Rotorua Project Steering Committee (RPSC)

Meeting Tuesday 17 September 2014

Today's topics

- Project schematic
- TAG update
- Professional Services Contract 1- Wastewater feasibility options
- Professional Services Contract 2- Discharge location and effects study
- Options, Effects and Comparisons Table (template)
- NPS Freshwater snapshot
- Wetland Types – examples

Discussion - Further Actions?

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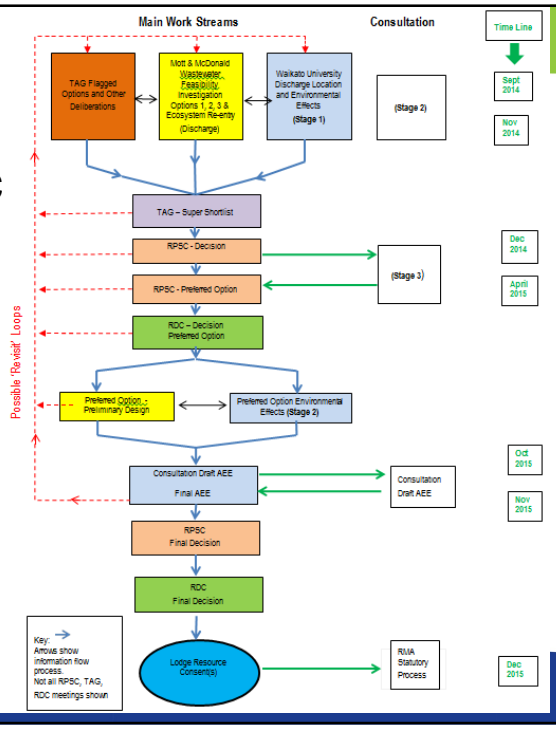
Project Schematic



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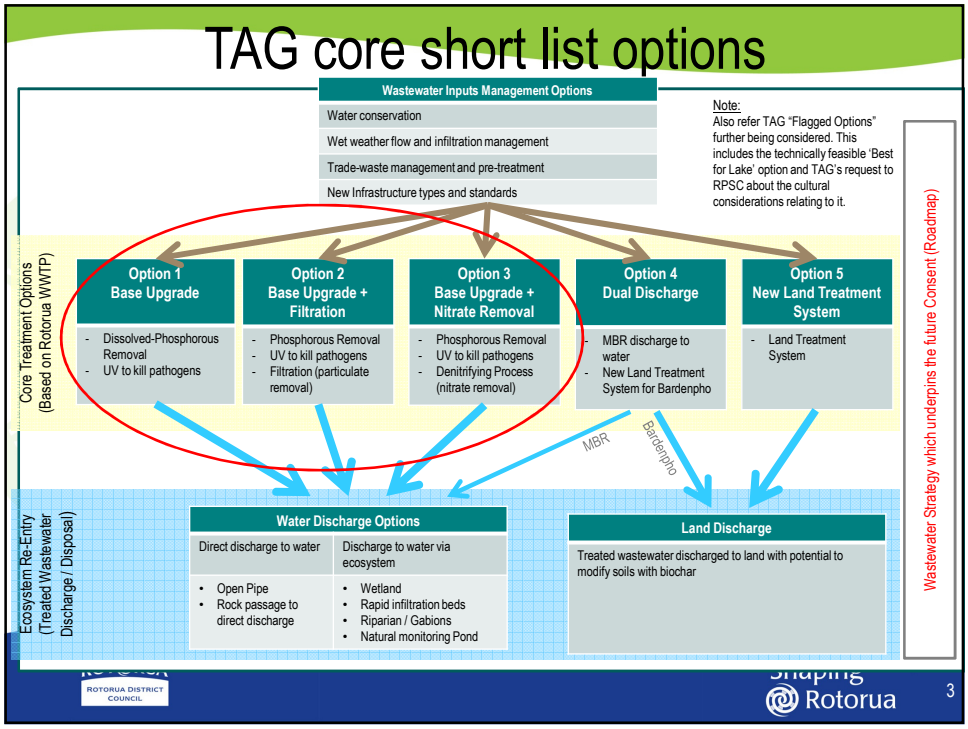
TAG core short list options



TAG update

- TAG met Fri 12 Sept
- Dealing with 20 activities on 'action list'
- Key focus is ecosystem re-entry – Location and Effects Study in 2 stages. RDC is engaging Prof David Hamilton and Chris McBride
- Questions from RPSC Chair: will predominantly be addressed by 'Location and Effects Study'; some interim answers follow
- Updating Project Glossary
- Other possible "add-ons" (previously called "flagged options"):
  - update from Indigitech (follows)
  - Activated Carbon (possible update by Gina Mohi)
  - no update received from 'Advanced Purification Systems'

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Indigitech update

Date # Response provided to initial set of questions (handout)

16/9/14 response:

- "Apologies for the late reply -- I have been away and recently returned from overseas. Thank you for your continued interest in our technology.
- We have significant international interest in our other technologies and this is occupying our full time and attention -- much more than we bargained on 2. Due to our workload, we have had to shift a couple of projects (including the building of the water filtering system) into early next year
- The water technology is still a high priority for us and we will be going ahead with building a system suitable for Councils and others to test as soon as we can. It's just that demand for our technologies is outstripping our ability to cover them all.
- So we are looking at early next year to revisit the waste water filtering project. I have let Wally and Peter know our position as well and will keep them updated.

