

How Far Can We Go?

Andy Bruere,
Lake Operations Manager,
Bay of Plenty Regional Council

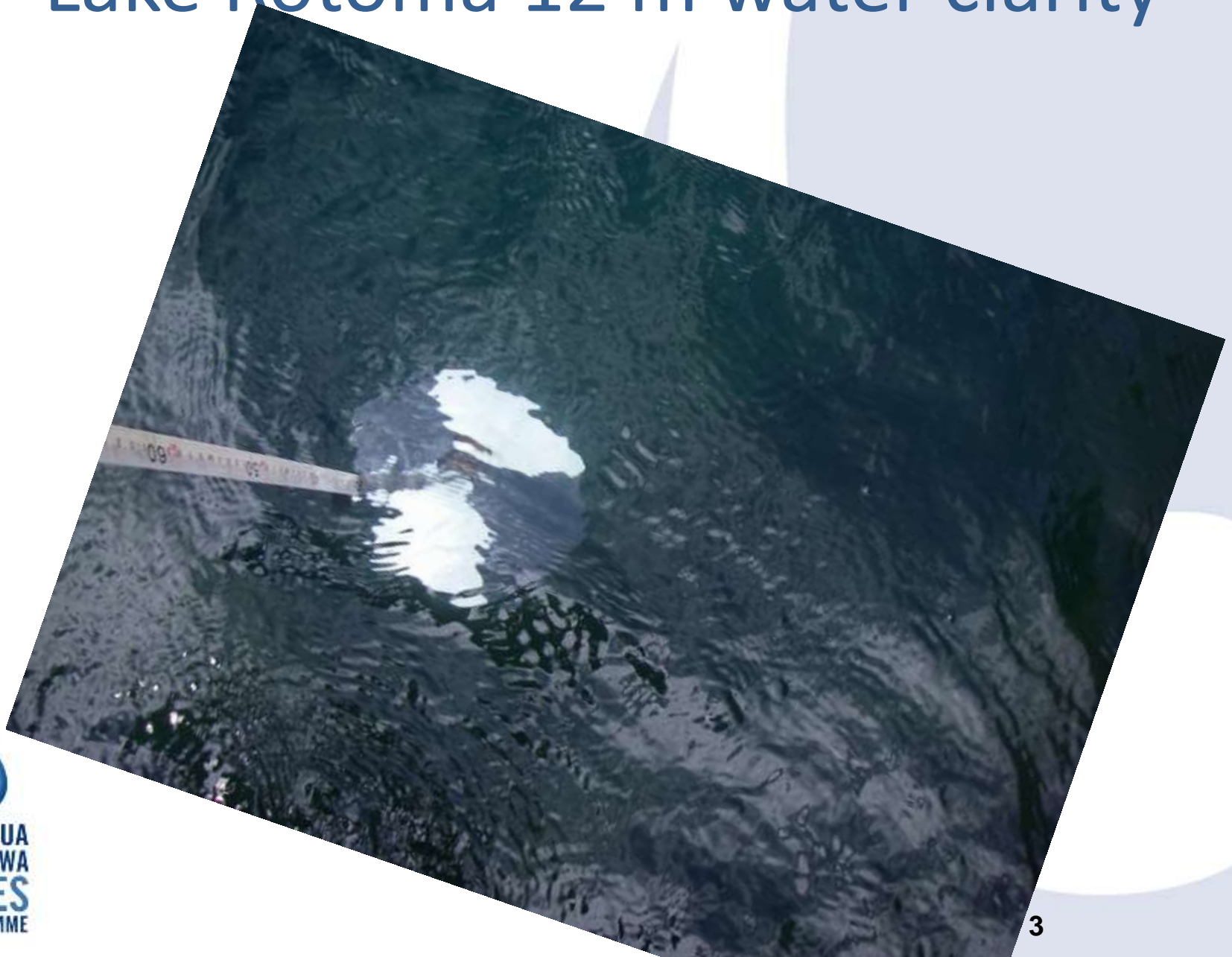


Proud Partners





Lake Rotomā 12 m water clarity







**ROTORUA
TE ARAWA
LAKES
PROGRAMME**







动家
66738

15827107332

活动度

13968884667

温馨提示



水深危险

禁止游泳

后官湖湿地公园



ROTORUA
TE ARAWA
LAKES
PROGRAMME





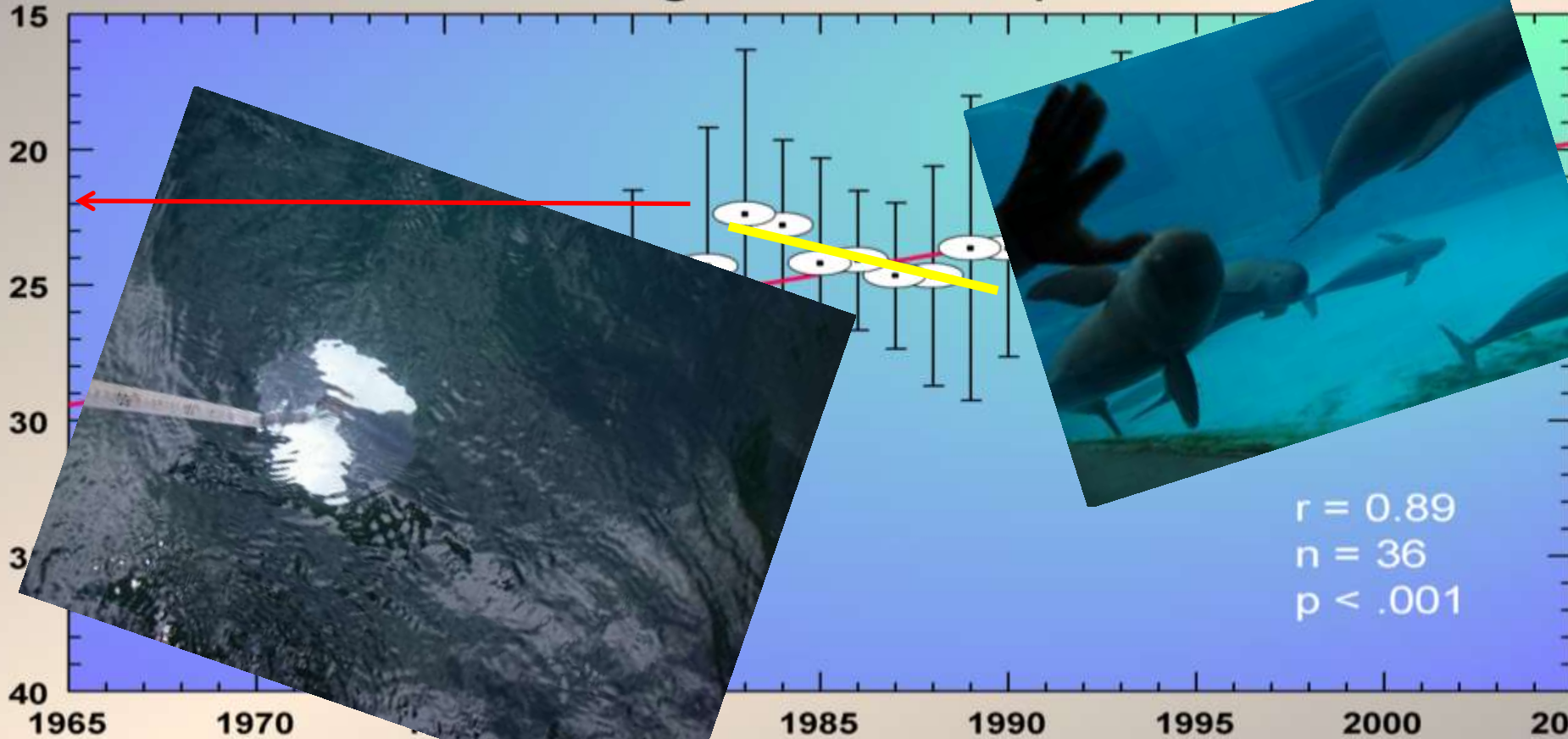
- 💧 Can we recover a eutrophic lake?
- 💧 What complicates the recovery?
- 💧 What tools do we have?
- 💧 Will we experience new challenges?
- 💧 Is it worth it?

The Tools



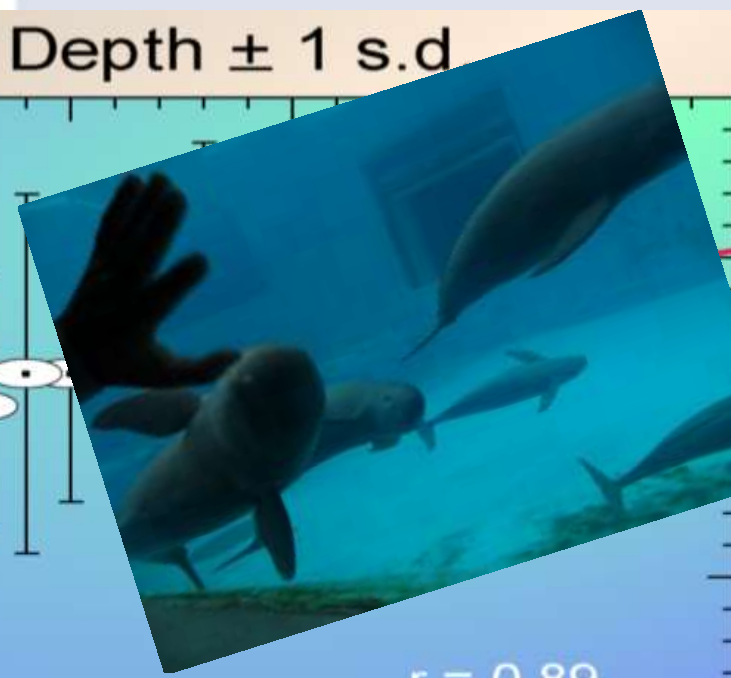
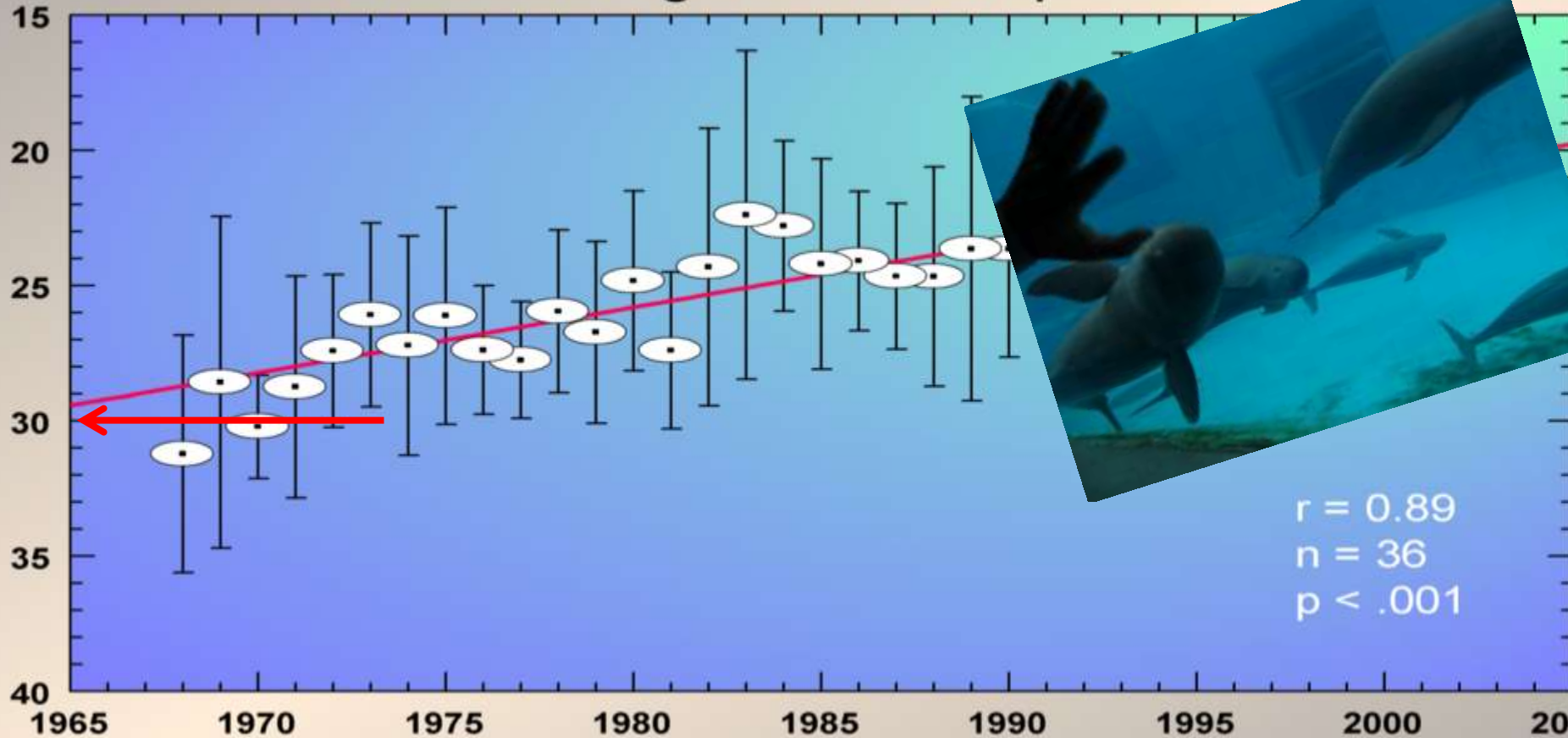
Monitoring: The value of long term records

Annual Average Secchi Depth \pm 1 s.d.



