RPSC Technical Workshop - 9am Thursday 25th June 2015

TOPICS

The following three Final Draft Mott MacDonald Reports will be presented by Kevan Brian.

1. **Alternative Land Treatment Investigations – Revision four: June 2015**
2. **Supplementary Report – Alternative Land Treatment Sites – Report Version 2: June 2015**
3. **Wastewater Strategy - Version Three: June 2015.** This develops an new Option 6 being a full MBR Treatment Plant

- These Reports in earlier draft form have been presented to and discussed by TAG and TAG comments incorporated into these final Drafts
- These Reports in terms of their scope and output meet RLC's consulting engagement with Mott MacDonald

4. **Technical and cost comparison of the six Options as they currently stand**

   led by Greg Manzano

RPSC Technical Workshop - 9am Thursday 25th June 2015

Go to Kevan Brian/Mott MacDonald's slides on the three reports which Kevan will present.

Separate file does not necessarily need to be inserted in this one.

TAG Core Short List Options - 1-5 Previously Adopted by RPSC

Note:
Also refer TAG "Add-on's" further being considered. This includes the technically feasible 'Best for Lake' option and TAG's request to RPSC about the cultural considerations relating to it.

Wastewater Inputs Management Options

- Water conservation
- Wet weather flow and infiltration management
- Trade-waste management and pre-treatment
- New Infrastructure types and standards

Core Treatment Options (Based on Rotorua WWTP)

Option 1 – Base Upgrade
- Phosphorous Removal
- UV to kill pathogens

Option 2 – Base Upgrade + Filtration
- Phosphorous Removal
- UV to kill pathogens
- Filtration (particulate removal)

Option 3 – Base Upgrade + Nitrate Removal
- Phosphorous Removal
- UV to kill pathogens
- Denitrifying Process (nitrate removal)

Option 6 – Full MBR Treatment Plant
- Phosphorous Removal
- Filtration (particulate removal)
- Nitrogen removal
- Membrane for Pathogens

Option 4 – Dual Discharge
- MBR discharge to water
- New Land Treatment System for Bardenpho

Option 5 – New Land Treatment System
- Land Treatment System

MBR

Bardenpho

Ecosystem Re-Entry (Treated Wastewater Discharge / Disposal)

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

Discharge Location Options to - Puarenga Stream, Lake Rotorua shoreline or lake bed

Land Discharge

Treated wastewater discharged to land with potential to modify soils with biochar

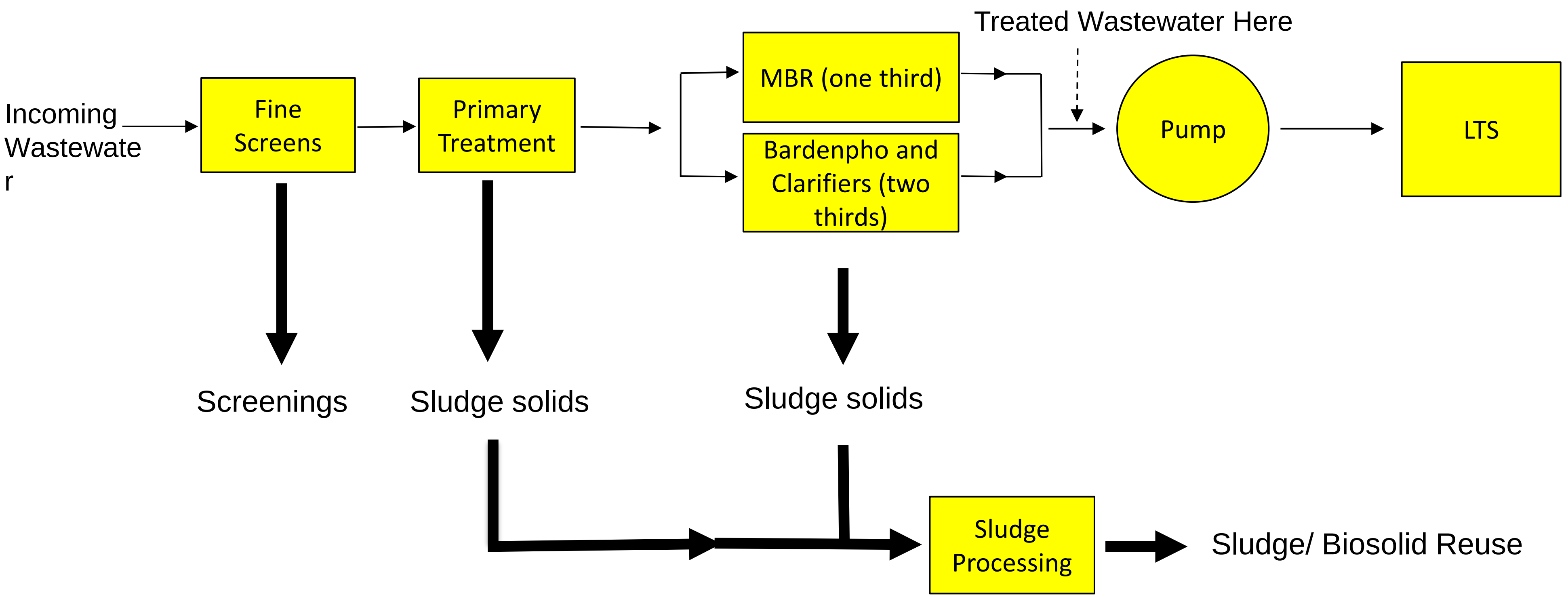
Wastewater Strategy which underpins the future Consent (Roadmap)

Graphic updated 23 June 2015

How do the shortlisted options fit together?

