four SOE monitoring locations, compared to TSS in Waituna Creek. Please not that methodology is the same, and there is a minor inconsistency with naming conventions.

2.2 Effects on the Coastal Marine Area

Information Requested

One risk not assessed in the Science Advisory Report or technical memo is that of human health. There may be elevated levels of faecal bacteria and/or toxin-producing cyanobacteria in the discharge, which is likely to make the water unsuitable

for swimming or gathering shellfish near the point(s) of discharge. The Waituna Lagoon is in a fairly remote part of the Southland Region and I understand it is not known to be a popular swimming location. As such, the actual risk to people is likely to be low. ***However, consideration of whether signage would be beneficial during opening events to warn/educate may be warranted if there is a chance that people may interact with the water.*** *The risk to people in the CMA is likely to be no greater than the risk people would have interacting with the water in the Waituna Lagoon itself; however, the lagoon water may not be suitable for human recreation at times due to elevated levels of faecal bacteria and/or cyanobacteria.*

Response

Response provided by Ash Rabel, Acting Science Investigations & Operations Manager, Environment Southland

The peer reviewers request regarding signage and human health risks has been considered and it is determined that further signage, beyond that already in place, is unnecessary.

During an opening event, there is already signage and fencing around the opening due to either a risk from sand banks slumping or people being swept away by strong flow in the cut and/or variable inshore currents. It is, therefore, unlikely that anyone would be engaging in recreational activities within a close distance to the point of opening.

Additionally, ongoing SoE monitoring is undertaken by Environment Southland across Waituna Lagoon. This includes testing for both cyanobacteria and *E. coli*. If cyanobacteria biovolume meets or exceeds guideline values within the lagoon, there will be signage erected at the main access points to the lagoon as well as public notification - both undertaken by Environment Southland through other work unrelated to the consent (this may also result in an alert warning on the DOC website). If there has not been a situation that warranted this notification prior to an opening, it is unnecessary to provide further signage during an opening event as the conditions would not warrant it.

In the case of the lagoon being opened under the consent due to a cyanobacterial bloom, it is noted that dominant bloom species, to date, have been from *Aphanizomenonaceae* – a freshwater obligate family of cyanobacteria. Any shift to brackish or marine conditions will quickly kill these cyanobacteria and mitigate risk to the public beyond the “first flush”, post opening. Thus, it is likely that the risk to humans engaging in recreational

activities on the ocean side of the opening are unlikely to be high, and, as noted, signage would already be in place around the lagoon itself in this situation.

The NPS-FM (2020) Primary Contact attribute state gives guideline values for risks of infection from faecal coliforms, and a means to infer the likelihood of someone becoming sick from contact with water in Waituna Lagoon. Calculating the relevant statistics from 60 months of the most recent closed-state *E. coli* data, from Environment Southland's centre monitoring location, the lagoon meets criteria for A-band (table 1), and the least likely category to pose risks to human health. While a closed state was used to calculate this attribute, as it is the most vulnerable period for the lagoon, and when salinity is unlikely to unduly influence *E. coli* monitoring results, it does not give direct information of risk for this water entering the ocean. However, given that there is expected to be a strong dilution factor and reasonably rapid mixing of the water, further reducing faecal coliform concentration, it is unlikely to pose any substantial risk to public.

Table 1: Summary statistics for E. coli state of Waituna Lagoon, when closed. These values have been calculated from the past five-year equivalent of closed periods (i.e. 60 monthly data points) and summarised to reflect NPS-FM (2020) primary contact attributes.

Median E. coli (cfu/100ml)	95th percentile E. coli	% results over 540 cfu/ml	% results over 260 cfu/ml
26	418	1.7%	16.7%

2.3 Avifauna Effects

Information Requested

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

An assessment of effects on native avifauna communities should be provided. This should include an assessment of whether there will be any meaningful change in

foraging habitat, as well as an analysis of the effects on breeding birds and any risks associated with increased predation.

Response

A detailed response has been provided by Sean Jacques, Biodiversity Supervisor - Department of Conservation and Dr Hugh Robertson, Principal Science Advisor - Department of Conservation, and is provided at **Appendix B**. This provides:

- a summary of the avifauna values of the lagoon, including available data and information on species, habitat types and bird functional groups; and
- an assessment of effects, particularly on foraging habitat and breeding birds.

In terms of foraging, optimal conditions differ by species and functional groups. All of the 'At Risk/Threatened' wading and migrant bird species listed in Tables 2 and 3 of **Appendix B** are more likely to be recorded, and in greater numbers when the lagoon is open and switches to a tidal regime. The response notes that '*a proposed regime that entails a lagoon that is closed during summer periods (noting that open periods will still occur) could have negative impacts upon foraging opportunities'* with these effects mitigated by the availability of the wider Awarua-Waituna Ramsar area. When considered in the context of the existing environment, which is that no consent is in place to manage the lagoon, a regime that provides for some openings over these periods is positive for these species (whist aiming to reduce their frequency for other ecological values).

In terms of predation risk, DOC and local community maintain a predator trapping network around the perimeter of Waituna Lagoon.

In terms of habitat for breeding birds, the response sets out that:

- Nesting events for banded dotterel (at-risk, declining) and variable oystercatcher (at-risk, declining) are unlikely to be affected by lagoon levels. These species '*typically nest at low density along the seaward shoreline, often favouring sites higher up the shingle in elevation (above tidelines)*'.
- *'Southern black-backed gull Larus dominicanus has been noted forming colonies on exposed islands during low water levels over recent summers, but no other migratory or colonial species have been seen to breed'*.
- Australasian bittern (threatened, nationally critical) are not typically observed at Waituna Lagoon, but are frequently recorded from the isthmus between Awarua Bay and Waituna. The assessment sets out that:

  'A lagoon regime that manages the site and its water levels for optimum

ecological health is more likely to benefit bittern and other swamp breeders that rely on the complex food webs of healthy and productive wetland systems. Drying of fringing wetland during the spring-summer breeding season will not only expose and endanger nests of cryptic swamp species (including to risk of predation by exotic mammals) but limit safe feeding opportunities for parents and developing young, increasing stress and ultimately reducing chances of survival. As noted above, the proposed water level regime for Waituna Lagoon aims to reduce the frequency of spring/summer openings that will support cryptic wetland birds'.

In summary, the proposed transitional regime will provide for a range of habitats for bird species. Foraging habitats for some wader species/migrants may be reduced during summer periods, when compared to more frequent spring/summer openings under past regimes, but the wider Awarua-Waituna Ramsar site provides other foraging habitat, and effects are positive in the context of the existing environment. The inundation of rushes will also support cryptic wetland birds, including the threatened, nationally critical Australasian bittern.

2.4 Regularity or Timing of Proposed Monitoring

Information Requested

Including a requirement around the frequency and timing of monitoring may be beneficial to ensure sufficient data are collected to enable informed decisions on opening events. ***We recommend that the conditions be updated so that the parameters to be monitored and frequency of monitoring are clearly specified. In addition, monitoring conditions should include the requirement to sample and measure parameters immediately prior to an opening event and over the period of time the lagoon is open, as well as between openings…***

…In terms of the monitoring conditions, I did wonder if you had considered implementing the monitoring through a Monitoring Plan. This way, the Plan could specify the details and could be amended if required. The conditions could specify the minimum information requirements for the plan.

Response

The draft proposed conditions of consent are updated and attached as **Appendix C**. These include an additional condition (Condition 15) which requires that the consent holders must engage a suitably qualified expert(s) to prepare a Monitoring Plan. The

Monitoring Plan must be submitted to the Consent Authority for certification no later than 60 working days following the grant of the resource consent, and prior to the exercise of the consent.

The purpose of the monitoring plan is to direct the parameters to be monitored and the frequency of monitoring the proposed opening triggers, and the primary and secondary indicators of lagoon water quality and ecosystem health specified in Appendix 1 and 2 to the conditions. A draft Monitoring Plan is provided as **Appendix D** to this addendum. As this is a draft only, it may be subject to change and refinement, and a final Monitoring Plan will be submitted for certification following consent approval.

2.5 Fringing Wetland Effects

Information Requested

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

Further commentary on the potential effects of lagoon opening on fringing wetland vegetation communities and their extent should be provided. This will allow for some certainty that any effect will be at an acceptable level.

Response

A detailed response has been provided by Dr Hugh Robertson, Principal Science Advisor, Department of Conservation, and is provided at **Appendix E**. The response draws on studies of the fringing wetland species of Waituna Lagoon undertaken, assesses the results of these studies, and applies these findings to the application.

The 2013 Report monitoring changes in shoreline vegetation communities at Waituna Lagoon, Southland (**Appendix E**) compared the species range across vertical elevations to conclude that the majority of wetland species recorded (35 or 39 species) appear to have extended their range downslope. While approximately half are versatile species which can adapt quickly to take advantage of new habitat and their range extension may be more recent, twelve of the species which have moved down slope are not short-lived species and this possible extension in their elevation range implies

that reduced water levels in the lagoon have affected their distribution. The report concludes that '*Lagoon levels should not be managed any lower than current levels to halt any continual downward creep of shoreline communities'*.

Drawing on this research, the assessment indicates native wetland plant communities will not be adversely affected by an increased duration of inundation >2.0m and 2.2m. These wetland species are adapted or resilient of wet conditions, and the increased duration is relatively small when compared to the previous short-term consent. Irregular inundation at higher levels is positive for these systems as they will also make growing conditions for exotic species, such as introduced grasses and gorse, more difficult.

However, there may be some transition and dieback of native terrestrial species that migrated downslope in response to a prolonged period of modified hydrology, as raised in submissions. During September 2024 water levels in Waituna Lagoon remained above 2.4m for a 2-3 week period and afterwards reports were received from community of dieback of some vegetation in discrete areas, such as manuka. The assessment sets out that:

> *'This reversion (and associated dieback) from terrestrial plants to more wetland plant communities can be viewed as part of the ecological restoration of the natural hydrological and ecological function of the lagoon ecosystem. In other wetlands of New Zealand, manuka has established because of altered hydrology (e.g. Whangamarino wetland) and has subsequently declined as the water levels were restored.*
> *The proposed transitional regime is supported to allow the native wetland vegetation to transition gradually overtime. The relatively short-periods above 2.3m (in winter) and 2.4m (in summer) for the initial 5 years will ensure that the Oioi rushland and other fringing wetland vegetation is not subject to a rapid shift in hydrological conditions'.*

In summary the proposed opening regime with graduated shifts for water level triggers at years 5, 11, and 16 over the term of the consent will allow indigenous vegetation to transition. This is likely to result in a reverse (and associated dieback) from terrestrial plants (such as manuka) to more wetland plant communities as part of the ecological restoration of the lagoon over time. These effects are positive when compared to the previous opening regimes, which terrestrial vegetation has become adapted to.

The observed changes to fringing wetlands in response to higher water levels have been addressed for the purpose of responding to submissions and providing an understanding of the anticipated changes to the fringing wetland plant community over the term of the consent. However the effects must be considered in the context of the existing environment, which is that no consent is in place to manage the lagoon. In

this context, effects are also considered positive, as a gradual shift to higher lagoon levels allows the indigenous wetland vegetation to transition gradually over time as part of the ecological restoration of the lagoon.

The applicants propose that the Monitoring Plan (draft attached in **Appendix D**), now proposed in Condition 15, includes a requirement for 5-yearly monitoring of changes in the fringing wetland plant community. This will ensure there is a consistent approach to the way the changes in fringing wetland plant community are monitored over the term of the consent. This monitoring will then feed into the consent holders 5-yearly review of the effectiveness of the consent, as proposed in Condition 17.

2.6 Effects from Opening Events

Information Requested

…one thing that has been on my mind is the adverse effects of opening (lowering water levels within the lagoon) and especially prolonged opening events (such as the current one), where the lagoon remains open for longer than a few months. I understand the main measure to try and avoid this is timing of the opening. ***As part of the response, are you/the experts able to address monitoring of the lagoon and fringing wetland conditions while it is open and what the mitigation measures would be if it remains open and adverse effects are occurring (noting the application does not include the provision to close the lagoon, but there is a reliance on the application that any adverse effects will be temporary). It would be helpful if they could look at the monitoring that has occurred over the duration the lagoon has recently been open, to support any conclusions around adverse effects.***

This is also key when assessing the proposal against the NPS-FM Policy 6 and effects management hierarchy, and direction within the NZCPS (Policy 13) and SWLP (Policies 20, 32, 33 and 33A) – regarding ecological values and natural character. ***It would be good if you could have a closer look at the stat assessment (particularly in relation to the above mentioned aspects) once you have the expert's assessment and revised conditions with particular focus on the adverse effects of opening/lowered water levels.***

Response

Monitoring Observations from Most Recent Opening

This response has been prepared by Ash Rabel, Acting Science Investigations &

Operations Manager, Environment Southland and Dr Hugh Robertson, Principal Science Advisor, Department of Conservation

Environment Southland, to date, continues state of the environment monitoring, including water quality and cyanobacteria, in Waituna lagoon during both open and closed phases. The samples are taken monthly from four locations and include continuous monitoring for DO, Conductivity, Temperature and pH at a central location. Looking both at historical openings and the most recent opening, all water quality parameters, including cyanobacterial biovolume improve during open phases. The only exception to this being conductivity which increases – as would be expected to occur with the influx of ocean water.

The purpose of the most recent opening event, when the lagoon was opened to the sea in September 2024, was to address concerns about the high likelihood of an algal bloom forming in the spring-summer period, which would be an emergency in terms of ecosystem health. Lagoon opening was considered necessary to flush the lagoon and reduce nutrient concentrations. Further, the lagoon was above the recommended water level threshold as proposed in consent conditions for future management.

During the most recent opening event, there appeared to be a visible die-off of bullies (*Gobiomorphus spp*) in some of the prior-inundated wetland along the shoreline of the lagoon. Speciation of the fish was difficult due in part to both the condition and presumed age of the individuals; however, no bully species are ranked as threatened and the At-Risk Blue Gill bully (*Gobiomorphus hubbis)* has not been identified in the lagoon, to date. No cause of death was able to be identified, but due to the location of the die-off it was presumed to be from rapid dewatering of the lagoon, leading to the fish being stranded. Whether this is a regular event that occurs during every opening or a result of prolonged water levels above 2.5m is uncertain. Further, it should be noted that lagoon opening events occurred naturally prior to human-intervention. This shift from freshwater-estuarine phase and the effects on biota are therefore part of the natural functioning of coastal lakes that open periodically to the sea.

In the most recent open phase, there was notable localised growth of a native macroalgae (C*ladophera*) in the lagoon for part of the open period. This species has been known to grow into blooms around the country in both estuarine and freshwater. *Cladophera* are typically linked with warm, low flow, sunny, conditions, and high phosphorus concentrations. These physical conditions will occur in Waituna Lagoon if the lagoon is open, but the phosphorus concentrations in the water typically drop – hence it is uncertain if there is another nutrient driver and would warrant further investigation if it was to continue to propagate during open phases. It is worth noting that this is the first year that this has occurred, and the conditions proposed around

openings intend to avoid summer opening conditions as much as possible.

In terms of fringing wetland vegetation, no detailed monitoring has occurred in response to recent opening events, although vegetation survey was undertaken previously (1998, 2013 reports). Both the 1998 and 2013 studies had observed a downslope migration of some plant communities associated with prolonged period of lower water levels. Nonetheless, many of the fringing plant communities that have established (e.g. extensive Oioi rushlands) provide valuable habitat for threatened and at-risk species (e.g. Fernbird) and are ecological important wetlands. The 2013 report concluded that 'Lagoon levels should not be managed any lower than current levels to halt any continual downward creep of shoreline communities'.

However, it is also accepted that there may be some transition and dieback of native terrestrial species that have migrated downslope based on the proposed opening regime. During September 2024 water levels in Waituna Lagoon remained above 2.4m for a period of ~2-3 weeks. Following this event, reports were received from community of dieback of some vegetation in discrete areas, such as manuka. This reversion (and associated dieback) from terrestrial plants to more wetland plant communities can be viewed as part of the ecological restoration of the natural hydrological and ecological function of the lagoon ecosystem. In other wetlands of New Zealand, manuka has established because of altered hydrology (e.g. Whangamarino wetland) and has subsequently declined as the water levels were restored.

During February-March 2025 monitoring of aquatic plant communities was completed by NIWA (2025, draft report) following the latest emergency opening event for water quality. This found that none of the ecological targets were met in 2025, for example, the lagoon-wide Ruppia cover and Ruppia biomass index were amongst the lowest values on record since 2009 and well below target levels. The target for macroalgae cover was also not achieved, being over the limit of <10% cover lagoon-wide. These results highlight the careful balance needed to manage opening events to address poor water quality pressures, provide for fish passage and conserve aquatic plants.

The main option to manage any adverse effects from an open lagoon is to allow the lagoon to close, changing the conditions back to a higher water level and freshwater dominated phase. There has been exploration of options relating to this extent, but none would guarantee any success. It is however possible to select lagoon opening sites that have more likelihood of rapid closure if this is necessary for future management, and this is enabled by Condition 20 which allows for alternative opening locations where the risks and environmental benefits have been assessed.

Additional S104 Statutory Assessment

The reporting officer has requested a closer look at the statutory assessment with regard to the additional information and changes in this information response including NPS-FM Policy 6 and effects management hierarchy NZCPS Policy 13 and SWLP Policies 20, 32, 33 and 33A – focusing on opening/lowered water levels.

NPS-FM Policy 6 and Effects Management Hierarchy

Policy 6

Policy 6 seeks to avoid the loss of natural inland wetlands, protect their values, and promote their restoration. No wetland loss is anticipated to occur as a result of the lagoon openings, nor for the opening regime as a whole. The purpose of the consent is for the restoration of the lagoon and protection of its values, consistent with Policy 6.

In terms of the short-term effects associated with an opening event, areas of fringing wetlands will be dewatered when opening events occur, which will result in pockets of isolated vegetation loss (such as manuka dieback as observed by some submitters). Although this will result in some change to terrestrial vegetation, a gradual shift to higher lagoon levels allows the indigenous wetland vegetation to transition gradually over time as part of the ecological restoration of the lagoon.

Effects Management Hierarchy

Effects management hierarchy, in the NPSFM means '*an approach to managing the adverse effects of an activity on the extent or values of a wetland or river (including cumulative effects and loss of potential value) that requires that*:

(a) adverse effects are avoided where practicable; then

(b) where adverse effects cannot be avoided, they are minimised where practicable; then

(c) where adverse effects cannot be minimised, they are remedied where practicable; then

(d) where more than minor residual adverse effects cannot be avoided, minimised, or remedied, aquatic offsetting is provided where possible; then

(e) if aquatic offsetting of more than minor residual adverse effects is not possible, aquatic compensation is provided; then

(f) if aquatic compensation is not appropriate, the activity itself is avoided'.

As outlined Section 10.4.2 of the application AEE, the application is considered to accord with the NPSFM effects management hierarchy. The proposed opening regime seeks to avoid adverse effects on the natural wetland values of Waituna Lagoon and to maintain and restore ecological health and cultural values of the lagoon ecosystem. As outlined in the AEE in Section 9, not all adverse effects can be avoided during the transitional period and there will be minor and short-term effects associated with opening events.

In applying Policy 33A as required by Section 3.22 of the NPSFM, although changes to habitat will occur over time as the lagoon and fringing wetlands adapt to higher opening levels than those it has adapted to historically, no loss of wetland extent is anticipated, and therefore the effects management hierarchy is not engaged. Should the reporting officer have a differing view, it is also noted that effects that are not avoided are minimised, and as the activity is for restoration and biosecurity purposes, the application meets the exceptions in 33A(a)(ii).

NZCPS Policy 13

The characteristics and qualities of Waituna Lagoon that contribute to the natural character of the lagoon are described in the application AEE and an assessment of the provisions of the NZCPS is provided at Section 10.2. A more detailed assessment of Policy 13 in the context of lagoon opening effects is provided below:

"To preserve the natural character of the coastal environment and to protect it from inappropriate subdivision, use, and development:

1. *avoid adverse effects of activities on natural character in areas of the coastal environment with outstanding natural character; and*

2. *avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on natural character in all other areas of the coastal environment; including by*:

3. *assessing the natural character of the coastal environment of the region or district, by mapping or otherwise identifying at least areas of high natural character; an*

4. *ensuring that regional policy statements, and plans, identify areas where preserving natural character requires objectives, policies and rules, and include those provisions".*

Areas of high or outstanding natural character are not mapped in the RPS, Regional Coastal Plan, or the District Plan. As outlined in Section 9.8 of the Application AEE,

lagoon openings will have temporary effects on natural character. The natural movement of water and sediment, and natural elements, processes and patterns will be temporarily disrupted (13(2)(1) and (5)). These temporary adverse effects on natural character values are necessary to protect landscape and natural character values that would otherwise be adversely affected if an algal bloom were to proliferate, or if fish passage was not enabled.

The application is therefore considered to accord with Policy 13, as without the proposed opening regime in place, the lagoon is at risk of declining natural character impacting those aspects of natural character listed in 13(2), including natural elements, processes and patterns, biophysical, ecological, geological and geomorphological aspects, natural landforms (wetlands), and places or areas that are wild or scenic.

SWLP Policies 20, 32, and 33

Policy 32 – Protect significant indigenous vegetation and habitat

Protect significant indigenous vegetation and significant habitats of indigenous fauna and maintain indigenous biodiversity associated with natural wetlands, lakes and rivers and their margins.

Policy 33 – Adverse effects on natural wetlands

Prevent the reduction in area, function and quality of natural wetlands, including through drainage, discharges and vegetation removal.

The purpose of the application accords with policies 32 and 33. As set out in Section 2.4 of this addendum, there may be small, isolated areas of vegetation dieback as the regime transitions to lagoon to higher levels over time. However, this is attributable to managing the lagoon at higher levels than in the past, not to lagoon openings. In the context of the short-term effects associated with an opening event, significant indigenous vegetation is not likely to be adversely affected as lagoon levels will increase again over time. Similarly, the short term dewatering of the fringing wetlands will reduce the function of these areas temporarily, and as soon as the lagoon is closed the effects reduce to nil, or will become positive (particularly where the lagoon has been opened for water quality or fish passage reasons).

Policy 20 – Management of water resources

Manage the taking, abstraction, use, damming or diversion of surface water and groundwater so as to:

1A. recognise that the use and development (such as primary production) of Southland's land and water resources can have positive effects including enabling people and communities to provide for their social, economic and cultural wellbeing;

Not applicable to the assessment of the short term adverse effects associated with opening events, noting that a reduction in lagoon levels is sought by most submitters and these short term changes are likely to be viewed positively by those submitters.

1. avoid where reasonably practicable, or otherwise remedy or mitigate, adverse effects from the use and development of surface water resources on:

(a) the quality and quantity of aquatic habitat, including the life supporting capacity and ecosystem health and processes of water bodies;

Short term effects on the quality of habitat during an opening event are anticipated as areas of fringing wetland that were inundated or wetted prior to opening will be dewatered. These effects are considered to be minor and of a temporary duration, with effects reducing to nil once the lagoon closes and fills again. Similarly, there may be associated short term effects on aquatic habitat during an opening event as the lagoon discharges into the CMA, and seawater enters the lagoon. These will be temporary, and are necessary to protect quality and quantity of habitat overall, particularly where the opening is required for water quality, biosecurity or fish passage reasons.

(b) natural character values, natural features, and amenity, aesthetic and landscape values;

Short term effects associated with amenity and landscape are assessed in Section 9.8 of the Application AEE, and natural character has been assessed under NZCPS Policy 13 above. The are minor, sort in duration, return to nil after the lagoon closes, and the short term effects are necessary to protect these values long-term (e.g. opening the lagoon to disrupt an agal bloom).

(c) areas of significant indigenous vegetation and significant habitats of indigenous fauna;

Already assessed against policies 32 and 33 above.

(d) recreational values;

The immediate area where an opening occurs on the gravel bar will be temporarily restricted to public access for reasons of public safety. Short term effects associated with opening events are likely to be positive for recreation values, particularly where

track access was hindered by higher lagoon levels. Fishing and boating access is possible at any time, whether the lagoon is in an open phase or closed phase. The reserve (and lagoon) is not a high use recreational site.

(e) the spiritual and cultural values and beliefs of tangata whenua;

Archaeological discovery conditions are proposed, and no adverse effects are anticipated, noting that Awarua Rūnanga are a co-applicant and support the application.

(f) water quality, including temperature and oxygen content;

This is met, as one of the key purposes of the application is to manage the lagoon to avoid adverse effects associated with poor water quality.

(g) the reliability of supply for lawful existing surface water users, including those with existing, but not yet implemented, resource consents;

(h) groundwater quality and quantity;

No short term adverse effects associated with lagoon opening are anticipated on groundwater quality or quantity.

(i) mātaitai, taiāpure and nohoanga; and

No adverse effects are anticipated, noting that Awarua Rūnanga are a co-applicant and support the application. Waituna Lagoon is a statutory acknowledgement site under the Ngāi Tahu Claims Settlement Act, and there are no mātaitai, taiāpure or nohoanga sites currently associated with Waituna.

(j) historic heritage values….

No adverse effects are anticipated, noting that archaeological discovery conditions are proposed in the unlikely event that archaeological material is discovered during physical opening works.

2.7 Effects of Proposed Changes to Conditions

Information Requested

… I also was wondering if you could ***provide a paragraph or two to discuss the application addendum and the effects of the proposed changes****….*

Response

The application addendum provided a summary of the proposed changes to resource consent conditions follow the prehearing meeting with submitters in March 2025 (Refer **Appendix C** for updated conditions, and **Appendix G** for an addendum explanation which summarises the changes). The purpose of the proposed changes was to respond to the concerns expressed by submitter at the prehearing and to narrow the issues of contention for the resource consent application. A summary of the changes, follow by a brief assessment of the effects of each change is set out below.

Changes to Opening Triggers

These changes include amending Condition 4 regarding water level triggers so that for the first 5 years the 1 September to 30 April trigger levels are decreased from 2.5m to 2.4m (for three consecutive days), and for years 6-10 a similar decrease to trigger levels from 2.5m to 2.4m (for three consecutive days). Changes have also been made to Condition 5 to ensure there is the ability to open the lagoon to prevent or mitigate an emergency situation, where the ecological and cultural values of the lagoon are under imminent risk of significant decline, taking account of the proposed lagoon indicators.

These changes directly respond to the key concerns expressed by most submitters in their submissions and during the pre-hearing that they consider the trigger levels are too high. Feedback received in response by the Waituna Catchment Committee and several other submitters is these further changes made by the applicants still do not go far enough, with most seeking levels ranging between 2m and 2.3m, and a shorter consent term.

Although the applicants understand that submitters seek a lower trigger level than the amended levels proposed, lower levels are not supported by the Science Advisory Group or the applicants. Lower levels are likely to have more than minor adverse effects on the ecological and cultural values of the lagoon, and would delay restoring the lagoon to a state of hauora, which is the primary purpose of the application.

The Science Advisory Group have advised that the proposed decrease from 2.5m to 2.4m is anticipated to have minor adverse effects on ecological values. This is based on further analysis of the frequency of lagoon openings comparing 2.5m and 2.4m levels. A summary of this analysis, prepared by Dr Robertson, is attached as **Appendix F**, and concludes that "*applying a 2.4m maximum trigger level will likely have some minor negative impacts on target ecological and cultural values and result in a*

slightly less natural opening regime".

On this basis, the applicants cannot support an opening regime any lower than the proposed amendments. The purpose of the resource consent application is the restoration of the ecological and cultural values of an internationally significant coastal lagoon and wetland environment. One of the primary reasons a staged approach over a 20 year period is proposed is to provide time for the catchment community to adjust to this change. The applicants have no ecological evidential basis to support lowering proposed opening levels further. The amended levels proposed will have minor effects in the short term, transitioning to positive effects over the medium-longer term of the consent.

Consent Implementation Plan (CMP)

The proposed Consent Implementation Plan directly responds to concerns expressed in submissions and at the pre-hearing regarding the applicants' ability to exercise the consent and the absence of a Reserves Act Authority being in place. The Consent Implementation Plan sets out how the consent will be exercised, including a decision tree setting out how decisions will be made regarding lagoon openings, and an undertaking to seek the associated Reserves Act Authority within 3 months of the grant of consent.

It is noted that the Reserves Act Authority (which is required to authorise disturbance and excavating part of the reserve, removal of plant material, soil and minerals and placing these in the reserve, bringing in machinery to undertake these actions, and partial temporary closure to the public – as required for the proper and beneficial management and control of the scientific reserve) was a concern for several submitters who considered the applicants should already have this in place. However conditions of consent are unable to lawfully require this, and there is little sense in applying for an authority until such time as approved conditions are in place, as the authority once applied for and granted, will likely require compliance with the resource consent (as has been the case previously). Therefore, the resource consent approval must come first.

Updated Communications Management Plan

These changes include an updated CMP prepared in consultation the Waituna Catchment Committee with the purpose of addressing their concerns raised at the pre-hearing regarding consent holder communications. The amended conditions require this be implemented and regularly reviewed, including a specific requirement to review it after the first 12 months.

None of these changes are anticipated to have adverse effects on people or the environment. The changes improve the application conditions by providing the Consent Authority and submitters with clarification regarding exactly how the community and stakeholders will be informed of the exercise of the consent.

Science Advisory Group (SAG) Clarification

These changes to Condition 11 clarify what 'suitably qualified expert' means and confirm that SAG is to include an independent Chair, and a suitably qualified expert on behalf of the Waituna Catchment Community – with the actual and reasonable costs to be shared by the Consent Holders.

None of these changes are anticipated to have adverse effects on people or the environment. The changes improve the application conditions by providing the Consent Authority and submitters with clarification regarding the experts on the SAG, and to assure Waituna Catchment Community that there are no costs associated with their nominated suitably qualified expert attending the SAG.

Other Miscellaneous Changes

These include:

- A change to Condition 7 to require that notices of lagoon opening provide information on the opening location and methodology, having considered the purpose of the opening, forecast weather conditions, and the coastal environment.

- An addition to Condition 14 to require that submitted monitoring information includes observations and information learned from lagoon openings.

- Additions to Condition 16 regarding the 5 yearly consent reviews – to include a review of the implementation and effectiveness of the CMP, SAG, and consent holder reporting and decision making, and whether the opening and methodology are the most appropriate to deal with adverse effects.

- None of these changes are anticipated to have adverse effects on people or the environment. The changes improve the application conditions by providing the Consent Authority and submitters with clarification regarding the opening process, monitoring, and consent review.

  None of these changes are anticipated to have adverse effects on people or the environment. The changes improve the application conditions by providing the Consent Authority and submitters with clarification regarding how the

consent will be exercised.

Appendix A: S92(2) peer review and email requests for associated information

Technical Memorandum

To:	Danielle Petricevich, Principal Planner	**From:**	Nicola Pyper, Principal Freshwater Ecologist Pete Wilson, Principal Marine Ecologist
Company:	SLR Consulting New Zealand (on behalf of Environment Southland)		**SLR Consulting New Zealand**
cc:		**Date:**	30 May 2025
		Project No.	880.016784.00001

RE: Waituna Lagoon Ecology Technical Review
APP-20242456

1.0 Introduction

SLR Consulting New Zealand (SLR) has been engaged by Environment Southland (ES) as the consent authority and regulator to undertake a technical review of a resource consent application submitted by joint applicants, namely Te Rūnanga o Awarua, the Department of Conservation Te Papa Atawhai, and Environment Southland (collectively referred to as the applicant). The applicant is seeking authorisation to periodically open the Waituna Lagoon for the purpose of maintaining and restoring the ecological health and cultural values of the lagoon ecosystem. A memorandum, dated 15 May 2025, provided by Danielle Petricevich on behalf of ES outlines the scope of the ecological peer review.

We have reviewed the relevant sections of the Assessment of Environmental Effects[1] (AEE), the Science Advisory Report[2] (Appendix B of the AEE), the conditions proffered by the applicant (Appendix C), the photos of lagoon opening events (Appendix E), the restoration plan (Appendix F), the vegetation technical report[3] (Appendix I), the summer vegetation reports (Appendix J), a memorandum regarding the impacts on the Coastal Marine Area[4] (CMA), and the application addendum[5]. We have also briefly reviewed the summary of submissions.

2.0 Review

The questions raised by ES relating to the potential ecological impacts of the proposed opening regime have been reproduced below (italicised and highlighted in green), and SLR's response follows.

[1] Taylor Planning. (2024) Periodic opening of Waituna Lagoon to maintain and restore ecological health and cultural values of the lagoon ecosystem. Prepared for Te Rūnanga o Awarua, Department of Conservation Te Papa Atawhai, and Environment Southland. 136 p. plus appendices.
[2] H. Robertson, N. Atkinson, M. de Winton, M. Schallenberg, R. Holmes, A. Rable, K. Wilson, C. Jenkins, D. Whaanga. (2024) Technical review of conditions for opening Waituna Lagoon. Prepared for the Department of Conservation, Te Rūnanga o Awarua and Environment Southland. 60 p.
[3] M. de Winton, I. Zabarte-Maeztu, A. Taumoepeau. (2023) Technical report on vegetation status in Waituna Lagoon: 2009-2023. Prepared for the Department of Conservation. 24 p.
[4] A. Rabel. (2024) Advice on impact to CMA from Waituna opening. Environment Southland. 2 p.
[5] Environment Southland, Te Rūnanga o Awarua, Department of Conservation. (2025) Update to resource consent officer and submitters 14 May 2025. 28 p.

Do you agree with the existing environment values stated by the applicant?

The Science Advisory Report identifies the following ecological and cultural values of the Waituna Lagoon:

- Taonga species.
- Cultural significance.
- Water quality.
- Submerged macrophytes.
- Fish and aquatic invertebrate populations.
- Indigenous species dominance.
- Bird populations.
- Fringing wetlands.

The application presents and/or references data resulting from repeated monitoring events undertaken over many years. Descriptions of the Waituna Lagoon and wider wetland complex have also been provided. Together, these provide a clear picture of the state and value of the existing lagoon environment. It is evident that the ecological values are diverse and, in some instances, unique to the ecosystem of the Waituna Lagoon. While not explicitly stated, the data and descriptions provided in the application are indicative of an environment that supports very high ecological and cultural values, although some features of the environment are existing in a degraded state, for example, the lagoon's water quality can have elevated nutrients and fine suspended sediments due to pressures from wider catchment land uses.

