File No. 85-08-503

NOTES OF ROTORUA PROJECT STEERING COMMITTEE WORKSHOP
HELD THURSDAY, 25 JUNE 2015 AT 9AM
IN COMMITTEE ROOM 1, AT THE ROTORUA LAKES COUNCIL

PRESENT:	Warren Webber (Chair)	–	Lakes Water Quality Society Inc
	Geoff Rice	–	Tapuika Iwi Authority
	Peter Staite	–	Ngati Te Kahu/Ngati Hurunga Te Rangi
	Andrew Te Amo	–	Ngati Whakaue/CNI
	Geoff Palmer	_	Rotorua Lakes Community Board
	Fred Whata	_	Ngati Pikiao
	Jimi McLean	_	Ngati Makino
	Louise Kirk	_	Ngati Hurunga Te Rangi
	Tamara Mutu	–	Ngati Hurunga Te Rangi
	Gareth Bowen	–	Timberlands
	Manu Pene	_	Tuhourangi Tribal Authority
	Leilani Ngawhika	_	Te Arawa Lakes Trust
	Alamoti Te Po	_	CNI Iwi Land Management Ltd
	Gina Mohi	_	Ngati Rangiwewehi
	Wally Lee	_	Tuhourangi/Ngati Wahio
	Dave Donaldson	_	RLC, Deputy Mayor
	Peter Bentley	_	RLC, Councillor
	Jim Bradley	–	TAG Chairperson
IN ATTENDANCE:	Antoine Coffin	_	Te Onewa Consultants Ltd
	Kevan Brian	_	Mott MacDonald
STAFF PRESENT:	Isabel Brell	_	RLC, Administrator
	Greg Manzano	_	Manager Water Planning, Water Solutions
	Alison Lowe	_	Environmental Scientist, Solid Waste & Sustainability
APOLOGIES:	Marama Meikle	_	Ngati Hurunga Te Rangi
	Roku Mihinui	_	Te Arawa Lakes Trust
	Rangitihi Pene	_	Tuhourangi Tribal Authority
	Jimi McLean	_	Ngati Makino(for lateness)
	Andy Bell	_	Director, Water Solutions

9am – 12pm -WORKSHOP

1. MIHI/KARAKIA

   Opening Karakia by Manu Pene

2. WELCOME AND APOLOGISES
   Apologies noted above

   Resolved

   That the apologies be received.

Geoff Rice/Warren Webber
CARRIED

3. WORKSHOP BUSINESS

3.1 ITEM C: DISCHARGE LOCATIONS TO LAND – ALTERNATIVE LAND TREATMENT SITES INCLUDING A RAPID INFILTRATION BASIN (TWO MOTT MACDONALD REPORTS)

Greg Manzano – location of the possible sites for alternative land treatment sites due to exit the current Whakarewarewa Forest. This report must be treated in confidence as no discussion with the owners of the considered sites, has been entered into. All the reports have been by reviewed by the TAG, with a supplementary report prepared to consider other options that have been discussed. A third report has also been prepared as a result of the possibility of having a full MBR plant with discharge to water. All the reports are available on the RLC website.

A Power Point presented by Kevan Brian, technical director, Mott MacDonald. (Attachment 1)

Geoff Rice – it will be easier to find 150ha than 600ha.
Kevan Brian – loading at the higher rate will require good soils.
Gina Mohi – the loading rates will be influenced by the soil type.
Dave Donaldson – the application rates will need to be consented – and are BOPRC engaged with TAG?
Warren Webber – Andy Bruere, BOPRC, is the representative on TAG.
Kevan Brian – nitrogen loading rate – how much you apply to the soil will have an effect of how much leaches. What are the best long term rates to apply?
Gina Mohi - is there way of increasing the rate of ammonia released so that it is not all in the form of nitrate?
Kevan Brian – yes - though this has not been looked at. The assumption is that the existing asset at the treatment plant will remain as good as it is. The land does the last part of treatment but will not do it all as a system like Taupo.
Gina Mohi – Taupo have a high ammonia rate going onto land – to be utilised by plants.
Kevan Brian – the scheme is to cut and carry the foliage.
Gina Mohi – could a feasibility study of this as an option be undertaken and include the impact on the plant?
Kevan Brian – this could be quite expensive, not only would you have the land plus you would have to take away and pay for a different asset at the treatment plant.
Alison Lowe – at the Taupo scheme ammonia is applied rather than nitrate. Whenneing the mass balance, and the cut and carry process – they are still applying a lot more than what they are removing. If the nitrogen was left as ammonia – some needs to be nitrified – we cannot convert the entire nitrate to ammonia without treating.
Geoff Rice – Taupo was easier – larger tracts of land, less farming owners, bigger Maori involvement, and cleaner lake.
Wally Lee – the three blocks are Maori land– Peka, Kapenga, Tumanui – sites of important ecological wetlands..
Dave Donaldson - the request to look at a LTS option came from iwi as there were concerns that the process was leading to treatment at the plant to discharge to a rock bed then to the lake.
Warren Webber – LTS should not be dismissed without looking at it as an alternative option.
Jim Bradley - from the TAG - parked land options were asked to be further considered by the committee. There is enough RMA wastewater consenting projects around the country that have been challenged for not doing an appropriate amount of alternative assessments.
Gina Mohi – most of the land around the caldera is Maori land and we did ask for this work to be done.

