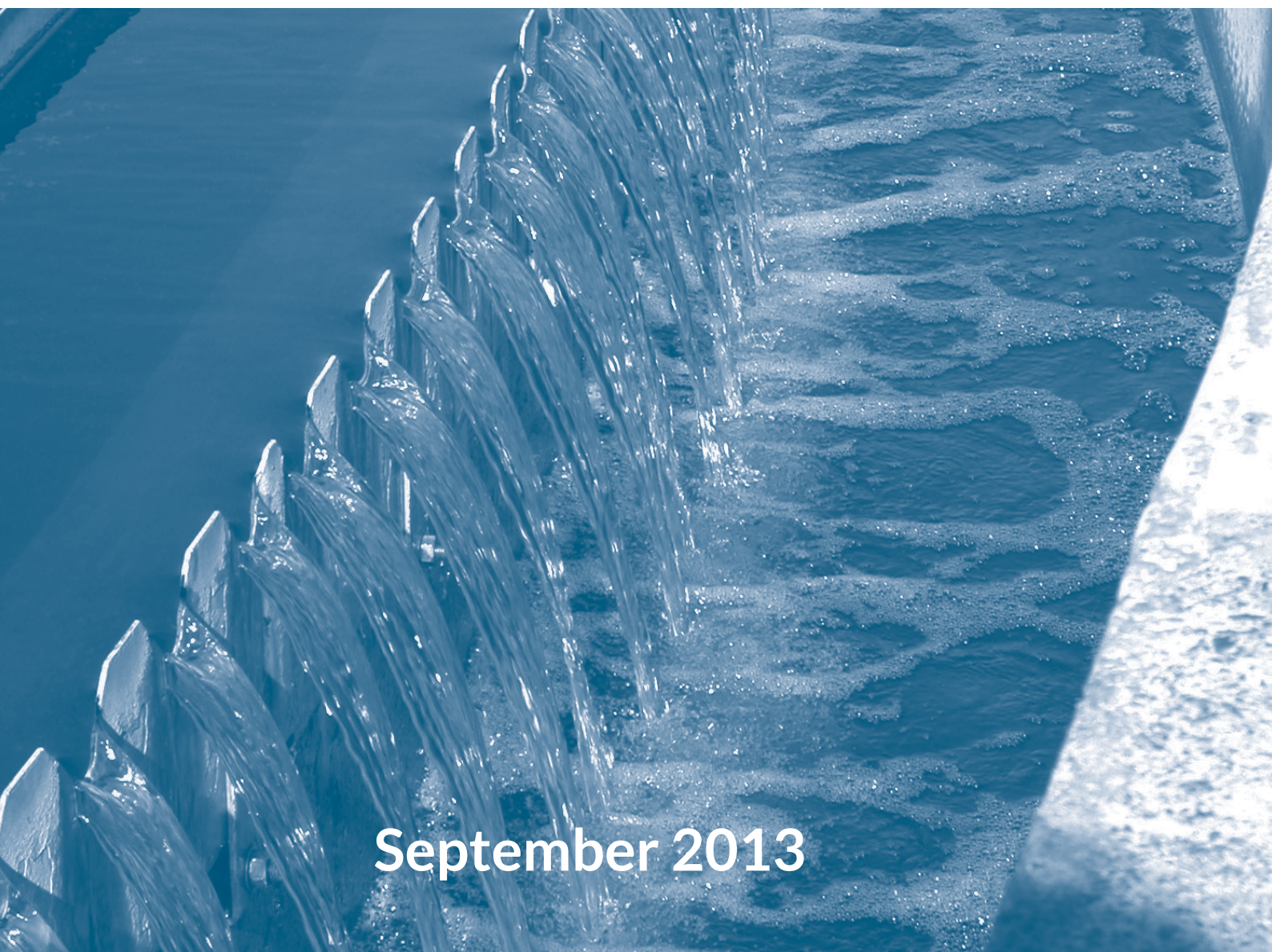




Project Rotorua **Clean-Water**

Lakes **WATER**
QUALITY Society



September 2013

EDITOR'S NOTE

The sources of these Proceedings were fully transcribed audio tapes and presenters' PowerPoint files. The record of the spoken word was edited and key graphs and pictures from the PowerPoint slides inserted into each presentation. Slides that contained only text were incorporated into the textual document where possible. Drafts were sent to the original presenter to check for accuracy.

Discussion sessions and the Breakout Forum have been included. These were somewhat more difficult to transcribe and may include some inaccuracies.

I would like to thank all the presenters who have kindly helped me with editing. It is a mammoth task. In the interests of expediency and accuracy I very much appreciated their support.

Ann Green

Disclaimer: These Proceedings report the formal presentations and workshop sessions of the Workshop, which was designed to encourage open discussion amongst the stakeholders and those with a strong interest in the management and development of the Rotorua catchment. The information is **not** intended to substitute for official policy statements from parent organisations.

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FOREWORD

The Project Rotorua Clean-Water field trip and workshop was organised by LakesWater Quality Society with the support and assistance of the Rotorua District Council.

The need for this workshop was identified at our Society's recent symposium on Transferable Development Rights. Councillor Dave Donaldson commented that there was constraint on future economic development imposed by the capacity of the Rotorua Wastewater Treatment Plant. The current Land Treatment Disposal System faces significant problems, and conditions of discharge consent are being breached. The newly commissioned lakeside sewerage schemes have added to the pressure.

This came as a surprise to many in the room. Our Society undertook to assist by engaging the wider Rotorua community. We sought to set out the facts of the Wastewater Treatment Plant situation and to explore the options available for the future: both to deal with existing problems and to allow for expansion. Invitations were sent to stakeholders to participate in a half day field trip, and a one day workshop held at Te Ao Marama Hall, Ohinemutu on Tuesday 1 October 2014. This document is the record of the proceedings of the workshop.

I would like to record my appreciation of the very professional way the workshop was managed and conducted. Special thanks go to Ian McLean and Warren Webber who facilitated the workshop. The spirit of respect for each other's views, and the acknowledgement that the Wastewater Treatment Plant is the responsibility of all members of the Rotorua community, allowed for full and frank discussion. The outcomes are summarised on page 82 and have been sent to the Rotorua District Council. The Council has set up a Project Steering Committee to advance the work.

I hope that in this spirit our community can now move forward to find enduring and sustainable solutions for the long term future of the Rotorua Wastewater Treatment Plant.

John Green
Chairman
LAKESWATER QUALITY SOCIETY

Key Facts

25 years ago the outflow from Rotorua sewage treatment was damaging water quality in **Lake Rotorua**. After spending of **\$60m** on the sewerage system, the Lake is improving. So too are Lakes **Rotoiti, Tikitapu,** and **Okareka** as a result of reticulation

Discharge through the “Land Treatment System” (LTS) in **Whakarewarewa Forest** initially worked well. Now it is not removing much **nitrogen**, and too much water is affecting the trees

The **nitrogen** level in Waipa Stream below the LTS has been more than the RMA consented level of **30 t nitrogen annually** for some years. The phosphorus level is within the consent of 3 t annually

The nitrogen level in the discharge from our wastewater treatment plant is **5.5 ppm**. This is the lowest of any city in **NZ**. Reducing the nitrogen further will be very expensive

The proposed BOP Regional Policy Statement sets out permitted nitrogen discharges into Lake Rotorua. **BOPRC** is planning to allow nitrogen trading amongst nitrogen dischargers in the catchment

The **Puarenga** stream has high coliform levels, arising from several sources

The population of Rotorua has been static for years. The sewerage system needs **capacity to handle growth in the city and district**

The existing consent expires in **2021**. A long term **sustainable** solution is required. This will take several years to implement. In the **interim** we need changes to our current consent to enable us to comply

The above facts are open for **discussion**, challenge or **endorsement** during the workshop

History of Wastewater Treatment in Rotorua

1891	The first sewers were laid in the CBD
	Treated effluent discharged to Lake Rotorua
1935-69	Septic tanks removed and replaced with reticulation in main suburbs
1973-78	\$2 million upgrade to serve 60,000. New Wastewater Treatment Plant – screens, shredder, grit separation, primary sedimentation, activated sludge, clarifier, sludge digestion
1978	Ngongotaha and Eastern suburbs were reticulated
	Stormwater is reticulated separately from wastewater
1979	Chemical stripping to remove 70% of P
1990	Secondary treatment changed to Bardenpho, state of the art to remove both N & P
1991	Treated effluent discharged to LTS in Whakarewarewa Forest
1993	Biosolids composted
2006	Bardenpho extended and commenced C- dosing
2006	Reticulation of Lakeside settlements began
2011	Biosolids vermi-composted with waste pulp mill fibre in Kawerau
2012	Membrane Bioreactor MBR
current	Investigations into new sludge processing technology, Terax™
	Investigations into an alternative to the LTS

Wastewater Treatment Plant construction 1970's

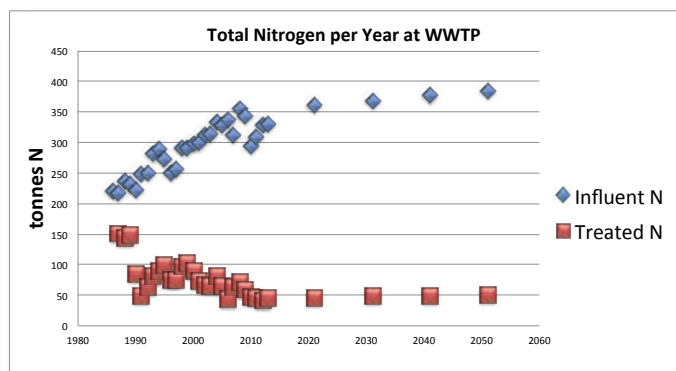


How wastewater is treated in Rotorua

Process	Main function
Screens	Remove large material
Pista grit	Removes grit and sand
Primary Tanks	Settle and remove primary sludge
Bardenpho 2/3 MBR 1/3 of flow	Remove 90% nitrogen and 50% phosphorus
C dosing	Ethanol (carbon) is added to help remove nitrogen
DAFs & Belt Press	Remove and de-water sludge – goes to vermi-composting
Land Treatment System	Removes 50% phosphorus, restores <i>mauri</i> to some extent



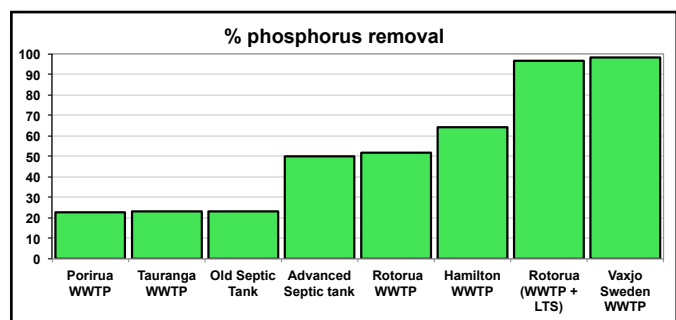
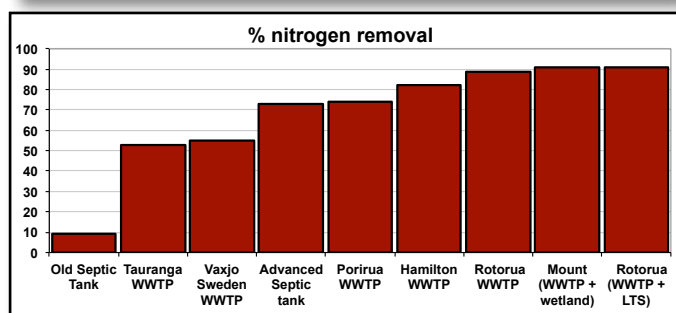
How much nitrogen enters the WWTP – and how much leaves?



Receives
20 million
litres of
wastewater
every day

Servicing
75,000
people

How clean is the WWTP discharge water after treatment?



WWTP receives
900 kg of N and
120 kg of P
every day

WWTP receives
330 tonnes of N
and 45 tonnes of P
each year

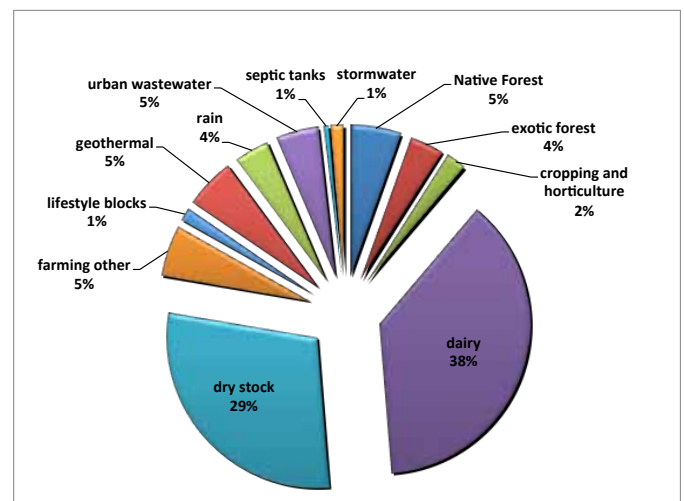
Land Treatment System in Whakarewarewa Forest

Facts

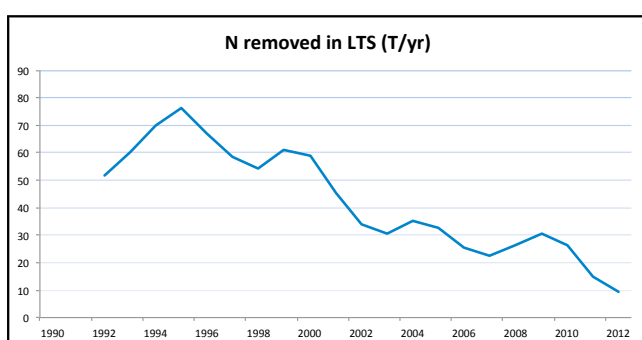
- Commenced in 1991
- 220 ha irrigated in Whakarewarewa Forest
- Discharge water is pumped from the Wastewater Treatment Plant up to balancing ponds in the forest
- There are 24km buried pipelines going to spray-blocks and 120 km overground pipelines
- Of the 16 blocks, 14 are irrigated at any one time which allows 2 blocks for forestry operations
- Unirrigated buffer zones separate the spray-blocks from main areas of public access, roads, riparian zones and wetlands.
- There are 47ha of wetlands scattered throughout the LTS - the water permeates through the soil and passes through riparian areas and wetlands before entering streams and flowing to Lake Rotorua
- Waipa Stream drains the catchment and feeds the Puerenga Stream
- The current Resource Consent allows for 30 t N and 3 t P in Waipa Stream each year
- The LTS doesn't remove much N but still removes P
- If we were to move away from a slow-rate irrigation system (such as the LTS), then we could treat to remove more phosphorous at the WWTP



Nitrogen into Lake Rotorua



Residual nitrogen after treating wastewater, contributes only 5% of the nitrogen going to Lake Rotorua



Glossary

Term or abbreviation	Refers to
ADF	Average daily flow of wastewater in Rotorua: approx 20 million litres everyday
Alum	A chemical used to efficiently react with P, which then settles as an alum-sludge, and is not available to plants and algae
BNR	Biological nutrient removal - live naturally - occurring organisms grown to remove the nutrients
Buffer zone	Refers specifically to the unirrigated area between a spray-block and an area of main public access or with a direct connection to a waterway discharging to lake Rotorua
C	Carbon. Carbon compounds provide chemical energy for growth and development and form the basis of organic life
C-dosing	The carbon we feed to the organisms that remove nitrogen in one WWTP process. Ethanol is the current source of C.
Clarifier	A tank where solids settle to the bottom and are pumped out and water flows out over the top
Direct discharge to water	Any discharge flowing directly into a waterbody
Discharge to Land	Any discharge that flows onto or into land
Discharge to Water	Any discharge that flows to, or is connected to a water-body, such as sea, lake, river, stream, extensive wetlands, wetland trenches, channels etc that might contain plants/objects. There could be further renovation as it flows through. Take care not to confuse with a direct discharge to water
Discharge water	The discharge, effluent treated water, outflow, AFTER treatment at WWTP. It is currently irrigated onto Whakarewarewa Forest. We are looking for another option for this discharge.
DWF	Dry weather flow of wastewater: in Rotorua about 16 million litres, which is around 220 L per person per day from Rotorua citizens and visitors. This is normal for NZ
Ethanol	An alcohol, an expensive by-product from Fonterra, (also added to Gull fuel) that we use for C dosing
Ferric	A form of iron used to react with P. Naturally abundant in the environment, brown, as in soda springs
I and I	Inflow and infiltration. RDC has an ongoing programme to reduce I and I volumes
Infiltration	Groundwater that flows into the sewerage system when the water table is high and the pipes are leaky
Inflow	Rain that should not but does enter the sewerage network. It generally enters via household gully traps
Land Treatment	A discharge to land that includes some renovation. It includes slow-rate irrigation, rapid infiltration, above- or below-ground, spray irrigation, flood plains, soak holes, etc
Mauri	The Te Reo word referring to the life-force, spiritual energy, or portion of the universal energy associated with a physical object
N	Nitrogen, one of the main nutrients used by plants and algae to grow
Nitrogen renovation	Removing nitrogen from water. We transform the nitrogen in sewage to ammonia (not very mobile through soil, can be toxic to aquatic life and like a fertiliser for plants) then to nitrate (very mobile in the soil and available plants) and ultimately nitrogen gas (harmless). There will always be some residual organic N, not harmful to aquatic life, somewhat mobile in soils, not available to plants in this form
P	Phosphorus, one of the main nutrients used by plants and algae to grow
P removal	Phosphorus is taken into the microorganisms we grow in the WWTP and removed as sludge. We can only remove about half of it by this biological process. It is also held in the soil in the LTS like phosphatic fertiliser. An alternative is to chemically remove P at the WWTP or add materials to a discharge arrangement to hold the P
P-stripping	Chemical removal of P – using alum, ferric iron or other chemicals
Reticulation	The network of pipes that transport wastewater. Stormwater (rain) is reticulated separately.
Riparian zone	The area between a wetland or stream and the soil
Rotorua LTS	Land Treatment System in Whakarewarewa Forest, it is slow-rate irrigation
Stormflow	Wastewater entering the WWTP during a storm: sewage diluted with rainwater. It can double the daily volume received in Rotorua, which is minimal compared to other cities because we have a good 'I and I' programme and keep up with pipe maintenance and replacement
Wastewater	Sewage & tradewaste, influent, inflow, that enters the WWTP
WWTP	Wastewater Treatment Plant

Project Rotorua Clean - Water Fieldtrip & Workshop

Day 1	Fieldtrip - LTS and Puarenga Stream - Mon 30th Sept	Facilitator - Warren Webber
1.00pm	Bus departs Te Puia Carpark, off Old Taupo Road	Commentators
1.30 - 2.15	Visit the Land Treatment System in Whakarewarewa Forest	CNI , Timberlands Alison Lowe RDC
2.30 - 3.15	Visit Puarenga & Waipa Streams confluence adjacent to Waipa M/Bike Park	David Hamilton Paul Scholes
3.30 - 5.00	Visit RDC Wastewater Treatment Plant	Andy Bainbridge
5.30	Refreshments and debrief at Te Puia	
Day 2	Workshop - Te Ao Marama Hall, Ohinemutu, Tues 1st Oct	
	Introduction and Stakeholders	Chair: Ian McLean
9.00 - 9.10	Welcome	Pihopa Kingi
9.10 - 9.15	The Day Ahead - Why we are having this Workshop? Context. Shape of the programme.	Ian McLean
9.15 - 9.45	Stakeholder introductions	
9.45 - 10.15	<i>Mana whenua</i> perspectives	Alan Skipwith Wally Lee
10.15 - 10.45	Morning break	
	RDC presentations	Chair: Todd McClay
10.45 - 11.10	History and current situation	Andy Bell Alison Lowe
11.10 - 11.40	Long term options	Eric Cawte
11.40 - 11.50	Interim consent change	Mark Buckley
11.50 - 12.00	Road map ahead	Greg Manzano
12.00 - 12.30	Discussion	
12.30 - 1.00	Lunch	
	Other technical input	Chair: Arapeta Tahana
1.00 - 1.15	BoPRC Lakes Programme and Nitrogen reduction targets	Warwick Murray
1.15 - 1.45	The science and options	David Hamilton
1.45 - 2.15	Discussion	
2.15 - 2.30	Outline and purpose of forum session, breakout topics	Ian McLean
2.30 - 3.00	Afternoon tea	
	Breakout forum	Facilitator: Ian McLean
3.00 - 4.00	Breakout groups	
	Current situation; Interim consent change - Future options; Roadmap; Paurenga	
4.00 - 4.30	Report back	
4.30 - 5.00	Workshop insights : Where to from here?	
	Stakeholder agreement to participate in process; issues and options identified for further work; roadmap ahead; forming a steering committee	
5.00pm	Close	John Green

Session One – Introduction and Stakeholders

SESSION CHAIR – Ian McLean, LakesWater Quality Society

Welcome

Pihopa Kingi, Te Arawa Kaumatua

The Day Ahead

Ian McLean, LakesWater Quality Society

My name is Ian McLean Together with Warren Webber and Rotorua District Council managers, I am involved in the preparation of today's programme. Can I pay my respects, Pihopa, and thank you for the welcome. It is great to be welcomed here. At times I have been invited to sit on the paepae at Tamatakapua at an appropriate ceremony. John Green, as Chair of the Society, we recognise you - it is good to have you here. We also have other elders in attendance – Toby Curtis, kia ora Toby; we also have Te Ohu Wi Kingi and Alamoti Te Pou. Welcome to you, and welcome to you all.

This is a great setting that we are in at Te Ao Marama, with St Faiths over here, Tamatekapua here looking out at the lake over the graves of the men of the Maori battalion. It is a splendid setting on a day like this.

The topic we have today is not sexy but is important. It is important for the forest, it is important for the water from Waipa right down the Puarenga Stream to the lakes, and down the Kaituna River. It is important to other lakes too where sewerage eventually will come – Rotoma and Tarawera. It is important to all the people who live and work in the city. The people who have legal responsibility are represented here today, the Regional Council which gives consent to discharge and the Rotorua District Council. The Rotorua District Council has the prime responsibility to provide sewerage for our needs. You might say it is a bit of a hospital pass for them with all the difficulties, but the responsibility does land on the Council. But beyond that it is the responsibility of us all; it affects every one of us, because we are all involved with the sewerage system daily.

It is not enough to look at the present population and say, "let's tweak the system a bit and fix it so that enough water and nitrogen can be sustained from the existing population." The Rotorua population has been static for some time but Grow Rotorua, which was set up a year ago - and I congratulate the Council on doing that - has plans to make the city grow. So the sewerage system needs capacity to deal with a growing population.

In my opening I missed one person who is sitting at the back because he has only got one arm on today - Kevin, Mayor of Rotorua, welcome, I pay my respects to you and you are very warmly welcomed here today.

Yesterday some of us went on a field trip to look at the forest. We saw the stream and the wastewater treatment plant. I have to tell you one thing about the wastewater treatment plant, quite apart from its efficiency as about the best in New Zealand; it is beautifully clean and tidy. Those who went on the field trip would be able to tell you what they saw.

The solution we are looking to work towards is for the discharge of the treated effluent from the wastewater treatment system, but also if possible to effect an improvement in the

Puarenga Stream. It needs to be a sustainable solution and that to my mind means it needs to be long term, economic, acceptable to the community generally, and be environmentally sound. In the context here it must not have an adverse effect on waterways and the lakes in particular. We do not expect to find the solution today; we expect to take one step along the road.

I should outline the rules of engagement for today. Number 1 - most of the people here have lords and masters sitting somewhere, a board or a manager or somebody who makes final decisions. We recognise that and also that people here will not be able to make a commitment to what their organisation will agree to. But at the same time please do not hesitate to put your own views out on the table for us to chew on. We will not hang you by taking your words as a commitment by the organisation, but we do need you to feed into the day.

Another rule of engagement is how this workshop relates to the process underway by the Rotorua District Council, to obtain a variation in consent for discharge. This workshop does not cut across that process, nor does it substitute for it in any way. What the workshop intends is to be part of the consultation with the community required under the Resource Management Act. It is supportive of the process.

So we come to today's programme. There are some changes in speakers which we will see as we go through the day and will tell you about them as they come. One or two people who wanted to be here - and I will particularly mention the Kaumatua from Tuhourangi, Anaru Rangihueua - unfortunately were not able to be with us today.

The programme starts with a voice from Tuhourangi, and then the core of today's workshop will be RDC laying out the work they have been doing, especially the options for the long term future. After that there will be a session where Warwick Murray from the Regional Council will give the background to work on the lakes, and particularly nitrogen. Professor David Hamilton will challenge us with possible options. Towards the end of the day we will seek to bring it all together. The organisers have no particular outcome in mind, except to map the road ahead, to help establish a Steering Committee and to bring stakeholders together. We have no particular solution in mind.

So we will now begin. The first thing we need to do is to introduce ourselves and explain our interest in today's topic.

Stakeholder introductions

Kia ora tatou. Kevin I am sorry I did not mention your name at the outset but you have been here so many times and sat on the paepae at Tamatekapua and we look on you as one of us, tena koe.

Pihopa Kingi: The sight of Lake Rotorua is imposing. I used to be the Chairperson of the Trustees for Mokoia Island who naturally have a great concern for the quality of Lake Rotorua. Ngati Pikiao believe that most of the effluent is coming from Lake Rotorua hence they supported that very expensive diversion wall beyond the Ohau outlet, which seems to have made a difference. Whether the cost that went in to putting it in relates to the amount of difference I sometimes wonder. I do not need to say much more, Ian, except that I believe the reason for calling this meeting here in Te Ao Marama, which is the church hall for the St Faith's activities, is that it is probably the building closest to the lake anywhere in the region of Lake Rotorua. From the wall there you can just about dive straight into the ruapeka, not that I am expecting anybody to do that. Kia ora tatou katoa.

John Green, LakesWater Quality Society: Pihopa welcome and thank you for hosting us here, it is a very special place. Just very briefly LakesWater Quality Society has been a major protagonist in what the public policy is with the cleaning up of the lakes and what the issues are. Over the years we have had a very committed team of people who have kept an eye on the policy makers and those taking the actions to clean up the lakes. I would have to say after at least 10 years of my time, seeing what has happened and where the lakes are now, we should be very proud of ourselves as a community.

One of the areas that we advocated for was to get sewerage around the lake communities and it was disappointing to us at the last symposium we held to be told by a Councillor that it is causing more problems for the wastewater plant in Rotorua. We took it upon ourselves to say, "We've helped cause the problem because we actioned for the lakeside community sewerage schemes and this extra volume of water coming into the wastewater plant is causing further problems in the Whaka forest." It is time for us as a community to all come together and solve the issues and that is why we are here. We strongly encourage open debate, respect for each other and hope that we can get the outcomes that we are all looking for - so thank you.

