

IN THE MATTER OF: The Resource Management Act 1991

AND

IN THE MATTER OF: Lake Rotorua Nutrient Management – Proposed Plan
Change 10 to the Bay of Plenty Regional Water and
Land Plan

STATEMENT by: CHRISTOPHER RUSSELL HOOK

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Qualifications and Experience

1. I am a director and founding shareholder of Farmorganix Europe S.R.L, a private company registered in Romania, that holds a license from BioSoil Enhancers Inc., of Hattiesburg Mississippi, USA, to distribute its organic bio-fertilizer technology ("bio-fertilizer) throughout the EU and Ukraine; known as "Sumagrow".
2. I have considerable international business experience, and for the last four years my primary focus has been on introducing Sumagrow to several countries in Europe, completing registrations, conducting field trials with a wide range of crops, and establishing distributorships.
3. I have been involved with the Sumagrow registration process in New Zealand and discussed the technology with a number of parties including DairyNZ, AgResearch, and various farmers and growers.
4. In Europe, I have seen the beneficial effects of Sumagrow in comparative trials, in various soil types and growing conditions, with a wide range of arable crops and vegetables, comparing the performance of a fertilizer programme that includes Sumagrow, against the normal grower standard chemical application. These trials have been conducted in Greece, Bulgaria, Romania, Czech Republic, and Ukraine.
5. In virtually every trial to date, the crop grown with a fertilizer programme including Sumagrow and reduced chemical fertilizer out-performed the 100% chemically fertilized crop with yield increases typically between 10% and 30%; which reflects the results from a large number of trials conducted worldwide including USA, India, Vietnam, and China.
6. I have visited BioSoil Enhancers Inc. on two occasions, met various farmers who are commercial users of a product containing Sumagrow, and the scientists who continue the research and development programme at the University of Southern Mississippi, led by Professor Glen Shearer PhD.
7. I have a small indirect financial interest in the development of a market for Sumagrow in New Zealand, but have received no remuneration from BioSoil Enhancers Inc. relating to my submissions or for any other services, nor has BioSoil had any involvement in formulating my submissions. My primary interests are in Europe.

Purpose of my Submissions

8. All parties with an interest in the outcome of Plan Change 10 need to know that there is new biological fertilizer technology available that can make a significant contribution to solving the problem of high nutrient levels in Lake Rotorua, within a relatively short time period.
9. My submissions support the introduction of regulations proposed by Plan Change 10, and provide a range of scientific evidence to demonstrate that Sumagrow can replace much of the chemical fertilizer applied to land in the Lake Rotorua catchment for the purpose of reducing nutrient discharge, without the need to disrupt present farming activities.
10. Bay of Plenty Regional Council officers have rejected my submissions, but I fail to see how they can ignore the evidence I provided with regard to the effectiveness of new bio-fertilizer technology and the benefit its adoption by farmers in the catchment would have on current nutrient levels in Lake Rotorua.
11. My submissions provide clear evidence that advances in bio-fertilizer technology offers a new way to grow a wide range of food sustainably for human and animal consumption while at the same time protecting the environment from the damaging effects of chemical fertilizer.
12. My submissions identify what I regard as the major "road block" to the proper evaluation of current bio-fertilizer technology by research groups that represent dairy, sheep, and beef farmers in New Zealand.
13. My submissions also draw attention to New Zealand's obligations under the 2016 Paris Agreement on climate change and the fact that approximately 50% of all greenhouse gas emissions are from agriculture, with a significant quantity due to the excessive use of chemical fertilizer.

Fertilizer Industry in New Zealand

14. Approximately \$1.5 billion is spent on chemical fertilizer each year in New Zealand, and while I don't know the tonnage this represents, somewhere in the range of 25%

to 40% of the total is not utilized for the intended purpose and enters the environment, either leaching into fresh water reserves, or as a greenhouse gas emission (nitrous oxide) into the atmosphere.

