Lake Rotoma Nutrient Leaching after Pine Forest Harvesting

Presentation to TAG Group 30 May 2016

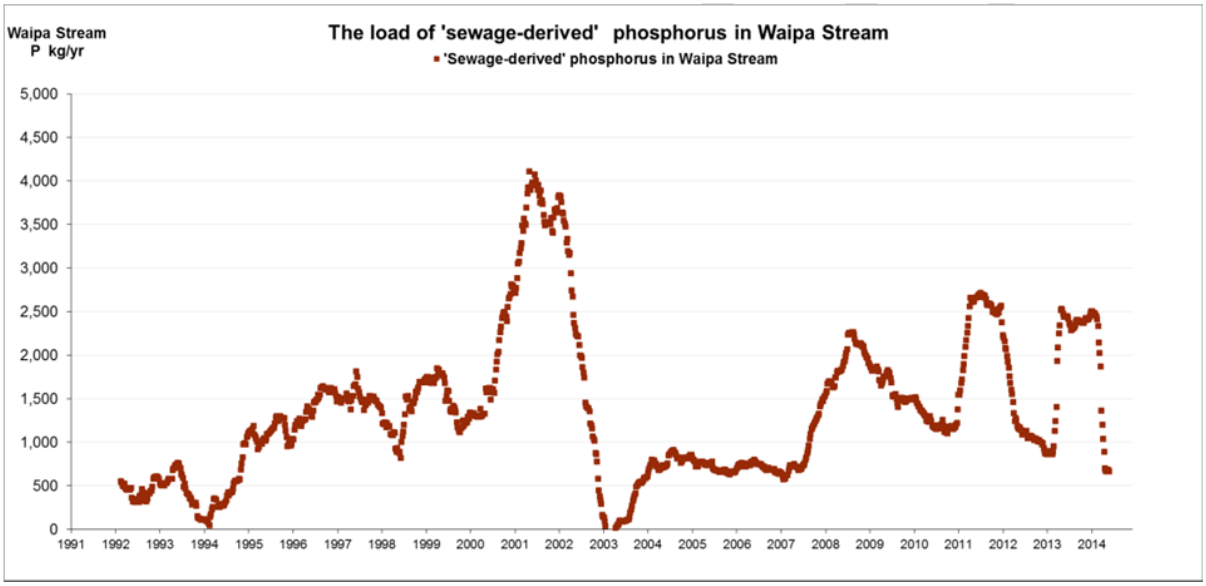
Forests are recognised internationally as being efficient nutrient cyclers, but there is little analysis of nutrient leaching losses from pine forest in New Zealand. Overall forestry as a land use tends to leach less nitrogen than other land uses such as farming, but it is known that for a period after harvest, forests do release some nitrogen.

Lake Rotoma is one of cleanest lakes in the region. A 100 ha pine block adjacent to this lake is being harvested between February and December 2016. With the agreement of the landowner and contractor this block presents an ideal opportunity to set up a monitoring project to assess nutrient runoff, pre and post harvest.

Key points of the project;

- The project has been designed and set up by Scion and consists of 12 lysimeters placed in gullies within the plantation. Water samples will be collected and analysed for volume, nitrogen and phosphorus content.
- Monthly monitoring began in March and will continue until the area is about to be harvested (anticipated August- Dec 2016).
- Lysimeters will be removed prior to harvest then relocated post harvest.
- Monthly monitoring will continue for at least 4 years along with post storm spot sampling.
- Scion will analyse the results and produce an annual report at the end of each calendar year.
- Due to the long term nature of post harvest change, it is recommended that the monitoring should continue after the initial 4 year period.

Info for Sewage discussion: Item 5:



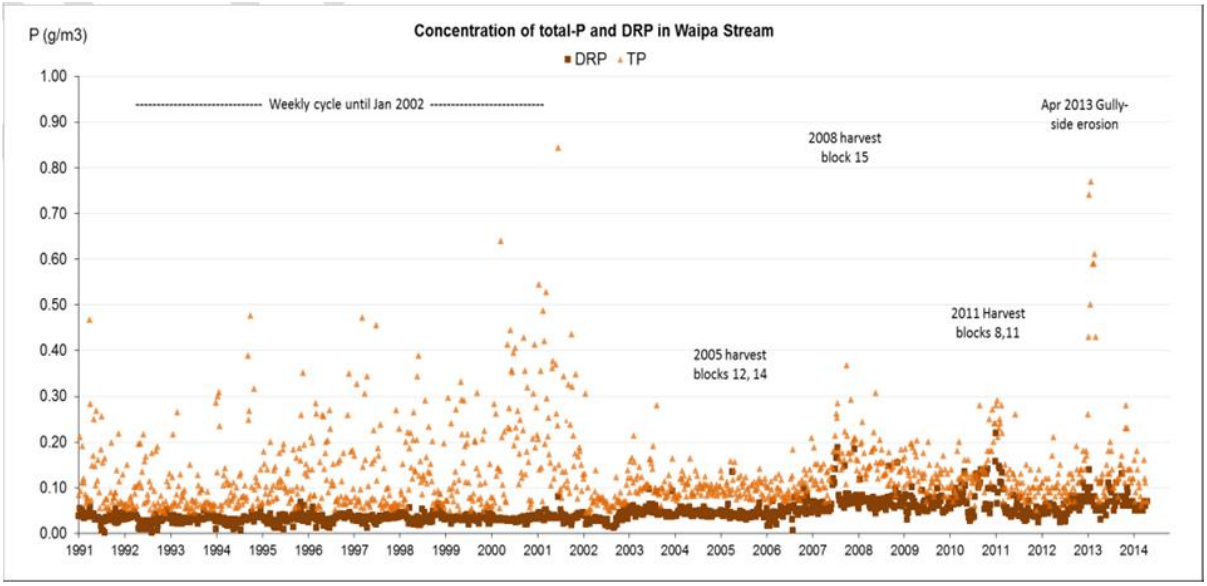


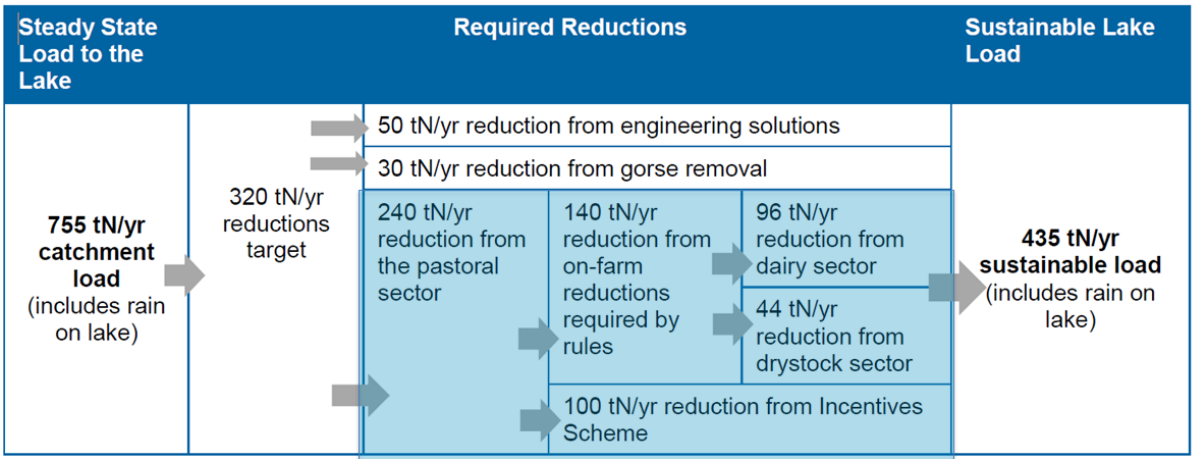
TABLE 1. Lake Rotorua Nutrient Inputs and Water Quality

Factors (1)	1965 (2)	1976–77 (3)	1981–82 (4)	1984–85 (5)	Target (6)
Population	25,000	50,000	52,600	54,000	—
Phosphorus inputs (t/yr)					
Raw sewage	5	18	30	47	—
Treated sewage	5	7.8	20.6	33.8	3
Stream	34	34	34	34	34
Internal	0	0	20	35	0
Total	39	41.8	74.6	102.8	37
Nitrogen inputs (t/yr)					
Raw sewage	34	100	170	260	—
Treated sewage	20	72.5	134	150	30
Stream (including septic tanks)	455	485	420	415	405
Septic tanks	50	80	15	10	0
Internal	0	0	140	>260	0
Total	475	557.5	694	>825	435
Average lake water quality					
Total phosphorus (mg/m^3)	—	23.8	47.9	72.6	20
Total nitrogen (mg/m^3)	—	310	519	530	300
Chlorophyll (mg/m^3)	—	5.5	37.8	22.6	10
Chlorophyll a (peak; mg/m^3)	—	28	62	58	17–24
Secchi disc (m)	2.5–3	2.3	1.9	1.7	2.5–3
Oxygen depletion rate (g/m^3/day)	—	0.4	0.7	0.9	0.25

Note: Catchment area = 424 km^2; surface area = 81 km^2; mean depth = 10.7 m; volume = 0.865 km^3; outflow rate = 18.5 m^3/s; and residence time = 1.5 year.