Are the opening triggers proposed appropriate for achieving the outcomes sought by the applicant (maintain and restore the health of the lagoon), including overall values of the wetland?

The Science Advisory Report presents the results of modelling exercises that have been supported by monitoring data collected over several years. The results of the modelling were used by the applicant to determine the proposed triggers for the mechanical opening of the lagoon. The triggers have been selected to promote the maintenance and enhancement of the ecological values of the lagoon, achieving a balance between returning the lagoon to a more natural hydrologic regime, while mitigating the effects of high nutrient loads and consequent degraded water quality.

It is evident that substantial consideration and analysis has been invested to determine appropriate triggers for opening that will support submerged macrophyte, migratory native fish, and water quality values. However, other ecological values, specifically fringing wetland plant communities and avifauna values, do not appear to have been specifically considered when determining an appropriate opening regime. This is discussed in more detail below.

With regard to water quality, the proposed consent conditions include triggers to manage poor water quality within the lagoon that may arise from algal blooms and/or low dissolved oxygen events. The triggers proposed (Science Advisory Report, Appendices 1A & 2A) are deemed to be appropriate as they align closely with the documented attribute bands of the National Policy Statement for Freshwater Management 2020 (NPS-FM), with critical indicator levels similar to the 'national bottom lines' of the NPS-FM. The warning indicator levels are generally set to alert those monitoring the lagoon to ecosystem health and water quality decline and allow the consent holder to monitor the lagoon more closely and prepare for action should a critical level (similar to the national bottom lines of the NPS-FM) be reached. Monitoring and reporting of the primary and secondary indicators of lagoon water

quality and ecosystem health are required by proposed condition 14a). We note this condition doesn't specify the regularity or timing of monitoring. Including a requirement around the frequency and timing of monitoring may be beneficial to ensure sufficient data are collected to enable informed decisions on opening events. We recommend that the conditions be updated so that the parameters to be monitored and frequency of monitoring are clearly specified. In addition, monitoring conditions should include the requirement to sample and measure parameters immediately prior to an opening event and over the period of time the lagoon is open, as well as between openings. This will allow the effects of the opening to be measured and assessed to inform ongoing adaptive management of the opening regime and the lagoon. Due to the complexity of the monitoring regime and the adaptive management approach, the preparation of a monitoring and management plan may be an appropriate way to direct a lagoon monitoring programme.

The applicant is also proposing to follow a transitional regime (in accordance with feedback received through consultation) and will gradually adjust opening triggers over the duration of the consent. The details of the proposed transition regime have been recently updated (cf. the application addendum) in response to further feedback received through submissions. While this transition period may not be optimal for ecological values, we acknowledge the need to balance various stakeholder interests.

The transitional regime also provides the applicant with the opportunity to monitor the adverse effects of opening at various levels and whether the opening regime triggers are resulting in the intended positive effects. The applicant has proposed conditions that will require regular reviews of the consent. This will allow for adaptive management of the lagoon and lagoon opening triggers can be reconsidered with reference to ongoing monitoring data.

Please specifically consider: The use of lagoon water quality and ecosystem health indicators (as specified in Appendix 1 to the proposed conditions) and any potential effects on other ecological values that should be considered.

We consider the use of water quality and ecosystem health indicators appropriate. The water quality indicator levels align closely with the documented attribute bands of the NPS-FM, with critical indicator levels similar to the 'national bottom lines' of the NPS-FM. The ecosystem health indicators (i.e., macrophytes, nuisance macroalgae, and diadromous fish) have been informed by long-term monitoring of the lagoon and a good understanding of the lagoon's values and dynamics.

However, potential effects on other ecological values should be considered, namely fringing wetland plant communities and indigenous avifauna. The application acknowledges that prolonged periods of lower water levels will dewater fringing vegetation and wetland habitats and that a lack of high water levels can promote the growth of exotic species. Little detail has been provided on the existing characteristics of the fringing wetland plant community, although there is some indication that threatened plant species may be present. As the lagoon has been subject to artificial openings in the past and severe fluctuations in water level, it is likely that the existing plant community is well-adapted to these conditions. However, more commentary on this and details on the character of the existing community would further understanding and help confirm that effects on wetland vegetation will be low.

Similarly, we are of the opinion that potential effects on indigenous avifauna need to be considered in more detail. The application notes that the Waituna Lagoon and wider wetland complex support a wide diversity of birdlife, including At Risk and Threatened species. While the application considers that the overall effects of the changed regime will be neutral for avifauna, the potential effects on these populations have not been discussed in detail. However, we are of the opinion that there should be an assessment of whether there will be any meaningful change in foraging habitat for threatened bird species, as well as an analysis

of the effects on breeding birds and any risks associated with increased predation. Of particular concern is the impact on breeding/nesting birds. Nesting birds are not able to easily relocate and there is a risk that nesting wetland species, for example cryptic species that nest on vegetation rafts/platforms, could be at greater risk of predation if water level reductions result in a nest sitting above dry mud/sediment. The risk of this could be reduced if lagoon opening events are avoided or minimised during the breeding season (spring/summer). Alternatively, nesting bird surveys could be undertaken prior to an opening event to identify and manage any nests that may be adversely affected by an opening event. A loss of foraging habitat within proximity of nests during the breeding season would also be considered an adverse effect. These effects have the potential to be significant and impact threatened species during vulnerable parts of their life cycle.

Please specifically consider: The effect of the proposed opening regime on erosion and sedimentation of the lagoon.

A review of a summary of the submissions on the application revealed that submitters are concerned about the adverse effects of erosion and sedimentation associated with extended closure of the lagoon (i.e., not the activity for which consents are being applied), which will likely result in longer and more frequent periods of inundation. The proposed opening of the lagoon will reduce water levels and, therefore, it is considered unlikely that there would be an adverse effect associated with the opening of the lagoon on erosion and sedimentation. However, we note that the potential for erosion and sedimentation effects has not been considered by the application and more information in this regard could improve understanding of the potential erosion risks created by the proposed opening regime.

Please specifically consider: Whether the fish passage opening triggers are considered appropriate.

The fish passage opening triggers are considered appropriate. In a natural state, the lagoon would be expected to open less frequently than under the proposed opening regime, therefore, effects on fish passage are expected to be positive. The opening period of 1 April to 30 November captures at least a portion of the peak upstream and downstream migration events of all indigenous fish species known to use the catchment.

Please specifically consider: The locations of the openings, process for identifying these / risk assessment and whether the potential adverse effects have been appropriately addressed and mitigated through the proposal.

The Science Advisory Report assessed the risks and benefits associated with three sites that could be used for lagoon opening. Based on the assessment, the report recommends that the Walker's Bay location continue to be used as the primary opening site. This is considered appropriate, as potential effects on ecological and cultural values, water quality, and fish passage have all been assessed and comparative information has been provided to support the recommendation for ongoing use of the Walker's Bay site.

The applicant is also proposing that, should it be determined that another site may be more appropriate, a risk assessment will be prepared and submitted to the consent authority prior to any alteration to the opening location. The proposed conditions require that the assessment consider the risk to the ecological values of the lagoon as well as the suitability of the location for managing poor water quality. As the consent holder will be required to consider the effects on ecological values and as the risk assessment will be reviewed by the Consent Authority, this is considered an appropriate way to manage potential effects on the lagoon and respond in an adaptive way to the results of ongoing data collection.

Please specifically consider: The actual or potential adverse effects on fringing wetland and terrestrial indigenous vegetation as a result of the proposed opening regime.

As noted above, there is the potential for native fringing wetland and terrestrial vegetation to be adversely impacted as a result of the proposed opening regime. While it is likely that the existing plant community is well-adapted to these conditions, more commentary on this and details on the character of the existing community would further understanding and help confirm that adverse effects on wetland vegetation will be low.

Are the effects on the coastal environment assessed appropriately and do you agree with the conclusions in relation to effects on the CMA.

The Science Advisory Report describes adverse water quality effects associated with the extended closure of the lagoon (i.e., not the activity for which consents are being applied for). Once opened, nutrient and chlorophyll-a levels within the lagoon typically decrease (improved water quality). As such, there appear to be no adverse water quality effects in the Waituna Lagoon from opening to the sea. As the lagoon historically periodically opened to the sea naturally, the increased salinity that may occur within the lagoon when it's open is not considered an adverse effect.

The key potential adverse water quality effects from opening the Waituna Lagoon are due to the discharge of water from the Waituna Lagoon into the CMA. This water may contain elevated levels of nutrients, fine sediment, faecal bacteria, and algae (potentially toxin-producing cyanobacteria if opened during a bloom event).

The Science Advisory Report provides no assessment on the potential effects of discharging from the Waituna Lagoon into the CMA. A brief, supplementary memo prepared by Environment Southland (Advice on impact to CMA from Waituna opening – dated 20 November 2024), does however provide some comment on this. The memo identifies the following effects during and following a lagoon opening event on water quality in the CMA:

- A visible plume. A different colour to water in the CMA but similar to that of the Waituna Creek. This colour is likely due to tannins in the water, but also presumably to some concentration of fine, suspended sediment.
- A discharge of nutrients into the CMA. Nutrient concentrations in the initial discharge were higher than in most Southland estuarine environments, except for New River.

The memo is silent on the discharge quality or effects in the scenario that the lagoon is opened to manage an algal bloom (which may include toxin-producing species) and on the effects of elevated levels of faecal bacteria.

After the initial discharge from the lagoon, the ongoing discharge has a relatively low flow as the largest contributing waterway, the Waituna Creek, has a mean flow of 1.67 m^3/s. This allows for substantial mixing with oceanic water.

The memo notes that water quality is not monitored in the CMA, making it difficult to infer whether there are adverse effects resulting from the discharge and whether any effects may persist.

Overall, there is limited assessment on the effects of the discharge of water from the Waituna Lagoon into the CMA. I agree with the statement in the memo that the CMA at the opening locations is likely to be a high-energy environment with high water movement. This provides a large potential for mixing and dilution of nutrients, faecal bacteria and algae, and the resuspension of deposited fine sediments. The most likely adverse effects in the CMA from discharges from the Waituna Lagoon are elevated levels of nutrients resulting in algal blooms, or sustained blooms in the CMA once discharged from the lagoon. The memo notes that there have been no reports of algal blooms in the CMA during the 80+ years of lagoon

opening. As such, I agree that it's unlikely that the discharge of water from the Waituna Lagoon is having long-lasting effects on water quality in the CMA. High water movement generally does not provide the right conditions to sustain algal blooms. Recording observations of visible water quality in the CMA during and following an opening event may be one approach to confirm this.

The nearest urban activities to the Waituna Lagoon are Tiwai Point and the Bluff Township, located approximately 15km west. Substantial dilution of the Waituna Lagoon discharge would occur in the high-energy marine environment over this distance, and it would be unlikely to have measurable effects on water quality near the entrance to Bluff Harbour. It may be helpful to confirm this by monitoring water quality (before, during, and after opening) or with a modelling-based approach.

One risk not assessed in the Science Advisory Report or technical memo is that of human health. There may be elevated levels of faecal bacteria and/or toxin-producing cyanobacteria in the discharge, which is likely to make the water unsuitable for swimming or gathering shellfish near the point(s) of discharge. The Waituna Lagoon is in a fairly remote part of the Southland Region and I understand it is not known to be a popular swimming location. As such, the actual risk to people is likely to be low. However, consideration of whether signage would be beneficial during opening events to warn/educate may be warranted if there is a chance that people may interact with the water. The risk to people in the CMA is likely to be no greater than the risk people would have interacting with the water in the Waituna Lagoon itself; however, the lagoon water may not be suitable for human recreation at times due to elevated levels of faecal bacteria and/or cyanobacteria.

Whether there is sufficient information to understand the adverse effects of the proposal and, if not, what further information is required.

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

- An assessment of effects on native avifauna communities should be provided. This should include an assessment of whether there will be any meaningful change in foraging habitat, as well as an analysis of the effects on breeding birds and any risks associated with increased predation.
- Further commentary on the potential effects of lagoon opening on fringing wetland vegetation communities and their extent should be provided. This will allow for some certainty that any effect will be at an acceptable level.

Confirm that the data used in the assessment is reliable and up to date and that the scientific methods employed are both appropriate and up to date. Identify any outdated or inappropriate methodologies and recommend alternative approaches where necessary.

We consider the methods employed for data collection to be appropriate and the data is considered up to date and reliable. The lagoon is regularly (i.e., annually for many parameters) monitored for a broad range of attributes, including trophic level index, nutrient concentrations, suspended solids, phytoplankton, and macrophyte biomass, with this monitoring having occurred over a significant period of time (at least 15 years for most metrics). In addition, fish monitoring commenced in 2020 and is ongoing. This data is considered sufficient to support robust modelling and the application's consequent recommendations for the proposed opening regime.

Whether the monitoring proposed is sufficient, or whether you recommend additional monitoring, including any changes to proposed consent conditions.

Regular monitoring of water quality and ecological attributes of the Waituna Lagoon has been occurring over several years. The applicant is proposing to continue monitoring which will allow a response to the critical indicators proposed in the conditions of consent. However, the specifics of monitoring (i.e., timing, frequency, location, parameters to be measured) is not prescribed by the conditions. Therefore, we recommend that the conditions be updated so that the parameters to be monitored and frequency of monitoring are clearly specified. In addition, monitoring conditions should include the requirement to sample and measure parameters immediately prior to an opening event, over the period of time the lagoon is open, and when the lagoon is closed. This will allow the effects of the opening to be measured and assessed to inform ongoing adaptive management of the opening regime and the lagoon. Due to the complexity of the monitoring regime, the preparation of a monitoring and management plan may be an appropriate way to direct the lagoon monitoring programme.

Additionally, further information is required regarding impacts on fringing wetland vegetation and native avifauna populations, and this information may highlight the need for ongoing monitoring of other ecological parameters.

Evaluate whether all assumptions and limitations are clearly stated in the assessment and have been appropriately addressed. Recommend any additional clarifications or mitigations needed to manage these limitations.

No clarification regarding limitations is necessary.

3.0 Closure

We have reviewed the application seeking authorisation to periodically open the Waituna Lagoon in order to maintain and restore the ecological health and cultural values of the ecosystem. Information gaps and concerns that have yet to be addressed by the applicant have been highlighted. In particular, we recommend that further information be sought regarding effects on fringing wetland vegetation and native avifauna populations.

Regards,

SLR Consulting New Zealand

Nicola Pyper
Principal Freshwater Ecologist

Pete Wilson
Principal Marine Ecologist

From:	Lisa Thorne
To:	Lisa Thorne
Subject:	FW: Request for commissioning of report for resource consent application - APP-20242456
Date:	Wednesday, 25 June 2025 10:10:28 am
Attachments:	image001.png image002.png

From: Danielle Petricevich <danielle.petricevich@slrconsulting.com>
Sent: Tuesday, 3 June 2025 12:06 pm
To: Lisa Thorne <lisa.thorne@taylorplanning.co.nz>
Cc: Resource Consents <ResourceConsents@es.govt.nz>
Subject: RE: Request for commissioning of report for resource consent application - APP-20242456

Hi Lisa,

That is the main issue to address, but there are a couple of other ones where the tech reviewers have raised or recommended something, these are:

- Regularity or timing of proposed monitoring
  - Including a requirement around the frequency and timing of monitoring may be beneficial to ensure sufficient data are collected to enable informed decisions on opening events. We recommend that the conditions be updated so that the parameters to be monitored and frequency of monitoring are clearly specified. In addition, monitoring conditions should include the requirement to sample and measure parameters immediately prior to an opening event and over the period of time the lagoon is open, as well as between openings.
- Monitoring conditions parameters
  - The applicant is proposing to continue monitoring which will allow a response to the critical indicators proposed in the conditions of consent. However, the specifics of monitoring (i.e., timing, frequency, location, parameters to be measured) is not prescribed by the conditions. Therefore, we recommend that the conditions be updated so that the parameters to be monitored and frequency of monitoring are clearly specified. In addition, monitoring conditions should include the requirement to sample and measure parameters immediately prior to an opening event, over the period of time the lagoon is open, and when the lagoon is closed.
- Erosion and sedimentation
  - We note that the potential for erosion and sedimentation effects has not been considered by the application and more information in this regard could improve understanding of the potential erosion risks created by the proposed opening regime.
- Effects on CMA
  - Address tech review comments, including mitigation such as signage for human health reasons

In terms of timeframes, I am ok with progressing my report and the conditions as quickly as possible. In terms of conditions, I think my main issues would be addressed by amending the conditions to give effect to the above points made by the tech reviewers. So, if you have time to make some amendments asap (to give effect to the above comments), you could make some changes and then I could review and make any further amendments. This will mean I can focus more of my time on the s42A.

In terms of the monitorong conditions, I did wonder if you had considered implementing the monitoring through a Monitoring Plan. This way, the Plan could specify the details and could be amended if required. The conditions could specify the minimum information requirements for the plan.

Regards,

Danielle

Danielle Petricevich
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SLR Consulting New Zealand Limited
Level 1, 17 Grey St, Tauranga, New Zealand 3110

From: Lisa Thorne <lisa.thorne@taylorplanning.co.nz>
Sent: Tuesday, 3 June 2025 9:53 am
To: Danielle Petricevich <danielle.petricevich@slrconsulting.com>
Cc: Resource Consents <ResourceConsents@es.govt.nz>
Subject: RE: Request for commissioning of report for resource consent application - APP-20242456

Thanks Danielle,

I'll circulate this to the expert team to see what can be achieved to inform the s42A and to see if they have any questions of clarification before responding. I'm assuming that this relates to the matters identified in section 3.0 '*Further information be sought regarding effects on fringing wetland vegetation and native avifauna populations'*? Let me know if there is anything else.

For some background/context on timeframes, I had requested to Lacey too if it was possible to have the s42A through by 4 July as the applicant's lead science expert Dr Roberston will be overseas shortly after that – and it would give Dr Roberston 5 working days following that to finalise their evidence before he heads away. Appreciate timeframes are tight but if that can be accommodated it would be much appreciated. Likewise with circulation of draft conditions, I agree that it would be helpful to both the applicants and the Consent Authority if myself/the applicant team are able to provide feedback on them – if you let me know what date you are likely to get these through and when you would need a response from us by, I'll work with the applicant team to ensure we hit those dates.

Yes, happy to send through a paragraph or two to discuss the application addendum and the effects of the proposed changes within it and will have this through in the next few days.

If you have any other queries just let me know.

Ngā mihi,

Lisa Thorne
Partner
P: +64 22 474 9254
E: lisa.thorne@taylorplanning.co.nz
W: taylorplanning.co.nz

From: Danielle Petricevich <danielle.petricevich@slrconsulting.com>
Sent: Tuesday, 3 June 2025 9:11 am
To: Lisa Thorne <lisa.thorne@taylorplanning.co.nz>
Cc: Resource Consents <ResourceConsents@es.govt.nz>
Subject: RE: Request for commissioning of report for resource consent application - APP-20242456

Hi Lisa,

Please find the finalised tech review report.
They are largely happy with the information provided in the application, however, have identified a couple of areas where further information could be provided and have made some suggestions regarding monitoring conditions.
If it is possible to address this before my s42A is due, that would be helpful as then I can address it.

I also was wondering if you could provide a paragraph or two to discuss the application addendum and the effects of the proposed changes.
I had also identified that the conditions could do with some work to address monitoring of adverse effects. I plan on working on a revised set of conditions and was hoping to get these to you to review/comment on in the next week or so, but if the hearing date is that last week of July, we might be pushed for time.

If the hearing is that week, my s42A is due to be circulated around the 7th of July, but I will have to have it to Council for review a couple of weeks before hand (around the 23rd of June).

Regards,

Danielle

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Appendix B: Avifauna Response

2.3 Avifauna Effects

Information Requested

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

An assessment of effects on native avifauna communities should be provided. This should include:

- ***Whether there will be any meaningful change in foraging habitat for threatened species.***
- ***An analysis of effects on breeding birds – noting nesting birds are not able to easily relocate and some species that nest on vegetation rafts/ platforms may be at greater risk of predation if reduced water levels (from a lagoon opening) mean nests are sitting above dry mud/ sediment.***
- ***Following on from this, whether lagoon openings during the breeding season could cause a meaningful change in foraging habitat to breeding birds. an assessment of whether there will be any meaningful change in foraging habitat, as well as an analysis of the effects on breeding birds and any risks associated with increased predation.***

Response

Response prepared by Sean Jacques, Biodiversity Supervisor – Department of Conservation, and Dr Hugh Robertson, Principal Science Advisor - Department of Conservation

Background

1. The following response is informed by data drawn from ebird[2] as well as local knowledge of the diversity and habitat preferences of avifauna at Waituna Lagoon and surrounding environments (e.g. estuarine habitat at Awarua Bay). Historic data in ebird may be limited with a predominance of records from the past decade.

2. Ornithological data sets for Waituna Lagoon are incomplete and patchy. The location was periodically surveyed in previous decades as part of systematic counts (mostly of trans-equatorial migrant species), but these ceased here in the late 1990s. The lagoon has not been included in the wading bird censuses of recent years, with the current

local programme focussing effort on key estuarine high tide roosts. Recent bird counts are largely from informal surveys.

3. DOC has also undertaken semi-regular surveys of cryptic wetland bird species (Australasian Bittern, Fernbird) in nearby wetland habitats of the Awarua-Waituna complex, and surveys of dotterel species occur on the barrier (gravel) beach. DOC and local community also maintain a predator trapping network around the perimeter of Waituna Lagoon.

4. The habitat used by different bird species is influenced by the variation of water levels between open (estuarine) and closed (freshwater) phases. Prior to human influence and the management of lagoon opening, Waituna Lagoon would have naturally had extended freshwater phases.

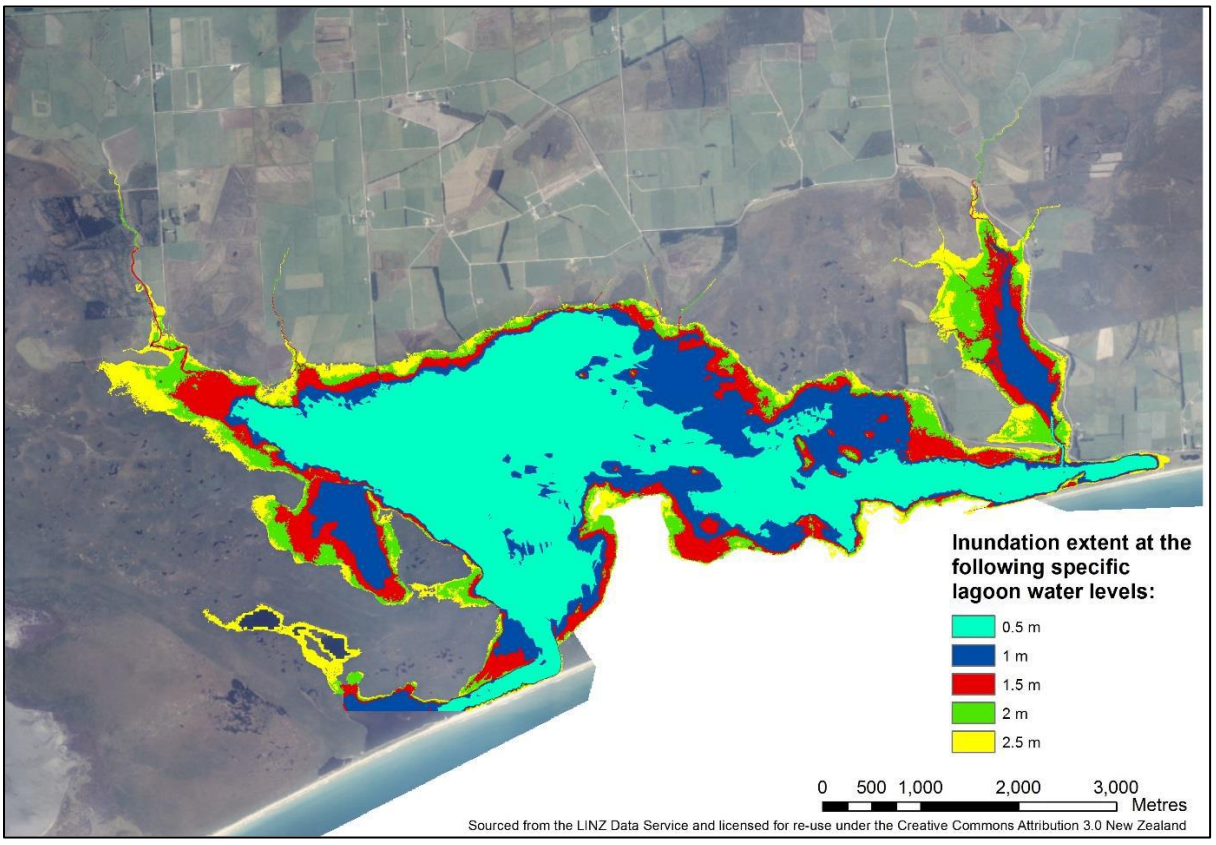

Figure 1. Waituna Lagoon inundation extent at different water depths. Source: Walsh et al. (2016).

5. The main habitat types for birds at Waituna Lagoon include:
    a. Open water areas, including habitat supporting native macrophytes;

b. Shallow water habitat on muds and gravels, which may be intertidal during open phase;
c. Fringing wetland habitat dominated by rushes and reeds (Oioi, wirerush); and
d. Barrier beach (pea-gravel).

6. With the exception of the barrier beach (that is mostly at higher elevation), each of the habitat types will be influenced by lagoon water levels. As noted in the response relating to fringing wetland vegetation (by Dr Robertson) '*there is anticipated to be an increase in the duration of inundation >2.0m and >2.2m for the transitional opening regime compared to how the lagoon has been managed previously. However, when compared to the previous short-term consent this does not exhibit a major change in the duration of 'higher water' periods. For example, it is modelled that water levels will be >2.2m above msl for 8.2 days per annum (compared to 2.0 days previously). Although, using the more conservative seepage rate, this may increase marginally to 12 days per annum >2.2m*'. Refer to Table 1 below.

Table 1. Number of days water levels projected to be >2.0m, 2.2m and 2.4m under Scenario D water level scenario, compared to the previous short-term consent.

Summary information	**Scenario D (transition regime)**	**Previous short-term consent**
Annual days above 2.0m	31.7 days	10.2 days
Annual days above 2.2m	8.2 days	2.0 days
Annual days above 2.4m	0.9 days	0.4 days

7. The Technical Report supporting the application (Robertson et al. 2024), in consultation with Dr Colin O'Donnell, noted:

In respect of migratory waterbirds and other native wetland bird species, Waituna Lagoon forms part of the wider Awarua-Waituna wetland complex on the Southland coast. Awarua is a large wetland/estuarine complex that comprises Awarua Bay, the New River estuary, extensive peatlands and the lagoon. Other coastal wetlands also occur nearby, including Fortrose estuary.

Collectively these areas form an important feeding area for more than 80 bird species including threatened species and trans-equatorial migrants, such as the far eastern

curlew (Numenius madagascariensis), whimbrel (N. phaeopus), and Caspian terns (Hydroprogne caspia). The Awarua wetland also supports notable populations of Australasian Bittern, Fernbird, New Zealand Dotterel, Black Swan, Grey Duck, Black Shag and Royal Spoonbill.

The positive or negative impact of the changes to the hydrological regime for Waituna Lagoon needs to consider the available habitat and resources for bird populations in Waituna Lagoon and across their geographical range. Research on the water level requirements for wetland bird species at Te Waihora (O'Donnell pers. comm.) indicates that different bird functional groups have different habitat preferences (Arctic migrant waders and overwintering waders --> shoreline feeding (0.6 to 0.8m depth); Swamp birds --> flooded reeds/rushes (>0.7m); Waterfowl and shags --> open water (0.4-1.4m)).

Given the contrasting habitat preferences, the open and closed status of the lagoon will have a varied effect on bird functional groups. The proposed conditions for lagoon opening (Scenario C) include both closed (freshwater) and open (tidal) phases. In this scenario water levels are estimated to be above 2.2m for approximately 21 days per year (Table 6) and will still provide for lower water levels during other times of the year for those bird species that prefer more shallow water. The bathymetric map for Waituna Lagoon (Figure 13) further indicates that extensive areas of Waituna Lagoon are inundated to depths >1m when water levels are 1.5m or 2.0m that limits the use of these areas by wading species, but provides habitat for waterfowl species. Waders also frequently use habitats at Awarua Bay and New River estuary.

Bird species and functional groups that occur at Waituna Lagoon and foraging habitats

8. For purposes of this analysis, the species of conservation concern known from Waituna lagoon are split into several functional groups applied by Dr Colin O'Donnell at Te Waihora (Lake Ellesmere), a similar ecosystem to Waituna Lagoon. Tthese functional groups are:
    - Arctic migrant waders and resident/internal migrant/overwintering waders (shoreline feeding);
    - Swamp birds (flooded reeds/rushes);
    - Waterfowl and shags (open water); and
    - 'Other' for threatened species that don't fit well into the above groups.

Migrant Waders

Table 2 below provides a summary of artic migrant wader species of conservation concern.

Table 2: Arctic migrant wading bird species of conservation concern

Species	Scientific name	NZ Conservation status	IUCN threat classification	Peak count Waituna Lagoon	Peak count 2019-2025	Peak count within Awarua-Waituna Ramsar site and specific location
Bar-tailed godwit	*Limosa lapponica*	At Risk, Declining	Near Threatened	204 (Aug 1983)	51 (Feb 2024)	3620 (Jocks Roost Nov 2024)
Red knot	*Calidris canutus*	At Risk, Declining	Near Threatened	51 (Jan 1963)	7 (Feb 2022)	700 (Shellbanks Jan 1987)
Far-Eastern curlew	*Numenius m adagascarie nsis*	Vagrant	Endangered	10 (Jan 1987)	None	11 (Fortrose Estuary Nov 1985)
Ruddy turnstone	*Arenaria inte rpres*	Migrant	Near Threatened	521 (Jan 1987)	57 (Jan 2023)	1037 (New River Estuary Jan 1963)
Red-necked stint	*Calidris ruficolis*	Migrant	Vulnerable	16 (Jan 1977)	2 (Feb 2024)	51 (Awarua Bay Dec 2016)
Sharp-tailed sandpiper	*Calidris acuminata*	Migrant	Vulnerable	35 (Jan 1963)	6 (Jan 2025)	170 (Awarua Bay Dec 1993)

9. All of the species in Table 2 make long-distance migrations along the East-Asian-Australasian Flyway to spend their non-breeding season re-building energy reserves during the austral summer, noting:
    - For some, a small percentage of birds (usually juveniles following their first migration) spend a full calendar year here.
    - Comparison to available historic data demonstrates the expected trend of significant, and in some cases drastic, reduction in counts of these species at Waituna.
    - Causes of decline are well understood[4] - large-scale habitat loss and degradation elsewhere in the flyway.
    - Foraging Arctic migrant waders require low water levels and exposed shorelines/flats in summer. However there is an abundance of suitable habitats elsewhere in the Ramsar site and nearby. A column is included in Table 2 to demonstrate that in most cases other parts of the protected area are significantly more important for these species.
    - Bar-tailed godwit *Limosa lapponica* and Red knot *Calidris canutus* are the species of most interest in terms of the importance of NZ populations within the flyway. Approximately 3% of subspecies *baueri,* Eastern bar-tailed godwit

summer in Southland, most within the Ramsar site. As shown in Table 2, Waituna is of relatively minor importance as a foraging site for this species, and for red knot.

Other indigenous species of conservation concern

10. Table 3 below provides a summary of other indigenous species of conservation concern, across multiple functional groups.

Table 3. Native spp of conservation concern known to forage at Waituna

'Functional group'	**Species**	**Scientific name**	**NZ Conservation status**	**Peak count 2019-2025 (most recent where duplicates occur)**	**Notes**
Resident/Internal migrant/ Overwintering waders (shoreline feeding)	Banded dotterel	Anarhynchus bicinctus	At Risk, Declining	149 (Jan 2025)	Regular, largest numbers during low water levels in late summer.
Resident/Internal migrant/ Overwintering waders (shoreline feeding)	Black-fronted Dotterel	Thinornis melanops	At Risk, Nat. Uncommon	3 (May 2023)	Occasional.
Resident/Internal migrant/Overwintering waders (shoreline feeding)	South Island Oystercatcher	Haematopus finschi	At Risk, Declining	7 (Oct 2024)	Regular in low numbers, Spring-Autumn peak.
Resident/Internal migrant/Overwintering waders (shoreline feeding)	Variable Oystercatcher	Haematopus unicolor	At Risk, Recovering	24 (Apr 2024)	Regular in low numbers year-round. Likely modest peaks at lower water levels.
Resident/Internal migrant/	Wrybill	Anarhynchus frontalis	At Risk, Nat. Increasing	1 (Oct 2024)	Occasional.

Overwintering waders (shoreline feeding)					
Swamp birds	White heron	Ardea alba	Threatened, Nat. Critical	1 (Feb 2024)	Occasional.
Swamp birds	Royal Spoonbill	Platalea regia	At Risk, Nat. Uncommon	53 (Feb 2024)	Fairly generalist species using a range of wetland types. Regular, peaks during low water levels in summer/early autumn, likely birds dispersing from nearby colonies.
Waterfowl and shags	Great Cormorant	Phalacrocora x carbo	At Risk, Relict	12 (Apr 2025)	Regular in low numbers year-round. Likely exploit fishing opportunities at lower water levels.
Waterfowl and shags	Great Cormorant	Phalacrocora x carbo	At Risk, Relict	12 (Apr 2025)	Regular in low numbers year-round. Likely exploit fishing opportunities at lower water levels.
Waterfowl and shags	Various	Various	Not Threatened	-	Ducks including grey teal, Australasian shoveler and NZ scaup use the lagoon at a range of water levels.
Other	Black-fronted tern	Chlidonias albostriatus	Threatened, Nat. Endangered	90 (Feb 2022)	Largest numbers in late summer/autumn during low water levels when counts sometimes close to 1% total population threshold at higher range of published estimate [3].

Other	Black-billed gull	Chroicocephalus bulleri	At Risk, Declining	1200 (Feb 2024)	Regular, largest numbers during low water levels in summer/early autumn.
Other	Caspian Tern	Hydroprogne caspia	Threatened, Nat. Vulnerable	2 (Dec 2020)	Occasional, no strong pattern to occurrences.
Other	Silver Gull	Chroicocephalus novaehollandiae	At Risk, Declining	107 (July 2019)	Regular in low-moderate numbers year-round. Peak numbers likely associated with lower water levels.

