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File Note From: Andy Bruere
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Subject: **Meeting Notes, Water Quality TAG - 23 April 2008**

Present: Peter Dine, Steph Parkyn, Chris Hickey, Hera Smith, John McIntosh, Dougall Gordon, Andy Bruere, Clive Howard-Williams, Trevor Stuthridge, Peter Verburg, Paul White, Rob Donald, Warwick Silvester, David Hamilton, Kit Rutherford and Max Gibbs

Apologies: Roku Mihinui

1 Follow up on notes from the last meeting and matters arising

- (a) Hamurana fisheries work is on hold and further discussion of Hamurana diversion is on the agenda. Comment was made by Max Gibbs that there is significant work involved in setting up the fisheries monitoring for the Hamurana work. It was also discussed that there are significant consenting issues surrounding the Hamurana diversion.
- (b) Zeolite progress at Tikitere – Peter Dine reported that the trial is continuing but there is no report prepared as yet.
- (c) ADCP Meter - David had explained that he had discussed the matter with Dirk Immenga of Earth Sciences at University of Waikato. Two ADCP meters could be used on either side of the wall to test velocities. He suggested that it would be worthwhile doing it for three weeks in June and three weeks in December and was going to get a quote of how much this would cost. It was then suggested that it was best to do it when the temperature difference between the two lakes is the greatest in June and then re-evaluate for other parts of the year.

Action: David to get quote for meters to be installed.

- (d) Wall progress – It was reported that driving piles for the wall will be finished in May 2008. There had been some holdup due to problems with the barge, which had to be removed for repairs for a month.
- (e) Supplementary Z2 dosing is on the agenda for further discussion.
- (f) Trevor reported on the ammonium capacity of Z2. SCION tested 27 zeolite products and Z2 absorbed 1970 mg/kg. It was in the top five in the 27 tested. Untreated zeolite could remove 2100 mg/kg and the average of natural zeolite is 765 mg/kg. He also commented that ammonium would be released in mild saline conditions. It was simply a cation exchange removal.
- (g) Core work for Rotorua is on the agenda. This is being discussed by the Sediment Group consisting of representatives from NIWA, University of Waikato, Scion and Environment BOP. This group will likely collectively decide on proposals to go forward to Environment BOP so that decisions can be made about consolidating Okaro findings and applying with confidence on the basis of further validation in Rotorua.
- (h) Andy Bruere and David Hamilton have held discussions with Hans Burggraaf about mechanical aeration of Tikitapu. A proposal has been received from Hans and there has been some discussion about IP arising. It was agreed to obtain a peer review of the detailed proposal in order to fully consider the physical feasibility of the system, before investment in infrastructure is made.
- (i) Gas harvesting from sediment. This was a task for Andy to talk to Roku Mihinui about possibilities of some sort of project in the future. Andy reported that no progress as this stage and it would be discussed with Roku in the future.
- (j) The ROTAN update is on the agenda.
- (k) Groundwater priorities – Dougall commented that priorities had not yet been set but commented on the following:
 - Significant amount of work had been undertaken in the Rotorua catchment and the results were readily available.
 - The greater Tarawera Catchment needs more work.
 - He acknowledged the work by students but commented that we needed to have a more complete strategy to avoid a piecemeal approach. David then added the following, that the three lakes in the east, Rotoiti, Rotoehu and Rotoma will eventually require further groundwater study. In particular with

the diversion of the Ohau channel from Rotoiti the groundwater contribution to Rotoiti would become more significant.

The other area of study is the seven lakes of the Tarawera Catchment. He commented that groundwater information was the key to making water quality predictions. The figure of 7 m³/second flow out of Tarawera was generally considered reasonable for the size of catchment. A French student was working with David Hamilton and Paul White to do a water balance for the wider Tarawera catchments

Action – Dougall to arrange the team to propose a strategy for groundwater work before the next TAG meeting with input from Paul and David. The team will comprise of Dougall, John, David, Paul and Andy.

Clive added that Andrew Tait from NIWA could be useful with assisting in this work.

Paul White updated the group on the Rotorua groundwater flow model. He also commented that they were working to link the catchment model with the 3D lake water quality model. This is working with David on the OBI. It will also be possible with this model and the lake models to test any nitrogen discharge into the lake and impact on the lake and impact in local bays.

Paul also commented on the Kaharoa rainfall recharge project:

- Measuring water flows through the soil but no data yet
- So far the work had shown 50% of the rainfall goes to groundwater and this would agree with the model.
- There had been some problem with second lysimeter and they had reinstalled recently
- There was also water quality monitoring from the lysimeter which indicated high nitrogen in winter.
- Two draft reports on this would be made available to EBOP in the next two weeks. A letter report on the lysimeter reinstallation and second report on the results of lysimeter water chemistry.