15. This wastage represents a significant economic cost to farm operations and gives rise to huge expenditure on the mitigation of damage to water resources.
16. This wastage also represents many tons of fertilizer, and while I have seen no data to confirm the tonnage of nitrogen and phosphate applied to farm land in the catchment, or leaching rates, the 240 tons that Plan Change 10 is intended to remove from Lake Rotorua may well be achieved by farms in the catchment doing nothing more than changing from chemical to bio-fertilizer.
17. According to submissions by the Fertilizer Association, Ravensdown and Ballance Agri-Nutrients (“fertilizer companies”) supply 98% of the chemical fertilizer consumed in New Zealand and are owned as co-operatives by some 45,000 farmers.
18. The fertilizer companies and Government have funded much research to date that has sought ways to mitigate the adverse effects of chemical fertilizers on the environment. However, there remains strong opposition to any regulatory controls that might limit fertilizer input rates, with the obvious reason being that to do so would have a negative impact on revenue and profitability of the companies and their farmer shareholders.
19. It seems clear that the only way to reduce on-farm consumption of chemical nitrogen and phosphorus is through regulation and that requires Government to break the nexus between the fertilizer companies and their shareholders. Collectively, they are acting in a monopolistic manner, and in self-interest, with society being left to incur the clean-up costs, which is unacceptable in a “user pays” society.
20. This situation has become of such prominence that there is a continuing public dispute between Greenpeace and DairyNZ over a recent advertisement about the detrimental effects on the environment from intensive dairy farming.
21. The Greenpeace advertisement touched a raw nerve, but what was said in the advertisement is thought by many people in this country to be fact.

22. How New Zealand's environment is to be managed in future is going to be one of the major issues that will be debated in the lead-up to this year's general election.
23. The new "Opportunity Party" has a stated policy that "Economic growth must not come at the expense of the environment", and I believe this will resonate throughout our society as an important long term goal for the country.
24. Sustainable future growth from New Zealand's primary industries is an important long-term objective, but we must not let the environment of New Zealand deteriorate to the extent it has in various Asian countries, and indeed parts of Europe.
25. Given the extensive research into bio-fertilizers being conducted worldwide, it is inevitable that usage of bio-fertilizers will increase in future years.
26. As farmers in general, and their research organizations appear unwilling to taking the lead to fully evaluate bio-fertilizer as an alternative to the continued use of chemicals it seems to be an imperative for Government to direct that appropriate and independent research be conducted in the interests of the country as a whole.

Scope of Evidence in my Submissions

27. It is clear that farmers who oppose implementation of Plan Change 10 anticipate a lower production from their properties and negative economic consequences. However, it is not in the farmers or New Zealand's interests for this to happen, nor should that need to eventuate as the price to pay for protecting the environment.
28. Based on the evidence in my submissions, production can be maintained and probably increased by catchment farmers, and indeed farmers throughout New Zealand, if new bio-fertilizer technology is adopted.
29. My submissions recommend the replacement of chemical nitrogen and phosphorous with a bio-fertilizer that is proven to be effective. Sumagrow is one, but there are others available that have similar functionality, and another option would be for farmers to change to an organic fertilizer regime.
30. Much of the evidence in my submissions is based on overseas research & development, field trials, and commercial users of a product containing Sumagrow, and while technical support is available from the USA it is ultimately the responsibility

of end users and their research organizations to conduct trials and satisfy themselves that the new technology can replace chemical fertilizer.

31. This is not happening in New Zealand because of the “closed market” existing between fertilizer companies, farmers, and their research organisations.
32. DairyNZ has been offered an opportunity to trial Sumagrow, but senior management declined to do so after a brief review of information I provided, saying they believed Sumagrow offered no benefit to dairy farmers. This can be easily disproved.
33. In 2014 it was stated in a published report that the only way to have dairy farmers in the Lake Rotorua catchment mitigate nitrogen discharge further was either through regulation or provision of financial incentives.
34. This was the conclusion reached after a four year research programme conducted on dairy farms in the catchment in a report published under the title:

“Nitrogen Losses from Lake Rotorua Dairy Farms; Modelling, Measuring and Engagement” Ref: www.massey.ac.nz/workshops Paper Park 2014

In the section “Commentary on Farmer Engagement”, it was stated as follows;

“Generally, the difficulties were more highly weighted than the positives, with the final conclusion being that any significant changes (over and above the efficiencies already undertaken by catchment farmers) would require a shift in the regulatory environment and or provision of incentives”.

35. Little seems to have changed three years later and it appears self-evident that the only way to reduce nitrogen and phosphorus discharge from chemical fertilizer applied to land in the catchment is to impose regulations.
36. My evidence clearly shows that bio-fertilizer technology provides a strong case to strictly control, or prohibit by regulation, the application of chemical nitrogen and phosphorus on pasture in such a sensitive area as the Lake Rotorua catchment.
37. This is not just my opinion. It is based on international research by highly regarded soil scientists, extensive trials, and commercial use of biological products.