11. Optimal foraging conditions differ by species and 'functional group', but in essence all of the 'At Risk/Threatened' wading bird species listed in Table 2 and Table 3 are more likely to be recorded, and in greater numbers when the lagoon is open and switches to a tidal regime. Exposed shorelines and more shallow water depths attract wading species that are otherwise often absent. In this respect a proposed regime that entails a lagoon that is closed during summer periods (noting that open periods will still occur) could have negative impacts upon foraging opportunities however these likely mitigated by;
    - **Wider habitat use:** Waituna is 1350ha within the c20,000 wetland habitat mosaic of the Awarua-Waituna Ramsar area. Birds will exploit exposed habitats of lower water opportunistically, but in their absence are likely to be able to forage, loaf, roost etc elsewhere within the complex. In the context of well-documented declines of bird populations (whilst local wetland remains in broadly good condition), it can be safely assumed that competition is relatively low and that the wider area is far from its carrying capacity of birds.
    - Further, black-fronted tern Chlidonias albostratus is the species of highest local concern (status x local abundance). It is a fairly generalist predator of invertebrates, skinks and small fish, adaptable in feeding approach and habitat use during the non-breeding season. In March 2025 a flock of c160 individuals were observed foraging and loafing on ploughed pasture adjoining but just outside the Ramsar designated area, attesting to their opportunism. Drivers for decline of this species are well understood[3] and do not include a shortage of non-breeding foraging habitat.

12. It should be noted there is a paucity of historic data for these species hence reference only to recent counts.

Habitat for breeding birds

13. The diversity of breeding birds found at Waituna Lagoon is reasonably low and data regarding confirmed nesting events and success of these is limited. On the barrier beach, banded dotterel Anarhynchus bicinctus and variable oystercatcher Haematopus unicolor typically nest at low density along the seaward shoreline, often favouring sites higher up the shingle in elevation (above tidelines), so nesting events are unlikely to be negatively affected by lagoon levels.

14. Southern black-backed gull Larus dominicanus has been noted forming colonies on exposed islands during low water levels over recent summers, but no other migratory or colonial species have been seen to breed.

15. The cryptic swamp species are likely to be, or have formerly been, an important component of the breeding bird community in the wetland habitats of the lagoon edge (rushes). Of these fernbird Poodytes punctatus (At risk, Declining) is widespread in the area and can be safely assumed to breed given the high frequency of sightings year-on-year of what is a relatively short-lived and sedentary passerine. There are a small number of records of marsh Porzana pusilla and spotless crake Zapornia tabuensis (both; At risk, Declining) none with breeding evidence, but these species are notoriously hard to detect and monitor. Presence of suitable habitat and occasional records suggest that nesting is likely to occur in the fringing wetland areas, and through much of the wider protected complex. All three of these species build nests very close to on the ground and nesting success and recruitment would likely be adversely affected by large and/or rapid fluctuation of water levels during the spring and early summer breeding period. Although it is important to note that in an unmodified lagoon ecosystem, changes in water levels would have naturally occurred during high rainfall periods. The proposed water level regime for Waituna Lagoon aims to reduce the frequency of spring/summer openings that will support cryptic wetland birds.

16. Australasian bittern Botaurus poiciloptilus (Threatened, Nationally Critical) also occur in the Awarua-Waituna wetland complex. There are very few records from Waituna Lagoon itself (see Figure 1), and although observations may not be captured in ebird, they are not typically observed at Waituna Lagoon.

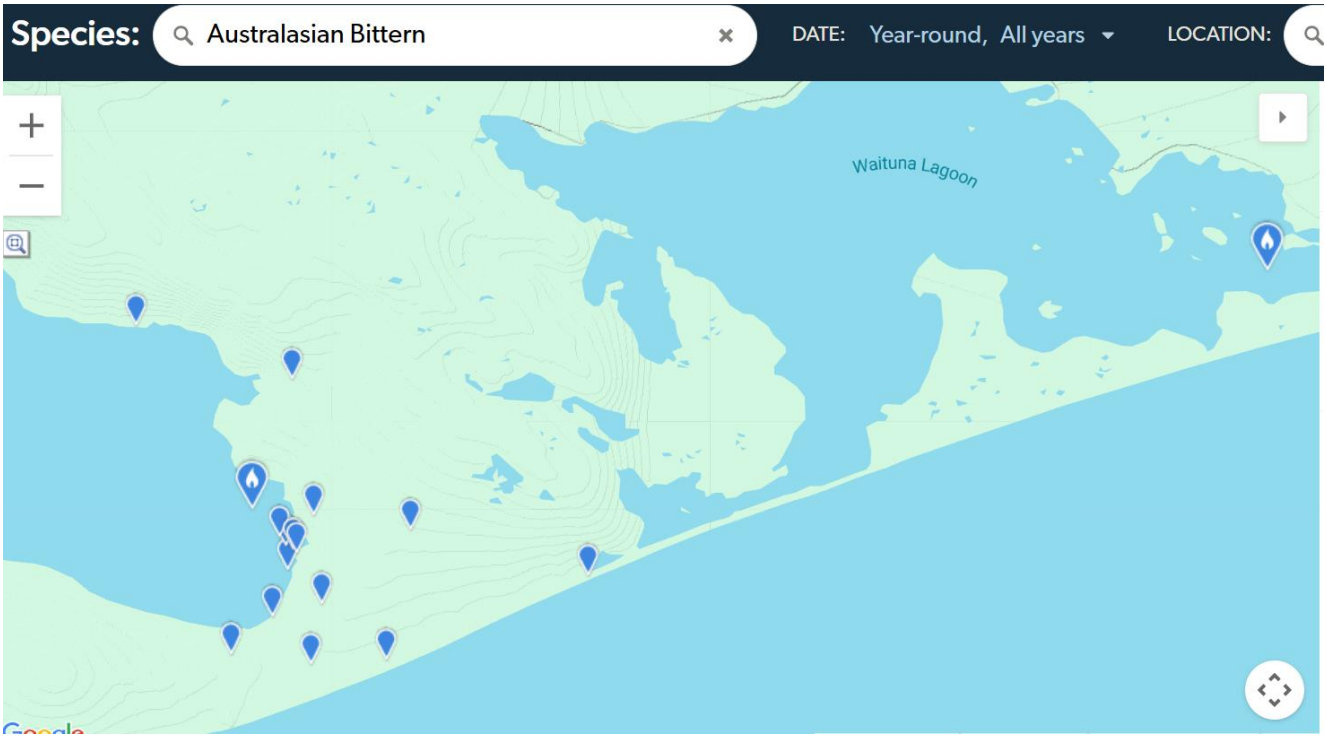

Figure 1: ebird records of Australasian bittern; the blue marker at right covers two sightings, most recent being from1987. The species is frequently recorded from the isthmus between Awarua Bay and Waituna.

17. Local DOC Ranger Sean Jacques has not observed any Bittern in many visits to the lagoon stretching back to late 2018. Other local DOC staff did reliably observe a well-known bird for a period near the Waghorn bridge, but not for some years now. The area with the highest density of sightings is the isthmus between Awarua Bay and Waituna Lagoon, with birds seen regularly foraging in dry areas (likely for skinks) and in flight, either flushed or commuting. There have been observations of multiple birds here, including at least one of three together in courtship behaviour and a nest with young found on one occasion. The many small tarns scattered through the peatlands here are not creek-fed, so likely not as subject to drying when the lagoon opens as are areas further north and east drained by Waituna, Moffat, Carran creeks etc. Though evidence (or absence thereof) suggests that bittern does not currently breed in the wetlands that immediately adjoin the lagoon, it can be assumed that any increase in the health, extent and hydrological stability (reduction of periods of drying and of sudden change in water levels) of fringing wetland is likely to be of benefit to this species and other cryptic native swamp birds.

18. Bittern and crakes in particular prefer to feed as far as possible in shallow water (c15cm[5] for bittern, less for crakes, pers. obs.) concealed by dense vegetation and have evolved plumages to be camouflaged in these environments. These habitats occur in the fringing wetland vegetation at Waituna Lagoon (Oioi rushes) can become dewatered (dry) with the lagoon is open to the sea. Feeding in the open areas (e.g. lagoon bed) is generally a sign of lowered inhibitions due to hunger, starvation being a known factor in population decline of bittern[6]. A lagoon regime that manages the site and its water levels for optimum ecological health is more likely to benefit bittern and other swamp breeders that rely on the complex food webs of healthy and productive wetland systems. Drying of fringing wetland during the spring-summer breeding season will not only expose and endanger nests of cryptic swamp species (including to risk of predation by exotic mammals) but limit safe feeding opportunities for parents and developing young, increasing stress and ultimately reducing chances of survival. As noted above, the proposed water level regime for Waituna Lagoon aims to reduce the frequency of spring/summer openings that will support cryptic wetland birds.

Summary

19. The proposed transitional regime overall will provide for a range of habitats for bird species, ranging from estuarine, shallow-water mud/gravel flats during open phases, to open water and shallow-inundated rushes during the closed freshwater phases. While foraging habitats for some wader species/migrants may be reduced during summer periods, there remain other foraging habitats often utilised throughout the wider Awarua-Waituna Ramsar site. The inundation of rushes will also support cryptic wetland birds.

References

1. National Wader Count Scheme - Birds New Zealand
2. About eBird - eBird.
3. Bell, M. 2013 [updated 2023]. Black-fronted tern | tarapirohe. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
4. Riegen, A.C.; Sagar, P.M. 2020. Distribution and numbers of waders in New Zealand, 2005–2019. *Notornis 67*: 591–634.
5. Dr Colin O'Donnell, pers.comm.
6. Williams, E. 2013 [updated 2022]. Australasian bittern | matuku-hūrepo. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
7. Home page | New Zealand Birds Online

Appendix C: Draft Updated Conditions of Consent

Draft Proposed Conditions of Consent

1. This consent authorises the opening of the Waituna Lagoon (Lagoon) to the sea through the gravel barrier in accordance with Conditions 5 to 7 at Walker's Bay between NZTM 1,262,340E 4,831,360 N and 1,261,460E 4,831,000 N or unless otherwise certified by the Consent Authority in accordance with Condition 19.

2. The level of the Lagoon will be measured at the Waghorn's Bridge gauge or if that gauge for any reason is not available an alternative gauge approved by the Consent Authority.

3. In this consent a Lagoon opening means:

    a) use of excavators operating on the gravel bar, starting from the landward side of the Lagoon; and

    b) formation of a channel between the Lagoon and sea, with excavated material retained alongside the channel and levelled off.

Lagoon Opening Conditions

4. Lagoon Opening – transitional regime:

    a) for the first five years from the grant of consent (years 1-5), being to [day month year]:

        i. summer openings (1 September to 30 April) may occur if water levels are at or above 2.45m for ~~24 consecutive hours~~three consecutive days; and

        ii. winter openings (1 May to 30 August) may occur if water levels are at or above 2.3m for seven consecutive days;

    b) for the next five years of the consent (years 6-10), being from [day month year] to [day month year], openings may occur if water levels are at or above 2.4m for three consecutive days; and

    ~~b)~~c) for the next ~~ten~~ five years of the consent (years 116-15), being from [day month year] to [day month year], openings may occur if water levels are at or above 2.5m for three consecutive days; and

    ~~c)~~d) for the final five years of the consent (years 16-20), being from [day month year] to [day month year] openings may occur if water levels are at or above 2.5m for seven consecutive days.

5. Lagoon Opening – to protect water quality and ecosystem health:

    a) The Lagoon may be opened to the sea at any time of the year when the water level in the lagoon is able to facilitate an opening, provided that:

i. One or more of the primary lagoon water quality and ecosystem health indicators in Appendix 1 have reached a Critical Indicator Level, or to prevent or mitigate an emergency situation where the ecological and cultural values of the lagoon are under imminent risk of significant decline, taking into account the indicators listed in Appendix 1 and Appendix 2; and

ii. The Science Advisory Group has considered the Primary Indicators in Appendix 1, and any other relevant scientific information, including additional indicators of Ecosystem Health set out in Appendix 2, and recommend in writing to the consent holders that opening the lagoon to the sea is necessary to manage the risk of a significant adverse ecological effect on the lagoon; and taking into account

iii. Any request in writing from a member of the public to the Consent Authority or to the Consent Holders that the lagoon be opened to protect water quality and ecosystem health.

Note:
Science Advisory Group means the group established in accordance with ***Condition 8****.*
Emergency Situation means an adverse effect or sudden event in accordance with s330(b)-(f) of the RMA.

6. Lagoon Opening - for the purpose of providing fish passage:

a) The Lagoon may be opened to the sea to provide for passage for diadromous fish species, provided that:

i. The opening takes place between 1 April and 30 November; and

ii. The lagoon has not been opened in the previous 24 months, or if the lagoon was opened during the past 24 months, where the timing of the open period did not support upstream migration of threatened or at-risk fish species, and

iii. The Science Advisory Group, has considered the lagoon water quality and ecosystem health indicators listed in Appendix 1 and 2, and any other relevant scientific and cultural information, and has advised the Consent Holders and Consent authority that opening the lagoon to the sea is necessary to enable fish passage.

Note: Science Advisory Group means the group established in accordance with ***Condition 8****.*

7. ~~Notification of~~ Lagoon Opening Process:

a) Lagoon opening must be in accordance with the Consent Implementation Plan in **Appendix 4.**

~~a) Prior to opening the Lagoon under **Conditions 4, 5, or 6**, and at least 24 hours in advance, the consent holders must:~~

~~i. Notify in writing via email:~~

- ~~Fish & Game New Zealand;~~
- ~~The Lake Waituna Control Association;~~
- ~~Landowners adjacent to the lagoon;~~
- ~~The Consent Authority.~~

~~ii. Notify the public of the opening on the Environment Southland website.~~

b) The opening notice~~s~~ in ~~Condition 7(a)(i) and (ii)~~ the **Consent Implementation Plan** must include:

i. The proposed date of the opening;

ii. The purpose of the opening in accordance with **Conditions 4,5 or 6**;

iii. ~~t~~The current water level at the Lagoon and average daily water levels for the previous seven days; ~~and~~

~~iii.~~iv. The opening location and methodology, having considered the purpose of the opening, ~~climate~~forecast weather conditions, and coastal environment; and

~~iv.~~v. a note of the prevailing wind conditions (direction and strength)~~.~~, and comment whether or not there is any reason to suspect that the water level is only temporarily raised at the gauge board by strong wind conditions; and

~~v.~~vi. any lagoon monitoring information necessary to show compliance with the opening criteria specified in **Conditions 4, 5, or 6**. This must include:

- A copy of the written advice from the Science Advisory Group of the reason for opening as specified in **Condition 5** if the opening is in accordance with **Condition 5**;
- A copy of the written advice from the Science Advisory Group of the reason for opening as specified in **Condition 6** if the opening is in accordance with **Condition 6**.

Science Advisory Group

8. The consent holders shall establish a Science Advisory Group. The purpose of the Science Advisory Group is to:

(a) Act as an advisory group to the consent holders; and
(b) Make recommendations to the consent holders under **Conditions 5**

and 6.

9. Decisions of the Science Advisory Group must be made unanimously or if a decision cannot be made unanimously by majority.

10. All organisations represented in the Science Advisory Group will bear their own cost of their representative. The actual and reasonable costs of additional experts in (c) is to be shared by the consent holders.

11. The Science Advisory Group:

    (a) must include suitably qualified expert representatives of:

        i. the Director-General of Conservation;

        ii. Awarua Rūnaka;

        iii. Environment Southland; and

    b) Must include a~~A~~ suitably qualified expert Chair, from an organisation independent of the Consent Holders and Waituna Catchment community.

    Prior to the appointment of the Chair, the nomination must be submitted by the Consent Holders to the Consent Authority for certification of the Chair's independence.

    c) May include:

        i. A suitably qualified expert representative of the ~~Lake Waituna Control Association~~ Waituna Catchment c~~C~~ommunity with scientific ~~or cultural~~ knowledge of coastal lagoon ecosystems, if one is nominated by the Waituna Catchment c~~C~~ommunity ~~within six months of the consent approval~~.

        The consent holders must provide the Waituna Catchment community ~~Lake Waituna Control Association~~ an opportunity to nominate a ~~suitably qualified technical expert as its~~ representative o~~f~~n the Science Advisory Group and accept the nominee, provided the nominee is a suitably qualified ~~technical~~ expert; and

        ~~i.~~ Other suitably qualified experts ~~technical experts~~ with scientific or cultural knowledge of coastal lagoon ecosystems approved by the consent holders.

        ii.

    Note:
    A suitably qualified expert means:
    A person acting in accordance with the Environment Court Code of Conduct for Expert Witnesses, with qualifications in a scientific or related discipline

related to coastal lagoon ecosystems (such as water quality, ecology, geomorphology, or freshwater or coastal processes), or a representative of Awarua Rūnaka with cultural knowledge.

12. The Science Advisory Group must advise the consent holders in writing whether opening the lagoon to the sea is recommended to manage the risk of a significant adverse ecological effect on the lagoon. This must occur as soon as reasonably practicable but not later than five~~ten~~ working days of the consent holders notifying the Science Advisory Group that monitoring in accordance with **Condition 14** demonstrates that one or more of the Primary lagoon water quality and ecosystem health indicators has reached its Critical Indicator Level.

Communications

13. The consent must be exercised in accordance with the Communications Management Plan (CMP) dated 6 May 2025:
    (a) The consent holder must review the CMP in consultation with the Waituna catchment community, 12 months from consent approval, and thereafter at 5 yearly intervals starting at year 5, and must provide the updated CMP to the consent authority for certification. ~~provide the Consent Authority with a Communication Management Plan within six months of commencement of this consent.~~
    (b) ~~The~~ The purpose of the CMP~~is plan~~ is to set out how:
        i. The consent holders will make matters related to the exercise of the consent publicly available and accessible, including but not limited to lagoon openings and monitoring information;
        ii. ~~inform~~ interested parties are to be informed of the matters related to the ~~Waituna lagoon~~exercise of the consent in (i) above; and~~.~~
        ~~i.~~iii. interested parties can make enquiries or raise concerns to the consent holders regarding the health of the lagoon or the exercise of the consent, and how these matters will be responded to.

Monitoring and Reporting Conditions

~~13.~~14. The consent holders must monitor and record the following information:

a) changes in the primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2 in accordance with the Monitoring Plan**;

b) when and where the lagoon is opened to the sea;

c) the water level in the lagoon at the time it was opened;

d) information to demonstrate compliance with the opening **Conditions 4, 5, and/or 6 in accordance with the Monitoring Plan**;

e) how long the lagoon is open to the sea, ~~and~~ when it closes (to the nearest week), and observations/information learned from the opening.

15. The consent holders must engage a suitably qualified expert(s) to prepare a Monitoring Plan. The Monitoring Plan must be submitted to the Consent Authority for Certification no later than 60 working days following the grant of resource consent, and prior to the exercise of the consent. The purpose of the Monitoring Plan is to direct the parameters to be monitored and the frequency of monitoring of:

- information to demonstrate compliance with the opening **Conditions 4, 5, and/or 6**; and
- the primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2.**

The Monitoring Plan must include as a minimum:

a) How the location of openings will be recorded;
b) The timing, location and methods of monitoring:
   a. the transitional regime water levels as specified in Condition 4;
   b. to protect water quality and ecosystem health as specified in Condition 5;
   c. for the purpose of provide fish passage as specified in Condition 6; and
c) The timing, method, and location of monitoring of all primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2.**

~~14.~~16. Information gathered under **Condition ~~13~~ 14** shall be provided in writing to the Consent Authority:

a) Annually on [insert date]; and

b) on request.

~~15.~~17. No later than [insert date – 5 years from grant], and thereafter at 5-yearly intervals, the Consent Holders must submit a 5-year review of the effectiveness of the ~~permit~~ consent (a Consent Review) in protecting lagoon health, to the Consent Authority, which as a minimum must assess:

a) whether any amendments to the ~~permit~~ consent are required to better protect lagoon and ecosystem health and cultural values;

b) whether the opening location and methodology are the most appropriate to deal with the effects outlined (c) below;

~~a)~~

~~b)~~c) whether the conditions of the ~~permit~~ consent are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the ~~permit~~consent, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the ~~permit~~consent, including effects on fish populations, and the effects of climate change;

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d) the efficiency and effectiveness of the ~~monitoring programme~~Monitoring Plan to inform the exercise of the ~~permit~~consent;

e) the implementation and effectiveness of the CMP in keeping the community engaged and informed about the exercise of the consent;

~~e)~~f) the efficiency and effectiveness of the Consent Holder reporting to the Science Advisory Group, of Science Advisory Group recommendations regarding opening, and the Consent Holder opening the lagoon; and

~~d)~~g) whether any amendments to the lagoon water quality and ecosystem health indicators are necessary.

Accidental Discovery and Spill Response Conditions

~~16.~~18. In the event of the discovery, or suspected discovery, of a site of cultural importance (Wāhi Taonga/Tapu), the consent holders must immediately cease works in that location and inform Te Ao Marama Inc and the Consent Authority. Works may recommence at a time as agreed upon in writing with the Consent Authority. The discovery of Koiwi (human skeletal remains) or Taonga or artefact material (e.g. pounamu/greenstone) would indicate a site of cultural importance. **Appendix 3** to this consent outlines the process that must be followed in the event of such a discovery. Note the consent holder is agreeable to use Environment Southlands standard condition in replacement of this condition.

~~17.~~19. In the event of an accidental spill of contaminants, such as fuel or oil spilt from the digger during the lagoon opening, the consent holders shall remove the contaminants immediately from the site and notify, without undue delay, the Consent Authority (email: escompliance@es.govt.nz or phone 03 211 5115) and the Operations Manager (Murihiku) of the Department of Conservation. Note the consent holder is agreeable to use Environment Southlands standard condition in replacement of this condition.

Lagoon Opening Location

~~18.~~20. Should the c~~C~~onsent h~~H~~olders seek to open the lagoon at an alternative location to Walkers Bay, a risk assessment must be submitted to the Consent Authority for certification and must assess as a minimum:

(a) The risk to ecological and cultural values of the Lagoon, including: habitat for submerged and emergent aquatic plants, habitat and migration pathways for fish species, and fringing wetlands,

(b) The suitability of the location for managing poor water quality, and protecting the ecological and cultural values of Lagoon, and

(c) The overall environmental benefits of the proposed location, relative to Walker's Bay, and taking into account the recommendations of the Science Advisory Group.

Consent Review

~~19.~~21. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holders of its intention to review the conditions of this consent on [insert date], or on receiving annual monitoring results or the 5-yearly Consent Review (required by **Condition 1~~6~~5**), or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent for the purposes of:

a) Determining whether the conditions of this ~~permit~~ consent are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the ~~permit~~consent, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the ~~permit~~consent, including the effects of climate change.

b) Ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, relevant plans and/or Policy Statement.

c) Amending the monitoring programme.

Appendix 1
Primary Indicators Levels for Waituna Lagoon

	Water quality, biosecurity or ecosystem health indicator	Warning indicator level	Critical indicator level
PRIMARY indicators	Chlorophyll-a (a sustained visible algal bloom* over a period of 14 days or longer)	0.012 - 0.06 mg/L	≥ 0.06 mg/L
	Cyanobacteria	Biovolume great than 5mm3/L (and more than 50% of phytoplankton biovolume present as toxic or potentially toxic cyanobacteria	Biovolume greater than 10mm3/L (and more than 80% of phytoplankton biovolume present as toxic or potentially toxic cyanobacteria)
	Bottom water dissolved oxygen concentration	< 2 and ≥ 0.5 mg/L	< 0.5 mg/L
	Incursion of a new non-native species that is a significant biosecurity risk	Incursion of worrisome species but low risk of proliferation	High risk species incursion (eDNA or positive sighting or capture of new non-native species)
Interpretation	* A "visible algal bloom" shall be identified by: (i)A chlorophyll-a concentration and/or (ii) An observations by an appropriately qualified and experienced person. These observations shall include the location and approximate extent and intensity of the visible algal bloom on each day of observation.		

Appendix 2
Secondary Indicators Levels for Waituna Lagoon

	Water quality or ecosystem health indicator	Warning indicator level	Critical indicator level
SECONDARY indicators	Total phosphorus concentration	≥ 0.05 and < 0.1 mg/L	≥ 0.1 mg/L
	Total nitrogen concentration	≥ 0.75 and < 1.5 mg/L	≥ 1.5 mg/L
	Water clarity (Secchi disc depth)	≥ 0.5 m and < 1 m	< 0.5 m
	Nuisance epiphytes or benthic algae**	>10% cover	>30% cover
	Macrophytes**	<30% lagoon wide cover abundance	<20% lagoon wide cover abundance
	Ruppia megacarpa**	Present at <20% of lagoon monitoring sites	Present at <10% of lagoon monitoring sites
	Diadromous fish (īnanga, lamprey/kanakana, eel/tuna) density (Waituna Creek)	Declines in diadromous fish populations (density and/or biomass)	Substantial declines in diadromous fish populations (density and/or biomass)
	Toxins/pathogens	Cyanotoxin producing genes in cyanobacteria present, but no cyanotoxins detected. Prolonged level of E. coli >260 cfu/100ml and not human source	Cyanotoxins detected across lagoon E. coli prolonged level above 1200 cfu/100ml

** Based on the results from annual surveys undertaken in late summer.

Appendix 3

Protocol in the event of a discovery, or suspected discovery, of a site of cultural importance (Waahi Taonga/Tapu)

1. ***Kōiwi tangata accidental discovery***

If Kōiwi tangata (human skeletal remains) are discovered, then work shall stop immediately and the New Zealand Police, Heritage New Zealand (details below) and Te Ao Marama Inc (Ngai Tahu (Murihiku) Resource Management Consultants) shall be advised. Contact details for Te Ao Marama Inc are as follows:

Te Ao Marama Inc

98 Yarrow Street, Invercargill, 9810~~P O Box 7078, South Invercargill 9844~~

Phone: (03) 931 1242

Te Ao Marama Inc will arrange a site inspection by the appropriate Tangata Whenua and their advisers, including statutory agencies, who will determine how the situation will need to be managed in accordance with tikanga māori.

2. ***Archaeological Sites***

Archaeological sites are protected under the Heritage New Zealand Pouhere Taonga Act (2014), and approval is required from Heritage New Zealand before archaeological sites can be modified, damaged or destroyed.

Not all archaeological sites are known or recorded precisely. Where an archaeological site is inadvertently disturbed or discovered, further disturbance must cease until approval to continue is obtained from Heritage New Zealand. As stated above, the New Zealand Police and Te Ao Marama Inc also need to be advised if the discovery includes kōiwi tangata /human remains.

Heritage New Zealand c/o Regional Archaeologist Otago/Southland

PO Box 5467, Dunedin

Phone: (03) 477 9871 Mobile 027 240 8715 infodeepsouth@heritage.org.nz

3. ***Taonga or artefact accidental discovery***

If taonga or artefact material (e.g. pounamu/greenstone artefacts) other than kōiwi tangata is discovered, disturbance of the site shall cease immediately and Southland Museum and Te Ao Marama Inc. shall be notified of the discovery by the finder or site archaeologist in accordance with the Protected Objects Act 1975. All taonga tuturu are important for their cultural, historical and technical value and are the property of the Crown until ownership is resolved.

4. *In-situ (natural state) pounamu/greenstone accidental discovery*

Pursuant to the Ngāi Tahu (Pounamu Vesting) Act 1997, all natural state pounamu/greenstone in the Ngāi Tahu tribal area is owned by Te Rūnanga o Ngāi Tahu. Ngāi Tahu Pounamu Management Plans provide for the following measures:

- any *in-situ* (natural state) pounamu/greenstone accidentally discovered should be reported to Te Rūnanga o Ngai Tahu staff as soon as is reasonably practicable. Te Rūnanga o Ngāi Tahu staff will in turn contact the appropriate Kaitiaki Papatipu Rūnanga;
- in the event that the finder considers the pounamu is at immediate risk of loss such as erosion, animal damage to the site or theft, the pounamu/greenstone should be carefully covered over and/or relocated to the nearest safe ground.

The find should then be notified immediately to the Group Head – Strategy and Environment, at Te Rūnanga o Ngāi Tahu. Their details are as follows:

Te Rūnanga o Ngāi Tahu, c/o Group Head - Strategy and Environment

Te Whare o Te Wai Pounamu

15 Show Place, P O Box 13-046, Ōtautahi/Christchurch 8021

Phone: (03) 366 4344 Web: www.ngaitahu.iwi.nz

Appendix 4 – Consent Implementation Plan

Consent Holders

1. The Consent Holders will implement the consent in accordance with the following principles:
    a. Collaboration: The Consent Holders are committed to working together in good faith toward a shared outcome that improves the environment and mana of the Waituna Lagoon. Each party's expertise is valued and utilised, and Te Rūnaka o Awarua interests will form a critical part of the collective aspiration.
    b. Trust: Trust will be built through demonstrating integrity by communicating openly and honestly, early and often; and by operating transparently.
    c. Collective integrated decision making: the Consent Holders will take a collaborative approach to decision-making while acknowledging their distinct roles and recognising each party may have different views from the others. Decision making and implementation will involve integrated approaches to enable complex social, natural and political processes to be navigated effectively.
2. The Consent holders will establish a Steering Group. The Steering Group will comprise representatives of the Consent holder organisations being Southland Regional Council, the Director-General of Conservation and Te Rūnaka o Awarua, and each of the three organisations will appoint a Relationship Manager for decision making on their behalf.
3. The Steering Group of the Consent Holders will meet at 6 monthly intervals at a minimum to oversee the exercise of the consent.
4. The Steering Group of the Consent Holders will meet more frequently if required where lagoon opening triggers are met or are anticipated to be met in accordance with the Decision Tree attached.

Decision Making

5. Decision making of the Consent Holders regarding lagoon openings will be in accordance with the Decision Tree attached as Schedule 1.
6. Decision making by the Consent Holders will be by consensus, or if consensus cannot be reached, by majority, in accordance with the principles above.

Lagoon Opening Location and Methodology

7. Decisions made regarding the lagoon opening location and methodology will take into account advice of the Science Advisory Group, and will be in accordance with the requirements of Conditions 19 (regarding opening location) and Condition 7 (regarding opening methodology).

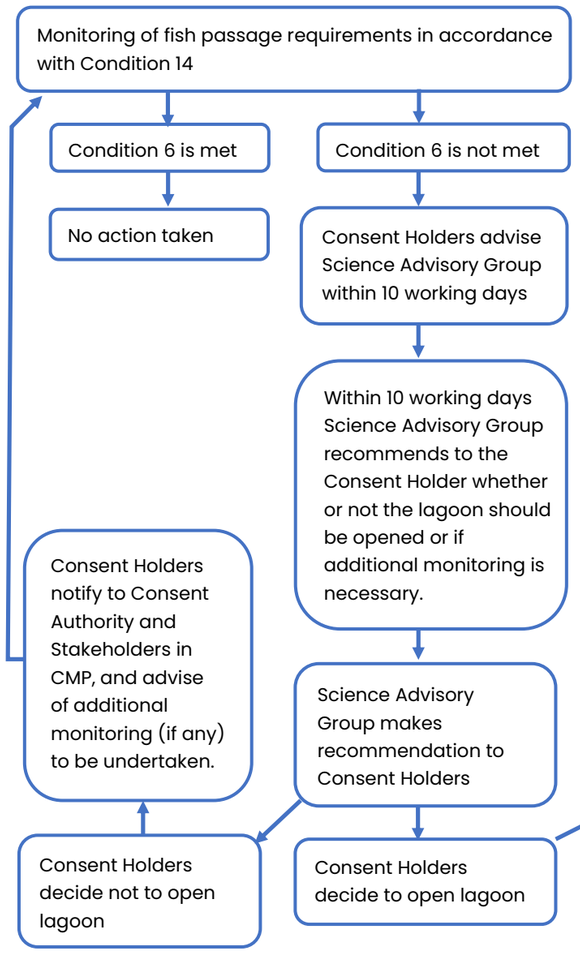
Reserves Act Authority

8. The Consent holders will apply for an Authority under the Reserves Act 1977 to facilitate the exercise of the consent within the scientific reserve, within 3 months of the grant of the consent[1].

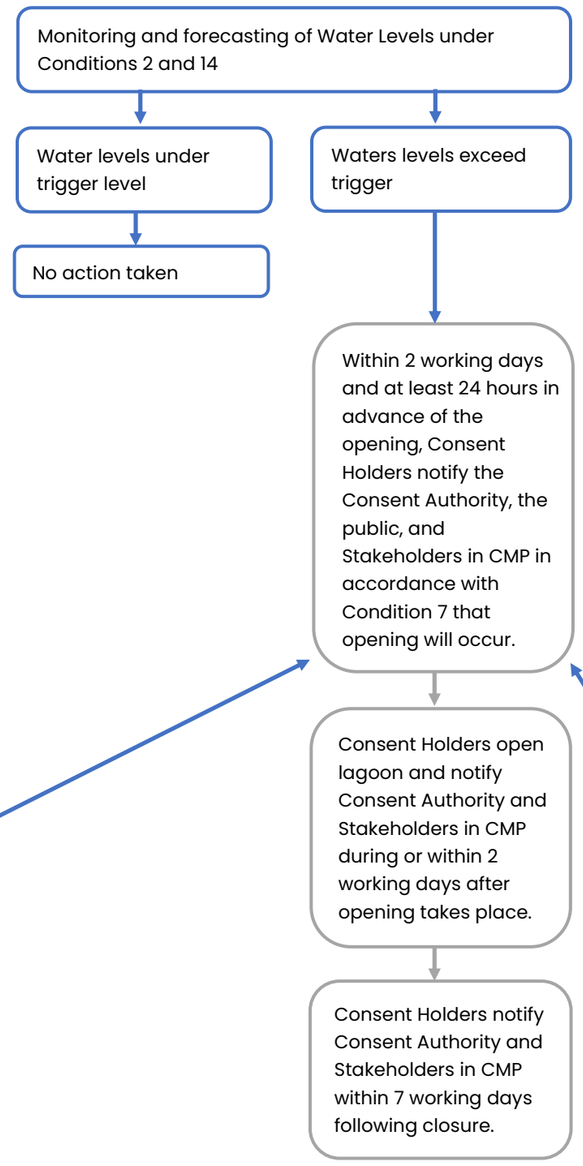
[1] Note: An approval under the Reserves Act cannot be a condition of consent.