Ian McLean: Can I tell you all that we recognise the special privileges of Kaumatua and the first two Kaumatua have had the special privilege of telling us a little bit more of their korero. For the rest of you can you please keep most of your korero for later in the day but tell us who you are and what your interest in this is, kia ora.

Kia ora tatou. Thanks and welcome to everyone, His Worship, John. My name is Te Ohu Wi Kingi, I wear many hats but in this forum today it is about trying to fix the lake. I was very grateful for the fieldtrip yesterday; I have known about the Whakarewarewa forest all my life, but I went there for the first time yesterday. Lovely talk yesterday afternoon. I have been to many forums in my life but this one here is special, to learn more of the operation, and the people within, and that something will be done. I cannot wait until 5 o'clock this afternoon to hear of possible solutions.

I represent Tuhourangi, the last marae at the Puarenga, the land that was gifted to us in 1891 because of the Tarawera eruption. My hapu, all my elders went to Ngati Maru, we were the only whanau - there were nine whanau that came out after that eruption from all the Iwi. We came back and five kuia stopped us outside a place which is now called Ngapuna and hence we arrived there. Ngati Whakaue passed te whenua, so we are very grateful for that, however growing up beside the Puarenga Stream all these years I have seen the downfall of the lake. Hopefully it will come back to its pristine nature and I know with the people here today that something will be done. I am here on behalf of Te Mana Whenua, I am here to help, to share, to explore, to put something down which will hopefully not be lost, and will follow through, kia ora.

Thank you for the voice from Tuhourangi.

Good morning everybody, my name is Alan Wills – I have recently picked up the responsibility of Rotorua/Taupo Federated Farmers. I do not live in the Rotorua catchment - I live at Reporoa and I assure you that out there in the upper Waikato we have nutrient issues to face there as well. You are probably 10 years at least ahead of us. I am here with my colleague, Stuart Morrison, who farms in the area and happy to be here and share with you.

Good morning everyone, my name is Stuart Morrison. I am a farmer in the catchment and have been involved with this issue for some time. I am a member of the Rotorua Primary Producers' Collective which is a group of all the dairy farmers and represents most of the other dry stock farmers as well in the catchment. I am also on the Stakeholders Advisory

Group (StAG) working with the Council to resolve some of the issues and look at how we might reduce our environmental foot print in the lake.

Good morning, my name is Robert Lei. I am here on behalf of Scion, formally known as the Forest Research Institute. We have a long history associated with the forest industry and research and also environmental research, certainly in this particular field, and as a significant member of the local community. Really pleased to be part of it.

Kia ora, Warwick Murray, from Bay of Plenty Regional Council. I lead the Rotorua Lakes programme which is charged with the task of improving the water quality in the lakes of the Rotorua district. I will talk a little more about that programme after lunch, but very pleased to be here and help in the discussion and debate.

Kia ora, good morning, Kevin Winters, Mayor of Rotorua, but also with my other hat on today as Chair of the Rotorua Te Arawa Lakes Strategy Group which was set up in 2006 under statute to enhance and protect the 12 Te Arawa lakes of Rotorua. Delighted to be here today and looking forward to the debate and korero. Can I also say another rule for today is that "nobody's wrong today".

Good morning everybody, Colin Kemeys is my name. I am a planning consultant and assisting the District Council with their application to change the current consent. You will hear from me shortly about that. Looking at this from the outside, can I just congratulate the Society for conducting this workshop. There is a tendency to think of these things as Council issues and you have clearly identified that this is a community issue needing a community solution to establish the long term future for wastewater, thank you.

Kia ora, everybody, my name is Eric Cawte, I work for the Rotorua District Council. My responsibility there is water supply and also provision of wastewater services. On a personal level I am born and bred in Rotorua. I can remember swimming in Lake Rotorua as a young boy and with my family have enjoyed the lakes and forests over the years. I am pleased to be involved in this on a personal level as well.

Kia ora, katou katoa, David Hamilton is my name. I hold a chair at Waikato University which is supported through the Bay of Plenty Regional Council and I am here to see if we can find ways in which science might be able to support some of the environmental improvements that are possible in Lake Rotorua, kia ora.

My name is Alamoti Te Pou, CNI Iwi Holdings, and I am primarily here in our role as land owners. The key thing for us is to talk about the environmental issues that have developed looking at the lakes, the water, but also the land itself as well. I also hold a very strong cultural position on this. The land was returned in 2009 to CNI Iwi Holdings which represents 8 Iwi. As I mentioned earlier we do not come here with a mandate for any final view but very keen to be a part of the conversation and to contribute constructively to the process, kia ora.

Tena koutou katoa. Rick Braddock. I am here representing the land owner also. I sit on the Board of CNI Iwi Holdings and am a recent appointment to their subsidiary land management board, CNI Iwi Land Management Ltd. My other role in this area is Chairman of Ngati Whare Holdings, their PSGE. I have strong views around sustainable and environmental welfare and as Alamoti has said we do not come here with a direct mandate, but we come here to listen and to constructively seek an outcome to the issues at hand, kia ora.

Kia ora tatou, my name is John Hura. I am also here with CNI Iwi Holdings Ltd and both Alamoti and Rick have expressed why we are here today.

Kia ora katoa, my name is Andy Bruere. I am the Lake Operations Manager for Bay of Plenty Regional Council. I have got an interest in any of the actions that are designed to protect or restore our lakes and sewerage reticulation is one of the main implementations in our programme to improve lake water quality. I am interested in ensuring that whenever we do reticulation it is doing the best we can do and improving lake water quality. It is for a number of lakes, not just Lake Rotorua. It does not include all of them, as some do not have much reticulation, or development around them.

Good morning, Greg Manzano. I am from the Rotorua District Council and part of the team that implemented the sewerage scheme and hopefully part of the team again to put the solutions in place.

Kia ora tatou. My name is Arapeta Tahana. I have multiple interests in this kaupapa, the primary one being a descendant of Te Arawa. I live at Lake Rotoiti and have grown up there all my life and swum in these lakes. My primary interest is my cultural and historical connection to these lakes and whenua. But also in my working professional role as Portfolio Manager for Te Tumu Paeroa, which is the new name for the Maori Trustee. We represent 47 Maori Land Trusts within the Rotorua catchment, but we also go beyond. We have about 250 trusts we work with throughout the wider Bay of Plenty area. I also sit as a member on StAG along with Stuart looking at the incentives and rules to help this whole programme, kia ora tatou.

Kia ora tatou. Tapa Nicholson, currently GM Operations Te Puia. We have a particular interest in the Puarenga for obvious reasons. Te Puia is one of the jewels in Te Arawa's tourism crown, and right through the middle of it is the Puarenga Stream. We have two ways of looking at this, we certainly support and advocate the tangata whenua Maori world view approach but we are also a business and want to develop. We want to develop with our environment at the forefront of our thinking, so looking forward to today. Kia ora.

Kia ora. Mauriora Kingi, I am at the Rotorua District Council, as Council's Director for Kaupapa Maori. I am also from Tuhorangi from Whakarewarewa and I support my Council colleagues in terms of what we have been doing at the wastewater treatment plant and land treatment system. I have been a member of the RSA for 30 years, which is important. Kia ora tatou.

Kia ora Kiri Mitchell, I represent the kotahitanga of Ngati Whakaue Claims Committee.

Kia ora I am Roger Gordon from the Chamber of Commerce. The work that has been done on the lakes to date has been absolutely incredible and we are very supportive of the efforts of RDC and Grow Rotorua to grow our economy into the future. But that growth has got to be sustainable and this is all very much a part of that need. We are here on behalf of businesses supporting these issues.

Joe Tahana, it is a lovely day outside. I understand it is the first day of the fishing season, that is where we should be, out there instead of here talking. Lastly, my compliments to the society for your leadership in calling this meeting together.

Ian McLean. Before Wally takes the microphone can I say that Wally is on the programme and soon has 10 minutes to speak to us, so you might want to have your korero in a moment or two Wally if that is alright?

Kia ora, Ike Reti. I have been a pain in the butt with the Council on this issue for nine years and it is amazing that you had a whole bus load of people in the forest yesterday. We could

not even get the Te Arawa Lakes Trust or anybody else to come with us, not one Councillor in the nine years we have been doing this. I am here to fight for a decision.

Kia ora, good morning to everybody, my name is Andrew Bell, I am the Group Manager Infrastructure Services for Rotorua District Council. My role is to implement Council's decisions, and it is my role to lead the Council towards a decision that is going to be a sustainable decision for the future. I have lived in Rotorua for 36 years, coming originally from overseas obviously. I was involved in the original implementation of the scheme which at the time we thought was going to be the real thing. Unfortunately it has not turned out to be in many respects. It is interesting for me to come round full circle again and be involved in looking for the sustainable solution for the Rotorua wastewater disposal issues, thank you.

Kia ora, my name is Hugh Riddiford. I am out outsider, I come from Auckland so please do not hold that against me. My background is farming and originally come from the Wairarapa. I have a passion for environmental land use and related waterways and would like to congratulate everybody here for the work that has been done. I am a newcomer to all this so listening with great interest. I want to congratulate everybody here for the progress that has been made, thank you.

My name is Annaka Davis; I'm Health Protection Officer with Toi te Ora Public Health Service so I work quite closely with the medical officers of health especially on issues to do with safe sewage treatment and disposal. So my aim is to work with Council to find a solution that is obviously a healthy one.

Toby Curtis. Mr Chairman I have about three things I would like to say. One – I, Te Arawa Lakes Trust went yesterday and saw the concerns that you had, why they did not go with you previously I would not have a clue. The second thing is that last year I went to a conference in China and tried to take over Warwick's role and make out I knew everything about how to clean up lakes. I was the 11th speaker of 15 speakers from all around the world, and by the time the 6th speaker spoke I was quite bored. They were saying similar things, talking about nitrates, phosphorus. I was almost becoming phosphorised myself. So as the 11th speaker I got up and decided not to speak to what I had prepared, about how we were cleaning up the lakes. Really David Hamilton was cleaning up the lakes.

I spoke about it from a cultural angle. We are forgetting one or two things about our lakes. Thank God Rotorua District Council was not around when Hinemoa and Tutanekai were alive, otherwise Hinemoa would not have swum in the lake and we would not have been born. From a cultural perspective it is more than just a mass of contained water. Rotorua is our ancestor Kahumatamomoe, and as a consequence we would like our ancestor to be clean and more women will swim in the lake.

I will finish up with a recollection of when I came back from Auckland after 40 years. When I returned I was thrown right into the midst of all the things that were happening here. I got involved with arguing the case of how is it that the Te Arawa Lakes Trust has only two members on the Rotorua Te Arawa Lakes Strategy Group? My argument was that it should be 100%. Anyway as you know things do not happen that way and through negotiation it went from 80/20 to 60/40 and then to 50/50 and this was agreed by government. However, when they came back to discuss with the Bay of Plenty Regional Council and the District Council they said, "How come the Rotorua Lakes Strategy Group has 50% representation and we only have 25% each? That is not fair." My argument was if its equal and you have a third, which it is now, the two Pakeha groups would gang up against the Te Arawa group and we would never get a say. That was my view at the time. However it was not long before I was on the committee and despite my personal views I say it is one of the best committees I have been on.

A lot of Maori tribes throughout the country have thought that by having representation where Maori was in the minority it would not work. Many Pakeha organisations felt that there were too many Maoris; where there were two, there should be one, and it was quite interesting. I have changed my view because we talk and talk until we agree. In this discussion today I would like to think we are going to talk and talk until we agree. What I like about the discussion today is it is involving everybody in the area who have a strong interest in the lake. So John thank you for leading the LakesWater Quality Group, we need your input, not just Te Arawa, but everyone in the area. If you did not have this kind of organisation in place I do not know how we could get the involvement of everybody that is here today. Thank you, I look forward to an exciting discussion this afternoon, kia ora.

Kia ora Toby. Toby is Kaumatua too so he gets a little extra licence.

Good morning everyone, my name is Tim Charleston. I am Environmental Manager for Red Stag Timber at Waipa Mill. Red Stag Timber is the biggest private employer in Rotorua and perhaps most notably in context for this meeting we are based in the Puarenga catchment, in the head waters on the Waipa Stream. Like you and me we all produce waste, and industry is no different. We are not connected to the RDC scheme as we have our own wastewater disposal system similar to RDC in the Whaka forest. We are a stakeholder in this whole lakes water quality environment ourselves. I look forward to contributing today as well, thank you.

Good morning, my name is Jim Howland, I am with the LakesWater Quality Society. My brief background is 50 years as an elected member of Local Government and with a keen interest in the environmental issues. This morning I pay my respects to the elders present today and His Worship.

Kia ora tatou, I am Alison Lowe. I have been in Rotorua now for just over 30 years and really proud to be part of this community. I am working with the Rotorua District Council and involved in wastewater treatment and want to do what I can to help the community agree on a solution. I hope we can all work together.

Hello, Luke Nelson, I am with Rotorua District Council, I am one of the more junior members of the team working on engineering solutions to help infiltration. Thank you.

Kia ora, my name is Warren Webber, I am helping Ian organise this workshop. I am a committee member of the LakesWater Quality Society and also on the StAG with Stuart Morrison and Arapeta Tahana, working towards collaborative solutions for our community and our lakes, thank you.

Good morning, my name is Hilary Prior, I chair the Lake Rotoiti Community Association and am also a committee member of the LakesWater Quality and very passionate about the lakes.

My name is Ann Green, I am on the LakesWater Quality Society and I do the little things at the bottom to help keep things going.

Mana Whenua Perspectives

Wally Lee, Tuhourangi Tribal Authority

Ian McLean: As in Te Arawa tradition Wally is one of the seagulls who has been calling out the warnings to us for some years and we recognise and honour you for that. A lot of us went to look at the forest yesterday and saw what you have been talking about. We welcome you and ask if you could in ten minutes give us your korero.

Wally Lee

Kia ora, Ian. Thank you for the opportunity to speak. I must apologise for yesterday as I was head deep in an assignment to finish for an Environmental Commission course. My apologies for not being present on the fieldtrip. As for today, I am only here for a short time. I am not on duty but there is a Rangatahi Expo encouraging our young people into career paths out at Apumoana Marae so I have ducked away from there to honour the duty that I had to Ian when he first asked me.

I have been on this path for a while - 2008 is when I started. We are now 2013, five years on. I am relatively young in terms of the others that have come before me such as Ike Reti, Peter Staite and others before them. This is not new, it has been around since about 1939 when the Waipa State Mill was commissioned and the pollution started flowing down the Puarenga from that time.

The reason I came on board was from a challenge by my koro in about 1996. Our whanau is at Whaka on the banks of the Puarenga and we were sitting on the veranda one day and looking at the water and it was flowing brown as it always does.

I said to my koro, "Why is the water so paru?"

He said, "Well that's just the way it is, there's a lot of stuff happening up in the forest."

I said to him, "Why don't you do something about it?"

He looked at me, and remember he's 81 years old at this time, and said, "Why don't you do something about it? My time is done."

That challenge never left me. I did more study, work, family, all the rest of it and then I became part of the Tuhourangi Tribal Authority and took over the environmental portfolio and that is when I decided to kick it off. The timing was right; we had just had a number of heavy downpours. I went up into the bush and had a good walk around and what I saw broke my heart. You went up yesterday in a rainy period, it is the time to see what is happening up there because that is the reality of the hydrology from the Wastewater Treatment Plant. I know the RDC are doing the best they can with the technology that they have to address the concerns of the entire community, but it is at significant expense.

Tapa, I heard your korero and we have had a number of meetings regarding how we feel about the awa (river). Te Puia and the Whaka Village are there. A whole bunch of tourism is based around the Puarenga Stream, and yet at certain times it flows black and filthy and has done so for a long time.

Once upon a time our pa sites were all along the banks of the Puarenga, from down at Te Pakira, Ngapuna, Whaka and further up inside the valley. They were there for a reason, because it was our food bowl. There is no kai there now that can be eaten, and I would not eat the watercress if it was there. There are certainly no fish, or very limited. I have seen a few water rats but I would not eat them either. That is about all that is left now. Once upon a

time it used to flow black with koura and kokapu (native fish); at certain times of the year it used to be full of koura but they have all gone.

So that is my little rant in terms of what has been destroyed. I take it from 1939 up until the present day because industry has grown more and more since then. We also have the dump which is situated on the banks of the Tureporepo Stream on State Highway 30. I acknowledge Tim Charleston from Red Stag and know you are also doing the best that you can, but it is not the best that we can do, there is more we can do. Hopefully with our combined efforts and thinking we can find that right solution, because at the end of the day our community wants to grow, but not at the expense of our waterways, and certainly not at the expense of the Puarenga.

This town is built on tourism, the tourists all go to the Puarenga and look over the bridge – I wonder what they think? Maybe I should do a survey one day and see what they do think of the water flowing through. I am sure they would have some interesting things to say about it. It is one of the first things that our tourists see yet it is in such a state and not what we really want them to see.

How do we fix it? That is the big question. I do not know, but all I wanted was to bring everybody's attention to the fact that we have a sick awa and as a consequence how does it affect us as tangata whenua? How does it affect us as a community? All the way from Rotorua, Te Pakira Marae, Ohau, the Kaituna. It does not stop and start here at the Puarenga, it flows on down to Maketu, the heartland. That is what I have kept saying all along, it does not just affect us at Whakarewarewa, Tuhourangi, Ngati Waihou, Ngati Whakaue, Ngahapu, it affects all of us. Therefore the solution rests with all of us, not just me with a squeaky wheel, but I will keep trying.

This is a good step, Ian and John, to find that way and I am confident in time with the advances in technology that we can find a solution and we are working towards that now. That is about me unless there are any questions or anything else you want from me and I will sign off and head back to my other job, the job that pays my bills.

Session Two – Rotorua District Council Presentations

SESSION CHAIR – Todd McClay, MP for Rotorua

The History

Andy Bell

My name is Andrew Bell and I am the Group Manager Infrastructure Services for the District Council. I would like to thank Todd and the LakesWater Quality Society for putting this day on. John Green, Ian McLean and I started to talk about the wastewater treatment issues a couple of months ago and how we have to move towards an advisory group of people able to work with Council to consider the problems and find solutions over a period of time. We have it mapped out until 2021 when our current consent expires but it is only 8 years to get from where we are now to a solution built and in place to take over from that consent in 2021. Although 8 years seems like a long time, that time is going to go quickly and we need to get our minds around this topic.

I would like to thank you all on behalf of the Council, particularly on behalf of myself and my team for coming along and being prepared to input into this and hopefully by the end of the day we will all be on a similar page as far as information goes and the way towards the future.

I am the oldest in our team so it is my privilege to give you the history. I was involved as a wastewater engineer many years ago when I was appointed as Group Manager and the responsibility has come back to me. I have drifted in and out of the wastewater scheme and then I re-kindled my interest in Rotorua's wastewater scheme about 8 or 9 months ago. I will give you a background of how we got to where we are today, which is important to understand the steps we need to take to move forward.

I will introduce the other speakers as we get to them; Alison Rowe, Eric Cawte, Colin Kemeys and Greg Manzano who will give their own presentations.

EARLY WATER QUALITY

- In 1970s to 80s lake water quality became an issue
- Lake water quality was poor
- High level of growth in Rotorua put pressure on wastewater infrastructure
- Sewage discharging to lake with low level of treatment

It was in the 1970s and early 1980s when water quality became an issue in Lake Rotorua. There was a very well-known comment made by an American visiting Rotorua who said, "Lake Rotorua was an unflushed toilet", and unfortunately that image hung around with us for some time. The lake water quality was poor. The central part of Rotorua had been reticulated for sewage for many, many years. But by the time we got to the 1970s and early 1980s the majority of the residential areas of both the old city areas and the county areas of

Ngongotaha and Eastern Suburbs were on septic tanks. The wastewater did go through municipal septic tanks which were massive tanks, the residency time was very low and it went through sand filters before being discharged into the stream and lake.

There were issues coming to a peak in that time and a lot of research was done. Scientists were involved in research in their fields and I sat in on a lot of those discussions and presentations. There was a lot of disagreement over what was important when it came to charting Lake Rotorua's water quality improvements for the future.

That culminated in the 1980s with information about what was being discharged into Lake Rotorua, what discharged into our wastewater treatment plant and that the problems were nutrient issues, either phosphorus or nitrogen, or both.

As it happened by the time we got to the mid-1980s, late 1980s, the decision had been made by the scientists involved that it was a problem caused by both nitrogen and phosphorus. However there is still on-going debate about which one was the most important. The goal posts were moving all the time.

Slide 4 shows that in 1964 the raw sewage contained 34 tonnes of nitrogen in a year. By the time we got to the early 1980s it was up to 170 tonnes which showed the increase in reticulation that was throughout city areas. By 1985 we had 260 tonnes of nitrogen in our raw sewage. At that stage our wastewater treatment plant had been implemented, Stage 1 was built in 1973 and in stages as the reticulation came on stream. We were not removing much nitrogen from our treated sewage. We still had 150 tonnes a year going into Lake Rotorua in the mid-1980s. The treatment plant in those days was not designed for nutrient removal, because nutrients were not seen as an issue in those days for wastewater treatment.

1980's Scientific Research

Summary of nitrogen inputs to Lake Rotorua. Adapted from Howard-Williams et al. (1986) and Rutherford et al. (1989).

	1965	1976-77	1981-82	1984-85	Target
Population	25,000	50,000	52,600	54,000	-
Nitrogen input					
Raw sewage t y ⁻¹	34	100	170	260	-
Treated sewage t y ⁻¹	20	66 ^b	134	150	30
Stream + rain t y ^{-1 a}	405 ^b	485	420	415	405
Septic tanks t y ⁻¹	50	80	15	10	0
Internal t y ⁻¹	ND	0	140	>260	0
Total t y⁻¹	475	558	694	>825	435

Nitrogen input in rain is 30 tN/yr. The consent limit for nitrogen input to the lake from treated sewage leaving the RLTS is also 30 tN/yr.

By comparison the streams and the rain effect within the Rotorua catchment had an impact of about 400 tonnes a year. As the reticulation in the city came on stream during the mid-1970s the nitrogen leaching out of septic tanks into the lake started to reduce and is now virtually zero. As we now know, all the time there are internal transfers of nutrients out of the sediments in the lake which is still an on-going problem.

CHANGING WASTEWATER TREATMENT

- 1891 CBD has wastewater reticulation
- 1935-69 Urban reticulation expansion
- 1973 WWTP constructed
- 1973-85 Balance of urban area, Ngongotaha and eastern areas reticulated
- 1979 Chemical phosphorus stripping

The Rotorua CBD was reticulated in 1891 which is surprising as it was a long time ago, but there were sewer pipes in the ground in the late 1800s. The urban reticulation expanded to cope with the increase in the CBD and by 1973 the first wastewater treatment plant of any major importance was constructed. The scheme was constructed in 3 stages through to about 1985. During that period the balance of the urban area was reticulated, Ngongotaha and the Eastern Suburbs were part of the old county council. As nutrient stripping was acknowledged as a necessary part of the wastewater system, the District Council started stripping phosphorus using chemicals in 1979. That is what is happening at the moment with the Bay of Plenty Regional Council's Phos-locking system in the urban streams, which is working very well. We were stripping phosphorus back in 1979, but not the nitrogen.

There was a lot of discussion, investigation and research in order for the nitrogen load to be reduced, some without agreement. There was a government funded scheme put forward to pipe all the wastewater past Lake Rotorua and discharged down the Kaituna River. That was overturned by the Waitangi Tribunal in the mid-1980s who recommended to the government that the scheme be abandoned, and that the solution was land disposal. The government took on that recommendation and set up an inter-departmental committee made up of various government departments and the Rotorua District Council who had one member on the committee. They set about looking for a land treatment system to abide by the Waitangi Tribunal's recommendations.

The result of those investigations in the late 1990s was that a very sophisticated wastewater treatment plant was installed for nutrient removal and that was to be polished by discharge into a spray irrigation area in the Whaka forest. The wastewater system was identified after a tour to look at the best nutrient removal treatment plants that existed in the world. Dr James Barnard came to talk to us in Rotorua and the Council adopted his system which is known as a Bardenpho nutrient removal system which is still operating down at the treatment plant today, and it was designed and installed to take out most of the nutrients.

The second stage to pump it into Whaka Forest, which in those days was a state forest park. It is irrigated by above ground irrigation into about 200 to 350 hectares of forest. Originally it was to be 350 hectares of forest but at the moment the operating system covers about 200 to 220 hectares. That system was to comply with our resource consent at the time of the 330 tonnes. In fact the consent was modified a few years later. I was involved in that. We thought

it was the answer to everybody's concerns but it has not worked out that way. Here we are again looking for another sustainable solution. It did last 20 years, which is not so bad, but it has caused some issues over recent years.

Since 1990/1991 the Bardenpho tanks have been extended to give us the capacity to cope with additional demand. (Slide 7) In 2006 we introduced ethanol dosing, which is a carbon source. Carbon is required to get rid of the nutrients in the wastewater treatment system and that has enhanced our removal capacity for nutrients. It is expensive as those who walked around the plant yesterday found out. It costs Council about \$750,000 a year in ethanol purchase. In 2012 we added further capacity and improved our nutrient removal again with the retro conversion of one of the older wastewater tanks. There were three secondary activation sludge treatment tanks next to each other. We retro converted one into a membrane bio-reactor which is drinking water quality standard equipment. About a third of the flow of the plant goes through that, and Alison will give you some information about this later. That has been another innovation brought into the Rotorua area.

Wastewater Solutions Put Forward

- 1990 Bardenpho development to remove nitrogen
- 1991 Land Treatment System developed
- 2005 Stage 4 Bardenpho expanded
- 2006 Ethanol dosing
- 2012 MBR constructed



DESTINATION
ROTORUA
ROTORUA DISTRICT
COUNCIL

Shaping
Rotorua

7

The Bardenpho system was a first in New Zealand and the land treatment system was the first of any major size in New Zealand. It followed the Whangamata system. The ethanol dosing is a first, but an expensive first, and the MBR plant was also a first. There are smaller ones in operation in New Zealand but nothing of that size. You can see that the District Council has been trying to meet those consent requirements and trying to improve the performance of the Wastewater Treatment Plant at all times and reduce the impact in the forest.