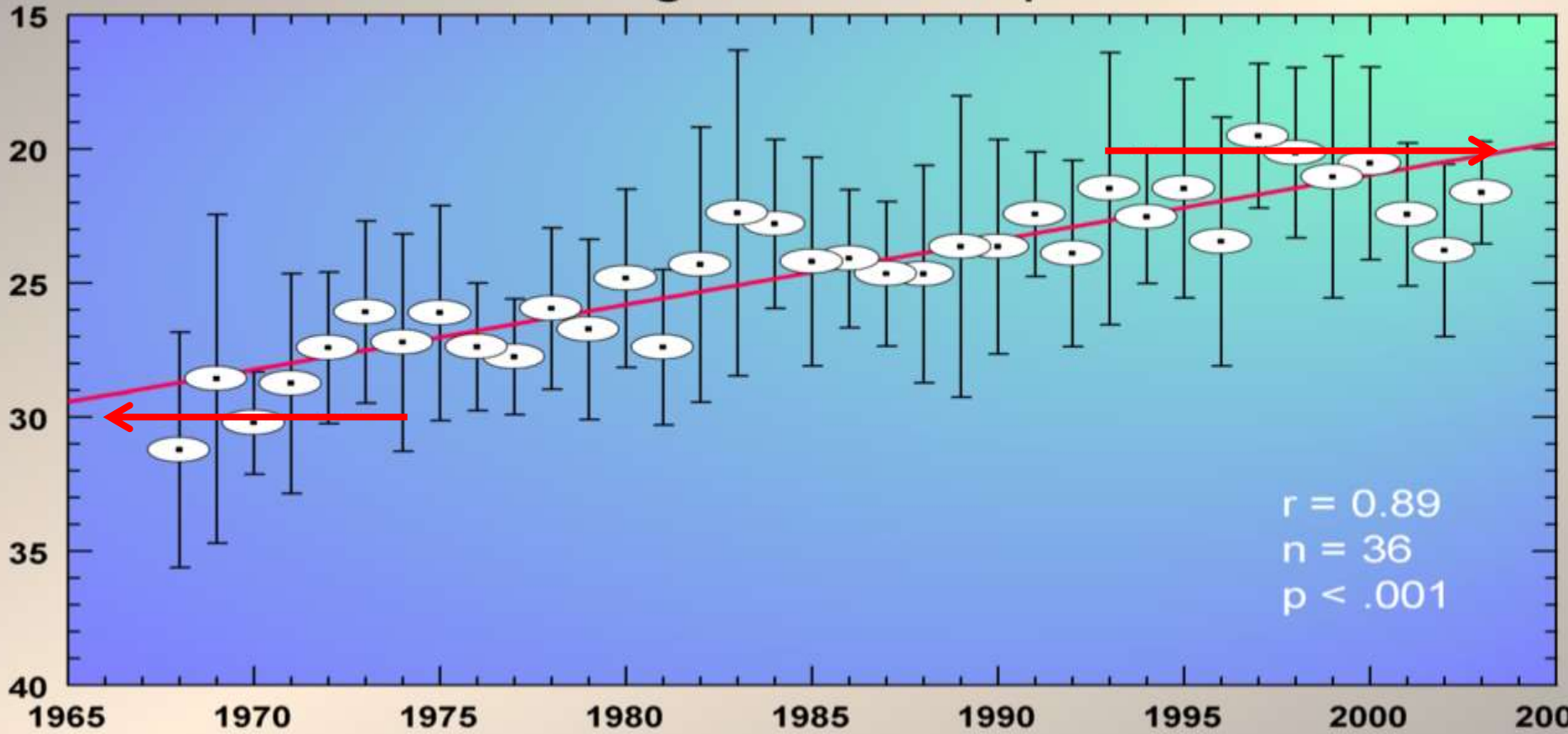
The value of long term records

Annual Average Secchi Depth \pm 1 s.d

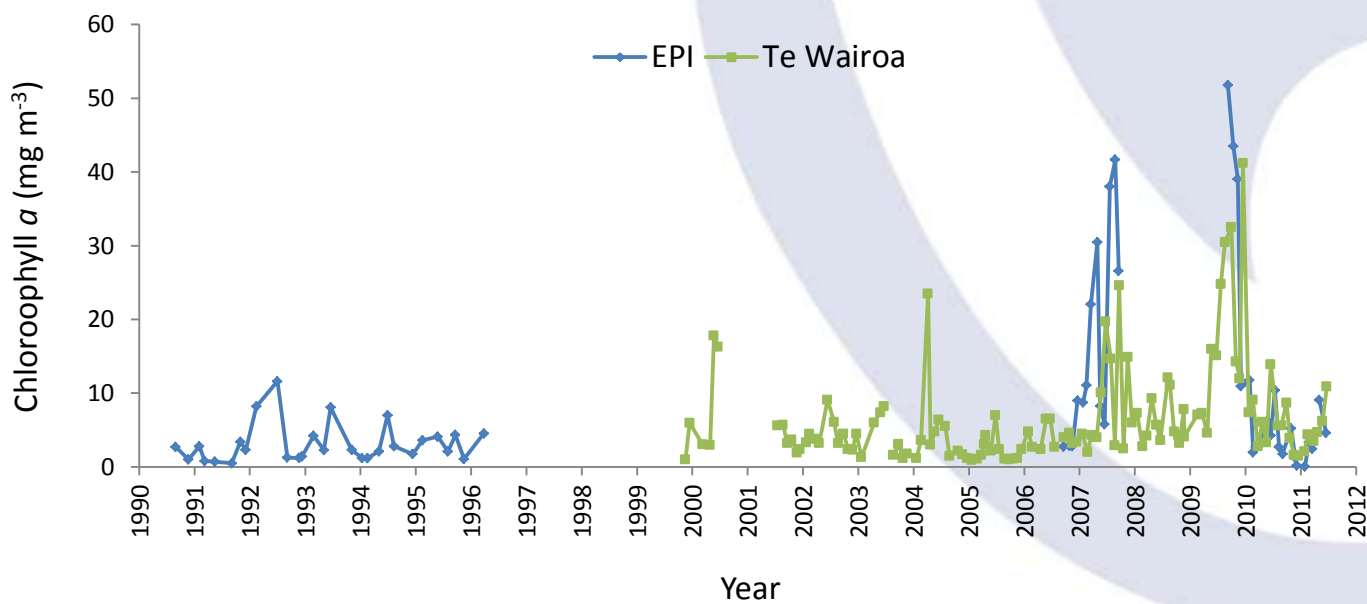
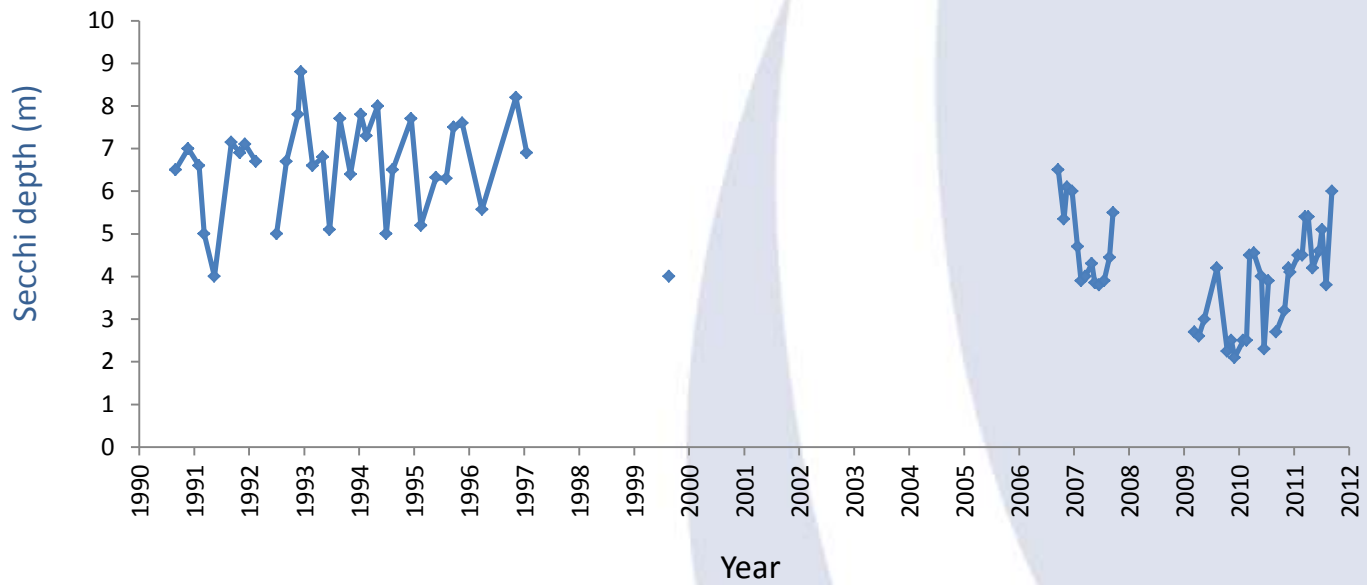


The value of long term records

Annual Average Secchi Depth \pm 1 s.d.







Hi frequency sampling

- climate and water quality 15 mins
- online web interface in real-time.

Meteorology: - wind speed/direction
- air temperature
- etc

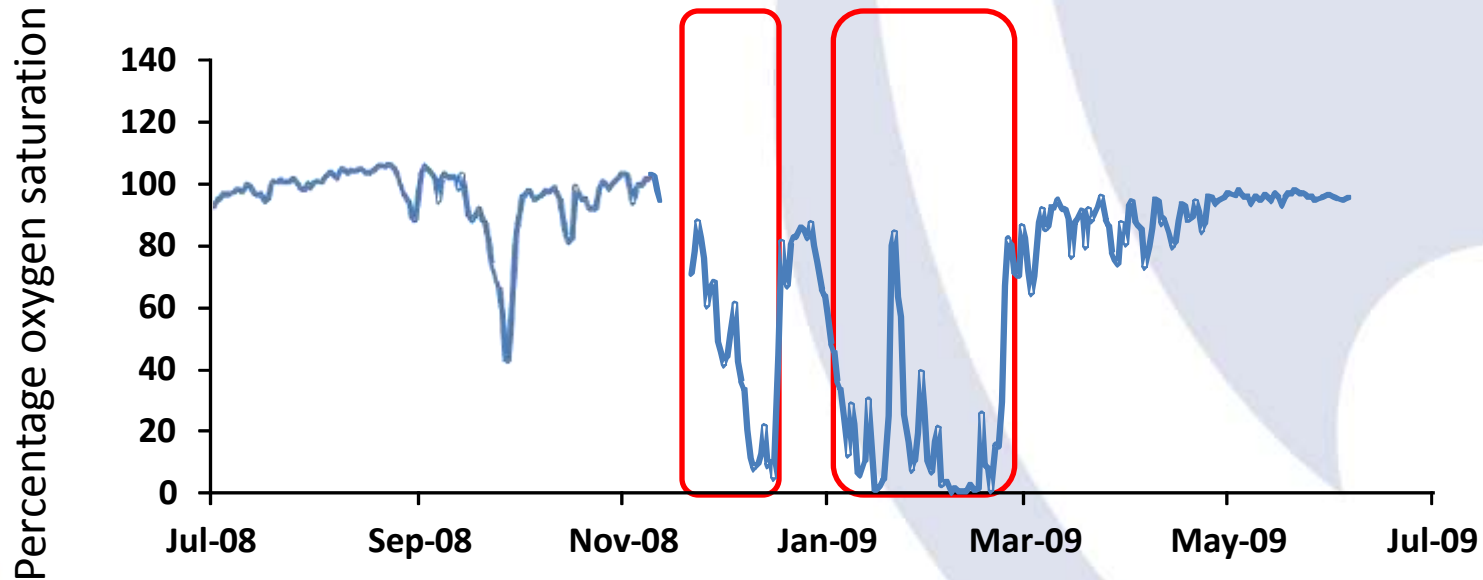
Water quality: - dissolved oxygen
- chlorophyll
- phycocyanin
- water temperature profile