Paul commented that further work on groundwater catchment boundaries is needed before these can be used for planning boundaries Rule 11. Paul also commented that we first need to complete the external boundary adjustment, and then further

work is also required to amend internal boundaries within the catchment in order to get the groundwater model water balance to work

- (I) Update on Tikitere work – Andy updated the group on the latest proposal for the removal of 30 tonnes of nitrogen at Tikitere. This was followed on from the GNS report to the last TAG meeting. Peter Dine and Andy had worked with GNS to work up a three stage proposal which consisted of:

- A lab scale trial to test nitrification and check for any inhibiting substances.
- A field scale trial at Tikitere testing the de-nitrification at a reasonable scale with a flow through of 2 litres per second. The design would be to overload the de-nitrification bed to enable quantification of for design purposes on the full scale plant is successful.
- Full scale de-nitrification plant would be installed after the field trials have proved successful for a reasonable period perhaps greater than one year. Peter Dine reported that the RDC lab trial had started.

The TAG group supported this approach.

Warwick Silvester commented that geothermal springs on the other side of the hill leading into Rotoiti could be a possible consideration for further connection into the de-nitrification project. They will be left for later consideration.

2 Rotorua core work

Max reported on the core work for the four sediment capping agents on Rotorua sediments. They are preliminary results which we will report in the near future. A PowerPoint presentation is available.

The work looked at various range of treatment rates in varying conditions for the blocking of phosphorus and nitrogen. One of the issues relating to the Z₂ usage is granule size and lack of bed coverage which was not such an issue with three finer products. Max had also worked out the load of each product required to move the phosphorus release (presented in a graph). It was raised that grinding Z₂ to say 0.5 mm would improve its performance. Other points were:

- Z₂ is the only product to remove ammonia in aerobic conditions
- Phoslock does leach lanthanum and there is a possibility of associated toxicity

- Chris Hickey commented that NIWA had performed toxicity testing of phoslock for the ERMA approval which was granted
- John McIntosh commented that there was a large ammonia spike in Lake Okareka after first application which seemed to fit with Max's results.

Action – Max to circulate to presentation to group.

3 Lake Okaro

David presented results on monitoring of Z₂ performance on Lake Okaro:

- The objective was to get a 50% reduction of phosphorus in the hypolimnium.
- He showed a graph which had results up and until January and commented that more recent results had shown phosphorus rising up to 0.2 parts per million. This is about 40% of last year's P release.

He commented that following the obvious spring bloom phase, algal biomass tended to be closer to the thermocline; the water appeared clear during this phase.

The main question being resolved here is do we need a second dose during the autumn and what is the longevity of this product at the bottom of Lake Okaro.

He commented that from the sediment group meeting last week there was support to leave dosing till after next summer. The discussion on this matter revolved around the conflict between resolving Lake Okaro water quality issues and meeting the Okaro Action Plan objectives compared with the benefits of extending this as a trial which will help with the decision in future capping for Lake Rotorua.

The outcome of this discussion was the group supported leaving further Z₂ applications until autumn 2009. The timing of the future Z₂ applications could be reassessed with results next summer after the stratification. Max commented that this dose rate was 350 grams per square metre which is 15 times what is required for suppressing the annual phosphorus release. He commented that it would be advisable to use a finer product next year.

David commented that if there is a reduction in algae then the lake would become more stable and there would be less deposition over the top of Z₂ next season.

John commented Environment Bay of Plenty data have indicated a higher release in April and that the estimate of success (50% P release suppression) was unlikely to be met.

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Therefore an application of 20 tonnes of fine material should be added after mixing in June 2008 to ensure 'success'.

Decision hold off second dose and reassess late 2008-2009. Aim to find result which might be more applicable to Rotorua for future.

Capping particle size following comments were made:

- Finer particle settling can complete cap sediment
- Sediment capping in the cores brings anaerobic conditions closer to the surface with gas release which cause problems within the cores. This may not of course be the same problem in the lake environment.

Chris Hickey updated the group on Lake Okaro ecology/biological investigations of Z2 dosing. A PowerPoint presentation is available. This included laboratory work, water column work, field trials and benthos investigations. A number of results were presented.

Survival of organisms in Z2 was good up to very high application levels (significantly higher than expected dose rates). Clive commented that within expected range of applications none of the chemicals were likely to be lethal.

Allophane was not tested. No ERMA approval is required for allophane as it is simply a natural product. There was some discussion the need to apply for ERMA approval for the Rotorua trial works.

