Meeting notes for Lakes Water Quality TAG (No 14), held on 12 December 2007 at Environment Bay of Plenty (Rotorua).

Present: Environment Bay of Plenty – Andy Bruere, John McIntosh, Dougall Gordon; Rotorua District Council – Greg Manzano, Peter Dine; NIWA – Max Gibbs, Clive Howard-Williams; University of Waikato – David Hamilton, Warwick Silvester; GNS – Paul White; SCION – Trevor Stuthridge.

Apologies: Julie Hall, Kit Rutherford, Roku Mihinui and Hera Smith.

Guests: Stuart Cameron (GNS) Louis Schipper (University of Waikato) and Graeme Anderson (Ag Research).

1 De-nitrification beds

Louie Schipper presented an option for treatment of the Tikitere geothermal flow through denitrification beds.

Action: Andy to forward power point presentation to TAG members.

Denitrification provides a third alternative for nitrogen removal from the Tikitere geothermal flow. GNS has experience at nitrogen removal, working with a number of other applications.

The form of nitrogen in the Tikitere flow is ammonium and therefore a nitrification step is required before treatment with denitrification beds. Some of the significant issues that need to be considered are the low pH of the Tikitere flow, ensure the suspended solids are at a level that does not clog the bed and the configuration needs to take account of head loss through the system. In addition some concern was expressed that the bed would need to be managed to avoid significant quantities of nitrous oxide being released at the front end.

The group supported further investigation into the proposal. The following steps are required to investigate it further: Investigate the feasibility and cost of the initial nitrifying step through engineering advice.

Action: Andy Bruere to work with Rotorua District Council on the nitrification costs before considering whether to go to a trial configuration.

Consider the installation of the trial bed over a reasonable scale. It was suggested in the region of 40 metres by 4 metres by 2 metres deep by Louis Schipper.

Action: Andy Bruere to communicate with GNS to pursue information on trial set up.

Clive commented that there had been significant amount of work undertaken regarding nitrification on the Tikitere Stream and that should be considered when assessing this work.

Peter outlined that about three litres a second of the stream flow water is discharged from the Waiora Spa complex and would be a reasonable place to set up a trial. Discussions included that there would be a reasonable land area requirement for a full scale de-nitrification bed set up as well as communicating with the land owner.

Action **Andy to initiate discussions with Waiora Spa owners regarding this proposal.**

2 Outstanding Actions

The outstanding actions from last agenda were reviewed.

Action: **Andy is to organize a presentation of the Hamurana Fisheries investigation to Ngati Rangiwewehe.**

The comment on the position statement/action plan "call to update the position statement N load to 150 t per year" is on the agenda for further discussion during the current TAG meeting.

Z2 application for Lake Okaro had taken place and discussion is on the agenda for the meeting. All other actions have been completed.

3 Tikitere Progress

Andy briefly outlined progress on diversion of Tikitere flow into the Rotorua wastewater treatment plant. Greg Manzano outlined testing information that is needed to check if there are any impacts on the sewage treatment plant from diverting this flow. He stated that they were investigating pipe performance and head work requirements. He also stated that a pilot trial of the effect on the plant would be required before making a decision on diversion. This would have to be for a reasonable term perhaps up to six months or a year.

The evaluation of the reticulation system would be finished by early March 2008.

The advisory group commented that pH adjustment could be made to the inflowing water to minimize any pH affect on the plant.

Zeolite trials – Peter Dine gave us a brief update on the trials using Zeolite to remove nitrogen from the Tikitere flow. He outlined that there was some potential commercial value in extracting nitrogen and using the product as a fertiliser on land. The person investigating this opportunity is not providing much feedback, but it appears there may some problems due to the low nutrient value of the product after absorbing nitrogen from the Tikitere Springs.

Action: **Peter Dine to continue following up with Craig Mowatt on Zeolite progress.**

A report is expected from Craig in due course.

4 Ohau Diversion

Andy and Peter outlined progress on the Ohau Diversion Wall. They are more than two thirds of the way through the project, three months ahead of schedule. The monitoring being undertaken for the wall was outlined.

Dave Hamilton pointed out that he is in the process of getting the two monitoring buoys in place on Lake Rotoiti and continues to have monthly bio-fish runs through from Lake Rotorua through the Ohau Channel and into Lake Rotoiti. When the wall is in place, these runs will continue but would have to follow the length of the wall to enter Lake Rotoiti. It was suggested by the TAG group that a current meter should be installed to check water flows around the tail end of the wall and ensure there is no back flow into Lake Rotoiti.

Action: Dave Hamilton to investigate installation ADCP meter at the tail end of the wall (on the Rotoiti side) in February/March 2008 (expected closure date).