High frequency monitoring buoys

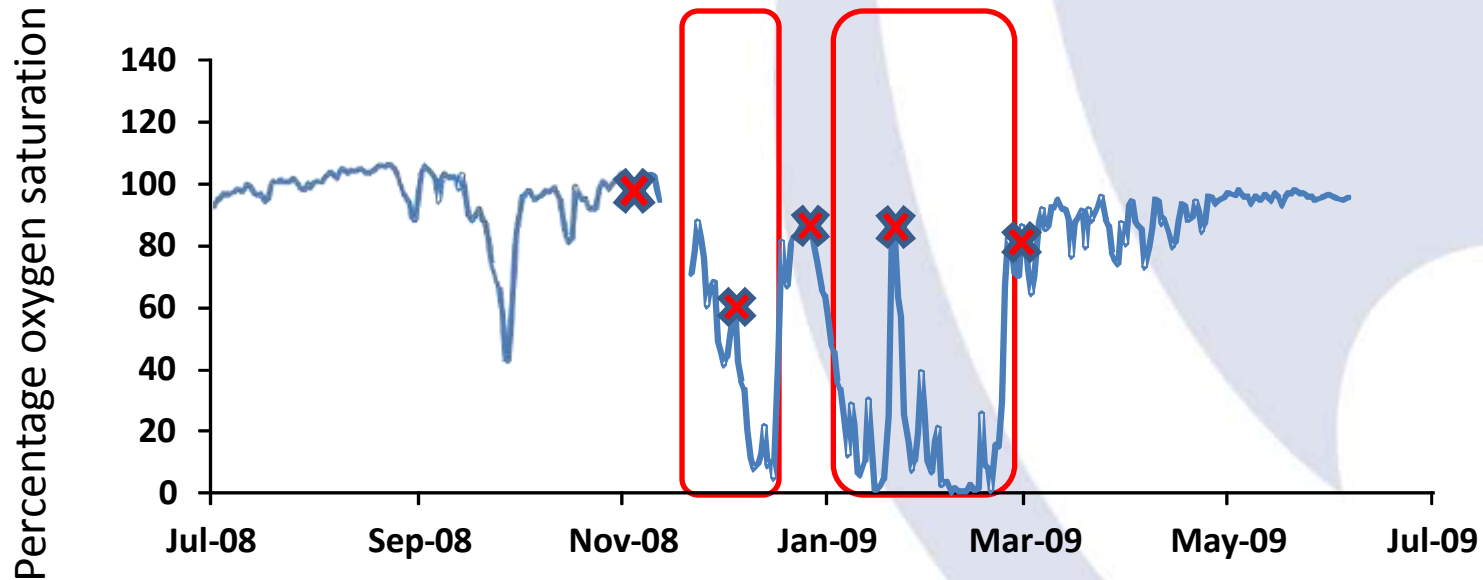
de-oxygenation of bottom waters





High frequency monitoring buoys

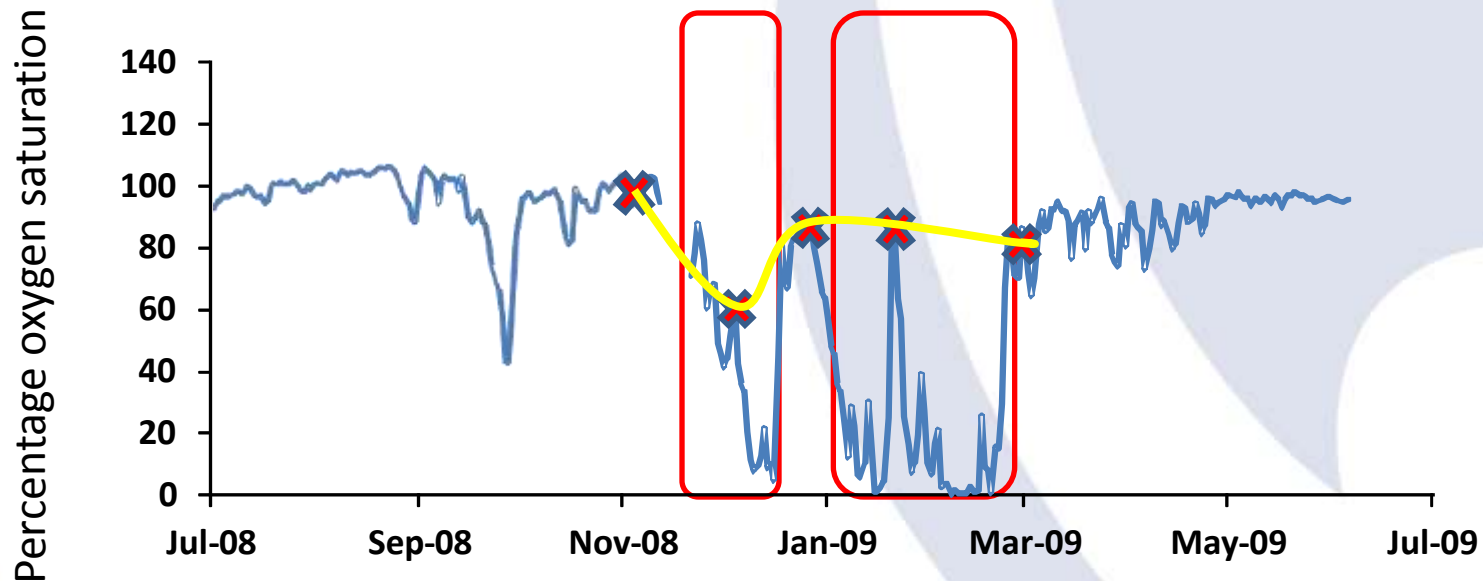
de-oxygenation of bottom waters



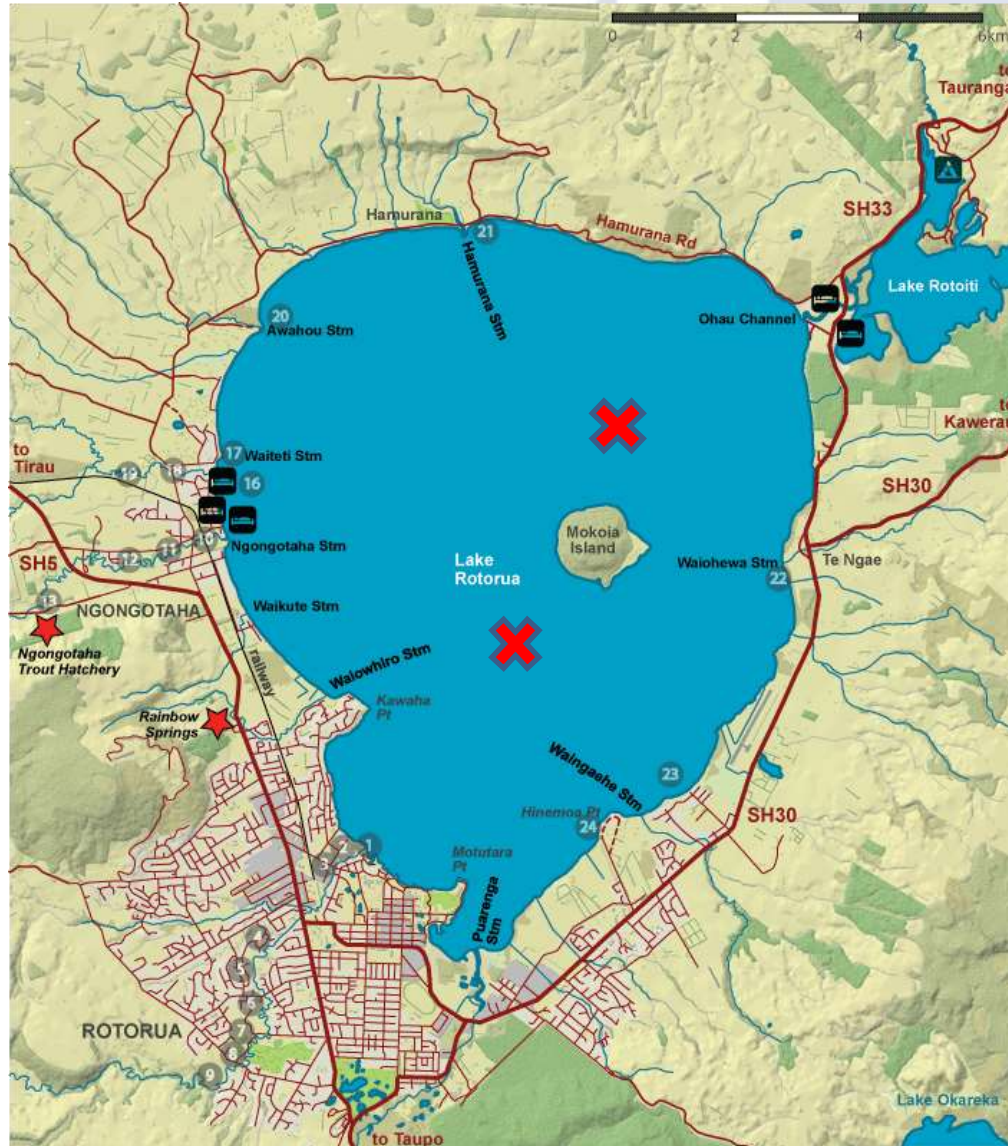


High frequency monitoring buoys

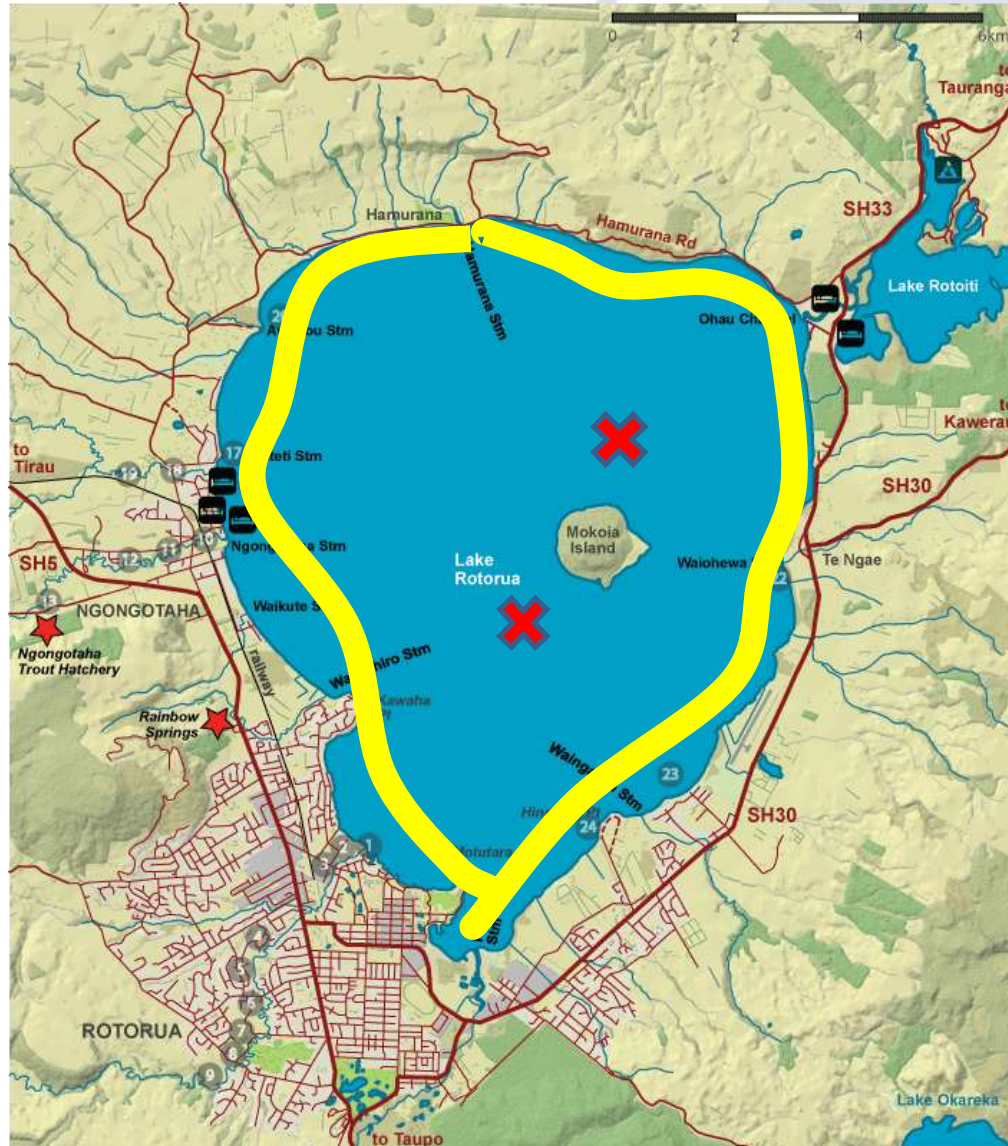
de-oxygenation of bottom waters



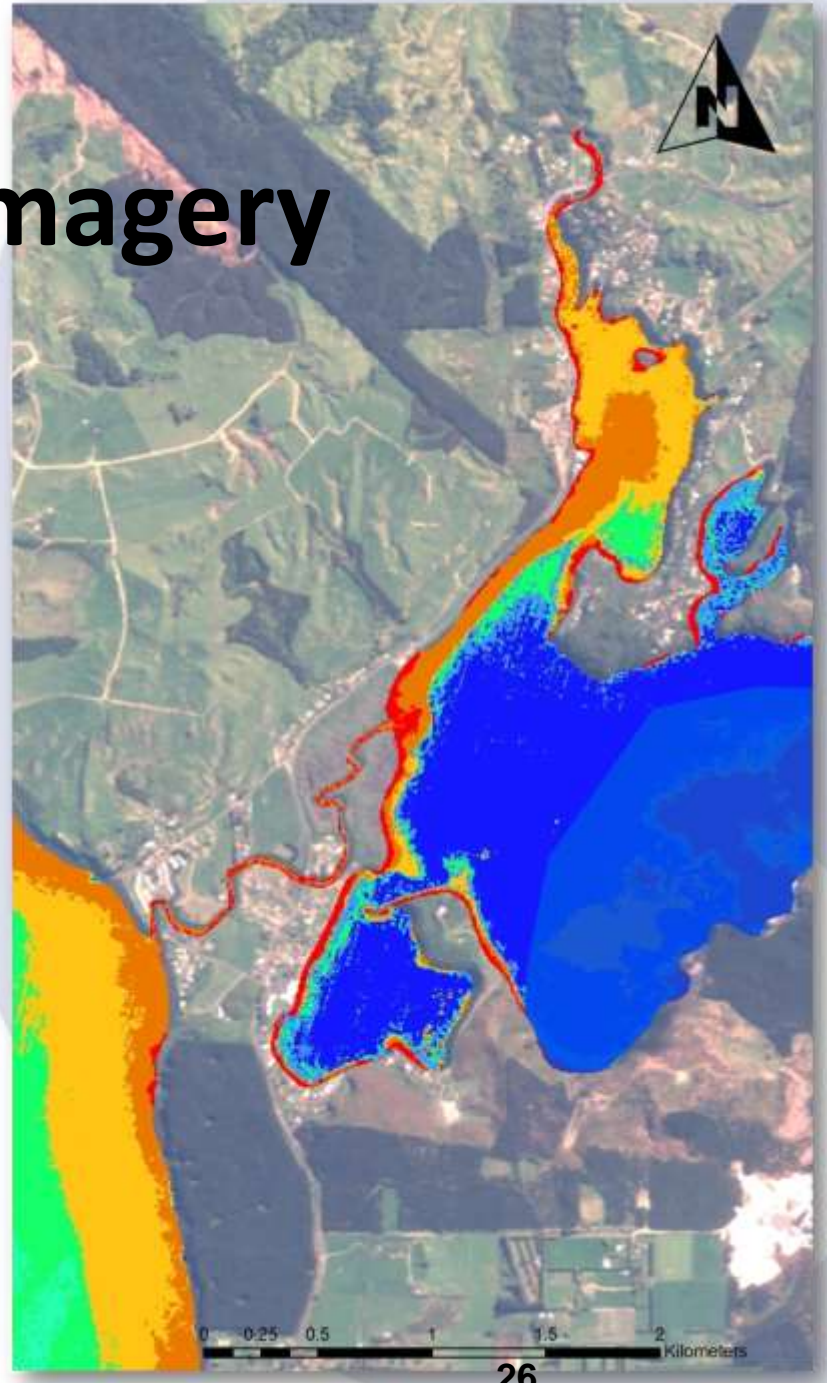
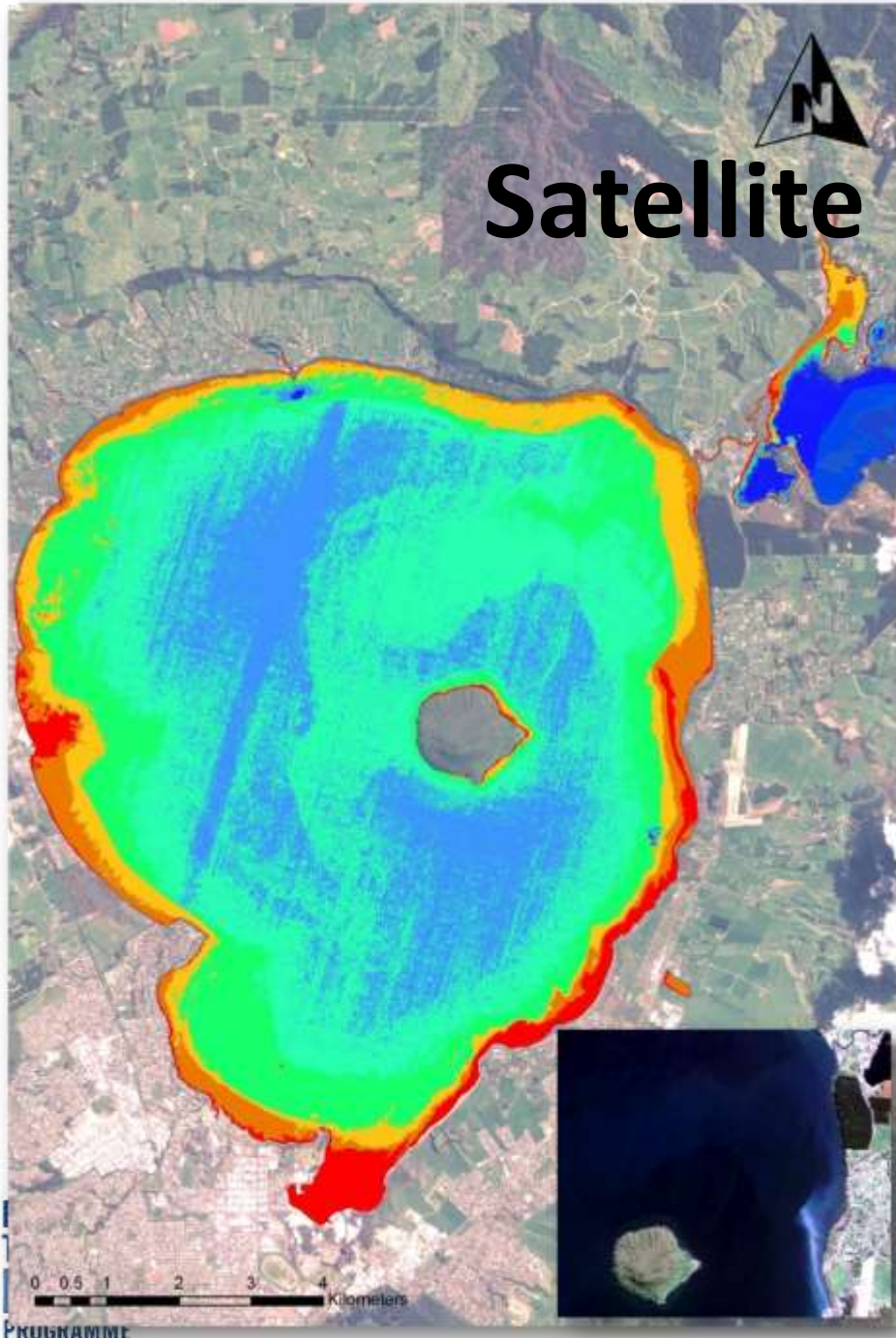
Spatial monitoring



