

Lake Waitahi (Morehurehu South 2)

30/04/2024

NRC Lake Number: 36



ECOLOGICAL VALUE SCORE

9 /20

Overall Rank: High to Moderate

Key impact

Forestry: Sediment and nutrients from the forestry is impacting the lake health.

Invasive Species: The lake is easy to access so the risk of invasive species introductions is high.

Declining state: There are signs of declining lake health.

Management action

Develop a collaborative forestry management plan to ensure that best practices are being used to reduce the impact on the lake.

Limit access to the lake, increase biosecurity awareness and add biosecurity controls to the forestry management plan.

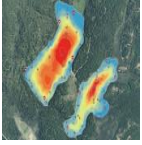
Routine monitoring including monthly water quality testing as well as 3-5 yearly ecological assessments and invasive species surveillance.



Did you know:

The threatened sundew (*Drosera pygmaea*) is found along the lake edge!

Report card glossary



Habitat size: This score is based on the size and depth of the lake. Large deep lakes are more stable because they have a greater dilution capacity and a larger area to support different habitat types.



Connectivity: This score considers the number of nearby lakes and wetlands. This connectivity is important as several threatened birds travel between waterbodies that form a network of habitats across the landscape.



Buffering: This score is based on the riparian vegetation around the lake and how much native vegetation and wetlands there are in the catchment. This vegetation filters pollutants entering the lake from the surrounding land.



Water quality: This score is based on the nutrient concentrations in the lake. Higher nutrient concentrations typically result in a poor level of ecological health and is often associated with murky water and algal blooms.



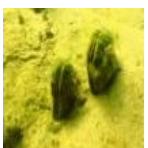
Aquatic vegetation diversity: This score is based on how many different species of aquatic plants live in the lake. Lakes with a high diversity of aquatic plants are usually in better ecological condition.



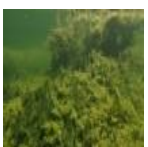
Aquatic vegetation integrity: This score is based on the extent, diversity and condition of native submerged plant. Fully vegetated lakes with a high species diversity are often in the best condition.



Endangered species: This score is based on how many endangered plants and fish live in this lake. Endangered species add value to the ecosystem and are an indicator of good ecological health.



Presence of key species: This score is based on the presence of freshwater mussels (kakahī or torewai). These mussels are important for lake health because they filter the lake and remove algae.



LakeSPI: This score is based on the health, density and extent of native and exotic submerged plants in the lake. This score also integrates the impact of invasive submerged plants.

General description

Lake Waitahi (Morehurehu South 2) was assessed during the following years: 2004, 2006, 2013, 2014, 2016 and 2024.

The lake (34°39'01"S 173°00'20"E) is small (0.78 ha) dystrophic lake located south of the larger Lake Morehurehu. It has a maximum depth of 3.6 m and is impounded by large sand dunes along the eastern and southern boundary. The remainder of the lake is surrounded by native scrub and harvested plantation forestry.