Warren Webber – the land area of 13 -20ha(for Rapid Infiltration RI) is more achievable than 600ha, the capex on the RI is $35million – still huge
Kevan Brian – most of the cost is treatment plant, the RI cost itself is about $5 -6million.
Warren Webber – so this includes the treatment plant upgrade.
Jim Bradley – this is option 3A – the denitrifying filters, UV, disinfection and the chemical removal of P.
Gina Mohi – RI is based around all the treatment being done at the plant. So what is coming out the system if the full upgrade occurred?
Kevan Brian – everything is on the same basis as meeting the need to remove to meet 30tonnes of N and 3 tonnes of P per yeara
Peter Staite – is there going to be an improvement from the current plant?
Warren Webber – if the plant was a 100% MBR plant we would be achieve 3-4ppm of N (current is about 5ppm) plus P removal would be added and/or UV – this would mean a higher quality discharge.
Kevan Brian – our assumptions have always been 30tonnes of N and 3tonnes of P – whether it is land doing the work or the plant doing the work
Peter Staite – we are seeking a much better filtering system than the current treatment plant – there will be add ons – but the discharge will be much the same.
Kevan Brian – the discharge to the land will be of a much higher quality. The land in the RI system does not do any treatment – the treatment plant does it.
Tamara Mutu – will the options provide an overall improvement from the current system but between the options the same result will be achieved?
Warren Webber – 1. Plant + Alternative LTS ++ reliant on land for treatment

2. Plant (upgrade) ++ Alternative LTS + not reliant on land for treatment

+ = level of performance

1. Emphasis on land to provide treatment.
2. Emphasis on the plant to provide treatment. present consented level. Our aspirations as a committee must be for improvement of the process.

Geoff Rice – are we trying to negate land options?
Warren Webber – discharge to land and subsequent land treatment will be very expensive. The capex is $60 - $107million.
Gina Mohi – a number of us have said that we do not want complete discharge to the lake. This leaves the land and the concern is the quantity required. The RI option is obvious – it doesn't require large amounts of land; provides for the upgrade at the plant.
Warren Webber – the current LTS is not working – we are looking at new LTS options and it is still telling us that it is expensive and has fish hooks.
Geoff Rice – at 150ha plus the land won't be available – iwi will not agree. RI might be an option.
Dave Donaldson – we are looking at these options on their merits of environmental outcomes. At some point cost will need to be considered.
Warren Webber – with the three land areas there are ancient and cultural issues to address; operational costs.
Geoff Rice – the only option in terms of area could be one of the Okohoriki Blocks.
- The wastewater would need to be treated to the highest level and whatever we do it is going to end up in the lake.
Warren Webber - scientifically why go through land if the treated wastewater is going to end up in the lake? If RI was a consideration, 20ha could possibly be found in close proximity to the treatment plant – this should be explored.
Kevan Brian - this is dependent on the soil type.
Jim Bradley – hugely important is the total head (Kevan Brian's slide Infrastructure Requirements) and the energy costs and the inflation. Currently the total head to the LTS is 80m static – the lift - and the friction/energy to drive it through the pipe is about 120m total (static plus friction). From ongoing energy costs - which go up with volume – Option C is a huge winner over Option A. The annual operating cost of the current scheme is about $800k for electricity and $200k for other energy costs.

Warren Webber asked the committee members for their comments/perceptions:

Wally Lee - a lot to take in; whatever decision is made it will be not be easy. In terms of land mass 150ha or, 600ha, 13ha -14ha for RI seems to be the best option regarding the quantity of land required. However the focus and the key is the level of quality of the treated wastewater from the plant and going to the discharge point.

Leilani Ngawhika – RI seems to be the standout option. Upgrades are needed in terms of water quality and going to land. From the Lakes Trust point of view, agree with the CAS not wanting to discharge directly to the lake.

Tamara Mutu – the land treatment system is preferable option over the direct discharge options - RI has the least impact in terms of land mass. The task is to find the land that can do the job.

Peter Staite - RI is not a filtering system. There is a cultural values need. The treated wastewater being returned to land is contaminated. We need the best add-ons to achieve the highest quality of treated wastewater needs to be achieved from the discharge pipe. I am pleased that the TALT agree that there should not be a direct discharge to the lake.

Geoff Rice – the plant is the answer – if experts can get the treated wastewater to the highest quality then after that we have to find the best discharge point – if it's land, it's available and meets the requirement – but we have to get the treated wastewater right.

Manu Pene – I agree to what has already been said.

Louise Kirk - the quality of the discharge water is important. I agree with Geoff about the plant being important in the process.

Fred Whata – the plant is one of the best in the world. The expectation is to improve the plant and we are not that far from achieving drinking water. If the plant can do that, discharge to the lake. There are other issues concerning the bottom of the lake that have to be attended to – the geothermal. However if the land is available you will need to prove that the land is the right option.

Anaru Te Amo - from the start the purpose of the group was to consider the purification of the wastewater- to have such a quality to enable discharge to the lake. I support the upgrade of the plant so the treated wastewater can go to the lake. I am opposed to the use of Maori land. We have been separated from our land for about 100 years. The land gives Maori their mana.

Alamoti Te Pou – key points have been raised. When making a decision and there is no clear solution, take the least negative approach. There is a lot of information to consider. To leave the land was an iwi decision and to potentially go back to land will be an iwi decision. I support that the wastewater needs to be treated to the highest quality before discharge.

Geoff Palmer – the cost will be an important factor. I support the points that have been made and most of the lakes residents would support a central treatment plant. The upgrade of the plant is important treatment plant and future technological advances should be tabled.

Gina Mohi – I related my views earlier in this meeting.

Dave Donaldson – the landowners and the Environment Court have asked us to consider alternative discharge options. The restoration of the mauri of the water by UV disinfection and further filtration is the option being funded through the long term plan. The the discharge would only need to go through a spiritual treatment before it enters the lake e.g. rock groin or wetland. RLC has a vision for the restoration and beautification of Ngapuna. Options which consider the Puarenga or Waititi catchments as locations to discharge to the lake will create issues which could lead us back to the Environment Court.

3.2 ITEM A: TREATMENT OPTIONS – WASTEWATER STRATEGY REPORT – FULL MBR PLANT (NEW OPTION 6)

A Power Point presented by Kevan Brian. (Attachment 2)

Greg Manzano – the effects to the environment of the differences – 50% of the time or 90% of the samples – it is not big. It is important that we meet on the consent over 12 months, 30tonnes of N and 3 tonnes of P.
Alison Lowe – exceeding the N limit is not a health risk, but it is in terms of the nutrients to the lake. The other risk is in terms of pathogens.
Kevan Brian – at the plant there is a primary settlement and a secondary treatment, MBR and Bardenpho. Both produce sludge which is treated then removed from the process then off site. There is value in the sludge that is not been realised. The intent is to change the configuration and to simplify the process – remove the primaries (primary treatment tanks)
Greg Manzano – included in the Capex of $32.8 million is $5 million for MBR new tanks. The plant needs to be operational during the upgrade. There is potential to save the $4million by using the two Bardenpho clarifiers as MBR – this will need to be investigated in the detail work.
Jim Bradley – a number of plants in New Zealand are now designed without primaries. The carbon is left in for the biological process. The design is not new.