Regards, Victor Main, Eight Associates Ltd, Auckland

Professional Services Contract 1 Detailed Feasibility Investigation

- Mott MacDonald engaged and actively working
  - WWTP process modelling underway (options 1-3)
  - Initial concepts for ecosystem re-entry submitted (next slides)
- They report to RDC Project Mgr Greg weekly
- On track for Nov 2014 delivery
  - initial draft report to Project Manager
  - Workshop with TAG

Ecosystem re-entry concepts being investigated by Mott MacDonald

Water Discharge Options	
Direct discharge to water	Discharge to water via ecosystem
• Open Pipe • Rock passage to direct discharge	• Wetland • Rapid infiltration beds • Riparian / Gabions • Natural monitoring Pond

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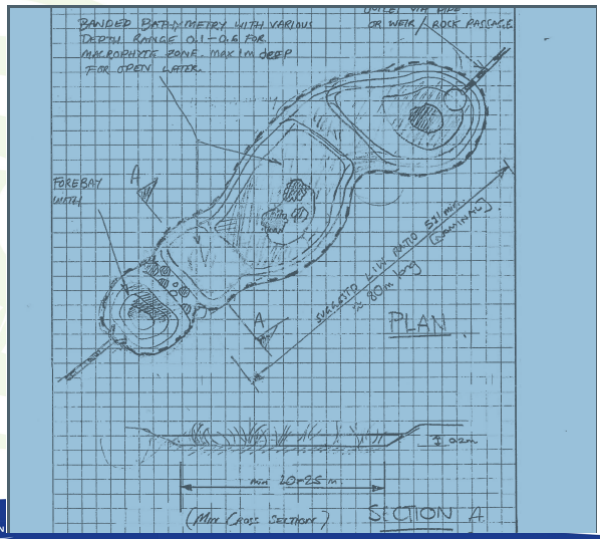
Wetlands



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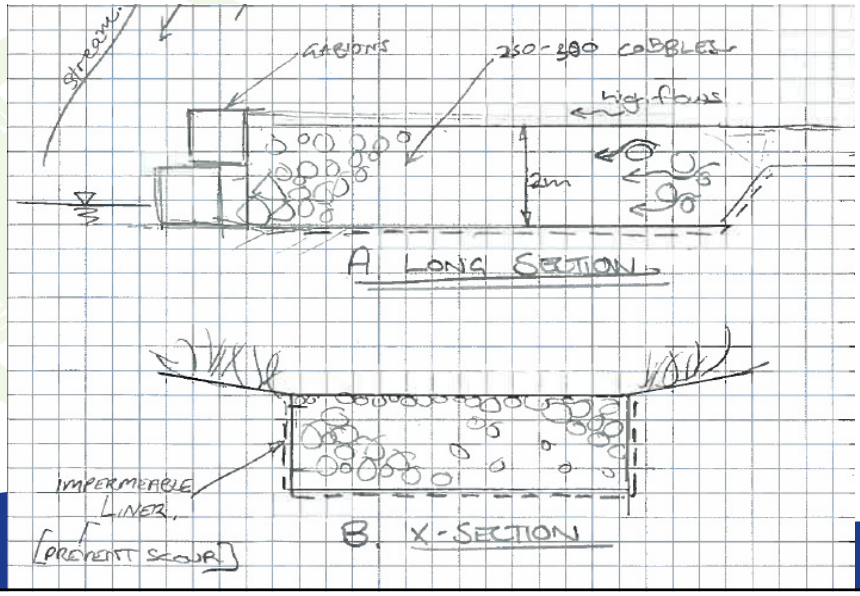
Rock Passage - Gabions



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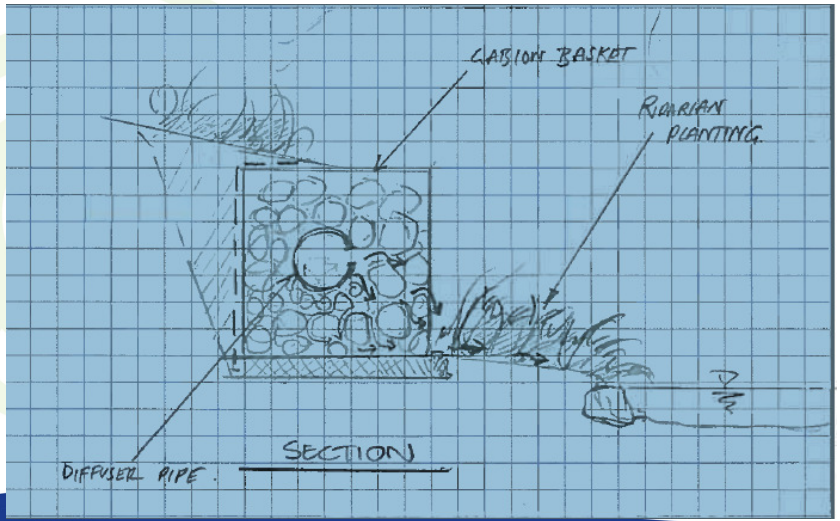
Gabions



