LakesWater Quality Society
(incorporation pending)
formerly known as The Lakeweed Control Society

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LakeScience Rotorua

A newsletter about research on the Rotorua Lakes

Produced as an occasional publication by the LakesWater Quality Society, in association with the Royal Society of NZ (Rotorua Branch)

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Welcome to the third issue of our email newsletter for those involved in or interested in scientific or management work on the Rotorua Lakes. It is up to **you** to make this informal newsletter a success by providing it with copy – our Society is merely providing the vehicle. We intend to email it free of charge to all those who attended the Rotorua Lakes 2001 Symposium and are on email, and also to anyone else who requests it. We will snail mail it on request. The newsletters will also be posted on the Royal Society (Rotorua Branch) website at www.rsnz.govt.nz/clan/rotorua. If you are interested in, or working on lakes, but not the Rotorua Lakes, we are still very happy to receive material from you and to send you newsletters.

The more copy we receive, the more frequently we will be able to send this newsletter out. Electronic copy is preferred but not essential. Only minimal editing is carried out. We hope to send another issue out in June 2002 – given sufficient copy.
Technical content of all contributions is essentially the responsibility of the authors

Material from this newsletter may be used provided that proper attribution is given.
All material and correspondence relating to *LakeScience Rotorua* to Nick Miller, millern@wave.co.nz, 91 Te Akau Road, R D 4, ROTORUA.

At the time of writing, cyanobacterial blooms are much in evidence, to the considerable disgruntlement of some residents, with angry posters appearing around Mourea and Okawa Bay, Lake Rotoiti. Certainly water quality issues are receiving much more attention in the Rotorua district than has been the case for many years. A meeting on the subject was held at Rotorua District Council earlier today (Wednesday 27th April). RDC have made financial commitments to a solution of the problem, subject to acceptance of the Annual Plan, and are now awaiting a delayed report on technical investigations.

Lakes chair, Waikato University
David Hamilton from the University of Western Australia has been appointed to this new position. We hope to have more details in our next issue.

NEWS ITEM
Forest Research and the Rotorua Energy Charitable Trust are funding a master's position on food chain dynamics and nutrient fate in Lake Rotorua using a stable isotope approach. Supervisors for the projects are Dr. Mike van den Heuvel (Forest Research), Dr. Brendan Hicks (Waikato University) and Dr. Nick Ling (Waikato University). The supervisor are currently seeking a top-notch masters student.

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GLEANINGS – a couple of interesting papers seen recently (other contributions to this section are welcome.) These slightly abridged abstracts are from papers published in *Water Science and Technology* Vol. 44 **No. 11-12, an issue devoted to wetland treatment of water quality problems.**

Plants as ecosystem engineers in subsurface-flow treatment wetlands
C.C. Tanner, 2001. *Water Science and Technology* Vol **44** No. 11-12 pp 1-8

Mass balance performance data from side by side studies of planted and unplanted gravel-bed treatment wetlands with horizontal subsurface-flow are compared. Planted systems showed enhanced nitrogen and initial phosphorus removal, but only small improvements in disinfection, BOD, COD and suspended solids removal, Direct nutrient uptake by plants was insufficient to account for more than a fraction of the improved removal shown by planted systems. Roles of plants as ecosystem engineers are summarised, with organic matter production and root-zone oxygen release identified as key factors influencing nutrient transformation and sequestration. (*Chris Tanner, of NIWA, needs no introduction to many of our readers*)

Performance of a recirculating wetland filter designed to remove particulate phosphorus for restoration of Lake Apopka (Florida, USA)
M.F. Coveney, E.F. Lowe, L.E. Battoe. 2001. *Water Science and Technology* Vol **44** No. 11-12 pp 131-136