The land treatment system was originally going to de-nitrify the nitrogen that was sprayed on to it. There was a huge amount of research carried out before this system was implemented. The phosphorus was entrapped in the soils. The nitrogen was supposed to go through a

biological system up in the forest, flow through the surface soils into the areas around the water ponds, the wetland areas around the margins of the ponds and the carbon in those wetland areas would de-nitrify the nitrates into nitrogen gas and most of our atmosphere is nitrogen gas so that would be ok.

There would be some uptake by trees and it was believed to be meeting the cultural aspirations at the time. But as those of us who went to the forest saw, it is affecting the trees and not working well and we have not been meeting our consent requirements for the majority of the time. Recently we have had very little rainfall and we have met our consent requirements. But as soon as it starts to rain again we do not. We know that we have to make some kind of change and find another sustainable solution.

Originally we believed that 90% of the nitrogen that went up to the forest system was going to be removed. Presently at about 40%, it is obviously not working anything like we expected. It has very little uptake by the trees, at the moment the main mechanism in the forest system is by soil storage which gets flushed out when it rains. There is a large volume of water and as was quite clearly indicated yesterday the trees do not like wet feet and it impacts on the forestry operations.

PROBLEMS WITH LAND TREATMENT SYSTEM

- Good removal initially with 90% nitrogen removal
  - Gradual reduction since 1994
  - Present removal at 40%
  - Very little de-nitrification occurring
  - Very little uptake by trees
  - Soil storage main removal mechanism
- Large volume of water
- Impacting on forestry operations

We are looking for a sustainable solution for 30 years at least and if we could get that it would be really good. The nutrient removal at the treatment plant has been maximised and the District Council is working to reduce the impacts of our wastewater discharges, such as reducing our peak wastewater loads by storage. We get two peaks a day, mid-morning and evening and our entire infrastructure and treatment has to cope with those peaks.

SOLUTIONS TO WASTEWATER ISSUE

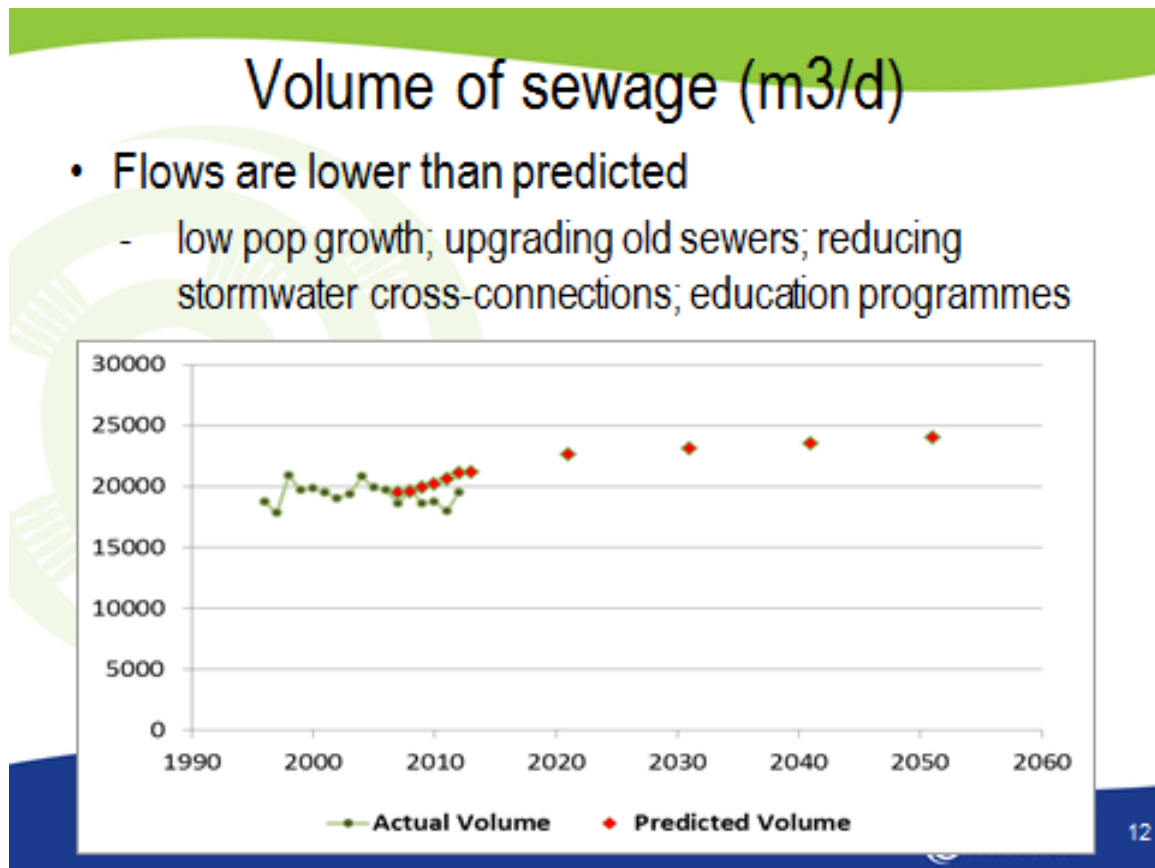
- Need sustainable solution for at least 30 years
- Removal at treatment plant has been maximised
- RDC working to reduce peak wastewater loads
- Need to work with stakeholders to find solution for Lake Rotorua catchment
- Robust sustainable solution capable of meeting growth aspirations while achieving nutrient limits

But we need to work with the stakeholders to find the solution for the Rotorua catchment and this is the first step in that process. When John, Ian and I talked about this we recognised that we needed to get a group of people together that could come with us on this journey and help us get there. It is not that the Council needs people to do the work for us; it is that the Council needs people on the same page so that when we get to a solution it is agreed to by all the stakeholders in the community.

The Current Situation

Alison Lowe

Andy has given you a bit of history and I am going to take a closer look at the current situation - what we have now at the treatment plant and the land treatment system.



Slide 12 shows the amount of sewage that is entering the wastewater treatment plant over the time period. The red dots are the predicted flows that will come into the treatment plant. We are around 20,000 cubic metres which is 20 million litres a day and the predicted increase is related to the extra lakeside reticulation that has been happening as well as population growth. The green dots are the actual amount of sewage coming into the treatment plant and as you can it is not increased. We think this is because population growth has been lower than predicted and we have a programme focused on upgrading and maintaining the sewers.

We looked at about 4,500 homes to check that the gully traps were not collecting rain water from the roofs, and people have been fixing their gully traps. For the last three years we have also had education programmes focusing on water use. We have made a concerted effort to try and reduce the volume of sewage that comes in to the treatment plant.

Slide 13 is a photo of the wastewater treatment plant. The sewage flow comes in at the bottom of the picture and is passed through screens and then into 3 primary treatment tanks. Then two thirds of the flow goes through the Bardenpho and one third through the MBR. After secondary treatment it goes to storage ponds and then is pumped up to the ponds in the forest. Those ponds only hold a day or two's flow so they are just balancing, not really storing the sewage.

Slide 13

Wastewater Treatment Plant



Slide 14 is the Bardenpho, a biological nutrient removal treatment followed by two clarifier tanks. In the Bardenpho we grow microorganisms, or 'bugs', and feed them a carbon source or ethanol, which is alcohol. These 'bugs' do the nutrient removal work, and we call them mixed liquor - not because we feed them alcohol. On the left you see how the mixed liquor with the 'bugs' looks brown and on the right is clear. You see when I shake it up and brown (*shaking a pottle of mixed liquor*), it is full of the bacteria that are treating the water and we need to separate it. In the clarifier tanks, the solids settle to the bottom and then the clean water flows over the edge. That is the treated effluent from two thirds of our sewage at Rotorua.

Bardenpho



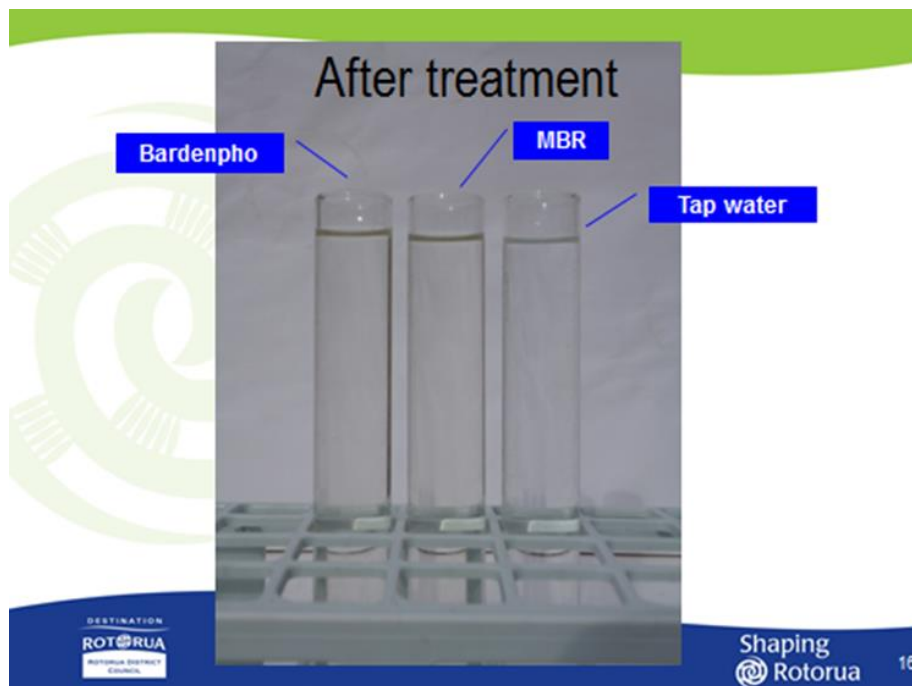
Clean water separated by clarifier tanks

MBR - Membrane Bioreactor

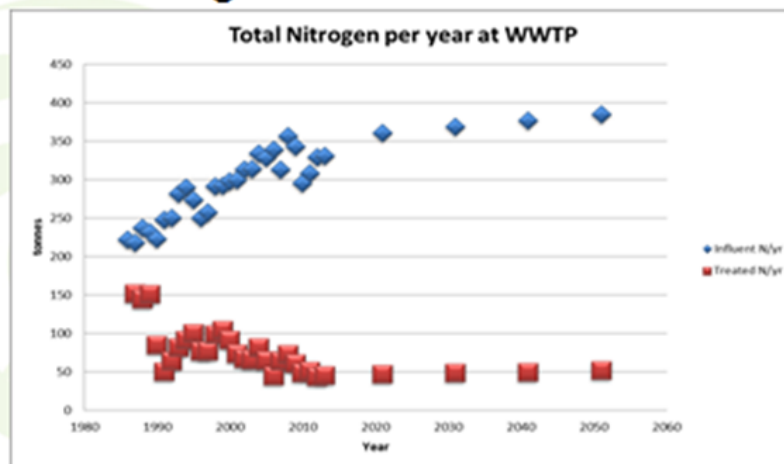


Clean water separated by microfiltration

The other third of the flow goes through the membrane bio-reactor (**slide 15**) which is the same biological treatment, but we separate the water differently. It is separated by using microfiltration, these membranes are in the mixed liquor in the centre of the tank. The membranes are like straws with tiny holes 4 thousands of a mm wide. The pumps suck the clean water out and all of the solids stay inside the tank and we end up with clean water, as you can see in **slide 16**. The pores are so small that even bacteria cannot pass through, but small viruses can. If we want to achieve the same limits as set in the drinking water standard, we would need to treat the last of the viruses with UV (treatment with ultra violet light), although of course no one would want to drink it. The three test tubes show treated effluent from the Bardenpho, the MBR process and tap water. Our treated effluent is remarkably clean.



Nitrogen removal at WWTP



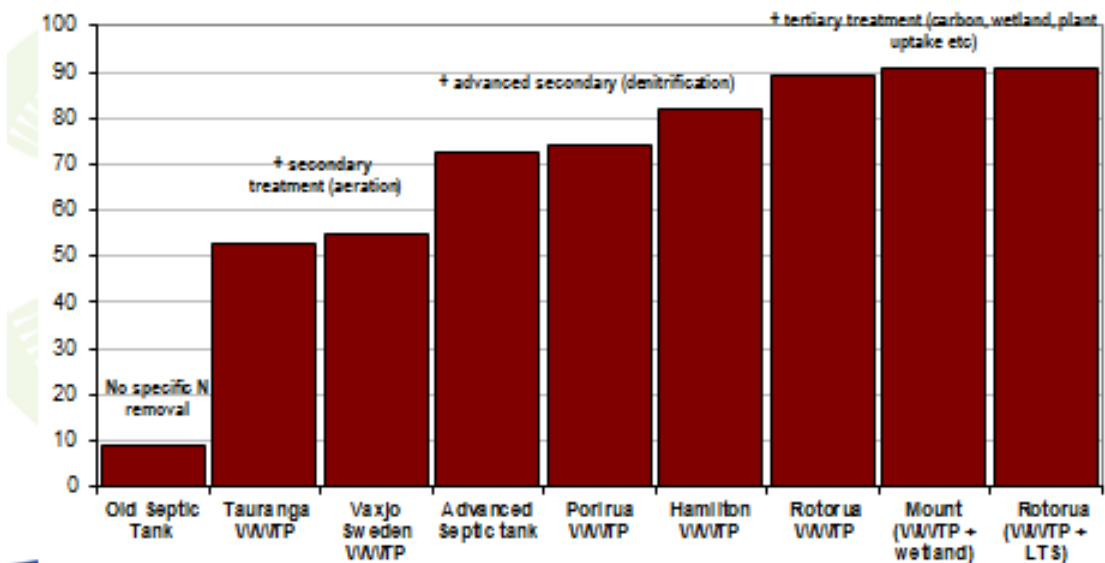
- Removing 90% but still 45-50 T after treatment

Slide 17 shows the amount of nitrogen from the 1980s and projected through to 2051 entering the treatment plant in the sewage and you see a significant and steady increase over time. The red is the nitrogen leaving the treatment plant and you can see we have been doing a very good job removing the nitrogen from the sewage. Andy mentioned the upgrades that we have had over time and we are using state of art technology.

As you can see the nitrogen bottoms out around 50 tonnes. The issue is that even though our treatment plant is removing as much nitrogen as possible, we still have 50 tonnes left over, and it is a point source. What are we going to do with this water, and can we remove any more nitrogen?

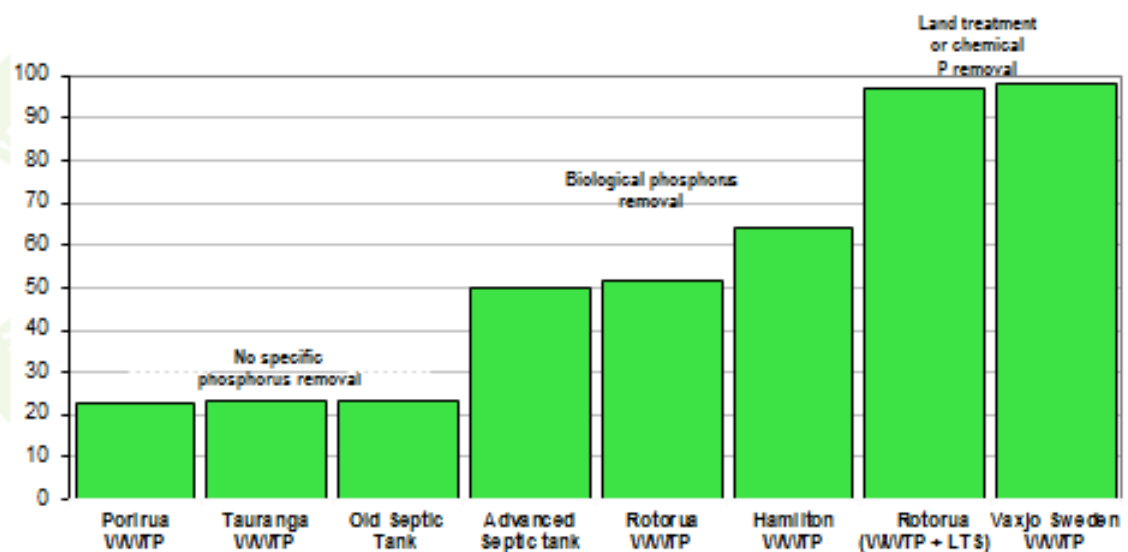
When you compare our treatment plant to others (**slide 18**), in terms of removing nitrogen, we are at the top with the best. On the left is an old septic tank which does not do much in the way of treatment at all. The next two have a little secondary treatment which is standard for a lot of treatment plants in the country. Extend the secondary treatment to de-nitrify and you achieve 75% removal, add carbon, which is what we are doing, or use a wetland or a land treatment system to denitrify as much as is practicable, and we can still remove only about 90% of the nitrogen. The last bar shows the added benefit of our land treatment system. Our treatment plant is very good!

Comparing N removal (%)



Slide 19 compares phosphorus removal. Here in Rotorua we only remove about half at our treatment plant through biological nutrient removal. We remove the other half in the forest - it stays in the soil like a phosphate fertiliser. An alternative to a land treatment system may have to remove this phosphorus at the treatment plant.

Comparing P removal (%)



After WWTP, treated water discharged to the Land Treatment System 'LTS'



- Whakarewarewa Forest
- Iwi land
- Crop managed by Kaingaroa Timberlands
- 47 ha natural wetlands

AIM

- Meet community aspirations (restore mauri, protect lake & waterways)
- Remove more P
- Remove more N

Let's take a closer look at the land treatment system in the Whakarewarewa Forest which is Iwi land managed by Kaingaroa Timberlands (**Slide 20**). It is a commercial crop and scattered throughout the area are 47 hectares of wetlands. This was very relevant for the initial design and proposal to irrigate. The aim was to meet the community aspirations at the time which was to restore the mauri of the water, protect our water ways and food sources, and remove more nutrients.

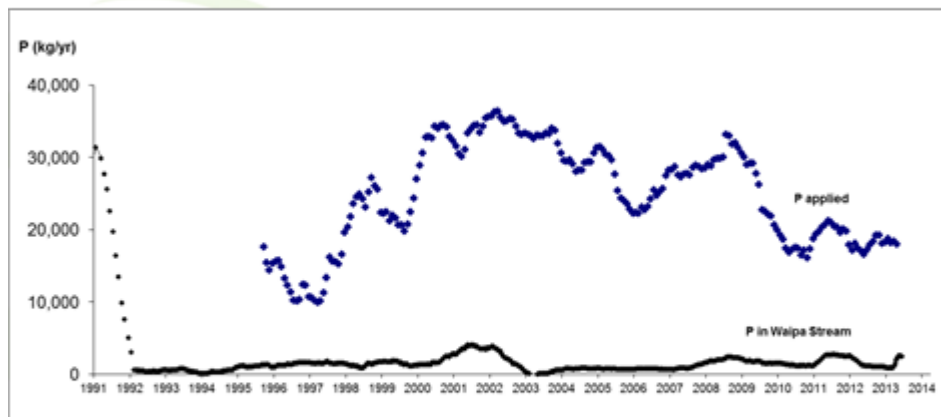
LTS



- 2 ponds balance flows
- 24 km underground pipes
- 120 km overground pipes
- 5000 sprinklers
- 16 blocks
- Slow-rate sprinkler irrigation; 5 mm/hr
- Operated to maximise nutrient removal

The area is divided into 16 spray blocks (**slide 21**). There is a huge lot of infrastructure, up to 5,000 sprinklers and lots of pipes. It is a slow-rate irrigation system, at 5mm an hour, which means a lot of land is needed. We realise now that we do not have enough land, and depending on the crop, we might need up to double the land size to have no impact on the health of the trees. We have been trying to optimise our irrigation to remove nutrients to achieve our resource consent limit.

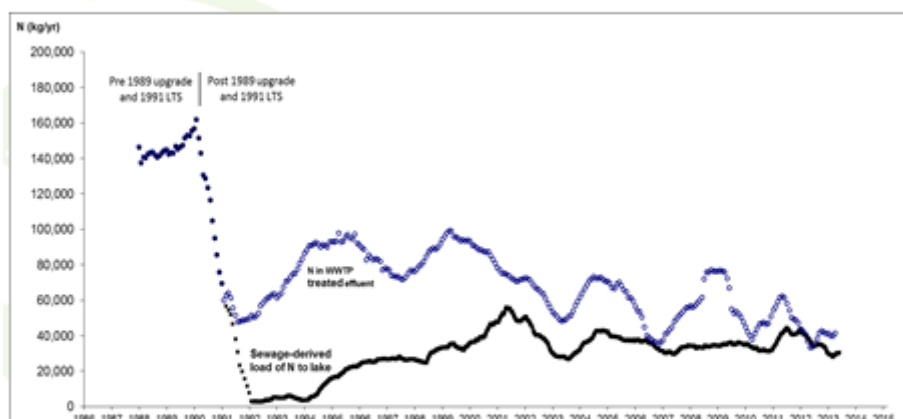
Phosphorus from WWTP & after LTS



- The LTS still retains P in the soil like phosphate-fertiliser

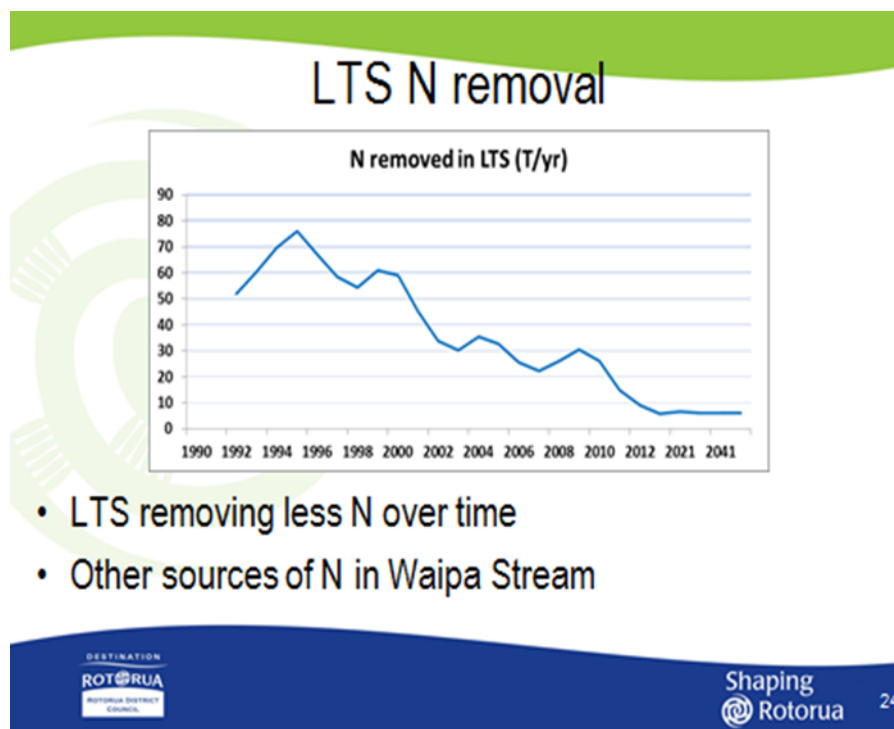
Looking at phosphorous (**slide 22**), the blue line shows that we apply 20,000 kilograms a year, or 20 tonnes of phosphorus to the land. The black line is the phosphorus coming out of the system down through the Waipa Stream. It does show how much the soil is continuing to retain the phosphorus.

Nitrogen from WWTP & after LTS



It is a different story looking at nitrogen (**slide 23**). We apply 80,000 kilograms which is 80 tonnes. This blue line is the nitrogen after treating at WWTP, and you can see we improved treatment at the plant with the upgrade in 1990. We are applying less nitrogen to the forest over time. The black line shows around 30-40 tonnes a year was leaching out of the land treatment system into Waipa Stream and then down through the Puarenga to the lake, and this has also been decreasing in the last couple of years.

Over time the land treatment system has been removing less nitrogen (**slide 24**). It originally removed all the nitrogen applied because it was holding it in the soil but now it is not removing much. But I must say that we measure it in the Waipa Stream which is difficult as there are other sources of nitrogen in that catchment - from forestry operations, gorse, Red Stag, and the background level of nitrogen has been increasing and we have not accounted for this.



We have been measuring all the nitrogen in Waipa Stream, and then subtracting the amount of nitrogen that was there in 1989-90, prior to the Land Treatment System. What is there now minus what was in the stream in 1990 is the nitrogen that is 'sewage-derived'. But we know that is not the case – we have been under-estimating a little the nitrogen removal.

Looking at nitrogen removal in the land treatment system, you might say, "Well why didn't it work, why didn't we know this at the beginning?" **Slide 25** explains - the design was to apply 60 tonnes. It was assumed that a lot of nitrogen would be removed by the de-nitrification processes in wetlands, turning it into nitrogen gas. The reality is that de-nitrification has not been as high as originally thought. We are not getting any de-nitrification in the upland soils and the wetlands are not performing as we had hoped either. The design anticipated that 21 tonnes of nitrogen would be removed by de-nitrification. In hindsight a 30 tonne consent limit was unrealistic. What was not included in the design was the nitrogen sitting in the soil as this was considered a temporary sink. Now it is in equilibrium and any extra nitrogen, more than what is denitrified or taken up by vegetation, is now moving through, so we are not going to remove any more nitrogen in the land treatment system.

