

Before the Commissioners appointed by Canterbury Regional Council

IN THE MATTER OF The Resource Management Act 1991

AND

IN THE MATTER OF Application CRC012011.1 by Christchurch City Council to
change/cancel conditions of the discharge permit Christchurch
Wastewater Treatment Plant into the Avon Heathcote Estuary/Ihutai

Submission from the Avon Heathcote Estuary Ihutai Trust



Treatment plant and oxidation pond processes.

1. My name is Alex Drysdale, I am the Chairman Avon Heathcote Estuary Ihutai Trust.

Introduction

2. In reviewing the information and advice that CCC has received over last few years concerning the current non-compliances it is no longer surprising that CCC are having difficulty deciding what they should be doing.
3. Two papers are of particular significance, they are recent, they specifically address the non-compliance issues and they come from reputed experts in their respective fields but they give conflicting recommendations.

Consultation and Discharge Audit Group

4. As a member of the Discharge Audit Group (DAG) set up to monitor the resource consent CRC012011, we were supplied with a considerable amount of information and reports about the operation of treatment plant and pond system. However information is of little use without understanding of the plant design and processes involved.
5. My previous experience with animal waste studies, treatment system design, monitoring and system operation was of direct benefit in assessing some of the information being supplied.

6. From the very first DAG meeting it was apparent to me that there was a serious problem looming in that there was insufficient effort being made to correct the concentration of the contaminants in the discharge that were to comply with reduced levels from 22/10/2005.
7. I raised this concern at the time but later found that it had been omitted from the meeting record.
8. I then took steps to have the matter of incomplete meeting records addressed as DAG had no powers, the meeting record would become very important if the DAG members ever needed to defend their position.
9. The point being that the DAG group members were in a precarious position of having a duty to audit the discharge. But with no independent means of recording meeting proceedings. No independent sources of expert advice. No means of effecting any recommendations about the discharge or plant operation and performance, they might wish to make. A duty without means is a wasted resource.

Documentation

10. The documents I refer to in my submission are:

Christchurch Wastewater Treatment Plant Operations Audit - May 2005, Australian Water Services.

Information presented by Dr. Rupert Craggs, NIWA, at Estuary and ammonia issues meeting, 1 September 2005 at ECan.

Agricultural Waste Manual, NZAEI Project Report No. 32. December 1984. Dr. Dale Vanderholm and Dr. David Warburton, Chapter 6, Aerobic Treatment.

Which refers to:

Ministry of Works and Development. 1974. Guidelines for the design, construction and operation of oxidation ponds. Public Health Section, MWD, Wellington.

Comparison of the advice from Dr. Craggs and AWS.

11. Both discuss the processes that can be used to remove ammonia. AWS addresses the whole plant and Dr. Craggs the aerobic pond processes.
12. AWS says the plant has good carbonaceous BOD removal and good disinfection performance with an ammonia concentration consistent with the expected performance of a treatment plant designed for BOD removal.
13. Dr. Craggs says the present low loading on the pond system following the upgrade of the secondary treatment plant has essentially turned the pond system into a eutrophic lake.