38. If regulations restricting application rates of chemical fertilizer are phased in as I believe are practical there would be certainty about the reduced level of nitrogen and phosphorus entering Lake Rotorua as leachate from farms in the catchment. **If no chemicals are applied to the land, there are none to leach.**
39. I have seen nothing in any other submission that provides certainty as to a minimum reduction in nitrogen and phosphorus discharge from farms in the catchment. **Only the introduction of bio-fertilizers can give that assurance.**
40. There is scientific evidence to say that if animals are fed grass that is bio-fertilized , there would be further reductions in leaching, particularly as soil would be less compacted, able to absorb more moisture (water and animal urine) and hold that moisture within a much deeper rhizosphere for use by the plants when required.
41. The expert evidence in the schedules attached to my submissions, and that provided by Dr Phillip Schofield, of Abron Limited, is conclusive. There is a new way for farmers and growers to fertilize their land, and in most if not all situations, changing from chemical to bio-fertilizer should not have a negative impact on the economics of current farming activities.
42. A significant source of leached nitrogen is from animal urine, and one way some farmers have mitigated nitrogen discharge from their properties is by lowering the stocking rate. Adoption of a bio-fertilizer will have a beneficial effect in terms of enabling the land to support a higher stocking rate per hectare.
43. The present nitrate content in urine will be lower if animals are fed on pasture and fodder crops grown with a bio-fertilizer, and there is research being conducted today in New Zealand on ways to remove nitrates from cow urine. A lot more work needs to be done, but the point I want to make is that only through regulation, will farmers and their researchers take a serious interest in finding ways to reduce / eliminate the use of chemical fertilizers while maintaining production and profitable farming operations.
44. Nitrous oxide, which is approximately 300 times more potent than carbon dioxide, results from soil becoming anaerobic. Nitrates from chemical fertilizer reduce to nitrous oxide, which is released into the atmosphere. This is an important issue that needs to be addressed on a national basis under a plan to reduce emissions.

45. While not part of the Paris Agreement, improving the quality of fresh water in streams, rivers, underground aquifers, and lakes, is also an increasingly important environmental issue, and while the Commissioners' focus is on a plan to improve the quality of water in Lake Rotorua I believe consideration needs to be given to New Zealand's obligations under the Paris Agreement as it relates to reducing emissions from the use of chemical fertilizer.
46. Agriculture is a very important sector of the New Zealand economy, but it must adapt over time to meet the reasonable demands of society with regard to protecting the environment for future generations.
47. There is much evidence available to show that most large multi-national food companies are investing heavily in "sustainable agriculture", and one with which I have personal contact is estimated to be investing over US\$200 million a year to achieve a goal whereby all of its food crops are grown sustainably. They see this as essential to maintaining a viable business and supporting its long-term capital value.
48. New Zealand's agriculture producers need to adopt a similar attitude to sustainability, and while some have committed to this principle, my discussions with farmers and growers, albeit limited, indicates that most are only willing to pay lip service to the concept although they clearly understand the need to nurture their land. Profit today appears to be more important than making any contribution to protection of the environment.
49. I believe that if bio-fertilizer is adopted by farmers in the Lake Rotorua catchment, the proposed lower discharge limits from their properties can be met without the need to change current economic activities or the need for financial compensation;
- i) Products containing Sumagrow, being the technology with which I am most familiar, enable plants to source nitrogen from the atmosphere, and unbind phosphorus and potassium in the soil that is not otherwise available to plants.
 - ii) In recent years, biological scientists in USA and Europe in particular have developed effective and reliable bio-fertilizers with long shelf-lives at ambient temperature that can fertilize large areas of land and replace or substantially reduce the use of chemical fertilizer.

- iii) Experience in the field has shown that for crops requiring heavy application rates of nitrogen fertilizer, new biological products can generally replace 50% of the chemical nitrogen, and with others, including pasture, chemical nitrogen and phosphorous can be eliminated over time.
- iv) By way of example, I have a personal involvement with a 2016 field tomato trial conducted in Greece on two precision farms that supply a multi-national food company under its sustainable food crop sourcing programme. When a product containing Sumagrow was applied at the rate of 10 litres/ha, the chemical fertilizer was reduced in one case by 500kg/ha, and in the other 600kg/ha. Crop yield and quality were maintained. If these reductions were applied to the company's total crop grown in Greece on just 500 hectares, the total reduction in chemical fertilizer per crop would amount to approximately 250 tonnes. What is happening to the excess fertilizer applied to each crop? It is primarily lost in surface run-off, or volatilized into the atmosphere as nitrous oxide.
- v) My experience from working in Europe reflects the original findings from research and development undertaken at Michigan State University, various independent institutions, and the University of Southern Mississippi, where there is a research laboratory with two scientists continuing development work that seeks to improve the performance of Sumagrow.
- vi) While I have no first-hand experience with the application of Sumagrow to pasture, I think it is reasonable to accept the evidence of Dr Allen Williams, and Dr Schofield, which clearly states that extensive trials in the USA and New Zealand with pasture and fodder crops have established that nitrogen fertilizer does not have to be applied to grow grass successfully.