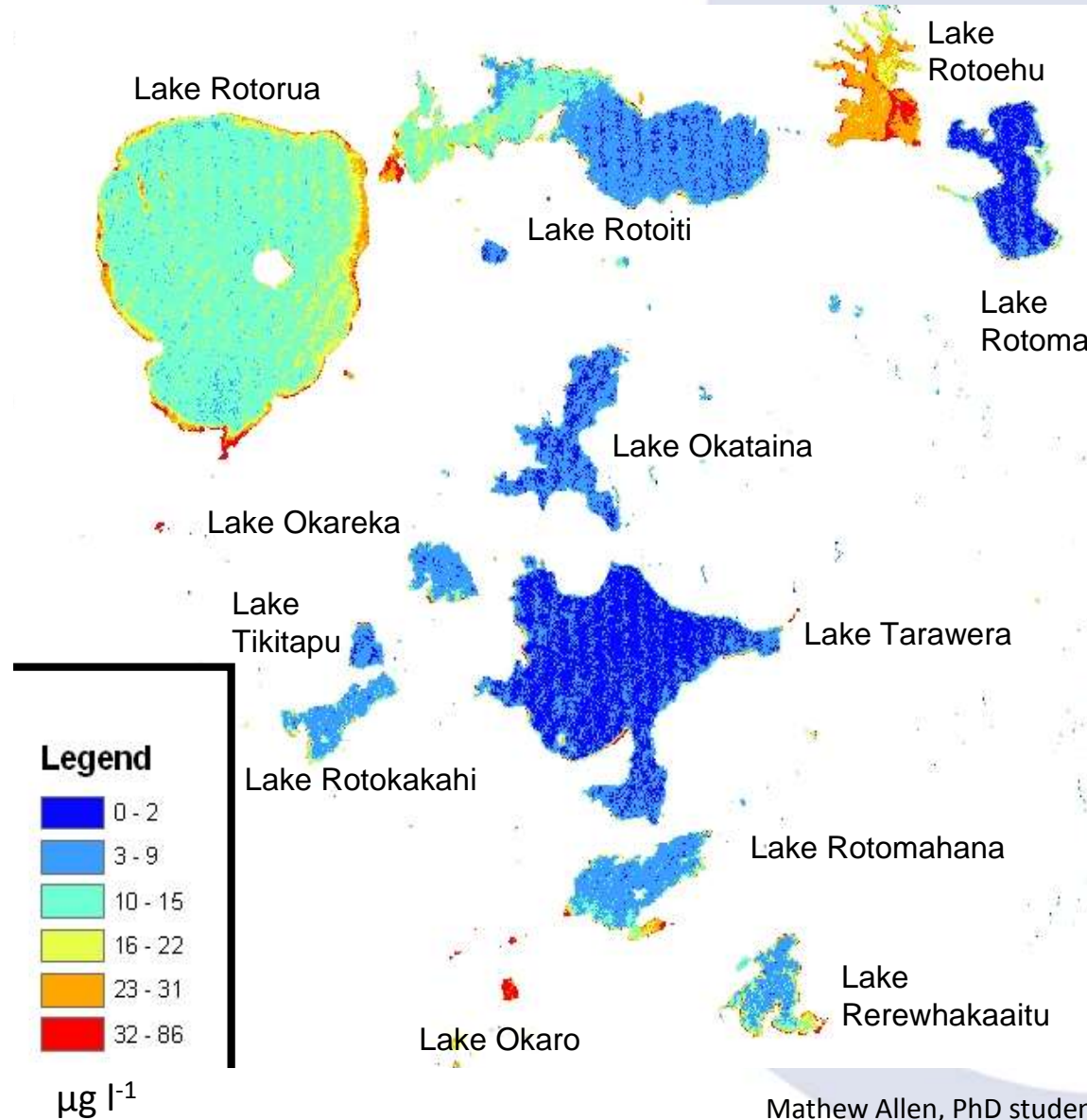
Spatial monitoring



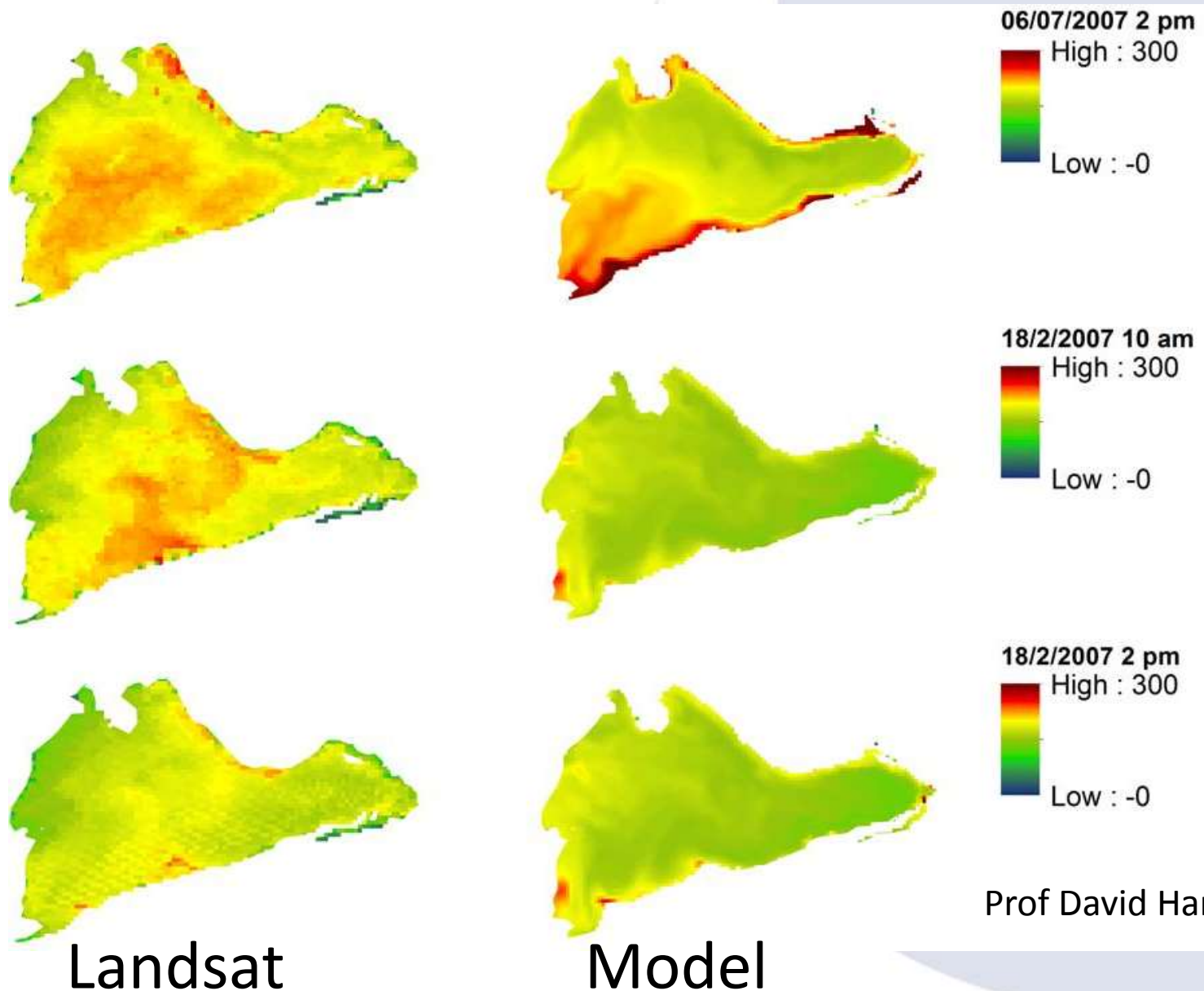
Satellite imagery



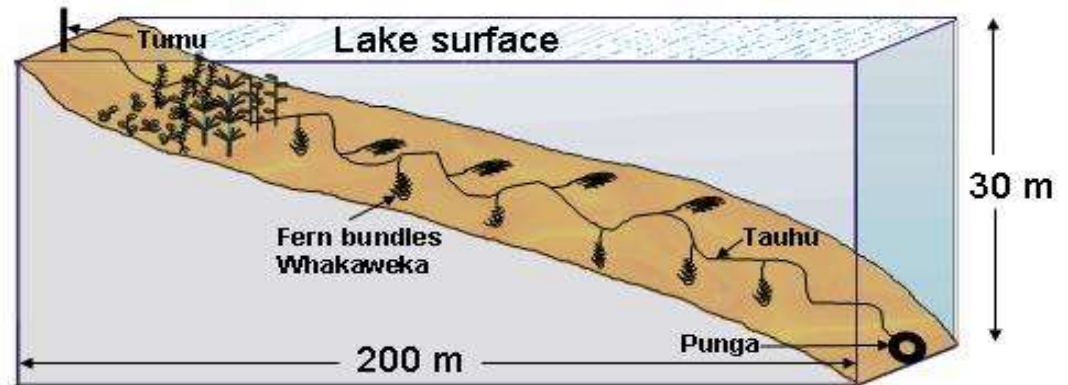
Remote sensing of chlorophyll across the volcanic plateau



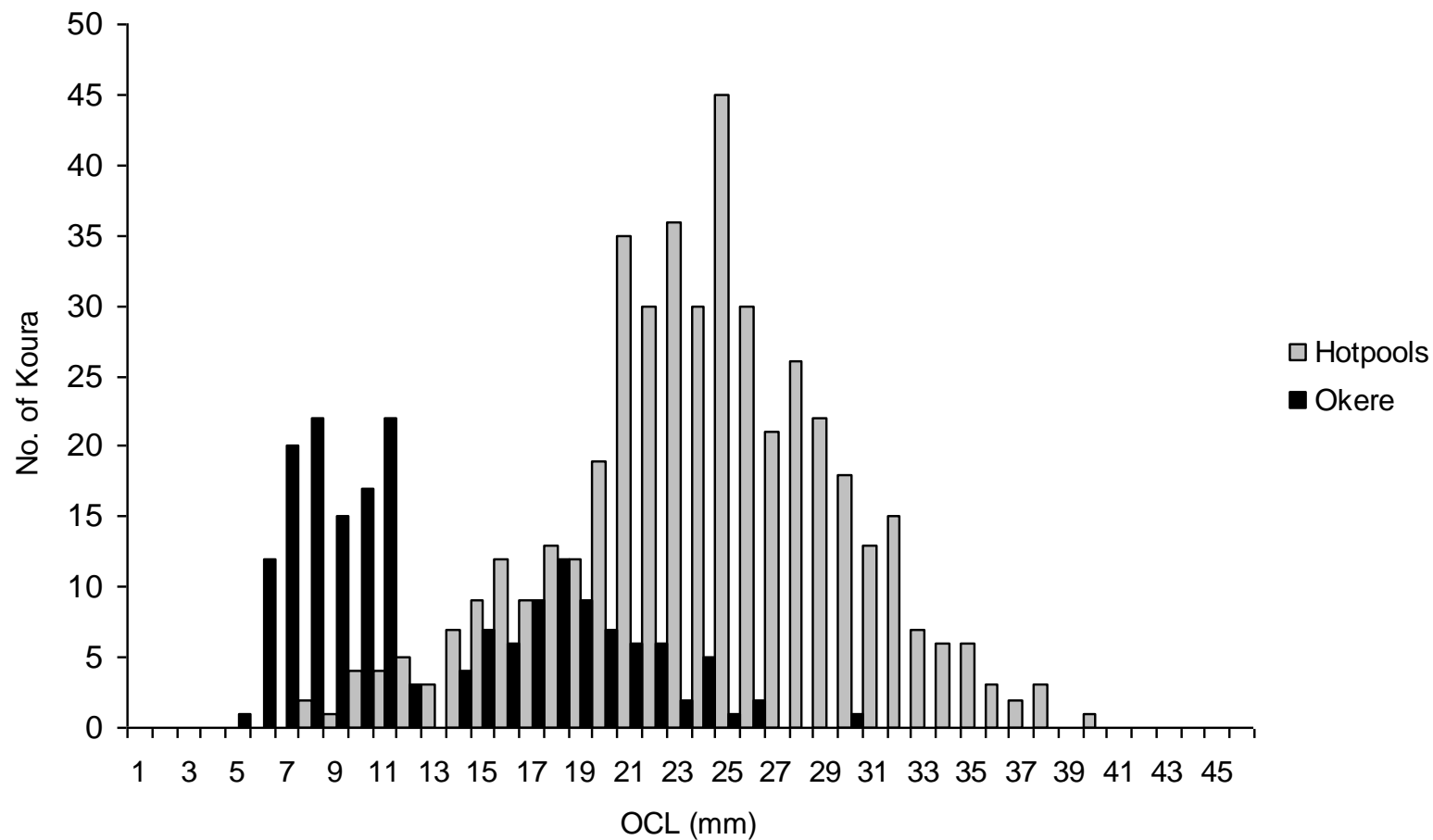
Suspended sediment concentrations (mg L^{-1})



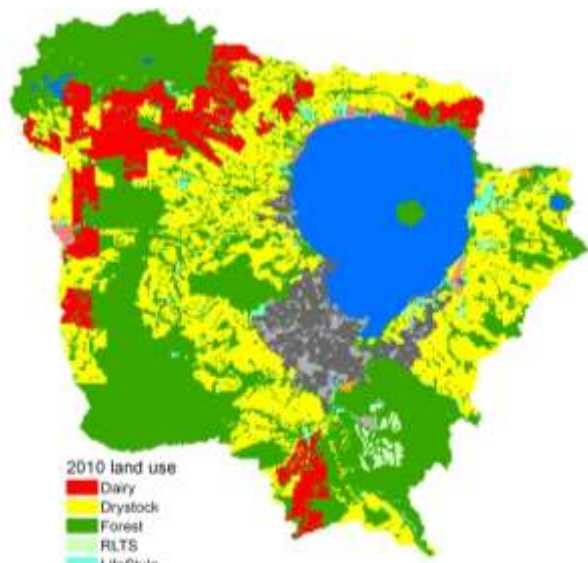
Traditional Māori fishing tools



Length frequency distribution of koura Te Akau & Okere, July 2010



Modelling approach



- 2010 land use
- Dairy
 - Drystock
 - Forest
 - RLTS
 - LifeStyle
 - Septic Tanks
 - Tikere
 - Urban
 - UOS
 - Water
 - Whaka

Land use

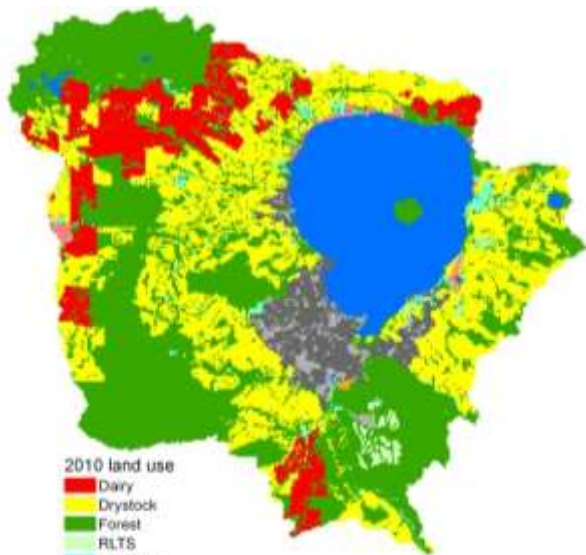
Proud Partners





1940 land use

- Dairy
- DryStock
- Forest
- SepticTanks
- Tikitere
- Water
- Whaka



2010 land use

- Dairy
- Drystock
- Forest
- RLTS
- LifeStyle
- SepticTanks
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Land use

Proud Partners

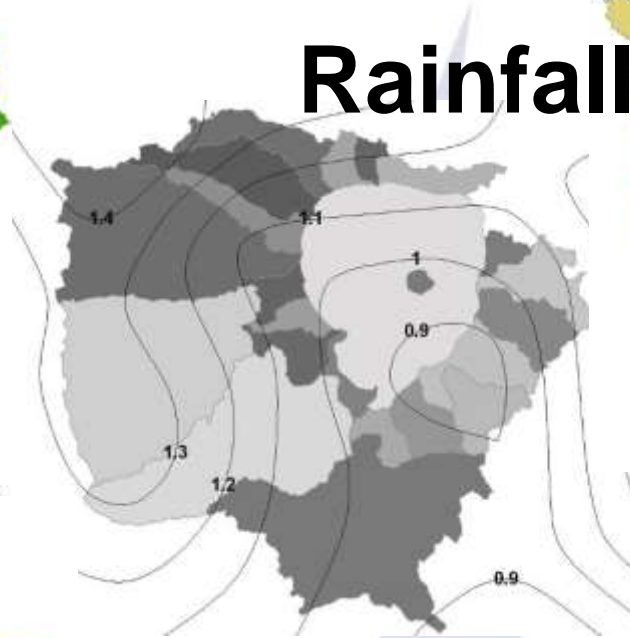


Catchments

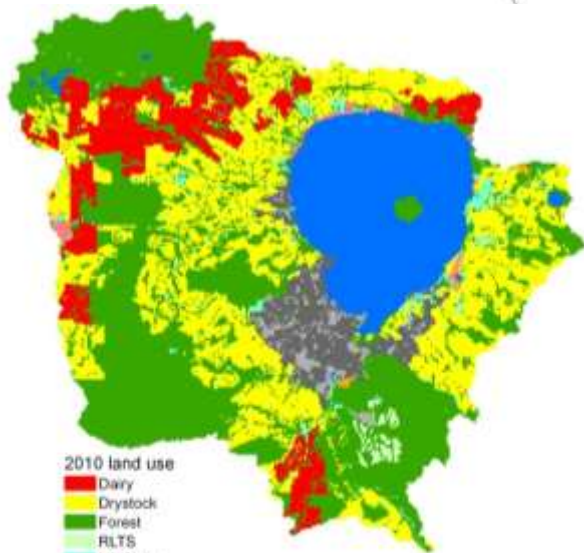
Rainfall



- 1940 land use
- Dairy
 - Dry Stock
 - Forest
 - Septic Tanks
 - Tikitere
 - Water
 - Whaka