Starting Point

The Existing Wastewater Treatment Plant (WWTP) and Land Treatment System (LTS) Simplified

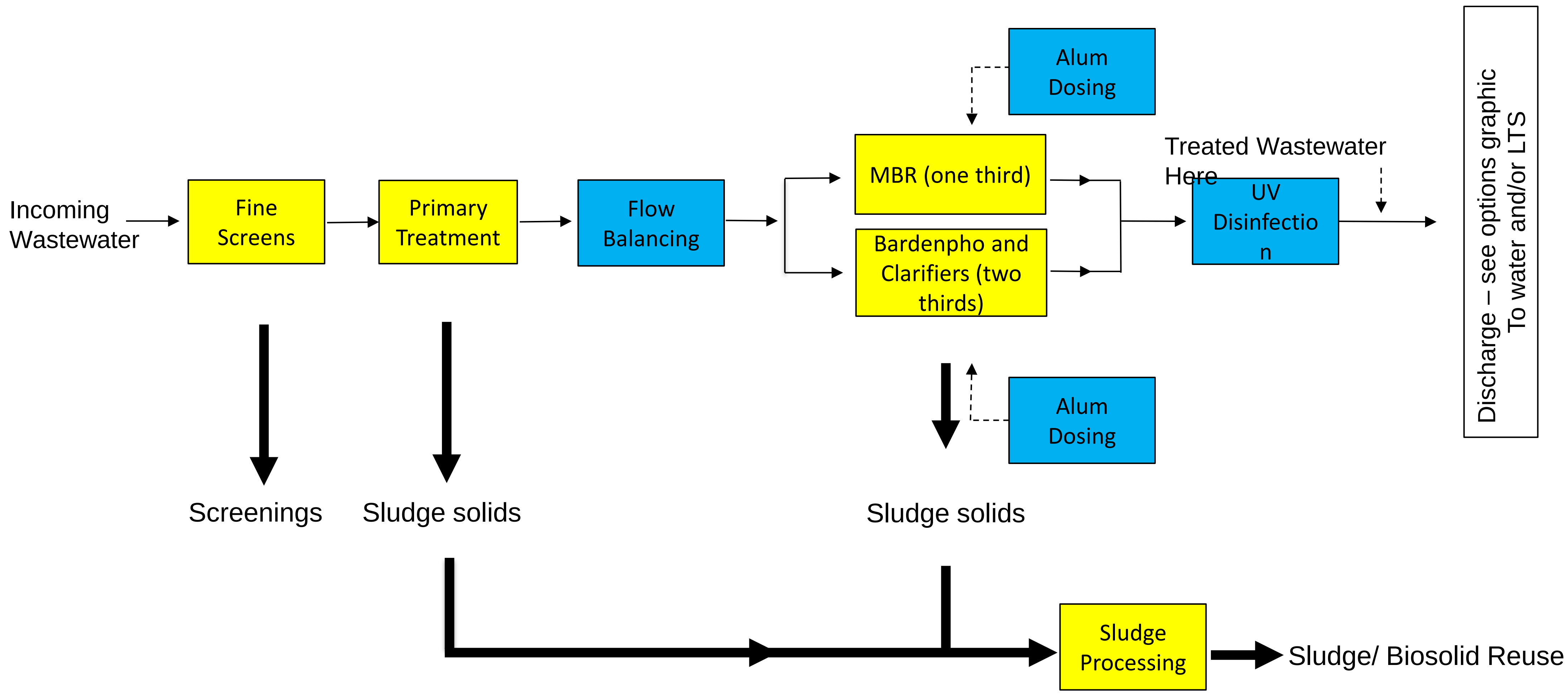


Key: Existing Process Base Case New Processes Option 2 Addition to Base Case Option 3 Addition to Base Case

Option 1 - The Base Case

Add in

- Flow Balancing
- Alum dosing for phosphorus removal
- UV disinfection to kill pathogens (germs)
- New discharge to water and/or LTS (refer separate graphic)



Key: Existing Process | Base Case New Processes | Option 2 Addition to Base Case | Option 3 Addition to Base Case | Option 6 New Processes