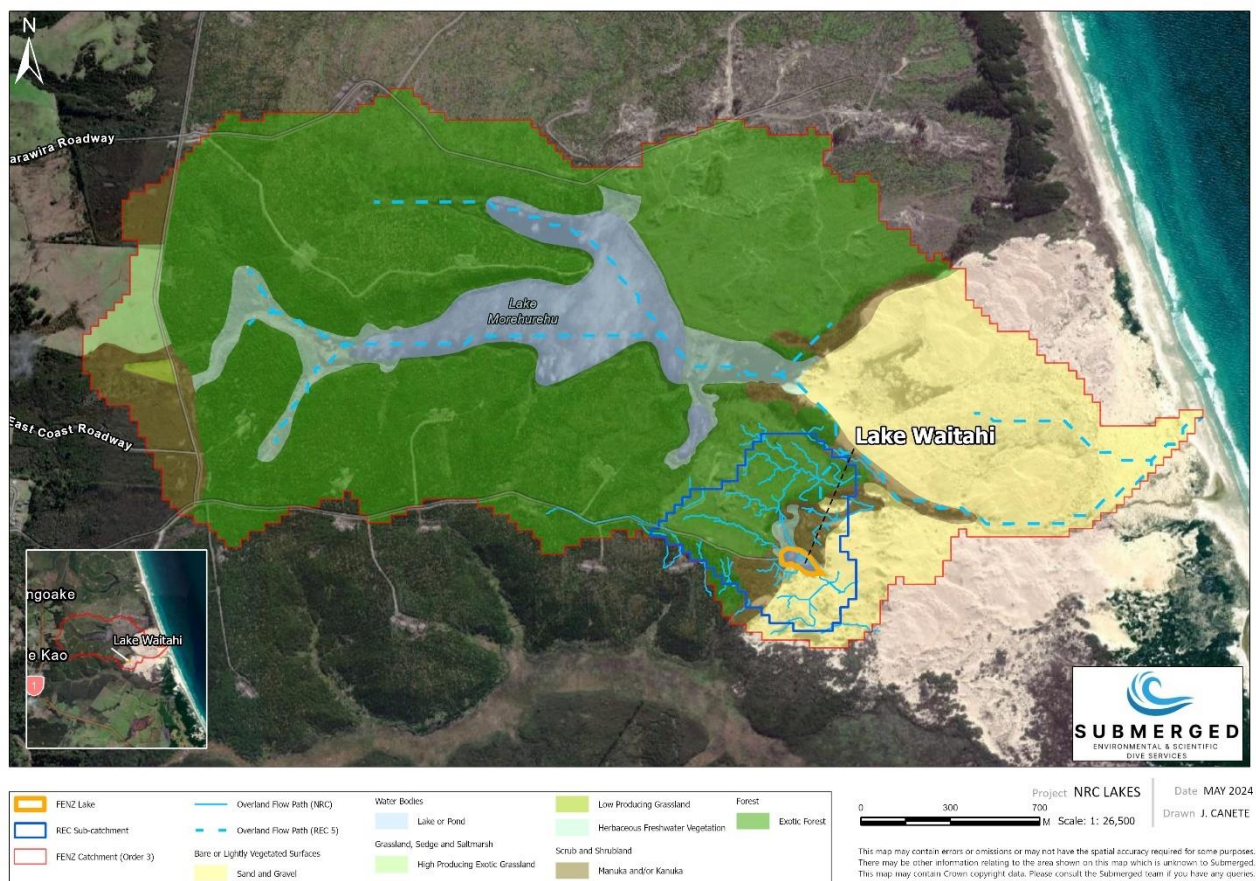
Lake Waitahi (Morehurehu South 2) - Eastern view indicating the impounding dune, emergent riparian vegetation and tannin-stained water

Catchment & sub-catchment description

The 535.82-hectare catchment is dominated by production forestry (60% of the total catchment) with small sections of pasture along the western catchment boundary. Manuka/kanuka scrub makes up 7% of the total catchment and wetlands account for 4%. Majority of the wetlands are associated with the larger Lake Morehurehu and do not provide any direct buffering to Lake Waitahi.

The 36.42-hectare sub-catchment is also primarily covered by production forestry (54% of the sub-catchment) with remnants of manuka/kanuka scrub (22%) along the northern and southern sections of the lake. The lake is surrounded by lacustrine wetlands that extend outward toward the northwest. The entire eastern part of the sub-catchment is a mobile sand dune.

The steep sided western slope of the sub-catchment consists of felled forestry and is likely contributing sediment and nutrient loads to the lake. The riparian buffer will provide some degree of contaminant attenuation however, the scale of overland flow draining into the lake from the adjacent bare slopes and forestry would likely result in significant impacts.



Lake Waitahi (Morehurehu South 2) catchment land cover and overland flow path network

In-lake description

The water was heavily tannin-stained and the visibility near the entry point was 0.5 m. The visibility improved along the northern and western sections of the lake, reaching a maximum of 1.6 m. The average underwater visibility was estimated at 1.2 m.

The lake sloped towards a deeper central bowl near the face of the dunes and got progressively shallower toward the opposite end of the lake along the northern and western banks.

The substrate was sandy and coarse along the southern and eastern sections of the lake with a thin surficial layer of fine silt. This is likely because of the adjacent sand dunes delivering fresh coarse sand to the area during high wind/rainfall events. The surficial layer of fine silt increased in thickness along the central bowl of the lake (>2 m deep) and along the northern bank. Decomposing organic matter was seen accumulating along the base of the emergent vegetation with a distinct deposition zone occurring along the western bank.