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Professional Services Contract 2
Discharge Location and Effects Study

- RDC is engaging Prof David Hamilton & Chris MrBride
- Next slides directly from David

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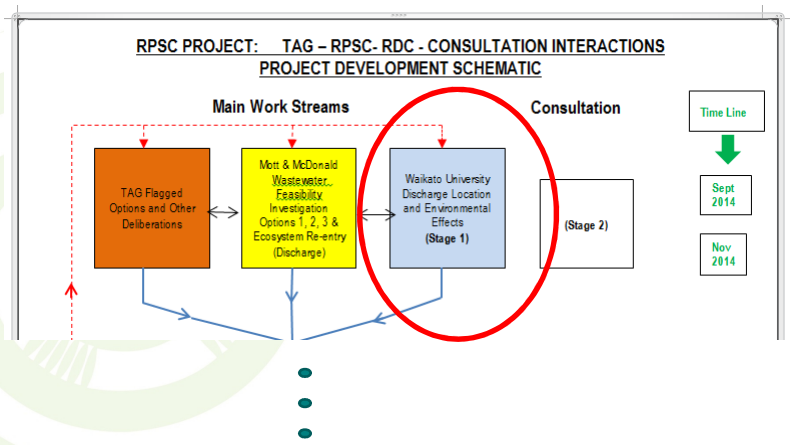
THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

RPSC: WWTP Discharge Options

David Hamilton and Chris McBride

Environmental Effects Study – Ecosystem re-entry



Spreadsheet to evaluate options….

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I consider the spreadsheet below (developed by CM) should be used as a starting point to address the complexity of options pre, intra and post WWTP treatment and to define discharge quality

Action	Include?	Flow	DRP	Part-P	TP (load)	NH4	NO3	Org-N	TN (load)
		$m^3 d^{-1}$	$g m^{-3}$	$g m^{-3}$	$t y^{-1}$	$g m^{-3}$	$g m^{-3}$	$g m^{-3}$	$t y^{-1}$
Pre-treatment									
Business as usual		23800	3.6	2.5	53.0	30.0	0.0	20.0	434.6
Water metering	n	23800	3.6	2.5	53.0	30.0	0.0	20.0	434.6
Phosphate free dishwashing	n	23800	3.6	2.5	53.0	30.0	0.0	20.0	434.6
Reduced infiltration	n	23800	3.6	2.5	53.0	30.0	0.0	20.0	434.6
Treatment									
Bardenpho		15600	2.50	0.80	18.80	0.50	3.10	2.60	35.33
MBR		8200	1.70	0.00	5.09	1.00	2.00	1.00	11.98
Sub-total (existing treatment)		23800	2.22	0.52	23.89	0.67	2.72	2.05	47.31
Bardenpho+FB + Terax +UV		15600	0.20	0.60	4.56	0.50	2.80	3.00	35.90
MBR+FB+UV		8200	1.70	0.00	5.09	1.00	2.00	1.00	11.98
Sub-total (minimum upgrade)		23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
+Alum	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
+Filtration (Disc)	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
+Denitrifying filter	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
+Carbon bed	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
+Third party e.g. Indigitech	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
End-of-treatment		23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
Disposal (concentrations and loads to lake)									
Direct to lake	y	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
Out of catchment	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
Lake via wetland	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
Deep re-injection	n	0	0.72	0.39	0.00	0.67	2.52	2.31	0.00
New LTS	n	23800	0.72	0.39	9.65	0.67	2.52	2.31	47.88
Load-to-Lake ($t y^{-1}$)		23800	6.23	3.42	9.65	5.84	21.94	20.09	47.88

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Environmental Effects Study – Ecosystem re-entry

1) Lower Puarenga – requires detailed mass balance and assimilative studies of Puarenga Stream. Needs to follow through to effects on Rotorua (1-D model)

2) Direct to Lake Rotorua – requires 3D modelling to map transport locations from outfall (including diffuse shoreline discharge and in-lake diffuser) and 1D modelling to simulate long-term effects of changes in nutrient load from WWTP

3) Upper Kaituna – requires detailed mass balance and assimilative studies of Kaituna River. ***If*** these studies indicate that this option is feasible then requires modelling of ecological effects on Kaituna River and Maketu estuary will be required.