Operation of a 14 km^2 wetland filter for removal of total phosphorus (TP) from lake water is part of the restoration program for hypereutrophic Lake Apopka, Florida. This system differs from most treatment wetlands because 1) water is recirculated back to the lake, and 2) the goal is removal of particulate phosphorus (P), the dominant form of P in Lake Apopka. The operational plan for the wetland is maximisation of the rate rather than the efficiency of P removal. A 2 km^2 pilot-scale wetland was operated to examine the capacity of a wetland system to remove suspended solids and particulate nutrients from Lake Apopka. TP in the inflow from Lake Apopka ranged from about 0.12 to 0.23 mg l^{-1} and hydraulic loading rate varied from 6.5 to 42 m ^{yr}-1. The performance of the pilot-scale wetland supported earlier predictions. Mass removal efficiencies for TP varied between about 30% and 67%. (*Oh, for USA-style restoration budgets. Perhaps Okaro or Okawa Bay…?*)

Our first contribution is from Ashleigh Bright of Waikato University

Dabchick survey

In early March a 6 month study investigating NZ dabchick/weweia breeding and nesting success will begin. The study involves finding and monitoring nests (monitoring with time lapse cameras) and observing NZ dabchick behaviour.

The study will be carried out on Lakes Rotoiti (mainly), Okareka and Tarawera, using canoe and sometimes a small motorboat. We will be searching for nests along shoreline in emergent vegetation, trailing willow branches, caves, crevices and jetties.

NZ dabchick is a protected endemic grebe, which formerly occurred in the South Island but is now confined to the North Island mainland. The total population is estimated at 1200-1500 birds, of which about 400 live on Rotorua lakes. The highest prevalence of birds is on Lake Rotoiti followed by Okareka and Tarawera.

NZ dabchicks prey on aquatic insects along with some fish, koura and molluscs. Nearly all feeding is done underwater and most dives are made directly from the surface. Dives average 20-30 seconds.

NZ dabchicks breed as pairs on small territories and peak breeding period in the Rotorua Lakes District is between September and March, but breeding can take place throughout the year. Recorded nesting success is poor probably due to water level fluctuation, wave action and disturbance of nests by other water birds.

The study is a joint collaboration between University of Waikato and Landcare Research and is supported by funding from the Department of Conservation, Rotorua District Council and Environment Bay of Plenty. Ashleigh Bright has being employed as a Research Assistant at the University of Waikato to assist with the study.

If residents around any of these lakes know of any dabchick nests or have seen dabchick pairs that may be nesting please let me know, any assistance or observations would be greatly appreciated.

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*Here are some contributions from Environment **B·O·P**, courtesy of John McIntosh, John Gibbons-Davies and Thomas Wilding.*

Lakes Restoration Study Tour

John McIntosh, Environment B·O·P, travelled to the USA for two weeks in September 2001, to examine the effectiveness of lake restoration strategies in Washington State. A report has been

completed and was presented to the Regulation & Monitoring Committee of Environment B·O·P on 10 March 2002.

Lakes Washington and Sammamish have similarities to Lakes Rotorua and Rotoiti and previously received the treated sewage effluent of greater Seattle area. Lake quality was greatly improved by diversion of the treated sewage effluent from the lakes via two long outfalls to Puget Sound. Further lake catchments are now being settled with little effect on lake quality by connecting houses to the main sewer lines. Stormwater control and treatment is incorporated into the design of new subdivisions and the glacial landscape lends itself to infiltration much as our volcanic landscape does.

Where lakes have suffered from past development and the quality of the water has deteriorated, intervention has been carried out to improve waters. Total success has not always been the outcome, however. Intervention is accompanied by reducing nutrient inputs from the surrounding catchment so that the restoration is not undermined.

Various restoration techniques include; alum flocculation, dredging, diversion of inflows (to or from the lake), aeration. In Washington State they had the advantage of a large pool of money that could be directed at a small number of lakes for a short period of time. In this way costly capital works could be carried out with the community picking up the maintenance costs. This pool of money had now dwindled because of the local political climate.

Education was a strong tool used to encourage individual practices that would lead to reduced nutrient flows from households while the local authority also clearly indicated where their infrastructure had the same purpose.

The local landscape was extensively wooded in native pine so that the natural character of the landscape was retained. However, the experience was sometimes lessened by the presence of a million and a half people and the transport networks. Very little agriculture was carried out in the two main lake catchments because urban development had displaced farming. The local authority had also purchased farms for water quality purposes and recreational facilities.