Table 4-2: Nitrogen loads to Lake Rotorua – Current and predicted

Sector		ROTAN 2010 Ultimate N Load[2] (tN/yr)	ROTAN 2010 N Load Subtotal (tN/yr)	Reduction (tN/yr)	2032 Ultimate Load (tN/yr)
Pastoral	Dairy	273	526	-96	256
	Drystock/Lifestyle	253		-44	
	Incentives scheme			-100	
	Gorse	(part of above)		-30	
Forest		76	76	0	76
Urban	Urban	24[3]	93	-20	73
	Urban open space	8[4]			
	Septic tanks	26[5]			
	Sewage treatment	34[6]			
Other	Geothermal	30	30	-30	0
	Rain	30	30	0	30
TOTALS		**755**	**755**	**-320**	**435**



Lake Rotokakahi Monitoring Proposal

Presentation to TAG Group 30 May 2016

In February 2014, the University of Waikato produced a report on proposed Water Quality Modelling in Lake Rotokakahi[1]. The report contained the following summary;

Monitoring indicates that water quality has recently declined in the lake, with a shift from a mesotrophic state in the 1990s, to currently being classified as eutrophic. Increased algal biomass

[1] Jones, H., Ozkundakci, D., Kochendoerfer, S., MacBride, C., Hamilton, D., 2014 Lake Rotokakahi water quality modelling. ERI Report 32 University of Waikato

has reduced water clarity and in May 2011 the first ever recorded algae bloom of a toxic cyanobacterium species may have resulted in a fish kill in Te Wairoa Stream. With the majority of the catchment in either exotic or native forest, the cause for the decline in water quality is unclear. However there is some concern that forestry harvesting operations may lead to increased surface runoff of sediment and associated phosphorus in ephemeral streams that feed into the lake. The objective of this study was to setup a water quality model for Lake Rotokakahi, which in the future may provide a decision-support tool for lake managers.

Modelling using the DYRESM-CAEDYM gave reasonable results, but did not satisfactorily capture chlorophyll a and some nutrients. The report suggested some reasons for the discrepancy, but also highlighted the significant uncertainty in the catchment water and nutrient loads which are likely to have affected model performance. The report recommends measurement of groundwater and ephemeral inflows and their associated nutrients.

A 'Project Brief' is currently being prepared for the development of a project plan to address the data shortfalls identified in the UoW Report. This will include;

- Design and preparation of a monitoring plan and schedule by BOPRC staff to address datashortfalls highlighted in the UoW report.
- The project design and method will be submitted to UoW for verification and confirmation that it will address the required shortfalls in current data.
- Monitoring will be undertaken by BOPRC staff and contractors.
- When the additional data becomes available, UoW believes that the DYRESM-CAEDYM model can be improved and possibly developed into a three dimensional coupled hydrodynamic water quality model such as ELCOM-CAEDYM.

ROTAN situation update: Andy Bruere

- Plan Change 10 was notified on 29 February 2016.
- The plan change can be located at http://www.rotorualakes.co.nz/vdb/document/1400
- This explains how nutrients are allocated and reductions are programmed from the 755 t N predicted to reach Lake Rotorua to achieving the 435 t N target in the Regional Policy Statement,
- The allocation is referred to as the Integrated Framework, and is based on the ROTAN modelling from 2011,
- This is a useful guide to the timing: http://www.rotorualakes.co.nz/what-will-happen-next
- As the OVERSEER programme has now been updated since the ROTAN model was run in 2011, there is a need to review the input data to ROTAN and confirm the nitrogen loads predicted to reach the lake under different scenarios. Unfortunately the GIS platform that supported ROTAN has now been superceded and the programme could no longer be run,
- A project to redevelop ROTAN commenced in early 2015 to do this. The initial option taken was for UoW to re-code the model then transfer the re-coded model to NIWA to test alignment of outputs with the initial model, and then calibrate for the new OVERSEER outputs and any additional WQ data since 2011,
- Re-coding has become more difficult than first envisaged and so NIWA has now transferred the project to a simplified spread sheet model (ROTAN annual) that will require calibration and validation to confirm various nitrogen outputs under a range of scenarios,
- This information will be used to support the integrated framework and in particular to predict if the N reductions required by the rules are still valid or needing adjustment.