Notes:

1. **We are embarking on a multi-million dollar investment and need to support this with state of the art models to develop a high level of confidence in the outcomes. A similar case study of Kaituna diversion/Maketu estuary has taken many months. While the models are already in use, there is a need to tailor input data and make many model runs. Time frames for such a detailed environmental effects study must be realistic.**
2. **It is not clear at this point whether information on discharge quality will be supplied for the environmental effects study or whether it will be embedded in it.**
3. **Cultural and economic effects need to be run alongside this study.**

Questions posed by RPSC

A brief response from David and Chris – all will be covered further in the location and effects study

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Action #14: Receiving environment quality (Lake/River) standards and guidelines matched against WWTP effluent now and option 1, 2 and 3 effluent for a range of water quality, contaminants and ecological indicators e.g. QMCI Chlorophyll a – incorporates output from action 13 – Life Supporting Capacity criteria

Table 1 (WW)

WHAT IF DIRECT DISCHARGE TO LOWER PUARENGA STREAM?							
			Flow (litres per day)		TN mg/l	TN (kg/day)	TN (tonnes per yr)
Puarenga Stream					1.136?		
Mean flow	2.03 m^3/sec	=	175.392 x 10^6 litres/day	x	1.150	201.701	73.621
Remove LTS	minimal flow change?		AL est. @ 28tN/yr		*less*	76.712	**28.000**
Resultant flow	what resultant flow?		175.392 x 10^6 litres/day	x	0.713	124.988	45.621
WWTP Discharge	minimal flow increase?				5.205	104.110	**38.000**
Combined Puarenga + WWTP discharge			195 x 10^6 litres/day	x	1.175	229.098	83.621
	If flow unchanged		*175.392 x 10^6 litres/day*		*1.306*		

Hysteresis on LTS, i.e. legacy loads combined with direct discharge loads?

Notes (DH/CM): WW assumes LTS load removal takes effect immediately. However, the load reductions will likely take several years to take effect. In the meantime, the combination of LTS legacy load and direct discharge to Puarenga could potentially push Puarenga towards chronic toxicity (NNN-N > 1.7, NIWA guidelines), at least in first years of operation, and particularly over periods of low rainfall.

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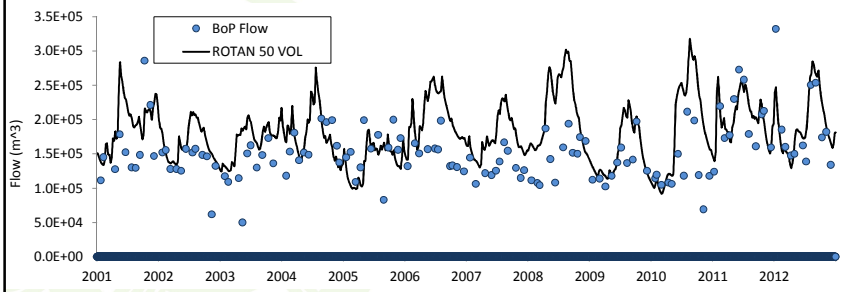
WW: how does this compare to ROTAN?

DH/CM: Example - ROTAN performs relatively well estimating flow for Puarenga but tends to over-estimate levels of total nitrogen



Notes:

- Flow refers to daily values, i.e. cubic metres of discharge in one day.
- Several wet periods in the last 5 years or so. Average Puarenga flow 2001 to 2012 is slightly lower, equivalent to 1.7 m^3/s.
- Monitoring (dots) is strongly biased to 'base flow' as monitoring is carried out predominantly under dry-weather conditions (i.e. monitored points will be more likely to be lower than modelled values represented by the line).

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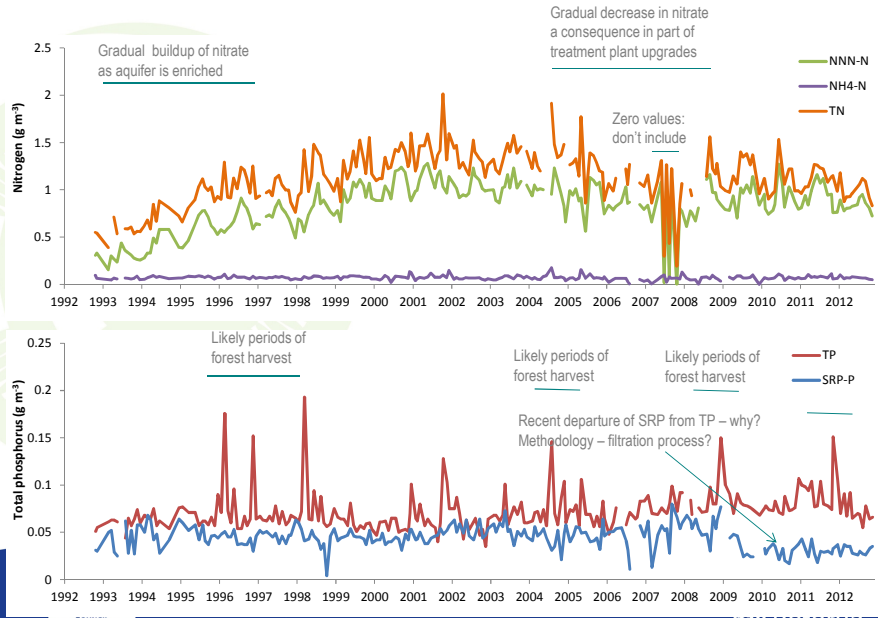
Historical N and P in Puarenga