50. It is apparent that all research and development undertaken to date and as proposed to be continued by the Lake Rotorua Primary Producers Collective, and its supporters, assumes that the only chemical fertilizer inputs will grow pasture and fodder crops.

51. Farmers representing the Lake Rotorua Primary Producers Collective, have shown no interest in evaluating Sumagrow to determine the beneficial effect that its use will have on the present level of nutrient discharge from farms in the catchment; despite being offered product for trials, and technical support.

52. This situation leads me to ask two questions that need to be addressed;

- i) Why is biological fertilizer not being adopted by farmers in New Zealand?
- ii) Why are farmer research organizations not evaluating biological fertilizers, including Sumagrow technology?

The answer appears to be self-evident. It is due to the strong nexus between research organizations and the chemical fertilizer companies that are owned by many farmers. It is a closed market.

53. These parties do not have any economic interest in evaluating new biological technology, let alone adopt a product that can replace chemical fertilizer.

54. The only way this may change is through the introduction of regulations, which in turn, should encourage farmers to fully evaluate the bio-technology option. I also believe such an evaluation should be a pre-condition to granting any financial compensation if farmers say they cannot maintain their incomes and comply with the lower nutrient discharge required from their property under the Plan Change 10.

55. There are numerous new biological products coming to market in the USA and EU, but in New Zealand, with such a strong financial links between farmers and the dominant chemical fertilizer companies there is little incentive for new products to go through the registration and market development process.

Biological fertilizers as replacements for chemicals (NPK)

56. The biology relating to poly-microbial bio-fertilizers is well understood. They are formulations constructed with several strains of naturally occurring soil microbes in very high concentrations that function symbiotically to enable plants to access the nitrogen they need from the atmosphere, and unbind phosphorus and potassium in the soil, which plants cannot otherwise access.

57. The expert evidence presented by Dr Schofield in support of my submissions deals specifically with his hands on experience in applying “a soil biology friendly fertilizer programme” to optimize pasture growth in New Zealand. His photographic evidence is clear and he reports that the biological option is being used increasingly by those farmers who recognize the damaging effect that chemical fertilizers have on soil.

58. Dr Schofield's evidence is supported by research conducted by the New Zealand Biological Farming Systems Research Centre in conjunction with the Rotorua Lakes and Land Trust (RLLT) – a joint venture set up in 2005 between Te Arawa Federation of Maori Authorities and Rotorua/Taupo Province of Federated Farmers. (See report attached under the authorship of G. N. Magesan and Gifford McFadden)
59. The RLLT report refers to a Massey University study which showed that the nitrogen contributions in urine from dairy cattle in organic farms was 645kg/ha compared with approximately 1,000kg/ha from conventional farms. It also refers to overseas studies that have reported reduced nitrate losses from alternative farming practices of between 59% and 62% compared with conventional practices.
60. In my view, the evidence is conclusive that significant nitrate leaching reductions will occur naturally if farmers in the catchment change their fertilizer regime from chemical to biological.
61. Schedule 1 of my submissions is a chapter from a book by Professor C. A. Reddy who lead the research conducted at Michigan State University over a number of years that resulted in the technology known as Sumagrow.
62. Professor Reddy reached the conclusion that *“poly-microbial formulations (Sumagrow in this case, referred to as F2) decrease the need for nitrogen fertilizers by almost 50% and pesticides, and have the possibility to greatly increase crop productivity with less dependence on chemical fertilizers and pesticides, greatly reduce the cost of cultivation, and alleviate negative health and environmental consequences associated with the use of the latter compounds”*. These are the key requirements for sustainable agriculture.
63. Schedule 2 is a paper by Dr Allen Williams PhD. a leading USA pasture scientist and advisor on food production and management, who is also recognized as an expert in grass-fed livestock production.
64. In this paper, Dr Williams discusses the importance of high organic matter (OM) in soil, which chemical fertilizers reduce, while biological fertilizers increase. I quote Dr Williams, who says; *“for every 1% increase in soil OM there are 1,000lbs of soil nitrogen, 100lbs of phosphorous, and 100lbs of potassium (potash) in the top 6 inches of soil”*. He goes on to say ***“In soils with organic matter of 4% to 5% the value of the soil organic matter is US\$ 3,000 per acre.***

