Taharoa Domain Governance Board Meeting
Thursday 28 May 2020

Freshwater Improvement Fund Dune Lakes Project
Sediment Mitigation Workstream
Kai Iwi Lakes

The purpose of this report is to:

- Seek your views on sediment and nutrient issues facing the Kai Iwi Lakes
- Provide background on the Freshwater Improvement Fund Dune Lakes Project Sediment Mitigation Workstream and an overview of the suggested mitigation measures.
- Request feedback on the sites identified for possible sediment mitigation earthworks and the proposed earthworks.
- Request contacts for ongoing dialogue, site visit and approvals for the project.

1) Kai Iwi Lakes Management Plan

The Kai Iwi Lakes Taharoa Domain Reserve Management Plan was adopted in 2016. The plan notes that the lakes' water quality is amongst the highest of any dune lakes in New Zealand.

The plan also identifies threats to water quality from the wider catchment that influences the lakes. *Reducing the risks and the likelihood of damage to water quality and aquatic ecology requires proactive management and will involve a number of organisations.*[1]

One of the objectives from the Kai Iwi Lakes Reserve Management Plan is: *to strengthen the integrity and resilience of the natural ecologies and water quality, and engage neighbours to minimise the risk of potentially harmful groundwater reaching Kai Iwi Lakes*

2) Introduction to the Freshwater Improvement Fund Project

The Freshwater Improvement Fund (FIF) Dune Lakes project is a 5-year project jointly funded by Northland Regional Council (NRC) and the Ministry for the Environment (MFE). The goal of the project is to improve the water quality of up to 26 of Northland's dune lakes, including the Kai Iwi Lakes, through a range of work streams that specifically target the threats to dune lakes. We will work with mana whenua, agencies, landowners and stakeholders who have an interest or own or live around the lakes identified in the project to find shared goals and undertake actions to improve water quality.

Different threats and issues are being addressed at each lake. There are several workstreams to the project, such as pest fish and weed removal, , mātauranga Māori, stopping the spread of aquatic weeds, education, fencing lakes and sediment mitigation.

[1] Reserve Management Plan Kai Iwi Lakes (Taharoa Domain) 2016 Kaipara District Council

Different workstreams are suggested for five lakes in this area:

	Sediment mitigation	Education Day	Fencing	Reticulation
Taharoa	✓	✓		
Kai-Iwi	✓			
Waikare	✓			
Shag			✓	✓
Midgley			✓	✓

The fencing and reticulation at Shag and Midgley Lakes is completed and the Get to know your dune lake education day was held in March 2020 at Lake Taharoa.

3) FIF Sediment Mitigation Work Stream

The FIF sediment mitigation work stream supports the Kai Iwi Lakes Reserve Management plan as it aims to work with mana whenua, kaitiaki, Councils, Department of Conservation and landowners in the lake catchments to reduce sediment and bound phosphorus from reaching Kai Iwi lakes.

With reduced nutrients entering the lakes, water clarity is maintained, weed and cyanobacteria growth are limited and low-nutrient-need native submerged plants (macrophytes) will thrive.

Sediment is an issue because phosphorus binds to sediment. Too much phosphorus causes enrichment and algal blooms in dune lakes.

4) Sites of interest for sediment mitigation

Two sites have been identified for investigation for sediment mitigation measures around two lakes. They are shown in the table and images below:

Lake Name	Site name	Potential earthworks
Waikare	Boat ramp	Swale
Taharoa	Promenade Point	Wetland

In addition to the sediment mitigation measures, fencing of streams and wetlands on farmland in the catchment, if they are not fenced already, is also recommended, along with riparian planting.

Lake Waikare boat ramp drain from farm land west of the boat ramp – swale?

Lake Taharoa Promenade Point drain – draining farm land west of the lake – wetland?