Appendix 4: Consent Implementation Plan - Schedule 1: Decision Tree

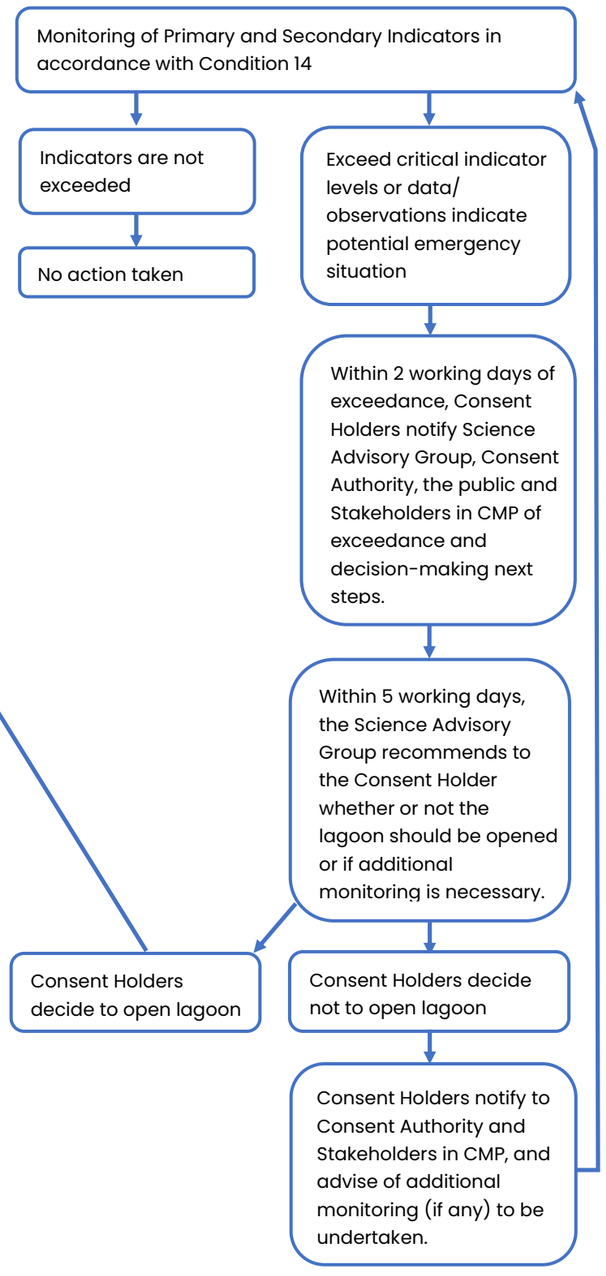
Fish Passage Trigger (Condition 6)



Water Level Triggers (Condition 4)



Water Quality and Ecosystem Health Triggers (Condition 5)



Draft Proposed Conditions of Consent

1. This consent authorises the opening of the Waituna Lagoon (Lagoon) to the sea through the gravel barrier in accordance with Conditions 5 to 7 at Walker's Bay between NZTM 1,262,340E 4,831,360 N and 1,261,460E 4,831,000 N or unless otherwise certified by the Consent Authority in accordance with Condition 19.

2. The level of the Lagoon will be measured at the Waghorn's Bridge gauge or if that gauge for any reason is not available an alternative gauge approved by the Consent Authority.

3. In this consent a Lagoon opening means:

    a) use of excavators operating on the gravel bar, starting from the landward side of the Lagoon; and

    b) formation of a channel between the Lagoon and sea, with excavated material retained alongside the channel and levelled off.

Lagoon Opening Conditions

4. Lagoon Opening – transitional regime:

    a) for the first five years from the grant of consent (years 1-5), being to [day month year]:

        i. summer openings (1 September to 30 April) may occur if water levels are at or above 2.4m for three consecutive days; and

        ii. winter openings (1 May to 30 August) may occur if water levels are at or above 2.3m for seven consecutive days;

    b) for the next five years of the consent (years 6-10), being from [day month year] to [day month year], openings may occur if water levels are at or above 2.4m for three consecutive days; and

    c) for the next five years of the consent (years 11-15), being from [day month year] to [day month year], openings may occur if water levels are at or above 2.5m for three consecutive days; and

    d) for the final five years of the consent (years 16-20), being from [day month year] to [day month year] openings may occur if water levels are at or above 2.5m for seven consecutive days.

5. Lagoon Opening – to protect water quality and ecosystem health:

    a) The Lagoon may be opened to the sea at any time of the year when the water level in the lagoon is able to facilitate an opening, provided that:

i. One or more of the primary lagoon water quality and ecosystem health indicators in Appendix 1 have reached a Critical Indicator Level, or to prevent or mitigate an emergency situation where the ecological and cultural values of the lagoon are under imminent risk of significant decline, taking into account the indicators listed in Appendix 1 and Appendix 2; and

ii. The Science Advisory Group has considered the Primary Indicators in Appendix 1, and any other relevant scientific information, including additional indicators of Ecosystem Health set out in Appendix 2, and recommend in writing to the consent holders that opening the lagoon to the sea is necessary to manage the risk of a significant adverse ecological effect on the lagoon; and taking into account

iii. Any request in writing from a member of the public to the Consent Authority or to the Consent Holders that the lagoon be opened to protect water quality and ecosystem health.

Note:
Science Advisory Group means the group established in accordance with ***Condition 8****.*
Emergency Situation means an adverse effect or sudden event in accordance with s330(b)-(f) of the RMA.

6. Lagoon Opening - for the purpose of providing fish passage:

a) The Lagoon may be opened to the sea to provide for passage for diadromous fish species, provided that:

i. The opening takes place between 1 April and 30 November; and

ii. The lagoon has not been opened in the previous 24 months, or if the lagoon was opened during the past 24 months, where the timing of the open period did not support upstream migration of threatened or at-risk fish species, and

iii. The Science Advisory Group, has considered the lagoon water quality and ecosystem health indicators listed in Appendix 1 and 2, and any other relevant scientific and cultural information, and has advised the Consent Holders and Consent authority that opening the lagoon to the sea is necessary to enable fish passage.

Note: *Science Advisory Group means the group established in accordance with* ***Condition 8****.*

7. Lagoon Opening Process:

a) Lagoon opening must be in accordance with the Consent Implementation Plan in **Appendix 4.**

b) The opening notice in the **Consent Implementation Plan** must include:

i. The proposed date of the opening;

ii. The purpose of the opening in accordance with **Conditions 4,5 or 6**;

iii. The current water level at the Lagoon and average daily water levels for the previous seven days;

iv. The opening location and methodology, having considered the purpose of the opening, forecast weather conditions, and coastal environment; and

v. a note of the prevailing wind conditions (direction and strength), and comment whether or not there is any reason to suspect that the water level is only temporarily raised at the gauge board by strong wind conditions; and

vi. any lagoon monitoring information necessary to show compliance with the opening criteria specified in **Conditions 4, 5, or 6**. This must include:

- A copy of the written advice from the Science Advisory Group of the reason for opening as specified in **Condition 5** if the opening is in accordance with **Condition 5**;
- A copy of the written advice from the Science Advisory Group of the reason for opening as specified in **Condition 6** if the opening is in accordance with **Condition 6**.

Science Advisory Group

8. The consent holders shall establish a Science Advisory Group. The purpose of the Science Advisory Group is to:

(a) Act as an advisory group to the consent holders; and
(b) Make recommendations to the consent holders under **Conditions 5 and 6**.

9. Decisions of the Science Advisory Group must be made unanimously or if a decision cannot be made unanimously by majority.

10. All organisations represented in the Science Advisory Group will bear their own cost of their representative. The actual and reasonable costs of additional experts in (c) is to be shared by the consent holders.

11. The Science Advisory Group:

(a) must include suitably qualified expert representatives of:

i. the Director-General of Conservation;

ii. Awarua Rūnaka;

iii. Environment Southland; and

b) Must include a suitably qualified expert Chair, from an organisation independent of the Consent Holders and Waituna Catchment community.

Prior to the appointment of the Chair, the nomination must be submitted by the Consent Holders to the Consent Authority for certification of the Chair's independence.

c) May include:

i. A suitably qualified expert representative of the Waituna Catchment community with scientific knowledge of coastal lagoon ecosystems, if one is nominated by the Waituna Catchment community.

The consent holders must provide the Waituna Catchment community an opportunity to nominate a representative on the Science Advisory Group and accept the nominee, provided the nominee is a suitably qualified expert; and

ii. Other suitably qualified experts with scientific or cultural knowledge of coastal lagoon ecosystems approved by the consent holders.

Note:
A suitably qualified expert means:
A person acting in accordance with the Environment Court Code of Conduct for Expert Witnesses, with qualifications in a scientific or related discipline related to coastal lagoon ecosystems (such as water quality, ecology, geomorphology, or freshwater or coastal processes), or a representative of Awarua Rūnaka with cultural knowledge.

12. The Science Advisory Group must advise the consent holders in writing whether opening the lagoon to the sea is recommended to manage the risk of a significant adverse ecological effect on the lagoon. This must occur as soon as reasonably practicable but not later than five working days of the consent holders notifying the Science Advisory Group that monitoring in accordance with **Condition 14** demonstrates that one or more of the Primary lagoon water quality and ecosystem health indicators has reached its Critical Indicator Level.

Communications

13. The consent must be exercised in accordance with the Communications Management Plan (CMP) dated 6 May 2025:
    (a) The consent holder must review the CMP in consultation with the Waituna catchment community, 12 months from consent approval, and thereafter at 5 yearly intervals starting at year 5, and must provide the updated CMP to the consent authority for certification.
    (b) The purpose of the CMP is to set out how:
        i. The consent holders will make matters related to the exercise of the

consent publicly available and accessible, including but not limited to lagoon openings and monitoring information;

ii. interested parties are to be informed of the matters related to the exercise of the consent in (i) above; and

iii. interested parties can make enquiries or raise concerns to the consent holders regarding the health of the lagoon or the exercise of the consent, and how these matters will be responded to.

Monitoring and Reporting Conditions

14. The consent holders must monitor and record the following information:

    a) changes in the primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2 in accordance with the Monitoring Plan**;

    b) when and where the lagoon is opened to the sea;

    c) the water level in the lagoon at the time it was opened;

    d) information to demonstrate compliance with the opening **Conditions 4, 5, and/or 6 in accordance with the Monitoring Plan**;

    e) how long the lagoon is open to the sea, when it closes (to the nearest week), and observations/information learned from the opening.

15. The consent holders must engage a suitably qualified expert(s) to prepare a Monitoring Plan. The Monitoring Plan must be submitted to the Consent Authority for Certification no later than 60 working days following the grant of resource consent, and prior to the exercise of the consent. The purpose of the Monitoring Plan is to direct the parameters to be monitored and the frequency of monitoring of:
    - information to demonstrate compliance with the opening **Conditions 4, 5, and/or 6**; and
    - the primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2.**

    The Monitoring Plan must include as a minimum:

    a) How the location of openings will be recorded;
    b) The timing, location and methods of monitoring:
        a. the transitional regime water levels as specified in Condition 4;
        b. to protect water quality and ecosystem health as specified in Condition 5;
        c. for the purpose of provide fish passage as specified in Condition 6; and
    c) The timing, method, and location of monitoring of all primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2.**

16. Information gathered under **Condition 14** shall be provided in writing to the Consent Authority:

    a) Annually on [insert date]; and

    b) on request.

17. No later than [insert date – 5 years from grant], and thereafter at 5-yearly intervals, the Consent Holders must submit a 5-year review of the effectiveness of the consent (a Consent Review) in protecting lagoon health, to the Consent Authority, which as a minimum must assess:

    a) whether any amendments to the consent are required to better protect lagoon and ecosystem health and cultural values;

    b) whether the opening location and methodology are the most appropriate to deal with the effects outlined (c) below;

    c) whether the conditions of the consent are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the consent, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent, including effects on fish populations, and the effects of climate change;

    d) the efficiency and effectiveness of the Monitoring Plan to inform the exercise of the consent;

    e) the implementation and effectiveness of the CMP in keeping the community engaged and informed about the exercise of the consent;

    f) the efficiency and effectiveness of the Consent Holder reporting to the Science Advisory Group, of Science Advisory Group recommendations regarding opening, and the Consent Holder opening the lagoon; and

    g) whether any amendments to the lagoon water quality and ecosystem health indicators are necessary.

Accidental Discovery and Spill Response Conditions

18. In the event of the discovery, or suspected discovery, of a site of cultural importance (Wāhi Taonga/Tapu), the consent holders must immediately cease works in that location and inform Te Ao Marama Inc and the Consent Authority. Works may recommence at a time as agreed upon in writing with the Consent Authority. The discovery of Koiwi (human skeletal remains) or Taonga or artefact material (e.g. pounamu/greenstone) would indicate a site of cultural importance. **Appendix 3** to this consent outlines the process that must be followed in the event of such a discovery. Note the consent holder is agreeable to use Environment Southlands standard condition in replacement of this condition.

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digger during the lagoon opening, the consent holders shall remove the contaminants immediately from the site and notify, without undue delay, the Consent Authority (email: escompliance@es.govt.nz or phone 03 211 5115) and the Operations Manager (Murihiku) of the Department of Conservation. Note the consent holder is agreeable to use Environment Southlands standard condition in replacement of this condition.

Lagoon Opening Location

20. Should the consent holders seek to open the lagoon at an alternative location to Walkers Bay, a risk assessment must be submitted to the Consent Authority for certification and must assess as a minimum:
    (a) The risk to ecological and cultural values of the Lagoon, including: habitat for submerged and emergent aquatic plants, habitat and migration pathways for fish species, and fringing wetlands,
    (b) The suitability of the location for managing poor water quality, and protecting the ecological and cultural values of Lagoon, and
    (c) The overall environmental benefits of the proposed location, relative to Walker's Bay, and taking into account the recommendations of the Science Advisory Group.

Consent Review

21. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holders of its intention to review the conditions of this consent on [insert date], or on receiving annual monitoring results or the 5-yearly Consent Review (required by **Condition 16**), or within two months of any enforcement action being taken by the Consent Authority in relation to the exercise of this consent for the purposes of:

    a) Determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment, including cumulative effects, which may arise from the exercise of the consent, and which it is appropriate to deal with at a later stage, or which become evident after the date of commencement of the consent, including the effects of climate change.

    b) Ensuring the conditions of this consent are consistent with any National Environmental Standards Regulations, relevant plans and/or Policy Statement.

    c) Amending the monitoring programme.

Appendix 1
Primary Indicators Levels for Waituna Lagoon

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	Bottom water dissolved oxygen concentration	< 2 and ≥ 0.5 mg/L	< 0.5 mg/L
	Incursion of a new non-native species that is a significant biosecurity risk	Incursion of worrisome species but low risk of proliferation	High risk species incursion (eDNA or positive sighting or capture of new non-native species)
Interpretation	* A “visible algal bloom” shall be identified by: (i)A chlorophyll-a concentration and/or (ii) An observations by an appropriately qualified and experienced person. These observations shall include the location and approximate extent and intensity of the visible algal bloom on each day of observation.		

Appendix 2
Secondary Indicators Levels for Waituna Lagoon

	Water quality or ecosystem health indicator	Warning indicator level	Critical indicator level
SECONDARY indicators	Total phosphorus concentration	≥ 0.05 and < 0.1 mg/L	≥ 0.1 mg/L
	Total nitrogen concentration	≥ 0.75 and < 1.5 mg/L	≥ 1.5 mg/L
	Water clarity (Secchi disc depth)	≥ 0.5 m and < 1 m	< 0.5 m
	Nuisance epiphytes or benthic algae**	>10% cover	>30% cover
	Macrophytes**	<30% lagoon wide cover abundance	<20% lagoon wide cover abundance
	Ruppia megacarpa**	Present at <20% of lagoon monitoring sites	Present at <10% of lagoon monitoring sites
	Diadromous fish (īnanga, lamprey/kanakana, eel/tuna) density (Waituna Creek)	Declines in diadromous fish populations (density and/or biomass)	Substantial declines in diadromous fish populations (density and/or biomass)
	Toxins/pathogens	Cyanotoxin producing genes in cyanobacteria present, but no cyanotoxins detected. Prolonged level of E. coli >260 cfu/100ml and not human source	Cyanotoxins detected across lagoon E. coli prolonged level above 1200 cfu/100ml

** Based on the results from annual surveys undertaken in late summer.

Appendix 3

Protocol in the event of a discovery, or suspected discovery, of a site of cultural importance (Waahi Taonga/Tapu)

1. Kōiwi tangata accidental discovery

If Kōiwi tangata (human skeletal remains) are discovered, then work shall stop immediately and the New Zealand Police, Heritage New Zealand (details below) and Te Ao Marama Inc (Ngai Tahu (Murihiku) Resource Management Consultants) shall be advised. Contact details for Te Ao Marama Inc are as follows:

Te Ao Marama Inc

98 Yarrow Street, Invercargill, 9810Phone: (03) 931 1242

Te Ao Marama Inc will arrange a site inspection by the appropriate Tangata Whenua and their advisers, including statutory agencies, who will determine how the situation will need to be managed in accordance with tikanga māori.

2. Archaeological Sites

Archaeological sites are protected under the Heritage New Zealand Pouhere Taonga Act (2014), and approval is required from Heritage New Zealand before archaeological sites can be modified, damaged or destroyed.

Not all archaeological sites are known or recorded precisely. Where an archaeological site is inadvertently disturbed or discovered, further disturbance must cease until approval to continue is obtained from Heritage New Zealand. As stated above, the New Zealand Police and Te Ao Marama Inc also need to be advised if the discovery includes kōiwi tangata /human remains.

Heritage New Zealand c/o Regional Archaeologist Otago/Southland

PO Box 5467, Dunedin

Phone: (03) 477 9871 Mobile 027 240 8715 infodeepsouth@heritage.org.nz

3. Taonga or artefact accidental discovery

If taonga or artefact material (e.g. pounamu/greenstone artefacts) other than kōiwi tangata is discovered, disturbance of the site shall cease immediately and Southland Museum and Te Ao Marama Inc. shall be notified of the discovery by the finder or site archaeologist in accordance with the Protected Objects Act 1975. All taonga tuturu are important for their cultural, historical and technical value and are the property of the Crown until ownership is resolved.

4. In-situ (natural state) pounamu/greenstone accidental discovery

Pursuant to the Ngāi Tahu (Pounamu Vesting) Act 1997, all natural state pounamu/greenstone in the Ngāi Tahu tribal area is owned by Te Rūnanga o Ngāi Tahu. Ngāi Tahu Pounamu Management Plans provide for the following measures:

- any *in-situ* (natural state) pounamu/greenstone accidentally discovered should be reported to Te Rūnanga o Ngai Tahu staff as soon as is reasonably practicable. Te Rūnanga o Ngāi Tahu staff will in turn contact the appropriate Kaitiaki Papatipu Rūnanga;
- in the event that the finder considers the pounamu is at immediate risk of loss such as erosion, animal damage to the site or theft, the pounamu/greenstone should be carefully covered over and/or relocated to the nearest safe ground.

The find should then be notified immediately to the Group Head – Strategy and Environment, at Te Rūnanga o Ngāi Tahu. Their details are as follows:

Te Rūnanga o Ngāi Tahu, c/o Group Head - Strategy and Environment

Te Whare o Te Wai Pounamu

15 Show Place, P O Box 13-046, Ōtautahi/Christchurch 8021

Phone: (03) 366 4344 Web: www.ngaitahu.iwi.nz

Appendix 4 – Consent Implementation Plan

Consent Holders

1. The Consent Holders will implement the consent in accordance with the following principles:
    a. Collaboration: The Consent Holders are committed to working together in good faith toward a shared outcome that improves the environment and mana of the Waituna Lagoon. Each party's expertise is valued and utilised, and Te Rūnaka o Awarua interests will form a critical part of the collective aspiration.
    b. Trust: Trust will be built through demonstrating integrity by communicating openly and honestly, early and often; and by operating transparently.
    c. Collective integrated decision making: the Consent Holders will take a collaborative approach to decision-making while acknowledging their distinct roles and recognising each party may have different views from the others. Decision making and implementation will involve integrated approaches to enable complex social, natural and political processes to be navigated effectively.
2. The Consent holders will establish a Steering Group. The Steering Group will comprise representatives of the Consent holder organisations being Southland Regional Council, the Director-General of Conservation and Te Rūnaka o Awarua, and each of the three organisations will appoint a Relationship Manager for decision making on their behalf.
3. The Steering Group of the Consent Holders will meet at 6 monthly intervals at a minimum to oversee the exercise of the consent.
4. The Steering Group of the Consent Holders will meet more frequently if required where lagoon opening triggers are met or are anticipated to be met in accordance with the Decision Tree attached.

Decision Making

5. Decision making of the Consent Holders regarding lagoon openings will be in accordance with the Decision Tree attached as Schedule 1.
6. Decision making by the Consent Holders will be by consensus, or if consensus cannot be reached, by majority, in accordance with the principles above.

Lagoon Opening Location and Methodology

7. Decisions made regarding the lagoon opening location and methodology will take into account advice of the Science Advisory Group, and will be in accordance with the requirements of Conditions 19 (regarding opening location) and Condition 7 (regarding opening methodology).

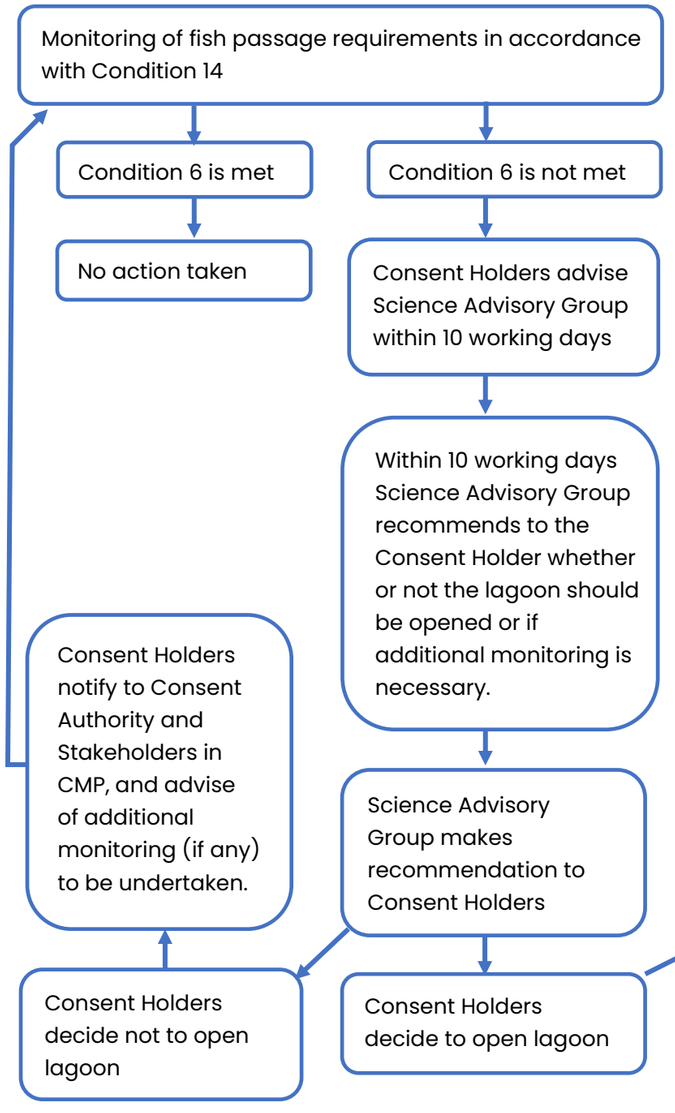
Reserves Act Authority

8. The Consent holders will apply for an Authority under the Reserves Act 1977 to facilitate the exercise of the consent within the scientific reserve, within 3 months of the grant of the consent[1].

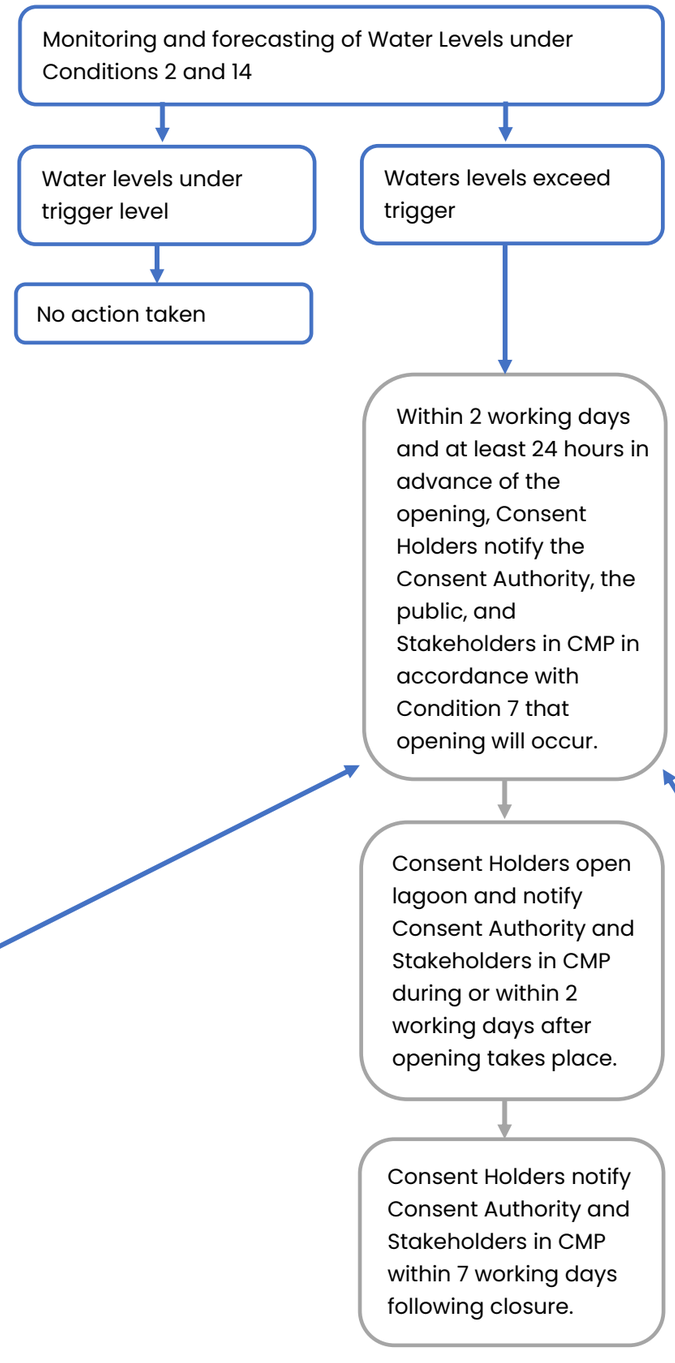
[1] Note: An approval under the Reserves Act cannot be a condition of consent.

Appendix 4: Consent Implementation Plan - Schedule 1: Decision Tree

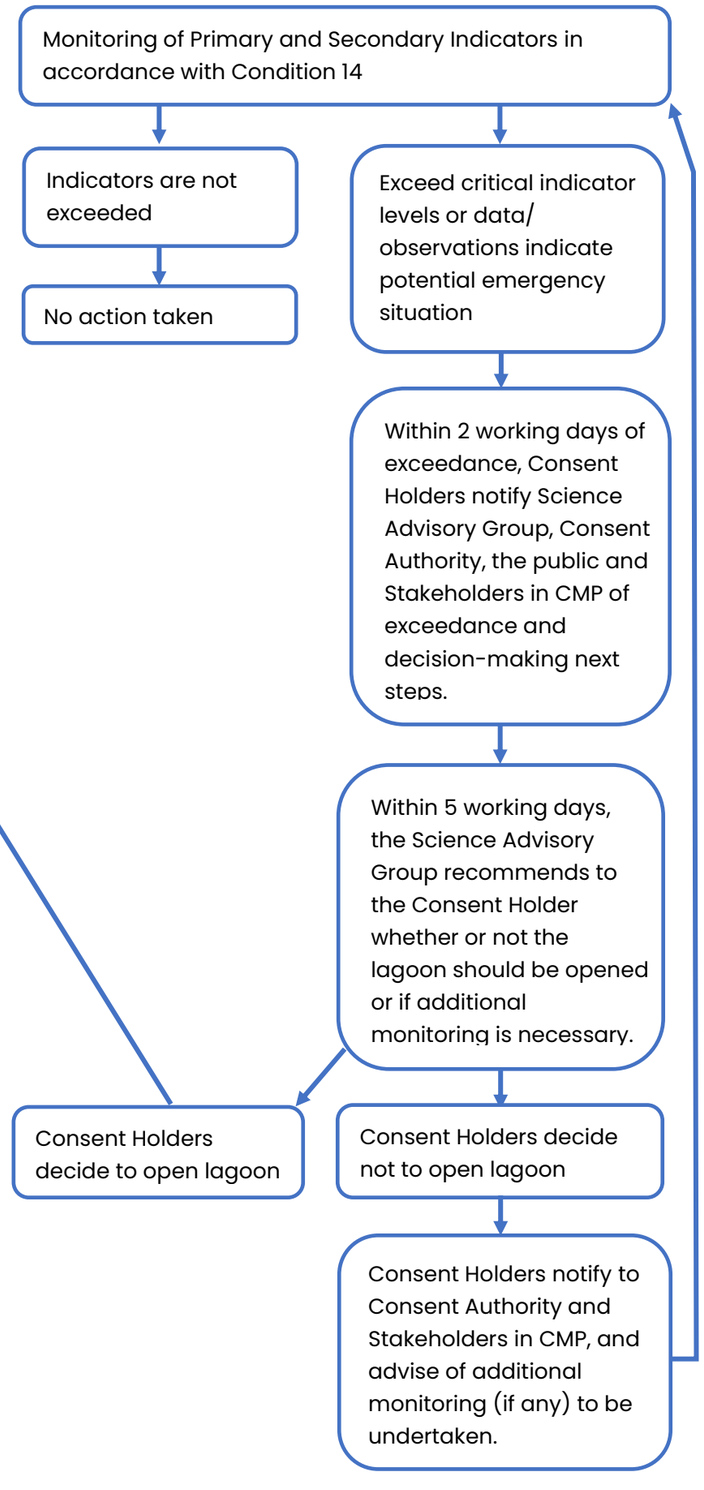
Fish Passage Trigger (Condition 6)



Water Level Triggers (Condition 4)



Water Quality and Ecosystem Health Triggers (Condition 5)



Appendix D: Draft Monitoring Plan

DRAFT Monitoring Plan – Periodic opening of Waituna Lagoon to maintain and restore ecological health and cultural values of the lagoon ecosystem

16 June 2025

1. Purpose

This document provides a summary of the proposed monitoring plan (draft) to be implemented as part of the proposed Resource Consent for the periodic opening of Waituna Lagoon to maintain and restore ecological health and cultural values of the lagoon ecosystem [APP-20242456].

2. Context

The application submitted by DOC, Environment Southland and Awarua Rūnanga aims to establish a new lagoon opening regime to maintain and restore the ecological health and cultural values of the lagoon ecosystem. The application has been informed by extensive monitoring of the lagoon ecosystem over the past 10+ years, including regular monitoring of the lagoon's water quality, water levels, and ecological values, and based on the 'Technical Review of conditions for opening Waituna Lagoon' (Robertson et al. 2024).

The proposed lagoon opening regime has three core components:

- A transitional lagoon opening regime that considers lagoon the water level (in masl), and the duration of water levels above certain thresholds (Condition 4);
- Lagoon opening to protect water quality and ecosystem health (Condition 5); and
- Lagoon opening for the purpose of fish passage (Condition 6).

The proposed conditions also outline the anticipated need for monitoring and reporting. It is recommended that the consent holders must monitor and record the following information (Condition 14):

- changes in the primary and secondary indicators of lagoon water quality and ecosystem health in **Appendix 1 and Appendix 2**;
- when and where the lagoon is opened to the sea;
- the water level in the lagoon at the time it was opened;
- information to demonstrate compliance with the opening **Conditions 4, 5, and/or 6**;
- how long the lagoon is open to the sea, and when it closes (to the nearest week)

To effectively implement the monitoring detailed above, appropriate field and analytical methods should be applied that are consistent, where appropriate, with the existing long-term monitoring implemented at Waituna Lagoon and using best-practice (e.g. aligned with indicators applied in the NPS-FM (2020) national objectives framework (NOF).

3. Proposed Monitoring Plan

The monitoring framework for the proposed consent has been developed to ensure the

information necessary to support Conditions 4, 5, and 6 is available, including to provide data necessary for reporting to the Consent Authority, providing updates to community, and to support the Science Advisory Group in making recommendations, when requested.

Table 1 (and sub tables) describes the monitoring required for implementation of the proposed consent, and associated indicators. For each indicator the recommended method, location and timing (frequency) of monitoring is specified.