Consideration of direct discharge to Lake Rotorua

WHAT IF DIRECT DISCHARGE TO LAKE ROTORUA?					
		Volume (litres)	TN mg/l		TN (tonnes) in water column
Lake Rotorua	At median level 279.8m				
	762.79 m^3 x 10^6	762.79 x 10^9	0.425		324.186
Remove LTS			5.205	*less*	**28.000**
Lake Rotorua less LTS			0.388		296.186
Add direct discharge ex WWTP (with nil attenuation)			5.205	*plus*	**38.000**
			with 10tTN increment		
Combined Lake Rotorua *less* LTS *plus* WWTP discharge			0.438		334.186
		Worst-case scenarion cos assumes nil attenuation			
		[With attenuation & 30tTN increment DH estimates 0.445]			

Notes:

- Surface water TN is ~0.320 g m^{-3} for 2009 – 2012, i.e. 25 % lower than figure given above.
- The above calculations do not consider retention and will therefore be in error by c. 50% or more.
- Estimated load to Rotorua is about 650 t yr^{-1} and current TN is 0.320 g m^{-3}.
- Assuming no internal load (in the case of alum all but eliminating internal load), retention coefficient will be c. 0.75 per annum.
- Addition load of 40 t yr^{-1} represents an increase of c. 6%, and we might expect to see an increase in lake TN concentration of c. 20 mg m^{-3} (0.02 g m^{-3}), to annual mean of 0.34 g m^{-3}. With the LTS removed, (net gain 10 t yr^{-1}), we might only get a c. 1.5 % increase, yielding TN of 0.325 g m^{-3}.

Effects, Comparisons with Statutory Requirements & Guidelines

for each of the various option, discharge locations and methods

→ Options, Approaches Effects Contaminants Lakes and Rivers – (Initial Draft List)	WWTP Discharge	OPTIONS			RECEIVING ENVIRONMANT (EFFECTS STUDY)		STATUTORY REQUIREMENTS & GUIDELINES				NOTES
	Now	1	2	3	Existing	Option 1, 2, 3	NPS Freshwater Mgt 2014	RPS	Regional and District Plans	ANZECC Guidelines 2000	
Total N – Ecosystem Health Total P – Ecosystem Health DRP - Ecosystem Health Phytoplankton – Ecosystem Health Periphyton - Ecosystem Health Q.M.C.I – Ecosystem Health Dissolved Oxygen – Ecosystem Health $cBOD_5$, Clarity - Ecosystem Health and Human Health Recreation Ammonia – Toxicity Nitrate – Toxicity E coli – Human Health for Recreation Cyanabacteria – Human Health for Recreation Suspended Solids – Ecosystem Health & Human Health for Recreation Life-Supporting Capacity based on? Other (TBA)											

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Decision drivers and tools

KEY DECISION DRIVERS for PROJECT (in place):
RPSC Goals; TAG Minimum Requirements; RDC's Values, Goals and Commitments

TOOLS that TAG will use to assist in decision-making (and for RPSCs consideration):

- MauriOmeter (see slides/handout provided from Dr Kepa Morgan)
- Effects Studies
- Best Practicable Option (BPO)
- NPV (life cycle cost)
- Multi Criteria Analysis (MCA)
- Cultural Health Indexing?
- Applicable consultation/feedback
- other?

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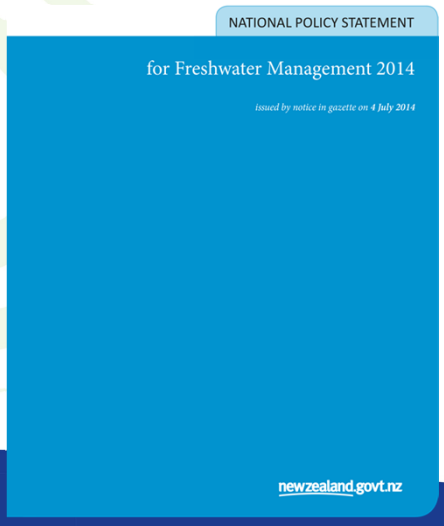
National Policy Statement for Freshwater 2014 (NPS)



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NPS: A Snapshot for RPSC

- National water quality objectives
- Tāngata whenua roles and interests – objective
- National values and uses for fresh water
- Lists attributes & provides values (examples follow)

RMA S104 states "Resource Consent shall have regard to …. NPS"

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A. Water Quality

Objective A1

To safeguard:

a) The life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of fresh water; and

b) The health of people and communities, at least as affected by secondary contact with fresh water;

In sustainably managing the use and development of land, and of discharges of contaminants.