Options 2A, 2B & 2C - The Base Case and Filtration

Add in to the Base Case – Filtration – three alternatives

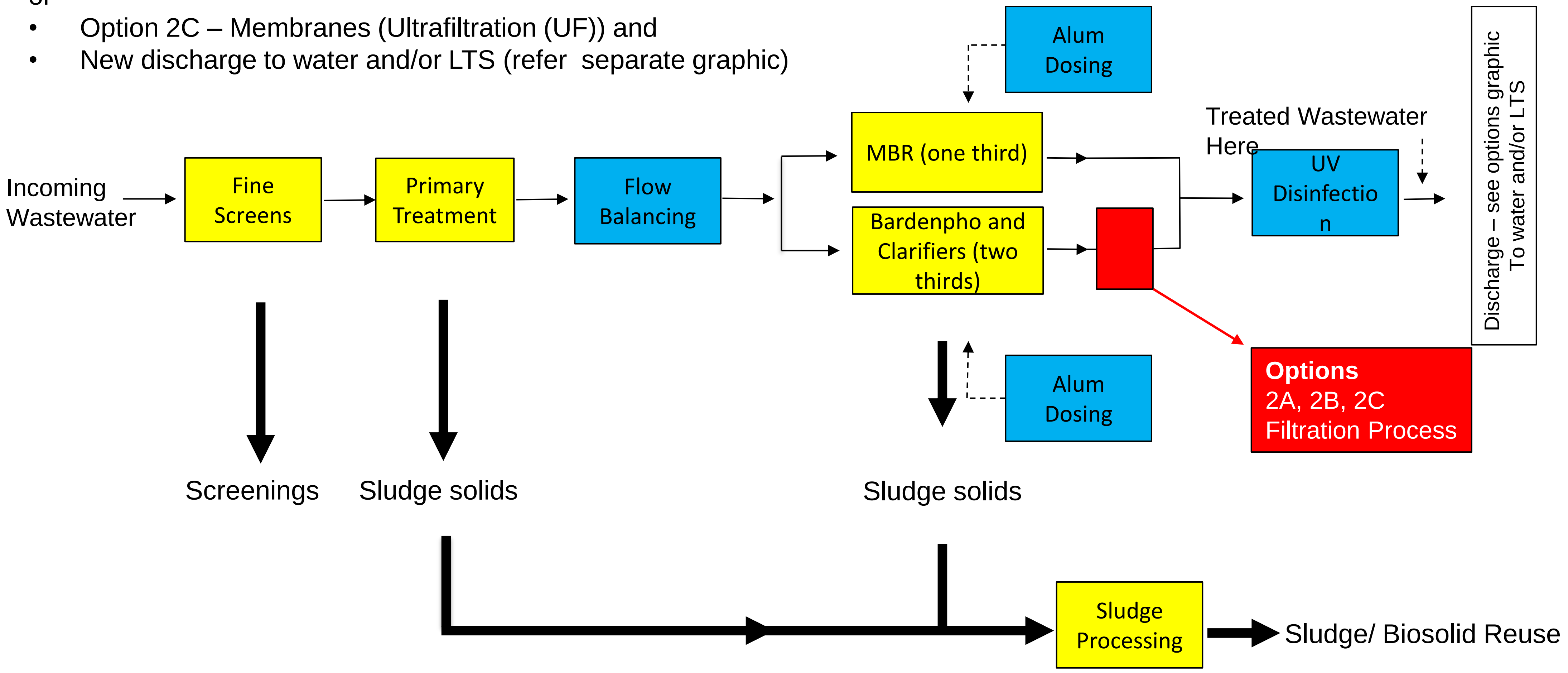
- Option 2A – Disc Filters

or

- Option 2B – Sand Filters

or

- Option 2C – Membranes (Ultrafiltration (UF)) and
- New discharge to water and/or LTS (refer separate graphic)



Key: Existing Process | Base Case New Processes | Option 2 Addition to Base Case | Option 3 Addition to Base Case

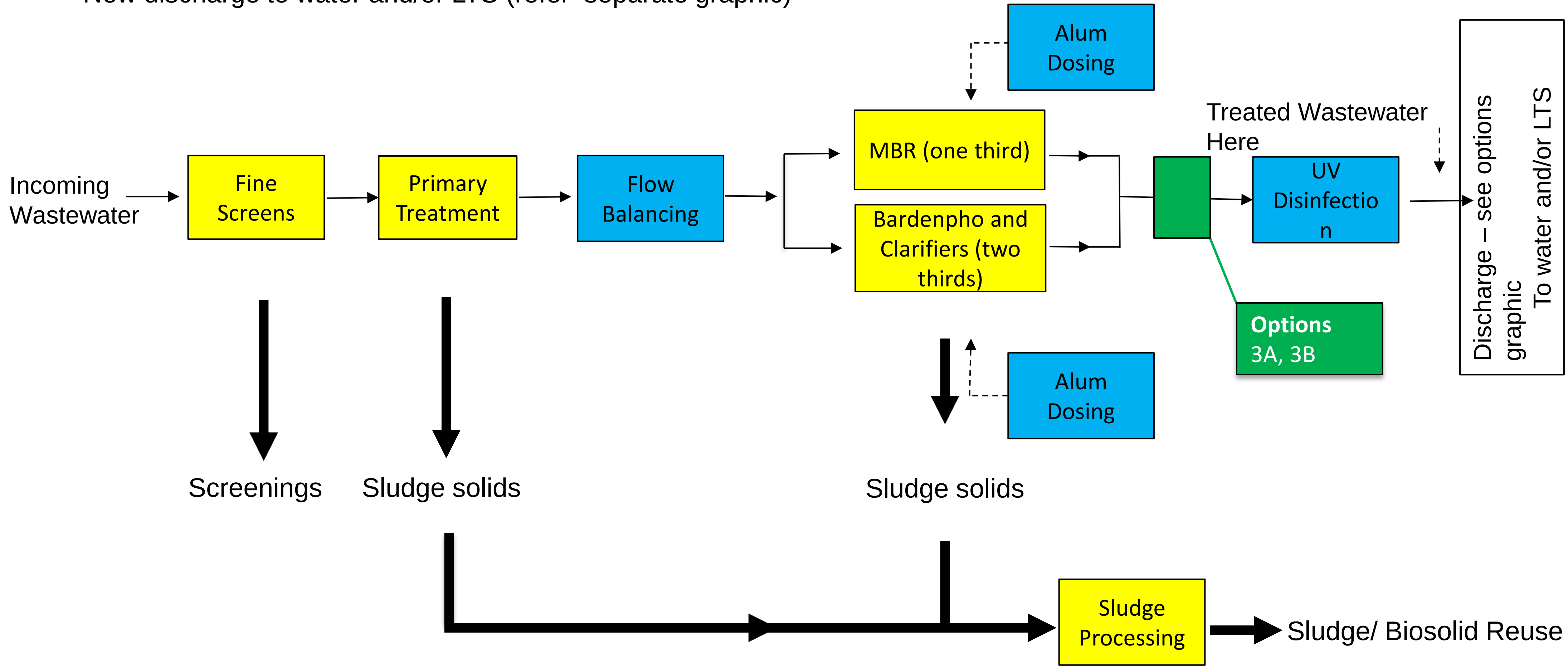
Options 3A & 3B - The Base Case and Denitrifying Filtration / Carbon Beds