4 **Rotorua sediment capping trial work**

David updated the group on the sediment group meeting. The sediment group comprises of Environment Bay of Plenty, Scion, NIWA, and University of Waikato. Notes of the sediment group meeting are available. The group agreed that a number of issues need to be resolved and cleared through the trial work and this should be undertaken by the sediment group in the near future. The main factors to be considered are as follows:

- Set up trial of plot could be difficult. Need to look at
 - spread of product
 - dispersal of product
 - trials at 10-12 m depths.

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- Move them further afield.
- Performance in effluent or soft bed layers of the lake
- Grain size of product (lab scale of experiment may be necessary to optimise)
- Range of products to test. It was agreed that Z2 and phoslock were probably the most appropriate products to retest. The application rates for allophane would be significantly higher because of the quantity required. It was expected that benthic chambers would be required on the lakebed to measure e-flux.
- Timing was not considered a major issue as Rotorua can have nutrient releases at any time.
- Consideration of trial and design monitoring

Warwick raised the question of how much P needs to be removed to get the lake P limited. There was discussion regarding whether Rotorua would get down to becoming P limited. It was suggested that there needs to be some calculation done to assess how much phosphorus needs to be reduced and how much that will reduced productivity of the lake.

Action – Assessment of P reduction required and expected reduction of productivity as a result to be undertaken for sediment group meetings. Clive commented that there would be a need to re-evaluate the work undertaken by Eddie White which indicated that there is a need to remove enormous amounts of P to achieve a reduction of productivity.

The plan by the sediment group would be reported back to TAG at their next meeting possibly June or July this year.

David raised the possibility of doing the whole of Lake Rotoehu which could also be a trial in advance of capping Rotorua. John McIntosh commented that this was not supported by the community action plan although Rotoehu has sediment release of P did not occur every year.

Action - Environment Bay of Plenty staff to discuss options and considerations of capping Lake Rotoehu before returning to the group for further discussions.

Max commented that Lake Rotoehu was similar to Lake Horowhenua a shallow lake which has micro-stratification. That made it very difficult to pick stratification through monitoring. It was agreed that the first step in assessing Lake Rotoehu may benefit from sediment capping would be to undertake DO monitoring over a period.

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5 Update on water quality monitoring

David gave a very brief update on water quality monitoring and committed to more complete update at its next meeting. The following is a summary:

- Rotorua has a 3D model. He commented that cyanobacteria levels from day to day are variable. The model links with output from Paul's groundwater model and also a climate change model.
- The phoslock work on Lake Okareka had been modelled as part of Masters study by two Danish students. An electronic copy of their report as part of their Masters is available on request to David .
- Rotoehu is also being modelled.
- Tarawera had a 1D and 3D simulation which would give water quality projection. Joseph Joseph Butterworth's work on Rotokakahi had given a good connection between water quality and the effect on kakahi.
- Okaro was being modelled by Deniz Oezkundakci as part of the assessment of effects of the zeolite application.
- Lake Rotoma had a 1D model.
- Rerewhakaaitu, Rotomahana and Okataina had not been modelled.
- Rotoiti 3D model is continuing as part of a Ph.D. study by Nina Von Westerhagen.
- PHD student Matt Allan was undertaking remote sensing work which would be used to validate the modelling.

6. Aeration work at Tikitapu

Andy updated group on the aeration work at Tikitapu. An attached memo outlines the detail of this work.

In brief Environment Bay of Plenty has signed a confidentiality agreement to receive information which will then be peer reviewed before bringing back to the TAG group.

The group made the following comments. Warwick commented that this was a change from aeration to oxygenation of the hypolimnium. David commented that the objective here was to look at portable options for treatment of various lakes. It was also commented that this could be applicable to other parts of the country.

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David suggested that John List in the United States may be a suitable person to check mechanical feasibility of this proposal.

Action – Andy to further update at the next meeting.

6 ROTAN update

Kit presented a PowerPoint presentation on the Rotan water balance and implications for Lake Rotorua catchment area. He commented that the work on rainfall by Andrew Tait had improved the reliability. His main conclusion was that ROTAN can make estimate of additional area to close the water balance. His estimate at this stage is that an additional 100 sq kilometres is required to satisfactory model the outflow of Ohau Channel. He also commented about the Puarenga and Waipa stream catchments gaining water. Paul White commented on the agreement of his groundwater modelling work. He also showed the groundwater boundary model addition for the Hamurana Springs. This indicated the significant additional area is somewhat in agreement with Kit's area but perhaps less than 100 sq km. Kit indicated there were significant management implications:

- Where to from here?
- How similar or different is this work to what already has been done.