LTS

	DESIGN t N/yr	REALITY t N/yr	Current t N/yr
N applied	60	60	45
N uptake by vegetation	7	0-7	0-7
Upland denitrification	12	0	0
Wetland denitrification	16	7	7
Predicted export (by difference)	24	46-53	36-43
Consent limit	30	30	30

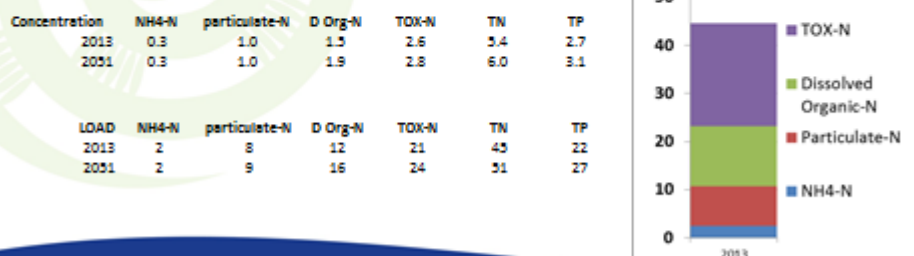
- N removal in the wetlands was overestimated by 21 T
- In hindsight a 30 T limit was unrealistic
- Good removal initially was due to soil storage

Before we move into Eric's talk about the long term options, I want to show you how nitrogen comes in different forms (slide 26). We start with around 350 tonnes of nitrogen in raw sewage. Of the 45 tonnes of nitrogen in the effluent after treatment, only two tonnes of it is ammonia-N which is easy to remove - we basically remove it all. The particulate nitrogen is like solids, and is mostly from the Bardenpho system, and could mostly be removed by extra

WWTP Discharge Water

Total 45 T nitrogen in various forms

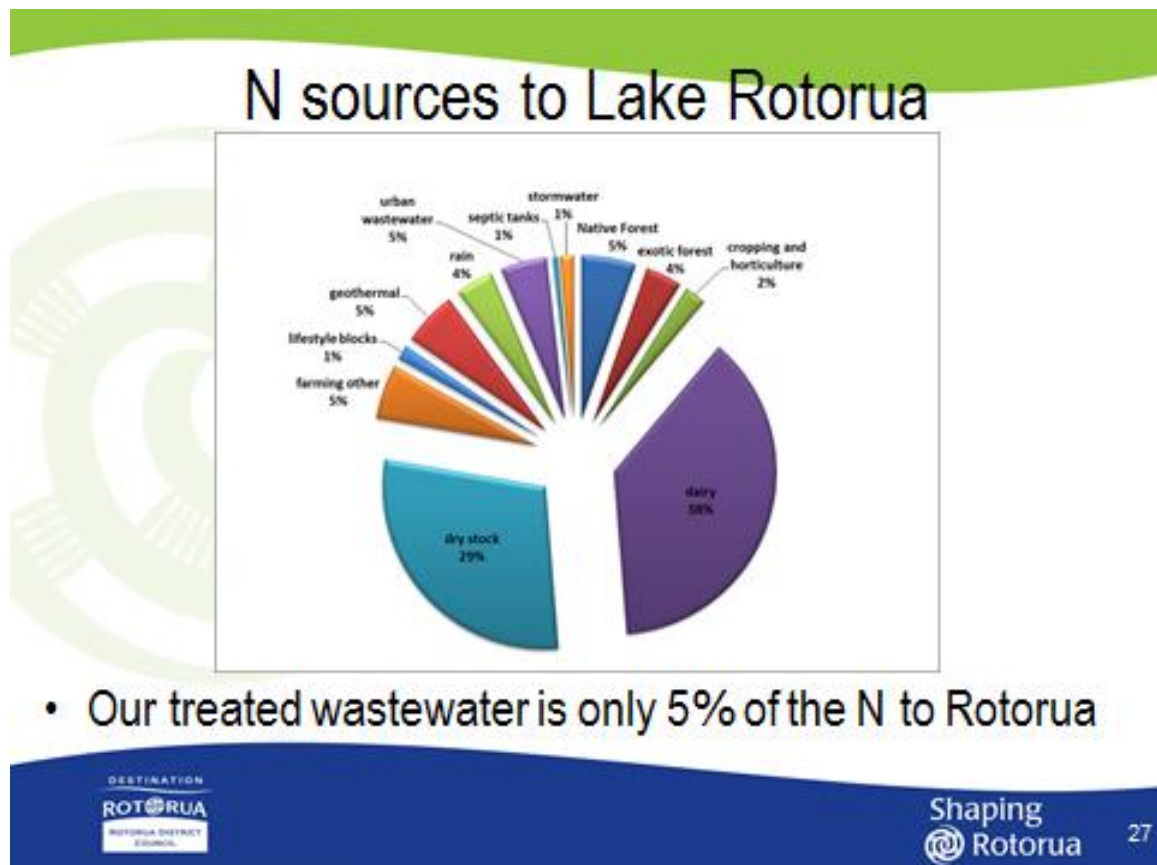
- 21 T nitrate – potentially removed biologically
- 8 T particulate nitrogen – potentially removed by membranes



filtration, up to 8 tonne. The dissolved organic nitrogen is a real problem and we probably are never going to get rid of that. The nitrate and nitrite, or the oxidizable nitrogen, is up to 20 tonnes in our effluent and we can focus on this because this can potentially be removed in our current biological process by flow-balancing before-hand, along with additional

biological processes. It is difficult to remove in the current wastewater treatment processes because it is very dilute, and the flow varies. So, there are options to remove a little bit more, but there are diminishing returns, as it becomes very expensive when we get down to these low concentrations. Eric will talk about our options.

To put in perspective, **slide 27** shows the sources of nitrogen going into Lake Rotorua. The 30-40 tonnes of nitrogen that, because of consent issues, is such a problem for us at the moment, is less than 5% of the load of nitrogen going to the lake. We need to keep that in perspective as it is a small amount relative to all the rest, but it is a point source, so we do have an opportunity to deal with it in the best way possible.



Long term Options

Eric Cawte

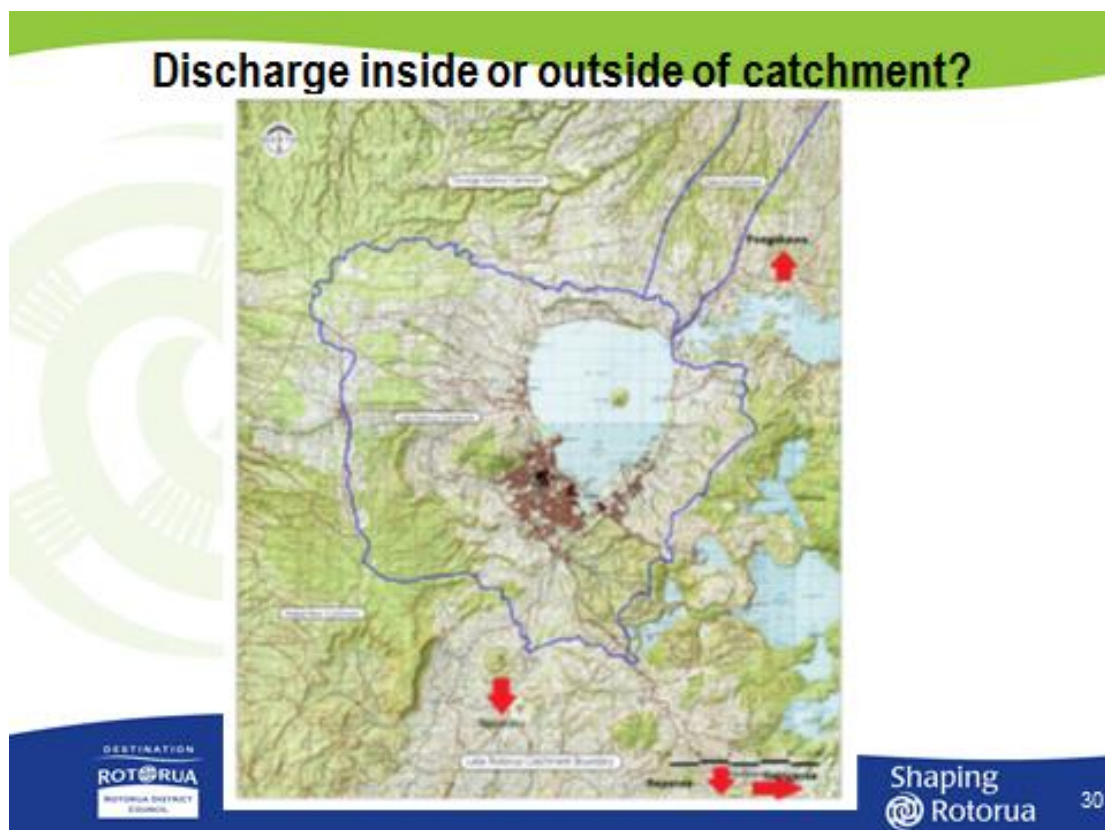
My name is Eric Cawte and my role is Utilities Operations Manager for the Rotorua District Council, the utilities being water supply and wastewater. When I took on the role 12 or 13 years ago my perception was that the big issues lay in water supply because we had sorted out the wastewater. But here we are again and we know that it is not the case down the track. I would like to talk today about the process that we have gone through to identify options that may provide a solution. I am not going to tell you what the solution is because we are a long way from that.

In evaluating the options some may appear more attractive but we have discounted none, nor favoured any, at this stage. We needed to establish some criteria that the options, or combination of, needed to meet.

The bottom line is to meet the 30 tonnes of nitrogen and 3 tonnes of phosphorus limits going into Lake Rotorua and to provide capacity until 2051. The expected average daily flow at present is estimated as 24,500 cubic metres per day. That allows for the current and planned sewage schemes planned to be connected to the Rotorua wastewater treatment plant.

The process was to determine a general scope of works for each option, establish a rough capital and operational cost which has varying degrees of difficulty depending on the option and what we knew about the current research. We identified the possible advantages and risks of each option and any further investigations that may be required. One underlying criteria that was not mentioned is that we want a solution that will meet the expectations of the wider community.

Is the discharge inside or outside the catchment?



We have not restricted ourselves to discharges inside the Rotorua catchment which is shown in the blue line in **slide 30**. We have looked at possible areas outside the catchment such as Ngakuru, Reporoa, Kaingaroa and Pongakawa areas, but only as a locality rather than any specific sites. With those sites outside the area there are barriers to the transport of sewage, both financial and cultural and those options will need to be worked through. As far as financial constraints we have looked at an approximate limit of 30 kilometres from Rotorua. After that the costs sky rocket.

I will work through the options one by one in no particular order that we have looked at so far.

Expanded land Treatment Irrigation System

The expanded land treatment irrigation system is a continuation of the slow rate irrigation system, about 5 millimetres per day. As **slide 31** indicates it is a piped system, currently with sprinklers, over a large area of the forest. The areas are rotated on a daily and weekly basis and we have enough land to retire blocks and accommodate the harvesting operations of the forest company. We need areas of land at a reasonable elevation but we do not want to pump up any higher than we do at the present time. The area needs to be a relatively rolling, gentle contour below 30%.

Expanded Land Treatment System (Slow rate irrigation)



Additional Land: 380 ha

- Involves staying at present location plus new site
- Uncertainty over amount of available land nearby
- Land purchase plus Infrastructure cost
- Capital Cost Estimate: \$18.3 million

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ECONOMY

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Rotorua

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We require about 380 hectares of additional land to meet that irrigation rate based on the predictions of the forest's soils ability to remove the nitrogen and it also allows for roading, buffer zones and retiring for future harvesting. Obviously it involves retaining the existing infrastructure and constructing additional infrastructure.

There is uncertainty over the amount of available land nearby. Possibly there is some additional land within Whaka Forest and land to the south across the other side of State Highway 5. But initial indications are that it is difficult to find enough suitable land. One concern is that this option does not alleviate the land and forest operators' concerns about us operating in there with a spray irrigation system.

The capital cost estimation is \$18.3million which includes land purchase and infrastructure costs. Further investigation is required and we need more work on the nitrogen and phosphorus removal rates and the impact of hydraulic load on the trees and soil health.

De-nitrification Beds

De-nitrification beds (**slide 32**) turn the nitrates and nitrites into nitrogen gas that floats into the atmosphere which is 70% nitrogen. It would involve the construction of beds downstream of the Katore Road ponds which at present pump up to the forest. The nitrogen beds would replace the current forest irrigation system. Bark or wood chips would be in the beds to provide a carbon source to facilitate the de-nitrification. Indications are that bark or wood chips may last 5 to 15 years before ceasing to do the work and would then need to be replaced, contributing to the operating cost of this option.

One concern is that the nitrogen concentration in our effluent may be too low for this to be effective at removing a lot more, but we need to do a lot more work. It would require additional phosphorus removal at the wastewater treatment plant, because the removal of phosphorus is pretty minimal from those beds. This could be done by some sort of chemical dosing at the wastewater treatment plant.

Denitrification beds plus Phosphorus removal at WWTP

- Bark/woodchip beds
- Converts nitrate-N to nitrogen gas
- Nitrogen concentration may be too low to be effective
- Requires additional phosphorus removal at WWTP
- Bed area of 2.5 ha
- Discharge field up to 26 ha
- Capital cost \$10.6 million



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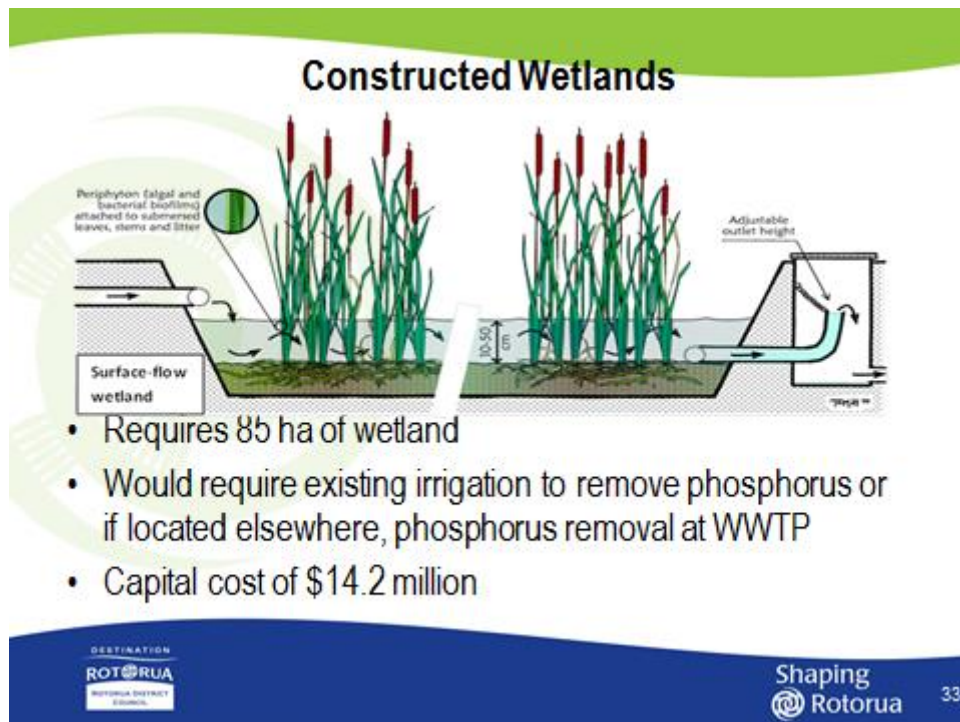
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Rotorua

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Indications are the bed area would be around 2.5 hectares and flow into a discharge field of up to 26 hectares. The bed would remove the nitrogen and the discharge field would remove a little more and remove BOD and faecal coliforms. The advantage is that it is a relatively small land area, 2.5 hectares plus the discharge field. The discharge field would be bare land, not forested, and would reduce forest impacts over the remainder of the forest no longer required for irrigation. The beds would be broken into parallel cells and could be taken off line for maintenance or replacement of the media.

Further investigations for this option would be the performance on discharge water with lower levels of nitrogen, performance of the seepage and removing field and removing those other elements such as the BOD and pathogens.

Constructed wetlands



In combination with our slow rate irrigation, downstream of the existing irrigation system, we would construct a number of wetlands (**slide 33**). The wetlands that are currently there are not operating as efficiently as a properly constructed wetland might. There is a lot of short circuiting going through flow channels and not using up the area. We would convert about 55 hectares of the existing wetlands and construct a further about 30 hectares in wetlands, the total area needed being 85 hectares. The system works by microbial de-nitrification through the plants and subsoil sediment accretion and some plant uptake as well.

There are several different types of wetlands; surface flow is the one currently recommended as being the most suitable. We would still require the existing irrigation to remove phosphorus, or if located elsewhere, we would have to remove phosphorus at the wastewater treatment plant. The capital cost is \$14.2 million.

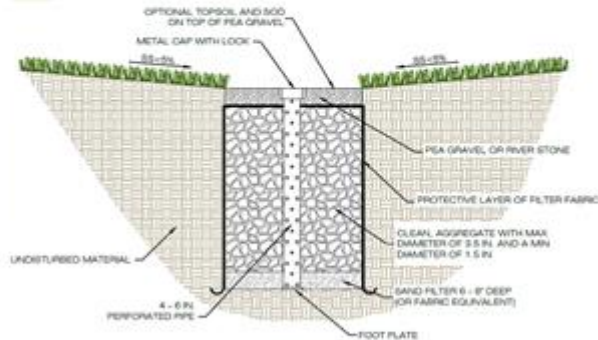
The advantages are that there is relatively no maintenance and they are perceived as environmentally friendly. They provide a habitat for aquatic and other fauna and flora. We would need further investigations to look into appropriate wetland configurations, about the constructability in those areas, and the ability of soils and sediments to retain phosphorus.

Rapid Infiltration

This is sometimes termed as 'aquifer recharge' depending on the depth of the infiltration trenches. **Slide 34** shows how a discharge to the land moves rapidly into the soil. Discharge through perforated pipes allows water to flow through the media around it and into the soil. It is dependent on the geology and ability of the surrounding soils to transmit the hydraulic load that is coming in. It is unlikely to be immediately suitable within the Rotorua catchment without additional nitrogen and phosphorus removal. The cost is very dependent on location, being remote from Lake Rotorua, the pumping or transporting costs of the liquid is a very big cost. The cost of constructing pumping mains, say for 10 kilometres, is about \$5.5 million, at 20 kms it is around \$11 million. No further investigations have been identified on this option.

Rapid Infiltration

- Discharge to land – rapidly moves into soil
- Area dependant upon geology
- Requires additional nitrogen and phosphorus removal
- Cost dependent on location



Indirect Discharge to Water

Indirect Discharge to Water

- Additional treatment for phosphorus and faecal coliforms required at WWTP
- Nitrogen treatment or offsetting required e.g. denitrification beds
- Treatment required for cultural considerations
- Percolation through rock/earth passage to surface water?
- Cost \$10 million



This option (slide 35) would require additional treatment for phosphorus and faecal coliforms at the wastewater treatment plant and nitrogen treatment, or off-setting, which I will talk about later. One option could be to have de-nitrification beds located at the wastewater treatment plant before discharge or indirect discharge to the ground and the water. Obviously cultural considerations are a huge issue here and we need to do more investigation about what would be suitable or acceptable in that respect. There are examples of other Councils, e.g. Hastings and Hamilton, who have used a percolation through rock or

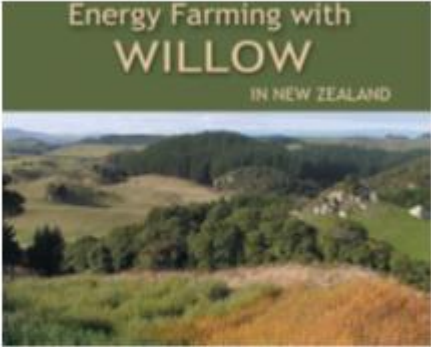
earth passage prior to discharging to water. It is sometimes termed papatuanuku¹. The cost is around \$10 million.

The advantages are no pumping to a remote location and no effects on the soils or trees in the forest. We would remove any influence directly on the existing forest and the Puarenga Stream. Further investigation needs extensive discussion regarding the cultural issues and looking into the most effective method for nitrogen removal.

Alternative Irrigation Methods (New Site)

Alternative Irrigation Methods (New Site)

- “Cut and carry” grass silage
- Short rotation crops eg. willows
- Either as complete replacement for or in addition to existing LTS
- Land requirements
  - 88ha for dual discharge or
  - 176ha + for all flow
- Issues: Large water volume, Low N concentrations
- Capital cost \$22 to \$48 million



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Slide 36 shows other irrigation methods. One alternative is to cut and carry grass silage, practised currently by Taupo District Council. It requires a very gentle contour for harvesting ability and safety and removes the nutrients which are exported and sold off outside the catchment.

Another option is short rotation crops such as willows or eucalyptus. This option would use sub-surface drip irrigation. Root intrusion can be a problem but that can be engineered with a solution. Crops and willows are not so efficient in winter so there may be risk of leaching. This could be either complete replacement for, or an addition to, the land treatment system. If it was an addition to the existing system we would need another 88 hectares. A complete replacement of the land treatment system would require over 176 hectare for all that flow.

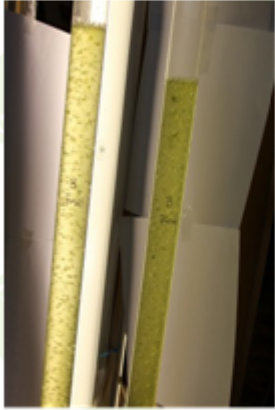
The issues with this option are the large water volume and finding the land to discharge on to. There are relatively low nitrogen concentrations in the effluent particularly for the silage option. Capital costs would vary between \$22 and \$48 million according to the distance to suitable land.

¹ In the Māori world view, land gives birth to all things, including humankind, and provides the physical and spiritual basis for life. Papatūānuku, the land, is a powerful mother earth figure who gives many blessings to her children. <http://www.teara.govt.nz/en/papatuanuku-the-land>

Further investigations would be on land availability, markets for bio mass and, if we were to go into the Waikato region, uncertain nutrient limits in the future. At the moment they are generally lower than the Rotorua catchment but who knows what the future holds.

Algae Removal for Nitrogen and Phosphorus

Algae Removal of Nitrogen



- Many species of algae – mainly blue-green used
- Research in its infancy – no full scale operation
- May only be effective for high nitrogen concentrations
- Initial trials on RDC treated effluent not promising

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There are lots of different types of algae and the first thing would be to get the right algae for the job. (Slide 37) They are all different in their behaviour and what they can achieve, if they can achieve what we need to do. Removal works by the nitrogen being assimilated into an algae bio mass and then either processing it with sludge or into a higher value product such as fertiliser. The research is very much in its infancy and there are no full scale operations to look at. It may only be effective for an effluent with a higher nitrogen concentration. We have some trials on our own effluent, which are not particularly promising at this stage.

The potential advantages, if it could work, would be to have an end product such as fertiliser that could be on-sold, or turned into biofuel. It is likely to be a culturally acceptable treatment method but there are still issues about the remaining water discharge from the process. Further investigations are reliant on other research being done. At this stage there are no costs because there are too many unknowns.

Reinjection into Geothermal Aquifers

This option is done to a limited extent overseas but only where large scale geothermal extractions occur, such as power stations (slide 38). There is a desire to replace that back into the aquifer but it is not happening to a significant extent in New Zealand and would require a very deep injection bore. In Taupo they were looking at one 3 kilometres deep and pressures and temperatures at that depth have their own challenges for constructability. Taupo investigated it but did not proceed any further.

Struvite

A more recent investigation has extracted struvite through biological wastewater treatments, but it needs to be supplemented with magnesium. It also removes phosphorus and nitrogen in the form of ammonia. As Alison alluded to before, ammonia is only two tonnes of our nitrogen load so this option would only be effective for the two tonne fraction. Struvite could

Reinjection into Geothermal Aquifers

- Done to limited extent overseas where large scale geothermal extraction is occurring (e.g. 1,000MWe)
- Would require very deep re-injection bore ~3km
- Investigated for Taupo but not implemented



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be sold as fertiliser however where it has been tried the cost of production is higher than the sale price for the fertiliser. It would only be viable in higher nitrogen and phosphorus waste streams.

Our initial assessment shows it to be uneconomic and our Terax process, which deals with our sludge fraction, is planned to remove most of the phosphorus that this might be applicable to. A rough cost is about \$5 million plus, but bear in mind that it may only be applicable to 2 tonnes of our nitrogen load.

Zeolite

Zeolite is a porous mineral that can also remove nitrogen in the form of ammonia. There are a number of types of zeolite with different characteristics and it is important to get the right product for the job. It would remove 2 to 3 tonnes of the ammonia. A brief calculation for a relatively low cost operation would require 482 tonnes of zeolite per annum for the existing wastewater treatment plant flows. At \$400/tonnes for zeolite it would be \$193,000 plus infrastructure costs. This method has been well researched at lab level but there are few examples. Studies indicate retention times must be met or effectiveness is significantly reduced.

Land Use Change through Farm Purchase

The next two options get into the area of nutrient benchmarking offsetting. They are rather similar in that they do not involve much infrastructure and would not solve the physical issues with our forest or current system.

As a bit of background, all properties greater than .4 hectares must have a nutrient benchmark allocated, which sets a limit on the allowable nutrient losses from the property. Our existing land treatment system benchmark is based on the forestry use of the land. Our irrigation land treatment irrigation discharges are considered a point discharge, which is regulated by a resource consent. There may be an opportunity to allow Council to transfer our allocation to another property, for example, a dairy farm with higher nutrient losses of 35kgN/ha/year. We could convert that to forestry at 4kgN/ha/year and have that nutrient load offset against the farm. In other words it could allow the opportunity to swap to continue discharging where you are. The calculation would be:

- To offset 10 T nitrogen = 322 ha of dairy pasture converted to forestry

Once converted it could be sold off to recoup some costs, with covenants on to say that it could only be used for forestry in the future. With land values changing all the time, the capital costs to purchase land could be around \$10 million.

Purchasing Nitrogen on the Market

In a similar vein a nutrient trading scheme would provide opportunity. There are currently no mechanisms for nitrogen trading in Rotorua, but if this system was adopted in theory we could purchase nitrogen from a private land owner and their nutrient benchmark would decrease accordingly. The outcome would be similar to direct purchase. Again the issue is that it is not addressing the concerns with our current operations, especially in the Whakarewarewa Forest.

The risk with these options is that there may be some opposition in the rural sector because both reduce the base from which the rural sector would have the opportunity to achieve their nutrient reduction targets in future. If nutrient limits were to change in the future Council would need to purchase more land or nutrients.

That is the summary of the options that we have looked at in a preliminary manner to date. There is a lot more work to be done. A final thought and it was said before by Ian McLean, that RDC has a responsibility to provide sewage services. That is quite true; however the community also has a responsibility. RDC is working on behalf of the community and for the community in providing those services. We all produce waste, our families, our businesses, produce waste and we all need to be on board and take responsibility. My personal opinion is that the whole community has to take responsibility for finding solutions. Council has the expertise and I believe we have done an excellent job, and are continuing to do an excellent job, in treating our waste at the wastewater treatment plant. It is a matter of technology. But disposing of what is left, no matter how well we treat it, Council cannot do that by ourselves. We cannot make decisions that affect the community without the community's input. I believe that the community has a responsibility to get on board with Council and help find the solution for the discharge.

Interim Consent Change

Colin Kemeys

I have been engaged by the District Council to assist with the application for a change of the current consent. The reason is that the District Council has not always been compliant with the consent and it is important that the Council has a consent that it is able to comply with. We therefore need to make some changes to that consent.

The current consent expires in 2021. The RMA allows a consent holder to apply for a change of conditions to a consent, and that is the process we are going through, but it cannot change the term of the consent. That is why the Council needs to focus on the picture beyond 2021.

We have had a number of hui about the change consent application and Peter Guerin always expressed the view that it provides the District Council with a bit of breathing space until the longer term solution can be sorted. He also hoped that at the end of this process it did not end up in an appeal situation. We have said all along that the consent will be a notified consent and there will be the opportunity to make submissions.