Add to the Base Case

- Option 3A – Denitrifying Filters

or

- Option 3B - Carbon Beds and
- New discharge to water and/or LTS (refer separate graphic)

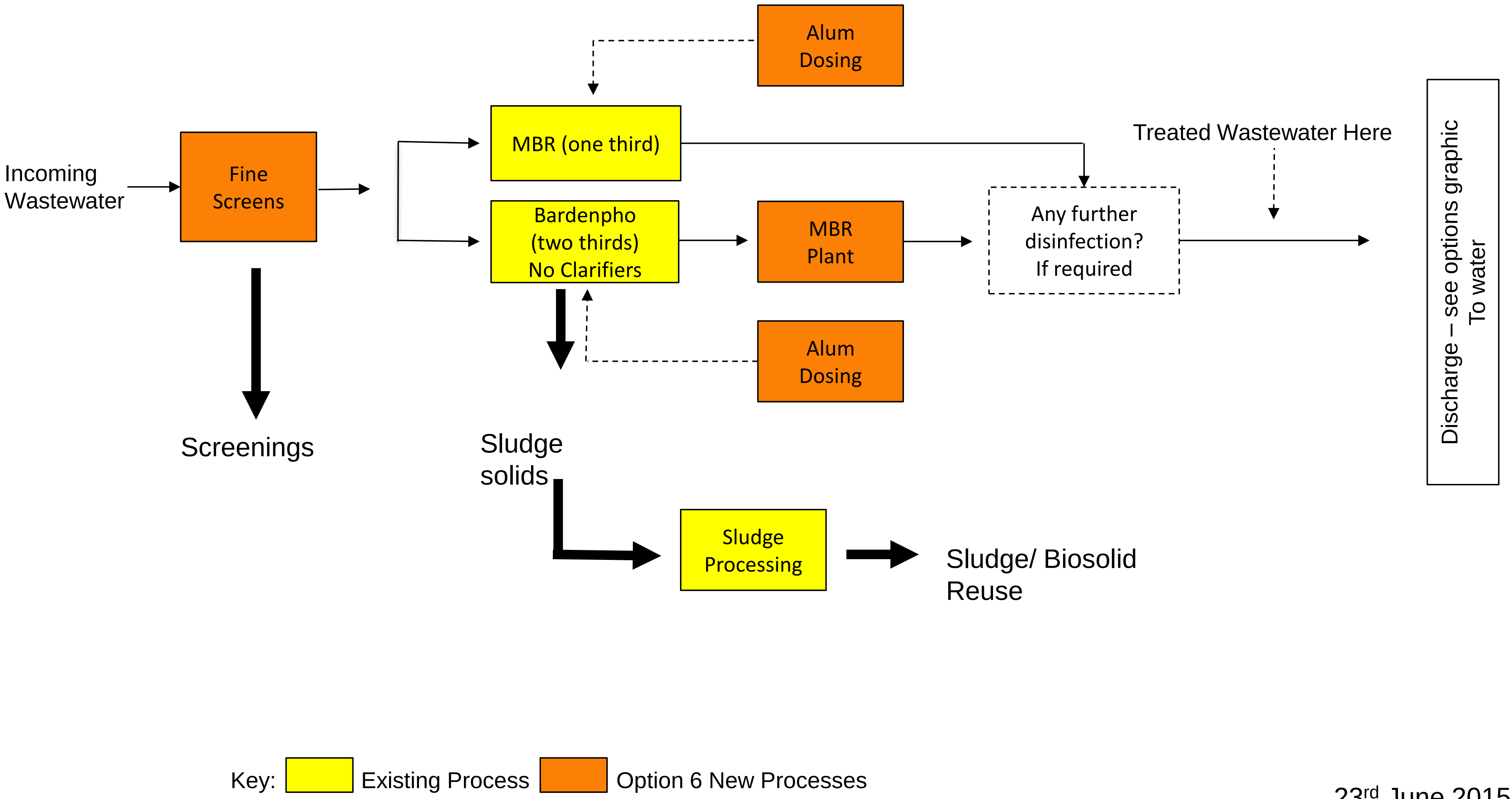


Key: Existing Process | Base Case New Processes | Option 2 Addition to Base Case | Option 3 Addition to Base Case

Option 6 – Full MBR Treatment Plant with Phosphorus Removal

Add in

- Alum dosing for phosphorus removal
- Membrane filtration to remove most of pathogens (germs)
- New discharge to water



23rd June 2015

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 (MLD)	Treated Wastewater: TP load estimate (mg/l)	Treated Wastewater: TP load estimate (ty^{-1})	Treated Wastewater: TN load Estimate (mg/l)	Treated Wastewater: TN load Estimate (ty^{-1})	CAPEX ($M)	OPEX/yr ($M)	NPV ($M)	Comments
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, archaelogical 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