Table 1. Monitoring required to inform the implementation of proposed consent conditions

Table 1A: Lagoon opening – transitional regime (Condition 4)

Monitoring required	Indicator	Method	Location	Timing
Water level monitoring to have at least daily information to evaluate the level of the lagoon relative to MSL (mean sea level) and duration of lagoon opening events	Water level of the Waituna lagoon above MSL (mean sea level)	Continuous water level monitoring	Waghorn's Bridge (existing gauge)	Continuous
	Duration (start date-end date) of lagoon opening events	Continuous water level monitoring	Waghorn's Bridge (existing gauge)	Continuous
Geographical information on the location of opening	GPS coordinates of the location of opening site	Record of GPS coordinates	Opening location	Each opening event

Table 1B: Lagoon opening to protect water quality and ecosystem heath (Condition 5)

Monitoring required	Indicator	Method	Location	Timing
Monitoring to provide adequate information relating to primary and secondary indicators defined in *Appendix 1* and *Appendix 2*	Chlorophyll-a (mg/L)	Surface water samples[1]; accredited analysis by laboratory.	4 sites, Waituna Lagoon (existing sites)	Monthly Inc. frequency if bloom detected
	Cyanobacteria (biovolume, mm^3/L)	Surface water samples[1]; accredited analysis by laboratory.	Center site, Waituna Lagoon (existing site)	Monthly Inc. frequency if bloom detected
	Bottom water dissolved oxygen concentration (mg/L)	Continuous logger; with additional manual records using handheld device[1].	Centre of Waituna lagoon for Logger, 4 sites for manual records	Continuous / Monthly. May inc. if cyanobacterial bloom detected
	Incursion of a new non-native species that is a significant biosecurity risk	Observations of field team	Lagoon-wide assessment	6-monthly
	Total phosphorus (TP) and Total	Surface water samples[1];	4 sites, Waituna Lagoon	Monthly

	nitrogen (TN) concentration (mg/L)	accredited analysis by laboratory.	(existing sites)	
	Water clarity (m)	Secchi disc depth[1].Turbidity; accredited analysis by laboratory.	4 sites, Waituna Lagoon (existing sites)	Monthly
	Nuisance epiphytes / benthic algae (% cover abundance)	Refer to NIWA 2024 for methods	47 sites, Waituna Lagoon (existing sites)	Annual
	Macrophytes (% cover abundance)	Refer to NIWA 2024 for methods	47 sites, Waituna Lagoon (existing sites)	Annual
	Ruppia megacarpa presence	Refer to NIWA 2024 for methods	47 sites, Waituna Lagoon (existing sites)	Annual
	Diadromous fish (īnanga, lamprey/kanakana, eel/tuna, and kokopu) density**	Electro-fishing, or equivalent methodology. Refer to Cawthron 2021 for methods	Waituna Creek, min. 2 sites (existing sites)	Annual*
		Netting and trapping approaches of lagoon: fyke and G-minnow. Apply Joy et al. (2013) guidelines	Waituna Lagoon, min. 4 sites	Annual*
	Toxins/pathogens	Surface water samples; tested by an accredited laboratory.	Sample from bloom location	If bloom detected

* Review frequency of fish monitoring following completion of 3 annual surveys.

** Plankton assessment may also be undertaken, if suitable and cost-effective methods are available to survey juvenile fish population abundance.

[1] Following National Environmental Monitoring Standards (NEMS) - https://www.nems.org.nz/

Table 1C: Lagoon opening for the purpose of providing fish passage (Condition 6)

Monitoring required	Indicator	Method	Location	Timing
Monitoring of the timing and duration of open/closed phases of Waituna Lagoon	[Refer to monitoring required for Condition 4]			

Monitoring to provide suitable information relating to primary and secondary indicators defined in Appendix 1 and Appendix 2	[Refer to monitoring required for Condition 5]

4. Additional monitoring parameters

In addition to the monitoring requirements outlined in Table 1, it is proposed to undertake monitoring of changes in the fringing wetland plant community, to survey and evaluate any positive or negative changes in the extent and composition of indigenous wetland plants that are temporarily inundated as lagoon water levels increase. This information will also support assessment of changes in habitat availability for bird species, recognising that bird populations are often migratory and are subject to multiple drivers that influence their population status outside of Waituna Lagoon (e.g. breeding status at other sites, effects of predation).

Monitoring required	**Indicator**	**Method**	**Location**	**Timing**
Monitoring of changes in the fringing wetland plant community	Extent (ha) and composition of indigenous wetland vegetation types	Vegetation survey transects, applying method consistent with Blythell (2013)	Transects (min 5), locations applied by Blythell (2013)	5-year frequency***

References

Blythell J. (2013) Monitoring changes in shoreline vegetation communities at Waituna Lagoon, Southland. Report prepared for the Department of Conservation

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Joy M, David B, Lake M. (2013) New Zealand freshwater fish sampling protocols. Massey University, Palmerston North, New Zealand.

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Appendix E: Fringing Wetland Response ●■●■●■●■●■●■

2.4 Fringing Wetland Effects

Information Requested

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

Further commentary on the potential effects of lagoon opening on fringing wetland vegetation communities and their extent should be provided. This will allow for some certainty that any effect will be at an acceptable level.

Response

Response prepared by Dr Hugh Robertson, Principal Science Advisor, Department of Conservation

1. The 'Technical review of conditions for opening Waituna Lagoon' recognised fringing or shoreline wetlands as a key ecological value of Waituna Lagoon (Robertson et al. 2024). The report noted a 'diverse native plant community is present within the fringing wetlands surrounding the lagoon. These wetlands provide habitat to support indigenous fauna, including threatened species.'

2. The fringing wetland plant communities of Waituna Lagoon were described by Johnson and Partridge (1998) and Johnson (2004). Following these surveys, a repeat assessment of the fringing wetland plant communities was undertaken during 2012-2013 as part of the DOC Arawai Kākāriki wetland restoration programme (Blythell 2013). The 2013 survey involved vegetation monitoring of 15 transects at Waituna Lagoon (Figure 1), with transects ranging in length from 22m - 292m. Transects extended from the lagoon edge and continued perpendicular to the shoreline.

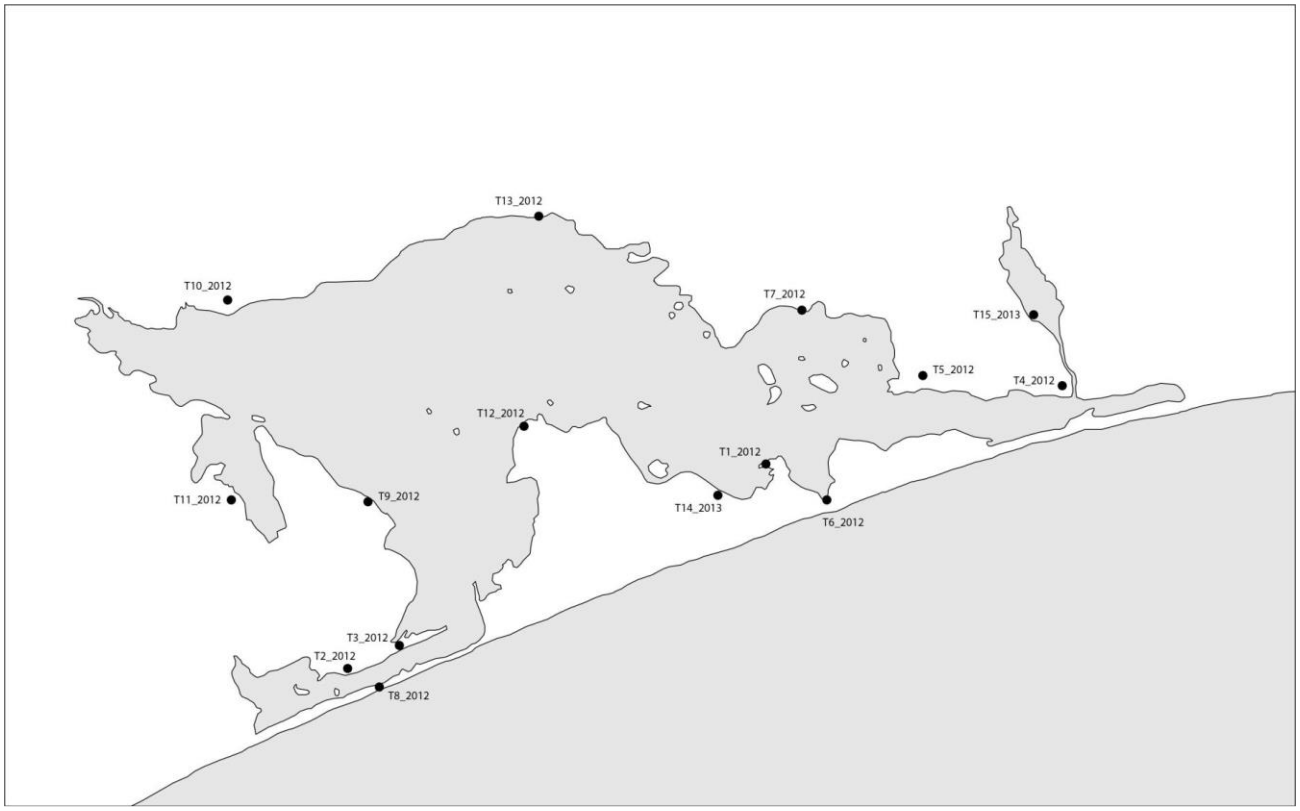

Figure 1. Map indicating position of shoreline transects around the margins of Waituna Lagoon.

3. The dominant wetland plant communities recorded during the Blythell (2013) survey, applying the Singers and Rogers classification system (2014), were:
   - Oioi restiad-rushland/reedland (most dominant in terms of extent)
   - Manuka-tangle fern scrub/fernland
   - Herbfield / Lakeshore turf
   - Modified flaxland
   - Carex Schoenus sedgeland
   - Oioi, knobby clubrush sedgeland

4. The exotic and non-wetland plant communities recorded were:
   - Exotic grassland
   - Exotic ruderal beach community
   - Manuka scrub
   - Shore bindweed, knobby clubrush gravelfield-stonefield
   - Bracken fernland

5. Wetland plant communities have different environmental water requirements depending on their adaptation or resilience to inundation, or dry soil conditions. Some plant species

are obligate wetland plants and always occur in wetlands due to the presence of water, while others are facultative (often associated with wetlands). Upland species are associated with terrestrial landforms and not typically associated with inundation.

6. Figure 2 provides a schematic illustration of the zonation of plant communities at Waituna Lagoon. Close to the lagoon edge fringing wetland vegetation is often dominated by the wirerush Oioi *Apodasmia similis*. There is a marked increase in land elevation where the landforms influenced by lacustrine (lake) processes change to landforms associated with the development of peatland soils and are often dominated by Mānuka *Leptospermum scoparium*.

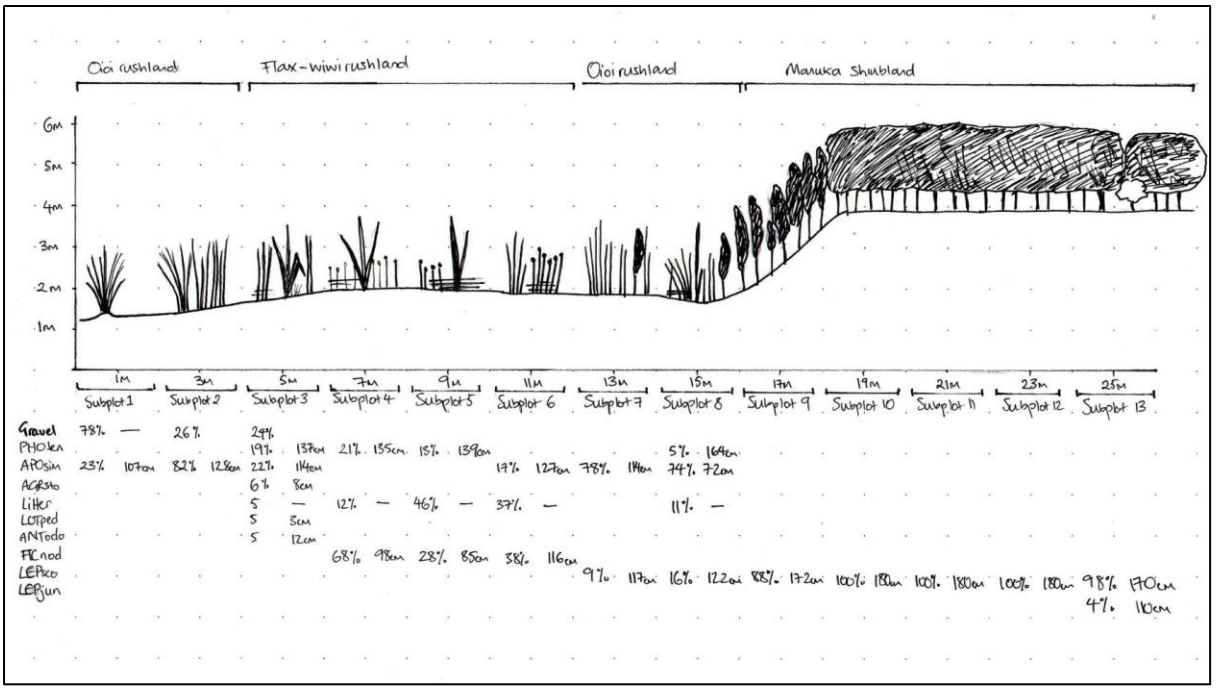

Figure 2. Schematic diagram of Transect 2 monitored during 2012-13 illustrating a typical transition of vegetation from the shoreline of Waituna Lagoon. Note some Mānuka (LEPsco) was observed at lower elevations (subplot 7). Source: Blythell (2013).

7. The proposed transitional regime for Waituna Lagoon, with provisions for regular opening to allow for fish passage, allows for gradual change in how water levels are managed in Waituna Lagoon. For the initial five (5) years of the consent, it is proposed opening events when water levels exceed 2.3m for seven consecutive days (in winter), and 2.4m for 3 consecutive days (in summer). *Note this reflects the latest version of proposed transitional regime.* Eventually, the maximum trigger level for lagoon opening will increase to 2.5m for 7 consecutive days. The extent of inundation at different water levels is shown in Figure 3, reproduced from the technical report (Robertson et a. 2024).

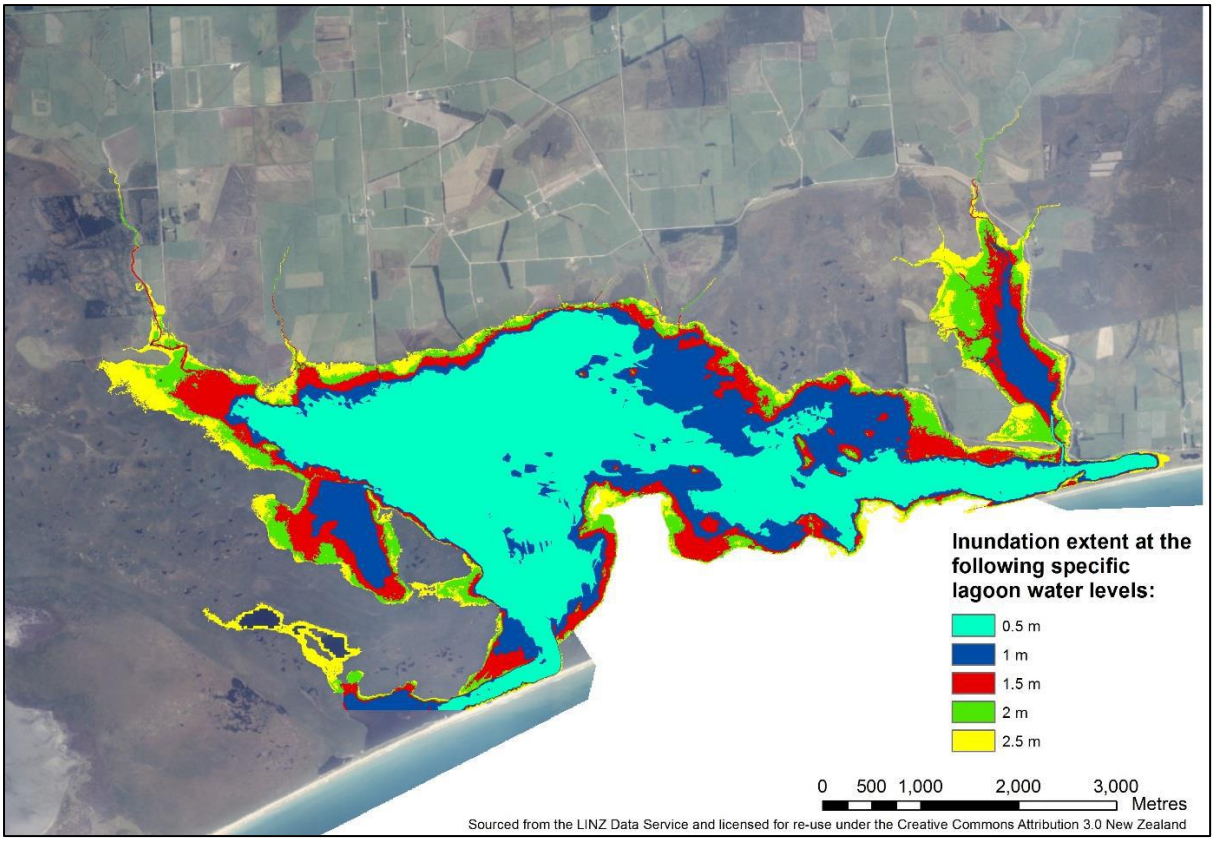

Figure 3. Waituna Lagoon inundation extent at different water depths. Source: Walsh et al. (2016).

8. The distribution of the fringing plant communities at Waituna Lagoon, relative to a lagoon water level (land elevation) of 2.4 m is shown in Figure 4. The vegetation mapping was undertaken in 2008 when delineating wetland plant communities across the Awarua-Waituna complex (Boffa Miskell & Urtica 2010). The classification system is slightly different than that applied by Blythell (2013) but is comparable.

9. The dominate wetland plant community between <2.4 m in the fringing wetland habitat is *Oioi restiad-rushland/reedland* (Figure 4). In relatively small areas dense manuka and flaxland are also present as observed in the eastern areas of Waituna Lagoon. (Figure 4b).

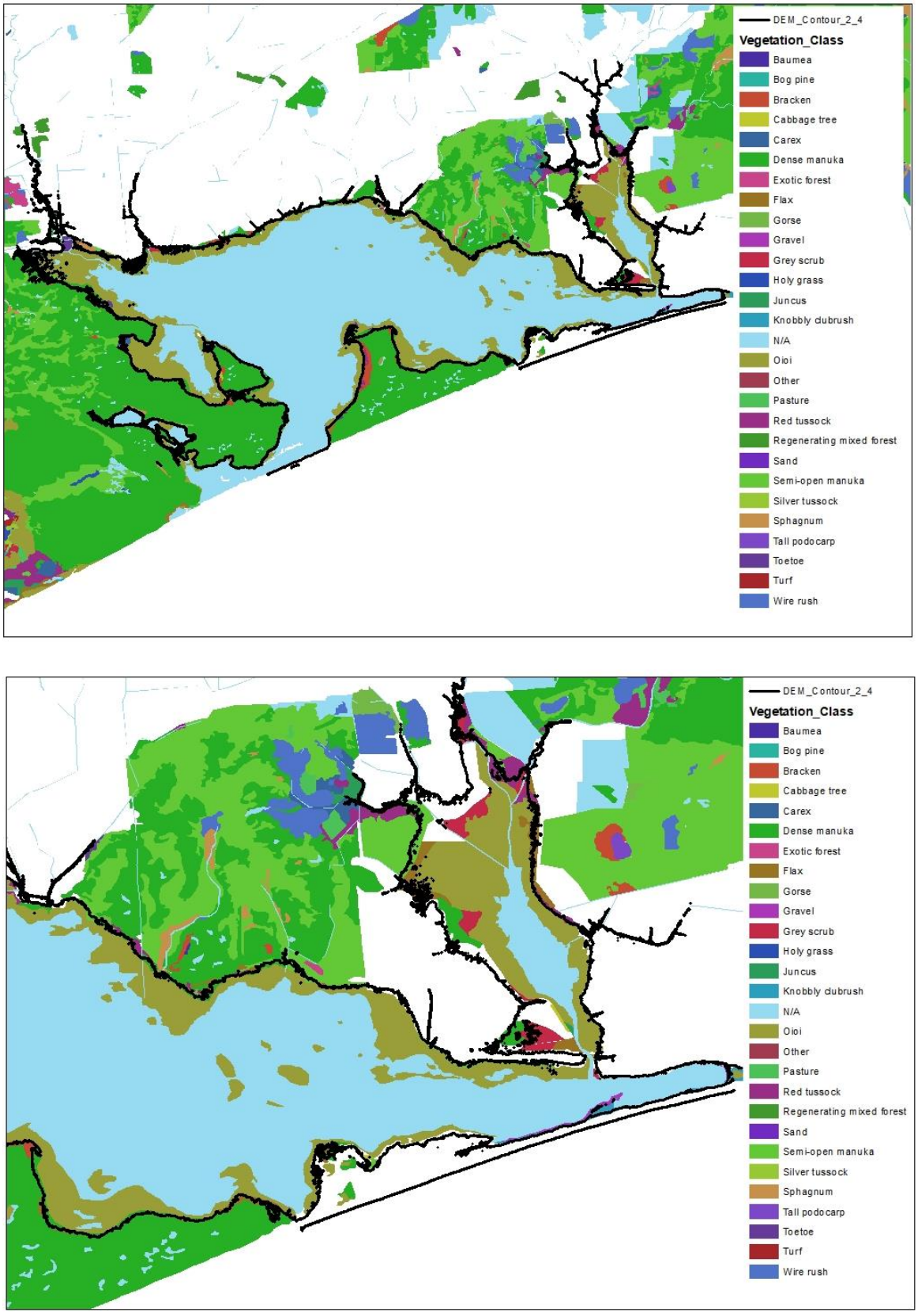

Figure 4. Extent of fringing wetland vegetation communities at Waituna Lagoon, relative to

lagoon water level of 2.4 m. **a)** Full lagoon extent; **b)** East lagoon area. Source: Boffa Miskell & Urtica (2010).

10. Updated hydrological modelling of lagoon opening scenarios was completed by Environment Southland (Jenkins March 2025, internal memo). Table 1 provides a summary of the *Scenario D*. In this scenario opening events occur when the '*level is 2.4 m for 1 day for the period 1 September to 20 April, and open when level is 2.3 m for 7 consecutive days for the period 1 May to 30 August or, if no opening occurred in the previous 2 years, open if the level exceeds 2 m (for fish passage)'.*

Table 1. Number of days water levels projected to be >2.0m, 2.2m and 2.4m under Scenario D water level scenario, compared to the previous short-term consent. Source: Jenkins 2025, internal memo.

Summary information	**Scenario D (transition regime)**	**Previous short-term consent**
Annual days above 2.0m	31.7 days	10.2 days
Annual days above 2.2m	8.2 days	2.0 days
Annual days above 2.4m	0.9 days	0.4 days

11. Table 1 indicates there is anticipated to be an increase in the duration of inundation >2.0m and >2.2m for the transitional opening regime compared to how the lagoon has been managed previously. However, when compared to the previous short-term consent this does not exhibit a major change in the duration of 'higher water' periods. For example, it is modelled that water levels will be >2.2m above msl for 8.2 days per annum (compared to 2.0 days previously). Although, using the more conservative seepage rate, this may increase marginally to 12 days per annum >2.2m (Jenkins, 2025).

12. Further, it is important to note that the baseline state against which the consent application to open the lagoon is being assessed against is a 'no consent' scenario where water levels would fluctuate naturally. In an unmanaged scenario the fringing wetland

vegetation would be subject to more frequent and prolonged inundation at high water levels >2.4m.

13. Using the wetland and non-wetland/exotic plant communities described by Blythell (2013) an assessment of the likely effect of the proposed water regime is presented (Table 2).

Table 2a. Expected effect of transitional water regime on wetland plant communities

Wetland plant communities	**Occurrence (Blythell 2013)**	**Effect of proposed water regime (Scenario D)**
Oioi restiad-rushland/reedland	Oioi rushland was the most abundant community type recorded, representing in 142 of the 221 subplots.	Apodasmia similis (Oioi) is the most common and widespread plant community. The rushes are tolerant of inundation and the 6-20 day increase in days inundated (compared to previous water level) is not considered a risk.
Manuka-tangle fern scrub/fernland	Only one subplot exhibited this community type.	Not common in fringing vegetation. Less tolerant of wet conditions. Likely present due to some terrestrial wetland plants to migrating downslope associated with the historical lower-water level.
Herbfield (Lakeshore turf)	Lakeshore turf communities occurred in 19 different subplots across nine of the fifteen transects.	Lakeshore turf plants are by their nature adapted to fluctuating water levels. The extended duration of events (6-20 day increase in days inundated) is not anticipated to have adverse effect on turf species, e.g. *Lilaeopsis novae-zelandiae, Limosella lineata*
Modified flaxland	This community type was only found in two subplots along a single transect.	Not common in fringing vegetation. Flax (Phormium tenax) is tolerant of wet conditions.

Carex Schoenus sedgeland	This community type occurred in three subplots along two different transects.	Not common in fringing vegetation. The key plant species *Carex coriacea* and *C. gaudichaudiana* are considered tolerant of wet conditions.
Oioi, knobby clubrush sedgeland	This community occurred in three subplots across two different transects.	Not common in fringing vegetation. *Ficinia nodosa* (clubrush) and Oioi are tolerant of wet conditions. The extended duration of events (6-20 day increase in days inundated) is not anticipated to have adverse effect on turf species.

Table 2b. Expected effect of transitional water regime on exotic and non-wetland plant communities

Non-wetland and exotic plant communities	**Occurrence and elevation**	
Exotic grassland	This community is widespread was found in 26 subplots from eight different transects.	Exotic grass species, e.g. tall fescue, Yorkshire fog *Holcus lanatus* are partly tolerant of wetland conditions. Increase in inundation anticipated to cause reduction of exotic grasses.
Exotic ruderal beach community	This community type occurred in five subplots along three different transects.	Exotic species that may establish quickly when conditions favourable (e.g. *Lepidium didymium, Rumex acetosella, and Atriplex prostrata*). Increase in inundation anticipated to cause reduction of exotic herbs.
Manuka scrub	This community occurred in nine different transects. There were eleven subplots containing an intact	Manuka has generally established at higher elevations in the fringing vegetation, although with some outliers where manuka is in

	manuka scrub community as well six subplots containing a mix of manuka scrub and oioi rushland. An estimated elevation range for intact manuka scrub is ≥ 270 cm above the lagoon bed, while a mix of manuka scrub and oioi rushland has an estimated elevation range of 80 – 150 cm above the lagoon bed.	associated with Oioi. Manuka is less tolerant or prolonged inundation. The extent of manuka is likely associated with the historical lower-water level allowing manuka to migrate downslope. Some limited dieback of manuka may occur as a result of reinstating a more natural water regime.
Shore bindweed, knobby clubrush gravelfield-stonefield	This community type occurred in five subplots along a single transect on the gravel bar which separates the lagoon from the sea.	Occurs at sites on the gravel bar in general above the influence of lagoon water levels.
Bracken fernland	This community occurred in seven subplots within three different transects.	Bracken has generally established at higher elevations in the fringing vegetation. Bracken and associated species (e.g. gorse, manuka) is less tolerant or prolonged inundation. The extent of bracken is likely associated with the historical lower-water level.

14. Johnson and Partridge (1998) commented there were '*several lines of evidence that the nature of the lagoon margin vegetation has changed in response to a generally lower lagoon level, combined with apparent increases in sedimentation. The resilient Apodasmia similis (Oioi) rushland has responded to these changes, by increasing its extent, and maintaining, at least so far, a predominantly native feel to the lagoon shores*'.

15. Similarly, Blythell (2013) commented '*Some comparison of the vertical elevation range of some species is possible using the list of 39 species with elevation ranges in Johnson and Partridge (1998). The majority of these species (35 out of 39) appear to have extended their range down slope. However, nineteen are versatile species which can adapt quickly*

to take advantage of new habitat and their range extension may be recent (primarily herbs and short some monocotyledons). Nine of these versatile species are exotic and ten are native. However, twelve of the species which have moved down slope are not short-lived species and this possible extension in their elevation range implies that reduced water levels in the lagoon have affected their distribution.' Blythell (2013) concluded that '*Lagoon levels should not be managed any lower than current levels to halt any continual downward creep of shoreline communities*.

16. Both the 1998 and 2013 studies observed a downslope migration of some plant communities that is not necessarily associated with a natural lagoon hydrology, but a modified environment. Nonetheless, many of the fringing wetlands that have established (e.g. extensive Oioi rushlands) provide valuable habitat for threatened and at-risk species (e.g. Fernbird) and are ecological important wetlands.

17. Overall, the assessment in Table 2 indicates **native wetland plant communities will not be adversely affected by the increased duration of inundation >2.0m and 2.2m** as the wetland species are adapted or resilient of wet conditions, and because the increased duration is relatively small, compared to the previous short -term consent. Irregular inundation at higher levels is positive for these systems as they will also make growing conditions for exotic species, such as introduced grasses and gorse, more difficult.

18. However, there may be some transition and dieback of native terrestrial species that migrated downslope in response to a prolonged period of modified hydrology. During September 2024 water levels in Waituna Lagoon remained above 2.4m for a period of ~2-3 weeks. Following this event, reports were received from community of dieback of some vegetation in discrete areas, such as manuka. This reversion (and associated dieback) from terrestrial plants to more wetland plant communities can be viewed as part of the ecological restoration of the natural hydrological and ecological function of the lagoon ecosystem. In other wetlands of New Zealand, manuka has established because of altered hydrology (e.g. Whangamarino wetland) and has subsequently declined as the water levels were restored.

19. The proposed transitional regime is supported to allow the native wetland vegetation to transition gradually overtime. The relatively short-periods above 2.3m (in winter) and 2.4m (in summer) for the initial 5 years will ensure that the Oioi rushland and other fringing wetland vegetation is not subject to a rapid shift in hydrological conditions.

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Monitoring changes in shoreline vegetation communities at Waituna Lagoon, Southland

Report prepared for the Department of Conservation by Jesse Bythell
Biosis

June 2013

Contents

1.0 Executive summary

Waituna Lagoon is a shallow coastal lake in Southland which is rich in biodiversity, recreational and cultural values. This naturally dynamic lagoon has been subjected to artificial openings as well as increased sediment load and nutrient delivery since the advent of European farming in the catchment. These changes have impacted upon its condition and ecological values.

This project attempted to remeasure nine transects established by Peter Johnson in 1995 in order to determine any changes in zonation patterns of shoreline communities at Waituna Lagoon. Unfortunately, due to limitations in the data available for the 1995 measurements few comparisons are possible. However, it does appear that several species at the lagoon have extended their elevation range down slope, which is consistent with effects that can be expected by the increased regularity at which the lagoon is opened artificially.

The data collected in 2012-13 provide a valuable benchmark for repeated monitoring in future. It is recommended that these transects are remeasured in 3-5 years to determine if any changes in vegetation can be confirmed.

If downward trend in species elevation range can be proven then lagoon levels should not be managed any lower than current levels. If the lagoon is continually lowered and simultaneously filled with sediment it could functionally disappear.

2.0 Introduction

Waituna Lagoon is a shallow coastal lake in Southland which is rich in biodiversity, recreational and cultural values (DOC 1998). The lagoon is a naturally dynamic environment which in pre-European times would have intermittently broken through the gravel bar which separates it from the sea. However, land use intensification and lower than natural water levels due to artificial opening of the lagoon are driving changes in water quality and are likely to be affecting shoreline vegetation communities. This report covers the results of monitoring carried out between May 2012 and April 2013 to remeasure transects established along these shoreline communities in an effort to detect changes in these communities.

2.1 Background

Waituna Lagoon (c. 1,350ha) is included within the Waituna Wetlands Scientific Reserve and is the focal point of the Awarua Wetlands wetland of international impotance recognised under the Ramsar Convention (1983). Waituna is one of the best examples of a shallow coastal lake in New Zealand (Kirk and Lauder, 2000). This type of lagoon is characterised by: naturally small sediment yields; natural openings to the sea are rare and brief; fresh-brackish waters influenced by salt spray; wind and seiches influence the variation in the water-covered low-lying areas, particularly downwind (*ibid.*). Waituna Lagoon had higher than current day average water levels and a wider range in water levels under pre-European conditions (Johnson and Partridge, 1998). Naturally the lagoon maintained a higher water level for longer periods until the lowest point of the gravel bar dividing it from the sea gave way, partially draining the lagoon (*ibid.*). Seawater would then enter the lagoon and it would enter an estuarine phase. In due course longshore drift from the west would deliver material and rebuild the bar and close the lagoon (*ibid.*).

Three nationally threatened species and one naturally uncommon species of plant occur on the shoreline of Waituna Lagoon. These species are: *Isolepis basilaris* (nationally endangered), *Deschampsia caespitosa* (declining), *Urtica linearifolia* (declining) and *Mimulus repens* (naturally uncommon) (de Lange, et al., 2009).

Since the early 1900s artificial opening of the lagoon to the sea has significantly lowered the water levels of the lagoon, effectively reducing its volume and diminishing the force of wind-driven processes within the lagoon (Johnson and Partridge, 1998). The intensification of land use in the relatively small (19,955 ha) Waituna catchment has increased the delivery of sediment and nutrients into this naturally low-nutrient and low-sediment yield lagoon (*ibid.*). Aerial photography analysis demonstrates that increased sediment delivery has already caused an increase in the density of oioi (*Apodasmia similis*) around the lagoon's shoreline since 1951 (Johnson and Partridge, 1998). One of the potential effects of increased sediment delivery into the lagoon is the raising of the lagoon bed at a faster rate than predicted rises in sea level caused by climate change (Clayton, 2011). This, coupled with decreased water levels due to the artificial opening regime could see vegetation advance downhill along the retreating shoreline and lead to the eventual disappearance of the lagoon (*ibid*.).

Changes in salinity, sediment load, increased nutrients and reduced water levels are likely to have affected the composition and abundance of shoreline vegetation. Some of these changes may have been developing since the artificial opening regime began, however recent intensification of land use and the practice of opening the lagoon at

lower levels to encourage 'flushing' of nutrients and sediment are likely to have accelerated any changes in shoreline vegetation communities.

3.0 Objectives

The intention of this monitoring project was to remeasure nine transects established by Peter Johnson in 1995 in order to determine any changes in zonation patterns of shoreline communities at Waituna Lagoon. Unfortunately quantitative comparisons between data collected in 1995 and 2012 are not possible for several reasons and any differences detected between the two sets of data may not be due to any real change in vegetation. The primary reasons these two data sets cannot be compared are: the original data have been misplaced (Rance 2012, pers. comm.) and summary data in Johnson and Partridge (1998) are not sufficiently detailed; and there is lack of certainty whether the 1995 and 2012 transects are in the same location (Johnson returned in 2005 to mark transect locations but due to high lagoon conditions the markers were only able to be placed at approximate locations).

However, data collected during this study can provide a basis for future, repeatable measures of these shoreline communities. All transects have been carefully marked and GPS coordinates recorded to ensure future measurements can be made with confidence. Analysis of future measurements can provide indications of changes in species richness, changes in the elevation range of species and changes in percentage cover/volume of species occupancy and changes in vegetation height.