The RMA requires two sorts of themes of assessment requirements. One is dealing with the effects of the change and the other one is to do with an assessment of the planning provisions. My role has been to trawl through all of the various documents - the National Environmental Standard for Fresh Water, the Regional Policy Statement, the Regional Plans, the District Plans and all other documents including the Te Arawa Lakes Settlement Act - to review the provisions of those documents and assess them in terms of the RMA. I have also prepared the linking document which is the application. We have had a number of specialists look at various components. John McIntosh dealt with water quality, Keith Hamill dealt with the ecology and we had a Cultural Impact Assessment prepared which was not entirely helpful. That Assessment looked at the collaborative effort that needs to go into the longer term picture. It is quite critical of the Council and its actions or what would deem to be lack of action over the last period. But there is a way forward identified in that Cultural Impact Assessment.

Proposed Changes to current Resource Consent

- Increase sewage derived nitrogen from 30 tonnes in Waipa Stream to 51 tonnes from the wastewater treatment plant, for a rolling 12 month period
- Change monitoring point for nitrogen compliance from Waipa Stream to outlet of WWTP
- Increase the phosphorus level from 3 to 4 tonnes, for a rolling 12 month period

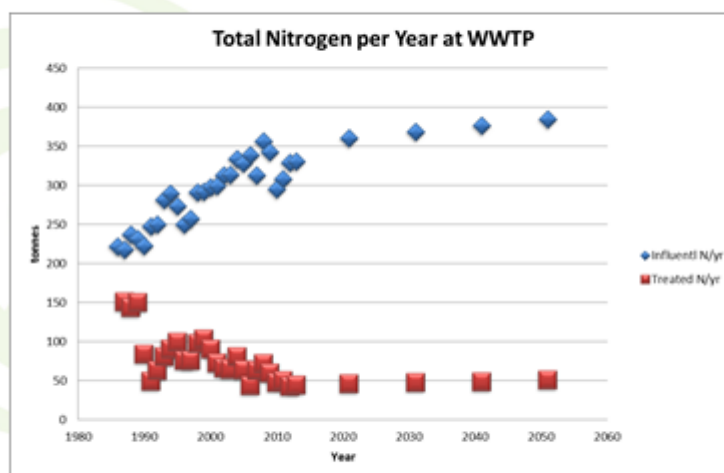
The current consent requires an output from the land treatment system of 30 tonnes of nitrogen and it is measured at site 5 which is in the Waipa Stream. The intent is to change in terms of compliance to 51 tonnes of nitrogen and that to be monitored at the wastewater treatment plant. The change is identifying a point at which the District Council has absolute control over the output which is at the wastewater treatment plant compared with the current requirement to comply at the Waipa Stream.

The difficulty that arises is that the upstream contributions to the nitrogen are unknown to a large extent and increasing. The consent allows the District Council to put out 30 tonnes. The output at site 5 is measured and a 5 tonne contribution from upstream is subtracted. That 5 tonnes was calculated in 1989 as a 1 year measurement of the upstream contribution. We know it has been increasing over time, so there is an exaggerated measure of the nutrients from the land treatment system.

There is a request to increase the phosphorus from 3 to 4 tonnes but it has not happened at this point. However, there is a concern that in extreme weather events it could possibly increase to 4 tonnes.

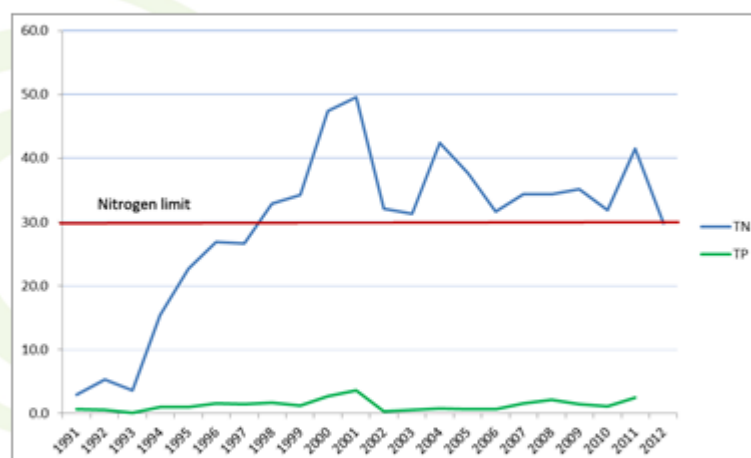
Slide 45 indicates the nitrogen coming in and out of the plant projected through to 2050 at around 50 tonnes. You can identify in the graph the sort of improvements that have occurred in the wastewater treatment plant - the upgrade in the 1990s with the Bardenpho and its expansion in 2005, then the ethanol dosing shows some decreasing.

Performance of WWTP



Performance of the land treatment system (**slide 46**) shows that there has been non-compliance, although it is significantly varied.

Performance to Date LTS



One of the other reasons why this change application needs to be made is the extra nitrogen removed through the reticulation of the lakeside settlements.

Lakeside Reticulation	2012
Lake Rotorua	13.3 T
Lake Rotoiti	8.9 T
Lake Okareka	3.3 T
<u>Lake Tarawera</u>	<u>-</u>
TOTAL	25.5 T

- Extra 25.5 T to the WWTP, but only 3.3 T after treatment
- Total removed from Lake Rotorua as a result of Lakeside Reticulation Programme is 13.3 T – 3.3 T = 10 T nitrogen

In terms of compliance, ROTAN modelling showed that the land treatment system was meeting the 30 tonnes limit in 2011, but the consent is not based on the ROTAN modelling. It is based on the 30 tonnes total which is subtracting the upstream influence.

Greg is going to talk about the programme moving forward and as part of this consent those are the basic changes that are being made to the conditions of the consent. What we are also suggesting is that there be a new condition in the consent which deals with the programme going forwards. A concern expressed by the Regional Council was that we might get to 2019 and still be in a position where not a lot has been achieved in terms of the overall long term consent, and the District Council is again in a position of having to ask for an extension to the consent.

The District Council is committed to the long term issue and we have proposed a condition in the consent which provides that linkage, so that there is a programme which will identify milestones and the District Council will have to comply with that condition as well.

Road Map Ahead

Greg Manzano

I have been in Rotorua for 12 years now, involved with wastewater projects since then. The first project that we did was the extension of the Bardenpho, then the ethanol dosing facility and lately the MBR upgrade at the treatment plant to reduce the nitrogen. As a side note, the MBR upgrade has been one of the finalists of the Institute of Professional Engineers and won excellence awards for innovation and as a community we should be very proud of it. Hopefully for the next 8 years I will also be involved with this project.

ROAD MAP AHEAD

- Existing consent up for renewal in 2021 (approximately 8 years from now)
- The intention is for an alternative solution to be operational before 2021

The road map ahead that we have developed is just our initial thinking and obviously this will be finalised in conjunction with the stakeholders. To provide an overall context, the existing consent that we have now is up for renewal in 8 years and we have time. But in terms of the context of the project we have a very short time. The intention is for us to complete the alternative solution in 8 years' time, and by that stage be operational.

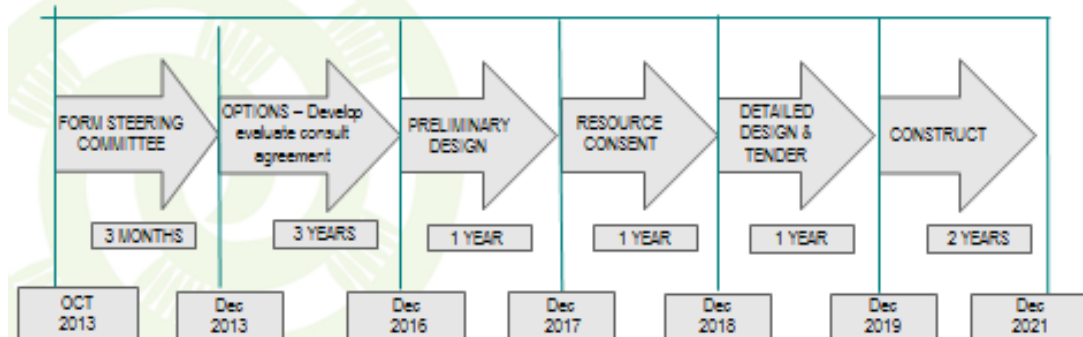
Key Tasks Ahead

- *The development and identification of alternative solutions that addresses the aspirations of all the stakeholders.* The options that Eric has presented are a start; there will be a lot of solutions that come later as we move forward as a community.
- *Obtaining a resource consent that would authorise the new solution.* It is hoped that with the support of the stakeholders agreeing on a common solution which is acceptable to everybody that we will have a smooth sailing resource consent process.
- *Find a suitable site for the alternative solution if it is required.* The question is – is there land available out there? Is there a willing seller out there?
- *Detailed engineering and construction of the alternative solution.*

Key Strategies to Identify and Develop an Alternative Solution

- *Form a Steering Committee of stakeholders.* Hopefully from the exercise of this Symposium we will be able to form a project advisory group.
- *Identify other options or combinations.* We can start from Eric's presentation and look at other options or a combination of options to explore.
- *Undertake feasibility investigations.* Most of Eric's options were developed from a desk top study with no detailed feasibility investigations done. But we will have to do a lot to confirm the performance of these options.
- *Consult and seek feedback.* This will be from stakeholders and the general community as well.
- *Agreement on Preferred Option.* Hopefully through this process we will agree on a specific option to implement.

Timeline



Slide 53 is a flow chart which gives indicative time lines on how to develop the process in the 8 years. We have allowed 3 years for the 'options stage' which is the longest duration in all the activities, because we need a comprehensive and very robust process to come to a finally agreed solution acceptable to all concerned. Then we go through further preliminary design and quite possibility more investigation for one year to support the resource consent application that we will put through. Following that would be a resource consent application renewal. It might be considered too optimistic with one year, but assumes that all the stakeholders are in support of the solution and that the resource consent application will be a smooth sailing application. After that it will be the difficult project development process, which is the build, design and engineering, tendering and commissioning the construction which will extend over a three year period.

Discussion

Todd McClay: Very briefly - we have heard about the history and current situation. We have seen where we have come from, the challenges that have grown and where we are today and therefore the challenges set for the future. Most important for us to consider today are the long term options and what we can do. I have jotted down a couple of things to help us focus on this.

The *land treatment system* – one of the options is larger, outside of the catchment with cost restrictions moving products more than 30 kilometres. *De-nitrification beds*, 2.5 hectares of beds needed and discharge area of some 26 hectares. *Constructed wetlands* to convert currently 55 hectares and construct another 30 hectares of wetlands. *Rapid infiltration systems*, *indirect discharge of water*, *alternate irrigation methods*, 88 hectares of land needed for dual discharges, 176 hectares for all flows, issues that have been raised around *nutrient benchmarking offset* or *nitrogen trading*.

Going back to Robert Muldoon's time, remember all those problems we had with oil and carless days, maybe it could be toilet less days for Rotorua. Something that the public could consider! We also heard about the *interim consent change*, Rotorua District Council's consideration of what needs doing over the next 8 years to deal with excesses of discharge over their current resource consent. The *road map* is how we move forward through the next 8 years to get solutions on the table.

I take from the presentations that this is about a process with the community to find solutions and deal with the challenge. Not as we see in other parts of the country a call for 8 more years of talk and not coming up with solutions. The problem only gets worse at the end of that time period, so I am thankful for those presentations.

Pihopa Kingi, Te Arawa: My question relates to the Lake Rotorua catchment and the streams flowing into Lake Rotorua. Three miles along the western highway to Wellington is a high point at Kapenga where a stream flows back into the Waikato region. The Puarenga Stream goes further on down there and we have heard that the water from the head of the catchment is clear until it gets to Waipa. That is the area we need to address. I am concerned with that map of the Rotorua region, certain people will think what a mighty area, but it is not. The catchment itself is confined to the head waters of only the Puarenga, the Utuhina, and 2 or 3 other streams around Lake Rotorua, which brings the catchment into a very concise area to focus on looking for solutions. Thank you for the time, kia ora tatou.

Alan Wills, Federated Farmers, NZ: Residing in Reporoa. Someone earlier referred to the Taupo system and to me there is a huge opportunity. Has anyone had a good look to understand how it works for them? How far can water be effectively pumped? If pipes and pumps are big enough it can get a fair way. At the risk of getting my hand slapped by my Rerewhakaaitu colleagues there is quite a bit of land at the back of Rerewhakaaitu on ash country. It is a sensitive catchment, but if you wanted to replicate Taupo there is an opportunity to seriously consider Rerewhakaaitu. They make wrapped silage which is a product that is easily transported. There are definitely opportunities to investigate.

Roger Gordon, Chamber of Commerce: This might be a silly question but I am going to ask it anyway. It appears to me that we have a lot of water. Water is one of the most valuable commodities there is. In the Waikato we had a drought and they were screaming out for water. Is there a commercial opportunity for water to be transported from here to there? There might be a storage issue for a certain period of time crossing over. The other issue is if the MBR system establishes a drinkable quality water, does it have a commercial value outside of our rohe, or outside New Zealand?

Peter Staite, Ngati Te Kahu/Ngati Hurunga Te Rangi: My question is concerning the MBR output, there was a reference made to the output failing to remove viruses and other things. How soon can you start removing these?

John Green, LWQS: I would like us to stop talking about sewerage; I would almost like us to stop talking about wastewater. I would like to pick up on Roger's theme that water is the world's scarce resource. We need to adopt an approach where we naturally reinvigorate what we have wasted. I would like to see a policy where we are sustainable; naturally replenishing what we are given by nature and returning it to its original natural state. Taking that theme forward, I heard from Alison that from an engineering point of view we can take out all the pathogens and we can take out the phosphorus and nitrogen. If we can get the community to agree to have replenished water sprayed on a golf course, or our farms, can we have a commercial reason for that plant to exist? It gets rid of the problems we have now?

Alison Lowe: Yes the MBR does remove the bacteria and some of the viruses, but not the small E. coli and at the moment we rely on the natural treatment and the land treatment system to kill the rest of the pathogens. We could UV treat at the treatment plant if that is what the community requires. It is not a big issue, but requires some capital investment.

Peter Staite: I should have been clear about it. Is it possible to remove the viruses at the discharge point, rather than send it out into the open environment? The sooner the Council can sort out the water to a higher quality, as you say almost drinking quality, and I look forward to that, then we have more options to deal with the discharge.

Alison Lowe: The operational costs were around \$400,000 a year, is that right Eric?

Eric Cawte: Ultra violet light disinfection is what we are talking about and at the present time we employ that on our drinking water supplies. It is a different system because with drinking water it is pressurised through a pipe line. We call it a reactor which is an oversized bunch of light bulbs inside a pipe. But for wastewater treatment it is usually under a gravity type arrangement like a trough with the ultraviolet light bulbs inside. I am not sure about costs in that configuration but the cost to install UV treatment for all our drinking water sources, and there are about 7, was \$2.4 million capital cost. The operating cost is the electricity for the light bulbs and I do not have that figure.

Alison Lowe: Just one comment, we can assume that we will UV treat the water if it is not going to a slow rate irrigation system somewhere else. The quality is then very high and could be used anywhere. We looked at demand for water but it is not high. We do not have enough droughts, just a 3 week period during the year on average when there would be demand. If anyone wants it put their hand up, it is Reporoa.

Luke Nelson, Rotorua District Council: We had a look at the potential of pumping water to Reporoa. Those in the rural community know that generally a flatter contour is needed to achieve irrigation, unless it is dragged around the hills. But the moisture deficit is probably only 3 or 4 months of the year which would mean we have to do something with it for the other 6 to 8 months which is the winter season. It is a potential solution but, as Eric mentioned, the cost of pumping per metre gets very expensive.

Alan Wills: What is your understanding of how the Taupo scheme works?

Luke Nelson: Simply, they have problems over the winter. Grass does not grow. They have much lower rates and not as much nutrient removal. I am not sure how far silage gets trucked away. There is potential. It is up to those on nutrient benchmarking to comply, but

those nutrients get cut and carried to somewhere, so where do they end up? Do we export them to the Waikato and it is their problem, or do we use them on our own farms here? I do not have the answer for that.

Warwick Murray, BOPRC: I wanted to make a couple of comments about the catchment issue. I think it is really important to remember that we need to think about this in the context of the whole Rotorua catchment, not just reducing the nutrients coming out of the Wastewater Treatment Plant. Taking anything out of the catchment requires thinking about what the situation is in the recipient catchment? The Rotorua catchment is severely nutrient restrained and other catchments face similar problems.

Todd McClay: Yes an important point. If we look at the Reporoa area some of that will be Bay of Plenty Regional Council, some will be in the Environment Waikato region and they have their own challenges and issues.

Jim Howland, LWQS: Continuing on with John's question about utilising the water, has the effect of the changing environmental situation been thought about? We are not always going to have the current rainfall; it may be more or less. I am not a specialist on that, but I do know that the Waikato region is short of water and in my mind that is going to be an ongoing problem for a large part of New Zealand. It is more important to look at how we can utilise water, rather than the disposal of it.

Ian McLean: Yes an important point. All over New Zealand we face challenges around the good use of water. In some parts of the country there is more than enough for everybody to use. It is more a storage issue.

Stuart Morrison, Farmer/StAG: Just an observation, we noticed the slide about the quality of treatment. Hamilton has a certain level of treatment and it is well known to everybody that a bit further down the river Auckland takes their water out of the Waikato.

Todd McClay: That's right, a lot of drinking water that the people in Auckland use in their very expensive houses comes from the toilets in Hamilton.

Alamoti Te Pou, CNI Iwi Holdings: Kia ora again everybody. I noticed that in 1991 the LTS system was established and then in 1996 it was no longer compliant. I note that it is not leaching as much as it used to. It appears it is neither a solution now nor a long term solution overall. If anybody could answer that query.

Todd McClay: Does anybody want to comment on that? The presentation on the current consent and the way forward over the next 8 years considers that. In my view Council at the moment are doing the right thing by wanting to go to the community to talk about the options, what will be accepted and what the longer term solutions are. One of the most interesting things over the last year or two is that as a community we have focused on the challenges; we need to do this in the whole catchment now that the understanding of science has changed our thinking and will continue to. But it is not enough to say - well, there may be solutions in the future that we do not know about now, so wait until then. But actually it is what we are all doing today that is important.

It struck me when we saw the solutions that some have greater promise than others. Some cost more for fewer deliveries, and whether it is all about one option or about a number. What is the best fit from the possibilities to meet the challenge and requirements that we have?

Mayor Kevin Winters: I want to carry on the conversation with my farming colleagues about pumping out to Rerewhakaaitu or Reporoa. I was under the impression from the Taupo

model that Fonterra were not keen to use silage grown from human waste to produce milk, because of the perception overseas of damage to our clean green image. If that has changed please tell me because I thought it was Fonterra policy. Yesterday I contacted the head office at Fonterra to find someone who can share that information with us.

Alan Wills: I have not got the answer but will at some stage. If you drive down the Broadlands Road past the Taupo facility wrap silage is not there for long. It is going on the back of trucks to somewhere. I do not know what it depends on, or whether they have refined their water sufficiently to shift it around. I cannot add any more, but we will get some answers.

Tapa Nicholson, Te Puia: Kia ora, it has been interesting hearing about the desktop options. That is what they are at the moment, desktop options. I am going to hark back to the Puarenga because, whilst I appreciate that Rotorua District Council is dealing with the issue of water reticulation out in the forest, at the head of the Puarenga on the other side of Te Puia there are two other contributors to that water quality. Now that we have got the industries here, the farmers and RDC, the two main contributors, maybe there is an opportunity for us to come together to deal with the issues that have been caused by our input to the Puarenga. While there is concern with leaching out of Whaka Forest, the other two contributors are the Tureporepo and Kauaka Streams. Kauaka brings the farming community in, Tureporepo is RDC. There is an opportunity for us to get together as industries and say, 'Alright, how do we deal with our contribution to it?' We are talking about Puarenga, Te Puia, Whakarewarewa, Ngapuna, Te Arikioa, Ohau and Maketu. That is the way we should view the issue. It is not just us, it is the whole community. Kia ora.

Te Ohu Wi Kingi, CNI Iwi Holdings: I share the same sentiments - it is about the catchment itself. If we go back to its nexus where this all derived from, whilst Whaka Forestry is one little incident, if we clean up our catchment properly, in a collective attack, it brings to mind the theory that if you clean the start-up, the trickledown effect will pay big time for all of us. We cannot put it in one basket and say, 'Here is the problem'. We have to go back to the start. We are all here today, only little things, but it means a lot as the down flow effect comes into play. It is no cost really; it is just opening our minds to the reality of life. 'What is causing all of this?' You have just heard about all the major contributoryies that are connected to the bottom of Sulphur Point.

For ourselves we should go to its nexus and come down again and then we will have a clear understanding of all the options that were portrayed to us a little earlier. There is nothing wrong with using the lot, one might work in one area, another might work in another area, 8 years is not long. Two major points I want to ask are, 'What damage has it caused over that period in the area? What damage is left, not only for CNI, but for us as Iwi?' These are pivotal points that we need to understand ourselves because then we can look at the reality of where we are at. We can come to consensus at 5 o'clock this afternoon and direct the plan of attack on all our behalf. Kia ora everybody.

Joe Tahana, Ngati Pikiao: Kia ora notato. Three comments. Firstly, I want to come back to the proposed resource consent seeking a variation. I consider it is reasonable and sensible to allow that consent to go ahead because the reality is we need 8 years to listen to all this wonderful innovative talk. Secondly, in terms of innovation, can you evaporate the 20 million litres of water? Here is the hottest geothermal spot in the lake. Surely there is enough energy here to turn water into H₂O, separate the H and put it over there, the O can go into the atmosphere. Is that not viable? I agree with what Warwick, Tapa and Te Ohu said that this is a catchment approach. The third point is that, whilst there are a lot of concerns about the Puarenga from the whanau down those ways, the nutrients from the Wastewater Treatment Plant are only one component. We need to apply the whole catchment approach. I understand from Warwick there are working groups underway, but we need more

community input into those groups. We cannot just have the stakeholders being farmers, Te Puia and all that. Whilst they do represent us to a certain extent they are looking after their interests as well, ka pai.

Roger Gordon: This is a question for Eric. When you looked at costing the options, given that the MBR system is UV feasible to create potable water, what would be the capital cost of putting in another MBR pond so that two thirds of the water went through the MBR rather than the one third/two thirds currently?

Alison Lowe: \$12 million to put microfiltration at the end of the MBR. We do not need the whole MBR just the microfiltration spaghetti things at the end.

Ike Reti, Hurungaterangi: Can I ask you a question? How many streams run into Lake Rotorua? The Regional Council map has 34 named streams; I am in my own time working on the streams to name every one of them and have 269 at the moment. The Tureporepo is one of the most dangerous streams that feeds into the Puarenga because it comes out of the dump site and we have a lot of problems up there. That is something that needs to be looked at.

John Green: Joe, just picking up on your point on the heating of the water, if I am going to ever leave a legacy for Rotorua it is to put in a district heating scheme for all the city, which picks up again from the 1988 closure that was bought about. If we want to get the best economic, health and social outcomes for Rotorua, and make us distinctive from any other city, it is putting in a district heating plan for all houses. It can be solar heating or geothermal, but the point that I make is if we use this water properly we could use it for the reinjection. By definition it is going to heat up and can keep us sustainable. That is what Grow Rotorua is thinking. There is a long road to go down but there is an opportunity for water reinjection which will protect the Pohutus of the field. We have a resource to help a resource, that's what I like.

Todd McClay: Ladies and Gentlemen, that brings us to the end of this session. I think it has been extremely useful. What I take from this session is that all the comments are positive and seek solutions. We do not need to cast our minds back too many years when this meeting would not have been as conducive to moving forward. There would have been arguing, bickering and blaming. Everybody in the room and everything that we have heard could be part of a solution. We need to continue to engage with our respective stakeholders and the wider rate paying community. Have them focus on what we need to do for everybody in New Zealand, which is find good sustainable solutions not only to continue to clean up our lakes, but also find better ways to use this valuable water resource.

We are fortunate in that we have had too much water for far too long and as a country we take it for granted. I think that the different sectors coming together today, and over the last year or so, show that we are changing our mind. We know it is valuable and we must value it.

Can I thank the presenters and Council for the work that you are doing. As far as wastewater treatment is concerned, it is not an issue just for our Council but for all of us because we are all out there flushing our toilets and using drinking water. These two are now being bought more closely together. We can focus on what the challenge is and must do it together.

Session Three - Other Technical Input

SESSION CHAIR - Arapeta Tahana

Bay of Plenty Regional Council Lakes Programme and Nitrogen Reduction Targets

Warwick Murray

Kia ora, Arapeta, and good afternoon. I hope you have enjoyed your lunch and I am not going to be so boring that you all fall asleep in that post lunch session. I am going to cover three things. Firstly I will give you an overview of the programme, what it is about and what it is doing to clean up the water quality in the lakes. I will then provide the policy context around what we need to do in Lake Rotorua, particularly addressing the catchment sources of nutrients. Lastly I will go through the recently approved rules and incentives framework in detail to give you an indication of how we might crack that nutrient source.

The programme is a partnership between Te Arawa Lakes Trust, the Rotorua District Council and the Bay of Plenty Regional Council. It had its genesis in 2006 with the Te Arawa Settlement when the ownership of the lakes was transferred to Te Arawa. The Rotorua Te Arawa Lakes Strategy Group was established under a statute at the same time, which is a joint committee between the three partners and is the governance body that gives direction.

The programme covers the 12 lakes within the Rotorua district and the main focus for our work derives from the strategy for the lakes of the Rotorua district, which is a high level statement about what the communities' expectations are for the lakes. It is a little wider than lake water quality, but the programme currently is very much focused on the water quality aspects.

While the programme covers all 12 lakes there are 4 which have been a priority and where a lot of the funding is going - Rotoiti, Rotoehu, Okareka and Rotorua. For the 3 smaller lakes we have made very good progress with a combination of engineering solutions in-lake and changes in the catchment that we have been negotiating on a voluntary basis. However, Lake Rotorua is a much bigger challenge, but even here we have seen some good success.

There was a deliberate focus in the early years to get short term improvement in the water quality with in-lake initiatives. As mentioned this morning the phosphorus locking in both the Puarenga and Utuhina Streams has been hugely beneficial in giving some short term gains. The sewerage reticulation has also been an important factor in gaining short term improvements.

Work is going on by farmers in the catchment, but the big effort needed will be in the back of the catchment where there is significant nitrogen and phosphorus loss into the ground water systems. The programme is large by any standard, \$233 million over a 10 year period. \$72 million of that is funded by Government, the balance funded by rate payers within the District and Regional Council through a mix of general and targeted rates.