65. Dr Williams also refers to a study conducted in New Zealand comparing the value of production from dairy farming on land with low and high organic matter in the soil. It was found that *"pasture with high OM produced an additional NZ\$150/ha in milk solids, and the study concluded that **the accumulated loss for low OM pasture, accounting for decreased forage and dry matter and milk solids production, was NZ\$1,239/ha**"* (in 2006) Ref: (Sparling et.al. J Environ.Qual 2006 Mar 1:35(2):548-557)

66. Schedule 3 is a paper by Phyllis Tichinin, a well-known Hawkes Bay scientist who is critical of New Zealand dairy farmers and the indiscriminate use of Urea to grow grass and the adverse effect this has on soil and animal health.

67. Arise Research and Discovery of Illinois, USA, conducted a comprehensive programme which had a focus on the reduction in nitrate leaching from soil in which corn was grown. A summary of this report is enclosed as Schedule 5 to my submission, but can be summarized by saying that when chemical fertilizer was reduced 50%, and replaced with a small quantity of a product containing Sumagrow, the nitrates in the run-off reduced by almost 80%, compared with the trial area that received 100% standard chemical fertilizer application.

The crop yield from the Sumagrow treated area was also 19% higher than the control, and produced a valuable economic benefit.

The reasons for such a dramatic reduction in nitrate leaching are easily recognized;

- 1) Only 50% of the standard chemical fertilizer was applied,
- 2) The inclusion of Sumagrow enabled the soil to retain significantly more irrigation and rain water.

68. There is now ample evidence from soil scientists in USA, Europe, and New Zealand who maintain that bio-fertilizers have the potential to replace much of the chemical fertilizer currently applied to agriculture land, and reduce nitrate and phosphorous leaching into fresh water resources.

69. It is not the role of the reputable USA scientists who discovered, researched, and subsequently developed the new technology, or the suppliers of products containing the technology to prove its efficacy to farmers in the Lake Rotorua Catchment.

70. In my view, farmers in the catchment, and their research organizations (DairyNZ in particular) have an obligation to satisfy themselves as to the efficacy of new bio-fertilizer technology if they will not accept the evidence presented by prominent overseas universities. Furthermore, once satisfied as to the new technology's performance, they should adopt it, regardless of their economic interest in the chemical fertilizer companies.

Biological fertilizers and their benefit to Lake Rotorua

71. My submissions and summary of recommendations, if implemented, are the only ones presented at this hearing that can guarantee an early and significant reduction of nitrogen and phosphorus leachate entering Lake Rotorua from farms in the catchment.

Economic and Environmental Considerations

72. Given the availability of bio-fertilizers in New Zealand, and evidence in my submissions, it is debatable as to whether or not nitrogen input restrictions placed on farms will have a negative impact on operating profitability.

73. In fact, the evidence I present points to a likely improvement in economic performance from farms that adopt bio-fertilizer to grow grass and crops.

74. There are many people in society who would say that the farmers who create environmental problems should be responsible for fixing them and meeting the financial cost of doing so.

75. There is little doubt that farmers would object to any form of levy or specific contribution required to remediate environmental damage they cause and this has the potential to become a divisive issue in society if not addressed. This has been recognized as a potential problem by the Parliamentary Commissioner for the Environment in a recent report to Government.

76. While there is evidence that farmers who switch to using a bio-fertilizer will benefit from an improved economic performance, the factual position can only be established through comprehensive scientific evaluation.

77. By way of example, if dairy farmers in the catchment eliminate chemicals from their fertilizer programme, and convert to organic production using a product containing Sumagrow, or similar, they would receive a significantly higher pay-out for milk solids from Fonterra.
78. Many articles have been published in national newspapers and social media expressing concern about the damage that chemical fertilizer is causing our environment, and in particular, water quality. The problems are now widely recognized throughout society, and there is a growing voice that says farmers must change their fertilizer practices.
79. This has culminated in Government making an announcement relating to improving the quality of waterways by 2040, with the primary activity being to fence of thousands of kilometres to prevent farm animals having access.
80. In my view, and of at least equal importance, would be the introduction of a policy requiring farmers to make substantial reductions in the application of chemical nitrogen and phosphorous to pasture, and also commercial growers of arable and vegetable crops.
81. Plan Change 10 is one example of a growing division within our society. On the one hand we have farmers who believe it is their right to use their land as they determine, and others with an equally strong belief that farming activities must be conducted in sympathy with the needs of society as a whole and the environment - not just for today - but for future generations of New Zealanders.
82. One thing that is certain is the decision on Plan Change 10 will not please all parties.