Lakes Water Quality

Environment B·O·P data on the water quality of Lakes Rotorua and Rotoiti for the six months to December 2001 indicates that there has been no change to their TLI's as reported in the Rotorua Lakes Water Quality Environmental Report 2001/29. A true indication of the water quality of the lakes will not be available until after the sampling year has been completed in June this year. The annual report will be available later this year.

Environment B·O·P has been involved in the work on Okawa Bay in conjunction with NIWA and RDC, and Dr David Ray, of NIWA, Hamilton, is currently writing up this work.

Aquatic Macrophytes as Water Quality Indicators Programme

Scientists from NIWA, Hamilton, are establishing this programme with the aim of using aquatic plants as indicators of lake quality, especially around the lake margins (littoral zone). Although still in the final stages of development, the programme focuses on the native and introduced species of aquatic plants, and how this compares to the overall health of a lake. Environment B·O·P staff have been assisting in establishing this programme over the past two summers, and are now waiting to view the final report that will be presented to the Ministry for the Environment in July this year.

Environment B·O·P will then decide if it will use this Indicator programme as part of its lake management process, depending on the findings in the report, and the costs involved in running such a programme. (*See below for more on this topic – Ed.)*

Blue Green Algae Monitoring

A windy summer has bought some relief from the blue green algae blooms. It was mid-January before blooms developed on Okawa Bay (Rotoiti), at least a month later than previous years. As many people will tell you, the algae more than made up for a late arrival by reaching very high numbers. Lake Rotoehu blooms yet again, but not to the same degree as previous years. Lake Rotorua was relatively quiet. Numbers are low for Okere Arm, but we need to keep a close eye on this area. Often it's a late bloomer (April-May).

Now a contribution from Tracey Edwards and John Clayton, both from NIWA.

LakeSPI – a new concept in ecological assessment

Ten Rotorua lakes from within the BOP region have been surveyed along with over forty other lakes from around New Zealand as part of a study to develop a biological method to indicate lake health. The result of this study is LakeSPI, a management tool based on key features of aquatic plants for assessing the ecological condition of water bodies. It focuses on littoral margins (lake edges) where submerged plants are most likely to be found and where greatest public interaction and perception occurs.

LakeSPI or 'Lake Submerged Plant Indicators' is a *new* concept, that has been developed by NIWA (National Institute of Water & Atmospheric Research) in conjunction with Pacific Eco-Logic with financial support from the Ministry for the Environment's (MFE) Sustainable Management Fund.

This new concept in monitoring, will allow lake managers to be able to quickly assess the health status of their lakes and to be able to monitor the trends occurring within them at both a regional and/or national level. LakeSPI can be applied to a wide range of lake types and conditions found in New Zealand. The method is practical, cost effective, sensitive to moderate change and can also be applied to historical vegetation survey data. It is anticipated that this type of monitoring would be required only every two to three years for most lakes, however high value and high risk lakes may benefit from more frequent monitoring.

There are two main purposes for the development of LakeSPI.

Firstly, there has long been a lack of cost effective methods for monitoring trends in water clarity, water quality and aquatic vegetation. High costs and levels of expertise have meant that in many cases present survey methods have not been systematically applied to all lakes. This has resulted in important lake trends not being observed and opportunities to manage lake problems being missed.

Secondly, it is hoped that LakeSPI will contribute to the implementation of a wider programme led by MFE that seeks to establish a complete toolbox of core environmental performance indicators for regional and national reporting purposes. Cabinet directed MFE to develop a national programme

of indicators to monitor performance in environmental management (EPIP – Environmental Performance Indicators Programme). Relevant national indicators that will be suited for the use of LakeSPI include the change in the biological condition for selected ecosystems and change in the distribution and relative abundance of weed species.

LakeSPI is based on a quick and simple field assessment of the 'Native Condition' and 'Invasive Condition' of submerged plants growing within a lake. Native condition is assessed based on various aspects of native plant distribution, diversity, depth and cover; while invasive condition, focuses on five particularly troublesome invasive weed species including *Lagarosiphon, Hydrilla, Egeria, Elodea* and *Ceratophyllum.*

Information from these two key factors (i.e. Native and Invasive Condition) contributes to the LakeSPI method, which interprets this information as a score or index. By generating a single index (i.e. Lake Condition) LakeSPI will enable lake managers to make comparisons between lakes, such as in the Rotorua region and enable change in lake condition to be detected over time.