His comments were that the additional 100 sq kilometres is a very large area is an uncertainty of about plus or minus 30%. He was also clear that the ROTAN model could determine the additional area required but would not identify the location. Secondly; he was pleased that this result is similar to what has been done already and that there was certain amount of agreement with Paul White's work.

There was discussion about the implications of this with regard to particularly Rule 11. Andy commented that the Rule 11 boundary had been defined by a line on the map and that the definition of the catchment area and catchment boundaries from this research will not have an impact on land uses until such time as Environment Bay of Plenty went through a plan change process for Rule 11. This would be communicated with the community at that time and was therefore not a matter of concern at this stage in these investigations.

Kit also updated the group on nutrient trading study group as the ROTAN model also provides a basis for nutrient in the Lake Rotorua catchment. He commented on monthly meetings of the study group that had now been completed. There was now a FRST fund project to mock up a nutrient trading system and NIWA had been subcontracted to

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develop a simple computer model which would include economics for nutrient trading. This had been called the N-trader model. He commented that the coupling in with the economics was difficult.

Action – it was agreed that Kit and Paul White work together and within two months complete their work showing the extent of the groundwater catchment for lake Rotorua. It was suggested that if the work of both consultants fitted within the accepted error bands then no further peer review would be necessary.

7 **Hamurana diversion**

Andy raised that he was concerned about undertaking further work on the Hamurana diversion due to the expected ambitious nature of the project and the current modelling results which indicated no significant advantage to Hamurana diversion until at least sediment nutrient releases had got under control. He raised the question about priority and the possible impact after sediment capping had taken place and that there were other significant community and cultural issues around the Hamurana diversion project.

Warwick Silvester pointed out that Hamurana was the main P input to Lake Rotorua and it was a major future nitrogen input.

David Hamilton commented that the modelling showed the impact of the diversion was neutral and the cold water from the Hamurana carries nitrate and plunges down the lakebed to offset N release. He commented that it is difficult to trace how far the effect into the lake goes.

Action – David agreed to undertake modelling scenario for impact of the Hamurana diversion after sediment capping had taken place. When available this could be presented to a future meeting.

8 **Nutrient targets - targeting of both nitrogen and phosphorus for lakes.**

Andy raised that there had been two positions statements released on targeting both nitrogen and phosphorus particularly for Lake Rotorua. It was significant to note that of the 250 tonnes reduction required of Lake Rotorua 80 tonnes of nitrogen was going to come from engineering type of interventions and then following the remaining 170 tonnes was to come from land use. He commented that the Land Futures Board had been formed and it was charged with giving leadership on how the 170 tonnes might be removed and that there was concern there would a need to present to that group and also

farming groups into the future the rationale for arriving at a required reduction in both nitrogen and phosphorus. Andy indicated that he thought it would be appropriate for one or more scientists to be able to present this case where necessary to the appropriate groups and defend their position.

One of the issues which raised some questions about the phosphorus target is that stream levels of phosphorus do not appear to have risen as a result of land use change and it could be questioned as to whether reducing phosphorus from land use in the catchment would actually achieve any reduction phosphorus reaching the lakes. There was discussion that the actual targets did not necessarily require assessment but the group needed to be comfortable around the rationale for deciding upon these targets as it was likely to be a source of questions as the pressure comes onto the land users in the farming community to reduce nitrogen and phosphorus loss.

Clive indicated that NIWA had looked at the target and possible mitigation to achieve 170 tonnes. From his memory he said 70 to 80 tonnes of nitrogen could be removed with current technology. Andy commented that this agreed with Environment Bay of Plenty's interpretation but however for an 80 tonne reduction of nitrogen in the catchment that might be an economic loss to some landowners. To give indication of the magnitude of the issue Andy reported that there about 26 dairy farms in the catchment and to achieve the target of 170 tonnes as dairy farms are the main contributor then to achieve 120 tonnes from their part of the contribution would required about a 40% reduction in nitrogen leaching from dairy farms. This may not be the actual form of the final solution but does give an indication as to the magnitude of the issue faced by the farming community within the catchment.

John McIntosh made the comment that we need to be careful not to only try to attempt to be nitrogen limited which might allow nitrogen-fixing cyanobacteria to dominate and potentially increase bloom risk.

Warwick indicated that it is difficult to be P limiting as nitrogen then is not targeted and the levels can increase.

Action – Andy to circulate questions and concerns to the group and bring back to the next meeting for a resolution of issues. Andy to email 2006 presentation to the group.

The meeting ended 2.30 pm

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