

A new integrated monitoring strategy for Te Waihora/lake Ellesmere

Background

Te Waihora/Lake Ellesmere is NZ's 5th largest lake by area, is highly diverse, contains values across the four well-beings (Cultural, Environmental, Economic, Social) and is a taonga for Ngāi Tahu. The outstanding values of the lake are recognised in a National Water Conservation Order as: habitat for wildlife, indigenous wetland vegetation, and fish; and as being of significance in accordance with tikanga Māori in respect to Ngāi Tahu history, mahinga kai and customary fisheries. Internationally, Te Waihora/Lake Ellesmere is significant for its birdlife abundance and diversity.

It has long been recognised that the health of the lake and its tributaries has declined since the arrival of European settlers. In recent response, a variety of lake and land management interventions are underway or planned. We need to monitor and report on the state of the lake in order to know if these interventions are working – to measure progress towards the restoration of Te Waihora.

While there is monitoring across the range of values (see Hughey et al. 2013) there are many gaps and there is a lack of integration and no formally agreed to strategy (except for birds, water quality and water quantity) that would enable regular measurement and reporting to help evaluate the effectiveness of management, or to report holistically on the state of the lake (and on the catchment more broadly). Such an approach would be consistent with the principles that underpin Monitoring, Evaluation, Reporting and Improvement (see <http://www.nrm.gov.au/my-project/monitoring-and-reporting-plan/meri>) generally.

An Integrated Strategy for Te Waihora

In 2014, following feedback from the fourth Living Lake Symposium in late 2013, and with a number of significant restoration initiatives underway or planned for the lake and catchment, work began on developing an integrated monitoring strategy to better link science, monitoring and management. Led by Ken Hughey¹ from Lincoln University and the Waterways Centre for Freshwater Management², the intention is to make integrated monitoring operational and enable regular, timely, reporting on the state of the lake – based on methods that are scientifically robust, fit-for-purpose, supported by the community and cost-effective.

Integration is on multiple levels: people and agencies working together, the combining of relevant environmental, social, cultural and economic data for reporting purposes, provision of data and information that can relate interventions and outcomes to each other on some level.

This strategy links with existing and proposed monitoring by the established management agencies, and with the applied teaching and research focus of Lincoln University³ (complemented by the University of Canterbury).

As a first step, in mid 2014, a reference group was established, with representatives from Lincoln University, University of Canterbury, Environment Canterbury, Department of Conservation, Fish & Game NZ, Ngāi Tahu and NIWA participating in discussions. Building on the report *Te Waihora/Lake*

¹ Also a Trustee of the Waihora Ellesmere Trust

² With funding support from the Whakaora Te Waihora Joint Cultural and Ecological Restoration Programme.

³ A strength of Lincoln University is its ability to integrate the required expertise from faculties that together represent the 4 well-beings, and that there are already courses that cut across the entire campus where applied monitoring associated with Te Waihora/Lake Ellesmere can potentially be included. Additionally the Waterways Centre and specific University of Canterbury courses are expected to contribute in other need areas.

Ellesmere State of the Lake 2013, a framework which articulates indicators and draft measures of success was developed (Table 1) and used in *Te Waihora/Lake Ellesmere State of the Lake 2015*.

Specific objectives for the strategy are that:

- the framework used can work irrespective of the lake management actions being undertaken by different parties
- it provides for a monitoring and reporting implementation pathway
- it outlines how the staff and students of Lincoln University and the University of Canterbury will regularly contribute to the monitoring and assist with reporting on the state of the lake and its environs.

The strategy is, by design, a work in progress. For more information relating to each of the topics covered by the strategy see www.wet.org.nz.

Table 1 below also includes, for each topic, an indication of the gaps in current monitoring and some recommendations for addressing those gaps. The challenge is to work collectively to progress these recommendations.