So why have we developed LakeSPI? What are the advantages of using submerged plants as indicators of lake condition? Submerged plants are predominantly rooted or anchored to the bed of lakes and therefore represent a readily observable and measurable feature. This contrasts with many other biological indicators that may be highly mobile (e.g., fish) or difficult to sample, measure or identify (e.g., plankton). Submerged plants also have the advantage that they effectively reflect the range of environmental conditions supporting plant growth for an extending period of time prior to sampling. This contrasts with other physiochemical methods (e.g., water chemistry and secchi disc), which require frequent measurements throughout the year on account of their variability. Key advantages of the LakeSPI method are the rapid speed of implementation, the low frequency of measurements required and consequently the low cost of assessing lake health. The submerged plant indicators used in LakeSPI help to measure the effects of two major influences on lake ecology and condition:

- increased sediment and nutrients from catchment activities
- displacement of in-lake native vegetation by invasive alien plant species

LakeSPI should not be seen as a replacement for other methods of monitoring but should be seen as another valuable tool that managers can use to help manage and assess their lakes. Methods such as the Lake Trophic Index (as discussed in the last newsletter) and NIWA's full lake vegetation survey will still play a valuable role for providing a more comprehensive statement on lake status, as will others.

The simplicity and ease of use of this method is seen as one of the key factors to the long-term success of LakeSPI. It needed to be simple enough that it could be used quickly and with minimal expertise but still scientifically robust enough to detect real change with a high degree of reliability and we believe LakeSPI is meeting all of these requirements. The method has just recently been given a final field test in the Rotorua Lakes using EBOP scientific and technical field staff. The results of our LakeSPI scores will be presented in a later edition of this newsletter. A technical

report and end-users manual will be completed by the end of June 2002 and it is hoped that full implementation of the method will be carried out in 2003.

Tracey Edwards and John Clayton

NIWA, Hamilton

Here is a contribution from Paul Sampson, Rotorua District Council, concerning sewerage of lakeside settlements. Initially a report to the RDC Work's Committee presented earlier this month, it has been slightly abridged.

SMALL COMMUNITY SEWERAGE SCHEMES (8508400)

Introduction

At the March 1995 Works Committee meeting the following list was adopted to prioritise the need for sewering the District's small communities.

Table 1:

Community	Estimated Cost 1995 $M ± 25%	Estimated Cost (Updated) $M	Priority
Parekarangi	**0.61**		**1**
Mourea	2.77	3.30	2
Kennedy/Otautu Bay	1.15	1.37	3
Okere Falls	3.36	4.00	4=
Okareka	2.96	3.52	4=
Otaramarae	1.07	1.27	6
Awahou	0.94	1.12	7
Hinehopu	2.26	2.70	8
Reporoa	**1.39**		**9**
Gisborne Point	2.73	3.25	10
Tarawera	5.50	6.55	11
Rotoma	2.05	2.44	12
Mamaku	2.62	3.12	13
Total	**29.41**	**32.64**	

The updated estimated cost was derived by applying the latest construction cost index factor to the 1995 estimated cost. The updated cost is being presented to provide guidance in appreciating the magnitude of the issue at the present time.

Septic Tanks Leachate Study for Rotorua Lakes

In 1996, Environment Bay of Plenty identified the communities of Hamurana, Mourea, Hinehopu and Okareka as having potential to cause adverse effects on adjacent lake water quality.

These lakeside communities are currently on septic tank and disposal field systems. The decline of the lake water quality within these communities was perceived to be caused by failed on-site wastewater disposal systems.

Council in conjunction with NIWA recently completed investigations to determine whether leachate from septic tanks is the prevalent cause of lake water quality deterioration within these communities.

The results of the current investigation show that there are high background levels of nutrient input into the lakes. The difficulty to even measure the input from septic tanks indicates that overall its effect can be minimal. Whilst it is possible to produce technical solutions with high capital and operating costs, this needs to be compared against what options exist for the other larger nutrient inputs.