There was limited benthic algal growth which could be a result of the shallow high-energy environment. Wind-induced scouring can often limit the establishment of benthic algal mats in shallow waterbodies.

Wetland vegetation

Emergent species encircled most of the lake (75%) and formed a wide 5 - 10 m band dominated by *Eleocharis sphacelata* growing to a depth of 2.1 m. Oioi (*Apodasmia similis*), *Machaerina teretifolia* and the At Risk - Declining rush *Empodisma robustum* were all common marginal species. A population of the At Risk - Relict sundew *Drosera pygmaea* was observed growing as a lake-side turf.

Submerged vegetation

The general submerged vegetation establishment pattern in the lake consists of a non-vegetated area along the dune face and entry point (southern and eastern banks), then a 2 – 3 m wide band of *Utricularia gibba* with stands of *Nitella leonhardii* along the remaining perimeter of the lake. This vegetated band extends across the entire width of the lake where the depth is less than 1.5 m (northern and western portions of the lake).

The areas with no emergent vegetation and/or against the dune face had no submerged vegetation and the substrate was well sorted. This is indicative of a high energy environment. It is possible that coastal winds create turbulent conditions in the shallow areas along the southern portion of the lake. This turbulence can create a

scouring effect, which is exacerbated by the coarse nature of the sand, this in turn limits macrophyte growth and hinders vegetation establishment.

Utricularia gibba and *Nitella leonhardii* were the only submerged vegetation species recorded during the 2024 survey. The invasive *Utricularia gibba* was the dominant species and achieved almost 100% cover in most parts of the lake. It had an average lake wide cover of 76 – 95% and formed tall (40 – 80 cm) beds across the entire vegetated depth extent (0.1 – 1.7 m). *Nitella leonhardii* also formed tall (40 – 75 cm) dense beds that exceeded 95% cover, but the average lake-wide cover was estimated at 26 – 50%. The maximum cover was often achieved along the deeper sections of the vegetation profile (1.5 – 1.7 m), and a few dense beds were found in the shallow (0.2 - 0.3 m). The macrophyte condition across the lake was good and there was limited smothering by epiphytic growth and benthic algae.

During the 2006 survey, the regionally significant *Triglochin striata* and Threatened - Nationally Critical *Utricularia australis* were observed. Charophyte meadows dominated by *Nitella* sp. aff. *cristata* and *Chara australis* were recorded to the lake's maximum depth of 3.6 m and *Utricularia gibba* was found growing to 2.5 m deep. The tall-growing native *Potamogeton cheesemanii* was also previously abundant.

In early 2013 no significant vegetation was found but improved water clarity and a corresponding increase in submerged macrophytes were noted in July 2013 (L. Forester pers. com.). In 2014, the lake had recovered again and was vegetated to the maximum lake depth (3.6 m). The species assemblage shifted and *Nitella leonhardii* replaced *Nitella* sp. aff. *cristata* and *Chara australis* as the only charophyte species. *Potamogeton cheesemanii* and *Utricularia gibba* were still abundant during this survey. In 2016 very low water clarity was reported and the lake was classified as non-vegetated.

The lake appears to move between vegetated and non-vegetated states. The 2024 survey recorded a high biomass of submerged vegetation however there are some signs that the lake could be transitioning to a non-vegetated state. The poor water clarity limited the photic depth to less than 2 m deep. Only two macrophyte species were detected and they had a much shallower maximum depth extent compared to historic records (1.7 m vs 3.6 m in previous surveys).

The exact reasoning for this state swapping is unknown however recent extreme weather events could have had a role in the current lake condition.

LakeSPI

Lake Waitahi (Morehurehu South 2) is categorised as being in moderate condition with a LakeSPI Index of 29%. Since 2013 the lake has been fluctuating between vegetated and non-vegetated states with the last survey in 2016 concluding that the lake was non-vegetated. The 2024 survey results indicate that the lake has recovered and still has a high macrophyte biomass.