3.3 ITEM D: OVERALL SUMMARY OF OPTIONS (OPTIONS 1-6 COMPARISON)

A Power Point presented by Greg Manzano and Alison Lowe. (Attachment 3)

Greg Manzano – this is the first attempt to summarize and compare the 6 main options with variations. Not included were the discharge options to water eg, wetland, and gravel – the cost is $500k to $1million.
Warren Webber – there are two considerations; the plant and the discharge point. The plant has to achieve less than 30t of N. The 100% MBR option would appear to be we are moving to. This may or may not include UV, or extra P removal. Whatever happens, there are performance standards that need to be met – less than 30t of N and 3t of P pa, removal of bugs and viruses, colour etc. The TAG team are showing us options that will improve the treatment of the wastewater. The discharge options include direct to water; the RI bed with the availability of 20ha of land, the land next to the cycleway.
Dave Donaldson – if 20mm per day is applied to a site, the hydraulic load equates to 7300mm pa. The average Rotorua rainfall is 1420mm pa. As a comparison, Fiordland's average rainfall varies from 1200mm to 8000mm.
Warren Webber – there will not be a crop grown with RI option.
Alison Lowe – option 3A achieves more N removal than option 6 (has a denitrifying filter). In terms of risk, option 6 is better, as nothing can get out of the plant without going through a membrane.
Dave Donaldson – 3A has UV treatment, 6 is MBR with no UV.
Kevan Brian/Jim Bradley – UV could be added on.
Warren Webber – what would the cost be?
Kevan Brian - $2million - $4million.
Warren Webber – are 3A and 6 the options we are considering?
Wally Lee – there is a lot of information to digest. The summary is good as it explains where we are at present. Where the 20ha will come from, changes to the treatment plant.
Warren Webber – the other land treatment options discussed today, appear to be less desirable than a RI bed.
Tamara Mutu – the round the table discussion indicated a preference for RI. The concern is the location of the RI.
Gina Mohi - of the LTS options the RI is the standout. The location is undecided.
Tamara Mutu – the alternative land options without the plant upgrade are no goes.
Fred Whata – cost is the concern.

Warren Webber – the options proposed are cost effective. This is a preliminary report – it is the best take on where we are at present.
Peter Staite – the next report should be refined, so we can concentrate on real figures. The duty is with the engineers.
Wally Lee – if it is RI, 20 ha – potentially on Maori land – that is where the cultural impact assessment will be important.
Gina Mohi – as a collective we are here to make and influence decisions. The CIA is critical but we have an opportunity to influence the final outcome. The report should be refined – there is an overwhelming amount of information – it should be in the background.
Jim Bradley – in the RMA framework, which is for the consent process, besides the CIA, the other fundamental driver, is the environmental effects study, especially to water. That is to be included next in the process. Between 3A and 6, the question to ask Professor Hamilton will be what the differences/effects in the lake are. It is important that we are not solely technology or culturally driven.
Alison Lowe – should the considerations be options 3A, 6 and RI?
Warren Webber – in terms of discharge, the parked options will be all the LTS except for RI. The clear message is to optimise the treatment level at a practicable level.
Tamara Mutu – parked options will not be discarded.
Greg Manzano – all the costings presented today are plus or minus 30%. If 3A or 6 were going to be the options to consider, a preliminary report could be provided which could give a more accurate cost. For RI the next stage is to look for potential locations.
Geoff Rice – if that stage is achieved, the CIA would become more workable because the options have been identified.
Alamoti Te Pou – it would be useful to minimise the + or – 30% - some of the options are similar in cost. If one is 30% higher and one is 30% lower that would reveal a different story.
Kevan Brian – it would be expensive to accurately cost out all options. The options need to be narrowed down.
Warren Webber – the first step is to get more detail on 3A and 6. Examine RI; park the remaining options with a view to able to reconsider them.

Please Note:

Item B of the Workshop Agenda “Discharge Locations to Water” was not specifically discussed but was commented on in a general way in some of the other agenda items.

Workshop with TAG

Alternative Land Treatment Sites

Rotorua WWTP

Kevan Brian
Mott MacDonald

25 June 2015

Scope of Works

- Identify potential sites for discharge of treated wastewater in the Rotorua Lake Catchment.
- Establish size and expected nutrient removal performance
- Establish land use of alternatives
- Scope and recommend the preferred discharge methodology
- Scope and size transfer main and pumping system options
- Establish site layouts and details
- CAPEX, OPEX and NPV
- Identify risks, construction & commissioning requirements, further investigative works

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Scope of Works

- Rapid infiltration on some/part of the existing LTS site using existing assets (pipe from plant)
- Reuse of pipeline to LTS if feasible

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Scope of Works - exclusions

- Investigations into consenting risk or strategies
- Land ownership details
- Land Purchase, partnerships etc

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Alternatives Assessed

Option	Name	Description
4	Dual Discharge	Discharge of one third of the total treated wastewater from the Membrane Bio-reactor to water with the remaining flow discharged to land
5	Total Discharge	Discharge of the entire treated wastewater to a new alternative land site within the catchment

- For both options, the discharge limits are set at 30T of nitrogen and 3T of phosphorus per annum

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Treated Wastewater Quality

- Treated wastewater is very low in ammonia <1mgN/L and organic nitrogen
- Relatively high levels of nitrate (40-60% of N)
- Nitrate is usually mobile in the soil and moves with soil water
- Wastewater composition is very different to other schemes such as Taupo where the goal is to remove all nitrogen via the land

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Land Area Requirements

Option	Discharge	Annual Average Daily Flow (m^3/day)	Land area (ha) – incl 20% buffer	Application Rate (mm/day)
4a	Dual	16,510	420	5
4b	Dual	16,510	105	20
5a	Total	23,810	600	5
5b	Total	23,810	150	20