14. AWS report a concentration of 30mg/l BOD leaving the clarifier and that this is higher than optimal, which will increase oxygen demand in the ponds and reduce the possibility of achieving nitrification.
15. This 30mg/l BOD equates to a daily pond loading rate of 2.2g BOD/ m² (220ha pond area and a daily input volume of 161000m³)
16. I understand the optimum daily loading rate for an aerobic pond receiving municipal waste to be 8.4g BOD/m² with a depth no greater than 1 meter (MWD 1974).
17. It is interesting that AWS says a daily load 2.2g BOD/m² is higher than optimal when MWD advise a daily load of 8.4g BOD/m².
18. It seems CCC may be trying to operate in an aerobic treatment phase not normally used in naturally aerated pond systems. The CCC phase of operation seems to be more consistent with that of a dilute, high flow rate/low retention time mechanically aerated treatment process.
19. So perhaps one should not be surprised at the plants failure to capture nutrients and may be this is the explanation of the applicants AEE comment that the plant was never designed to achieve nutrient removal?
20. I understand the upgraded ponds are deeper than 1.5 meters. This is deep enough to allow the lower strata to become anoxic if poor natural mixing prevails or mechanical mixing is absent. When there is insufficient aeration, photosynthesis by green algae is restricted and if anoxic conditions prevail photosynthetic algae are eliminated from the pond.
21. Dr. Craggs further states that low organic loading on a pond system allows algae and bacteria grazing invertebrates to flourish. This in combination with the low organic loading means there is a deficit of inorganic carbon available for both nitrification and for ammoniacal N removal by algal photosynthesis and assimilation
22. The reduced photosynthesis combined with suboptimal organic carbon levels allows other nutrients to pass through the pond without taking part in the production of biomass. Biomass production is the key process to nutrient removal from a naturally aerated aerobic pond system.
23. CCC is keeping oxygen demand low by limiting the BOD load so that the ponds can be operated in a "deep" mode. This keeps the retention times up without having the penalty of having to increase the surface area to match the higher BOD load needed to sustain healthy algae and bacterial populations. By operating in this way the opportunity to capture nutrients by growing biomass is lost. But the single advantage is the preservation of indicator organism die-off rates.

Conclusions

24. My conclusion is the ponds are being loaded lightly to keep algae concentrations low by supplying insufficient amounts of organic carbon to sustain a healthy algae population that would otherwise restrict light penetration and thus impact on the indicator organism die off rates.
25. The issue is there is a fundamental disagreement about how naturally aerated aerobic ponds discharging to an Estuary should be designed, built and operated.
26. A further complication is the apparent disconnection of Enterococci numbers and fecal coliform numbers. It is of concern because the indicator organisms with poor co-relations may not be as reliable at indicating levels of fecal contamination as once thought.
27. It seems the CCC mode of operation is to achieve maximum indicator organism die off.
28. Dr. Craggs and MWD mode is to achieve optimal conditions to achieve optimal biomass production and nutrient removal by assimilation.
29. The applicant agreed to the original conditions but now seeks to have them changed rather than operate the treatment system in a mode that would allow the existing conditions to be met. The reasons they give to justify the change in conditions are weak. Especially in the light of the fact that knowledge of how aerobic treatment ponds receiving municipal waste behave has been well known for several decades.
30. I recall discussing the consequences of deepening the ponds with one of the applicant's advisors at the time of the original hearing. I recall being concerned that they intended to deepen the ponds and that this would lead to anaerobic conditions that would inhibit the stable operation of the aerobic treatment system.
31. The existing consent conditions are achievable. But we are having this hearing because CCC seem to have chosen to operate the plant and pond system so that indicator organism consent levels alone, are met.
32. It is the duty of the commissioners to determine that there is sufficient knowledge and experience available to select which mode of operation or combination of modes should be used so that the discharge from the pond system meets the existing conditions of the resource consent.

Recommendations

33. That the commissioners list the additional parameters and data sets they would have found helpful in reaching their decision. There have been comments made for some time now that it would have been beneficial if we had better data on several different issues. The Ihutai Trust has promoted getting several data sets on various aspects of the waste discharge to the estuary.

We started working on getting the fish surveys funded three years ago. However we are a voluntary organization and regretfully there are limits to how thinly we spread our resources.