4.0 Methods

The methodology was developed following suggestions in Clayton (2011) and in consultation with Dr Hugh Robertson (Scientific Advisor – Freshwater (Wetlands)), Brian Rance (Technical Advisor - Ecology) and Polly Bulling (Acting Project Manager - Awarua Wetlands). Where practical, the method aimed to duplicate the methods used by Johnson and Partridge (1998) in order that the two data sets could be compared.

4.1 Transects

A total of fifteen transects were measured, including remeasuring eight original transects and the establishing seven new transects. The locations for the new transects were selected to gain an even geographic spread and to ensure that a representative range of plant communities and shoreline types were included. All transects began at the first terrestrial vegetation at the water's edge[1] and continued perpendicular to the shoreline until reaching dryland communities (i.e. those which are not substantially influenced by changes in water level). Transect lengths varied according to how gradually the elevation changed and how soon dry communities were reached. Transects ranged in length from 22 – 292 m. Transects did not extend into the lagoon to include aquatic plants as per Johnson and Partridge (1998) because other monitoring projects are undertaken to these measure these communities.

The start and end of transects were permanently marked with a warratah and warratahs were also placed at 50 m intervals along the transect to assist in remeasuring the transects with 50 m tapes. Sometimes it was not appropriate to place warratahs at the exact start or end points of transects because they could become

[1] Due to most of the transects being measured when the lagoon was relatively high (≥1.25 m), in practice the transect start was usually determined by the presence of taller vegetation such as oioi.

navigational hazards to boaters or they would be in places frequented by the public. In these cases short wooden stakes were used or warratahs were set at different points along the transects and notes were made to ensure that transects can be re-established correctly in future. GPS coordinates were recorded for all transects start and end points as well as all subplots along the transects and internal warratah positions. All coordinates were recorded in New Zealand Transverse Mercator Projection using a Garmin 60CSx with typical accuracy of 3 m. The compass bearing for each transect were recorded. Any additional species found within two metres either side of the transect which did not occur in the subplots were noted, with particular effort being made to find any threatened or rare species.

The transition between different vegetation communities along each transect was also recorded. In many cases community boundaries were not discrete and ecotone ('mix') communities were recorded too.

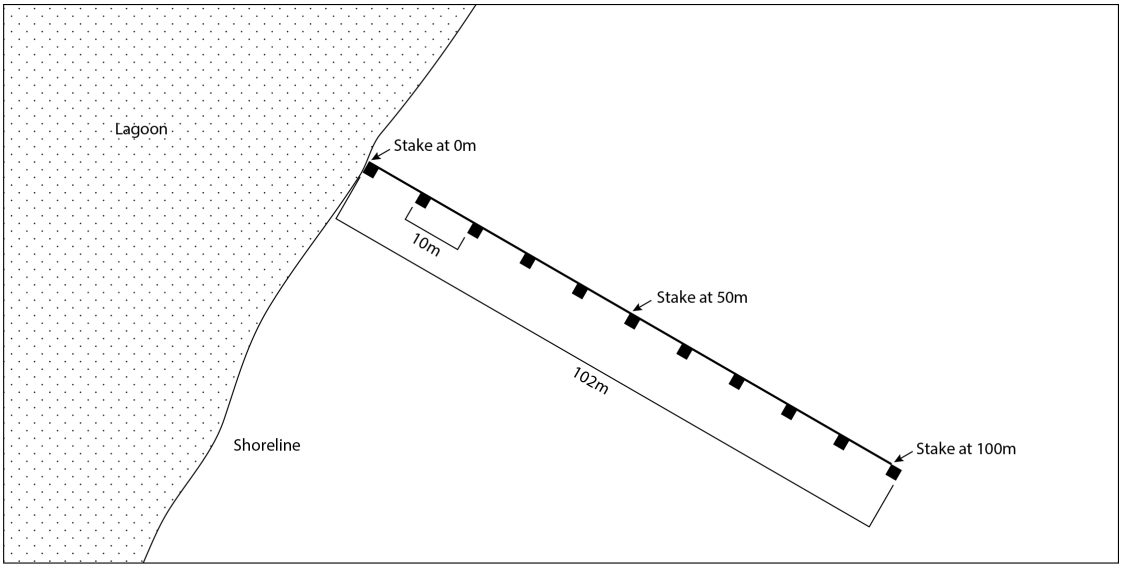

Figure 1: Example of transect layout

4.2 Subplots

Subplots measuring 2x2m were placed along the true right side of the transect allowing for movement along the true left of the transects without trampling vegetation within subplots. Subplots were established using four bamboo stakes and a 20m tape as illustrated in Photo 1 below.

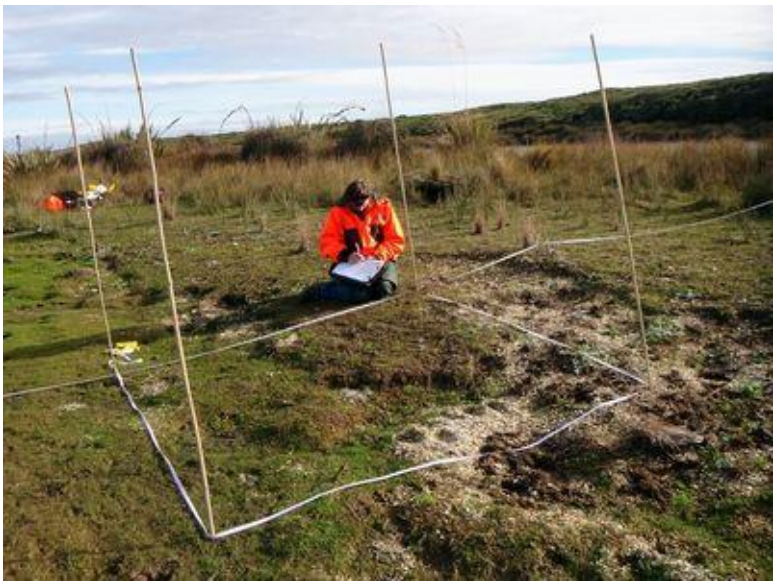

Photo 1: Subplot established on turf community along T3_2012 (Bythell, 2012)

The percentage of cover and the mean and tallest height for each species was recorded for all subplots (excluding flowering parts of plants). No height was recorded for species that are naturally shorter than 5 cm (e.g. *Selliera radicans*). Water depth was also measured at the centre of each subplot where necessary. Species were not recorded in separate strata as this proved too difficult in practise. Most plant communities consisted of one stratum, however in the manuka shrubland more than one stratum was present in a subplot and the percentage cover for many of these subplots totals more than 100%.

It would have been too time consuming to measure subplots along the entire length of each transect as per Johnson and Partridge (1998) so subplots were spaced at intervals along transects. The intervals between subplots were based on the length of the transect, see Table 1 below:

Table 1: Transect length and subplot intervals

Transect length	Subplot intervals	Number of transects
20 – 29 m	every 2 m (i.e. contiguous)	3
30 – 39 m	every 3 m	none
40 – 49 m	every 4 m	2
50 – 59 m	every 5 m	2
60 – 69 m	every 6 m	1
70 – 79 m	every 7 m	none
80 – 89 m	every 8 m	none
90 – 99 m	every 9 m	none
≥100 m	every 10 m	7

Additional subplots could be added if necessary to capture any plant communities occurring along a transect that were not already covered by the regularly spaced subplots. Additional subplots were added to capture turf communities in to two transects (T8_2012 and T12_2012).

Elevation measurements were taken for subplots using a tripod mounted surveyor's level (or 'dumpy level') and a graduated staff (see Photo 2 below). The datum for the elevation measurements for each transect was the mean water level on the gauge at Curran Creek on the day which the transect was measured.

Unfortunately, it was not always possible to measure elevation along the full length of all transects due to obscuring vegetation and therefore no elevation readings were taken for 72 of the 221 subplots. Typically elevation measurements were not possible for subplots at the upper end of transects, however vegetation was too tall along the entire length of T5_2012 for any elevation measurements to be taken.

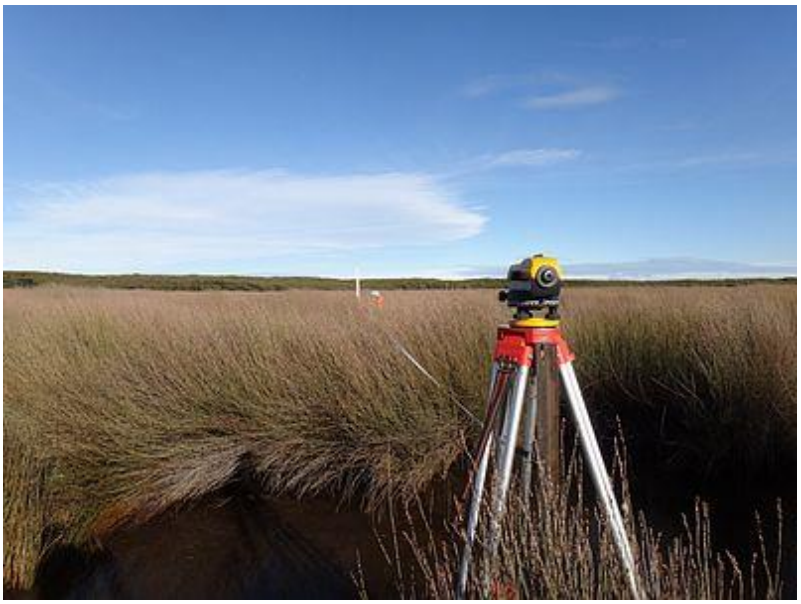

Photo 2: Using the builder's level to measure changes in elevation along T11_2012 (Bythell, 2012)

4.3 Soil samples

Soil samples were collected from within subplots at the start, centre and end of each transect. Core samples were taken using a piece of plastic pipe measuring 6.5x10cm, labelled and double bagged in zip lock bags and kept cool. Samples were sent to Landcare Research's Environmental Chemistry Laboratory in Palmerston North within one week of collection. Paired soil samples were taken at each site; one to measure bulk density and the other to analyse soil salinity, nutrient status, pH and organic content.

4.4 Photopoints

Photopoints were established at the start, centre and end of each transect. Four photos were taken at each photopoint: i) facing the lagoon, ii) at right angles with the lagoon to the left, (iii) facing along the transect, (iv) at right angles from transect line with the lagoon to the right. The bearing for each photo was recorded. All photos were taken with no zoom, at head height (approximately 165cm) using a Sony digital camera

i) facing the lagoon

ii) at right angles with lagoon on left

(iii) facing along the transect

(iv) at right angles with lagoon on right

Photos 3-6: Photos from the start of T9_2012 showing examples of photo point images (Bythell, 2012)

(Cybershot DSC-TX10 16.2 mega pixels). Unfortunately several photos are of mediocre quality due to the low position of the sun when most of this work was undertaken.

5.0 Results

5.1 Summary of transects

Fifteen shoreline transects were measured during this project (see Table 2 below for a summary of the transects).

Thirteen transects were measured (seven original and six new ones) over 15 days between 19 May and 15 July 2012. Limitations imposed by the weather, short daylight hours and tides reduced the available hours when fieldwork was possible and high lagoon levels have affected the measurement of the lower portions of some transects. T1_2012 and the lower portion of T12_2012 were measured after the lagoon was opened to the sea on 2 July.

Two additional transects were established in April 2013 to provide a dataset of fifteen transects, and the lower portions of transects T7_2012, T10_2012, T11_2012 and T13_2012 were remeasured because it was suspected that turf communities were likely to be present under the water when the initial measurements were made in winter 2012. Transect T11_2012 was burned by the November 2012 fire which spread from Awarua Bay. Some new shoots had developed from the burnt oioi stumps and a range of small native and exotic herbs were flourishing in the intervening space.

Table 2: Summary of transects (2012-2013)

Transect name	Length (m)	Number of subplots	Lowest elevation (cm)	Highest elevation (cm)	Community types[2]	Native species	Number of exotic species	Additional species in transect but not in subplots	At risk/ threatened species	Total species	Notes
T1_2012	42	11	107	176	WL10, WL10(m), NN2	4	4	RANgla	none	8	
T2_2012	26	13	137	271	WL10, DN5, F13	20	14	PTEesc, DRAlon	DESces	34	
T3_2012	26	13	115	171.5	WL15, NN1	21	20	None	ISObas	41	
T4_2012	142	15	122	245	WL10, WL10(m), NN1, NN2	20	13	CARdip, CARsec, PHOten, COPrig	none	31	
T5_2012	92	10	unable to measure		WL10, WL10-WL20, WL12, F19	13	2	PLAdiv, LEPjun	none	15	Only transect where WL12- manuka-tangle fern scrub occurs; very few weeds
T6_2012	102	11	88	500	WL10, NN1	18	11	AUSric, SELrad, SEDacr	URTlin	29	
T7_2012	112	12	75	>80	WL10, WL15, WL10-WL20, F13	23	11	MACten, CERfon, EMPmin, LEPjun, CHIrub	MIMrep	34	2 subplots remeasured in Mach 2013 and 5 extra native spp. and 6 extra exotic spp. found.

[2] See section 5.4 for descriptions of these community types based on Rogers and Singers (in press).

T8_2012	50	11	72	431	WL15, SA4, NN1, NN2	13	11	SAMrep, PLAdiv	MIMrep	24	The only transect with SA4 - shore bindweed, knobby clubrush gravelfield-stonefield community
T9_2012	22	10	125	>340	WL10, WL15, WL18(m), F19, F13	24	17	COPtay, HISinc, SCHaru	URTlin	41	The only transect containing WL18(m) - modified flaxland
T10_2012	292	30	106	>146	WL10, WL15, WL10-WL20, F13	43	19	CHEamb, MONfon, JUNpal, CHIrub, EPIcil	ISObas, MIMrep	62	3 subplots remeasured in Mach 2013 and 10 extra native spp and 7 extra exotic spp. found.
T11_2012	240	25	88	>118	WL10, WL15, F13	25	5	DESces	DESces, URTlin, ISObas	30	5 subplots remeasured in 2013 and 11 extra native spp. and 2 extra eoxtic species found. Entire transect burnt in 2011
T12_2012	274	29	122	290	WL10-WL20, WL10, F13, NN1	34	8	URTlin, COPrig, ELAgra, CARbre, CIRarv, SENvul	URTlin	42	Only transect where CARbre occcurred
T13_2012	40	10	124	>150	WL10, WL15, F13	29	19	RANgla, ELAgra	URTlin	48	2 subplots remeasured in Mach 2013 and 8 extra native spp. and 6 extra exotic spp. found.
T14_2013	52	11	56	>80	WL10, WL15, F13	21	8	PSElut, PHOten, PLAdiv	ISObas		
T15_2013	56	10	72	130	WL10, WL15, WL22, NN1	23	20	CARpro	ISObas, MIMrep	43	New record for Waituna, Spergularia bonnei found

Transects ranged in length from 22 - 292 m and yielded a total of 221 subplots. Subplots ranged in elevation from 56 - 500cm above the estimated bed of the lagoon.

5.2 Species summary

A total of 140 vascular plant species were recorded within the shoreline transects.

Table 3: Number of vascular species recorded in transects

	Native	Exotic	Total
Trees and shrubs	9	1	10
Herbs	38	30	68
Grasses, rushes, sedges	38	13	51
Other monocots	2	none	2
Lianes	2	none	2
Ferns	7	none	7
Total			140

The following eight species occurred within transects but not within subplots: toetoe (*Austroderia richardii*[3]), red tussock (*Chionochloa rubra* subps. *cuprea*), *Eleocharis gracile*, *Epilobium ciliatum*, tall fescue (*Schedonorus arundinaceus*), *Machaerina tenax*[4], *Montia fontana*, *Nertera scapanioides*, and stonecrop (*Sedum acre*).

5.3 At risk and threatened species

One Threatened and three At Risk plant species were recorded during the monitoring. At least one of the at risk or threatened plant species known from the area were recorded in thirteen of the fifteen transects. None of theses species were abundant and did not account for much of the cover of any of the subplots in which they occurred.

5.3.1 *Isolepis basilaris* (pygmy clubrush)

Isolepis basilaris (nationally critical) was initially only found in one subplot of T3_2012. However, remeasuring the drowned portions of transects T10_2012 and T11_2012 revealed more of this species and it was recorded in three additional subplots. This plant is very small and inconspicuous, preferring silty WL15 - Herbfield (Lakeshore turf) communities with an elevation range of 88 – 141 cm above the lagoon bed. Competition from taller exotic herbs is likely the most common threat to this species at Waituna Lagoon.

[3] Syn. *Cortaderia richardii*
[4] Syn. *Baumea tenax*

Photo 7: *Isolepis basilaris* in transect T10_2012 four months after the fire (Bythell, 2013)

5.3.2 ***Deschampsia cespitosa* (tufted hair grass)**

Deschampsia cespitosa (declining) was only recorded in two transects (five subplots within T2_2012 and outside of any subplots but within T11_2012). *Deschampsia cespitosa* was found in two community types, WL10 - Oioi restiad-rushland/reedland and DN5 - oioi, knobby clubrush sedgeland. Based on these occurrences, the elevation range for this species is 174 – 202 cm above the lagoon bed.

Johnson and Partridge note (1998) *Deschampsia caespitosa* as a common element in grassland communities on gravel bars. *Deschampsia caespitosa* is abundant in WL10(m) – modified oioi restiad-rushland/reedland on the western side of Moffat Creek, although few seedlings have been observed recruiting into the dense sward of *Agrostis stolonifera* which characterises this community. *Deschampsia cespitosa* observed in dense oioi rushland were typically small and appeared be struggling to compete with the much taller oioi. Competition with exotic grasses and taller species such as oioi appear to be the main threats to this species.

5.3.3 ***Urtica linearifolia* (swamp nettle)**

Urtica linearifolia (declining) occurred within six different subplots in five different transects (T6_2012, T9_2012, T10_2012, T13_2012 and T14_2013) and also in T12_2012 but not within a subplot. This species was found within the following communities: WL10 - Oioi restiad-rushland/reedland, WL10(m) – modified oioi restiad-rushland/reedland and WL15 - Herbfield (Lakeshore turf). Based on theses occurrences the elevation range for *Urtica linearifolia* is 120 – 149 cm above the lagoon bed.

Typically *Urtica linearifolia* grows from the silt trapped at the base of oioi clumps to scramble over oioi and adjacent vegetation such as *Plagianthus divaricatus*. In WL10(m) communities *Agrostis stolonifera* is likely to compete with young *Urtica linearifolia* plants.

5.3.4 *Mimulus repens* (native musk)

Mimulus repens (naturally uncommon) occurred in six subplots in four different transects (T7_2012, T8_2012, T10_2012 and T12_2012). This species is difficult to find when lagoon levels are high. Revisiting transects under lower water conditions proved important in determining whether *Mimulus repens* was present as four of the five observations for this species were made when lagoon levels were 75 cm (T12_2012 in July 2012 after the lagoon was opened to the sea, T7_2012 and T10_2012 when they were revisited in March 2012). Based on theses occurrences the elevation range for *Mimulus repens* is 75 - 122 cm above the lagoon bed.

Mimulus repens appeared to have been grazed by waterfowl when it was recorded in transect T12_2012 in July, making it very difficult to spot. This species appears widespread across the exposed lower portion of the shoreline which as sheltered with silty substrate and a relatively gentle slope (e.g. western ends of the lagoon) and was observed frequently en route to transects T11_2012 and T10_2012 while remeasuring their lower subplots in March 2012. *Mimulus repens* is also common on the lower shore of Little Waituna Lagoon. Because most transects were established when lagoon levels were high their starting points were usually determined by taller vegetation such as oioi. If these transects had been established under lower lagoon levels they are likely to have begun further down slope to include populations of short statured turf species such as *Mimulus repens*.

5.4 Vegetation community types

This report describes community types according to the Rogers and Singers (in press) ecosystem classification system. Where plant communities are substantially modified by exotic species (or in a few cases burnt by fire) they have been described as modified (m), e.g. WL10(m). This convention is helpful for discussing changes at Waituna Lagoon but is not part of the classification system developed by Rogers and Singers (in press). See Appendix 3 for a comparison of different names used by various authors for the community types found at Waituna.

Community types recorded within the shoreline transects fall into three broad categories: wetland communities, non-wetland communities and non-native communities. These community types are summarised in Table 4 below:

Table 4: Summary of different community types recorded in shoreline transects (2012-2013)

	Number of subplots	% of subplots	Elevation range (cm above estimated lagoon bed)	Native species	Exotic species	Total species	At risk/threatened species	Notes
Wetland community types								
WL10 - oioi restiad-rushland/reedland	106	48	70 – 190	43	25	68	DESces, URTlin, MIMrep	
WL10(m) - modified oioi restiad-rushland/reedland	18	8.1	80 – 160	14	9	23	URTlin	AGRsto suppresses small species which add to diversity
WL10-WL20 mix	7	3.2	130 - 190 (est.)	11	4	15	None	Oioi with some shrubs
WL10 - F13 mix	6	2.7	unable to measure	11	2	13	None	Oioi with some manuka
WL10-WL15 mix	3	1.5	100 - 130	20	20	40	URTlin, ISObas	
WL10(m)-WL15 mix (burnt)	2	2.7	90 - 100	11	4	15	ISObas	
WL12 - Manuka-tangle fern scrub/fernland	1	0.45	Not measured	8	none	8	None	
WL15 - Herbfield (Lakeshore turf)	14	6.3	50 - 130	26	18	44	ISObas, URTlin, MIMrep	
WL18(m) - modified flaxland	2	0.9	150 – 180	15	8	23	URTlin	
WL22 Carex Schoenus sedgeland	3	1.5	100 – 150	11	8	19	None	
DN5 - Oioi, knobby clubrush sedgeland	4	1.8	190 – 250	8	17	25	DESces	Higher elevation supports exotic spp.
Non-wetland community types								
SA4 - Shore bindweed, knobby clubrush gravelfield-stonefield	5	2.2	120 –390	5	3	8	None	Mostly gravel, supports few species
F13 - Manuka scrub	11	4.9	≥270	15	2	17	None	Too shady for weeds

	Number of subplots	% of subplots	Elevation range (cm above estimated lagoon bed)	Native species	Exotic species	Total species	At risk/threatened species	Notes
F19 - Bracken fernland	7	3.2	≥270	16	10	26	None	
Non-native community types								
NN1 - Exotic grassland	27	12.2	80 - 500	38	30	68	MIMrep	Weeds dominate % cover
NN2 - Exotic ruderal gravel beach community	5	2.2	130 - 210	6	16	22	None	
Total	221							

5.4.1 Wetland community types

There are five different community types at Waituna which can be classified as wetland communities within the Rogers and Singers (in press) ecosystem classification system.

- **WL10 - Oioi restiad-rushland/reedland**

Oioi rushland was the most abundant community type recorded, representing in 142 of the 221 subplots. Of these, 106 subplots included an intact community of oioi rushland (WL10) while 18 subplots included modified oioi rushland (WL10(m)). Only two of the fifteen transects did not include instances of oioi rushland (T3_2012 and T8_2012).

Oioi rushland ranges from 70 – 190 cm above the lagoon bed. Below 150 cm individual oioi plants grow in clumps, often with turf communities nested between them, but above 160 cm it forms dense swards in which very few other species occur. Other native species in this community include coastal ribbonwood (*Plagianthus divaricatus*) and sedges such as *Carex appressa*, *C. dipsacea*, *C. secta* and *C. virgata* occur in small amounts.

Modified oioi rushland (WL10(m)) refers to subplots where the space between oioi clumps has been invaded by a dense sward of creeping bent (*Agrostis stolonifera*) with some native species intermingled, including *Eleocharis acuta*, *Galium propinquum*, *Myriophyllum propinquum* and silverweed (*Potentilla anserinoides*). The diversity of native species is much lower in the modified oioi rushland than it is in the intact version of this community, in large part due to the *Agrostis stolonifera* inhibiting the presence of small native turf species. The elevation range for this modified community is 80 – 160 cm above the lagoon bed. This modified community type occurs where oioi grows in clumps and represents <75% of the overall cover. The substrate for this community type is almost always silt. Some of the largest populations of *Deschampsia cespitosa* at Waituna Lagoon have been observed in this open oioi rushland, although not in any of the transects established for this project. It is likely the prevalence of creeping bent in the open oioi rushland areas will reduce recruitment opportunities for Deschampsia cespitosa.

Sixteen subplots were composed of mixed communities where oioi rushland blended with another community type (i.e. WL10-WL15 mix, WL10-WL20 mix and WL10-F13 mix). The WL10-Wl20 - Coprosma Olearia scrub mix community occurred in 7 subplots across three different transects. It typically occurred at the upper limits of WL10 - Oioi restiad-rushland/reedland before the elevation became sufficiently high and dry for manuka scrub (F13) to become the dominant vegetation. The WL20 community always occurs as a mix with oioi rushland and typically contains mingimingi (*Coprosma propinqua*), *C. rigida* and a small amount of manuka. Tall vegetation prevented elevation readings from being made for most instances of this community. Very few exotic species were recorded in this community.

These the WL10-WL15 mix and WL10-F13 mix communities are described below.

- **WL12 - Manuka-tangle fern scrub/fernland**

Only one subplot exhibited this community type, at the end of transect T5_2012. This community was part of a sequence preceded by oioi rushland-Coprosma Olearia scrub mix (WL10-WL20 mix) followed by bracken fernland which then ended at Waghorn Road. The elevation range for this community type could not be measured as vegetation was too dense along the length of the transect to facilitate the use of the builder's level. No exotic species were recorded within this community.

- **WL15 - Herbfield (Lakeshore turf)**

Lakeshore turf communities occurred in 19 different subplots across nine of the fifteen transects. This includes 14 subplots which are occupied entirely by turf communities (WL15), three subplots which are a mix of both turf communities and oioi rushland (WL10-WL15) and two subplots which are occupied by a mix of burnt oioi rushland turf communities (WL10(m)-WL15). The elevation range for turf communities is 50 – 160 (431) cm above the lagoon bed.

Turf communities occur on silty substrates at elevations ranging from 50 – 120 cm above the estimated bed of Waituna Lagoon often around the base of oioi pedestals. Typically these silty turf communities include: *Isolepis cernua, I. basilaris* (nationally critical), *Hydrocotyle hydrophila*, *Samolus repens*, *Lilaeopsis novae-zelandiae, Limosella lineata, Mimulus repens* and *Myriophyllum triphyllum. Urtica linearifolia* (declining) seedlings often occur at the base of oioi pedestals mixed oioi-turf communities. Exotic species found within these lower elevation creeping bent, toad rush (*Juncus bufonius*) and herbs such as *Cotula coronopifolia,*hairy plantain (*Plantago australis*),curled dock (*Rumex crispus*) and *Atriplex prostrata*. These exotic species and are capable of enduring drowning and exposure (e.g. creeping bent) or can rapidly colonise exposed ground when the water level is low (e.g. *Atriplex prostrata*).

Turf communities on gravel substrates occur at shore elevations ranging from 110 – 160cm[5]. Typically these gravelly turf communities include: *Chenopodium ambiguum, Selliera radicans, Pseudognaphalium luteoalbum, Samolus repens, Limosella lineata, Lilaeopsis novae-zelandiae, Crassula moschata, Leptinella dioica*, silverweed and very small amounts of *Myriophyllum triphyllum* in subplots partially covered in water at the time of measurement. Exotic species in gravelly turf communities include: creeping bent, annual poa (*Poa annua*), hawkbit (*Leontondon taraxacoides*), scarlet pimpernel (*Anagallis arvensis*), *Cotula coronopifolia*, smooth sow thistle (*Sonchus asper*), birdsfoot trefoil (*Lotus pedunculatus*), hairy plantain and Atriplex prostrata.

All the exotic species found within turf communities are taller than the turf species and threaten them by competing for light and space. Versatile species such as *Atriplex prostrata* may displace native turf species by rapidly colonising newly available habitat before native species can occupy this space.

[5] Subplot T8_2012_S11 occurred on the edge of a pond part way up the gravel bar which separates the lagoon from the sea, hence the relatively high elevation of 431cm above the estimated lagoon bed. This turf community was comprised almost entirely of *Leptinella dioica* and its proximity to the coast means it might rightly be classed as SA5 – Herbfield (coastal turf).

- **WL18(m) – Modified flaxland**

This community type was only found in two subplots along a single transect and only a modified variant of it was observed. The elevation range for these two subplots is 150 – 180 cm above the lagoon bed.

This community type would normally be dominated by flax but in these two subplots it appears that gorse had invaded the area and displaced the flax. Subsequent weed control work had removed the gorse leaving bare ground which has been colonised by creeping bent and gorse seedlings. This community type occurred within the elevation range 150 – 180 cm above the lagoon bed level. This flaxland community occurred between oioi rushland-lakeshore turf mix (WL10-WL15 mix) and bracken fernland (F19).

- **WL22 Carex Schoenus sedgeland**

This community type occurred in three subplots along two different transects (T13_2012 and T15_2013). The elevation range for the sedgeland community is 100 – 150 cm above the lagoon bed.

This community is usually dominated by cutty grass (*Carex coriacea*) and *C. gaudichaudiana*, with some *C. appressa*, *C. sinclairii* and *C. dissita*. Exotic species present in the sedgeland community include: creeping bent, cocksfoot (*Dactylis glomerata*) and small herbs such as birdfoot trefoil.

- **DN5 – Oioi, knobby clubrush sedgeland**

This community occurred in three subplots across two different transects. The elevation range for this community type is 190 – 250 cm above the lagoon bed.

Knobby clubrush (*Ficinia nodosa*) is typically the dominant species within this community, with some oioi, flax, cutty grass and small amounts of *Deschampsia cespitosa*. Exotic species present in this community type include: creeping bent, cocksfoot, Yorkshire fog (*Holcus lanatus*), Californian thistle (*Cirsium arvense*) and gorse.

5.4.2 Non-wetland community types

Three non-wetland native community types were recorded, all falling within the upper ends of the shoreline transects where they occurred. These communities include shore bindweed-knobby clubrush stonefield (SA4) and two seral communities, manuka scrub (F13) and bracken fernland (F19).

- **SA4 – Shore bindweed, knobby clubrush gravelfield-stonefield**

This community type occurred in five subplots along a single transect (T8_2012) on the gravel bar which separates the lagoon from the sea. This community type is comprised of sparse vegetation cover over a quartz gravel substrate, with an elevation range of 120 –390 cm above the lagoon bed.

Knobby clubrush and shore bindweed (*Calystegia soldanella*) are the dominant species with occasional *Muehlenbeckia axilaris* and *Haloragis erecta*. Exotic species in this community only make up a small amount of cover and include *tall fescue*, Californian thistle and curled dock. Pieces of driftwood were recorded as

far up slope as 254 cm above the lagoon bed, indicating that wave action partly influences this community.

- **F13 - Manuka scrub**

This community occurred in nine different transects. There were eleven subplots containing an intact manuka scrub community as well six subplots containing a mix of manuka scrub and oioi rushland (WL10-F13 mix). Elevation measurements for this community were difficult to make because the height of the vegetation prevented us from using the builder's level. An estimated elevation range for intact manuka scrub is ≥ 270 cm above the lagoon bed, while a mix of manuka scrub and oioi rushland has an estimated elevation range of 80 – 150 cm above the lagoon bed.

The manuka scrub included both dense manuka and semi-open manuka communities. The dense manuka was younger and included very few other species, whereas the semi-open manuka was older and contained species such as mingimingi, prickly mingimingi (*Leptecophylla juniperina*), and ferns such as bracken and *Blechnum minus*, with occasional occurrences of inaka/turpentine shrub (*Dracophyllum longifolium*) and *Coprosma dumosa*. Gorse was the only common exotic species in this community, but was limited to open manuka scrub where there was sufficient light.

- **F19 bracken fernland**

This community occurred in seven subplots within three different transects. The elevation range for this community is ≥ 270 cm above the lagoon bed.

Bracken fernland is typically dominated by bracken with some manuka, flax and small amounts of prickly mingimingi and mingimingi. Few exotic species occur in this community, but there were some instances of gorse and exotic herbs and grasses such as creeping bent and birdfoot trefoil open areas with sufficient light.

5.4.3 Exotic plant communities

Two exotic plant communities were encountered while measuring the shoreline transects: NN1 – exotic grassland and NN2 – exotic ruderal beach community. The communities are not covered by the Rogers and Singers (in press) classification system which is concerned with native ecosystems.

- **NN1 – exotic grassland**

This community is widespread was found in 26 subplots from eight different transects. The elevation range for this community type is 70 – 500 cm above the lagoon bed.

This community may contain some native species and many instances of it likely represent native communities which are so modified by the presence of exotic grasses that is would now be difficult to confidently assign a native community type. Typically the low elevation exotic grassland (70 – 150 cm) is dominated by creeping bent with some jointed rush (*Juncus articulates*) present. Mid-elevation exotic grassland (150 – 300 cm) is dominated by creeping bent with other pasture species such as Yorkshire fog, tall fescus, sweet vernal (*Anthoxanthum odoratum*), *Poa pratensis*, cocksfoot and herbs such as hawkbit. On dunes (at elevations

above 300 cm) creeping bent is replaced by marram grass (*Amophila arenaria*) as the dominant exotic grass species.

- **NN2 – exotic ruderal beach community**

This community type occurred in five suplots along three different transects. The elevation range for this community is 130 – 210 cm above the lagoon bed. Species in this community type include twincress (*Lepidium didymium*), scarlet pimpernel, sheeps dock (*Rumex acetosella*), and *Atriplex prostrata*. These communities are quick to appear when conditions are favourable and their distribution at different elevations along the relatively bare shore can often indicate previous lagoon levels. Native species such as *Pseudognaphalium luteoalbum* occur in small amounts.

5.5 Vertical elevation range of species

Some comparison of the vertical elevation range of some species is possible using the list of 39 species with elevation ranges in Johnson and Partridge (1998) (see Appendix 4 for a full list of these species and their elevation ranges). The majority of these species (35 out of 39) appear to have extended their range down slope. However, nineteen are versatile species which can adapt quickly to take advantage of new habitat and their range extension may be recent (primarily herbs and short some monocotyledons). Nine of these versatile species are exotic and ten are native.

However, twelve of the species which have moved down slope are not short-lived species and this possible extension in their elevation range implies that reduced water levels in the lagoon have affected their distribution.