Overall Summary of Option continued…

DISCHARGE TO LAND (All flows)

Option	Description	Flow (MLD)	Treated Wastewater: TP load estimate (mg/l)	(ty^{-1})	TN load Estimate (mg/l)	(ty^{-1})	CAPEX ($M)	OPEX/yr ($M)	NPV ($M)	Comments
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 LTS 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 denirifying sand filter in the Treatment plant.
										- Assumed result will be similar to Option 3A

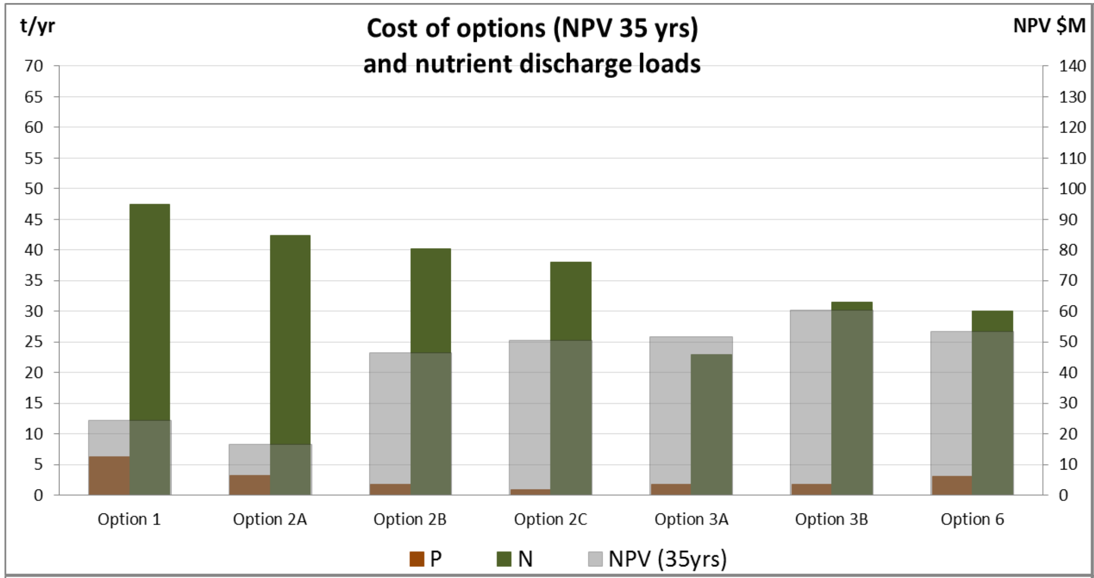
DISCHARGE TO WATER

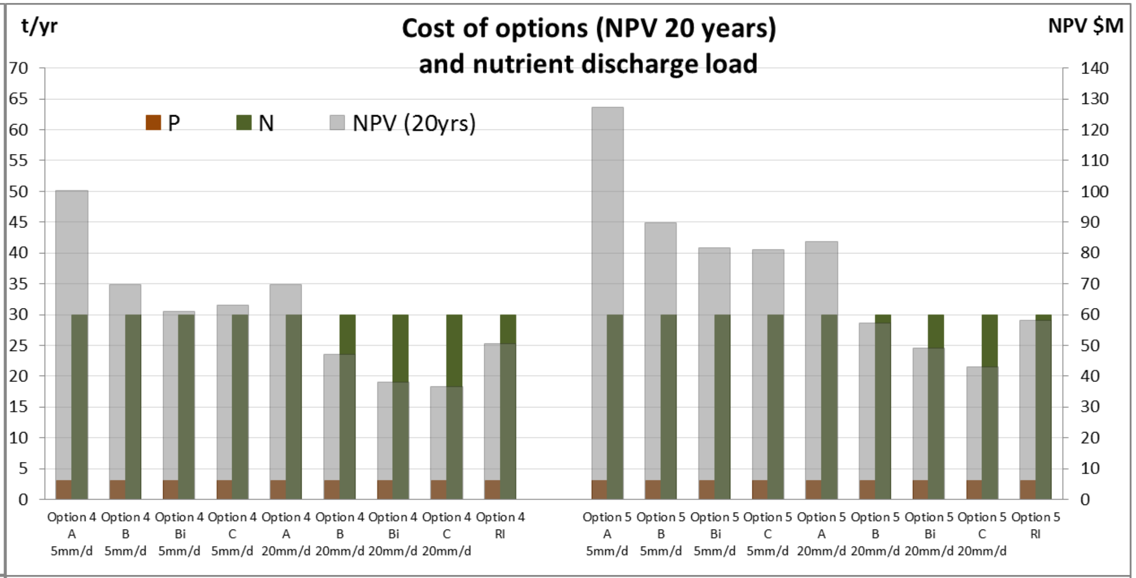
Option	Description	Flow (MLD)	TP (mg/l)	TP (ty^{-1})	TN (mg/l)	TN (ty^{-1})	CAPEX ($M)	OPEX/yr ($M)	NPV ($M)	Comments
6	Full MBR	23.8	-	3.00	-	30.00	29.78	1.13	53.40	- Secondary clarifiers will be replaced with membrane filtration (MBR). Full MBR process could achieve target N and P consent limits.
										- 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).