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Hydraulic Loading

- Baseline Rate – 5mm/d
- Current LTS – 9mm/d
- High rate – 20mm/d
- Rapid Infiltration – 150mm/d
- Taupo loading rate 5mm/d (35mm/week)
- Significant further investigations required to determine actual sustainable loading rate. Both baseline and higher rate included for comparison

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Nitrogen Loading

- Nitrogen in (combined) wastewater from plant – 5.9mgN/L
- Over 600ha this is a loading rate of 85kgN/ha/yr
- Over 150ha this is a loading rate of 340kgN/ha/yr
- Current Loading rate is 165kgN/ha/yr
- Taupo LTS consented loading rate is 640kgN/ha/yr for cut and carry
- Significant P removal required by LTS
- RI system assumed to remove no N or P

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Preliminary GIS Mapping Constraints

Parameter	Limit/Constraint
Slope	< 20°
Soil	Well to moderately drained
Flood return – Lake Rotorua	Not within 1:20 FRI and landward SH30
FRI – rivers and streams	Flood class 1 to 3 (< 1:20 FRI)
Distance WWTP	Within 10 km of WWTP
Urban areas	Exclude

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Selected Land Options

Option A

- Outside of 10km distance from WWTP
- Total area is 1,082 ha
- 300 ha meets initial design criteria
  - Note: Option 4 requires 420 ha while Option 5 requires 600 ha
- Area restricted by:
  - Volcanic mound formations (granite) and
  - River valleys
  - Steep
- Currently livestock farming/forestry and some patches of significant natural forest

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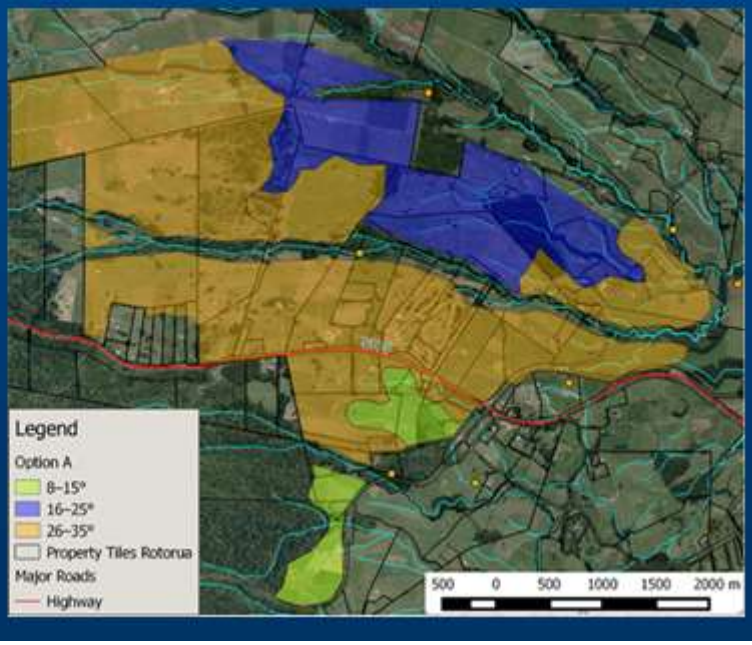
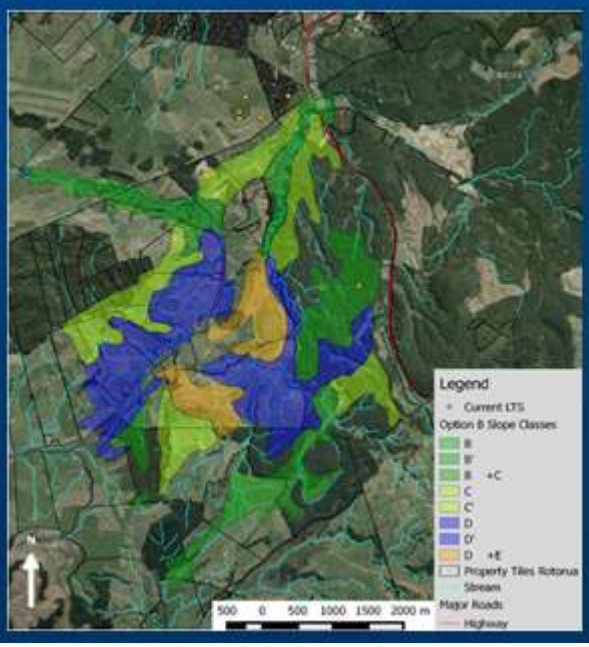
Option A with slope classes



Option B with slope classes



- Total area is 1,399 ha
- Meets the initial design criteria
- Livestock farming, dairying, forestry and scrub
- Close to WWTP and LTS
- Potential reuse of existing infrastructure with this option

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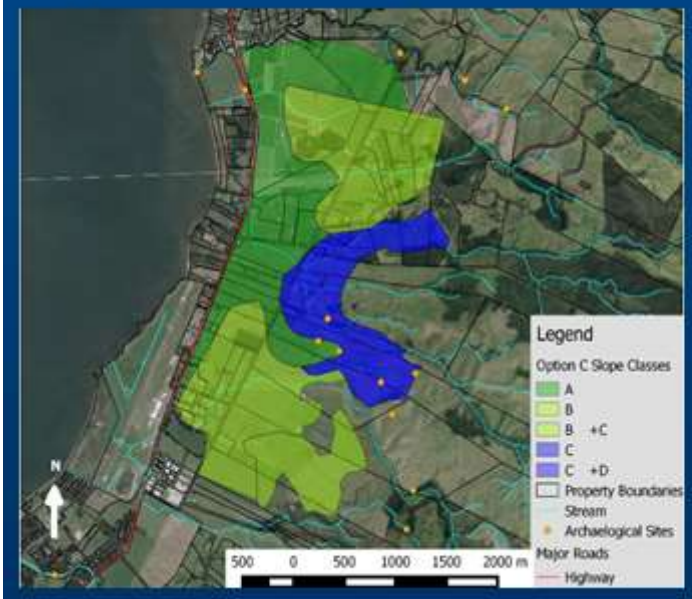
Option C with slope classes