5) Sediment Reduction and Mitigation Options

Best practice sediment reduction and mitigation takes a two-pronged approach - **in-field** mitigations and **edge-of-field** mitigations.:

1) **In-field** mitigations aim to **prevent** erosion occurring in the first place by binding soil to prevent its mobilisation and reduce rainfall impacts. These include:
   - increased pasture density,
   - spaced tree planting on pasture,
   - good land use practices to reduce erosion such as well-maintained races
   - conversion to forestry, native or exotic of highly erodible land.

2) **Edge-of-field** mitigations aim to **mitigate** erosion that does occur by reducing run-off velocity and trapping suspended sediment. These include:
   - riparian fencing and planting,
   - sediment retention infrastructure such as swales, traps and bunds,
   - wetlands.

Co-benefits of sediment mitigation include mitigation of nitrogen, phosphorus and *E. coli,* maintaining soil health and fertility, and other ecosystem services on site and off site such as flood mitigation and habitat for native and endangered plants and wildlife.

The FIF Sediment Mitigation workstream principles are to:

- ✓ Consider the entire catchment in a holistic way
- ✓ Look at land use around the lakes to prevent sediment loss in the first place
- ✓ Protect and / or expand existing wetlands and riparian margins
- ✓ Find critical sources of sediment and reduce these first

NRC staff are working with landowners around lakes to prepare Farm Environment Plans. These plans recommend best practice actions on farms to minimise erosion potential and to mitigate sediment and other nutrients where they occur on site. Several landowners have been actively working to improve water quality on their farms. Ideally NRC would like to engage with all landowners in the lake catchments.

6) Natural, constructed and reconstructed wetlands

Wetlands work in four ways to mitigate nutrients and sediment arising from pasture to improve water quality:

- Denitrification – removing nitrogen by microbial production of nitric oxide (NO), nitrous oxide (N2O) and N2 from nitrate
- Nutrient uptake by plants – wetland plants taking in N and P from the surrounding water column and sediment. Aquatic plants such as raupo and sedges have reported nutrient uptake rates of 13-263 gN/m^2 /y and 2-40 gP/m^2 /y^2
- Deposition - settling of nutrient containing sediment, flocs, detritus, phytoplankton from the water column e.g., floodplains, soil deposits

- Adsorption - physical or chemical bonding of molecules to the surface of solids

A broad array of wetland options are available, with the relative suitability of each form dependent on flow path, primary contaminant type, size, slope, and soil type. A typical constructed wetland for sites with potentially high sediment loads is shown in Figure 1.

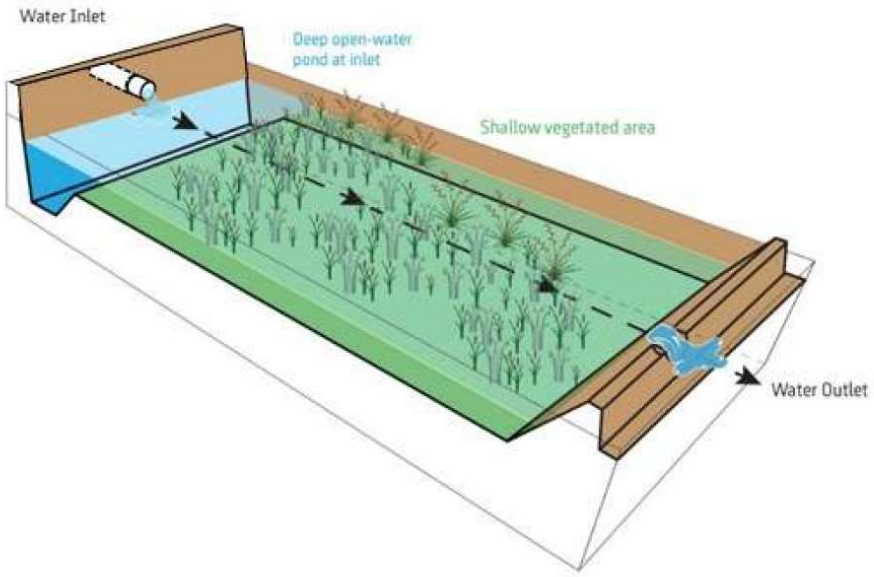

Figure 1: Elongated wetland with open water deep zones receiving surface flow. In the wetland area, there is an initial deep zone to aid spreading of flow across the full width of the wetland followed by alternating shallow vegetated (~70% of area) and deeper open-water zones where microbial processes, plant uptake and sorption processes reduce nutrients [3].