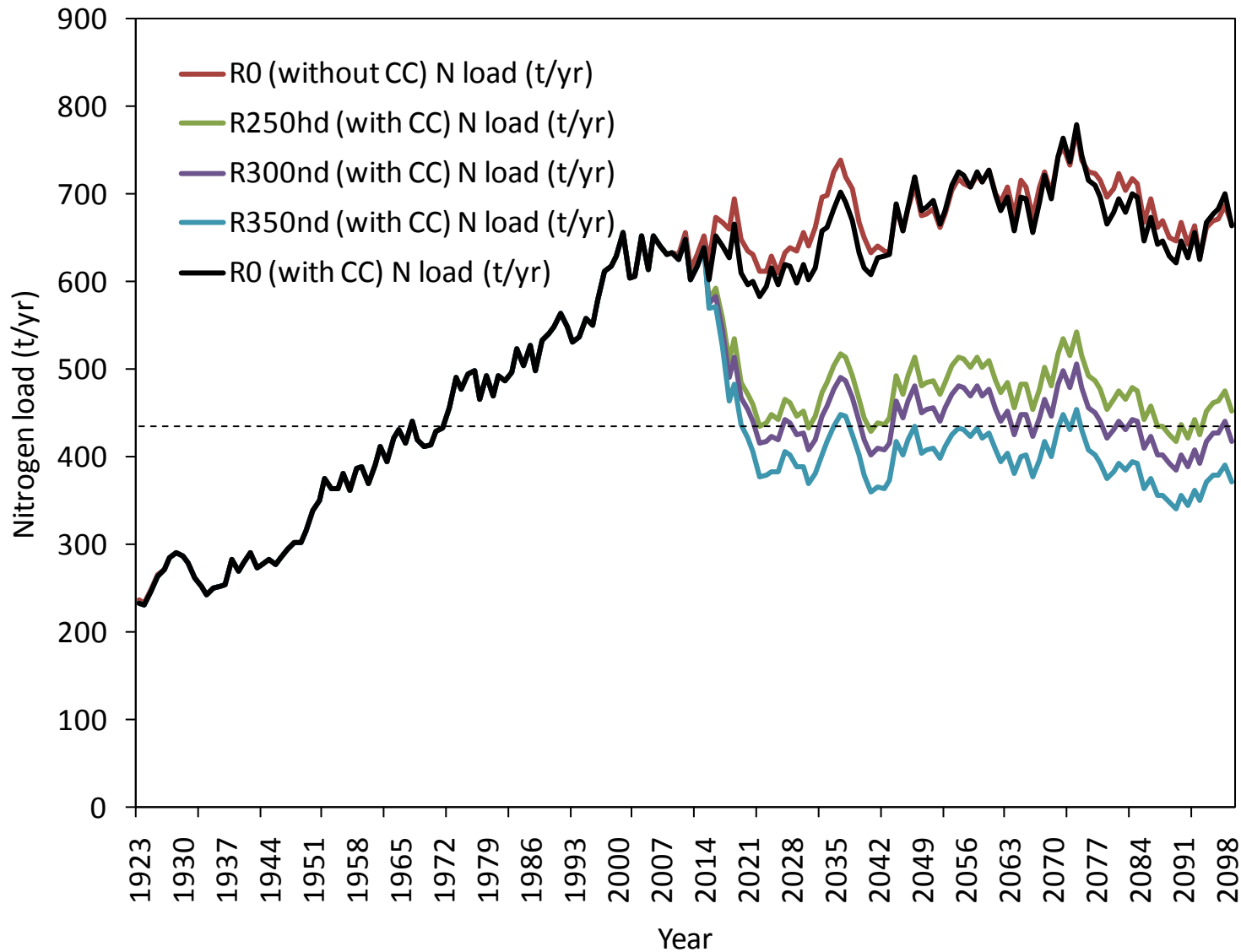
Aquifers



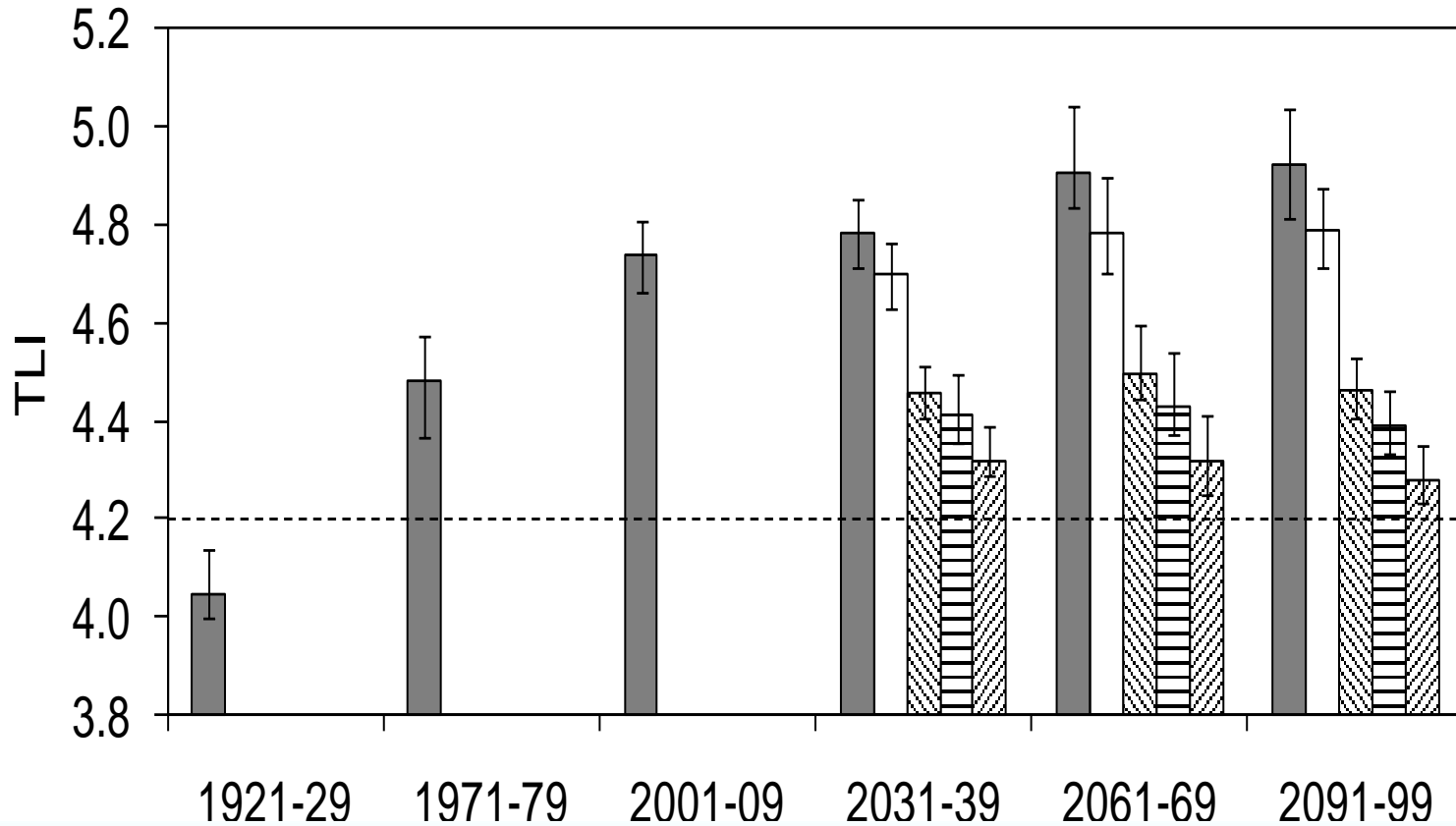
- 2010 land use
- Dairy
 - Dry Stock
 - Forest
 - RLTS
 - Life Style
 - Septic Tanks
 - Tikitere
 - Urban
 - UOS
 - Water
 - Whaka

Land use

Land use change scenarios

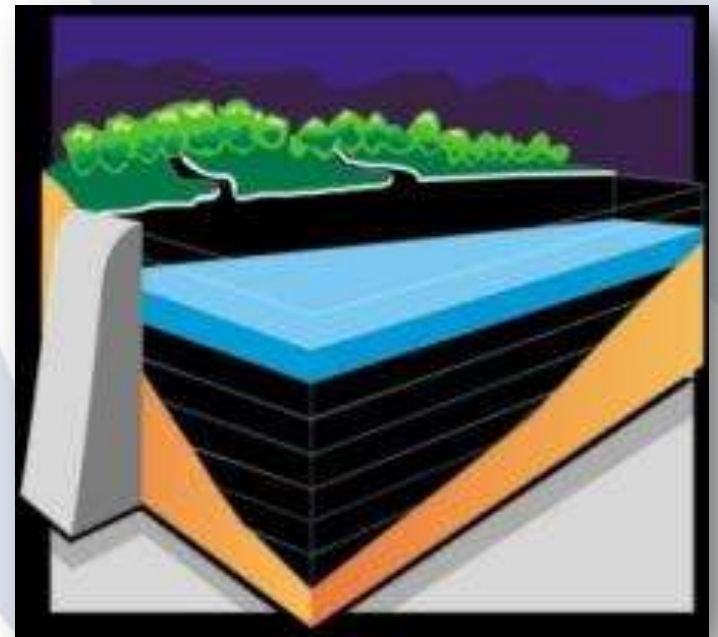


LAKE MODEL: Effects of land use change and inflow diversion

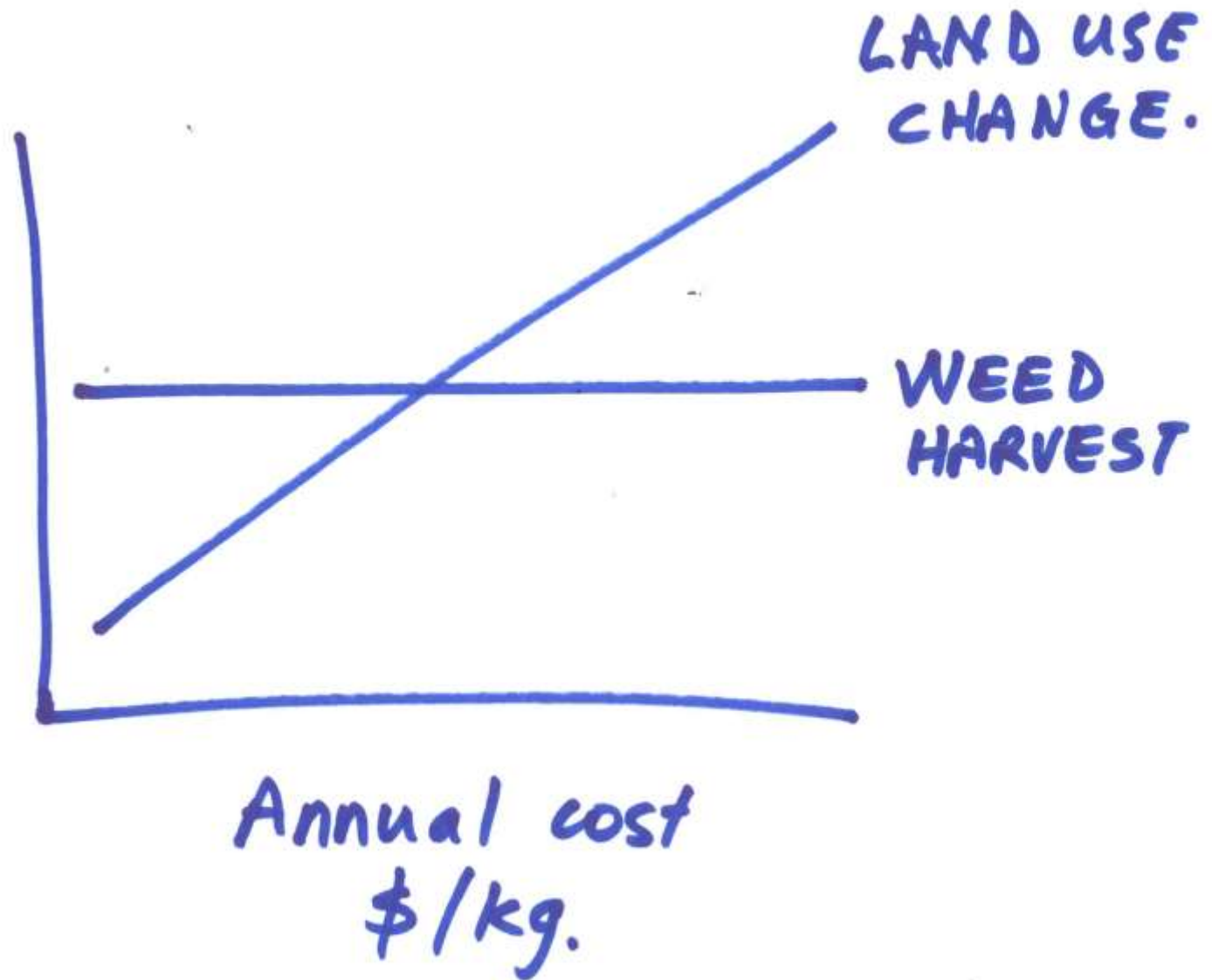




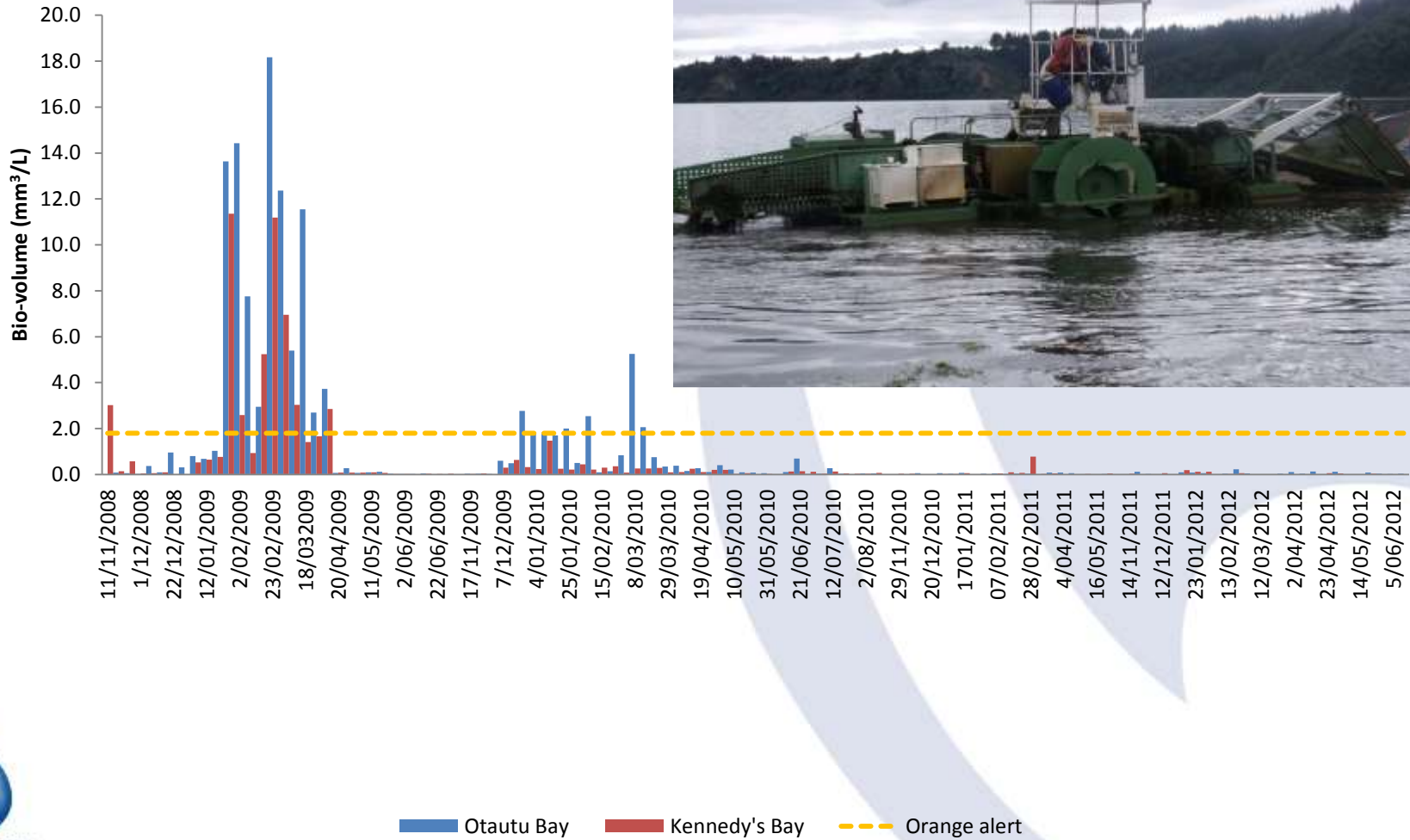
VS



Cost in
Perpetuity.
(\$M)



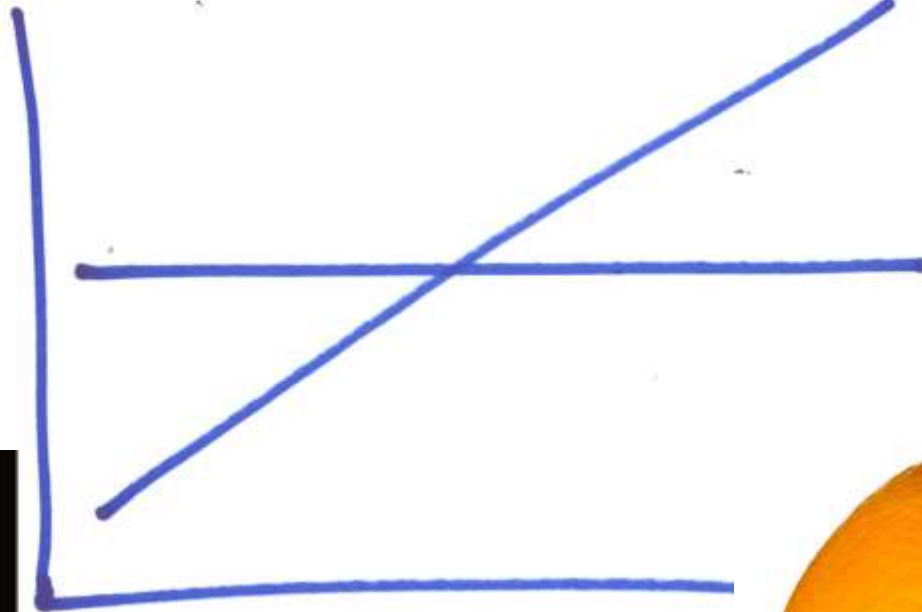
Cyano-bacteria



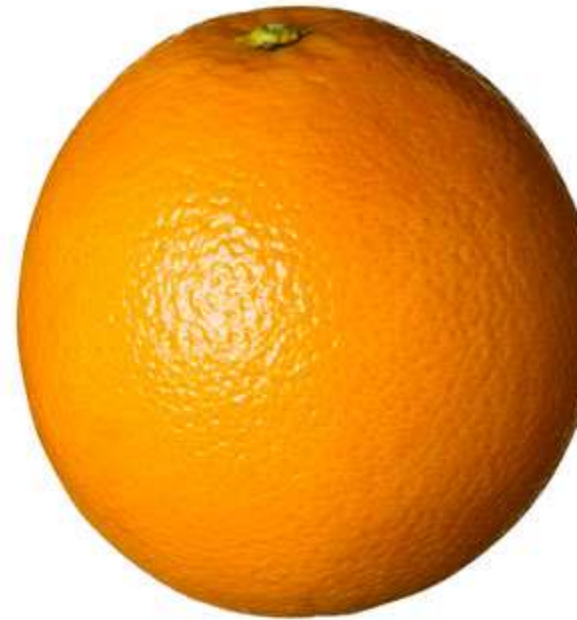
LAND USE CHANGE.

WEED HARVEST

Cost in Perpetuity. (\$M)



Annual cost \$/kg.