December 2015
Waihora Ellesmere Trust

Table 1. Draft Success Measures

TOPIC	How will we know if we have achieved success?	Draft Measures of success ⁴	What gaps have been identified? What are the recommendations?
GOVERNANCE AND MANAGEMENT	The role of Ngāi Tahu and kaitiakitanga is recognised in governance of the lake and catchment, there is integrated management of land and water use, and the wider community included in decision making	<ul style="list-style-type: none"> • Ngāi Tahu express satisfaction with governance and management arrangements • All other agencies and key stakeholders are satisfied • Community are happy with levels of consultation and understand the decision making processes with respect to the lake and environs 	A survey of awareness of and attitudes towards the lake among local community members
LAND USE AND LAND COVER	Land use and development is integrated with water management; natural and cultural values are respected; all land use activities operate at good practice or better	<ul style="list-style-type: none"> • Diverse agricultural landscapes are supported with no one predominant land use • Properties >20ha have restored/managed native vegetation/naturally occurring wetlands • Restoration plantings show positive annual survival and growth trends • Land and Water Regional Plan, Plan Change 1 (PC1) stock exclusion targets for waterways being met • Farm Environment Plans receive audit grade A or B 	<ul style="list-style-type: none"> • FEP audit results • quantitative data about riparian management and restoration projects, • explore ways of sharing data, including making better use of geographic information systems (GIS) and the web for state of the lake reporting.
WATER QUANTITY AND WATER QUALITY	<p>Water quantity: ecosystem and cultural health is restored and safeguarded; water users have reliable supplies, including for customary use, and recreational activities</p> <p>Water quality: water quality is improved to sustain cultural values; indigenous and wildlife species are supported; drinking water is safe and water quality suitable for recreation</p>	<ul style="list-style-type: none"> • Trophic Lake Index (TLI) - mid lake limit = 6.6, margins = 6 (PC1) • Water Quality Index - Fair or better (Canterbury Water Management Strategy (CWMS target) • Invertebrate/habitat grades - Fair or better (CWMS target) • Recreation grades - 'Suitability for Recreation Grade' of Good-fair (PC1, derived from MfE 2003) • Potentially toxic cyanobacteria - < 1.8 mm³/L (Public health guideline -Ministry for the Environment and Ministry of Health in 2009) • Ground water quality (N&P) - 8.5 mg/L for nitrate nitrogen (PC1), NB for drinking water Maximum Allowable Value of 11.3 mg/L nitrate nitrogen for drinking water (MoH, 2013), E. coli < 1 organism/100 ml (PC1), no target set for P • Water Quantity (tributaries) minimum flow and restriction regimes set out in PC1 	<ul style="list-style-type: none"> • maximise the impact of available information, including real time monitoring data, through visual interpretation that speaks directly to the many communities of interest in lake management. • other parties (e.g., universities, local community) involvement in additional monitoring of the lake/tributaries • information is stored in a central repository/data base <p>Further recommendations will come from a current Waterways Centre research project to design a water quality monitoring programme for the lake and catchment.</p>

⁴ Source of draft measures of success acknowledged where derived from a planning document or similar; otherwise developed by author of the monitoring strategy based on discussion with a reference group