5.6 Soils

Thirty-seven soils samples were collected from thirteen transects (no samples were collected for the new transects established in 2013). Samples were taken from the start, centre and end of transects, although unfortunately due some samples being mislabelled there is no end sample for transect T1_2012 and due to water levels being too high at the time, there is no start sample for transect T9_2012.

Soil samples were taken from the three main substrates at Waituna: silt, gravel and peat. The elevation range for the soil samples is 70 – 500 cm above the lagoon level. Samples were collected from most community types, with the exception of WL12 - Manuka-tangle fern scrub/fernland. The majority of samples were collected within WL10 - oioi restiad-rushland/reedland.

Interpreting the results of the soil sample analysis is beyond the capability of this author. The full results have been submitted with this report and for other more qualified people to review.

5.7 Limitations of comparison between 1995 and 2012 measurements

There are limitations to comparing data collected in 1995 to those collected in 2012. Firstly, the original 1995 data have been misplaced and these data are only summarised in Johnson and Partridge's 1998 report. Secondly, because the 1995 transects were not intended to be remeasured they were not permanently marked at the time. Johnson returned in 2004 to record GPS coordinates and mark transects with aluminium stakes based on his notes and memory of the sites. However, due to high

lagoon levels at that time not all transects were marked and none were marked at their start to indicate where the shoreline had been in 1995 when the transects were measured. Table 5 below summarises the difficulties associated with relocating and re-measuring the original transects:

Table 5: Summary of the re-establishment of Johnson's transects

Transect name in Johson and Partridge (1998)	Transect established and renamed in 2012	Comparison between 1995 and 2012-2013 measurements possible	Notes on re-establishment of transect
Transect 1	T1_2012	Yes	The aluminium stake erected by Johnson in 2004 near the start of Transect 1 appears to have been lost to erosion and the 2012 transect was re-established based on notes and the transect description
Transect 2	N/A	No	Transect not marked with a stake in 2004 and notes indicate GPS coordinates are only an approximate. Analysis of coordinates revealed a possible scribing error. A new transect was placed in the area (T2_2012) but because of uncertainty about where the original transect comparison between these two transects is not possible.
Transect 3	T2_2012	Yes	Transect 3 was re-established along stakes placed by Johnson in 2004 and superficially the sequence of vegetation has not changed much between 1995 and 2012. However, the exact start point of the transect could not be determined because the stakes placed by Johnson were 11.2 m inland from where the shore was deemed to be when the 2012 measurements were taken.
Transect 4	T3_2012	Yes	Transect 4 was re-established based on the notes in Johnson (2004) and by reference to the aluminium stake placed approximately 10m from the transect (not placed in exact location due to high lagoon levels). Superficially the 1995 and 2012 transects are very similar (turf community grading into exotic grass-rushland and back to a turf community).
Transect 5	T4_2012	Yes (partially)	Area near Curran Creek frequently visited by the public so no stake positioned in 2004. Re-established in 2012 based on bearings and landmarks in Johnson's 2004 field notes but one landmark had been removed and the alignment of the creek mouth appears to have shifted. Transect now marked with warratahs and short wooden stakes.
Transect 6	T5_2012	No	No stake located, quite likely it has been removed by nearby drain cleaning. Transect re-positioned approximately 15m to the west between two drains avoid future loss of stakes.
Transect 7	T6_2012	Yes	This transect was re-established based on the sketch and coordinates in Johnson (2004) and the stake placed in 2004.

Transect 8	N/A	No	Not revisited in 2004 and unable to relocate in 2012 because vegetation appears to have changed substantially compared to that described in Johnson and Partridge (1998). New transect (T8_2012) established nearby to capture a different diverse community.
Transect 9	T9_2012	Yes (partially)	Unable to relocate stakes and transect re-established based on Johnson's 2004 field notes and information in Johnson and Partridge (1998).

Some qualitative comparisons are possible between previous and recent measurements of Transects 1 (T1_2012), 3 (T2_2012), 4 (T3_2012) and 7 (T7_2012 by looking at the width of plant communities and the relative abundance of the dominant species (see Appendix 6 for an attempt to compare the 1995 and 2012 data). However, without having a clear indication of where Johnson's transects began, direct comparison between subplots is not possible. For this same reason comparison is not possible between the 1995 and 2012-13 'distance from shore data' summarised in Johnson and Partridge (1998). The species cover is represented in a simplified manner in the elevation sketches in Johnson and Partridge (1998) making comparison between 2012 and 1995 measurements impossible.

Comparing the mean height for each species is not possible because these data are not available for 1995 and the plants in the elevation sketches are not drawn to scale.

Comparing species richness between previous and current measurements is problematic because the elevation sketches in Johnson and Partridge (1998) only include species amounting to ≤2% cover. Small-stature species, such as those found in turf communities, are often only minor components of overall cover and therefore may not be included by Johnson in elevation sketches of all transects where they did occur.

6.0 Discussion

Differences between the data sets and uncertainty around the exact positioning of the earlier transects have limited the amount of comparison possible between the measurements taken in 1995 and 2012-13. This is unfortunate, and has resulted in an inability to confirm changes in species richness or abundance which appear to have been occurring over the intervening years. However, the data collected in 2012-13 provide a valuable benchmark for repeated monitoring in future. It will be interesting to see how quickly any changes in vegetation can be confirmed after remeasuring these transects.

Some qualitative comparisons are possible between the observations noted in Johnson and Partridge (1998) and the 2012-13 measurements. These comparisons reveal several differences, although some of these may be attributable to natural change (e.g. succession or lagoon processes) and it is not clear how much change may have been caused by lower water levels or increases in nutrients and sediment.

It is clear that undertaking this type of work while the lagoon is high (i.e. over 1 m) reduces the ability to measure turf communities. Remeasuring portions of some transects illustrated how many species were present beneath the water.

A selection of 1995 elevation ranges for some species has provided insight into a downward shift in elevation range for most of these species.

7.0 Recommendations

- All transects should be remeasured in 3-5 years following the same method outlined in this report. Ideally this work will be undertaken in late summer and should occur under lower lagoon levels than when the 2012 monitoring was undertaken (shortly after the lagoon is opened to the sea is optimal).
- Investigation into a better method of measuring fine changes in elevation may prove helpful if elevation data for the full length of each transect is required.
- The height of each warratah projecting above the level of the ground should be recorded in future to provide some understanding of whether sediment is accreting at different elevations along the transects.
- Lagoon levels should not be managed any lower than current levels to halt any continual downward creep of shoreline communities. If the lagoon is continually lowered and simultaneously filled with sediment it could functionally disappear.

8.0 Acknowledgements

I would like to thank Liz Gunning (Department of Conservation) for her diligence and determination in often frustrating field conditions, and Alex Fergus for his botanical insights and field assistance, as well as Polly Bulling, Lee Boyde, Karen Maw and Darren May for their assistance in the field. Thanks are due to Murray Waghorn for allowing access through his property and providing advice on how to successfully cross the pea gravel in a 4x4 vehicle. This work would have been much more difficult to undertake without Chris Owen and his expert boat skills and his with Waituna Lagoon. Brian Rance (Department of Conservation) has been invaluable in identifying some shockingly poor specimens collected at a less than optimal time of the year and provided some helpful insight into how this report might be structured. Gratitude is also owed to Hugh Robertson and Polly Bulling (Department of Conservation) for their advice and support during this project.

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Appendix 1 - Map indicating position of shoreline transects around the margins of Waituna Lagoon

Appendix 2 – Complete species list for 2012-2013 transects

Six letter code (non-NVS codes in bold)	Species (* indicates exotic species)
Trees and shrubs	
COPdmo	Coprosma dumosa
COPpro	Coprosma propinqua
COPrig	Coprosma rigida
DRAlon	Dracophyllum longifolium
GAUmac	Gaultheria macrostigma
HALere	Haloragis erecta
LEPsco	Leptospermum scoparium
LEPjun	Leptecophylla juniperina (syn. Cyathodes juniperina)
PLAdiv	Plagianthus divaricatus
ULEeur	* Ulex europaeus
Herbs	
ACAnov	Acaena novae-zelandiae
ANAarv	* Anagalis arvensis
APIpro	Apium prostratum
ATRpro	*Atriplex prostrata
CALsol	Calystegia soldanella
CALsta	* Callitriche stagnalis
CALpet	Callitriche petriei
CAPbur	* Capsella bursa-pastoris
CARdeb	Cardamine debilis agg.
CENery	* Centaurium erythraea
CENuni	Centella uniflora
CERfon	* Cerastium fontanum
CHEamb	Chenopodium ambiguum
CIRarv	* Cirsium arvense
CIRvul	* Cirsium vulgare
COTcor	*Cotula coronopifolia
CRAmos	Crassula moschata
EPIcil	*Epilobium ciliatum
GALpal	* Galium palustre
GALLIU	Galium aff. perpusillum
GALpro	Galium propinquum
GENgri	Gentianella grisebachii
HYDdis	Hydrocotyle dissecta
HYDhyd	Hydrocotyle hydrophila
HYDnzm	Hydrocotyle novae-zelandiae var. montana
HYDsul	Hydrocotyle sulcata
HYPrad	* Hypochaeris radicata
LEOtar	*Leontodon taraxacoides
LEPdid	* Lepidium didymum
LEPdio	Leptinella dioica
LILnov	Lilaeopsis novae-zelandiae
LIMlin	Limosella lineata
LOTped	* Lotus pedunculata
MIMrep	Mimulus repens
MONfon	Montia fontanum

MYRIOP	Myriophyllum sp.
MYOlax	Myosotis laxa
NERbal	Nertera balfouriana
NERdep	Nertera depressa
NERsca	Nertera scapanioides
PARvis	* Parentucellia viscosa
PERmac	Persicaria maculosa
PLAaus	*Plantago australis
POTans	Potentilla anserinoides
PSElut	Pseudognaphalium luteoalbum
RANaca	Ranunculus acaulis
RANfol	Ranunculus foliosus
RANgla	Ranunculus glabrifolius
RANrep	* Ranunculus repens
RANscl	Ranunculus sceleratus
RUMace	* Rumex acetosella
RUMcri	* Rumex crispus
SAGpro	* Sagina procumbens
SAMrep	Samolus repens
SEDacr	* Sedum acre
SELrad	Selliera radicans
SENvul	* Senecio vulgaris
SENmin	Senecio minimus
SONasp	*Sonchus asper
SPEarv	*Spergula arvensis
SPEBoc	*Spergularia bocconei
STEmed	* Stellaria media
STEals	Stellaria alsine
TRIdub	* Trifolium dubium
TRIrep	* Trifolium repens
URTlin	Urtica linearifolia
VICsat	* Vicia sativa
VIOcun	Viola cunninghamii

Grasses, rushes and sedges

AGRsto	* Agrostis stolonifera
ALOgen	Alopecurus geniculatus
AMMare	* Ammophila arenaria
ANTodo	* Anthoxanthum odoratum
APOsim	Apodasmia similis (syn. Leptocarpus similis)
CORric	Austroderia richardii (syn. Cortaderia richardii)
BAUten	Baumea tenax
CARapp	Carex appressa
Carbuc	Carex buchananii
CARbre	Carex breviculmis
CARcor	Carex coriacea
CARdip	Carex dipsacea
CARdis	Carex dissita
CARfgl	Carex flagillifera
CARfla	Carex flaviformis
CARgau	Carex gaudichaudiana
CARova	*Carex ovalis
CARsec	Carex secta
CARsin	Carex sinclairii

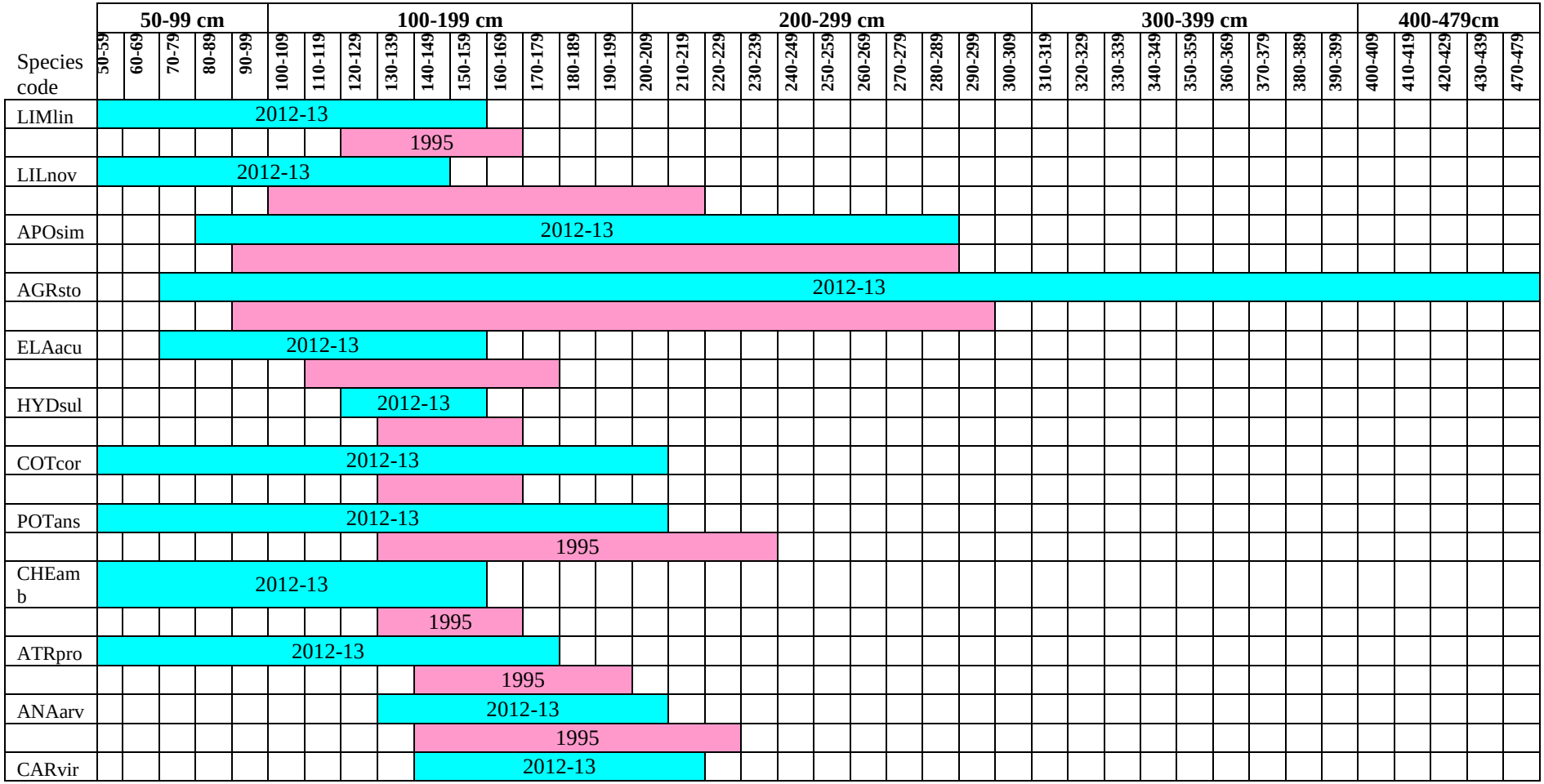
CARvir	Carex virgata
CHIrsc	Chionochloa rubra subsp. cuprea
DACglo	* Dactylis glomerata
DESces	Deschampsia cespitosa
ELEacu	Eleocharis acuta
ELEgra	Eleocharis gracilis
EMPmin	Empodisma minus
FICnod	Ficinia nodosa (syn. Isolepis nodosa)
HOLlan	* Holcus lanatus
ISObas	Isolepis basilaris
ISOcer	Isolepis cernua var. cernua
ISOhab	Isolepis habra
ISOret	Isolepis reticulatus
JUNart	* Juncus articulatus
JUNbuf	* Juncus bufonius
JUNedg	Juncus edgariae (syn. Juncus gregiflorus)
JUNeff	* Juncus effusus
JUNpro	* Juncus procerus
JUNpal	Juncus pallidus
LACstr	Lachnagrostis striata
LEPaus	Lepidosperma australe
LOLper	Lollium perenne
LUZcon	*Luzula congesta
LUZpic	Luzula picta
POAann	Poa annua
POAcit	Poa cita
POApra	* Poa pratense
POApus	Poa pusilla
SCHaru	* Schedonorus arundinacea
SCHpun	Schoenoplectus pungens
SCHmas	Schoenus mascholinus
TRIstr	Triglochin striata
Other monocots	
CORaus	Cordyline australis
PHOten	Phormium tenax
Lianes	
MUEaxi	Muehlenbeckia axillaris
MUEcom	Muehlenbeckia complexa
Ferns	
BLEmin	Blechnum minus
BLEpen	Blechnum penna-marina
GLEdic	Gleichenia dicarpa
HISinc	Histiopteris incisa
PAEsca	Paesia scaberula
POLves	Polystichum vestitum
PTEesc	Pteridium esculentum

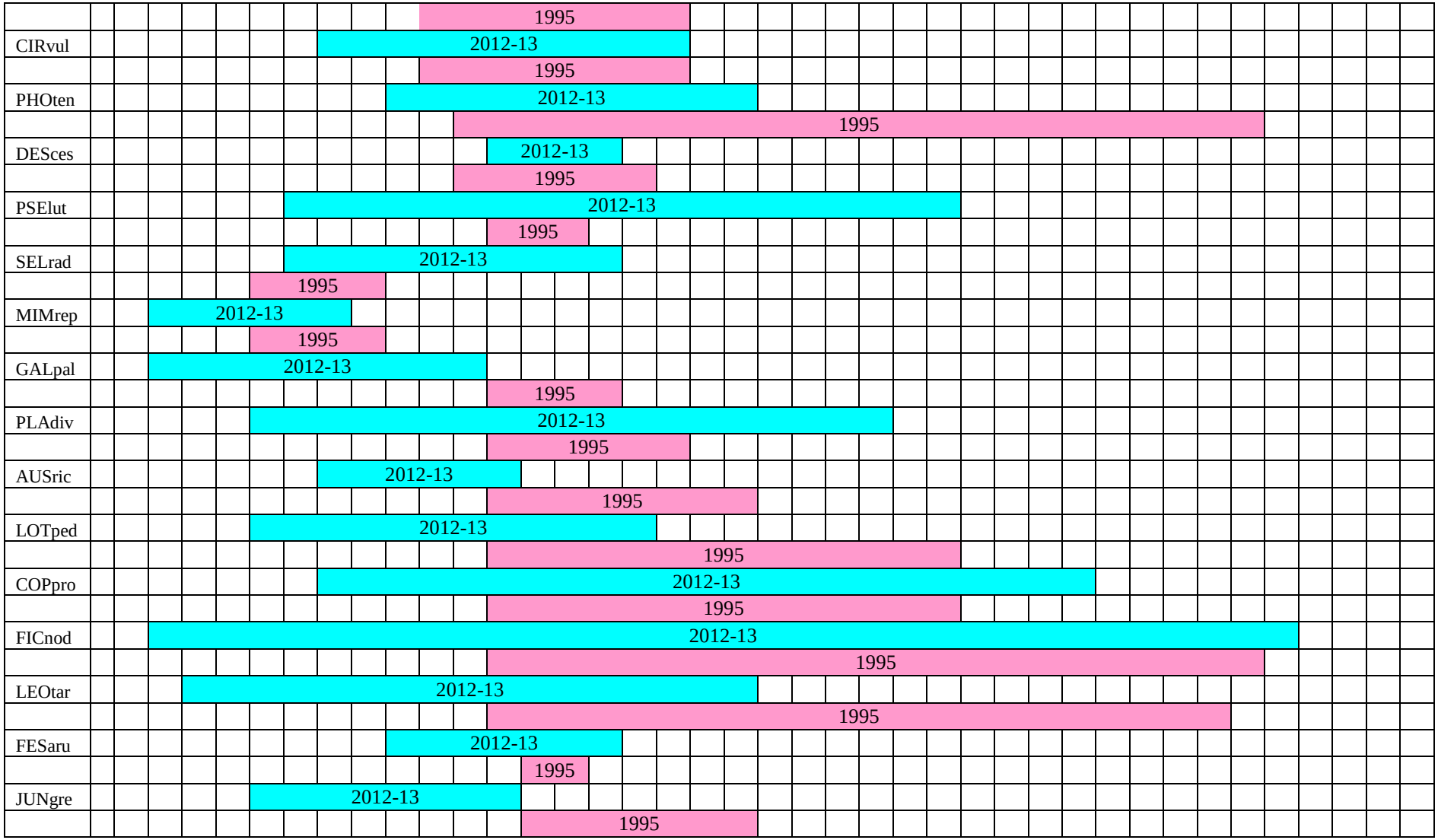
Appendix 3 – Summary of different vegetation community classifications relevant to shoreline transects at Waituna Lagoon

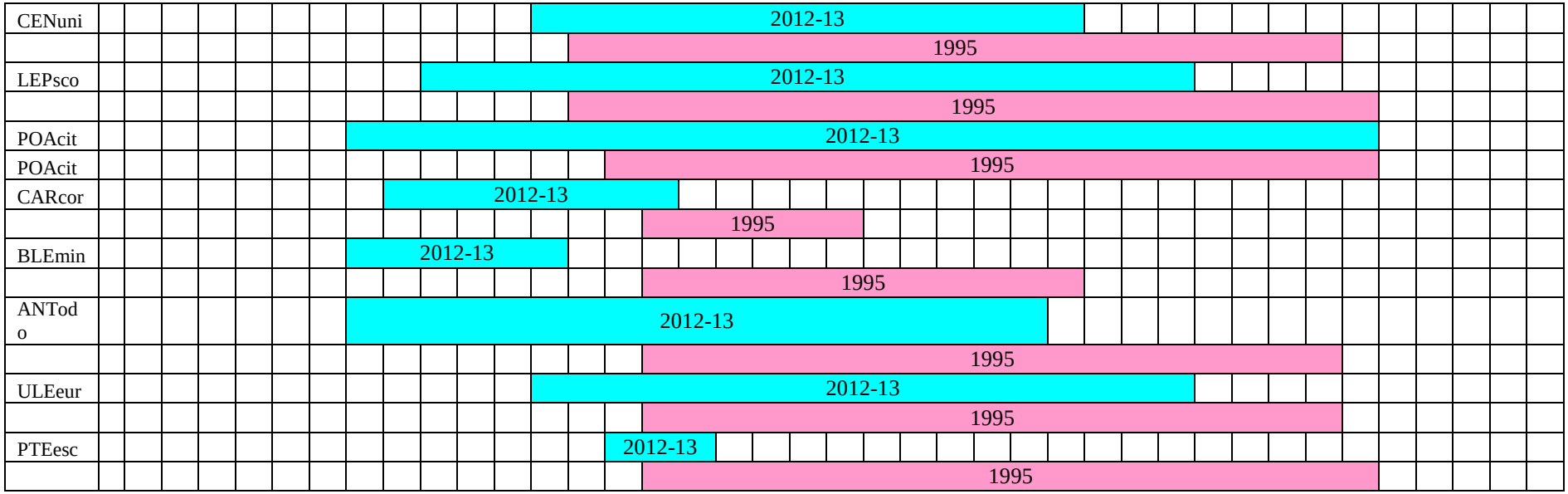
Johnson & Gerbeaux, 2004	**Rogers and Singers (in press)**	**Johnson and Partridge (1998)**	**Boffa MiskellLtd and Urtica Inc, 2010**
Wetland vegetation			
Marsh	WL10 - Oioi restiad-rushland/reedland	Leptocarpus rushland	AP - Oioi
Bog	WL12 - Manuka-tangle fern scrub/fernland	Manuka scrub	DM - Dense manuka
Fen	WL20 - *Coprosma Olearia* scrub	Scrub community	GS - Grey scrub
	WL22 - *Carex Schoenus* sedgeland	Sedge community	CA - Carex
Swamp	WL18 - Flaxland		PH - Flaxland
	(DN5 - Oioi, knobby clubrush sedgeland)	Rush community	N/A
Ephemeral wetland	WL15 - Herbfield (Lakeshore turf)	Turf comunities	N/A
Non-wetland vegetation			
	SA4 - Shore bindweed, knobby clubrush gravelfield-stonefield	Gravel beaches	PO - Silver tussockland
	F13 - manuka scrub	Manuka scrub	Manuka scrub
	F19 - Bracken fernland		Bracken fernland - not mapped

Appendix 4 - Vertical range of species in 1995 and 2012

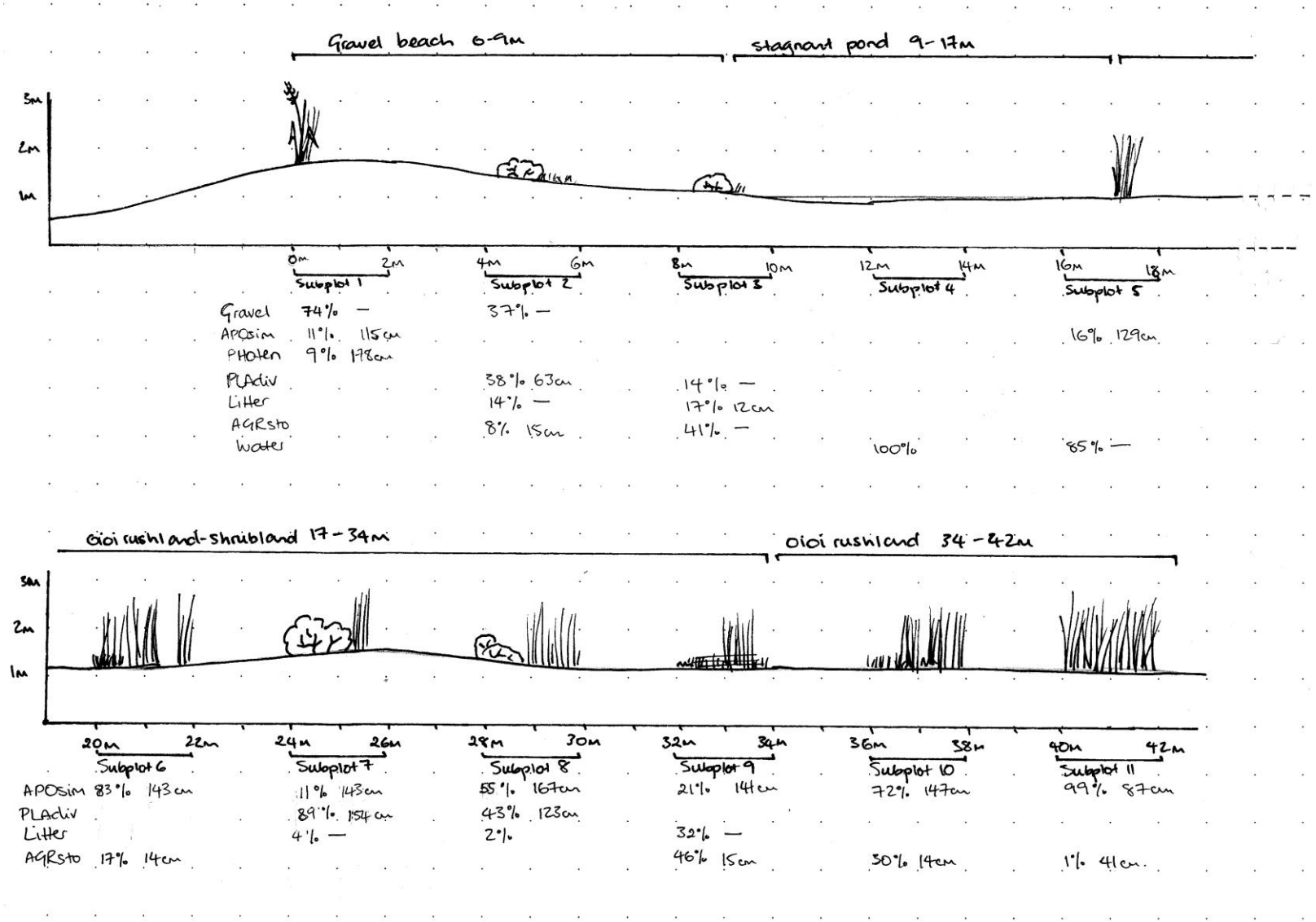
1995 elevation range based on Figure 4 in Johnson and Partridge (1998)




1995
CIRvul
2012-13
1995
PHOten
2012-13
1995
DESces
2012-13
1995
PSElut
2012-13
1995
SELrad
2012-13
1995
MIMrep
2012-13
1995
GALpal
2012-13
1995
PLAdiv
2012-13
1995
AUSric
2012-13
1995
LOTped
2012-13
1995
COPpro
2012-13
1995
FICnod
2012-13
1995
LEOtar
2012-13
1995
FESaru
2012-13
1995
JUNgre
2012-13
1995


CENuni
2012-13
1995
LEPsco
2012-13
1995
POAcit
2012-13
POAcit
1995
CARcor
2012-13
1995
BLEmin
2012-13
1995
ANTodo
2012-13
1995
ULEeur
2012-13
1995
PTEesc
2012-13
1995

Appendix 5 – Qualitative comparisons between 1995 transects remeasured in 2012
T1_2012



Vegetation communities redfined based on Rogers and Singers:

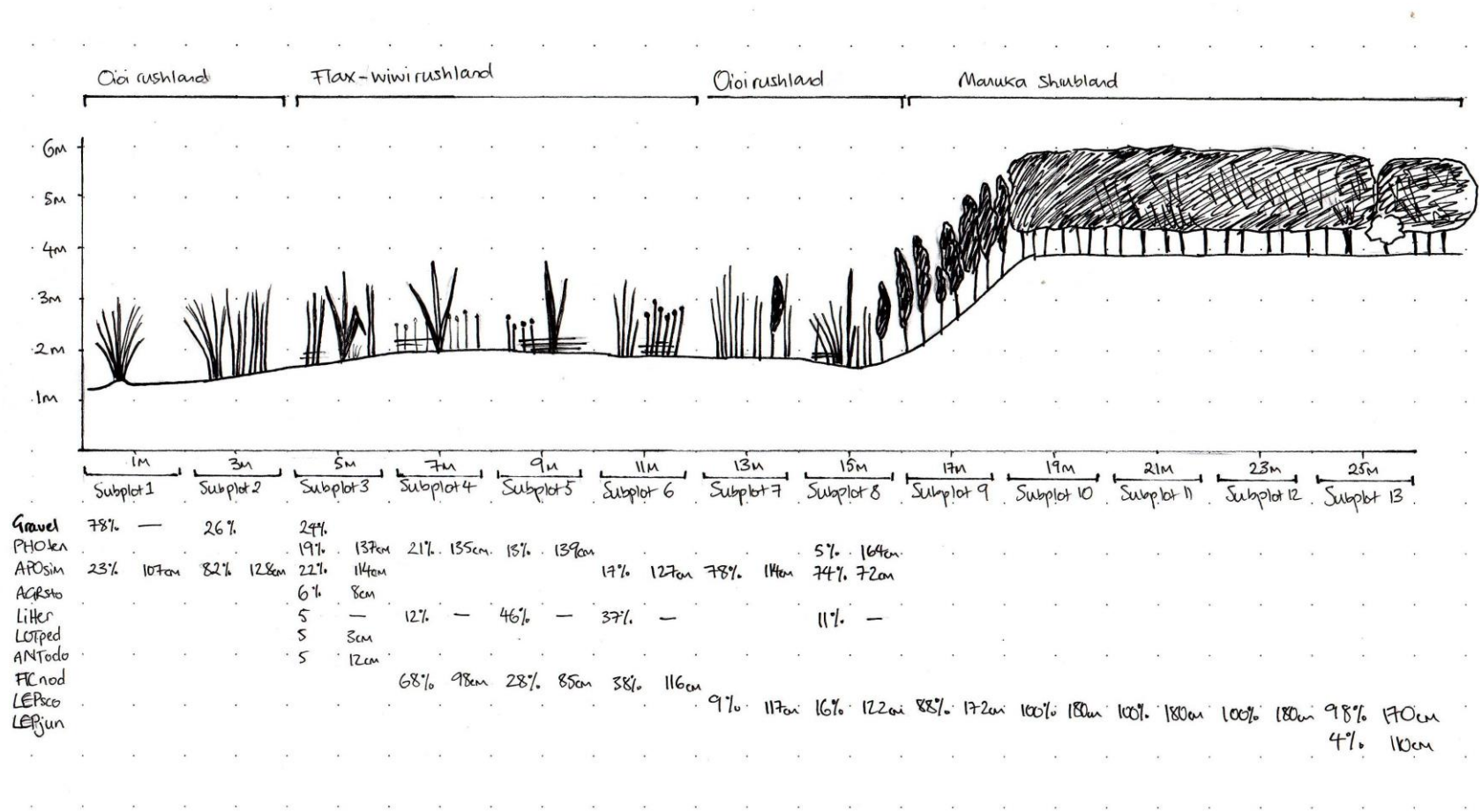
0-17 m WL10
17-34m WL-WL20 mix
34-42m WL10

Changes observed between Transect 1 (1995) and Transect T1_2012

The aluminium stake erected by Johnson in 2004 near the start of Transect 1 appears to have been lost to erosionand the 2012 transects was re-established based on notes and the transect description in Johnson and Partridge (1998). Some changes are apparent:

- **The gravel beach at the transect start has eroded** – in 1995 the transect began at 150cm to include the oioi and creeping bent growing on the gravel beach. In 2012 vegetation begins at the beach crest at 176cm and dead flax and oioi clumps scattered nearby indicate the vegetation is being actively eroded from this gravel beach. This is likely to natural wind and wave action.
- **Turf species are absent -** There is no sign of the turf species *Selliera radicans, Lilaeopsis novae-zelandiae* and *Cotula coronopifolia* recorded in 1995. These turf plants could have scoured away when the other species were removed.
- **Species diversity is reduced –** prolonged ponding along this transect has caused underlying vegetation (probably creeping bent) to die and there is no sign of the *Cotula coronopifolia* and *Myriophyllum propinquum* previously recorded. This ponding is described as a natural process in Johnson and Partridge (1998). It will be interesting to note which species colonise these hollows/ponds.