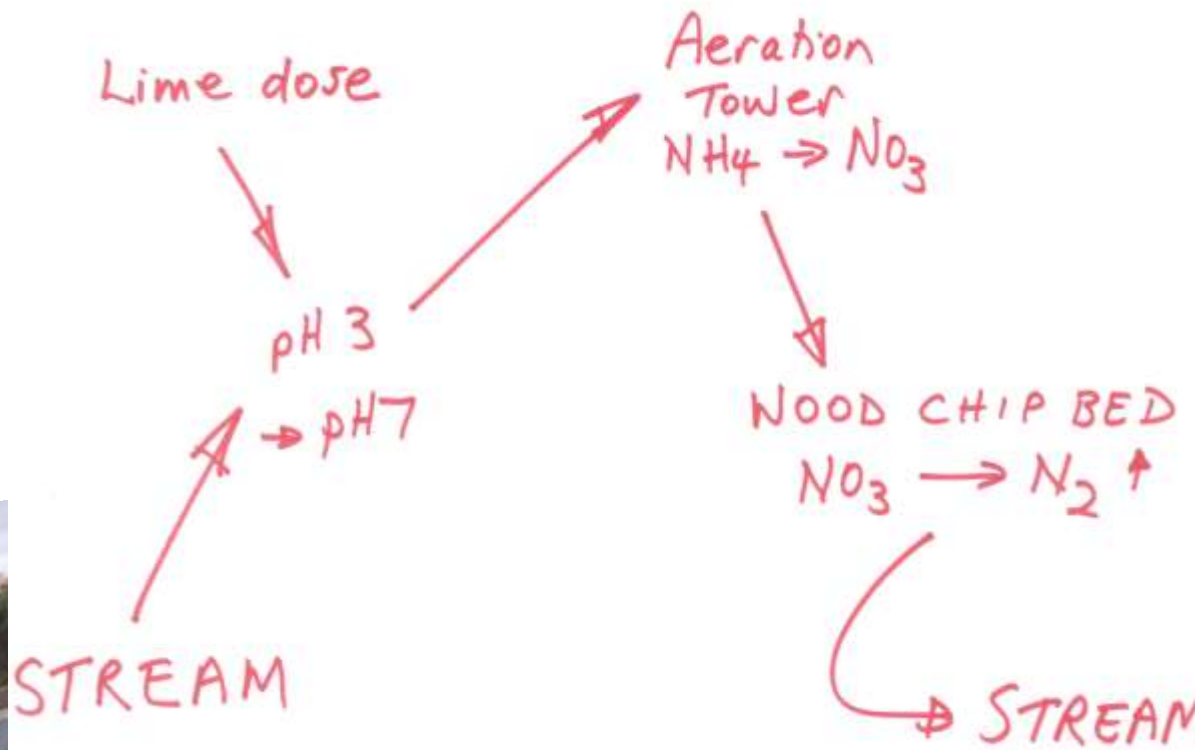


Restoration Tools



Projects

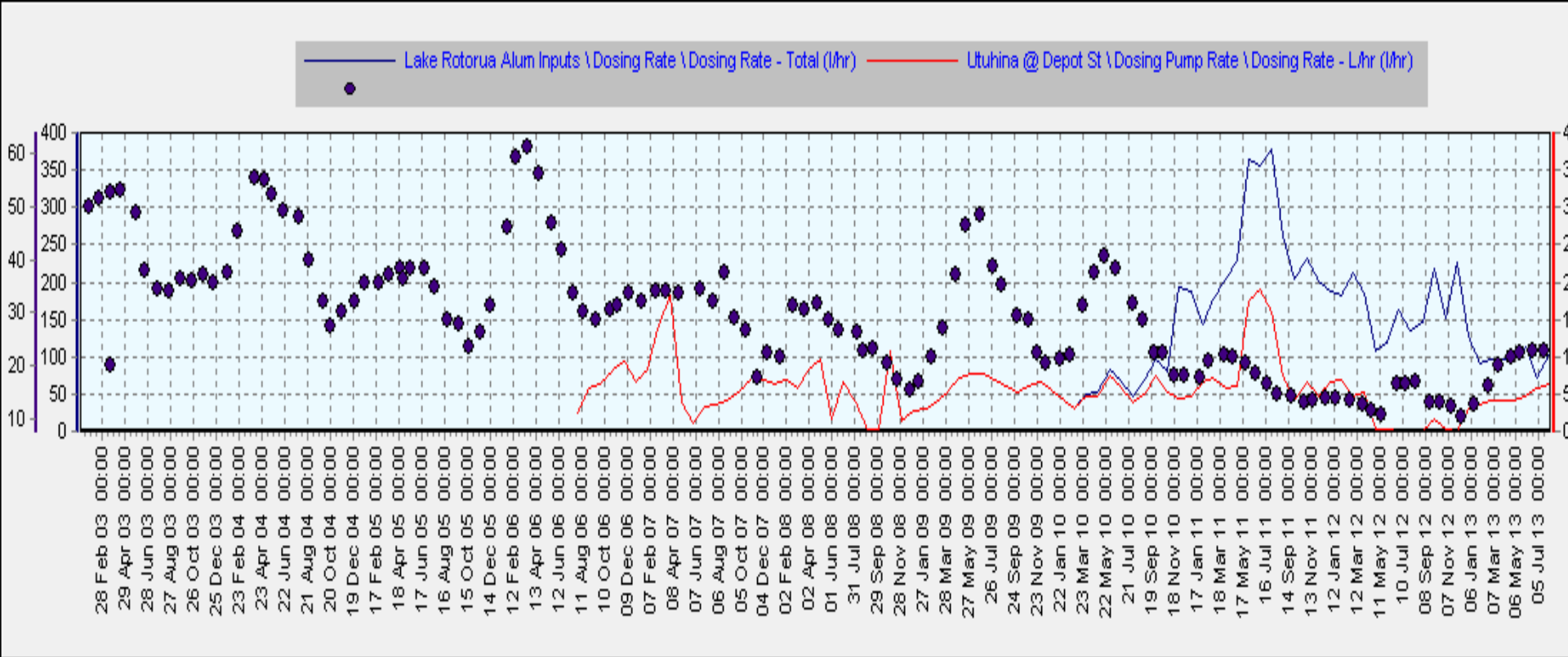
- 💧 Success is project and lake specific
- 💧 Some fail
- 💧 Some spectacular
- 💧 Not always WQ outcome





Alum dosing

Alum dosing





Rotorua City

Lake Rotorua

Makoia Is

Ohau Channel

5 m³s⁻¹

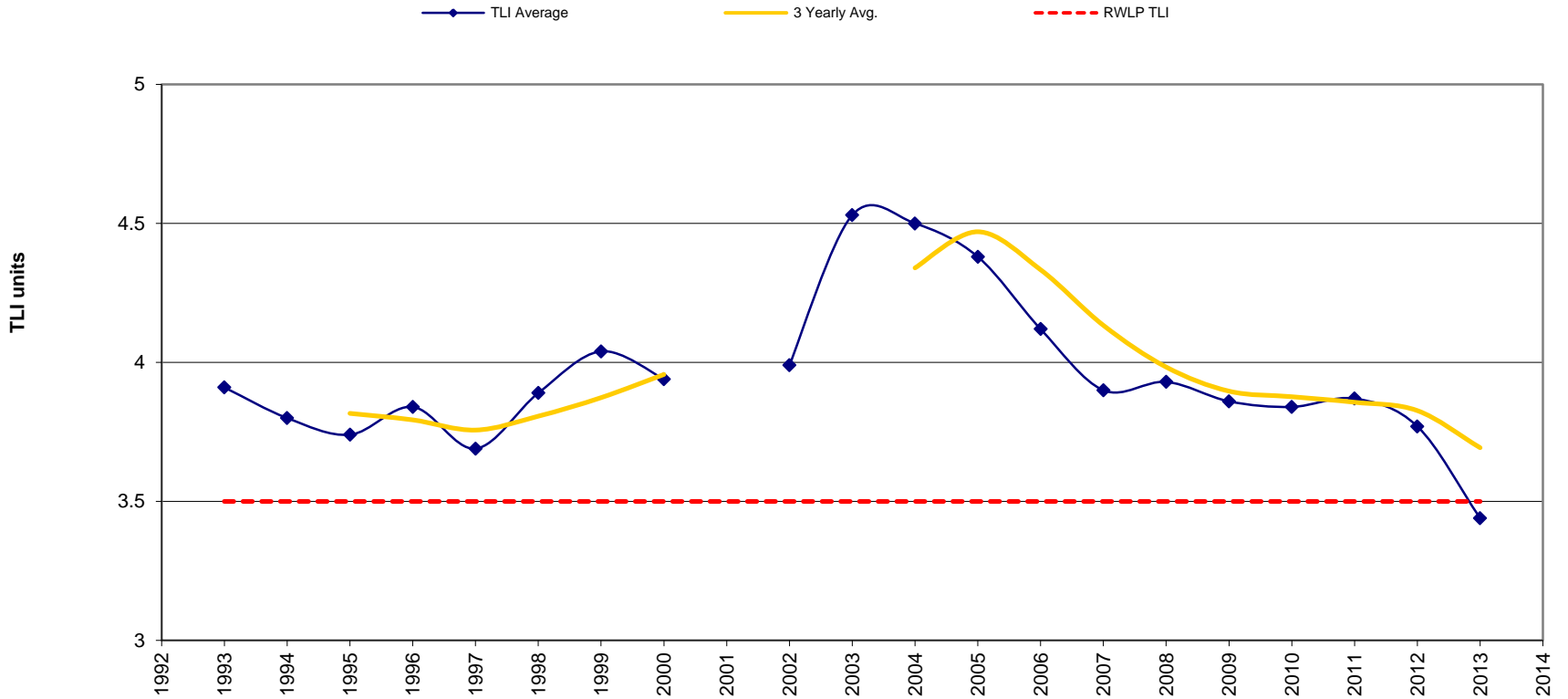
16 m³s⁻¹

21 m³s⁻¹

Lake Rotoiti

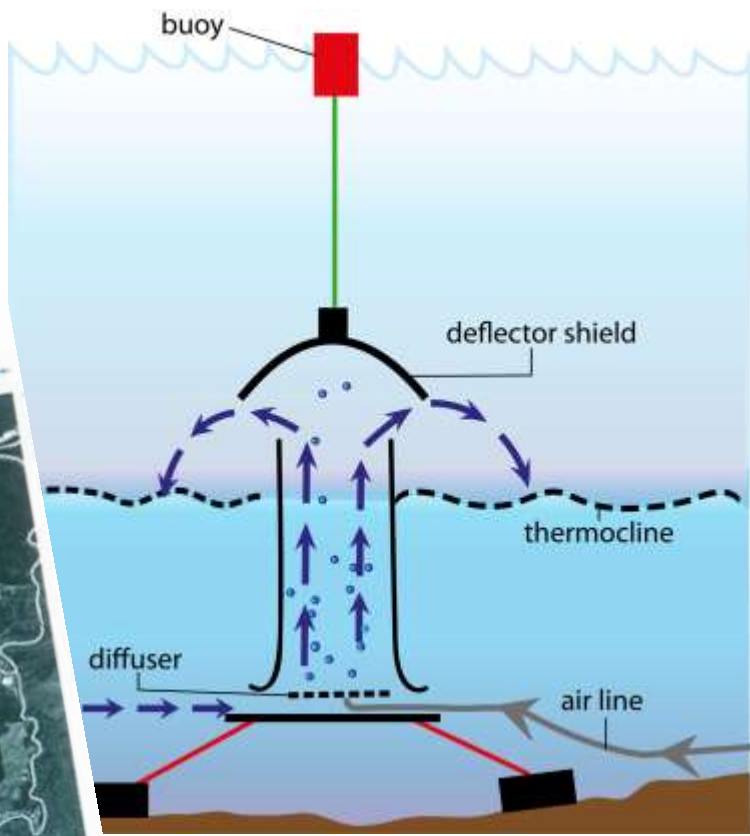
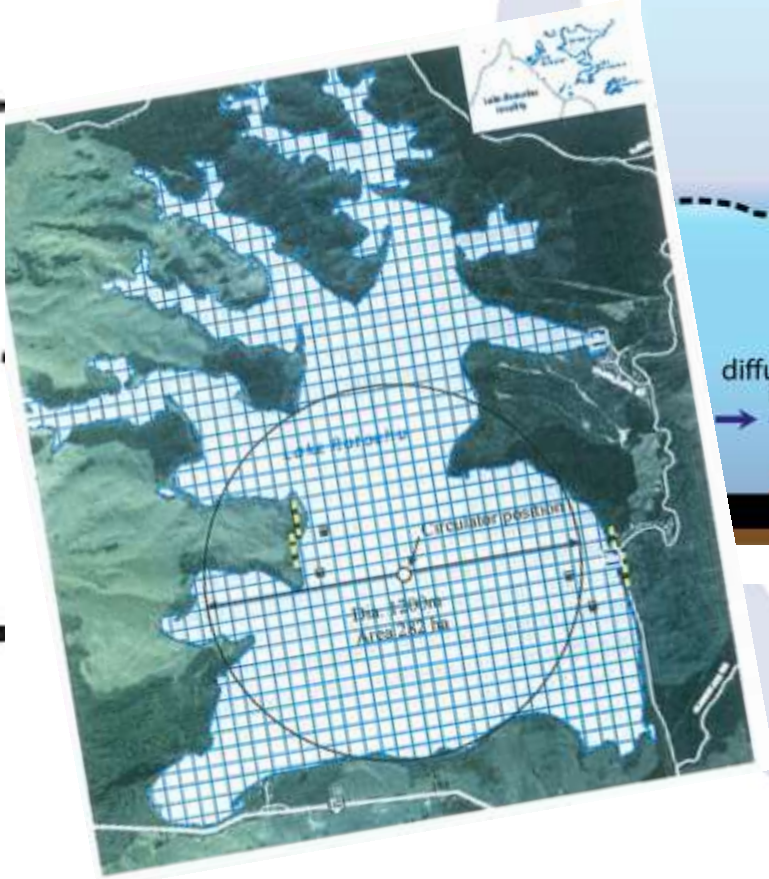
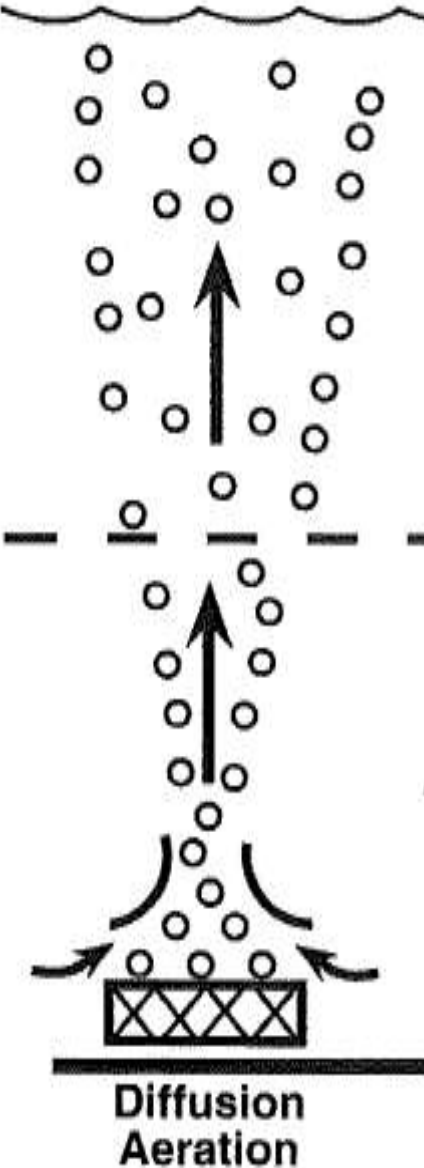
Rotoiti