34. That when considering pond performance, COD and BOD values be obtained because there are difficulties with BOD, if there are no living organisms in the samples to consume the dissolved oxygen. I understand that there are some rapid tests that use inoculated cells that may be a useful alternative.
35. That the long term pond data set does have value even with the apparent limitations claimed by the applicant. I have compressed some of the data from pond 6 into three groups of ten years and is shown in table one, Summary of Selected Pond 6 Data 8/01/75 to 19/02/2004. Table 2 Summary of Pond 6 Data Feb - April 2006 has been treated in the same way for direct comparison. Some of the values were < or >, these have been ignored and will be a source of error. But as I do not have access to the original data and do not know the reason for them being reported in this way I have included them as the value they are less or greater than.
36. This shows that:
 - Suspended Solids discharge increased in the period 1995-2004 then fell again to pre 1995 levels in the Feb- April 2006 period
 - BOD discharge remained constant over the period 1985 - 2004 and fell in the Feb- April 2006 period
 - Dissolved BOD fell in the period 1995-2004 and 02-04 2006
 - DO levels were lower in the period 1985-1994
 - TKN has risen from 20mg/l to 31mg/l to 35mg/l to 36mg/l in the 4 periods
 - Ammonia has risen from 15mg/l to 22mg/l to 28mg/l to 32mg/l
 - Nitrite was lower in the period 1985-1995 and very low in 02-04 2006
 - Nitrate has fallen from 0.82mg/l to 0.23mg/l and to 0.07mg/l in 02-04 2006
 - pH has remained constant
 - Temperature has remained constant
 - Total P has increased from 3.87mg/l to 6.91mg/l
 - Faecal col. was high in the period 1985-1994
37. That a Bioengineering Group (similar to the current DAG group) be given the opportunity to design and carry out pilot scale trials to confirm the issue of BOD loading on ponds in relation to the ammonia concentrations in the discharge. I estimate that this could be completed within 2-3 months.
38. That when this demonstration is complete and shown to be effective the ponds should be loaded with additional BOD to confirm the trial results.
39. It is important not to overlook the fact that the current "upgraded system" is ideal for the ocean discharge in that the SS content is low at about half the concentration discharged over the previous ten years. The indicator organism counts are low which is important when considering the community expectation that the beach must not be affected by the ocean outfall.
40. The proposed higher BOD pond loads are for the remaining period of the Estuary discharge and would cease once the pipeline is commissioned. They can be achieved simply by returning

a proportion of the removed biosolids to the pond input stream. This is the "Big Wheel" that needs to be turned to dial up the correct load to the ponds so that they receive sufficient levels of carbon to promote adequate algae growth.

41. It might seem counterintuitive at first glance to remove solids so they can be returned to the waste stream. However the clever part is they are a free source of carbon that you can easily regulate to control the ammonia levels in the Estuary discharge.
42. Dr. Maben showed a graph with a big dip in the pond ammonia levels in January 2005. It has been reported to me that this dip coincides with an accidental discharge of raw sewage to the ponds during a plant malfunction. If this is true then it seems that it should be investigated to verify that this additional carbon load on the ponds caused the ammonia levels to drop.
43. That pilot scale trials on various ways of increasing surface area in the ponds be carried out. I understand commercial devices are available but may have limitations in that they are susceptible to clogging over time. Rock is the poorest alternative and fine fibres have a much higher surface to volume ratio and show promise provided they can be cleaned occasionally.
44. When this issue was first raised by Dr. Craggs in September 2005, I made an alternative high surface area device that attempted to address the issue of clogging.
45. I have the first and second iteration that I showed the plant manager but in this format a full-scale version was considered to be too expensive. However without any trials to verify the concept of adding high surface area to volume occupied materials no progress is possible and the final solution will never occur if some basic research is not carried out.

Alex went on to discuss the relative surface area to volume ratios of various materials starting with 1 cubic meter A:V = 6:1, a 300 mm rock A:V = 20:1, a 1mm sand particle A:V = 6,000 a 0.7mm wire A:V = 5700:1, a 35µm wool fibre A:V = 3,900,000:1, a 13µ wool fibre A:V= 16,500,000:1

So to apply increased surface area to a pond to provide a place for bacteria to live, rock is the last thing you would add because it takes up all your volume for very little additional surface area.

The point being increased surface area is readily available using readily available materials and at reasonable cost. It's exact configuration needs to be determined hence the need to have a Bioengineering group sort out the exact details needed. This can happen quite quickly given good will and well intentioned co-operation of all concerned.

He also observed that the ponds were discharging compliant concentrations of NH₃ N in the period 1975 - 1984, if we knew what was happening then we would better understand how to achieve compliant levels now.