It was raised by Max that as the diversion wall is closed off at the landward side, care needs to be taken to ensure that we do not end up forcing water across the shallow shelf and perhaps causing erosion of the shelf and land beside the shore. He suggested a methodology where a gap is left in the wall further away from land, and as the last point of closure is away from land rather than advancing shoreward.

Action: Andy and Peter to raise this issue with the contractors to see if this or similar methodology can be adopted during construction.

5 Hamurana

It was agreed that there was no need to pursue evaluation of mud-crete at this time as further scientific work was required before assessing the engineering options. Evaluation of mud-crete is on hold until a later date.

Fishery work - Environment Bay of Plenty is working with Dave Rowe of NIWA to get trout monitoring work around Hamurana completed during next season. Andy reported that some discussions had taken place with NIWA and it isn't likely to proceed for some time until such time the tracking equipment was imported from the United States of America.

Action: Max agreed to check progress on this monitoring work.

It was agreed that the Hamurana diversion is a significantly complex and controversial part of the program and that further discussion on how the pros and cons should be undertaken at the next TAG meeting.

Action: Andy to place on agenda for further discussion at next TAG meeting.

6 Lake Okaro

John McIntosh gave a brief rundown on the Lake Okaro sediment capping and explained the water treatment issues to supply the surrounding houses and some farms from Lake Okaro. He explained the issues were dealt with, but that this delayed the dosing.

Trevor Stuthridge explained that the Z2 manufacturers have now come up with a name for the product called Aqualixir (AQL).

David Hamilton summarized the long term Environment Bay of Plenty monitoring of phosphorus and oxygen levels in the lake water. He explained that Deniz Oezkundakci was complementing the monitoring work with modeling to assess the natural variation in the lake water quality.

David reported that the sediment group had agreed success of the trial in the Lake Okaro would be a 50% reduction in the hypolimnion phosphate concentration. He explained that the group set a simple measure for success rather than to look at other measures such as algae or TLI which could be impacted by factors other than phosphate concentration and controlled by AQL.

He explained that the 50% reduction in phosphate would be assessed against a modeling prediction made by Deniz producing what the hypolimnion concentration would have been if capping had not taken place.

David also explained Deniz's core and video work on Lake Okaro in conjunction with NIWA. He explained that this showed Z2 on the surface of the sediment but in some cores it seemed to have been buried up to 10 cm. He suggested that this burial is unlikely to occur in a natural situation as a result of release the gas and disruption of the sediment.

Max presented information on the trapping experiment for Lake Okaro, this is where baskets were put in place in various locations to see the distribution of zeolite. The target distribution rate was 500 grams per square metre and some traps were as high as 1,600 grams per square metre.

Action: Andy to circulate Max's report to TAG group.

7 Supplementary Addition of Z2 on Lake Okaro

Trevor explained that any supplementary addition of Z2 to Lake Okaro would be a finer ground material. Environment Bay of Plenty has 20 tonnes of AQL stored and it is possible that this could be ground to a finer product for this application.

Action: Trevor to check out with manufacturers whether this material can be ground to the finer product.

A decision on any supplementary application would be made subject to the results of monitoring and the level of success. The aim would be to make a decision before April 2008.

Action: Andy to email TAG group to assess results presented by David prior to April 2008.

David presented information on dissolved oxygen and phosphate in Lake Okareka. He explained he was running the model through the period of Phos-lock applications to see if phos-lock has had an effect on P release. John commented that he suspects that we may have underestimated the P discharge from septic tanks. He also commented that the Phoslock was applied at a rate of 35g/m^2, as opposed to AQL at 500g/m^2. So the effectiveness of sealing the sediment would be less for Okareka where the objective was to lock up a defined quantity of phosphorus.

Action: Andy to circulate to group, David's diagram on Okareka DO and Phosphate.

8 Okaro Core Study Work and Rotorua Trials

Max presented information on the results of his core study work for Lake Okaro.

Main points:

- 500 grams per square metre is more than adequate to cope with sediment pre-release from the lake.
- That quantity is about 10 to 15 times the predicted seasonal release from lake beds. Note however that sediment on top of capping will provide P supply for future seasons.
- Lake Rotorua has about twice the available P for release compared with Lake Okaro on an areal basis.

With respect to sediment capping on Lake Rotorua, Max outlined there are significant differences between Lakes Okaro and Rotorua. In particular Rotorua appears to release at many times other than just summer. He is preparing to repeat the Okaro core study work using Rotorua sediments. All sediments have been collected below 15 metres.

Action: Max to ensure that core samples are collected below 15 metres using the University of Waikato diagrams prepared by Chris Hendy.

8.1 Summary of Lake Okaro core work

- AQL blocked all of the P release of about 32 to 34 milligrams per square metre.
- There were no other impacts such as metal releases and no impact on nitrification/de-nitrification processes.