Lake Rotoiti





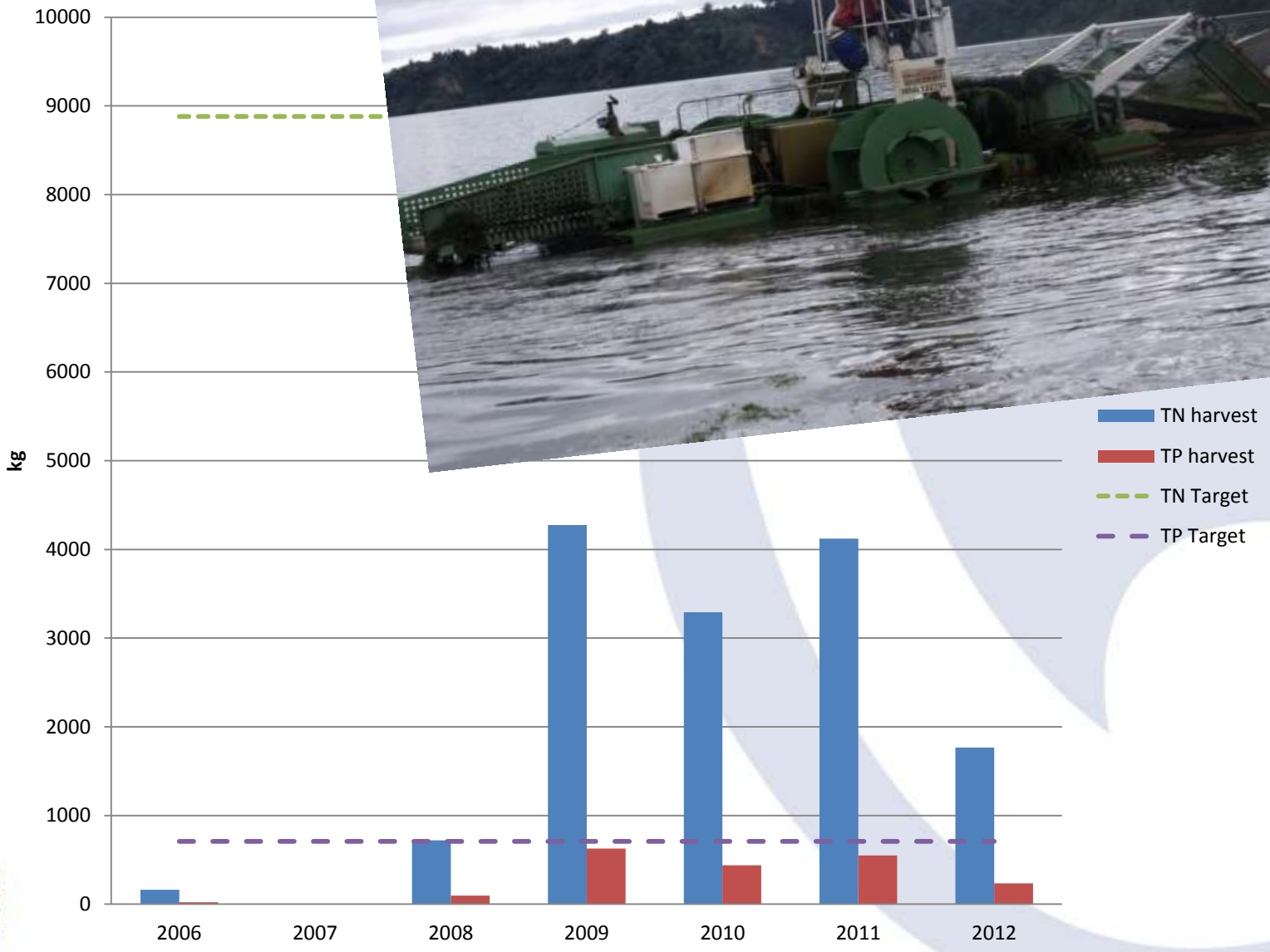
De-stratification



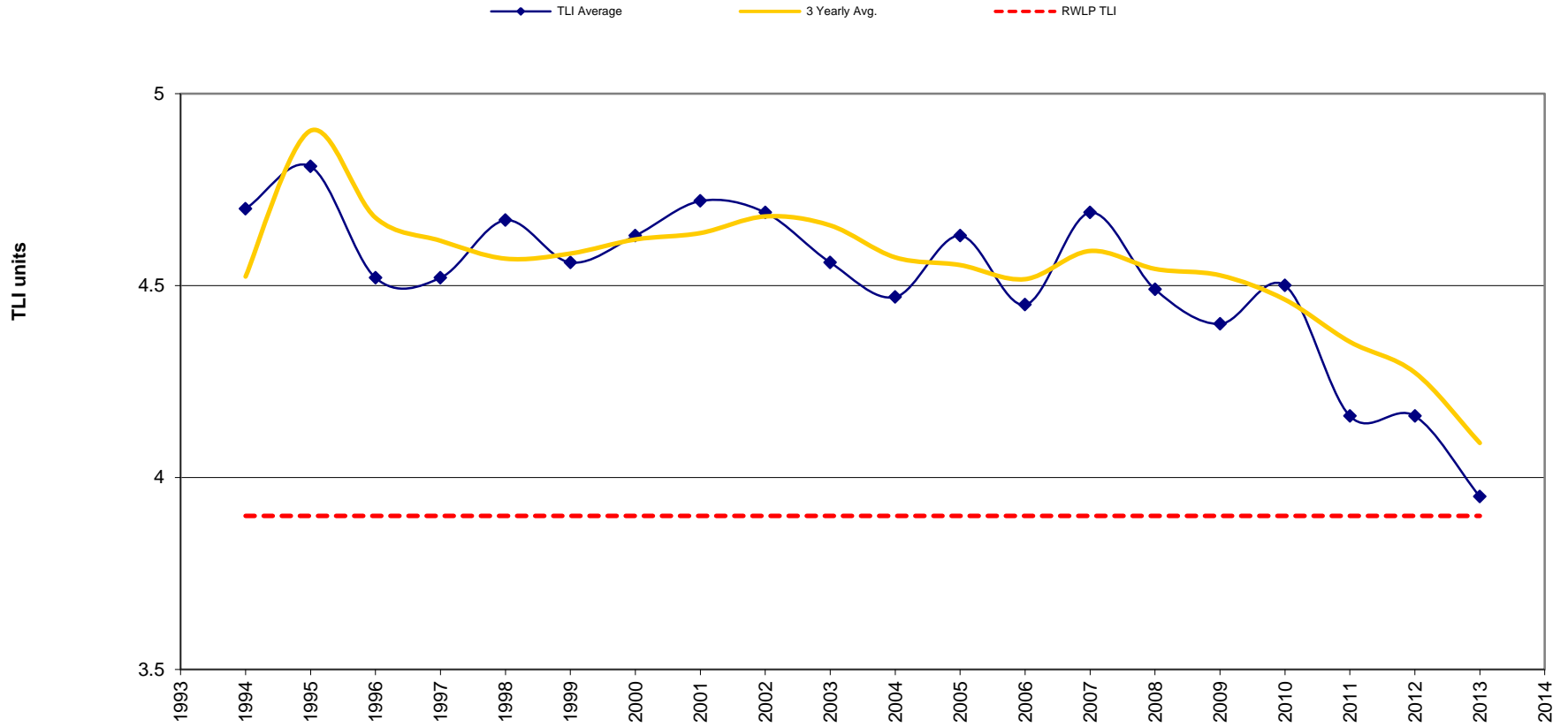


Bio treatment?





Lake Rotoehu

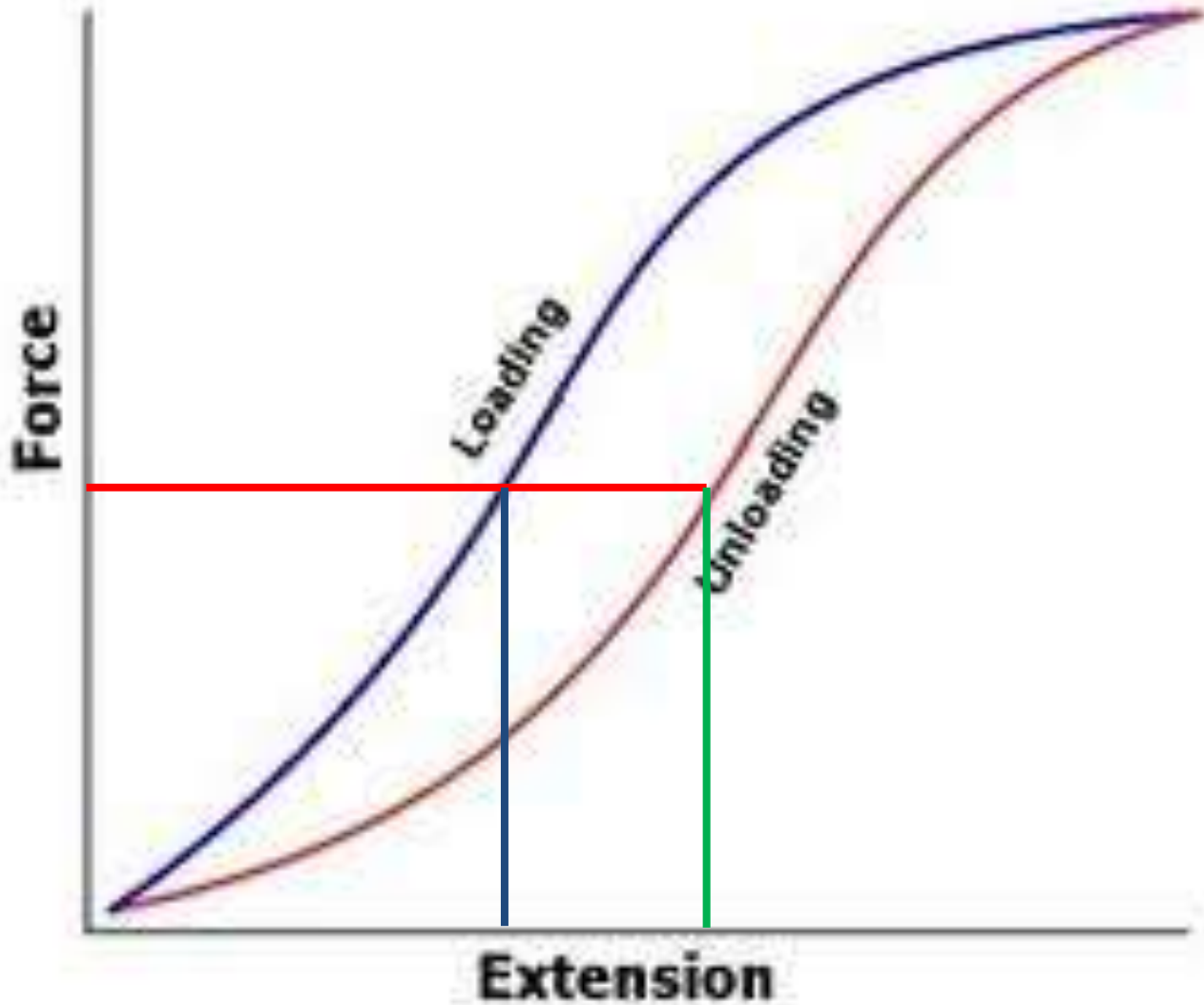


A Trout Barrier

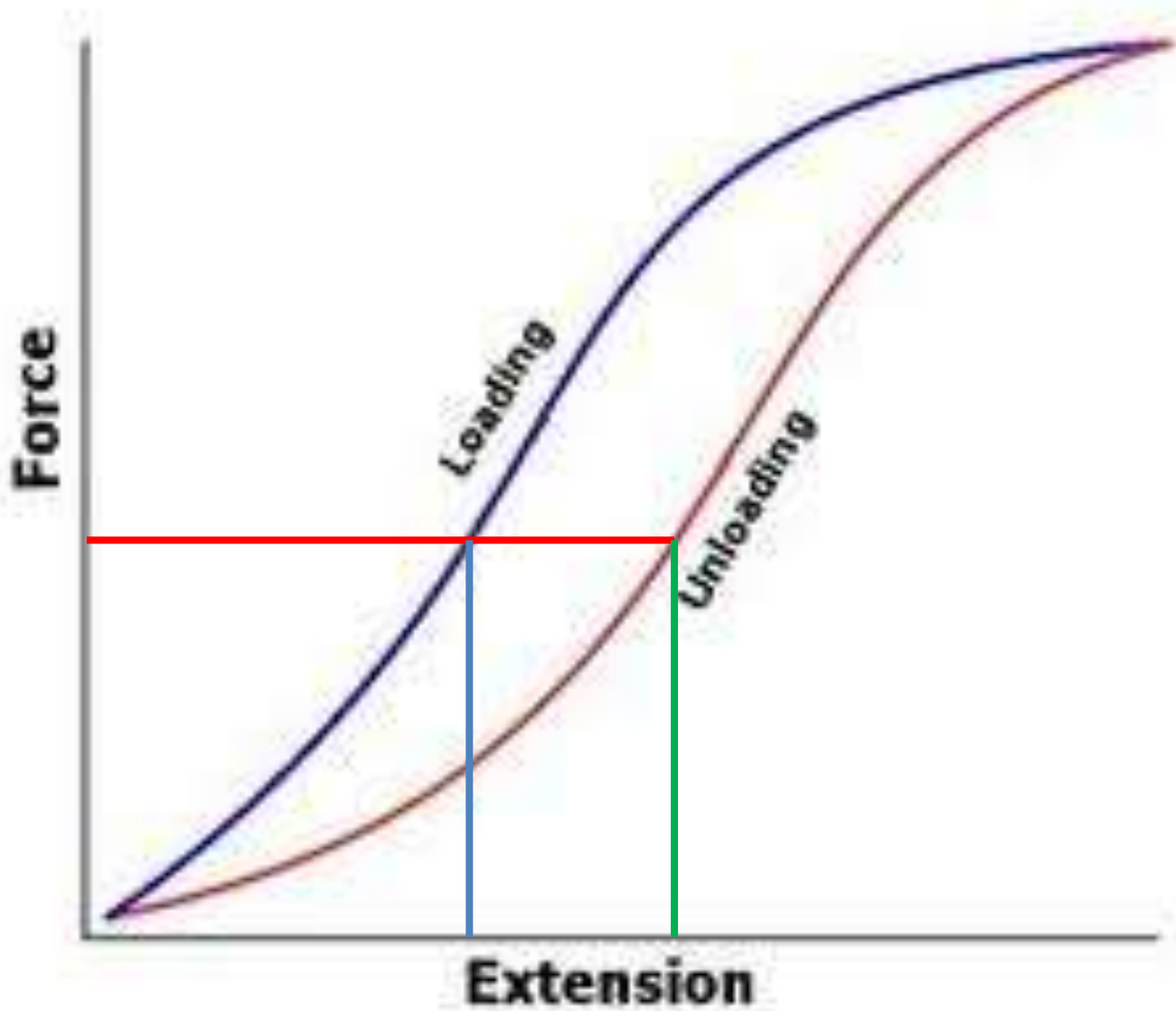


- 💧 Zeolite absorption
- 💧 Aqual P
- 💧 Ōkaro pH buoy
- 💧 Sewage
- 💧 Phosphorus detention ponds
- 💧 Land based wetlands