Wetlands occupying 1% to 5% of their catchment area should, on average, remove between 24% to 52% of their long-term average total nitrogen (TN) inputs. Wetlands occupying 1% to 5% of their catchment area should, on average, remove between 26% to 48% of the long-term average total phosphorus (TP) input [3].

The most cost-effective option is to retain existing wetlands, or secondly, to restore and improve degraded wetlands. Extending existing wetlands is also an option, as well as construction of new wetlands.

Wetlands are a preferred mitigation measure as they have multiple benefits, those listed above, as well as habitat for native flora and fauna.

The recommendation is to treat water coming to the lake via a wetland to increase the amount of sediment that falls out of suspension and the increase the amount of nutrients absorbed by wetland plants before the water reaches the lake.

[3] Provisional guidelines for constructed wetlands treatment of pastoral farm runoff - Dairy NZ and NIWA – Chris Tanner 2020

7) Swales

A swale (either grassed or vegetated) provides water quality treatment, primarily via interception by vegetation, as runoff flows along the surface of the swale (Figure 2)[4]. Swales are good at stopping large volumes of water building up. The more velocity water has the more it can erode. The proposal is to build a vegetated swale, similar to that in figure 3 below, planted with native reeds such as wiwi and oioi.

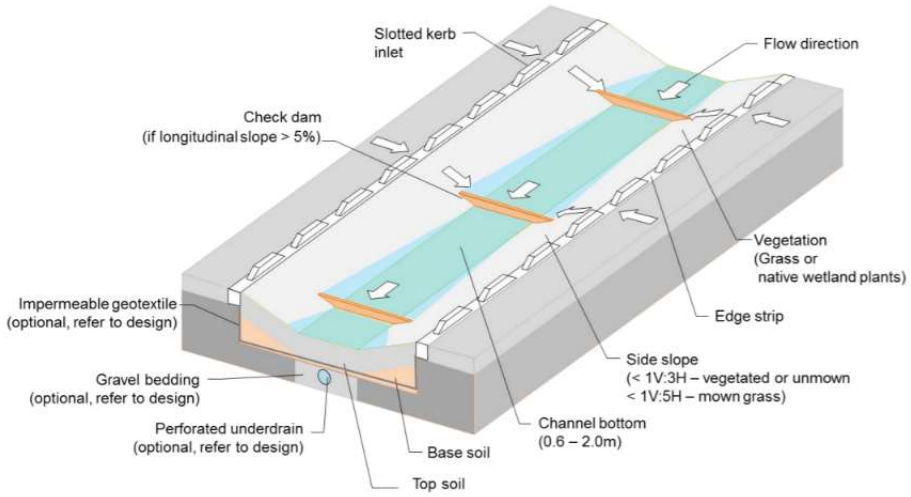

Figure 2: Schematic of a typical swale cross section.

Figure 3: This image shows a swale planted with native plants.

[4] GD01 Stormwater Management Devices in the Auckland Region. Auckland Council 2017

8) Feedback on the possible sediment mitigation earthworks

Please provide feedback and questions on the suggested sediment mitigation sites and measures outlined in this report. Are there other sites you feel would benefit from treatment?

This report provides a high-level outline of proposed works only, and if permission is given to go ahead and continue with the proposal more detailed information will be provided once it is available, for example detailed construction plans. A site visit with mana whenua, Kaipara District Council and the Department of Conservation is requested to look at the sites identified in detail.