- Total area is 676 ha
- Meets the initial design criteria
- Relatively flat
- Close to WWTP
- Livestock farming, tree nursery, life style blocks

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Nutrient Removal Assessment

Option	Nitrogen	Phosphorus
4	12.03 T requires removal	15.6 T requires removal
5	17.35 T requires removal	22.6 T requires removal
Assumptions	▪ 100% removal of ammoniacal-N ▪ 100% particulate organic N ▪ 60% soluble organic N	Assume for P: ▪ 100% particulate organic P ▪ 87% soluble organic P
Summary	❑ Consent limit would be achieved. Note that with RI all treatment would be needed at plant	❑ Likely to meet consent limit. ❑ If not, dose with alum at the plant to offset ❑ RI assumes treatment at plant

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Infrastructure Requirements

Option	Irrigation Method	Total Head (m)	New Pumping Stations (No.)	New Transfer Main Length (m)	New Holding Pond (m^3)
A (4)	Fixed sprinkler	202	3	17,060	28,000
A (5)	Fixed sprinkler	195	3	17,060	40,000
B (4)	Fixed sprinkler	137	2	9,670	28,000
B (5)	Fixed sprinkler	133	2	9,670	40,000
B (4) Reuse	Fixed sprinkler	144	1	6,780	N/A
B (5) Reuse	Fixed sprinkler	152	1	6,780	N/A
B(4&5)	Rapid Infiltration	N/A Gravity	N/A	1,000	N/A
C (4)	Pivot	45	1	8,610	28,000
C (5)	Pivot	41	1	8,610	40,000

Summary (5mm/d application rate)

Note: Cost estimates include land acquisition and professional fees.

Option	Land Area (ha)	CAPEX ($M)	OPEX ($M)	NPV ($M)	Key Risks
A (4)	420	86.16	2.33	100.37	Geotechnically challenging.
A (5)	600	106.90	3.11	127.38	
B (4)	420	55.81	1.85	69.86	High no. of streams, hilly, complex irrigation arrangement.
B (5)	600	70.44	2.45	89.73	
C (4)	420	60.06	1.13	63.08	Sandy soils, proximity to Lake Rotorua, likely to have relatively high land value.
C (5)	600	77.83	1.42	80.96	


Additional Risks
Access to lay pipes – easements etc required
Scheme may need to cater for all flows (even dual discharge) as redundancy might be required when MBR is off line or if there are any issues with maintaining consent limits
Securing land for purchase
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Wastewater Strategy Study

Rotorua WWTP

Kevan Brian
Mott MacDonald

25 June 2015

Scope of Works

- Identify the most appropriate treatment process for the WWTP to meet future nutrient limits of 30tN/yr and 3tP/yr.
- Study based on identifying a treatment process that will meet the proposed nutrient limits without any assumption of using TERAX or not
- Compare to other processes/ plant to validate likely performance
- CAPEX, OPEX and NPV

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Project Drivers

- Ability to meet the mass discharge of 30tN/yr and 3tP/yr from the plant
- Requires an average total N of 3.5mg/L
- Requires an average total P of 0.35mgP/L in future
- No clear bio solids drivers – max dry solids and minimum volume assumed
- No disinfection standard but a likely requirement if final effluent is discharged to surface water – needs more investigation

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Option Selection – Phosphorus Removal

- Good nitrogen removal and biological phosphorus removal can be achieved in current plant(s)
- Additional Carbon dosing is double the cost of Alum

Conclusion use chemicals to remove phosphorus

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Option Selection – Filtration

- Bardenpho has high suspended solids in effluent (ave 23mg/L)
- These solids contain N & P – about 7%N and 2%P
- If current performance is maintained then effluent TSS represents 10tN/yr and 3.65tP/yr
- Removing solids is essential if targets are to be met
- Best filtration (most solids removed) is via membrane filtration – UF or similar

Conclusion filtration of final is essential to meet future limits – membranes will give highest TSS removal (smallest effective pore size)

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Option Selection – Nitrogen Removal

- Many ways to remove nitrogen including current type of process
- Nitrogen removal efficiency of approx 93% needed to met new limits
- Can a secondary process achieve this or is a tertiary system needed
- Can the required level of N removal be achieved without tertiary treatment (other than filtration)?

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Option Selection – Nitrogen Removal

- Water Research Foundation (WERF) study "Quantifying Nutrient Removal Technology Performance"
- Takes 22 of the best performing plants in US and compares N&P removal against, plant type and configuration

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Option Selection – Nitrogen Removal

Plant	Configuration	Median TN (mg/L)	N Removal
Piscataway, MD (79,000m3/d)	Activated sludge and Tertiary Filters	3.00	86%
Eastern WRF, FL (64,000m3/d)	Bardenpho and tertiary Filters	3.64	90%
Parkway, MD (21,600m3/d)	4 Stage Bardenpho	3.40	88%
Rotorua WWTP (23,600m3/d)	?	3.50	93%

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Option Selection – Nitrogen Removal

- Secondary can meet limits proposed, however:
  - Data presented by WERF is based on median (or 50% of the time) performance
  - If higher levels of confidence are required say 90th percentile (i.e 90% of samples are less than) then tertiary process essential
- Secondary process considered suitable for limits proposed (i.e. ave or median of 3.5mgN/L)

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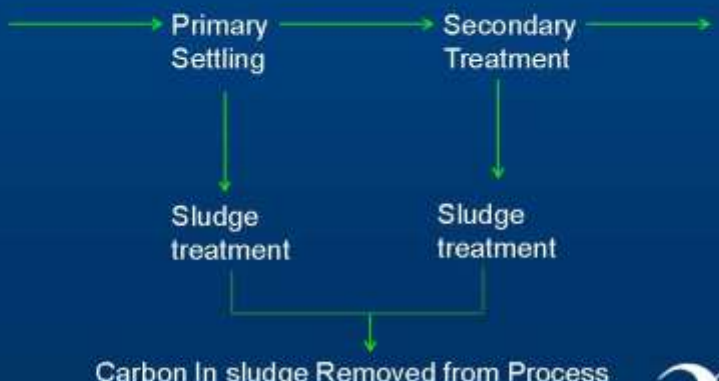
Option Selection – Carbon Balance