For Lake Rotorua the key policy document is the Regional Policy Statement which BOPRC has now signed off on and it has gone through the Environment Court process and is effectively operative. It sets the nutrient loss target for the Rotorua Lake at 435 tonnes as the sustainable load. It provides that 435 tonnes of nitrogen per year be allocated to land use

with individual land and property owners within the catchment. It also provides that this level must be achieved by 2032 and an interim target of 70% by 2022. This is the regulatory side of the equation.

The Policy Context

Regional Policy Statement

- Limit set – 435tN/yr
- Limit to be allocated amongst land-uses
- Limit to be achieved by 2032; intermediate catchment-wide target to achieve 70% of reduction by 2022

Ten Year Plan

- \$45.5 million nutrient reduction fund

The other side of the equation is the incentives. The Regional Council has set aside \$45½ million in its 10 year plan to support the land owners in achieving that nutrient loss reduction. That money is not guaranteed. Half is government funding and Cabinet has not yet given their approval. We are hopeful that by the beginning of the next calendar year we will have that approval. Minister McLay is not here, but he is certainly aware of the importance of that \$45 million as it is key to achieve our goals.

Another important part of this policy context is the work that the Stakeholder Advisory Group has done. Our Council made a deliberate policy decision to work with the stakeholders to develop the rules and incentive framework that would drive the nutrient reduction in the catchment. It was set up about a year ago, meeting monthly, and has been instrumental in getting the policy framework over the line. It has not been an easy task to do, but I admire the way that the Group have committed themselves to working in a constructive way to find a solution that will work for everyone. The model has proved enormously successful and is something that can be looked at for other areas of resource use change.

Nitrogen reductions required

	Tonnes nitrogen/yr
Current nitrogen load*	755
Sustainable nitrogen load	435
Reduction required	320
Possible engineering reductions	50
Pastoral reductions	270
Current pastoral load	526
Sustainable pastoral load	256

*Based on 2011 ROTAN data, not the 2009 Action Plan (746T N/yr)



Slide 1

Slide 1 gives an idea of the scale of the task ahead of us. The current estimate is that 755 tonnes of nitrogen is lost into the catchment each year. That is predicated on the assumption that 30 tonnes comes from the wastewater treatment plant. The sustainable load is 435 tonnes, so we need a reduction of 320 tonnes of nitrogen per year. We believe that through possible engineering solutions, such as stripping the nitrogen out of the Tikitere stream, 50 tonnes can be removed which would leave a reduction of 270 tonnes from the pastoral sector. It is a substantial challenge for farmers. The current pastoral load is 526 tonnes, and the sustainable load for the pastoral sector 256 tonnes, over a 50% reduction in their nitrogen loss. It is a substantial challenge.

In terms of the framework **Slide 2** shows there are 3 components. The first is 140 tonnes that will be achieved by the pastoral sector in meeting their nutrient discharge allowance. There will be 526 tonnes of nitrogen allocated out to individual farmers as a nutrient discharge allowance. It is 130 tonnes above the sustainable load and I will explain why later. On average we would expect that it would be about 35 kilograms per hectare loss for dairy farms and 13 kilograms per hectare for sheep and beef. It is do-able, but it will not be easy. This is one of the key features of the model that the Advisory Group came up with, because when the Regional Council first put up the option it was allocating the 435 tonnes, that meant 26 kilograms for dairy and 7.7 kilograms for sheep and beef, which clearly was not do-able. This model was the better of two not particularly palatable options.

Slide 2

The Framework

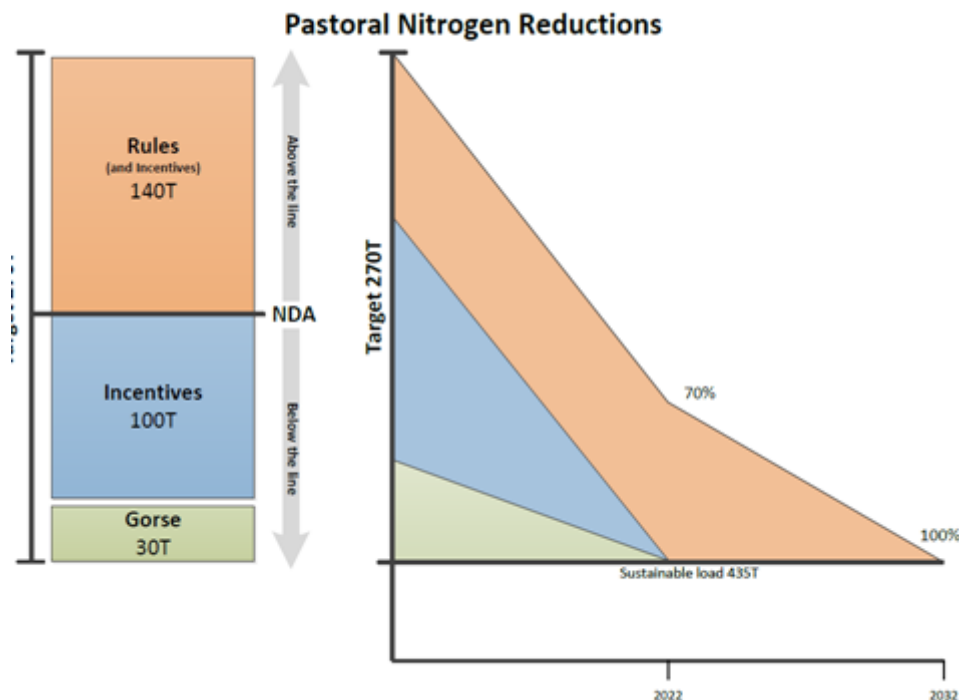
Rules programme – 140 tonne reduction		
By 2015	Farm nutrient plans	Plans will be put in place for every farm, setting out a practical pathway of staged nutrient reductions
By 2017	Resource consents	Farms will be consented, with nutrient reduction plans as a consent condition
By 2032	Nitrogen Discharge Allowances	Average of 35kg N/ha for dairy and 13kg N/ha for drystock, with adjustments made for geophysical and farm system characteristics
Incentives programme – 100 tonne reduction		
By 2022	Incentives fund	\$40m "below the line" to remove 100 tonnes of N \$5.5m "above the line" to get to the NDAs
Gorse programme – 30 tonne reduction		
By 2022	Gorse fund	Separate funding to remove 30 tonnes of N from gorse

The second chunk is 100 tonnes which we propose to achieve by buying back some of that 526 tonnes that we allocated out as nutrient discharge allowance on a voluntary basis entering the market to buy nutrients. We hope that we can get that 100 tonnes with \$40 million of the \$45 million dollars incentive programme. This leaves \$5½ million to support farmers to achieve their nutrient targets, what we call 'above the line' stuff.

The remaining 30 tonnes is for a gorse programme. We know gorse contributes nitrogen to the catchment. It is not included in the 755 tonnes. We want to take it outside the incentive programme in a separate programme which will be funded to provide support to change gorse country into an alternative use at 4 kilograms per hectare or better. For practical purposes this means forestry.

Slide 3 explains the timing of the expected pastoral nitrogen reductions. We would expect that the incentive fund for the gorse programme will show significant gains in the short term. Those people who will be willing to sell nutrients, perhaps with changed land use, have nutrient discharge allowances that would then be available to be sold. They may sell to the Regional Council and we would hope that by 2022 we will have achieved that 100 tonnes and also the 30 tonnes from the gorse. There are about 140 tonnes to get from the rules, 130 tonnes in the first 10 years and then the balance would come over the subsequent 10 years.

Slide 3



The farmers have agreed that they will be bound through a consenting regime to put in place a plan by 2017 as a condition of consent to show how they are going to achieve their individual nutrient discharge allowance by 2032. This framework has been approved by the Regional Council and the Te Arawa Lakes Strategy Group. We are now getting into the detailed design and will continue to work with the Stakeholder Advisory Group.

At the same time as approving that framework, our Council and the Strategy Group agreed in principle to establishing a nutrient trading regime. The value of nutrient trading is to create a market to buy nutrients and it also allows trading between farmers for more efficiency in land use change. The better land for intensive farming is the land that may potentially have higher nutrient loss. But the economics would be more preferable to intensively farm this land and perhaps retire some of the more marginal land. Nutrient trading allows this to happen and it provides the most economically efficient distribution model for those limited nutrient discharge allowances.

The detail has not yet been developed and the Council has not yet agreed whether point sources can participate. What that means is that the Rotorua wastewater treatment plant is a point source. Potentially it too could get into the market and buy nutrients. But that decision has not been made and the detail is yet to be fleshed out. That will come over the next year or two.

Science to support future options for Wastewater Treatment and disposal for Rotorua

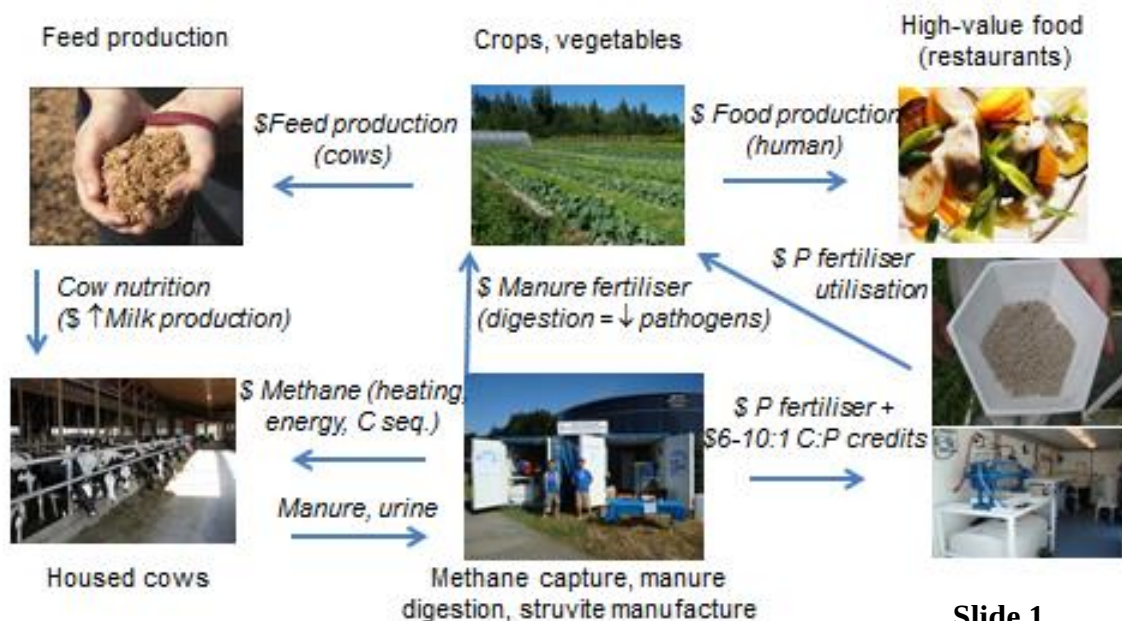
Professor David Hamilton

I was going to present a slide of a little summary of my personal opinion on what the options may be. The first option which I have heard very little about today is water conservation. This is a critical issue. The people of Rotorua use at least 267 litres per person per day on average, which is well above the national average. In fact it is comparable to some of the greatest water use of anywhere in the world on a per capita basis. Water conservation has been pushed by the Regional and District Council over the last 3 or 4 years, but I notice when I stay in a hotel here that I do not see it pushed at that level. It would have multiple benefits in terms of reducing the intake of spring water from places like the Taniwha Springs and the Awahou. We would not need to pump as much water up the hill and another benefit would be that the de-nitrification process would be much more efficient in the forest. Water conservation is absolutely fundamental and we could immediately meet resource consent limits.

If Rotorua goes from 267 litres to a 20% drop of 212 litres per person per day those resource consent limits would be met now and for the next 5 years. I serve on an International Peer Review Panel for the Queensland Water Commission appointed by the Premier of Queensland. In Brisbane they reduced from 280 to 130 litres per person per day during a drought phase. They have crept back up, but are still well under 200. It can be done; water metering is one way with a regulatory approach but there are other ways. It must be done.

Yesterday, as we looked at the forest, ideas came to mind and people talked about the wet feet of the Douglas fir. One has to wonder whether a species like kahikatea has greater potential. It would require an investment and that investment would have to offset the inability to get a viable crop out perhaps for 80 years. I wanted to sow the seed and get

Re-engineering dairy farming: closing the loop with value-added waste streams



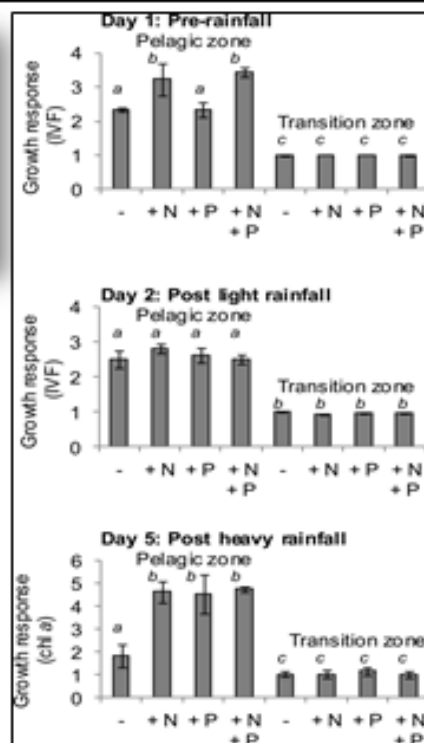
Slide 1

people's thinking along the lines of a similar crop. If the water is not taken up the hill and discharged into the forest then the treatment that is adopted here has to be absolutely foolproof and anything can be done.

Slide 1 above shows some of the technology and thinking being used in Canada. The concept is about what can be gained at every step. What can you do with the water? Unfortunately in Rotorua it is difficult because we are lower in the landscape and any pumping has a huge cost, particularly if pumping up over the Mamakus. However potentially we do have energy here. How much energy can be derived from things like methane that might be produced from the carbon that comes in the wastewater? There is also carbon and nitrogen. The Canadians are thinking at every step, 'What can we do with it?' 'How can we gain the benefits of capturing the nitrogen and phosphorus and use it for commercial benefits?'

Today we have heard about nitrogen and phosphorus effects on algae. Both nutrients are absolutely critical to the lake quality. **Slide 2** below looks at nutrient limitation in the Ngongotaha transition zone where it enters the lake. The low values on the right-hand side of the bar graph indicate that there was no nutrient limitation in that transition zone. Those inflows are bringing in nutrients, either the Puarenga or the Ngongotaha, to reduce nutrient limitation. In the middle of the lake nutrient limitation is much more prevalent and additions of nutrients such as nitrogen stimulate algal growth while additions of phosphorus also stimulate algal growth but not to the same extent.

Phytoplankton nutrient limitation



•Phytoplankton community-level nutrient limitation status varied in time and space

Slide 2

You have to be able to limit and regulate both nutrients, and they are dynamic in time and space. One of the big arguments in New Zealand at the moment is – do we have nitrogen or phosphorus limitation of algal growth? Taking a track down either way – to limit just one of these nutrients – is slightly dangerous because you cannot control inputs of one nutrient all the time and if the other is high there may be very strong algal growth. The strategy that is being adopted here to limit both is certainly the right one.

Why is Lake Rotorua currently looking so good? Well, the target TLI of 4.2 has been attained and total phosphorus concentrations in Lake Rotorua have dropped markedly. When getting down to .01 milligrams per litre (= grams per cubic metre) it is a very nearly pristine system. That is a remarkable drop. Going back about 10 years ago the concentrations I saw were around .05 milligrams per litre.



Total phosphorus concentrations in Lake Rotorua



Slide 3

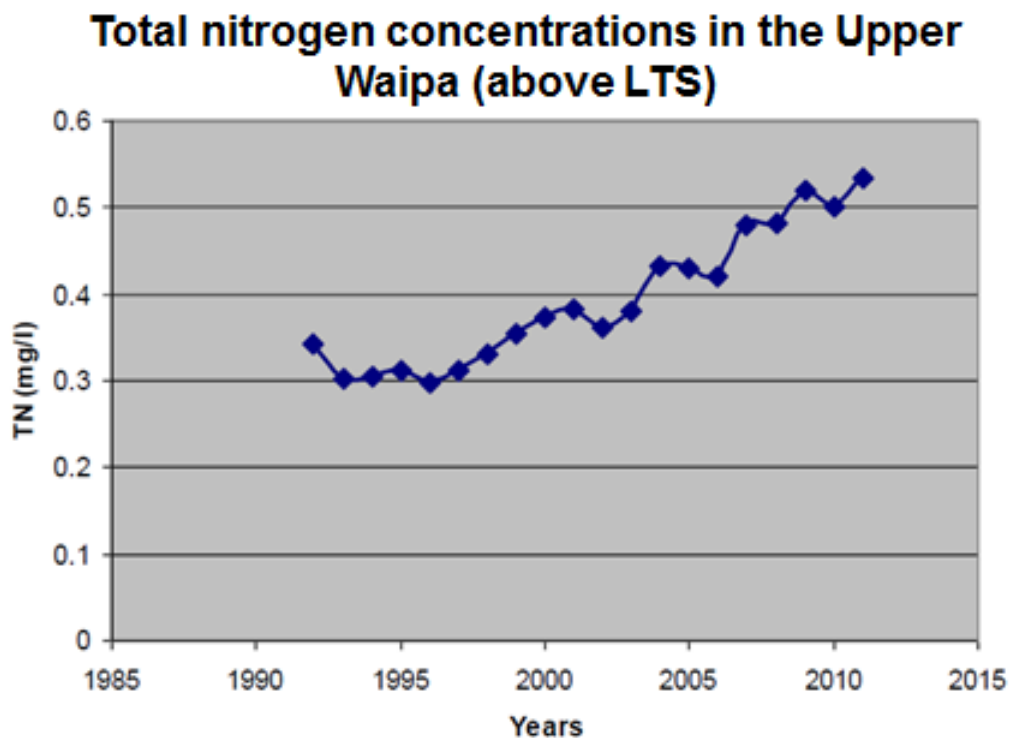
This inconspicuous white tank (**Slide 3**) is actually very important. It is the major reason why the concentrations have dropped and why there has to be continued vigilance to decrease every possible source of nutrients present. However if we rely on this white tank, as an engineered solution, we are in dangerous territory and it may not be the long term sustainable option.



Slide 4 shows the Waipa Stream above the Land Treatment System.

Waipa Stream (above LTS)

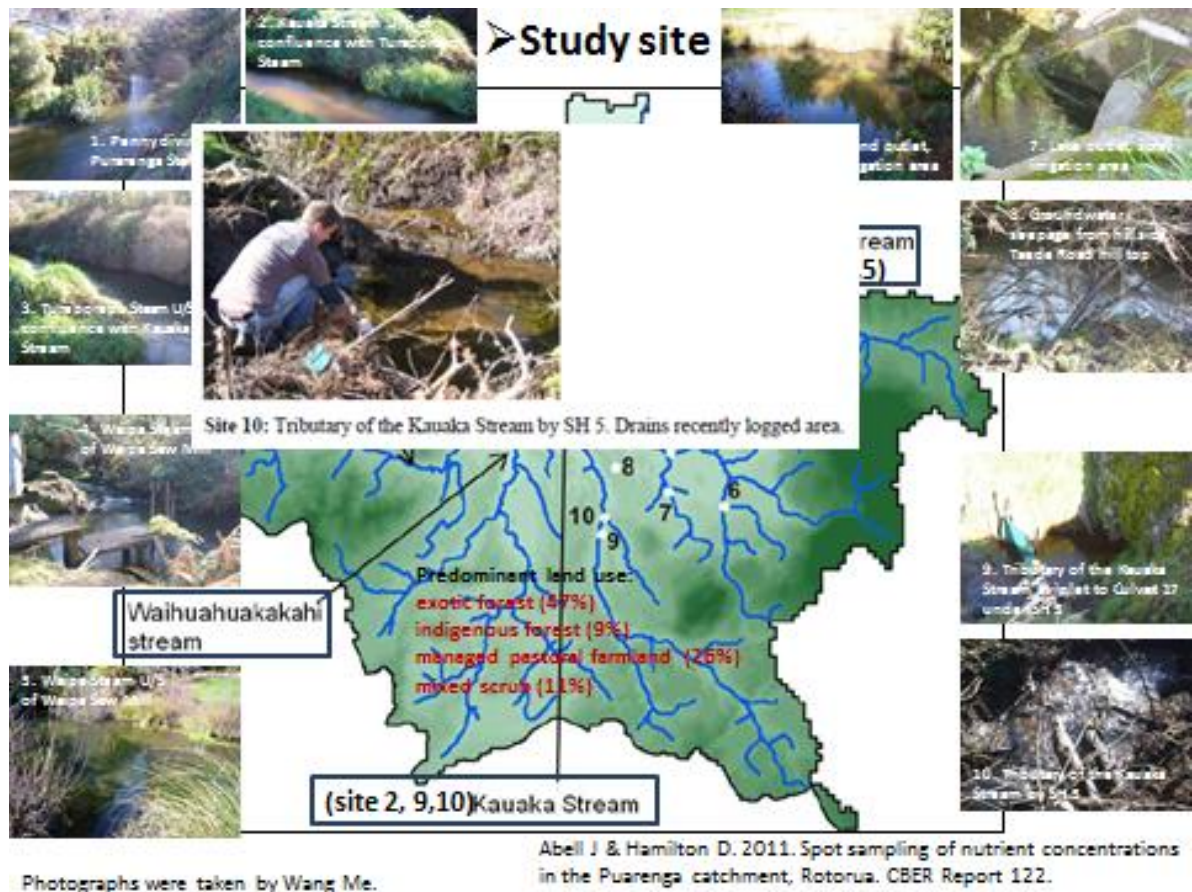
Slide 5 is total nitrogen concentrations as a sequence through time above the Land Treatment System and they are clearly going up. We do need to understand why they are going up to such an extent. This phenomenon is common to almost all of the tributaries around Rotorua but it means that it is much more difficult for RDC to operate under the existing wastewater Resource Consent discharge. They have to be that much more efficient and, to give credit to Rotorua District Council, they have been more efficient, but they are also fighting what has happened above the land treatment system.



Slide 5

Slide 6 (over) shows some of Jonathon Abell's work in the Puarenga Stream. He did a lot of spot sampling here. Site No. 6 is in the Upper Waipa. I wanted to present this snapshot to give you some idea of what concentrations look like through the whole of the catchment. This is work that will not usually be seen because we do not normally monitor lots of streams at the sub catchment scale. No. 9 is a tributary of the Kauaka Stream and you can see that the riparian area is not looking too flash in that region.

Slide 7 (over) shows two horizontal lines. The dashed line represents the ANZECC guidelines and the solid line represents the chronic toxicity guidelines. What you can see is that several of the streams in that catchment do have quite high concentrations as a result of land use activities that take place in the catchment.



Slide 6

Study site

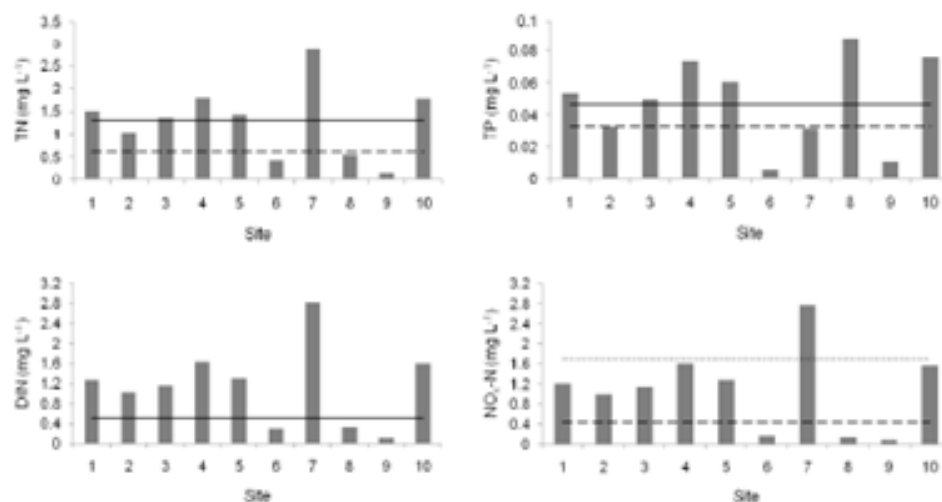


Figure 2: Measured nutrient concentrations at ten sites sampled in the Puarenga Stream catchment on 18 July 2011. Site locations are shown in Figure 1. Details of the mean and guideline values used for comparison (horizontal lines) are presented in Table 1.

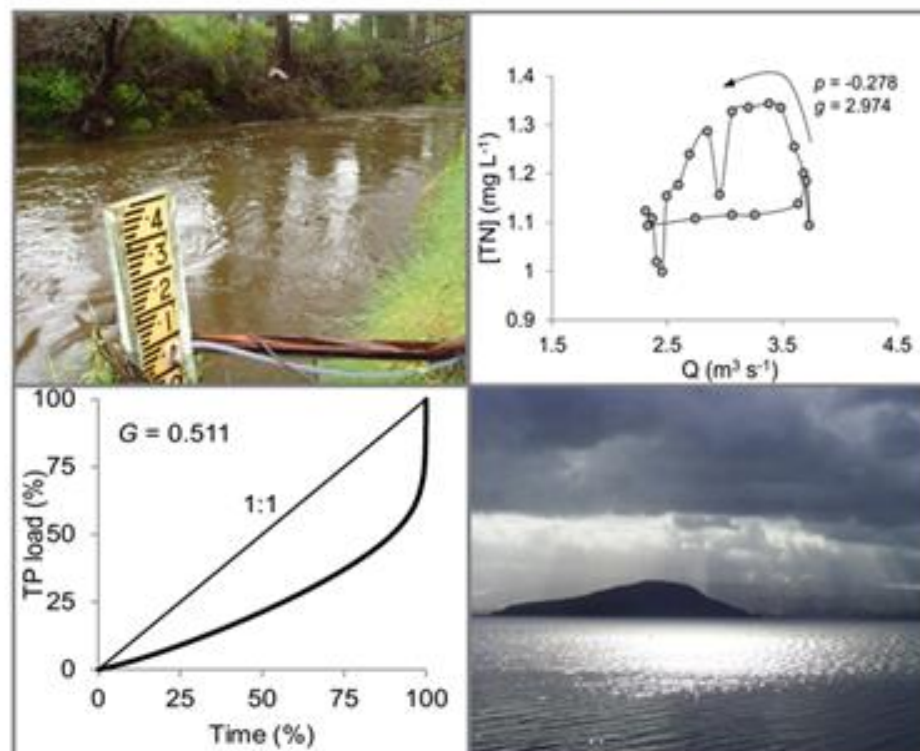
Slide 7



Slide 8 shows the land treatment area. Obviously the suitability of different tree species comes to mind for the wastewater irrigation that is taking place. It is difficult because the area has multiple use activities; forestry, recreation and of course it has to be able to absorb and take up nutrients.