9) Contacts for ongoing dialogue about the project

Permission, confirmation of land ownership, ongoing dialogue and negotiation with mana whenua, landowners, kaitiaki, the Department of Conservation and Kaipara District Council is required for this work to go ahead, along with resource consents. Please provide a list of contacts you recommend I liaise with to progress this project and confirm who would give formal approval to work on this land.

10) The sediment issue

It is estimated that 192 million tonnes of soil are lost in New Zealand every year, 44 percent of this is from areas in pasture. Erosion and sedimentation are natural processes driven by climate and geology but these processes have been accelerated by human activities such as: housing and roads, clearing forest and scrub, mainly to make way for the development of housing and farm land. This results in increased levels of hillslope and surface erosion (Appendix 1).

Land use intensification, draining wetlands and inappropriate land management have increased erosion. The suspended and deposited sediment results in economic, cultural and environmental effects on land, floodplains and freshwater such as

- reduced soil fertility
- increased impacts from flooding
- infrastructure damage
- diminished aesthetic values
- algal growth from increased phosphorus
- water turbidity
- smothering of shell fish beds in lakes, estuarine and coastal environments.

11) Monitoring

The Northland Regional Council (NRC) State of the Environment (SOE) monitoring team currently monitor water quality in 27 lakes, including Kai Iwi, Taharoa and Waikare Lakes. The data collected includes water clarity, chlorophyll content, total phosphorus and total nitrogen. From these parameters a Trophic Level Index (TLI) value is calculated. This SOE monitoring provides a base line of data to measure progress against.

Following these sediment reduction actions, we expect to see a reduction in nitrogen and phosphorus in lakes which will result in improvement or no further decline in TLI scores over several years. The data are available to the public on the LAWA website (www.lawa.org.nz). Data are available from 2008 in most cases.

The three Kai Iwi Lakes all have good water quality and excellent ecological conditions according to the LAWA data (Figure 4)

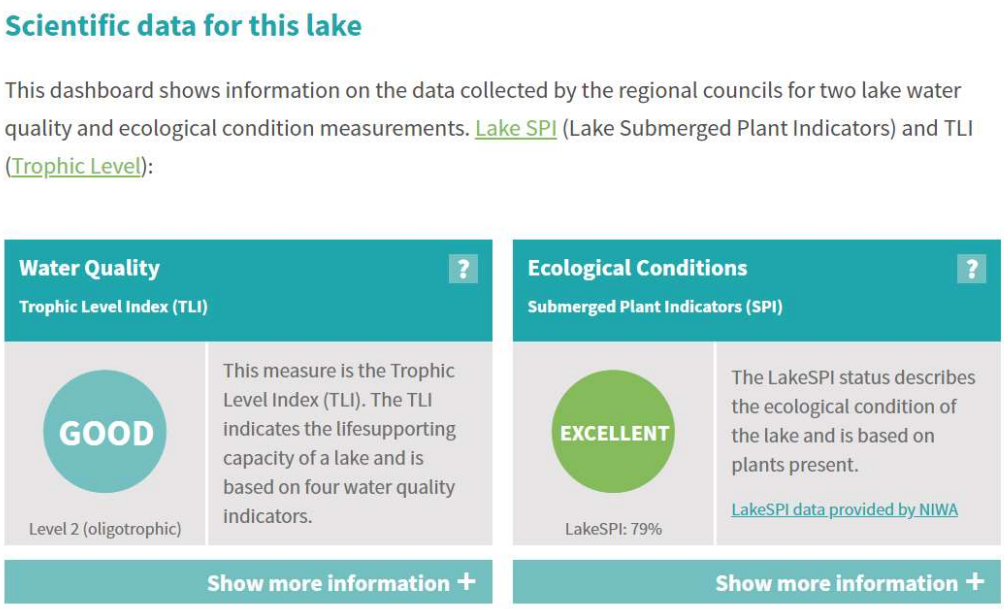

Figure 4: screen shot of the LAWA website showing results from one of the three Kai Iwi Lakes. All three Kai Iwi Lakes have the same overall results.

Appendix 1 – Overview of erosion and sedimentation issues