National and Global Considerations

83. Matters of national importance such as lowering the country's emissions and maintaining the environment to the agreed standard need to be dealt with as decisive bi-partisan political decisions that are clearly explained and accepted by society. In my view, time is not on our side to deal with individual and regional issues such matters as Plan change 10 under the Resource Management Act.

84. I appreciate that this hearing is dealing with a specific issue. But in my view, the correct outcome will only be reached if it is consistent with New Zealand's obligations under the 2016 Paris Agreement, and the important global issues relating to climate change.
85. My submissions are primarily those of an advocate for the introduction of bio-fertilizers, which I say must be adopted in future by farmers and growers in New Zealand.
86. There is a global need to conserve non-renewable energy sources. Natural gas is the primary raw material for nitrogen based fertilizers, of which a significant percentage of the annual production is wasted into the environment. This is now having a serious negative impact on the quality of fresh water resources in many parts of the world, and is a significant contributor to global warming.
87. Another issue is the comparative capital costs associated with manufacturing equivalent volumes of chemical and biological fertilizers, the energy consumed in the manufacturing processes, and cost of distribution.
88. These are big subjects in themselves, but everything points to very significant economic and environmental benefits being gained from the adoption of bio-fertilizer, which is starting to be evidenced by commercial use, and also by the huge sums being invested in biological research by multi-national chemical companies such as Monsanto and Bayer.
89. The Paris Agreement obligates the Government of New Zealand to start implementing a programme that will mitigate current levels of greenhouse gas emissions, of which approximately 50% are produced by agriculture. Government must act decisively, and regulations requiring a substantial reduction in the use of chemical fertilizer are a high priority.
90. In the 50 years between 1960 and 2010 the world's population increased from 2.5 billion to 6.5 billion, and is estimated to increase to 8.5 billion by 2030.
91. In the same 50 years, production and consumption of chemical fertilizers increased fivefold, while food production volume has only doubled (approximately). There is a

huge excess of chemical fertilizer applied to land every year and this must start to reduce if greenhouse gas emissions and global warming are to be halted.

92. Some climate scientists say the point of no return for mankind may be reached by as early as 2050 and that there is an imperative to take action now.
93. New Zealand is blessed with a good climate and all the natural resources needed to grow high quality food, which it has done successfully for many years, through hard work by farmers and innovation. But, in future, this may be all to no avail unless farmers change their current fertilizer practices
94. Farmers should not be looking to cut agriculture production to protect the environment without first evaluating all options to maintain and increase production using new technologies.
95. The global market for bio-fertilizers and bio-pesticides is growing at a compound rate of about 15% per annum, and in five years from now it is projected to be worth in excess of US\$10 billion.
96. In contrast, chemical fertilizer production and consumption seems to have plateaued and is likely to start going into decline.

Summary

- A. The use of chemical fertilizers at the present application rates must be reduced if;
 - i) New Zealand is to meet its emission reduction obligations under the Paris Agreement on climate change,
 - ii) Water quality is to improve and costs of mitigation reduced.
- B. Dairy farmers in the Lake Rotorua catchment are unwilling to make further voluntary changes to their economic farming models without regulation and or financial incentives.
- C. Regulation of nutrient discharge from land in the Lake Rotorua catchment has become necessary, and if bio-fertilizers are adopted by farmers, financial incentives may not be required to achieve the desired outcome from Plan Change 10.

- D. There is clear scientific evidence from the USA, Europe and New Zealand that adoption of a bio-fertilizer will significantly reduce the level of nutrients in run-off water and retain urine from animals within the soil rhizosphere for the root systems of grasses to use as a slow release fertilizer.
- E. Farmers in the Lake Rotorua catchment and their research partners should be required to evaluate bio-fertilizer technology, which may require up to three years to determine the overall benefits. But there is extensive evidence that says bio-fertilizers available now can support farm production while achieving the environmental benefits sought by Plan Change 10.
- F. Government needs to give high priority to implementation of a plan that meets New Zealand's obligations under the 2016 Paris Agreement on climate change, and one of the most important issues it must deal with is the current level of emissions from agriculture, and improving water quality.

C R Hook

Date: 25 February 2017