Slide 9 shows the lower Puarenga when it floods. During some of these floods the river discharge may increase ten times while the concentrations can also increase several times, resulting in high nutrient load delivery. As a result, on about 16 days of the year when you get storm flows there is the equivalent delivery of sediments as for the remainder of the days of the year. Being able to deal with those high storm flows is obviously quite critical.

Stormflows in the Puarenga Stream

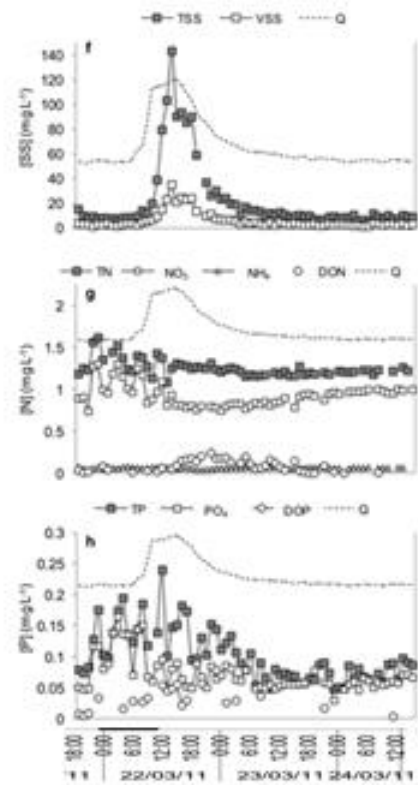


Slide 9

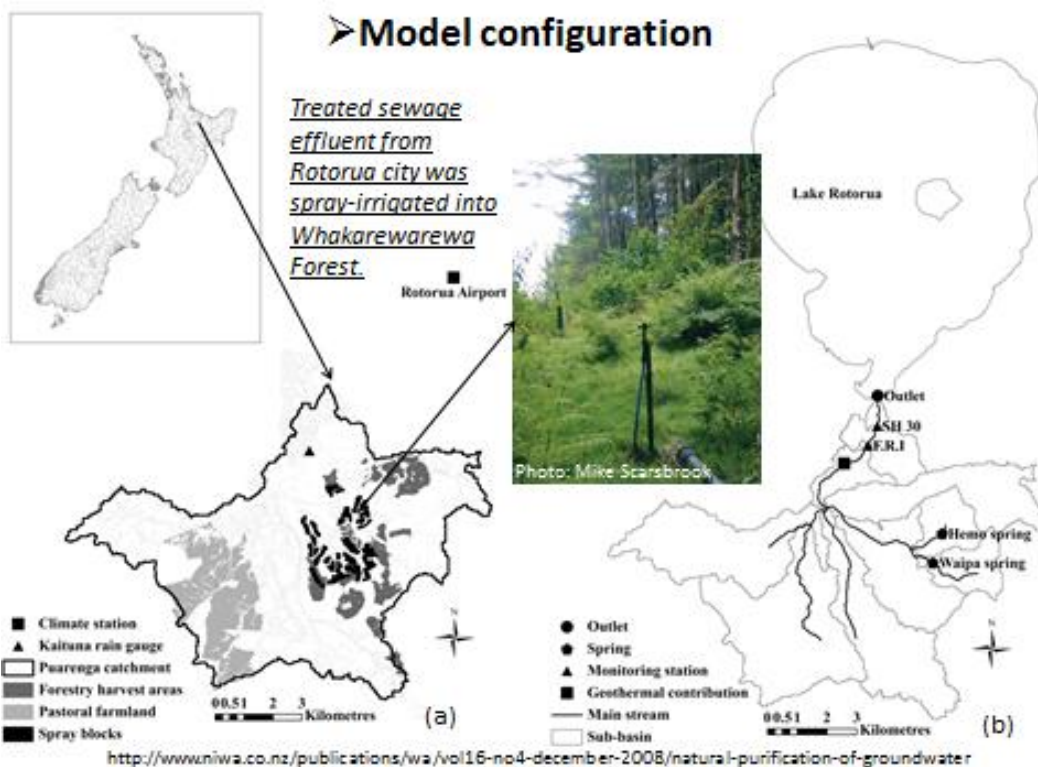
What happens during stormflows in the Puarenga



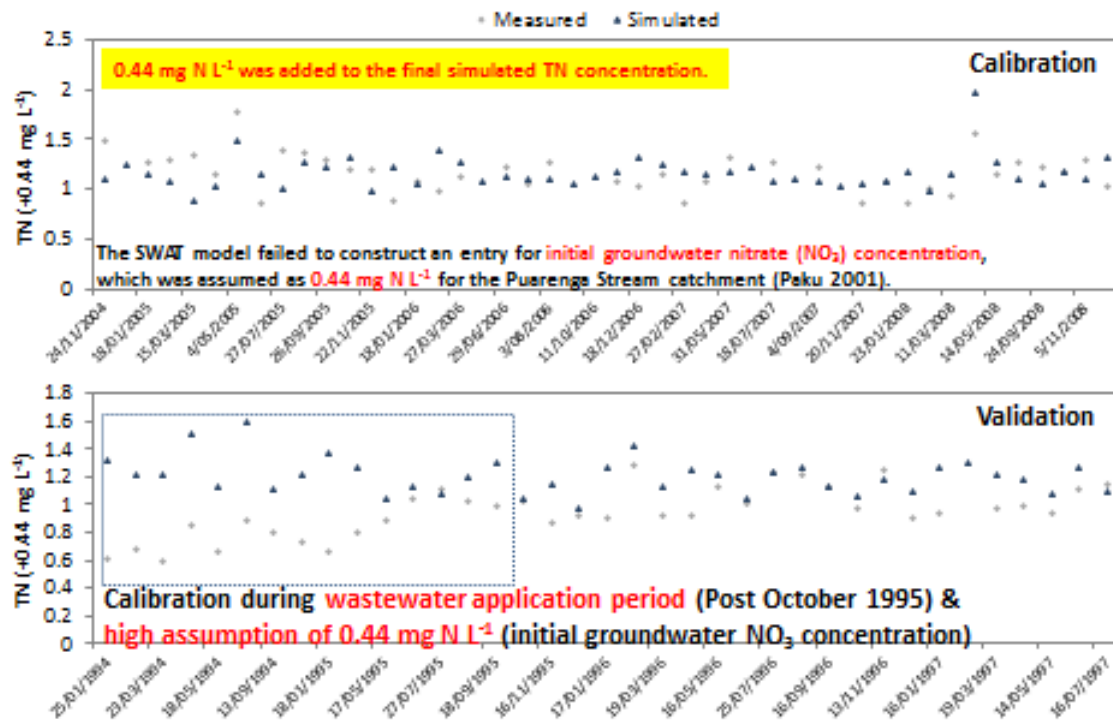
Slide 10



Slide 11



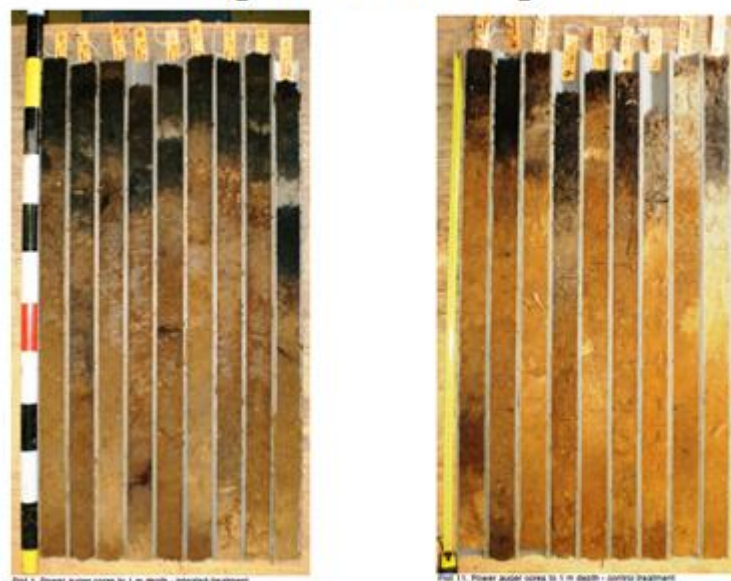
➤ **Model auto-calibration & validation of instantaneous total nitrogen (TN) concentrations measured once a month**



Slide 12

We have been trying to model these storm events. **Slide 12** shows measured versus model data for total nitrogen. You can see that in the early nineties the concentration of nitrogen went up progressively as the soil became impacted by all the wastewater that was sprayed on. The nitrogen increased until about 1995 and there is more or less an equilibrium condition now with little effective uptake in the forest.

**Total phosphorus concentrations in the soil profile
Irrigated vs non-irrigated**



Slide 13

The additional wastewater inputs represent about .45 milligrams per litre of additional total nitrogen going on above the base level occurring naturally in the stream. From a Scion report put together by Rotorua District Council, you can see soil profiles (**Slide 13**). On the left is the wastewater application and the other is the un-irrigated application. You can see a whole lot more organic (dark) material in that wastewater application.

Eventually those soils are going to become saturated with phosphorus and as this increases more phosphorus will run into the lake. In the long term the level of phosphorus coming out of this catchment will be an issue. A lower rate of wastewater application would in fact enhance the de-nitrification that occurred in this upper zone and prolong some of the ability of the soils to hold phosphorus.

Slide 14 shows the phosphorus accumulation. Twenty centimetre soil layers are used to show differences from baseline, in other words without the irrigation, comparing 1995 and 2012.

Total phosphorus concentrations in the soil profile

Depth interval	1995 Difference P kg/ha	2012 Difference P kg/ha	1991-1995 Storage Rate P kg/ha/year	1995-2012 Storage Rate P kg/ha/year
0-20 cm	430	1202	108	45
20-40 cm	81	950	20	51
40-100 cm	20	542	5	30
100-150 cm	-	92	-	5
150-200 cm	-	-11	-	-1
0-100 cm	531	2694	133	127
0-200 cm	-	2775	-	132

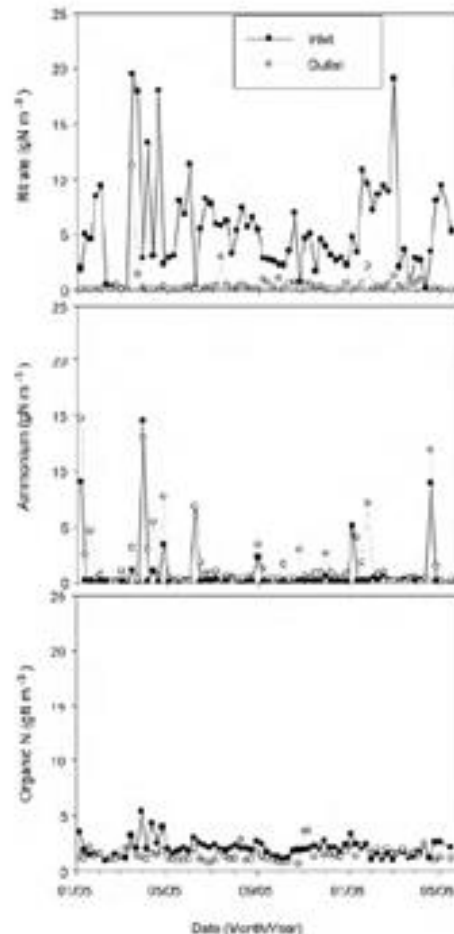
Slide 14

What options do we have? **Slide 15** (over) is an example of de-nitrification beds at Kinloch. Kinloch only handles about 180 cubic metres a day which is not a large volume of water. We are talking about handling 22,000 cubic metres a day to be able to handle with de-nitrification beds. That is not trivial. There is some suggestion 2½ hectares of de-nitrification beds full of wood chips might be required but it might be up to 5 hectares to treat this volume of wastewater. It is a substantial area to be able to take that nitrate out and prevent it going into the forest.

Denitrification beds



Slide 15



What of the Future?

We have to be mindful of what the future might look like because in the design of Wastewater Treatment Plants planning is not just for a few years, sometimes it is 50 years ahead. I asked a few colleagues around the world of what they thought might be coming up.

The EU, U.S. and now Canada have adopted the EU acronym BAPT = Best Available Proven Technology for waste treatment based on life cycle analysis and energy savings AND proven in the field, either demo or full-scale. Energy, water, nitrogen and phosphorus all have to be taken out and used sustainably from that wastewater stream.

The Province of Manitoba is following suit and has recently legislated 'no chemical treatment' of any waste and will only accept/fund biological nutrient recovery technology. Ontario will also follow. That would immediately have major implications for us here in the Rotorua Treatment Plant, particularly in terms of the alum dosing. We must be wary of that as we design into the future.

Something coming out of the US EPA which seems a bit over the top, but they are now mandating that the WWTP's of the future must deal with the big 5 = water, energy, carbon, N, P. They have a 'zero sludge' mandate. Obviously the technology with Terax promises a lot, but increasingly we are being asked to deal with the organic sludge produced from the wastewater treatment process as a resource and minimise the waste.

Interestingly what we call conventional nitrification / de-nitrification configurations, of which Rotorua is one, which was highly innovative when first installed, will now ultimately be phased out because of high aeration costs. The use of methanol or ethanol, which costs a

fortune, is being used. There is a lot of sludge to deal with which might partially be helped by the Terax process.

Other technologies are evolving quickly and Anammox-type systems are being advocated, roasting struvite to drive off the ammonia and recover it. We need to be aware of these as we go, including production of struvite. I would take argument with some of the costs around struvite production that have been estimated for Rotorua. It is pretty much standard technology in Europe and Canada and some people have done very well out of it by being part of patenting that process.

Peroxide microwave technology is also a way of making wastewater easier to digest and break down. With an energy source such as we have in Rotorua maybe we might have the ability to do something a little bit extra with that technology.

To summarise, I pulled out **Slide 16** but then thought, 'Gee that looks like a coastal zone, but it's not that far away from Rotorua.' If you use a bit of imagination to picture the museum it shows the sort of issues we have. The Wastewater Treatment Plant is at the bottom, we pump up to the forest and we know that eventually that forest will be full of phosphorus. It is already leaching a lot of nitrate back down. We might be able to double the area; we might be able to optimise some of what is done in the forest with additional irrigation. A lot has already been improved in a very innovative way by the Rotorua District Council, although they do not have complete control over the forest.

We could try to do something on the shore which might involve de-nitrification and use of other materials to take out phosphorus. But we need to be very mindful that we have a resource in the wastewater and with the production of struvite, the de-nitrification beds may be an option, as well as production of energy from the wastewater treatment process.

Slide 16



Questions

Arapeta Tahana: For David, I wanted to make a brief comment on one of your opening points about water conservation. It dawned on me that often with this issue people like to say, 'Let's blame the farmers, let's blame someone else'. Your point was very practical that each and every one of us in this city can do something to help this problem. Thank you for raising that, and also giving us different solutions and angles to address this problem.

Rick Braddock, CNI Iwi Holdings: Warwick, you were looking to reduce dairy to 35 kgs of N per hectare, can you tell me what the current average is?

Warwick Murray: That is a difficult question. The 2001/2004 benchmark would suggest that it is around 54, I suspect it is significantly lower but we do not have current data. A number of the dairy farms have redone their numbers and would suggest that it is below 50 now.

Rick Braddock: Is that using Overseer?

Warwick Murray: Yes.

Rick Braddock: A second question I have in terms of the overall catchment – what allowance have you made for conversion of forest to pasture?

Warwick Murray: We have Rule 11 currently operating which effectively caps everybody to the nutrient discharge that was the average during the years 2001/2004. That killed any further conversion. It is something that we need to look at particularly with reference to trading. What we will try and avoid is fixing everybody so that under-utilised land cannot be fully utilised with trading. It makes economic sense to do that.

Warren Webber: Adding to that there is not much Class 2 and 3 land in the Rotorua catchment but 2½ thousand hectares of it is in forestry. I would argue that there probably is the potential for some offsetting so long as the caps are not exceeded.

Stuart Morrison: Just a comment to expand on the cost. Warwick mentioned the public cost that is \$45½ million. The Farmers' Solution Project done by farmers with the help of Regional Council, identified costs to farmers in the order of \$88 million as direct loss of productivity and income. On top of that an additional \$38 million in equity loss particularly pertaining to sheep and beef farmers, a total of \$126 million. The public is fronting up with \$45½ million. The pastoral sector is taking a hint from the rest. It is going to be a very difficult thing for them to do and we are hopeful that over the period to 2032 we will find solutions that allow us to alleviate some of that cost.

Alison Lowe: David, I was wondering if you could confirm that the phosphorus leaching from the land treatment system will leach in the future. I assume that is only if we were to keep irrigating. Is that the case?

Prof David Hamilton: Yes, that's right

Alison Lowe: So the soil is now full of phosphorus and if we get a lot of erosion through storms the phosphorus will move down. If we were to stop irrigating, there will be some movement of phosphorus through erosion but not really through leaching in the future.

Prof David Hamilton: The phosphorus in the soil is like a giant store. It will not generally be mobilised except through something like erosion.

Peter Staite: I have a concern about what happens to the organic sludge and whether it is contained after it has been captured? The second question is similarly the saturated bark and Phoslock, I would like to know where all the solids that contain harmful substances go to and whether or not there is a risk of them getting into the environment sometime in the future? Another question is whether all the pollutants that go into the river will flow down into the lake, and on down the Kaituna River to the coast and whether or not there have been measurements taken of nitrogen levels around our foreshore and seabed. Is there going to be any negative effect in our estuaries around our foreshore of the Bay of Plenty, kia ora.

Eric Cawte: The question about what might happen to the bark residue from the denitrification beds, is that the case? I am not 100% sure, obviously it is yet to be established but one of the obvious solutions might be – is it able to be processed into a fertiliser that can be applied in a controlled manner, or otherwise beneficially reused?

Warwick Murray: I am not sure whether I can answer regarding the Phoslock. Sludge from the Wastewater Treatment Plant is currently being vermacomposted in the Eastern Bay of Plenty and applied to land as a fertiliser for maize crops. We have the Terax project which is underway to process the sludge into a carbon source for our treatment process, and that is well documented. Is anyone else here able to answer about Phoslock?

Andy Bruere, Regional Council: We do not use Phoslock now. We used it once in Lake Okareka, but we use aluminium sulphate in the dosing plants around Lake Rotorua and Rotoehu. We are very concerned about the environmental impact of it being discharged into the streams and we have a programme of monitoring the ecology in those streams as well as the ecology at the outlet of the streams into Lake Rotorua and Rotoehu. We also have a programme with the University of Waikato monitoring the aluminium and phosphorus concentrations in the sediments. There is a transect across the lake that extends from the streams where the P-Locking occurs to the Ohau Channel. The results of the ecological monitoring show that we have not exceeded any standards recognised to cause a problem to the ecology. With respect to the sediments, the report from Waikato University was that we could detect a minor increase in aluminium concentrations close to the streams, but could not detect any increase in aluminium in the sediments further afield in the lakes. We monitor about every 3 years, to keep an eye on the trend. If there are any negative impacts we would look at the dose rate and the longevity of that programme.

Prof David Hamilton: Regarding what is happening on the coast, the biggest issue around New Zealand traditionally has been sediments coming from land and silting up coastal estuaries and the coastal area generally. The focus now is switching more towards nitrogen, particularly given the increase of coastal algal blooms and shellfish toxin production. Watch this space because increasingly there will be a connection for people about the nitrogen that comes off the land into the coast.

I would also like to mention once again that when we hear about a nitrogen or phosphorus strategy, e.g. that phosphorus is usually limiting in fresh water, here in the volcanic plateau it is as much about nitrogen as phosphorus. But on the coast it is nitrogen that limits the amount of algal growth. So strategies that are based upon saying, 'Oh well the system is phosphorus limited and we're going to forget about controls on nitrogen,' are fraught with difficulties for the New Zealand situation. We have a close connection between the land, fresh water and the coast.

Arapeta Tahana: Do you know whether the levels of nitrogen have increased in the Kaituna? I know that for a lot of Maori around here when the Ohau Channel wall went in we had concerns that down in Te Puke, our relations would have a lot more pollution in the river. Do we know whether there has been an impact?

Prof David Hamilton: You could say that Rotorua is cleaned up to such an extent, which was unexpected, and the water takes about 2 to 3 days to go down the Kaituna into the Maketu estuary and coast. The impacts there were perceived to be less, and they are certainly less now than what was anticipated because Rotorua is in a lot better state than what was expected. Obviously that is part of the whole healing process for the Kaituna system and the reinstatement of the estuary and the Maketu. When you look at the nutrient levels brought from Rotorua and Rotoiti compared with what comes in along the river's journey it is a lesser component than what happens further down the Kaituna. I believe there are still some big issues to address there.

Joe Tahana: Two questions, the first question was a point raised in terms of water usage. I have to kick my daughter out of the shower after half an hour, so that said I am directing this question either at Andy or Eric. Has there been research done on metering of water for this township? The second question is – in 20 years' time, once we get the sustainable input of nutrients into the lake, is it at the stage, Warwick, which you propose to address the sedimentation that is already in the lake bed?

Eric Cawte – I will try to resist preaching about our water conservation strategy and the work that we are doing, because we do have a water conservation strategy and there is a lot of work going on to encourage water conservation. As far as metering goes, every 3 years at the Long Term Plan process Council asks for a report on the costs and benefits of water metering for the city. Currently within the urban area only commercial and industrial premises are metered, domestic premises are unmetered. In our rural supplies all consumers are metered, domestic and business, farms, etc. The last two of those reports showed that the costs were about \$7 million capital cost to install meters.

Looking at the benefits, financial and potential environmental, it was decided that the costs outweighed the benefits, so Council did not proceed. What we have done though is focussed more on our own networks and have a programme of sectorizing our networks so that we can measure what the losses are in the networks and implement them into a number of discreet areas and with pressure reduction. We believe we are doing that right at the moment. We are about a third of the way through a \$1.6 million project to completely sectorize and reduce pressures in our network.

I am also working on a report for the Regional Council on the conditions of our resource consent and our progress being made in the implementation of our water conservation strategy. Our strategy was last reviewed in 2009.

Arapeta Tahana: Without metering, how do you measure that progress?

Eric Cawte: Yes that is a good question. What we did last year was install 350 sample meters on residential premises to get more accurate estimates on what people actually use. What we take from the environment we measure with bulk meters, but we do not know for sure. That is one of the drawbacks of not having residential metering. We have to use evidence from other areas and adapt that with some measured information from our own networks. So that would be one advantage of metering - you can measure it - but we have to do our best at assessing what our consumption is and what our losses are.

Arapeta Tahana: Warwick, how do you propose to address the sedimentation that is already in the lake bed?

Warwick Murray: Yes I will attempt to answer that question, but actually David or Andy might be better equipped to answer this so feel free to jump in if I get it wrong. There is a significant amount of phosphorus, in particular, tied up in the sediments within the lake. It is factored in to the sustainable load and our focus going forward is reducing both nitrogen and

phosphorus. We want to reduce the amount of sediments that are adding to that phosphorus load that is already in the lake. Once we get the sustainable load, or get the catchment source nitrogen down to 435 tonnes per annum, I am not sure about the store of phosphorus that is in the sediments. Perhaps Prof Hamilton or Andy might answer that.

Prof David Hamilton: The phosphorus has gradually depleted since the Wastewater Treatment Plant stopped discharging into the lake. Gradually those sediments recover. The concept around dredging them is economically not worth consideration. It was over \$100 million as I remember from Nick Miller's report; Andy mentions \$80 to \$200 million. I believe there are promising signs that there has been recovery of the sediment. Now we are certainly seeing less phosphorus and nitrogen release into the water than what occurred in early 2000.

Te Ohu Wi Kingi: David, you brought up the fact that after a drought Queensland households cut in half the use of their water. That is a very good, what were once vices are now habits. We are in a habitual world and we do not know how to consume or use water properly. At the time it came down was it legislated, or was it just the assumption of the Councils in Queensland, or the Premier, that made the bold statement to make a cut? We live in the world of convenience, I am sad to say. If we can cut that convenience down to a proper end use in every household we might get the result in the long term we are all looking for. So my question is simply this – how did they do it and what did they do?

Prof David Hamilton: It was forced by necessity because their dam got down to about 11% of full supply level. They were in real danger of running out of water and they put in some pretty draconian measures - no watering of lawns and every household had to be fitted with double flush toilets and water saving shower heads, and that did it. They look now to use 120 litres per person per day as a threshold that is needed for survival, for normal going to the toilet, drinking, washing and other everyday uses.

Te Ohu Wi Kingi: Therein lies a lesson.

Session Four – Breakout Forum

FACILITATOR: Ian McLean

Outline and Purpose of Forum Session

Kia ora, I will be very brief. This is in preparation for the forum after a cup of tea. We will be working in two groups. There will be a list of questions for the groups which Warren will put up on the screen and we will ask each group to consider. There will be a facilitator for each group: Roger Gordon and Warren Webber. We will then report back in Open Forum. I ask you in the groups to see what consensus you can develop, not a whole list of everybody's views. There is intended to be a much wider consultation but the planning needs to be done by a small group and for the formation of a steering committee.

The question is who should be on that Steering Committee? Essentially there are three groups, one group which is Iwi, one group which is other stakeholders and one group is the public authorities – the Councils, plus anybody else who may need to be there such as the public health or whoever. The questions that need to be considered as are how many of each and how will they be selected?

There needs to be a small number, about a dozen amongst the Iwi, other stakeholders and officials. There also needs to be a chair and the proposal is that there be an independent chair selected by RDC but presented to the steering committee for concurrence. That is the proposal. Would you think about that in your groups please? Thank you very much everybody, have a cup of tea and we will be back here afterwards.

Breakout Forum

1. What is your view of the current discharge of treated effluent into the forest?

Roger Gordon: The view of the group was that the current discharge was not working.

Warren Webber: Group two concurs with Group One completely; the current system is not working and not the solution for the future. It is ok for phosphate in the medium term only but there is increasing risk as we go forward.

Ian McLean: Ok – does anybody from the floor wish to add, modify?

Roger Gordon: I did not give any qualifiers to that as Warren did, but we felt that originally it was a suitable site, but it is no longer. The water could be put to a higher value use and that discharge overload at present needs to be remedied.