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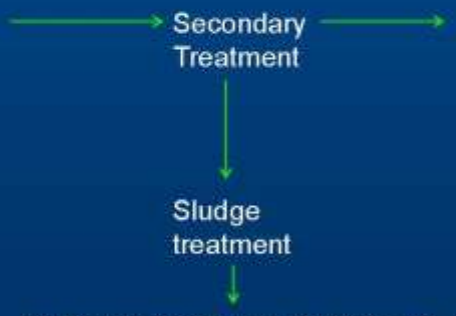
Option Selection – Carbon Balance



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Option Selection – Carbon Balance

- Potential to reduce ethanol use by 700L/d
- Reduce sludge production by 40%
- Consequence is that there are more solids in secondary reactor (Bardenpho)
- Unlikley that clarifiers will have sufficient capacity to handle increased flow and increased solids.

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Process Selection

- Given that:
  - Phosphorus removal is via chemical means
  - Filtration is essential
  - Single stage process can achieve standards
  - Can make better use of carbon but this would means clarifiers of Bardenpho over loaded
  - Disinfection likely to be required

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Process Selection – Full MBR

- Ideal Process is:
  - Bypass of primary tanks
  - Conversion of Bardenpho reactor to MBR and modify aeration
  - Dewater Biosolids and remove from site either as a "cake" or destroy solids via TERAX
- Standards for disinfection unknown but UF will remove bacteria

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Process Selection

- Performance of MBR (current) with respect to indicator organisms:
  - Median FC – 0FC/100mL
  - 95th % ile FC – 14FC/100mL
  - Median E. coli – 0/100mL
  - 95th % ile – 6/100mL

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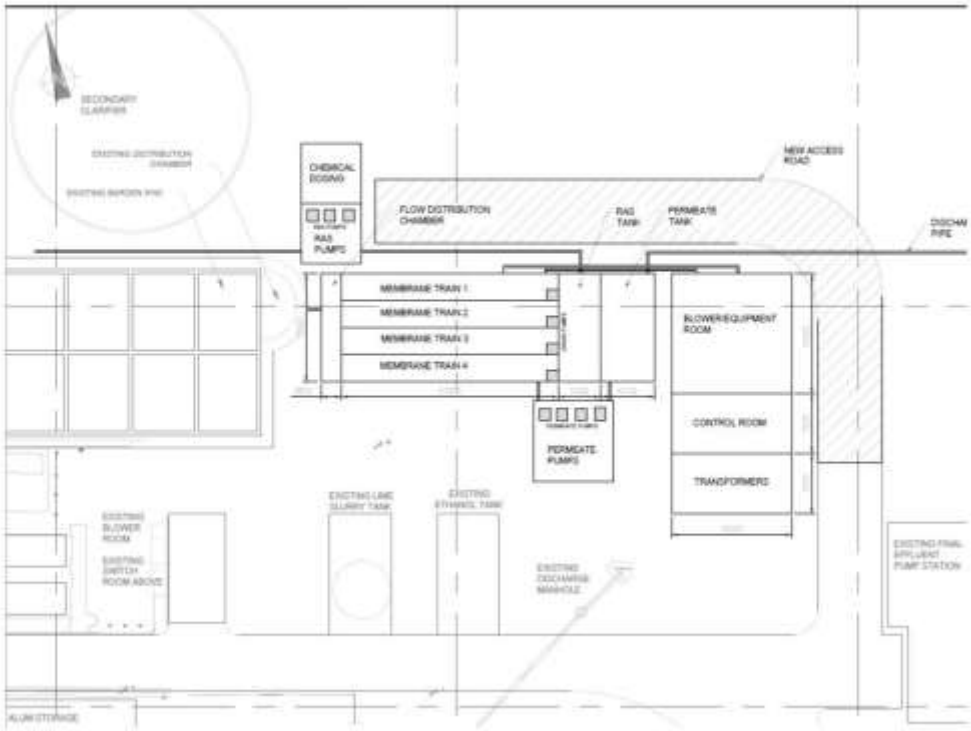

Costs

- CAPEX - $21 Million inclusive of dewatering and alum dosing
- CAPEX -$32.8 Million with non works costs and contingency