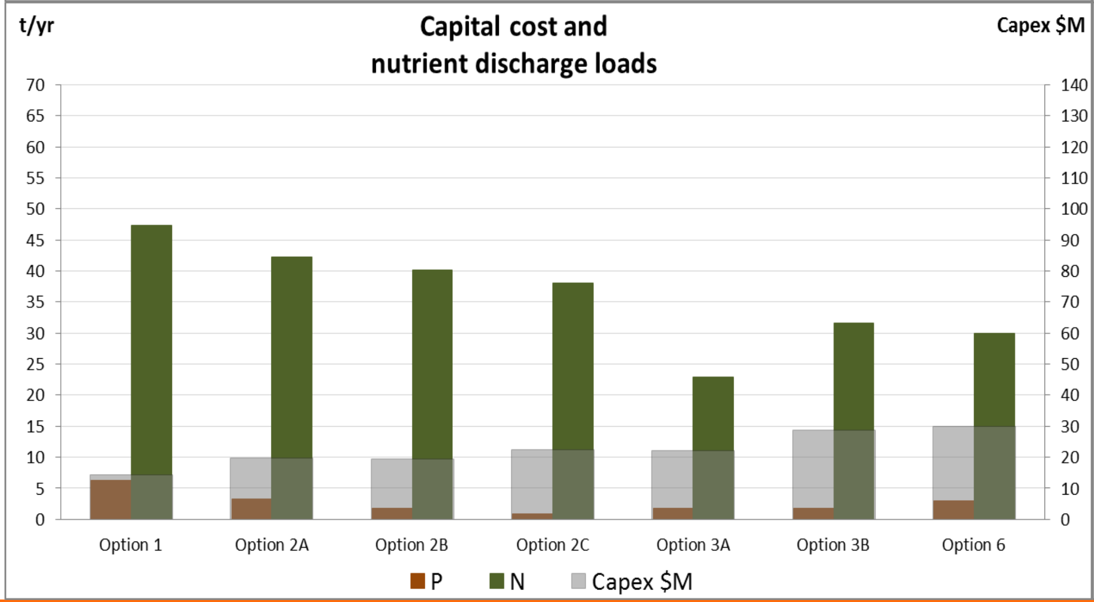
Notes: *1. The CAPEX, OPEX and NPV costings for Options 1, 2, and 3 will be udjusted to include cost of risk mitigation associated with the TERAX process as noted above. Kevan Brian will provide an updated cost summary for these.*

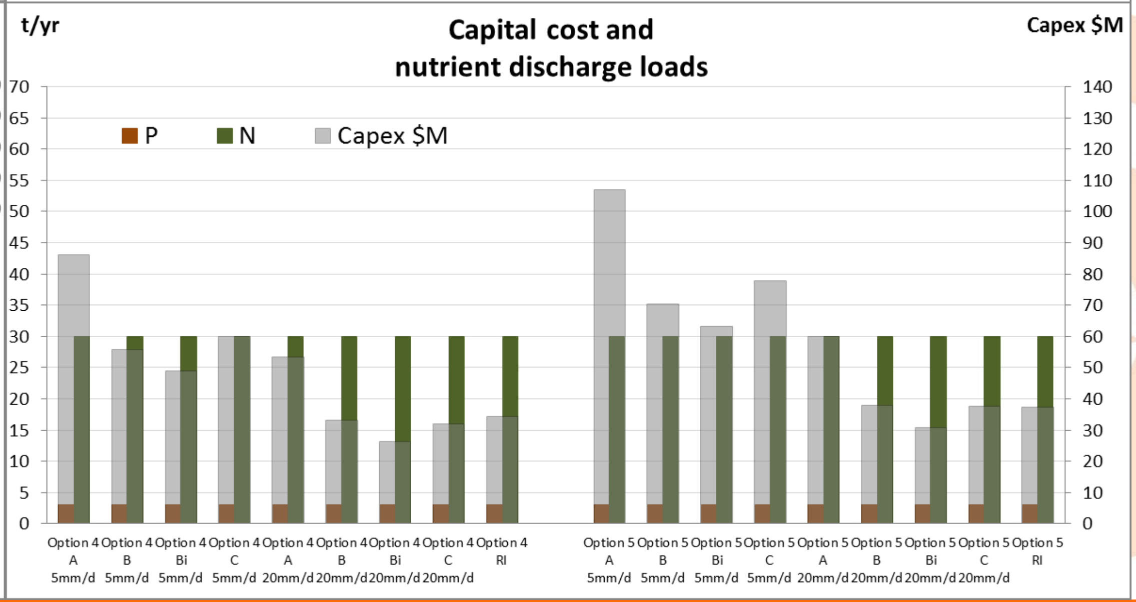
2. NPV (Net Present Value) for Options 1, 2, 3 & 6 are 35-year NPV, Options 4 and 5 are calculated based on a 20-year period.