The maximum Potential Native Condition Score for this lake is 15 and the current assessment score is 3 (Native Condition Score of 20.00%). This low score is a result of only one native species being found and a limited vegetated depth extent. The maximum Potential Invasive Condition Score is 27 with a current assessment score of 18 (Invasive Condition Score of 66.67%). This is largely due to the widespread establishment of *Utricularia gibba* across the lake. The maximum Potential LakeSPI Score is 35 and the current score is 10 (total LakeSPI Score of 28.57%). This score reflects the high level of invasive species impact and deteriorating vegetation extent.

Despite the relatively high macrophyte biomass, the lake could be transitioning to either a non-vegetated state or becoming completely overrun by *Utricularia gibba*.

Lake Waitahi (Morehurehu South 2) LakeSPI scores as a percentage of the maximum Potential LakeSPI score, Native Condition Index, and Invasive Impact Index

Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
April 2024	Moderate	29	20	67
April 2016	Non-vegetated	0	0	0
May 2014	High	54	67	52
April 2013	Non-vegetated	0	0	0
March 2006	High	57	73	48
Nov 2004	High	57	73	48



Lake Waitahi (Morehurehu South 2) LakeSPI survey transects

Wetland birds

No birds were sighted during the 2024 survey however, the following priority conservation species have been sighted near the lake: weweia (dabchick) (*Poliocephalus rufopectus*), matuku (Australasian bittern) (*Botaurus poiciloptilus*), black shag (*Phalacrocorax carbo novaehollandiae*), white heron (*Ardea alba*) and mātātā (fernbird) (*Poodytes punctatus*).

Most of these species were sighted in 2018, 9 km northwest of the lake. Matuku (bittern) were also recorded 6 km south of the lake in 2000. Black shag and mātātā (fernbird) have been regularly sighted in the area since 2014. White heron have been sighted between 2013- 2021 near Spirits Bay and Rangaunu Bay estuary so it is possible that they use wetlands/lakes across the northern tip of the region. Weweia (dabchick) were sighted at Lake Ngakeketo and the surroundings in 2023. Kawau (black shags and pied shags) are also commonly sighted species in the far north so likely occupy the adjacent waterbodies.

Fish

No fish were observed during the 2024 survey however, shortfin eels (*Anguilla australis*) were detected using eDNA analysis. Schools of inanga (*Galaxias maculatus*) were reported amongst the emergent vegetation in 2004 and also noted during the July 2013 visit (I. Middleton, NRC, pers. comm.).

Aquatic invertebrates

A variety of common aquatic invertebrates were sighted amongst the emergent vegetation. These included representatives from the following orders: Ephemeroptera, Plecoptera, and Trichoptera.

No freshwater mussels were found during the 2024 survey and there is no record of them in this lake. The substrate is suitable and there have been records of appropriate host fish however the extensive growth *Utricularia gibba* would likely prevent this species from establishing in the lake.

Endangered species

A population of the At Risk - Relict sundew *Drosera pygmaea* was noted as a lake-shore turf and does not appear to be threatened by current land use. The Threatened - Nationally Critical *Utricularia australis* is apparently extinct, not being recorded after 2006. The At Risk- Declining inanga was observed in 2013 and 2014. Connection to Parengarenga Harbour is maintained through the outlet to the north of the lake, allowing migrations of this species but none were seen during the 2024 survey.

Lake ecological value

Lake Waitahi was assessed as having “High to moderate” ecological value with a score of 9 out of 20. This score was based predominantly on the extent of bordering emergent vegetation and the presence of At Risk *Drosera pygmaea* and *Empodisma robustum*.

Lake Waitahi is a shallow (3.6 m), small (0.78 ha) lake so it scores a 0.5 out of 3 for the Habitat Size metric. This score indicates that the lake has a limited capacity to cope with high levels of impacts. It is adjacent to the larger Lake Morehurehu South and a series of wetland features, so it gets an additional point for connectivity to other waterbodies.

The lake scores a 2 out of 3 for the Buffering Metric. Majority of the lake perimeter (75%) consists of mature emergent vegetation and 4% of the wider catchment is considered as wetlands. The size of the lake means the relative percentage of wetlands to lake area is high. The immediate surroundings have a moderate percentage of native vegetation (22% of the sub-catchment) however, the wider

catchment is dominated by forestry (60%) with 11% native vegetation which brings down the overall score.