- Greg Manzano to present OPEX costs

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Overall Summary of Options

Option	Description	Flow	Treated Wastewater				CAPEX	OPEX/yr	NPV	Comments
			TP load estimate		TN load Estimate					
		(MLD)	(mg/l)	(ty^{-1})	(mg/l)	(ty^{-1})	($M)	($M)	($M)	
0	**Current WWTP Performance (2051 flows)**									
	Bardenpho (with TERAX)	16.5	3.40	20.49	6.23	37.54				
	MBR	7.3	1.90	5.06	3.68	9.81				
	Current performance @ 2051 flows:	23.8		25.55		47.35	-	-	-	
DISCHARGE TO WATER (Note: The TERAX liquor is included in the WWTP liquid stream. The cost of mitigation works to address the risks associated with TERAX process is not included in the original cost estimates (MMD December 2014 report).										
1	**Base option**									
	Bardenpho + Flow balancing + Alum dosing + UV treatment	16.5	1.00	6.03	6.23	37.54				˜ Additional phosphorous removal by alum dosing.
	MBR + Flow Balancing + Alum dosing + UV treatment	7.3	0.10	0.27	3.68	9.81				˜ Does not include any additional nitrogen removal.
		23.8		6.30		47.35	14.40	0.47	24.30	
2	**Base option + Basic Filtration**									
2A	Bardenpho + base option + Disc filters	16.5	0.49	2.95	5.39	32.48				˜ Minimal improvement in treated wastewater nitrogen.
	MBR + Base option	7.3	0.10	0.27	3.68	9.81				˜ Phosphorous levels approaching target limit.
		23.8		3.22		42.29	19.80	0.58	16.50	˜ Rrequires bypass or bigger and expensive filter units to properly manage peak flows.
2B	Bardenpho + base option + sand filters	16.5	0.24	1.45	5.04	30.37				˜ Sand filter could blind due to high solids. It has low output and regular backwashing required.
	MBR + Base option	7.3	0.10	0.27	3.68	9.81				˜ Minimal improvement on treated wastewater nitrogen.
		23.8		1.72		40.18	19.50	0.59	46.40	˜ Phosphorous levels below target limit.
2C	Bardenpho + base option + membrane filters	16.5	0.10	0.60	4.68	28.20				˜ Marginally improved nitrogen removal.
	MBR + Base option	7.3	0.10	0.27	3.68	9.81				˜ Phosphorous levels below target limit.
		23.8		0.87		38.01	22.30	0.65	50.60	˜ No reference plants that use tertiary UF in municipal applications in NZ
3	**Base option + Denitrifying Filtration**									
3A	Bardenpho + base option + denitrifying sand filters	16.5	0.24	1.45	2.74	16.51				˜ Additional carbon source assimilated to the denitrifying sand filter that could remove nitrogen to target limit.
	MBR + Base option + Denitrifying sand filters	7.3	0.10	0.27	2.38	6.34				˜ No reference sites in NZ
		23.8		1.72		22.85	22.00	0.72	51.60	
3B	Bardenpho + base option + Carbon beds	16.5	0.24	1.45	3.74	22.54				˜ No available application or data for carbon beds on using as polishing stage (1-2mgN/l), sizing and performance uncertain
	MBR + Base option + Carbon beds	7.3	0.10	0.27	3.38	9.01				˜ Carbon beds could risk leaching of colour, COD and nitrogen (shown in early stages of other trial sites).
		23.8		1.72		31.55	28.80	0.60	60.20	˜ Use of carbon beds have no track record similar to Rotorua WWTP scale (no reference sites). Will require a comprehensive trial to prove performance.

Overall Summary of Option continued…

DISCHARGE TO LAND & WATER (Alternative to current Whakarewarewa Forest LTS)

Option	Description	Flow	Treated Wastewater				CAPEX	OPEX/yr	NPV	Comments
			TP load estimate		TN load Estimate					
		(MLD)	(mg/l)	(ty^{-1})	(mg/l)	(ty^{-1})	($M)	($M)	($M)	
4	Bardenpho only (MBR discharge to water)	23.8								- P and N levels assumed to achieve to consent limits. - No proven work to confirm acceptability and sustainability of the 20mm/day application rate at this stage ion the project.
4A	Area A (17.06 km Northwest of WWTP along SH5)			3.00		30.00				- Steep slopes and volcanic mound formation in area A that could result to run-offs
	5mm/day loading rate	16.5	-	-	-	-	86.16	2.33	100.37	- Cultural acceptability, cost to land acquisition, difficult construction of transfer mains
	20mm/day loading rate	16.5	-	-	-	-	53.27	1.99	69.73	
4B	Area B (9.67 km Southwest of WWTP along SH30			3.00		30.00				- Cultural acceptability, availability and cost of land acquisition.
	5mm/day loading rate	16.5	-	-	-	-	55.81	1.83	69.86	- Archeological site constraints and buffers, stream buffer requirements.
	20mm/day loading rate	16.5	-	-	-	-	33.16	1.51	47.10	- Slope and run-off in Area B.
										- Difficulty in transfer mains construction.
4B-I	Area B but Partially utilising existing LTS Infrastructure			3.00		30.00				
	5mm/day loading rate	16.5	-	-	-	-	48.98	1.59	60.91	- Structural condition of existing transfer main.
	20mm/day loading rate	16.5	-	-	-	-	26.32	1.25	38.15	
4C	Area C (8.61 km Northeast of WWTP right side of SH30)			3.00		30.00				- Sandy soils, risk of leaching nutrients.
	5mm/day loading rate	16.5	-	-	-	-	60.06	1.13	63.08	- Zoning implications on suitability of land, availability and high cost of land acquisition.
	20mm/day loading rate	16.5	-	-	-	-	31.85	0.82	36.57	- Cultural acceptability, consenting issues, proximity to residential areas and to Lake Rotorua, archaeological sites.
4D	Bardenpho to exist. forest ponds + Rapid Infiltration (MBR discharge to water)	16.5	-	1.72	-	22.85	34.49	1.68	50.53	- Requires denitrifying sand filter at the WWTP in same configuration as Option 2C - Assumed result will be similar to Option 3A

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Overall Summary of Option continued…

DISCHARGE TO LAND (All flows)

Option	Description	Flow	Treated Wastewater				CAPEX	OPEX/yr	NPV	Comments
			TP load estimate		TN load Estimate					
		(MLD)	(mg/l)	(ty^{-1})	(mg/l)	(ty^{-1})	($M)	($M)	($M)	
5	Bardenpho + MBR (Total flow discharge to land)									* P and N levels for Options 5A to 5C assumed to achieve consent limits.
5A	Area A (17.06 km Northwest of WWTP along SH5)			3.00		30.00	106.90	3.11	127.38	
	5mm/day loading rate	23.8	-				59.91	2.62	83.62	
	20mm/day loading rate	23.8	-							
5B	Area B (9.67 km Southwest of WWTP along SH30			3.00		30.00				
	5mm/day loading rate	23.8	-				70.44	2.45	89.73	
	20mm/day loading rate	23.8	-				38.08	1.96	57.22	
5B-I	Area B but Partially utilising existng LT5 infrastructure			3.00		30.00				* Structural condition of existing transfer main.
	5mm/day loading rate	23.8	-				63.26	2.27	81.58	
	20mm/day loading rate	23.8	-				30.90	1.79	49.07	
5C	Area C (8.61 km Northeast of WWTP right side of SH30)			3.00		30.00				
	5mm/day loading rate	23.8	-				77.83	1.42	80.96	
	20mm/day loading rate	23.8	-				37.52	0.97	43.10	
5D	Bardenpho + MBR to existing forest ponds + Rapid infiltration (150mm/day application rate)	23.8	-	1.72	-	22.85	37.29	2.07	58.14	* Allowed for alum dosing, UV disinfection and denitrifying sand filter in the Treatment plant. * Assumed result will be similar to Option 5A