Ian McLean: Thank you. Now anybody from the floor wish to add, subtract?

Peter Staite - In addition, our decision to the first question is long term because down further the sheet of questions we were asked if we agree to a consent process and that looked to contradict it.

Roger Gordon: The decision was modified by the acceptance of the current resource consent change going through, that the land will be used over the next 8 year time frame, but there was an overall agreement that it should not be the long term solution.

Warren Webber: Just to add to that we also agree that the interim consent is ok but it must have milestones and we would also encourage pilot trials to test solutions as soon as possible within that 8 year period.

Ian McLean: Thank you. Now we will move to the second question.

2. Regarding the long term options for discharge:

(a) Which of the options on the list do you prefer for further investigation, and why?

(b) Which would you reject, and why?

Ian McLean: Now what we will do is go to the other group first and can you tell us which options on the list you prefer for further investigation please and why.

Warren Webber: I am going to side step that question first by going to what our group regards as the most critical question, and the first step, and that is the definition of restoration of mauri. We regard that as the first and primary step which should precede any other actions or decisions.

Ian McLean: Yes the other group spent some time on that as well.

Roger Gordon: Yes we did. We started with the three headings on the whiteboard and quickly found that they were not appropriate to our discussions. We did discuss the understanding of mauri. Does somebody else want to speak on this for me?

Peter Staite: We agreed using different words that water from the wastewater treatment plant had to be brought back to drinking water quality standard and if it is fit for human consumption then it is no longer wastewater. In other words it is restoring the mauri of the water.

Ian McLean: Thank you.

John Green: You called it the sustainability of life.

Tapa Nicholson: At the front end of that particular question was the Maori world view that the mauri of the water is uppermost in our thinking. The question then was – What is mauri? If you restore the mauri of the water the water will give life. If the water does not have those life giving properties you do not put it anywhere, it is just a waste of time. We have wasted our time. Restoring the mauri, that is the most important thinking that we all had.

Roger Gordon: Our solution was that the water needs, in terms of its wastewater treatment, to be de-N'd and de-P'd and then sterilised and then that sterile water could be reused and re-injected. Would that meet the criteria?

Ian McLean: We will hold that thought a moment because we are coming to the solutions now.

Warren Webber: I would like to make a comment here, we agree completely with that process, but we would add some wetland exposure.

Ian McLean: I am going to stop you; we are not into solutions yet. Do we need to say anything more about mauri? Ok, now we will go through which options you would prefer for further investigation.

Warren Webber: Our preference is to enhance the water further by de-nitrification and removal of phosphorus and also remove the pathogens, bacteria and virus and then whatever else is required to restore mauri.

Roger Gordon: We totally concur; we went through the same process. We did identify, as you did Warren, some of the possible uses of the water after that process was completed. One was by wetlands, the other re-injected into the water system and the other was agricultural irrigation. Once you have the water to a state where it is potable and usable it becomes the higher value product.

Toby Curtis: Kia ora, I just want to make an appendage to that so that we are very clear. No matter how much you sterilise the water and you make it clean, safe and everything else, it is not until it can be consumed by a human being without any ill effects, then it has the mauri. If the water affects the human being the life force has not been returned and the use by human beings is our gauge as to whether the life force has been returned.

Roger Gordon: Yes we had an interesting discussion as to when wastewater ceases being wastewater and at what point. There was a cultural issue as well and if that water has been in contact with something that is unacceptable in the past does it still retain that association?

Ian McLean: Roger, I must apologise for cutting you off in the past but you were giving what I think now was your preferred option and could you run through that again please?

Roger Gordon: Our preferred option was in line with what Warren was saying that water needs to be treated at the plant. It needs to be de-N'd, de-P'd and then using some method, whether it be by UV or by the use of geothermal for sterilisation, and when in a condition that it could be re-used, either re-injected or used in some other way that we talked about – wetlands, re-injected or agricultural irrigation.

Ian McLean: Can I ask a question for clarification – did the groups think that if the discharge is to be in something like wetlands or some other land treatment system it still needs to be sterilised before that happens? Are you saying that whatever happens to it you want it sterilised, or are you saying that if it is going to be discharged somewhere sensitive like crops or freshwater then it needs to be sterilised?

Roger Gordon: Yes, the option for a sustainable long term solution was that the imperative is that it be treated on site to the point of sterilisation.

Warren Webber: Yes we would agree with that. Our sentiment would be to optimise the outcome and we would only do that by ensuring that we do not have pathogens.

Ian McLean: Restore the value of the water. Ok, so I will put that to the floor? Does everybody agree with that? Was that aye or nay?

All Participants: Aye.

Ian McLean: That is unanimous I would say. Well nearly unanimous as one person did not vote, but it is unanimous apart from one. The group consensus is overwhelmingly unanimous for sterilisation. There you are Alison, they have spent some money for you.

So are there any other solutions that you do favour?

Warren Webber: We did discuss the possibility of a new land treatment system in conjunction with crops, be it grass for silage making, or kahikatea or shrub willow. I would

say that is possibly our next most favoured option, but it is so far below this option and not worth consideration really.

Andy Bell: Yes ok, because Warwick has not got a microphone, within the 8 year interim consent period we want to reinforce David's message about water conservation to optimise the outcomes in that interim period.

Roger Gordon: Yes we discussed that and certainly felt that support for metering should be considered to reduce water usage.

Ian McLean: Is that the feeling of the group as a whole? Shall we vote? Yes, why not? That's pretty well unanimous.

Roger Gordon: Can we also say we talked about whether the use of this water was acceptable inside our rohe and outside the rohe and what we decided was that the choice is for the user. If the water was restored to the desired quality then if there was surplus to our requirements it was up to an external user whether they saw value in buying that water. That is my commercial dollar again. Could be taken out of the catchment but at their choice and cost.

Ian McLean: Did you look at the outside catchment?

Warren Webber: No we did not.

Alison Lowe: Warren, what did your group think?

Warren Webber: Would anyone like to comment from our group?

John Green: Once the water was treated to drinking water standard at the treatment plant and the mauri restored, then would your group be happy for people outside the catchment who wanted to take it, use it, and are prepared to pay the cost of getting it there?

Roger Gordon: I would think that our group would support that. Has anybody got any objections?

Warren Webber: No, we considered it primarily in the first 8 years of the consent period and would look to see the water put through a wetland and go back into the lake. Beyond that we would expect the water to have its mauri and it would be able to do all the things that you are talking about and I would not see that as an impediment.

Ian McLean: Ok, thank you, have we missed anything you favour?

Peter Staite - in relation to the use of metering, the Council may wish to write that off due to costs. But as I see it metering could be by street, or by little communities, or sectors. That way we can deal with the high cost factor, but at least we would get some control over water volumes been used at any one place.

Roger Gordon: There was a point raised by you, Ian, that we did not address the financial implication of water conservation. It was just the philosophy of water conservation.

Warwick Murray: I wanted to make a comment about the question of shipping water out of the catchment. I am expressing a personal view here but I would not have a problem with sending it out of the catchment. But we need to look at other alternatives where you can add value. One of the things that we talked about was putting the water that had had its mauri restored through a wetland at the bottom of the Puarenga that had been there before. By

doing that value is added by restoring some of the native biodiversity that was there historically.

Luke Nelson: Just a query – I see the second group have de-nitrification beds on the board for a solution for N, but I cannot see that highlighted as a preferred option as opposed to wetlands or cut and carry.

Warren Webber: We would see that as part of the process of optimising the outcome from the treatment station.

Ian McLean: Ok, we will move now to the next question – which of the possible solutions do you reject?

Roger Gordon: All barring the one we have mentioned. We decided that we had a preferred option and concentrated on refining that to get clarity. We felt that none of the other options addressed the outcomes that we wanted.

Warren Webber: Our group would concur with that. We want the emphasis on the restoration of the quality of the water, the mauri of the water.

Ian Webber: From the floor are there any options to reject?

John Green: I would reject putting it straight into the lake. Put the 2½ hectare de-nitrification bed in, during the 8 year period, near where the fields are down near the plant. We could have a process where only two thirds of the water goes up into the forest and the other third goes through the de-nitrification system. We have to prove that it works, so we need monitoring and testing. It is UV'd and then goes into wetlands. We allow that process to develop and then slowly wean it off the forest. By 2021 we will have proven the technology and its capability of being put in the lake through the wetlands.

Ian McLean: I am reminded of the story of the Auckland power failure when they were fixing the old cables through the tunnels and finally got the cable fixed and read to pump electricity through. When the Chief Executive went to switch it on it went 'bang', and he said, "Oh bother, what's Plan B?" Now all I am saying is if we are putting up only one option to RDC I think we are constraining them somewhat. Are there options that we still think that might be explorable?

Strong dissent was expressed from the meeting.

Ian McLean: So does the meeting agree that its view is that no Plan B is required? The meeting agreed without indication of contrary view that no Plan B is required.

Alison Lowe: I think it is very clear there are some key things that we need to do and everyone has agreed with that. I do not believe that is constraining us. We need to sterilise and we need to de-nitrate, taking out as much N and P as we can. There are still options for the way we do develop that process, but it is not another land treatment system. We can deal with it at the present treatment plant. That is fantastic, making it so much easier to progress, but I am not sure how we get around a consent to wean us off the forest.

Roger Gordon: We did not look at totally defining or protracting the use of the water after it had got to the point of sterilisation. In fact we gave a number of options, but certainly not the fact that it should go through that process at the plant to end up being sterile before any future uses.

Ian McLean: The consensus of the group is that this is the direction you want RDC to explore and you have no other advice to give them on their exploration.

Jim Howland: I believe that we need to look for a new site if it is a land disposal system because that particular site will always be very culturally unacceptable to the treatment of sewage. The Council could find themselves in 20 years still having the same argument as we are having now from a cultural point of view. I agree with all the suggestions for improvements but for long term if we are talking about land disposal in that catchment they would be far better off to look for another site.

Peter Staite: We agreed that we would support an 8 year resource consent process, but within that process there has to be some periodic improvements, measurable milestones over that period of 8 years which would be the basis for agreement for the resource consent.

Warren Webber: Yes we concur with that completely.

Roger Gordon: We have not got to that point yet. That is your next question is it not Ian?

David Hamilton: I want to mention that the constraint brings about focus as well and takes away the hassle of the land irrigation area, the irrigation, the pumping, and brings the focus to the necessity of treatment.

Ian McLean: Just to make sure I have got it clear. What we have decided is we want RDC to focus in this direction and it has all these elements (everything on the white board). It is tied up with mauri, with conservation and sustainability. We are not going to say to RDC, "Here's a list of different types of treatment." Rather, "This is the general direction we want you to go." Is that what you have said?

All: Agreed.

Ian McLean: We will move on to the next question.

3. What issues does the RDC proposed application for interim consent raise?

Roger Gordon: We supported the interim consent; we felt that there needed to be a reasonable amount of time for Council to undergo this transition. However we did say that that support was only on the establishment of certain measureable milestones along the way and a commitment towards achieving this alternative solution.

Ian McLean: Ok, Warren did your group agree?

Warren Webber: Yes, we have got nothing more to add, other than that we would be concerned that if an interim consent was not granted we would really be in deep doodoo.

Roger Gordon: Even that would be untreated doodoo?

Ian McLean: Can I get clarification? You are not saying that support for a consent would only be agreed to after all this has been done, but that you want these things to be included in the consent application?

Roger Gordon: The consent application must include some of the conditions of mitigation that we talked about, with set milestones towards an agreed outcome that is sustainable at the end of the 8 year period.

Warren Webber: One more point which we were quite definite on is that if there is a renewal of a consent that it is for a single term only, not a rolling consent.

Roger Gordon: Well that is inherent in having those established milestones sitting there.

Ian McLean: From the floor is everybody happy with that?

All: Yes.

Ian McLean: Wonderful, you are doing well. We come down to the last question.

4. Road Map

(a) Are you happy with the road map for consultation?

(b) Who should be on the Steering Committee?

Warren Webber: The road map is what Greg put up, a series of arrows, and we agree with that suggestion. We believe that it is realistic and pragmatic.

Roger Gordon: We could not remember the diagram, but what we assumed was that the milestones would be developed and built into the consent process and would reflect some programme and road map towards the alternative solution. Does that make sense?

Ian McLean: I think so. I must apologise that you did not have the road map in front of you. Nobody saw anything wrong with the road map when it was put up earlier.

John Green: We have listened to Alison and heard about the science and she said that we can achieve everything in a fairly quick period of time. As long as the key objective is to restore the mauri in the water by a certain time frame I am sure the community will be on board with that objective. Greg's process might have a bit of time up the sleeve to achieve those actions, because Alison may well be able to put them in more quickly than Greg was contemplating.

Ian McLean: The point is the result of today may lead to a shorter period of community consultation. Ok, has everybody agreed on that?

All: Yes.

Ian McLean: We come to who should be on the Steering Committee.

Roger Gordon: We agreed with your suggestion of 12, but we made the proviso that they would involve themselves in greater consultation with stakeholders outside of that representative group. We felt that it was not appropriate for us to say who should be in Iwi, but we did see sense in a 4,4,4 split. Iwi in our group thought that 4 were sufficient but there should be some flexibility within that group depending on the topic of conversation or discussion at the time. We thought that the authorities should be represented and the operators and regulators as well.

We were a bit rushed in this question but felt that the group should include specialists in this area, particularly Professor Hamilton and people of his calibre, who would add real quality to the conversation. We felt that there should be representation of Federated Farmers and the wider business community, those with a stake hold in the issues.

Ian McLean: Thanks Roger; we will hold the thought of the technical input for a moment if we may. Warren please.

Warren Webber: I will preface this by a comment that Alamoti Te Pou made before he left, he asked for two things. One for access to the PowerPoints that have been provided today and we would like speakers to give us their permission please to be able to provide that to the group. It has been recorded and will also be available in a transcribed form.

His other plea was for more communication. He wants the Steering Group, or representatives, to present to their board and to keep this communication going. He also suggested that the Steering Committee include land owners.

In our group we had land owners, Iwi, community and the appropriate authorities. Taking some lead from the StAG Group, within the authorities we would like to see both governance and management represented, not necessarily in voting capacities, but certainly at the table. That precedent has worked very well for the StAG Group. Whilst it can be sectorial appointments or suggestions the important thing is the skills that they bring to the table, not necessarily their sectorial interests. We also believe that it must have a robust secretary.

Ian McLean: Does the other group go along with that?

Roger Gordon: We had governance in there. Local government politicians, both RDC and Regional Council, at management and councillor level.

John Green: We had a conversation about a chair, do you want to talk about that?

Ian McLean: The process of selecting chair is RDC's responsibility. RDC need to take today's discussions to their people and get approval to go forward with this approach. The Chair gets selected by RDC and then in conjunction between RDC and the Chair they consult with the various groups and find the people that they need.

Stuart Morrison: Reflecting on the operation of the StAG Group which I have also been involved with, it is particularly important to develop the working relationships - Councillors with the Stakeholder Group, staff with the Stakeholder Group and Technical Support with the Stakeholder Group and achieving that working relationship is really what makes it all go.

Ian McLean: There is one point that experience shows can cause problems and that is if the Council itself appoints the Chair without obtaining a concurrence from the Group. This happened way back in history with the Lake Okareka Action Plan where the Council appointed on the basis of "Buggins turn",¹ and for all sorts of reasons that person was not able to carry out the job effectively. I understand the Rotorua District Council has been exploring possibilities and is likely to suggest to the Steering Committee somebody from outside the area who is very well qualified indeed.

Roger Gordon: They did adopt a very good process when they selected the Chair of Grow Rotorua and involved the stakeholders in the business community and I am still yet to receive something from John's little back pocket! They included the community who were very supportive of the choice by Council.

Ian McLean: I am sure we would agree with that Roger. One of the people from CNI Iwi Holdings commented to me that they felt land owners should be there as well and I think that is important. Now is there anything else on the Steering Committee? From the groups are there any other issue that you want to bring forward to us?

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¹ The method of appointing people to positions based on rotation rather than on merit. - www.oxforddictionaries.com/definition/english/Buggins'-turn

Warren Webber: Yes the Puarenga Stream was raised and we should not lose sight of this. Issues around contribution of land fill to nutrient leaching in that catchment and that there needs to be a review of what is happening there. Tapa, would you mind making some comment?

Tapa Nicholson: Kia ora. We are more aware now than we ever were about problems that contribute to the water quality of the Puarenga. At the top end of our operation where the Waipa meets the Kauaka and Tureporepo streams, Waipa is still perceived as a potential increase by those of us who are the residents and stakeholders along the stream. I am talking about the Waipa right to Te Arikioa and beyond really, we end up at Rotoiti and wherever. We are concerned that if we do not keep drawing attention to it we will lose sight of the fact that there are other contributors to the state of that waterway. It might be the opportunity alongside this initiative to promote with the Council a partnership with industry which deals with the water quality and the contributors to that stream and that waterway. Kia ora.

Roger Gordon: I totally agree with you and find it difficult to see why those major stakeholders are not included in the future package, because they are a major contributor to the whole clean water aspect of Rotorua.

Ian McLean: Did you want to say anything about the Puarenga?

Warwick Murray: Yes we do need to keep a focus on the Puarenga itself as we do for the wider Rotorua catchment. We talked in our group about the fact that there are some farmers there. They are going to have to face the same challenges as all other farmers in the catchment. There are also other point sources within that catchment that are subject to consents that we as a Regional Council will continue to work with to ensure they meet their obligations. There is still more work to be done, but it is do-able.

Roger Gordon: Do any of my group wish to add anything?

Peter Staite: My understanding in coming here is that the focus was on the land treatment system rather than the upper catchment which is not part of that system. That is how I have contributed and in concluding I expect that the fundamental principle of this group is to act in the utmost good faith and spirit of co-operation. I would expect nothing less from the officials, representing Councils, and from the Councillors and any other persons that represent government centrally and locally.

Ian McLean: Kia ora, that is correct. Focus on the waste water treatment system, but also keep at the back of our mind the Puarenga Stream.

Te Ohu Wi Kingi: In a nutshell it was a parallel approach. Whilst we are just concentrating on the treatment plant we have this opportunity to fine tune and we must not forget where it all stems from and hence the parallel approach. We have a double up, nothing wrong with that.

Warren Webber: A further comment regarding the Steering Committee, we did have a suggestion that there should be a technical advisory group which is used on an as required basis.

Ian McLean: It everybody happy about that, it has happened with the StAG Group. Ok nothing else on the Steering Committee, nothing else on other matters? Is everybody happy with this summary representing your views? (Referring to the summary on the white board.)

Before I hand over to John Green to close this workshop I want to say that when you look at what RDC has done with wastewater over the years, they have shown great initiative and

are to be congratulated. The staff, who are actively involved, should also be congratulated on what has been achieved. It may not have been quite perfect in the forest, but it is arguably the best plant in New Zealand and it was wonderful to walk around there yesterday. I hope that the Fonterra plants are as clean and tidy as our wastewater treatment plant is.

Congratulations to RDC. Congratulations to them on supporting this workshop and thanks very much to Warren for all the work he has done and Hilary Prior who has helped here today. Now I have much pleasure in handing over to John Green, Chair of LakesWater Quality Society. Kia ora.

John Green: Julius Caesar said – *We came, we saw and we conquered*, but I could say – *We came, we talked and we conquered*, because today you have all contributed to a very special occasion in the life of Rotorua. RDC has tried, and realised that over time nature has not been able to help in the way that it thought. Now we have come up with further ideas which hopefully will bring us to a sustainable situation.

Alison, I have to thank you so much because a lot of predication and our thinking is relying upon your technology and capacity to perform these engineering solutions. But as a group of people I have never been involved with one so positive, united and supportive of what we are trying to achieve here today and the solutions that you have all come with, the consensus has been amazing and it has been a great day.

Ian, I have to thank you very much for the time and effort you have put into this and I know that you have spent a lot of time thinking it through and as usual it is at a very professional level. We all as a community have to be grateful and thankful for the work that you do and your knowledge and experience at dealing with a disparate group like us. It has been proven in the way that today has resulted in a consensus conclusion which is an outstanding outcome. I hope that we can carry it through with RDC and hopefully Warwick and the Bay Of Plenty Regional Council will agree to other processes going forward.

Warren, thank you very much for the support that you have given as well, it is greatly appreciated. LakesWater Quality Society has an expert team of people very committed to the environment.

David Hamilton, thank you very much for coming today and on the field trip yesterday and giving us your pearls of wisdom which you do from time to time. We are all so grateful to have you as part of our process and working very closely behind us.

Pihopa, thank you very much for hosting us here at Ohinemutu, it was greatly appreciated. Could I ask for a prayer from you and close the hui.

Pihopa Kingi: Thank you John, at this stage I would like the Chairman of the Arawa Lakes Trust to make a very few concluding remarks, Haere mai Toby.

Sir Toby Curtis: Kia ora, I think we have said all we wanted to say so could I just quote this little verse –

We are limited only by our imagination to dream of what could be

Only by the extent of our daring to hope

And only by our determination in terms of our will determining what will be

As the old Saint Christopher motto says – it is better to light a candle than curse the darkness

I would think, Ladies and Gentleman, today we did not curse the darkness, we lit a candle so we can see the bright day ahead of us and John you are so right. If I could finish off with the words of Douglas General McArthur when he said –

Do not substitute words for action

We are now at the action phase and he also said –

*Do not seek the path of comfort, it isn't going to be an easy road for us to hoe,
but with a collective mind such as ours today we will get there.*

Pihopa Kingi:

Let us pray – Lord, let now thy servants depart in peace according to thy word for our eyes have seen our salvation which thou has placed before the faces of all people and glory be to the Father, to the Son and the Holy Spirit as it was then, is now and evermore for Jesus Christ sake, Amen.

And again in Maori the final granting of our blessing –

Kia tau kia tatou katoa
Te atawhal o to tatou Ariki a Ihu Karaiti
Me te aroha o Te Atua
Me te whiwhinga tahitanga ki te Wairua Tapu
Ake, ake, ake – Amine.

And may the Almighty keep watch over all of you as you return to your homes, to your families and some of you to your faraway places. God bless you all. Kia ora tatou.

Project Rotorua Clean-Water: Recommendations

1. The Workshop Project Rotorua Clear-Water unanimously recommended a preferred option for dealing with treated effluent. This option would:
  - a. First and foremost restore the Mauri of the waste water plant discharge water – this would require the restoration of ‘life-giving’ properties and implies a return to potable standards.
  - b. By 2021 close the LTS in the Whakarewarewa forest.
2. The preferred option involves several components. All but one would be located in the general area of the WWTP. They are:
  - a. Remove phosphorous to acceptable levels by treatment in the WWTP, with residual mitigation by a wetland.
  - b. Reduce nitrogen by denitrification beds of carbon.
  - c. Remove pathogens by ultraviolet light treatment.
  - d. Establish a wetland for the purified water to finally flow to the lake or the lower Puarenga Stream. A constructed wetland on land adjacent/close to the WWTP should be considered (The workshop was advised that a wetland is essential to restoring the Mauri of the water. The water by then is of drinking water standard. The wetland would also reduce the low residual P and N to some extent).
  - e. Intensify water conservation measures (and consider metering).
3. By completing the above, along with Terax methodologies, the WWTP will be world-class in every way.
4. Iwi put great value on remediation of the ancient rubbish dump to the north and west of the WWTP. If such a site is unsuitable for a wetland because of the risk of contamination being released, then remediation should be considered as a separate project concurrent with the construction of the wetland.
5. Puarenga Stream improvement should go hand in hand with the actions at the WWTP. We would hope that programmes for the Puarenga would get strong support from iwi.
6. There was unanimous opposition to looking at other options for discharge.
7. An interim consent to continue discharge was supported, providing it included conditions that required expeditious progress on the long term options.
8. The very good progress in achieving a consensus should shorten the timeline of the roadmap.
9. Steering Committee:
  - a. Four groups in structure: iwi, landowners, rest of community, and councils.
  - b. Councils be represented by both staff and councillors.
  - c. Sectoral representation is supported but specific skills are critical.
  - d. RDC to propose a chair for concurrence by Committee.
  - e. Ongoing communications with community is important.
10. A Technical Advisory Group was also suggested, which Professor David Hamilton has since offered to lead.

LIST OF ATTENDEES

Name	Organisation
Alamoti Te Pou	CNI Iwi Holdings
Alan Skipworth	Tuhourangi Tribal Authority
Alan Wills	Federated Farmers of NZ
Alison Lowe	Rotorua District Council
Anaru Rangiheuea	Tuhourangi
Anaru Te Amo	CNI Iwi Holdings
Andy Bainbridge	Rotorua District Council
Andy Bell	Rotorua District Council
Andy Bruere	BOP Regional Council
Ann Green	Secretary, LWQS
Annaka Davis	Toi te Ora Public Health
Arapeta Tahana	Te Tumu Paeroa
Colin Kemeys	Rotorua District Council
David Hamilton	University of Waikato
Dick Braddock	CNI Iwi Holdings
Eric Cawte	Rotorua District Council
Francis Pauwels	Grow Rotorua
Glenys Searancke	Chair, RDC Infrastructure Services
Greg Manzano	Rotorua District Council
Hamuera Mitchell	Te Komitinui o Ngati Whakaue
Hare Williams	Ngati Makino
Hilary Prior	Lake Rotoiti Community Association
Hugh Riddiford	Grow Rotorua
Ian McLean	LWQS
Ike Reti	Hurungaterangi
Jim Howland	LWQS
Joe Tahana	Ngati Pikiao
John Cronin	BOP Regional Council
John Green	LWQS
John Hura	CNI Iwi Holdings
Kevin Winters	Mayor
Kiri Mitchell	Hurungaterangi
Luke Nelson	Rotorua District Council
Margaret Noble	Waiariki Institute of Technology
Mauriora Kingi	RDC
Mark Smith	Grow Rotorua
Paul Scholes	BOP Regional Council
Peter Staite	Ngati Te Kahu/Ngati Hurunga Te Rangi
Pihopa Kingi	Te Arawa
Piripi Jennings	Tmberlands
Rick Braddock	CNI Iwi Holdings
Robert Lei	Scion
Roger Gordon	Chamber of Commerce
Stuart Morrison	Farmer
Tapa Nicholson	Te Puia
Te Ohu Wi Kingi	CNI Iwi Holdings

Tim Charleston
Tim Cossar
Tim Senington
Toby Curtis
Todd McClay
Vanessa Epiraima
Wally Lee
Warren Webber
Warwick Murray

Red Stag
Te Puia
Rotorua District Council
Te Arawa Lakes Trust
MP Rotorua
CNI Iwi Holdings
Tuhourangi
LWQS
BOP Regional Council