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VEGETATION	Significant indigenous vegetation of the lake margin, wetlands and tributary streams is protected and restored	<ul style="list-style-type: none"> • An annual net gain of key habitat (e.g., raupō) and maintenance of important habitat types (e.g., saltmarsh) • Maintain or increase populations of threatened or at risk plant species • Annually reduce and stop spread of key problem willow species and other significant animal and pest weeds of native vegetation • Aquatic macrophyte beds re-established and show positive growth rates 	<ul style="list-style-type: none"> • Establishing permanent 10x10 m monitoring plots on public conservation land and ensuring comprehensive monitoring is undertaken at regular intervals, e.g., 3 yearly • Continue to monitor lake margins and key tributaries for weed spread • Where willows have been removed, and where vehicle/stock access has been removed from lake shore, establish photo points to monitor change <p>An offer has been made to compile a list of threatened species known to be present around the lake, and current threat ranking</p>
WILDLIFE	Indigenous wildlife (birds, lizards, terrestrial invertebrates) and associated habitats are protected	<p>BIRDS:</p> <ul style="list-style-type: none"> • Bird species diversity is maximised with a target average level of 39 species from 7 guilds recorded per annum • Bird species with a defined conservation risk and which rely on the lake for critical life stage requirements have populations enhanced • The optimised range of habitat conditions for the diversity of bird species present is provided <p>LIZARDS - Specific measures not yet identified TERRESTRIAL INVERTEBRATES - Specific measures not yet identified AQUATIC INVERTEBRATES (LAKE): Measures needed NB aquatic invertebrates are monitored for rivers and streams and reported in the Water section</p>	<p>For birds and lizards:</p> <ul style="list-style-type: none"> • maintain current monitoring and species recovery interventions, and report on responses <p>Terrestrial invertebrates:</p> <ul style="list-style-type: none"> • maintain current monitoring and species recovery interventions, and report on responses • encourage student researchers to target key shoreline areas of the lake to document species presence <p>Aquatic invertebrates:</p> <ul style="list-style-type: none"> • develop and implement a monitoring programme for lake flies (<i>Chironomus zealandicus</i>) that links to changing lake levels.
FISH	Native fish (including koura and mussels) populations and associated habitats are protected and restored	<ul style="list-style-type: none"> • An upward trend in diversity and abundance of native fish populations • Economically and culturally viable populations of harvest/mahinga kai species maintained • Habitat for key 'threatened and at risk' species increased and maintained • Pest species having a significant impact on native fish or on lake habitat generally are controlled to effective levels • Fish barriers removed or negative effects mitigated 	<p>While fishes occupying the lake have been the focus of recent research</p> <ul style="list-style-type: none"> • There are many tributaries that flow into the lake and the importance of these areas as habitat and for fish migrations are poorly understood. For example, tributaries may be the key spawning grounds for species that cannot find adequate spawning habitat in the lake (although many of the species will spawn at sea), may provide temperature refuge at times when the lake temperature is particularly high, and are critical habitat for longfin eels. • At present we do not know the extent of spawning in tributaries for key prey fish species such as common bully or whether fish species that spawn in the lake are limited by the availability of spawning habitat. • It is not currently known whether recruitment of small fish is limiting these eel and flounder populations or whether there are

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			<p>sufficient prey resources available to increase the abundance of eel and flounder species.</p> <ul style="list-style-type: none"> Examine the effects of extended low summer lake levels on fish communities. Specifically, work could focus on the loss of lake margin habitat and high water temperatures.
ECONOMY	Sustainable water use supports economic development	<ul style="list-style-type: none"> Economic development in the Selwyn District is decoupled from water quality – the health of the lake and its tributaries have improved and economic activity in Selwyn is buoyant 	<ul style="list-style-type: none"> Calculation of composite economic indicators such as expenditure on environmental protection associated with the lake, GDP compared to water use and water quality. Changes in these types of indicators will show whether human induced pressures on the lake and its tributaries (from production and consumption in the Selwyn District) have lessened. Economic indicators focused on the pressures from and benefits of economic activity (around and on the lake) should be measured at a finer scale than at District level.
RECREATION	Compatible recreation needs are provided for, including good access, water quality, and habitat for wildlife, including for sports fisheries	<ul style="list-style-type: none"> Recreational user survey results show increased level of use Recreational user survey results show increasing quality of experience (quality includes measures of visitor facility provision, ease of access, signage/information availability, fish and game catch limits, water quality and lake level) 	<ul style="list-style-type: none"> User days per annum statistics for the main activities – trout angling, waterfowl hunting, whitebaiting, cycling, bird watching, walking and picnicking, perhaps undertaken on a bi- or triennial basis Quality of experience measures – size and number of trout, number of waterfowl, access and other visitor-related facilities and provisions (including improved signage, walkways, boat ramps), water level and quality. Perceived quality can be gauged during the user days surveys The formation of an ‘expert panel’ of lake recreationists to help monitor, report and advise on both the quality of experience and on user levels should also be considered as a way of helping progress these ideas. a facilitated discussion forum is required to clarify and attempt to resolve conflict issues, eg between hunters and bird watchers. An ongoing strategy to improve and share information about recreational opportunities Develop a business case for constructing and developing a visitor/research centre for Te Waihora/Lake Ellesmere.
CULTURAL HEALTH	Customary rights and use are recognised and mahinga kai species abundance and diversity is restored to a level to enable customary use	<ul style="list-style-type: none"> The 11 objectives, taken from the Mahaanui Iwi Management Plan 2013 are achieved 	