The result of the investigations are summarised below for each of the four communities:

Hamurana

There is relatively little contamination of Lake Rotorua from septic tanks. The groundwater seepage near the boat ramp thought to be possibly contaminated from septic tank, eventually dried out during the autumn of 2001.

EBOP has recognised the facts related to Hamurana and have deleted the area from the On-Site Effluent Plan requirements. Therefore, no further works will be undertaken on this community except for occasional inspection of the groundwater seep site to check that the seep does not reappear.

Mourea/Okawa Bay

Septic tanks along Okawa Bay contribute up to about two thirds of all the nitrogen inputs into the lake, which is considered significant. The limited natural water turnover capability of Okawa Bay was also cited as compounding the problem.

The management options that have been identified as a solution to the above issues:

- Removing the septic tank discharges from the catchment of the Bay and;
- Introduce a diverted flow of water from Ohau Channel to the Bay.

Detailed investigations have commenced towards the provision of a community sewerage scheme for the Mourea and Okawa Bay communities.

Further investigation and modelling work is now underway by NIWA to determine the feasibility of the Ohau Channel water replacement. The amount budgeted for the total project is $3.6m.

Gisborne Point/Hinehopu

Septic tanks between Hinehopu and Gisborne Point contribute only about 1 to 2% of the total nitrogen into the lake, which is considered insignificant.

There were few signs of bacterial contamination of groundwater at Gisborne Point last winter. Further sampling is due shortly to confirm the previous results. Based on the current results there appears little justification for a sewerage scheme based in the Gisborne Point area.

Groundwater sampling near the drain at the rear of the houses at Tamatea St (Hinehopu) showed high levels of bacterial contamination as did the discharge culvert to the Lake. To protect public

health, a sewage reticulation system collecting effluent from these house's septic tanks and disposal by soakage field to a site a considerable distance from the Tamatea drain is proposed.

Investigation of the feasibility of this solution will now commence once the latest results of Gisborne Point are received. It should be noted that a stand alone full treatment scheme for Hinehopu with the low number of houses some with infrequent occupation is unlikely to be feasible operationally. If Gisborne Point is included it may be possible with some difficulties.

If Gisborne Point is not an issue then the Hinehopu proposal is just to remove the discharge from the septic tanks to a subsurface disposal field more remote from the lake.

Okareka

Septic tanks at Okareka contribute to about one third of the nitrogen inputs into the lake. Studies undertaken on Councils behalf by NIWA/ESR (Executive Summary attached) have determined the safe setback distance between septic tanks and the bathing shores of Lake Okareka. The report indicates that if septic tank disposal fields are located at least 16++m from open drains or the lake shore (or 51m, if the more conservative Drinking Water Standards are adopted), public health risks to bathers should be minimal.

Further consideration is needed related to Okareka as it may well be that only a few septic tanks may be creating a potential health risk to bathers (non reported) which could be resolved upon redevelopment or a small scheme similar to Hinehopu. A fully reticulated scheme at $3.5m plus, needs to be considered against what options exist for the remaining 70% of nutrient input from the other land users, i.e. farming etc.

Further analysis of the investigation data will be undertaken to ascertain:

- The location and source of high nutrient readings along the lake;
- The extent of septic tank/disposal field systems not complying to the minimum setback distances.

Re-Assessment of Priority List

The priority list adopted in 1995 was developed based on a scoring system that took into account the effect of on-site wastewater disposal systems to public health and environment including community support for a sewerage scheme.

The application of scores was based on a subjective evaluation of each community.

The two areas of highest concern, Parekarangi (see Table 2) and Reporoa have been addressed by ground water lowering and to date has been successful.

The recently completed NIWA Septic Tank Leachate Study for Rotorua Lakes quantified the risk posed by on-site wastewater disposal systems to each community in terms of nitrogen input into and bacterial contamination of the receiving lakes. The results provide more robust data necessary for assessing the need for a sewerage scheme in each community.

EBOP in its Annual Plan submission to Council last year advised that this Council should also be looking at schemes for Tarawera and Gisborne Point. The reason appears to be somewhat anecdotal. Given the current research this Council has undertaken, there needs to be a 'meeting of the minds' of both Councils to determine what is to be the driver for such schemes given the high capital and ongoing operational costs.