Reversing Eutrophication: Hysteresis

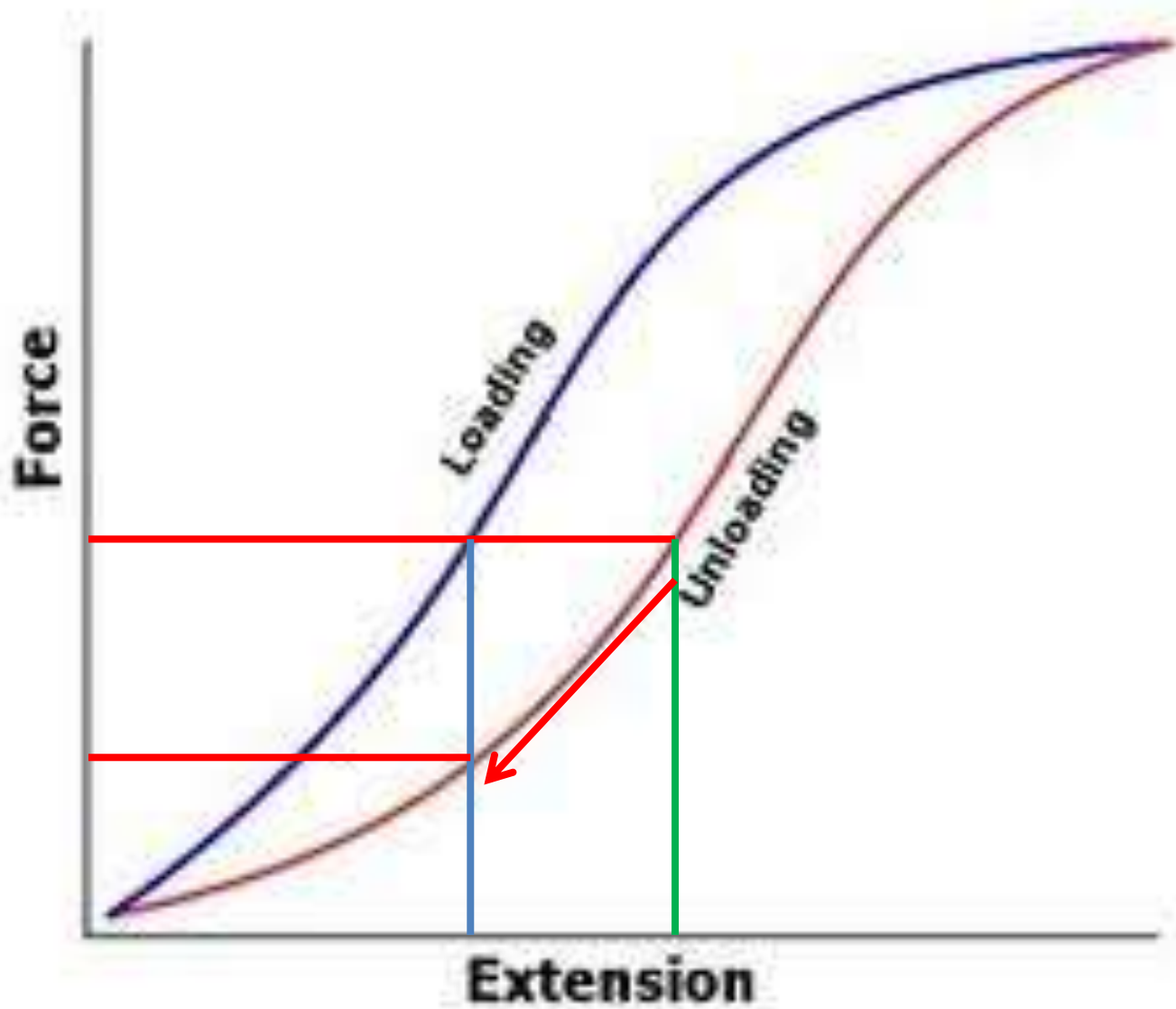


Phosphorus



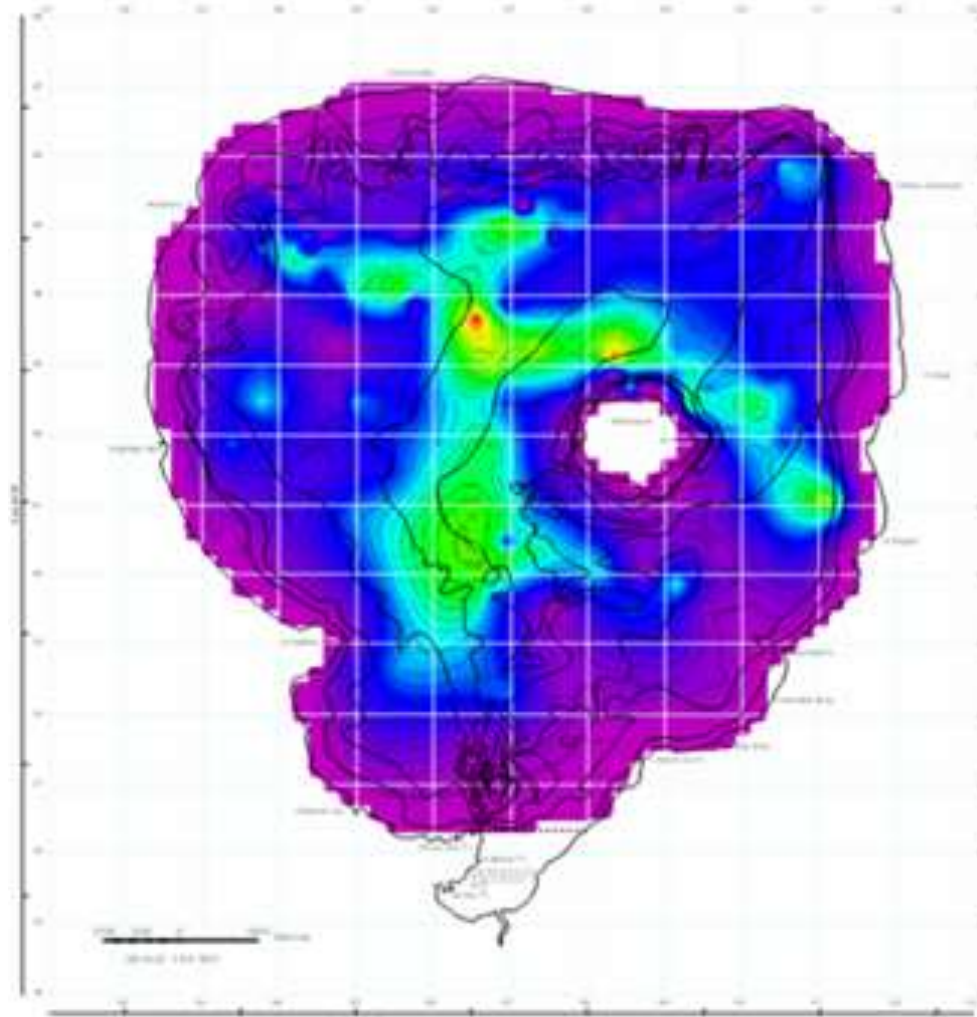
Trophic Level Index

Phosphorus

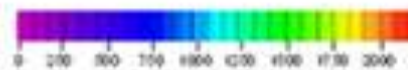


Trophic Level Index

Concentration of Phosphorus in Lake Rotorua Sediments 0-10 cm



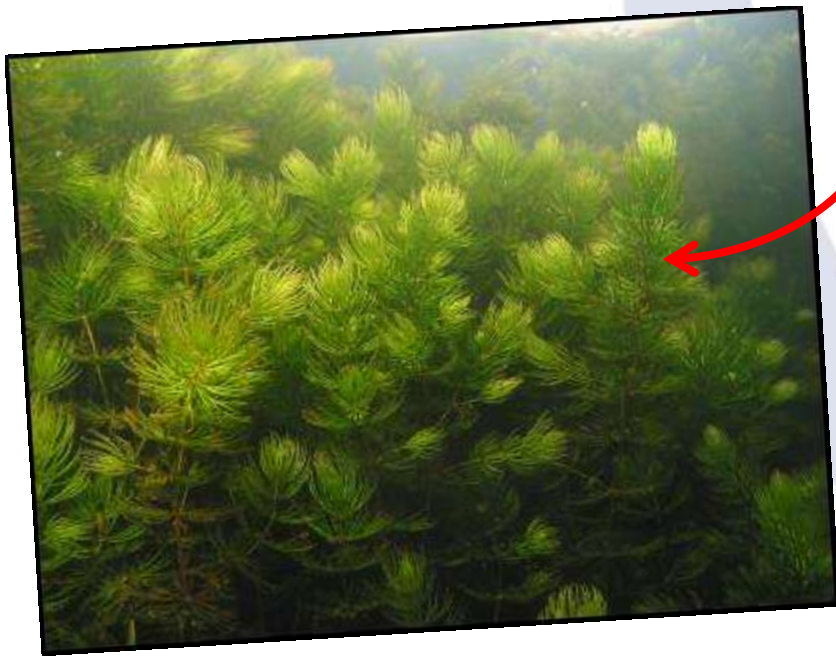
Method
Gravity and Pisten Cores
Pisten cores concentration doubled to account for loss



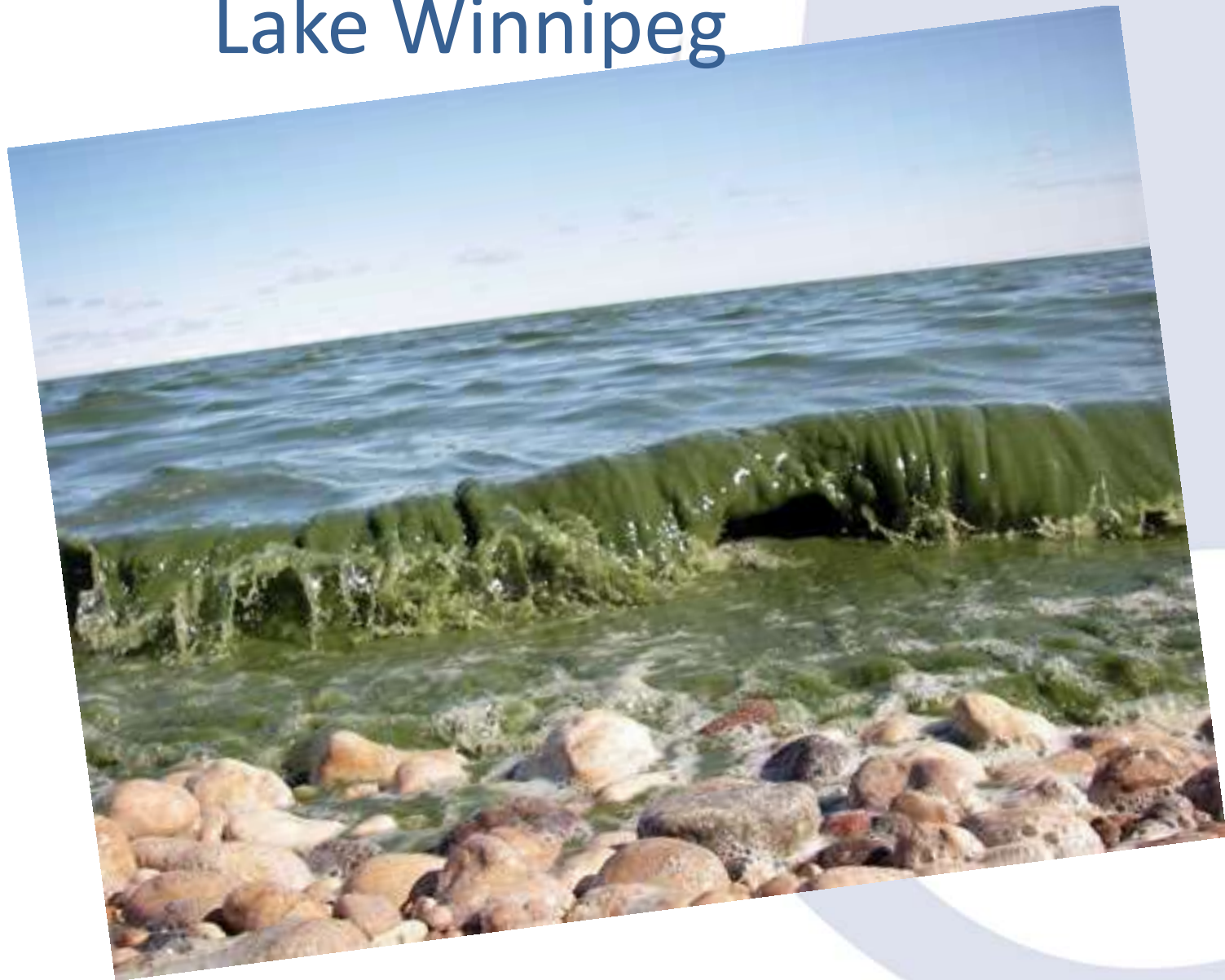
**Chris Hendy, Lisa Pearson,
Olivia Motion, Dennis Trolle**

**[Dry sediment P]
Surface samples**

Algae bloom – Lake Rotorua



Lake Winnipeg



THE FOAMING SLUDGE at Connaught Beach on Lake Winnipeg is another sign that the lake is getting close to the tipping point

CANADA'S SICKEST LAKE

Living, toxic goo is killing lakes the world over. It may be too late for Lake Winnipeg.

BY NANCY MACDONALD •



Cisco! Walleye! Whitefish! From the foredeck of the MV *Namao*, a scientific research vessel on Lake Winnipeg, student-scientists in rubber boots and banana-yellow hard hats are calling out the catch. They've also landed troutperch and emerald shiners, whose weight, stomach contents, skin tissues and isotopic concentrations will help gauge the health of the huge prairie lake. The trawl net—which looks like a bright blue tube sock with a nine-metre hole—was hauled aboard by a yellow crane just before the skies went suddenly dark, unleashing a heavy wall of rain like only the prairies can. Walloped by wind and rain, even the *Namao*—at 34 m, the biggest ship on the lake—is rocking and rolling on Lake Winnipeg's dangerous, ocean-sized waves.

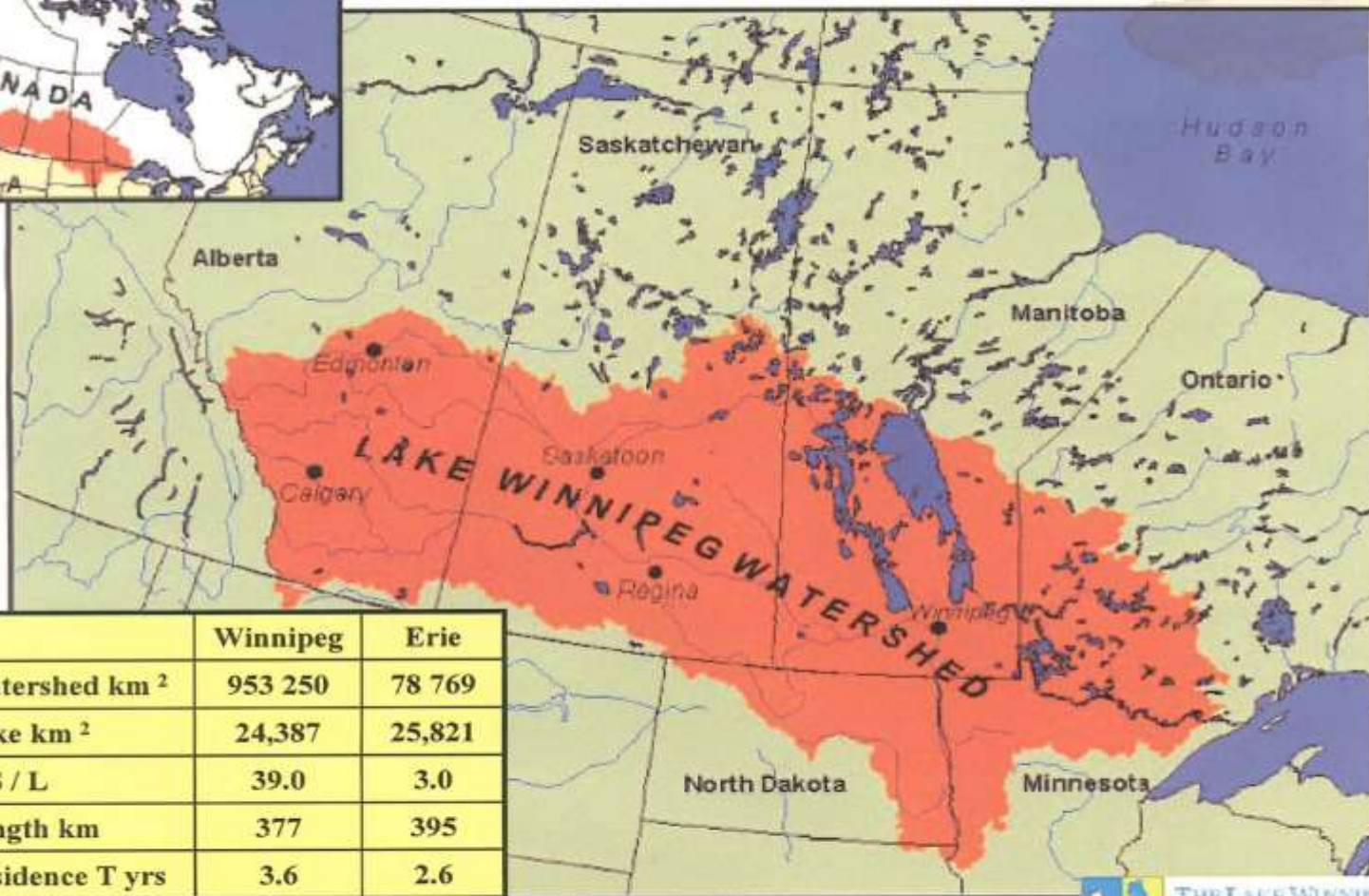
Perfect storm conditions are also brewing below the surface. Ironically, the isolated prairie lake, ringed by pristine boreal forest,

tucked far away from industry and major population centres, has become the sickest big lake in the country. What was once a small patch of algae, first noted in the 1990s, now grows to smother more than half of the massive 24,500-sq.-km lake most summers. In 2006, the pea soup blanket covered almost the entire lake, home to 10,000 cottagers, \$100-million tourism and recreation industry, and a \$25-million commercial fishery. It's "like sailing through a sea of green paint," says *Namao* head biologist Alex Salki, one of a handful of concerned local lake scientists who founded the Lake Winnipeg Research Consortium. The putrid green mat, twice the size of P.E.I., and clearly visible from deep dropping evidence of an ecosystem in deep trouble. Already, Lake Winnipeg, the world's tenth-biggest lake, is in worse shape than notorious Lake Erie, says David Schindler, one of the world's top water authorities, based at the University of Alberta.

Lake Winnipeg expert Hans Schreier, Globally, the problem—known as "eutrophication"—is the "No. 1" water quality issue we face, says Salki. The culprit isn't oil spills, toxic waste or even pesticides, but nutrient overloading from fertilizers, human and animal waste, nitrogen and phosphorus do precisely in water what they do on land: cause plant life to multiply like crazy. The process is accelerated by the channelization of waterways, the destruction of wetlands and areas. Wetlands, "nature's kidneys," as natural filters and nutrient traps, are reduced by 70 per cent in the Carleton Place River Valley, which contributes to Lake Winnipeg's phosphorus problem. Lake Winnipeg's phosphorus levels have seen a hundredfold increase in the so-called "hog boom" in the 1970s, when the number of hogs on the prairies peaked at 8.2 million. Dumping, a major problem in Alberta, the western prairie area, has another source of phosphorus: hogs and cattle.

Globally, toxic and coastal systems are being choked in number, free in the Yellow River, the sailing of the Olympics, and the largest fishery in the world, two million tonnes of fish and shellfish, and the oxygen levels in the

Lake Winnipeg Watershed



	Winnipeg	Erie
Watershed km ²	953 250	78 769
Lake km ²	24,387	25,821
WS / L	39.0	3.0
Length km	377	395
Residence T yrs	3.6	2.6
Secchi m	0.8-1.9	2.0-3.6



THE LAKE WINNIPEG
RESEARCH CONSORTIUM INC.

Summary

- 💧 Protection is better than restoring?
- 💧 Nutrient inputs vs recycling,
- 💧 Understand the changes happening,
- 💧 One size does NOT fit ALL!
- 💧 Long term monitoring!
- 💧 Apples \neq oranges !
- 💧 It's not all about WQ
- 💧 Get community support!
- 💧 It is possible?



Questions