T2_2012



Vegetation communities redefined based on Rogers and Singers:

0-4 m = WL10
4-124 m = DN5
34-42 m = WL10

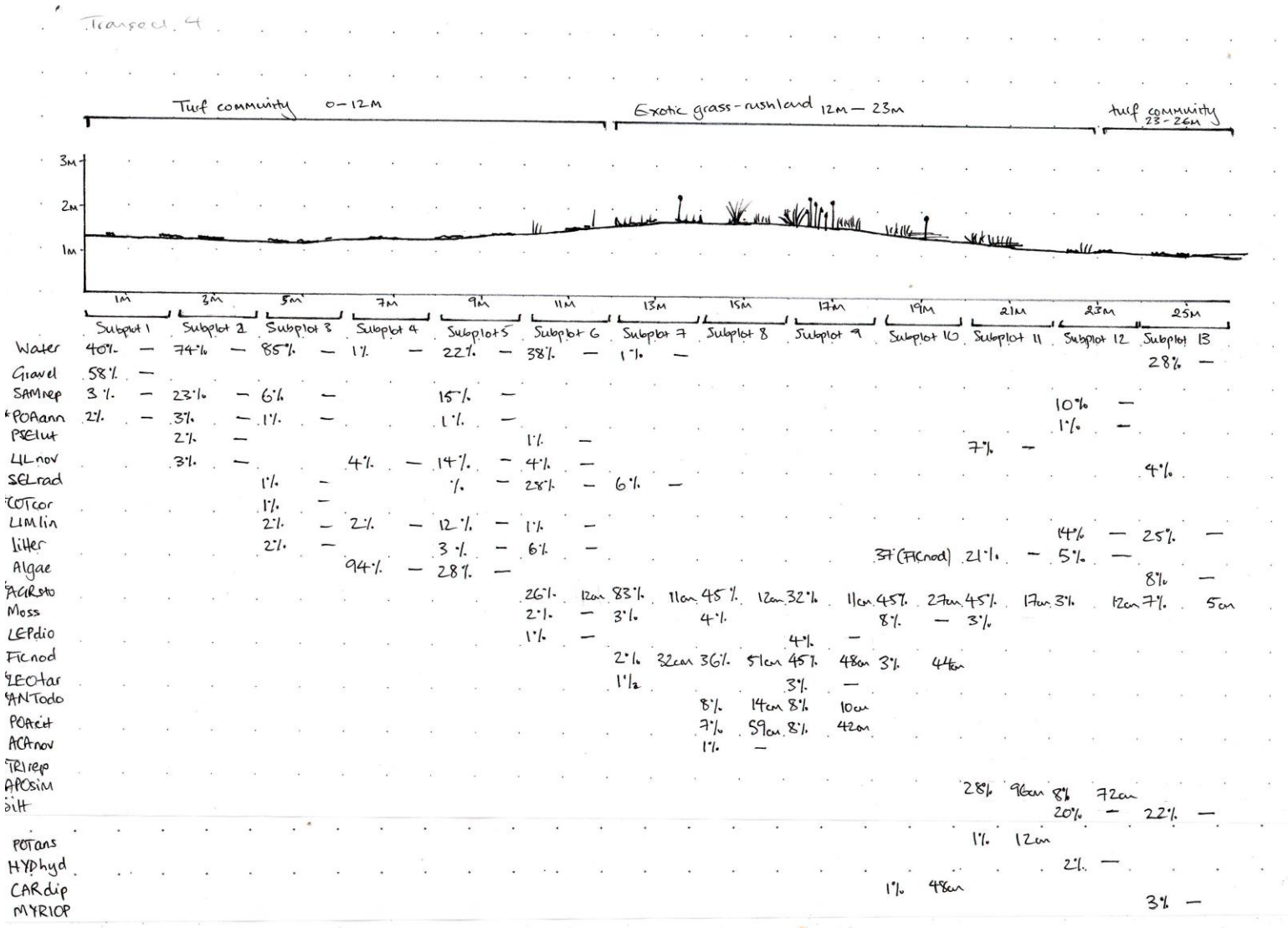
Changes observed between Transect 3 (1995) and Transect T2_2012

Transect 3 was re-established along the stakes places by Johnson in 2004 and superficially the sequence of vegetation has not changed since 1995

and 2012. Both measurements captured a sequence of oioi- rushland followed by oioi, knobby clubrush sedgeland and then manuka scrub as the transect ascends a small scarp. However, several differences are apparent:

- **The elevation pattern has changed -** In 1995 the transect gradually ascended from 120cm to 200cm before climbing a steep scarp to approximately 380cm. In 2012 the transect began at approximately 135cm and climbed to 200cm before descending to 170cm and then climbing the scarp to approximately 370cm. The development of a small hollow behind the gravel beach at the beginning of this transect is likely due to natural processes because the shoreline here is exposed to the effects of southerly winds and wave action. Large pieces of driftwood and thick layers of litter were observed in and around the transect.
- **Turf species are less abundant and there is change in the species present** - In 1995 Johnson recorded five species with covers ranging from 5-25% (*Selliera radicans, Samolus repens, Lilaeopsis novae-zelandiae, Limosella lineata* and *Isolepis cernua*). In 2012 four species were recorded but each one comprised less than 1% of the cover in the 2x2m subplots where they occurred (*S. radicans, Potentilla anserinoides, Hydrocotyle novae-zelandiae var. montana* and *Apium prostatrum*). It is not clear whether changes in turf species are real or due to changes in the positioning of the transect. It is possible that turf species recorded by Johnson at 120cm are still present but were underwater during the 2012 monitoring.
- **Native grasses have been replaced by oioi in a newly developed hollow at 10-16m along the 2012 transect -** Previously Johnson recorded *Poa cita* (silver tussock) and *Austroderia richardii* (toetoe) along with *Agrostis stolonifera* growing between the oioi rushland and the manuka shrubland. A search approximately 15m either side of the transect in 2012 did not reveal any silver tussock, but one toetoe was seen nearby. *Deschampsia caespitosa* accounted for 5% cover in the 1995 transects but in 2012 it was only 2% or less in the subplots where it occurred. Reduction in *Deschamspia caespitosa* cover may be due to it being shaded by the taller oioi. *D. caespitosa* measured between 45 and 55cm tall and oioi around 120cm tall in subplots where they occurred together on this transect. The changes in species composition on this part of the transect may be due to the hollow and the wetter conditions favouring oioi.
- **Manuka shrubland has become denser and shaded out bracken and *Dracophyllum longifolium* -** Both bracken and *D. longifolium* were minor components within the 2012 transect but did not occur in any subplots. This transect is exposed to the south and strong wind may preclude the leading edge of the shrubland getting tall enough to support a diversity of understorey species. Outside the transect open patches containing bracken, flax and gorse occur within the manuka shrubland. This change in the manuka shrubland is a natural part of the maturation of this plant community.

T3_2012



Vegetation communities redefined based on Rogers and Singers:

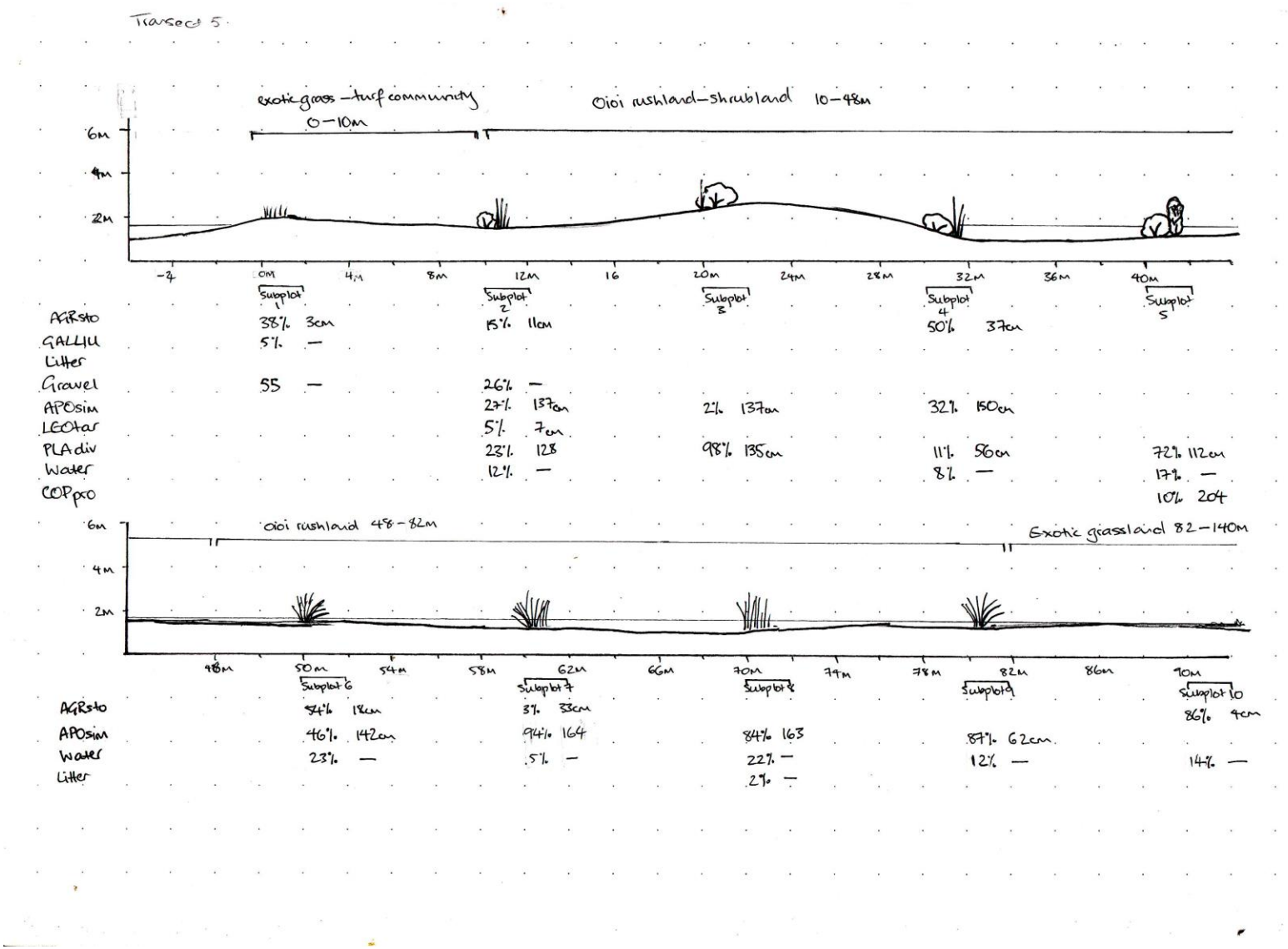
0-12 m = WL15
12-23 m = NN1
23-26 m = WL15

Changes observed between Transect 4 (1995) and Transect T3_2012

Transect 4 was re-established based on the notes in Johnson (2004) and by reference to the aluminium stake placed approximately 10m from the transect. Superficially the 1995 and 2012 transects are very similar (turf community grading into exotic grass-rushland and back to a turf community). However, comparison with Table 2 in Johnson and Partridge (1998, p. 19) shows there has been an increase of largely exotic species. In 1995 20 native species and 14 exotic species were recorded within Transect 4[6]. In 2012 the following mix of nine native and exotics species were absent: *Mimulus repens, Crassula sinclairii, Apodasmia similis, Acaena microphylla, Lachnagrstis striata, Juncus bufonius, Galium palustre, Holcus lanatus* and *Sedum acre*. These additional 12 species were recorded in 2012, most of which are exotic: Hydrocotyle sulcata, Leptinella dioica, Ranunculus acaulis, *Coprosma propinqua* (seedling), *Poa annua, Senecio vulgaris, Sonchus asper, SAgina procumbens, Capsella bursa-pastoris, Rumex acetosella, Parentucellia viscose* and *Trifolium dubium.*

[6] This figure excludes two species of moss because non-vascular species such as moss and algae were not indentified in 2012.

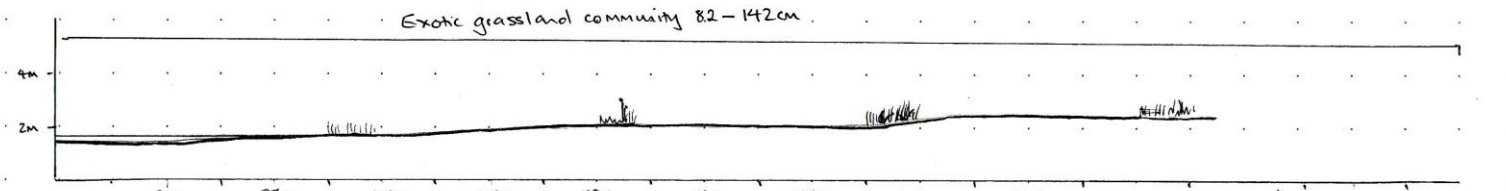
T4_2012



Vegetation communities redefined based on Rogers and Singers:

0-10 m = NN2
10-48 m = WL10-WL20 mix
48-82 m = WL10
82-142m = NN1

Transect 5 cont.



	Subplot 11	Subplot 12	Subplot 13	Subplot 14	Subplot 15
AGRsto	62% 9cm	70% 8cm	77% 16cm	82% 9cm	12% 12cm
LEOtar	32% 1cm	18% 1cm			
Silt	14 —	5% —			
JUNbuf	1% —				
JUNart	1% 8cm				
FICnod		3% 62cm			81% 63cm
HOLlan			23% 15cm	2% 10cm	
Moss			1% —	3% —	
OACglo					3% 50cm
HYPrad				1% —	
litter				12	

Changes observed between Transect 5 (1995) and Transect T4_2012

Transect 5 was re-established using notes and sketches provided by Johnson in 2004. The lower two thirds of the transect appear to have changed since 1995 but the upper portion is similar. Most differences between the two measurements of Transect 5 can probably be accounted for by the likelihood that the 2012 transect is not in exactly the same places as the 1995 one and variation in the alignment of nearby Curran Creek. Notable changes in vegetation include:

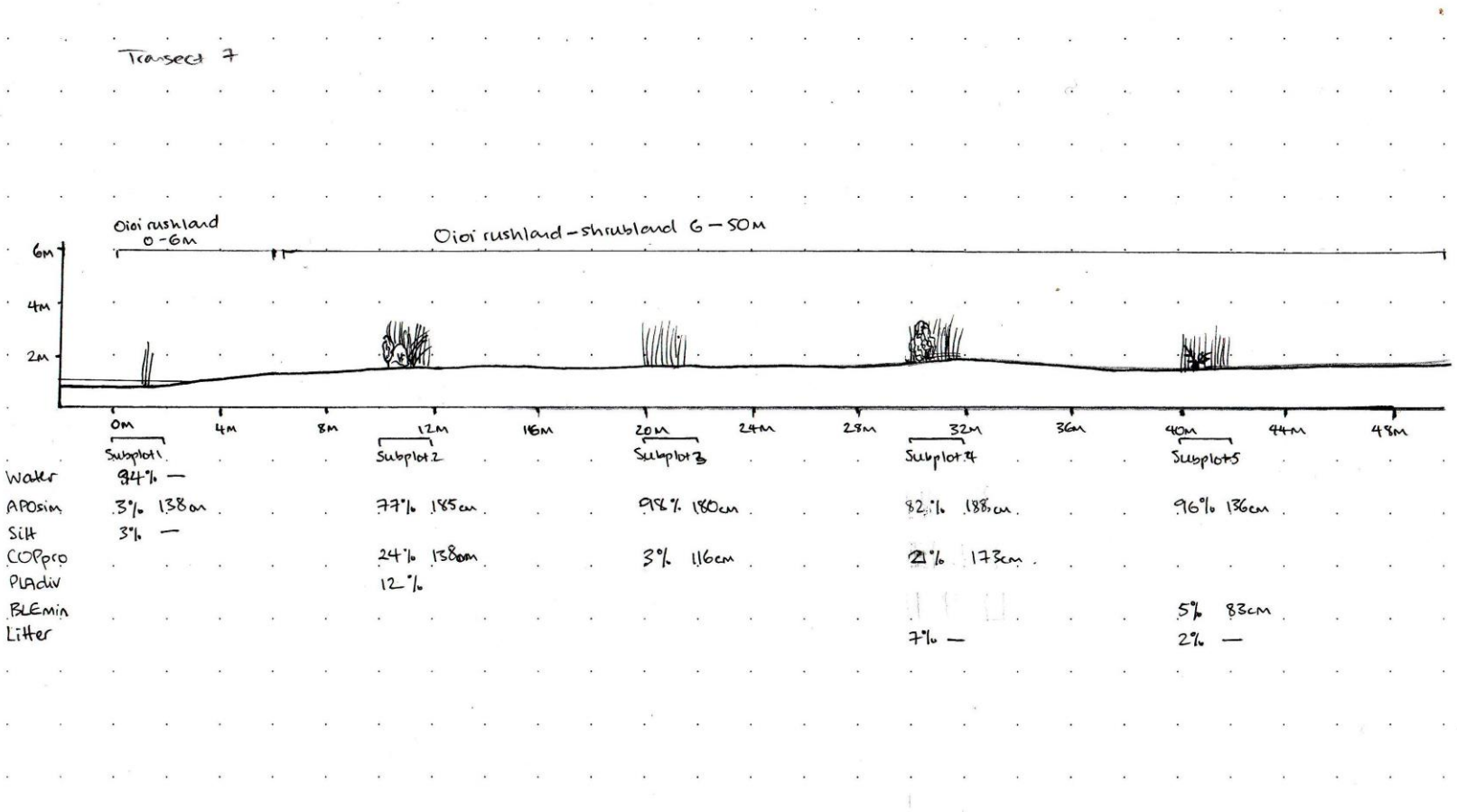
- **Turf community appears to have altered in composition -** Johnson recorded '*Muehlenbeckia axilaris* and other vegetation' at the start of 1995 transect but turf species recorded in 2012 included *Potentilla anserinoides*, *Selliera radicans* and *Gallium* aff. *perpusillum* and *Muehlenbeckia* was not present.
- ***Schoenoplectus pungens* no longer occurs within the transect -** When the transect was re-established in 2012 this species did not occur within the transect although it is growing nearby.
- **Shrubs species along the transect have changed -** *Plagianthus divaricatus* and *Coprosma propinqua* were recorded along the 2012 transect but did not comprise ≥2% cover to be included in the 1995 elevation sketch. Gorse and tree lupin no longer occur in the upper portion of the transect and this is probably due to weed control in the intervening time period.

Changes observed between Transect 6 (1995) and Transect T5_2012

Although Transect 6 was marked in 2004 the stake could not relocated in 2012 and it is likely it was removed during the cleaning of a nearby drain. Therefore Transect 6 was established approximately 15m to the west of where it is believed to have been to avoid future loss of markers through drain cleaning operations. No elevation sketch has been produced for this transect because the thick vegetation prevented the use of the builder's level. The 1995 and 2012 transects are not in the same location and cannot be directly compared. However, the broader vegetation patterns between the two transects are similar in that both recorded oioi rushland followed by an oioi-shrubland mix and then manuka shrubland. However, there is a noticeable reduction in the number of species recorded in 2012 compared with those recorded in 2012. Species now absent from the upper portion of the transect include: toetoe, *Chionochloa rubra* subsp. *cuprea*, *Coprosma elaterioides*[7], gorse, *Lepidosperma australe* and *Ficinia nodosa*[8] in the oioi-shrubland zone. These changes may be due to an increase in dominance of oioi in the oioi-rushland zone. Johnson recorded additional understorey species in the manuka shrubland including: *Viola cunninghamii*, *Nertera setulosa*, *Centella uniflora*, *Carex sinclairii*, *Gaultheria macrostigma*, *Gentianella grisebachii* and *Carex flaviformis*. The decreased diversity in the manuka shrubland may be due to grazing, road maintenance and drain cleaning.

[7] *Coprosma* aff. *intertexta* in Johnson and Partridge (1998).
[8] Syn. *Isolepis nodosa*

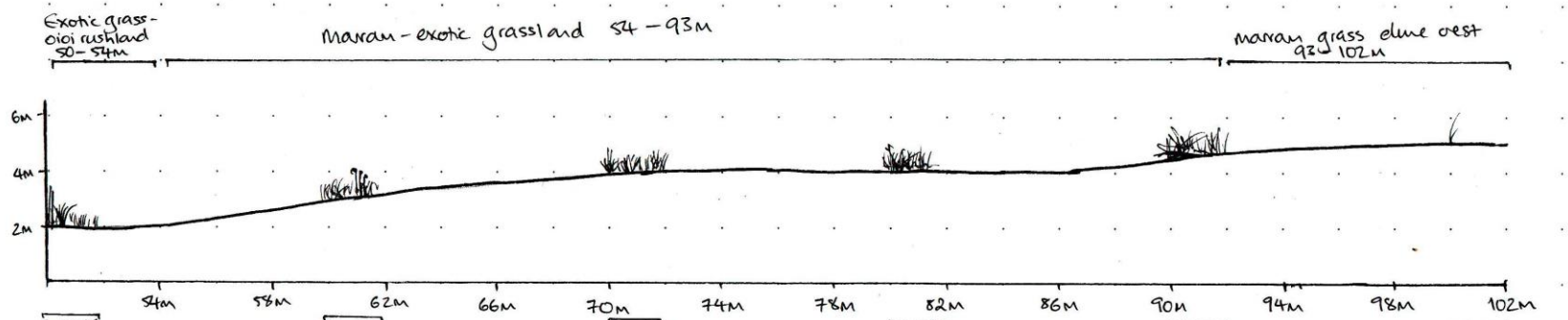
T6_2012



Vegetation communities redefined based on Rogers and Singers:

0-6 m = Wl10
6-50 m = WL10-WL20 mix
50-54 m = WL10(m)
54-102m = NN1

transect 7 cont.



	Subplot 6	Subplot 7	Subplot 8	Subplot 9	Subplot 9	Subplot 10
APOsim	4% 110cm					
DACglo	25% 60cm	4% 24cm	28% 35cm			
FICnod	7% 53cm					
CARAV	7% 17cm					
AGRsto	25% 35cm	25% 18cm			16% 13cm	
AMOare		25% 70cm	62% 80cm	45% 62cm	43% 75cm	1% 28cm
POApra		30% 19cm		55% 23cm		
FICnod		8% 62cm	3% 70cm			
ANTodo		4% 22cm				
Litter			6% —	2 —	8%	
CALsol					4% 8cm	
Gravel					27% —	100 —
Driftwood					5% —	

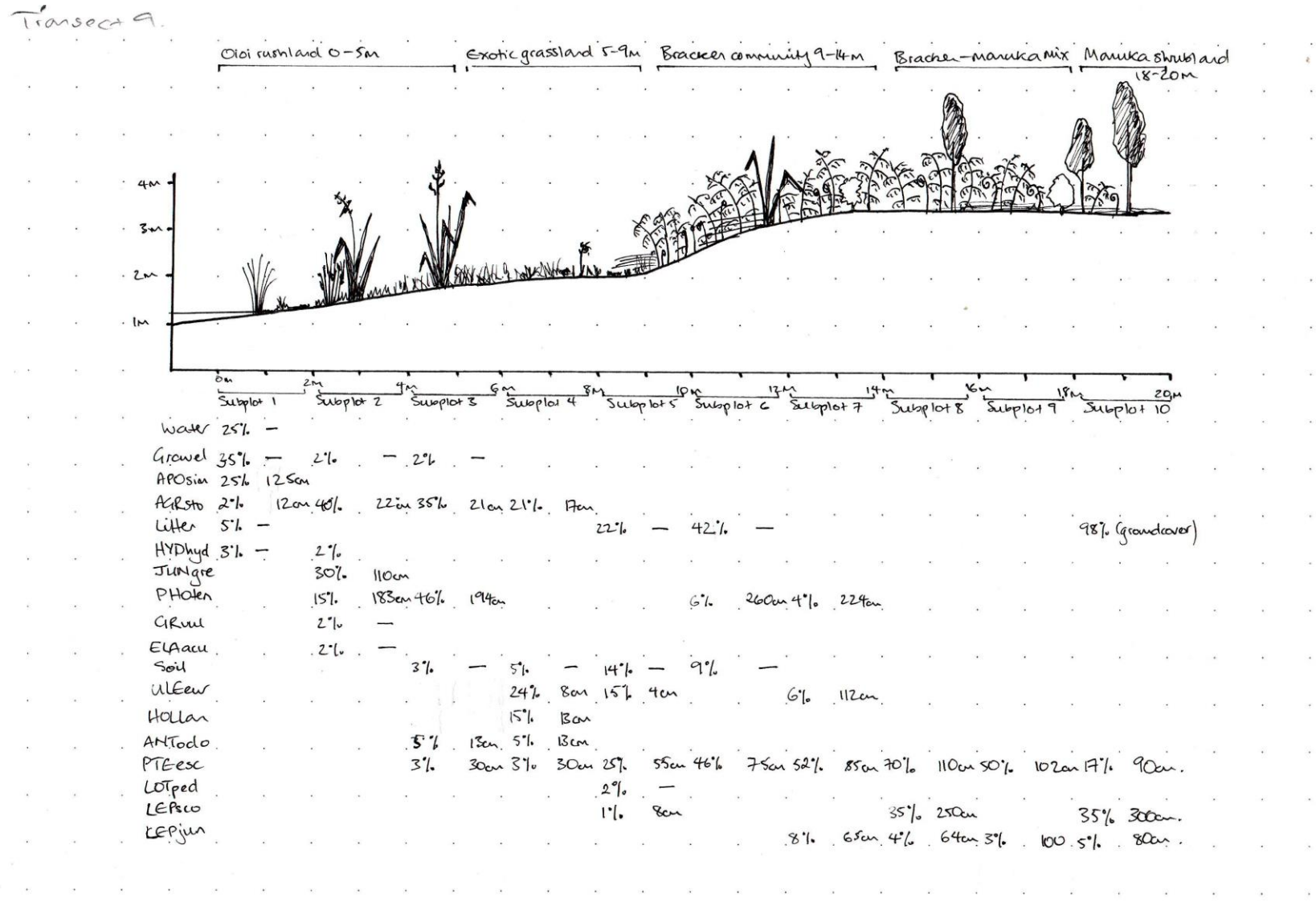
Changes observed between Transect 7 (1995) and Transect T6_2012

This transect was re-established based on the sketch and coordinates in Johnson (2004) and the stake placed in 2004. Differences between the 2012 and 1995 transect descriptions include:

- **Species diversity is significantly reduced** – A diverse range of 68 species is listed by Johnson and Partridge (1998) in the table on pages 20-21. Of these, 43 were not recorded in 2012, although some are likely to have been missed due to the time of year (e.g. *Microtis unifolia*). Six additional species were recorded in 2012.
- **Turf species and Schoenoplectus punges are absent** – Schoenoplectus was not present anywhere near the start of this transect in 2012 despite being the dominant in the lower 15m of the transect in 1995. The shoreline appears to have eroded and large loose clumps of dead oioi root bases can be seen lying on a gravelly bed of the lagoon nearby. Previously the lagoon has been opened to the sea very near to Transect 7. Likewise, several turf species are absent which are listed in Johnson and Partridge (1998, p. 20)[9]. The disturbance created by the opening may be responsible for the loss of the *Schoenoplectus pungens* and erosion of the lower portion of this transect.
- **Gorse and broom have been removed from this transect**

[9] Note that there are two tables labelled 'Table 2' in this report. The table on page 19 refers to Transect 4 and the table on pages 20-21 refers to Transect 7.

T9_2012



Vegetation communities redefined based on Rogers and Singers:

0-2 m = Wl10-WL15 mix
2-9 m = WL18(m)
9-19 m = F19
19-20m = F13

Changes observed between Transect 9 (1995) and Transect T9_2012

The stake marking Transect 9 was not relocated in 2012 and therefore the transect was re-established using Johnson's 2004 notes and the elevation sketch in Johnson and Partridge (1998). A greater diversity of species were observed in 2012 but this could be due to the placement of the transect and the fact that the elevation sketch (Johnson and Partridge, 1998) is simplified and only shows a few dominant species.

Appendix F: Advice on application of 2.4m or 2.5m trigger level for transitional lagoon opening

Advice on application of 2.4m or 2.5m trigger level for transitional lagoon opening

Context

1. Following the pre-hearing meeting science advice was requested on the application of a 2.4m or 2.5m maximum trigger level, utilising the most current version of the Waituna Lagoon hydrological model. This advice has been used to inform proposed changes to the transitional regime for lagoon opening.

Data from hydrological model (updated by Chris Jenkins, ES hydrologist)

2. The Waituna Lagoon model was rerun to consider the following hydrological scenarios:
    - **Scenario A**: open when level is at 2.4 m or above for 7 consecutive days;
    - **Scenario B:** open when level is 2.4 m or above for 7 consecutive days or, if no opening occurred in the previous year, open if the level exceeds 1.5 m (for fish passage);
    - **Scenario C:** open when level is 2.4 m or above for 7 consecutive days or, if no opening occurred in the previous 2 years, open if the level exceeds 1.5 m (for fish passage);
    - **Scenario D:** open when level is 2.4 m for 1 day for the period 1 September to 20 April, and open when level is 2.3 m for 7 consecutive days for the period 1 May to 30 August or, if no opening occurred in the previous 2 years, open if the level exceeds 2 m (for fish passage).
3. For these scenarios, **Scenario D** is the one that represents the proposed transitional regime (initial 5 years) for Waituna Lagoon, although modified to have a 2.4m (not 2.5m) maximum trigger in the winter period. In addition, two seepage rates (a historic and recent seepage rate) were applied in the model runs, based on recent observations that seepage rate can change overtime.
4. The key variable examined was the estimated frequency of opening events during the summer period, and annually. That is, since increased frequency of summer opening events in particular contribute to the degradation of ecosystem health.
5. The model outputs indicate there is a minor difference between the frequency of summer openings between the 2.4 m and 2.5m trigger levels. Under the 'recent' seepage rate there is a slightly higher chance of a summer opening at 2.4m (e.g. Scenario D = 0.37 probability of opening in summer) when compared to 2.5m (Scenario D = 0.30 probability). Although the difference between 2.4m and 2.5m is negligible under the 'historic' seepage rate (Table 1).

6. There was not a great difference in the frequency of opening events per annum between the 2.4m and 2.5m scenarios, irrespective of whether the 'historic' or 'recent seepage' rates are applied (Table 2).

7. It is recognised the hydrological model outputs do have some uncertainty, and consideration of the two seepage rates provides a 'sensitivity' assessment to understand the range of water level conditions that may be observed.

Table 1: Frequency of openings Sept-April (summer)

Model run	**Modelled average number of openings 1 Sept to 30 April**			
	A	**B**	**C**	**D**
2.4 'recent'	0.44	0.45	0.44	0.37
2.4 'historic'	0.19	0.25	0.20	0.14
2.5 'recent'	0.38	0.43	0.38	0.30
2.5 'historic'	0.14	0.25	0.17	0.15

Table 2: Frequency of annual openings (per year)

Modelled number of average openings per year				
Criteria	**Scenario**			
	A	**B**	**C**	**D**
2.4 MSL - 'recent'	1.23	1.24	1.22	1.29
2.4 MSL - 'historic'	0.49	0.81	0.58	0.70
2.5 MSL - 'recent'	1.12	1.14	1.11	1.28
2.5 MSL - 'historic'	0.42	0.79	0.55	0.69

Summary

1. Within the proposed consent conditions there are a range of options to open the lagoon to manage ecological and cultural values at any water level below the maximum trigger level, for example when poor water quality events are occurring, or fish passage is required.
2. 2.5m remains the recommended maximum trigger for Waituna Lagoon in the long-term, given the goal to minimise the frequency of lagoon opening events (annually and in summer periods) and enable restoration of ecosystem health and transition to a more natural regime.
3. Applying a 2.4m maximum trigger level will likely have some minor negative impacts on target ecological and cultural values and result in a slightly less natural opening regime.

Appendix G: Summary of changes to conditions made in May 2025

Update to Resource Consent Officer and Submitters 14 May 2025

Amended Proposed Conditions of Consent

The applicants – Awarua Rūnaka, the Department of Conservation and Environment Southland – are grateful to submitters who were able to attend the pre-hearing meeting on 7 March 2025. The applicants found the discussion useful.

Following the Pre-Hearing Meeting the applicants have been working to identify areas where amendments to the proposed conditions of consent respond to matters raised by submitters. These amendments are attached, and summarised below:

- In Condition 4 regarding water level triggers:
    - A change to the 1 September to 30 April (summer) trigger levels from 2.5m to 2.4m for three consecutive days – for the first five years of the consent, and
    - for years 6-10 a change to trigger levels from 2.5m to 2.4m for three consecutive days.

  No changes to water level triggers for years 11-20 are proposed.
- A Communications Management Plan (CMP) has been prepared in consultation with the Waituna Catchment Committee. The amended conditions require this be implemented and regularly reviewed, including a requirement to review it after the first 12 months.
- A Consent Implementation Plan has been prepared, providing more detail regarding how the Consent Holders will exercise the consent. This includes a decision tree illustrating the steps and timeframes related to decision making regarding lagoon openings to ensure clear and timely decision-making. Changes have been made to the conditions to require opening to be in accordance with the Consent Implementation Plan.
- The Consent Implementation Plan includes an undertaking the Consent Holders will apply for an Authority under the Reserves Act 1977, to facilitate the exercise of the consent within the scientific reserve, within 3 months of the grant of the consent.
- Changes have been made to Condition 5 (water quality and ecological trigger) to ensure there is the ability to open the lagoon to prevent or mitigate an emergency situation where the ecological and cultural values of the lagoon are under imminent risk of significant decline, taking account of the proposed lagoon indicators.
- A change to Condition 7 is made to require that notices of lagoon opening provide information on the opening location and methodology, having considered the purpose of the opening, forecast weather conditions, and the coastal environment.
- A change to Condition 11 regarding the Science Advisory Group (SAG):
    - to clarify what ‘suitably qualified expert’ means, and
    - to confirm that SAG is to include an independent Chair, and a suitably qualified expert nominated on behalf of the Waituna Catchment Community – with the actual and reasonable costs to be shared by the Consent Holders.
- An addition to Condition 14 to require that monitoring information submitted includes observations and information learned from lagoon openings.

- Additions to Condition 16 regarding the 5 yearly consent reviews – to include a review of the implementation and effectiveness of the CMP, SAG, and consent holder reporting and decision making, and whether the lagoon opening and methodology are the most appropriate to deal with adverse effects.

Appendix A contains a tracked changes version of the proposed conditions so the changes are easily identified, and **Appendix B** contains a full clear copy version of all conditions, including the Consent Implementation Plan and Communications Management Plan.