Objective A2

The overall quality of fresh water within a region in maintained or improved while:

a) Protecting the significant values of outstanding freshwater bodies;

b) Protecting the significant values of wetlands; and

c) Improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated

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D. Tāngata whenua roles and interests

Objective D1

To provide for the involvement of iwi and hapu, and to ensure that tāngata whenua values and interests are identified and reflected in the management of fresh water including associated ecosystems, and decision-making regarding freshwater planning, including on how all other objectives of this national policy statement are given effect to.

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Appendix 1: National values and uses for fresh water

Compulsory National Values

- Te Hauora o te Wai / the health and mauri of water
- Te Hauora o te Tangata / the health and mauri of the people

Additional National Values

- Te Hauora o te Taiao / the health and mauri of the environment
- Mahinga kai / food gathering, places of food
- Wai tapu / sacred waters

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Value	Ecosystem health		
Freshwater Body Type	Lakes		
Attribute	Total Nitrogen (Trophic state)		
Attribute Unit	mg/m³ (milligrams per cubic metre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	Annual Median	Annual Median	
	Seasonally Stratified and Brackish*	Polymictic	
A	≤160	≤300	Lake ecological communities are healthy and resilient, similar to natural reference conditions.
B	>160 and ≤350	>300 and ≤500	Lake ecological communities are slightly impacted by additional algal and plant growth arising from nutrients levels that are elevated above natural reference conditions.
C	>350 and ≤750	>500 and ≤800	Lake ecological communities are moderately impacted by additional algal and plant growth arising from nutrients levels that are elevated well above natural reference conditions
National Bottom Line	**750**	**800**	
D	>750	>800	Lake ecological communities have undergone or are at high risk of a regime shift to a persistent, degraded state, due to impacts of elevated nutrients leading to excessive algal and/or plant growth, as well as from losing oxygen in bottom waters of deep lakes.

* Intermittently closing and opening lagoons (ICOLs) are not included in brackish lakes.

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Value	Human health for recreation		
Freshwater Body Type	Lakes and rivers		
Attribute	*E. coli**		
Attribute Unit	*E. coli*/100 mL (number of *E. coli* per hundred millilitres)		
Attribute State	**Numeric Attribute State**	**Sampling Statistic**	**Narrative Attribute State**
A	≤260	Annual median	People are exposed to a very low risk of infection (less than 0.1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating)
		95th percentile	People are exposed to a low risk of infection (up to 1% risk) when undertaking activities likely to involve full immersion.
B	>260 and ≤540	Annual median	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95th percentile	People are exposed to a moderate risk of infection (less than 5% risk) when undertaking activities likely to involve full immersion. 540 / 100ml is the **minimum acceptable state** for activities likely to involve full immersion.
C	>540 and ≤1000	Annual median	People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating). People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities likely to involve immersion.
National Bottom Line	1000	Annual median	
D	>1000	Annual median	People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).

*Escherichia coli

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Wetlands

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Ecosystem Re-entry

Role of Wetlands – Types – "Some Confusion"

- Term "Wetlands" rather generic in use
- A number of different types – terminology not well defined
- Important to know:
  - What is your objective and what function do you want from a wetland
  - The type of wetland
  - What it achieves and does not
  - Costs and risk factors

- Types of Wetlands:
  - Engineered
  - Wetland ponds (monitoring – re-entry)
  - Visual/wildlife
  - Cultural
  - Other?

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Engineered Wetlands

- Engineered Wetland – close planted - Far North, Ruakaka, St Arnaud, Taumaranui and others. Also subsurface wetland designs.

- Floating Wetland - Approximately 9? in NZ at present for wastewater ponds

Undertakes some treatment function for solids (algae, fine solids), BOD, nutrients, micro-organisms but seasonal variation. Generally associated with low tech treatment plants

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Wetland Pond

short detention time to re-introduce treated wastewater to nature – little treated wastewater quality change – can be some improvement and/or some deterioration depending on the contaminant in question.