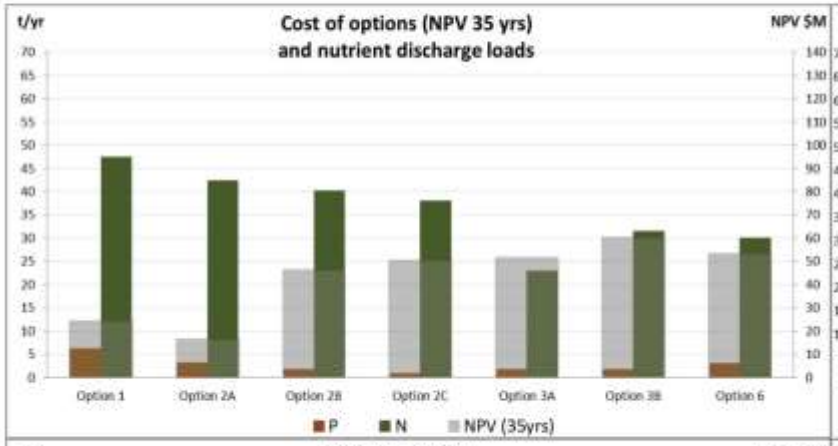
DISCHARGE TO WATER

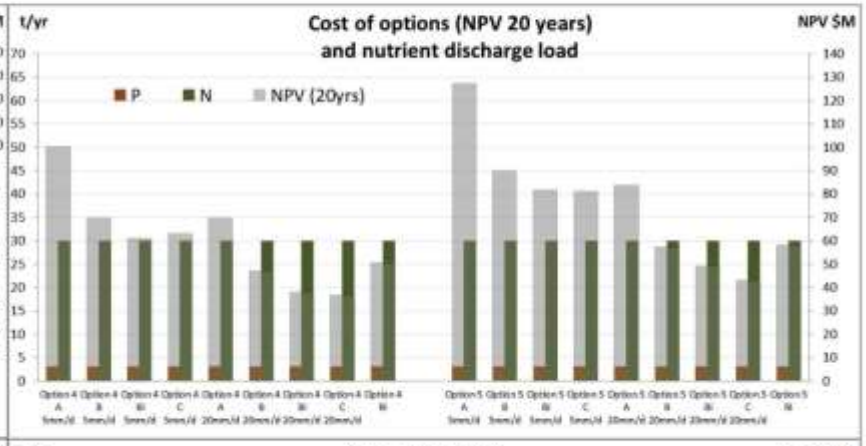
6	Full MBR	23.8	-	3.00	-	30.00	29.78	1.13	53.40	* Secondary clarifiers will be replaced with membrane filtration (MBR). Full MBR process could achieve target N and P consent limits.
										* Primary sedimentation tanks by passed and can be used for flow balancing.
										* Output of existing sidestream MBR reduced from 7 MLD to 5 MLD due to higher solids contents.
										* Headworks inlet screen improved from 3mm to 2mm screens.
										* Sludge dewatering process replaced with centrifuges (currently belt press).

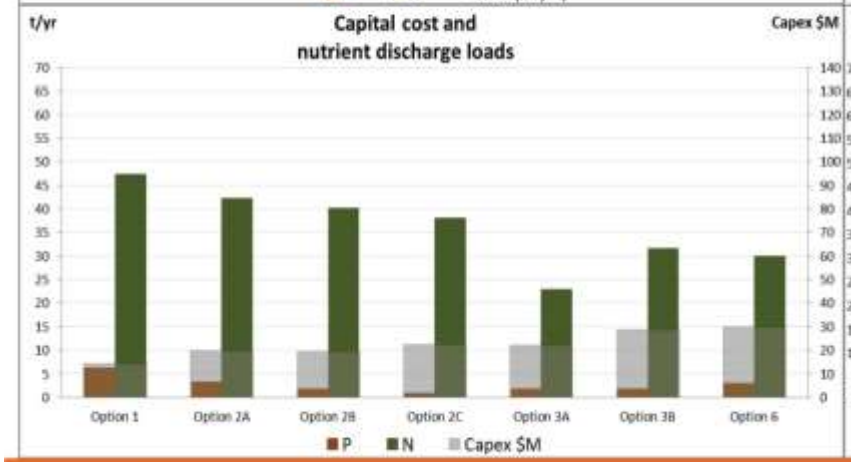
Notes: *1. The CAPEX, OPEX and NPV costings for Options 1, 2, and 3 will be adjusted to include cost of risk mitigation associated with the TERAS process as noted above. Steven Brion will provide an updated cost summary for these.*

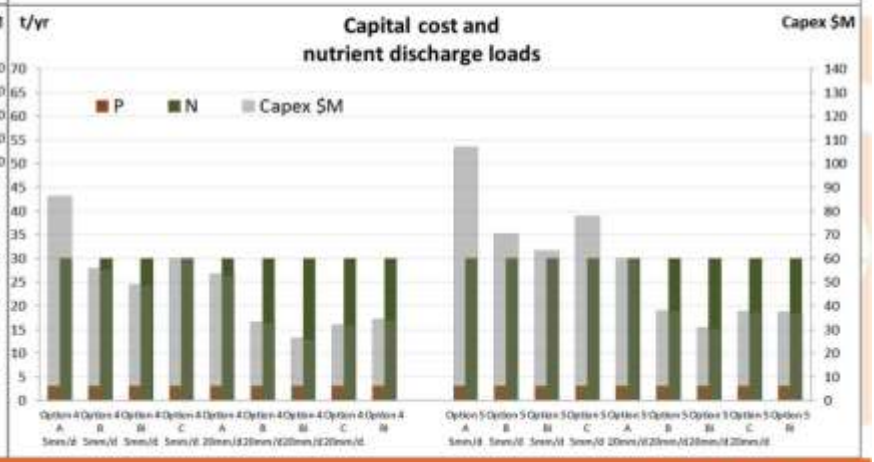
2. NPV (Net Present Value) for Options 1, 2, 3 & 6 are 25-year NPV, Options 4 and 5 are calculated based on a 20-year period.

Comparing the cost and nutrient discharge of the options









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