Comparing the cost and nutrient discharge of the options









FOR RPSC MEETING 25TH JUNE
SUMMARY TAG MEETINGS- #7 28TH MAY & #8 16TH JUNE

- Both busy meetings
- Antoine Coffin (who TAG invited) updated on the CIA activities and technical requirements. Including a wide range of potential mitigation measures that could be considered.
- Key Agenda items TAG #7. Alternative Land Treatment Sites and Wastewater Strategy (Option 6 Development) Mott MacDonald Draft Reports. Presented by Kevan Brian
- Key Agenda items TAG #8
  - Further updates on Mott MacDonald Draft Reports
  - Lake Rotorua Treated Wastewater Discharge: Environmental Effects Study Draft Report presented by Professor David Hamilton and Chris McBride
- Other Topics included
  - Discussions/Update on TERAX by Greg Manzano
  - Advanced treatment options
  - Discharge locations to water
  - “Add-on’s” and developing TAG approach for the future
- Remaining questions from RPSC – refer later in the meeting
- Programming matters and methodology for shortlisting – preferred options assessment

TAG's SUGGESTION TO RPSC & RLC ON HOW TO HANDLE "ADD-ON'S" IN THE FUTURE PROJECT

- Time is now running out for looking at third party "Add-on" proposals/ideas for yet unproven on a commercial/full use scale, new and innovative treatment processes.

- To seriously consider an "Add-on" that maybe proposed by a third party, the "Add-on" must be well proven at a sufficiently large size and scale consistent with Rotorua's WWTP flows, loadings and infrastructural components

- TAG propose that in seeking new Resource Consents for the future selected treatment and discharge arrangement, then RLC suggest a resource consent condition that requires RLC to undertake periodic reviews of technology changes and if appropriate, then incorporate new processes and/or discharge procedures into their wastewater management approach.

cont…

TAG's SUGGESTION TO RPSC & RLC ON HOW TO HANDLE "ADD-ON'S" IN THE FUTURE PROJECT cont…

- The above TAG proposal is consistent with
  - The concept of a "Wastewater Strategy" underpinning the scheme chosen and Resource Consents
  - Keeping future flexibility and being able to adopt changes/new technologies throughout the duration of new resource consents and beyond
- RPSC and RLC accept in principle the TAG's suggest approach as above
- Third parties who have offered "Add-on" technologies or who may in the future offer "Add-on" technologies be informed of the above approach (providing it is accepted by RPSC and RLC).

RPSC REMAINING QUESTIONS AND ANSWERS CONTINUED

Further information to that presented to previous meetings

Question 1 Effects of Wastewater Treatment of Health compounds in sewage

- Question related to US Department of Health Household Products List
- Professor David Hamilton has information from the Brisbane Reclaimed Water project he was involved in and will present this in the July Workshop

Question 4 Water quality of unpolluted springs and lake water for comparison with treated wastewater and treated wastewater once discharged

- Regional Council has good information on key parameters that are being used in the Effects Assessment
- This information will be included as part of the Effects Assessment so that comparisons with previous and current water quality and ecology can be made to the discharge assessment. This will be covered at the July Workshop with Professor David Hamilton and the associated RPSC meeting.

RPSC REMAINING QUESTIONS AND ANSWERS CONTINUED

Question 5 Further information on Black Mica as an "Add-On"

- Refer RPSC 19th March 2015 information Slide 2 and "Add-On's" update RPSC 22nd April 2015
- No new full scale "case history" had been obtained to date – still awaited

Question 6 Status of Various "Add-On's"

- No new information. Refer TAG's suggested position on "Add-on's" in terms of the future.
- Correspondence being sent from RLC to Everse in response to their Report presented to RPSC on 20th May 2015
- Refer to TAG's suggested approach in respect to "Add-on's" for the future of the Project

GROUP B: QUESTIONS & ANSWERS cont… NEW QUESTIONS

New Questions

Question: **Are there UV disinfection systems where the lamps rotate rather than the water flowing past the lamps?**

Answer: No proprietary devices that we are aware of, but could be. Information available and sent to Peter Staite on various UV arrangements and the wastewater flow vortexing (swirling around the lamps

Question: What is Gasification? Where does it fit in Wastewater Treatment?

Answer: Gasification is a process that converts organic or fossil fuel based carbonaceous materials into carbon monoxide, hydrogen, methane and carbon dioxide. This is achieved by reacting the material at high temperatures (>700 ° C), without combustion, with a controlled amount of oxygen and/or steam.

In Wastewater Treatment the process can gasify the waste solids to almost completely eliminate them. Almost completely eliminates wastewater solids - gasifies >99% of organics, leaving only inorganics (typically around 13% of wastewater solids)

Can handle sludge with solids content from 4% to 25%

http://en.wikipedia.org/wiki/Gasification
http://www.genifuel.com/text/Gasification%20of%20Wastewater%20Solids.pdf
https://www.osakagas.co.jp/en/rd/technical/1198912_6995.html

GROUP B: QUESTIONS & ANSWERS cont… NEW QUESTIONS

Question: Virus Treatment Questions paraphrased by Jim Bradley

"*What are the harmful/worse viruses from a public health point of view?"*

"What do they result in?" e.g. Norovirus effects vomiting and diarrhoea, Adenoviruses effects, urinary tract, eyes, respiratory etc.

"How effective will an MBR Membrane Plant of the type that Rotorua WWTP has at 0.04 microns"

Refer to following three slides and handout of these questions and answers – prepared by Annaka Davis Toi Te Ora Public Health, RPSC Member . Apologies from Annaka for her absence today.

Toi Te Ora
Public Health Service
BAY OF PLENTY DISTRICT HEALTH BOARD
Serving Bay of Plenty and Lakes Districts

Questions & answers about viruses

What types of viruses are in wastewater?

- There are over 150 different types of enteric viruses found in raw sewage.
- Types of viruses found in wastewater depend on those circulating in the community

"What are the harmful/worse viruses from a public health point of view?"

- A virus known to cause illness is a public health risk.
- The level of harm is based on the:
  - extent of disease
  - number of people who may be exposed
  - likelihood of exposure to enough viral particles to cause an illness and;
  - level of defence a person or population has against infection/illness.