Wetland pond showing land (gravel/rock) passage into the pond (Palmerston North)

Bankside rock diffuser discharge into Manawatu River (Palmerston North)

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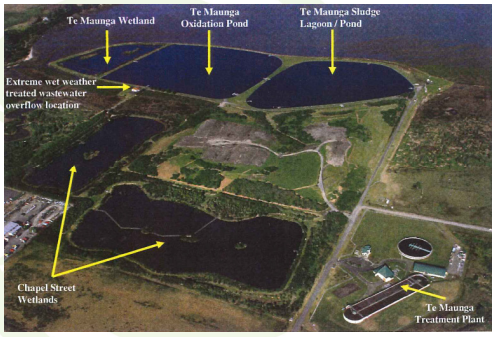
Wetlands for Wildlife – Aesthetic – Cultural purposes

Te Maunga, Tauranga (as visited on RPSC/RRSSC hikoi)



Wetlands – natural process variable water quality seasonal changes and bird contamination

With variable detention periods and greater open water clarity/suspended solids and bird contamination – very seasonal – can be very green algae-laden during summer periods.

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for Wildlife – Asthetic – Cultural purposes cont…

Cambridge – to be decommissioned

Te Puke (as visited on hikoi) natural – but deteriorates the microbiological quality

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Ecosystem re-entry options

Others being investigated include:

Rapid Infiltration Beds - Cambridge

Diffuse discharge through gabion baskets - Tokoroa, river discharge – refer also Te Puke from hikoi)

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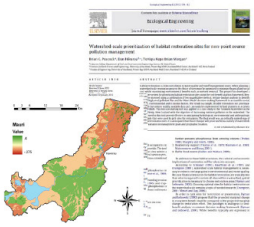
Discussion – Further Actions?

Slides provided by Dr Kepa Morgan

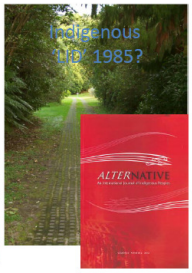
Mauri Model

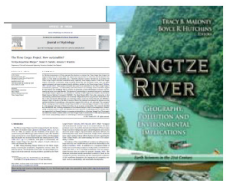


First published 2004

2009 Post Graduate Engineering course

- *Used widely*
- *30+ students 2014*
- *Cawthron Institute recommendation*





www.mauriOmeter.com

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Mauri Model Process

- Choose indicators for each dimension
- Evaluate indicators using mauriOmeter
- Calculate dimension averages and overall
- Apply worldview quantification for sensitivity analysis
- Quantify cumulative impact over time for various options being considered
- Verify results with stakeholders

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Ecosystem Mauri (Environmental) Indicators - *Kaitiakitanga*

1. Concentrations of contaminants in water column
2. Non-point source (sediment) contamination to water
3. Surface borne debris in water bodies
4. Ground water quality - contaminant discharges
5. Ground water recharge – spring & stream baseflows
6. Wetlands, springs, streams, estuaries, harbours
7. Threatened species habitat and reproductive capacity
8. Habitat Integrity - Algal blooms, Noxious weeds, Invasive species,
9. Catchment Resilience - Removal of contaminants
10. Contaminant concentrations in wetland, stream, river, esturine sediments

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Iwi & Hapū Mauri (Cultural) Indicator - *Tino Rangatiratanga*

1. Kawa - Respects Tapu associated with specific sites
2. Tikanga - Maintains relationships with others
3. Whakatipuranga - Manages the Mauri of waters to facilitate future generations needs/practices
4. Wāhi tapu- capacity of places to support traditional practices retaining integrity of purpose
5. Taonga – resource suitability for traditional use
6. Manākitanga - suitability for cultural harvest
7. Rangatiratanga - Treaty Principles recognition
8. Kaitiakitanga - traditional roles acknowledged
9. Orangatanga - mauri of water is mauri of people
10. Wairuatanga -

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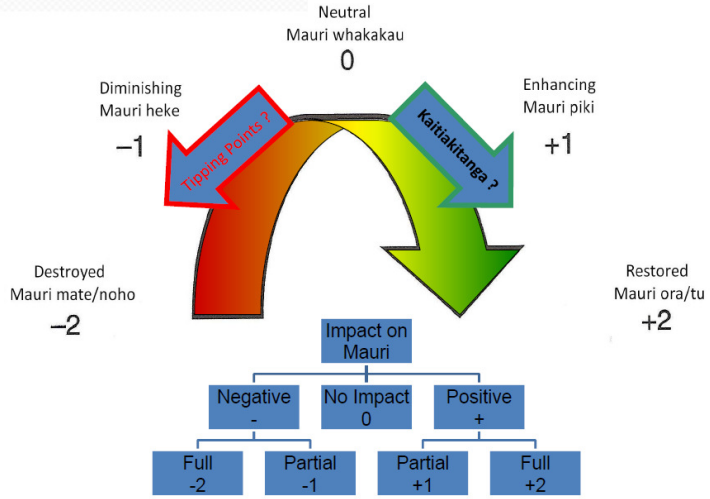
Hapori Mauri (Social) Indicators - *Manakitanga*

1. Water quality suitable for potable use (consumption)
2. Water quality suitable safe accidental consumption
3. Water quality suitable for water contact recreation
4. Water quality suitable for safe food gathering
5. Air quality free of odour from pollutants (PAHs)
6. Public safety – reduction of flooding risk
7. Public Health – reduction wastewater overflows
8. Aesthetics – visual amenity of waterways
9. Aesthetics – visual amenity of river banks / beaches
10. Biodiversity resilience in water bodies