No water quality data is available for the lake, so it is automatically assigned a 0 out of 3. This is done to ensure a standardised approach when scoring unmonitored lakes and is representative of the worst-case scenario. Water quality data from the larger neighbouring Lake Morehurehu show that it is in a mesotrophic state (TLI4 of 3.68). While this lake is much bigger than Waitahi, it provides an indication of the likely nutrient loads entering both lakes. Combined with the in-lake observations it is likely that Lake Waitahi is in the upper mesotrophic range.

The lake scores a 2 out of 3 for the Aquatic Vegetation Diversity Metric because 20 indigenous emergent, free-floating, and submerged vegetation species were recorded during the survey. The lake supports a rich diversity of riparian vegetation.

The Aquatic Vegetation Integrity metric is taken from the LakeSPI Native Condition and the resulting score is 0 out of 3. This score is reflective of the limited vegetated depth extent, loss of native species, and the increasing dominance of invasive *Utricularia gibba*. This metric also integrates the effects of the deteriorating water clarity.

The At Risk - Declining *Empodisma robustum* and At Risk - Relict *Drosera pygmaea* were found during the 2024 survey which resulted in 1 out of 3 for the Endangered Species Metric. *Utricularia australis* was last sighted in the lake in 2006 and was not found during the 2024 survey.

No endangered fish were seen during the survey, but matuku (bittern), weweia (dabchick), and māātātā (fernbird) have been regularly reported. Considering the proximity to the larger Lake Morehurehu and the number of waterbodies in the wider catchment, Lake Waitahi is likely used by a variety of threatened wetland bird species.

No freshwater mussels were seen during the 2024 survey and the current in-lake conditions are unlikely to be able to support this species.

Threats

The expanding coverage of *Utricularia gibba* in the lake poses a significant ecological challenge. This aquatic plant's rapid proliferation can outcompete native vegetation, leading to habitat degradation and reduced biodiversity.

Runoff from the surrounding forestry contains sediment, nutrients, tannins and other pollutants which contribute to the degradation of water quality. These impacts can worsen during felling and high rainfall events where high volumes of contaminants are delivered to the lake via diffuse overland flow. The soil in the area is sandy and highly porous so waterborne contaminants enter the lake with limited filtration.

The nutrients drive eutrophication and can lead to increased benthic algal growth, harmful surface algal blooms, oxygen depletion, and overall degradation of water quality, further stressing the lake ecosystem and potentially leading to cascading impacts on aquatic life. Sediment loads reduce the water clarity and increase the deposition of fine silt, both of which limit macrophyte growth and establishment.

The improved access road, to facilitate forestry activities, and the increased residential development on the outskirts of the forestry have resulted in an increased risk of invasive species introductions.

Working with the forestry to create best practice management plans to minimise the impacts on the lake is essential to maintaining the ecological value of Lake Waitahi.

Management recommendations

The primary threats to Lake Waitahi are invasive species, sedimentation, and eutrophication. The following management actions are recommended:

Forestry management plan

The impacts from the surrounding forestry can be managed through an effective forestry management plan. An initial assessment of critical contaminant source areas at various stages of forestry development should be done in collaboration with the forestry managers. A collaborative plan should be drafted to ensure that the forestry is meeting best practices and the impacts on the lake are managed. A focus should be placed on the management of effects during felling and high rainfall events as these contribute large loads of contaminants to the lake.

Pathways assessment & biosecurity control plan

Access to the lake has become easier and there are several urban residential developments bordering the adjacent forestry block. This increases the risk of invasive species introductions that would add to the damage already being done by *Utricularia gibba*. Biosecurity controls should be discussed with the community and forestry managers and incorporated into the forestry management plan.

Routine monitoring

Despite the presence of endangered riparian species, the impacts of invasive *Utricularia gibba* are persistent and the in-lake conditions are deteriorating. The increasing pressure and small size of the lake can result in rapid changes in lake health. It is recommended that routine monitoring includes monthly water quality sampling as well as 3 – 5 yearly ecological assessments and invasive species surveillance.