Trevor noted that AQL had capacity to uptake ammonium at about 20 grams per kilogram but he would confirm to the group the actual performance.

Action: Trevor to confirm ammonium trapping capacity of AQL.

The Rotorua core trial will test four products. It was discussed whether at the end of the trials further sediment should be added to see the impact of accumulation on P release.

Action: Max to update Rotorua core proposal for Environment Bay of Plenty.

9 Rotorua Trial Plots

There was concern regarding scaling the capping work from core trials to whole of lake situation. It was also raised that there was a need to consider the impact of dropping a capping product on to the nepheloid layer and to check sinking of the flocculent material through the sediments. Trevor suggested it may be possible to use a finer material which will stay semi-suspended if sinking becomes a problem.

It was agreed the trial plots on Lake Rotorua would be necessary to take this further in Rotorua and that rather than going for a 30 by 30 metre plots, simply apply the product that performs the best in the core trials, to a large area of Lake Rotorua and form plots amongst that area.

Conclusion on Rotorua trial plots:

- In-lake trials are certainly needed.
- Nepheloid assessment work will be done in parallel with the plot trials.
- Aim for undertaking plot work in about August 2008 after the results of core trials are completed. However timing was not critical.
- Discuss the detail further at the sediment group meeting in 2008.

Action: In-lake trial to be set up after the results of the core testing on the various products are completed. At the end of the core trials there needs to be some sediment deposited on the core that performed at highest P removal to simulate burial beneath lake sediments.

Action: David and Chris Hendy attempt to get a Masters student to do some work on the nepheloid layer, its interactions with the deeper sediments, its variability and its capacity to retain a flocculent and not have it buried.

10 Lake Nutrient Targets

10.1 Rotorua Land Use Target

In the previous Water Quality TAG notes there was a reference to updating the Position Statement/Action Plan land use load to 150 tonnes per year. The group was not happy to specify 150 tonnes and agreed that they remain with the land use target, which should be around 150 to 200 tonnes of nitrogen. They commented that the quantity that needed to be stopped or removed would increase over time and that 150 to 200 tonnes of nitrogen is therefore still appropriate. This is confirmed with the statement from Clive and Dave in 21 November 2006 TAG notes.

10.2 Lake Rotoma Target

John presented and explained the Lake Rotoma targets and assumptions. The target date of 1994 shows a TN:TP ratio of 40:1 and this has crept down to ratio of 20:1. John suggested the change that previous work on septic tanks P load may have produced underestimates. There was some discussion about the cause of this. John suggested that septic tank effluent could be responsible for all of the nutrient increases in the lake water since 1994.

The group however did agree that the N:P ratio was important and that P removal to get a ratio back closer to 1994's 40:1 was an important target.

There was some discussion around detergent use and whether it contained high levels of phosphorus. This is a matter which can be investigated in general for Lake Rotorua program but not specific to Lake Rotorua.

The group agreed the 40:1 ratio was the correct approach and an aim for the targets to achieve this is a reduction of 1.32 tonnes of nitrogen per year and 250 kilograms of phosphorus per year.

11 Tikitapu Aeration

Andy outlined Hans Burgraaf's proposal for aeration on the Rotorua Lakes.

David Hamilton has been discussing with Hans his proposal and suggested an alternate configuration as a portable unit that would boost aeration in several of the lakes. It's possible that this low energy system could be used with a solar power force and pure oxygen injection. His recommendation is that this system is placed below the thermocline so that it does not disturb the thermocline. He pointed out that the deep chlorophyll maximum in Lake Tikitapu could be disturbed by this process and suggested that this method of aeration might be more suitable on Lakes Okareka, Okataina or Rotokakahi. Permission from the owners of Rotokakahi would be required of course.

David believes the power requirements for this type of system are very modest and explained that the design is not experimental, it is proven overseas. More detailed design is required on:

- The capital cost.
- The running cost.
- Portability.
- Anchoring on very deep lake beds such as 85 metres.

Action: Andy to get more detailed proposal from Hans and work with David to vet proposal.

Clive suggested some communication with Adrian Meredith at Environment Canterbury. Some surface aeration systems in Lake Opua in the South Island had been used.

David also showed a couple of other technologies which he had been discussing with Hans. One of these was a pool treatment system for nitrification and phosphorus removal. There is a filtration system to eliminate the use of traditional pool chemicals. The second technology that he showed us was sediment methane capture from lake beds. The plant is moved around on the lake bed. The sediment is covered by a hood at the bottom of the lake. The sediment below the cap is gently heated to release gas and in the process sediment porewater can be filtered to remove this high nutrient water which is disturbed. This treatment would take a number of years to remove quantities of nutrient from lake sediments, but the advantage is that the production of gas from the system maybe sufficient to fund the running costs.