Whanau Mauri (Economic) Indicators - *Orangatanga*

1. Water treatment costs – capital expenditure
2. Water treatment costs – operational expenditure
3. Retrofit / replacement cost - capital expenditure
4. Retrofit / replacement cost - operational expenditure
5. Call out cost – non-scheduled maintenance
6. Clean-up cost – return period failure event
7. Long-term Economic Impact - Insurance implications
8. Land requirement – opportunity cost
9. Land requirement – availability cost
10. Land requirement – maintenance cost

mauri meter trend assessment



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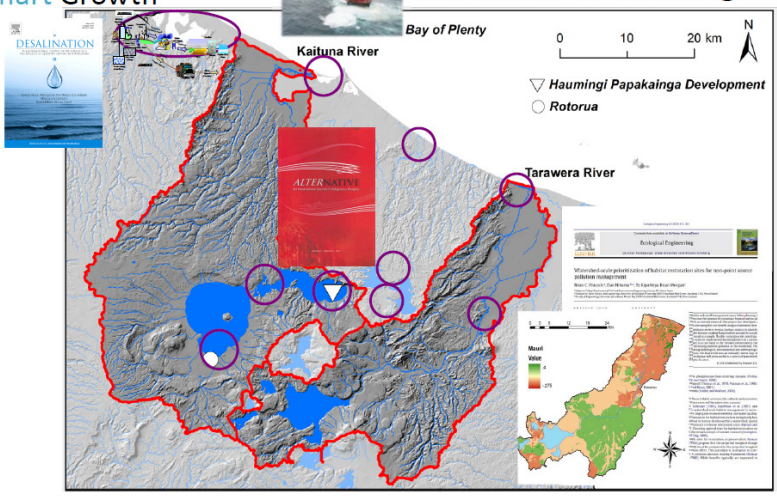
Mauri Model Assessments in Bay of Plenty

Smart Growth

MV Rena Grounding



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Otautahi
Mahia
Tuai
Waikato
Kopua
Huntly
Otaiti
Wastewater
Omapere
Ngawha
Ahipara
Karikari
National Reach of Mauri Model Assessments
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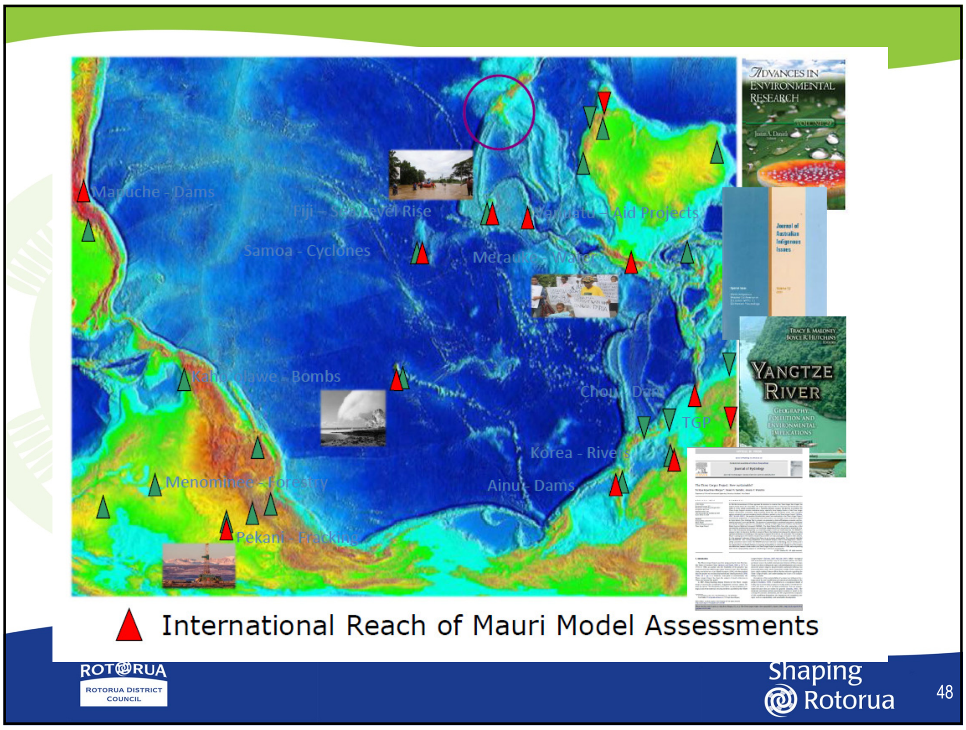
Advances in Environmental Research
Samoa - Cyclones
Yangtze River
Korea - River
Ainu - Dams
Menominee - Forestry
International Reach of Mauri Model Assessments
Rotorua
Rotorua District Council
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