The NIWA/ESR Report indicates that if septic tank discharges are 16+m, away from open drains or lake shores, bathing water standards should be met. In large part most septic tank are beyond 16 meters, however, this needs to be verified and some specific locations may need to be addressed. The EBOP Onsite Effluent Treatment Regional Plan addresses the standard of septic tanks and disposal fields, whilst not addressing the issue of nutrients to provide for upgrading of the systems The primary issue remaining is therefore not of public health but of nutrients to the lakes. The fundamental question is should this Council take the initiative to address the issue of nutrient removal considering the high capital and operating costs to ratepayers. The benefits are much wider to the whole region.

Considering all of the above, the adopted 1995 priority system has been tentatively reviewed (Table 2 below). The priority list of communities needs to be reassessed after septic tank leachate studies on the following communities adjacent to the major lakes is completed:

- Kennedy/Otautu Bay
- Okere Falls
- Otaramarae
- Awahou
- Tarawera
- Rotoma

The estimated cost to undertake the study is about $180,000 for the six communities.

Table 2:

Community	Estimated Cost (2002) $M	Old Priority	Current Status	Proposed Programme	Current Priority
Parekarangi	completed	1			
Mourea	3.30	2	Design in hand	Complete installation 2 years	1
Kennedy/Otautu Bay	1.37	3	Limited issues	Investigate*	
Okere Falls	4.00	4=	Limited issues	Investigate*	
Okareka	3.52	4=	Investigation 90% complete	Concept determined 2002/03	3
Otaramarae	1.27	6	Limited issues	Investigate*	
Awahou	1.12	7	Limited issues	Investigate*	
Hinehopu	2.70	8	Concept determined	Design 2002/03	2
Reporoa	completed	9			
Gisborne Point	3.25	10	Limited need	Unlikely to be justified	
Tarawera	6.55	11	Limited issues	Investigation 2003/04*	
Rotoma	2.44	12	Limited issues	Investigation 2003/04*	
Mamaku	3.12	13	Limited issues	Low priority - inland	
Total	**32.64**				
* Identify all septic tanks within close proximity to the lake re Bathing Water Standards and investigate the degree of nitrogen input into and bacterial contamination of the receiving lakes from septic tanks.					

Summary

Currently Council has a full 3 year programme to complete the upgrading of the Wastewater Treatment Plant, providing a solution for Okawa Bay and Hinehopu and finalise the Okareka situation.

Given that the current indications are that the Public Health aspect will be addressed within the current programme before bringing on additional capital works wider consideration of the body responsible for the priorities and who should fund such schemes needs to be addressed.

Conclusion

This Council has undertaken quite comprehensive research into the effect of residential land use on the lakes. Overall the public health issues can be addressed incrementally in isolated situations.

Where the residential areas are introducing low additional nutrient inputs, this needs to be considered as only one of the polluters, and options for improving the lake water quality considering all nutrient sources should be determined. If the capital cost and capitalised operating costs are considered it may well be that some higher upfront capital project would enable wider benefits. For example conversion of pasture to natural vegetation, i.e. creating a Regional Park would achieve a better solution.

In an overall context, the deterioration rate of the lakes from the residential and farming communities should also be understood.

RECOMMENDATION E02/03/019

A) THAT THIS REPORT BE RECEIVED.

B) THAT THE ADOPTED 1995 PRIORITY SYSTEM BE REVIEWED SUBJECT TO SITE SPECIFIC SEPTIC TANK EFFLUENT STUDIES.

C) THAT A RECOMMENDATION BE FORWARDED TO THE 2002/2003 ESTIMATES MEETING THAT $60,000 BE ALLOCATED FOR THE NEXT THREE YEARS TO UNDERTAKE THE INVESTIGATIONS TO DETERMINE THE DEGREE OF NITROGEN AND BACTERIAL CONTAMINATION FROM SEPTIC TANKS INTO THE RECEIVING LAKE ON THE FOLLOWING COMMUNITIES:

- **KENNEDY /OTAUTU BAY**
- **OKERE FALLS**
- **OTARAMARAE**
- **AWAHOU**
- **TARAWERA**
- **ROTOMA**

D) THAT THE ISSUE OF RESPONSIBILITY AND FUNDING OF CAPITAL TREATMENT AND DISPOSAL SYSTEMS TO MEET NUTRIENT STANDARDS BE DISCUSSED WITH EBOP AT THE POLITICAL LEVEL.