Action: Andy (and David) to discuss with Roku/Te Arawa (as they are the owners of the lake bed) to see if they have any interest at all in pursuing it as a joint proposal with Environment Bay of Plenty. It is likely to require a major capital investment.

12 Lake Model Progress

Dave Hamilton outlined how the GNS model of groundwater loads and nitrogen and phosphorus loads couples into a lake model. GNS has produced a model of the baseflow for which the outputs (discharge, nitrogen and phosphorus) can be coupled in as inputs to the lake models (one-dimensional DYRESM-CAEDYM and three-dimensional ELCOM-CAEDYM). These models were being driven by a common climate model from the International Climate Change Institute at the University of Waikato. The ROTAN model is likely to have similar outputs to the GNS model but with a focus of surface transport of water, nitrogen and phosphorus, and stormflows. It seems clear that the models are complementary and if lines of communication are maintained then there is potential to generate a comprehensive modeling framework for the generation of potential management scenarios. Access to model outputs between the researchers is a critical step for optimizing knowledge and information.

Action: Clive and Kit to update the TAG on progress with ROTAN model at next meeting.

Paul White explained that for the groundwater and ROTAN model to be connected there needs to be some discussion between Kit and Paul White. The main issue which Paul thought needed discussion was rainfall data.

Action: Kit and Paul White to communicate so that programs can be progressed.

Dougall explained that there is a need to decide how small (detailed) the catchment sizes need to be.

Action: Dougall to follow up with Kit, discussion on sub-catchment size. (Some discussion may be required with Dave if required.)

Paul White provided a presentation on the groundwater flow model. He outlined the new groundwater boundaries which have been extended, particularly in the Hamurana and Awahou areas. He explained that drilling to identify groundwater divides may in fact be difficult due to the low gradients in some of those areas.

However, significant points were:

- Groundwater nitrate levels were generally higher than surface water nitrate levels.
- Nitrate concentrations are high in shallow wells and lower in deep wells.
- The highest nitrate concentration was in the Waingahe catchment underneath the Ngati Whakaue farm.

Paul suggested we focus the work where required to define groundwater boundaries on the north-eastern boundary near Mission Bay on the north-west boundary on the south-west boundary. Bores are probably the best method of getting an accurate determination of the groundwater boundaries.

It was raised by Dave Hamilton that we need to consider the best place to spend our resources on determining groundwater inputs. For example he raised that the Tarawera catchment includes a number of other lake catchments where we want to understand the groundwater better and we need to take that into account before deciding exactly where we should spend our resources in determining groundwater boundaries.

Action: Paul White to do minor refinement of groundwater boundaries.

Action: (Environment Bay of Plenty) Dougall, John and Andy to decide priorities for groundwater bore work to define boundaries including considering other lakes.

The aim was to link groundwater work with 3D lake models. Currently work is about six months behind schedule.

13 Utuhina Phosphorus Locking

John presented a PowerPoint presentation on the Utuhina P-locking. He explained the alum dosing had been reduced to about one part per million (in-stream aluminium concentration) but has been trialed at up to at least three parts per million. At the higher levels, foaming problems occurred and these were less evident at one part per million. The plant has been operational for about 18 months. Approximately 1.5-2 tonnes of phosphorus per year are removed from this site.

John also explained that some floc can be seen downstream settling on the bed. Max asked if there was any possibility of P release from the floc and suggested monitoring pH in the settlement zone to establish if any P release is occurring.

This discussion led on to the proposal to put in two further P locking plants in Lake Rotorua streams as well as the P-locking plant at Lake Rotoehu. This also connected with the discussion around the Hamurana diversion and if that did not eventuate it may be possible to undertake P locking on that stream. Warwick Sylvester made the observation that from the discussion today we were perhaps changing from considering our lakes as being N-limited to P-limited and that we need to consider if this is an appropriate strategy to assist in the protection and restoration. David believes there is a significant amount of complexity in nitrogen cycling in the lake and processes such as denitrification can be influenced by the C:N ratio. (See attached diagram).

Action **It was agreed that this is a matter which needs to be discussed further in the next TAG meeting. The aim is to ensure that we agree that there is a need to check/target both nutrients and not simply take one as the limiting nutrient and focus on that alone. In addition, the objective would be to ensure that we understand clearly why we are undertaking our strategy because now that we are asking for commitment from landowners to reduce nutrients, we need to be in a position to clearly explain to them and justify our philosophy.**

14 Other Matters

Dave Hamilton raised concerns that Te Arawa Lakes Trust was absent from this and wanted to ensure that we (Environment Bay of Plenty) was still engaging with them on the water quality issues so that we could continue to get their feedback and collaboration and also ensure that we are addressing their concerns.

Action: **Andy to follow up and discuss with Roku to ensure TALT is getting information required.**

Andy Bruere
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for Group Manager Water Management