Readers may recall that in Issue 1 of this newsletter, we included an abstract of the following paper;

Lee, T.J., Nakano, K. and Matsumara, M. (2001). Ultrasonic irradiation for blue-green algae bloom control. *Environmental Technology* **22** 383-390

Here is a description of a commercial application of this technology.

Controlling Of Some Algae Using Ultrasound

Introduction

Controlling of algae using chemicals and or filters may not be a safe or economically viable option for water use applications such as drinking water, fish farming and hydroponics. For the last 4 years, the hydroponics industry in The Netherlands have been using ultra-sound devices for reducing algae levels. The reason for this is the requirement to recycle water and in doing so having to sterilise the water to avoid contamination.

Ultra violet lamps are used for sterilisation of the recycled water however for these to work the level of the algae during the warmer months must be reduced. The use of ultra-sound has no detrimental impact on the water quality and allows the ultra-violet to succesfully sterilise the water.

How Does It Work?

The frequencies that have been choosen to be emitted by the transducer are the resonance frequencies for sub-micron and micron sized cells. Over time the sound waves disrupt the gas vacuole contained inside most algae. The algae subsequently die, initially rising to the surface and then sinking after rain or wind disturbs the water surface.

Application in New Zealand

Trials are currently underway in New Zealand applications to check on the effectiveness of this technology. The results of a trial started October 2000 are discussed below. This trial is a drinking water reservoir at Helensville, controlled by the Rodney District Council. Since that trial we now have trials operating in oxidation ponds, sedimentation tanks, recreational pond, wildlife refuge lake and another drinking water reservoir.

Variables that affect Algae Growth and Subsequent Algae Numbers

Many factors can and do affect the levels and speed at which algae multiply. A reduction in Algae from one year to the next may be caused by a number of factors. The trial conducted at Helensville showed a reduction of the 3 types of algae being measured by greater than 75%. At the same time the water temperatures was 2 degrees warmer. We believe this size of the reduction in algae to be significant given the warmer water temperature. As results from other trials become available we will be able to use this information in gaining better knowledge on the ffectiveness of this technology and its application to the New Zealand market.

1.0 The Costs

The largest unit has a range of 150m radius from the face of the transducer. It emits sound waves in a 180 degree arc from this point and thus can cover an area of 3.5 hectares. Its power consumption

is 45 watts, its cost is NZ$7000 + GST installed. Where multiple units are required this cost will be reduced per unit.

Safety:
The unit requires 230 volt power this is however reduced to 12 volts for the signals sent via a cable to the remote transducer. It has been found that invertebrates located in the water are not affected by the sound waves.

2.0 Further Trials

We had planned to install two units in a small lake in the Rotorua District as a trial this summer. For reasons unknown this trial offer was not taken up by Rotorua District Council. Although two units would have only covered a small portion of the lake the location of the devices could have provided an interesting comparison with the rest of the lake given the relatively small movement of water in the lake. Rotorua District Council have shown interest in obtaining the results from other trials once they become available.

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Editor's note
*It will be interesting to see whether such an application of ultrasonic energy will require a Resource Consent for its field use. The RMA is somewhat obscure on the matter, at least on first reading. A "contaminant" is defined under the RMA as including energy (**excluding noise**), which would seem to cover Section 15, and although Section 13 forbids the disturbance or destruction of plants, indigenous or exotic, in, on, or under the bed of any lake or river, there are many who contend that cyanobacteria are not plants. Also, 'above' the bed of a lake is not mentioned. Hmm!*

One wonders whether suitable selection of ultrasonic frequencies would have any effects upon the vacuoles and metabolism of aquatic macrophytes. Certainly it is becoming recognised that the use of ultrasound can produce a variety of powerful biological, chemical and physical effects.