What health effects do viruses cause?”	
Disease	**Symptoms**
Acute viral gastroenteritis	causes vomiting and/or diarrhoea, fever, abdominal pain, headache, and body aches**.**
Respiratory illnesses	cause cold-like symptoms, sore throat, bronchitis, pneumonia and pink eye (conjunctivitis).
Viral hepatitis A-E	Hepatitis A causes fever, tiredness, anorexia, nausea and abdominal pain followed by jaundice (yellowing of skin and eyes).

“How effective will the RLC WWTP MBR Membrane Plant of 0.04 microns be against viruses”

- A 0.04 micron filter equals 40 nanometres (nm).
- Viruses range in sizes (rotavirus - 60nm, norovirus 20nm, adenovirus 70-90nm.

Therefore, the current 0.04 filter at the Rotorua WWTP will be effective against rotavirus and adenovirus but not norovirus. Note: clumping of viruses commonly occurs which means that some viruses may be retained by a filter with pore size larger than a single virus.

A 0.01 micron would be needed for treatment to be effective against all viruses. *However* the degree of treatment needed to protect public health is dependent on where the treated wastewater will be discharged.

Ultrafiltration (UF) equipment and Pore Sizes and Correction of earlier incorrect figure showing existing MRB at 4 Micron Pore Size TO BE FURTHER MARKED UP BY JIM SHOWIN NOROVIRUS RELATIVE TO MBR PORE SIZE

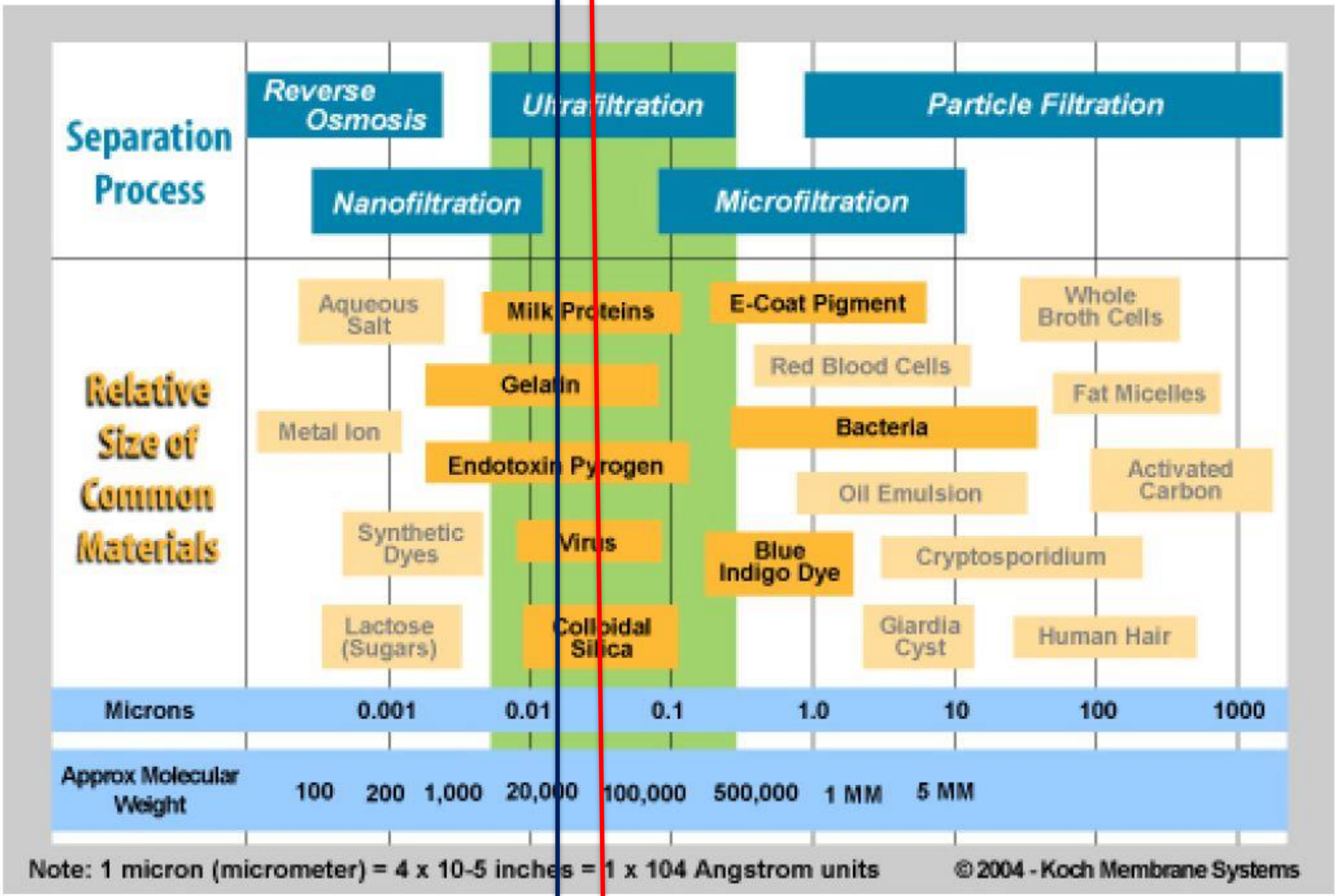


Figure 1.0 Relative Particle Sizes (Koch, 2004)

Existing MBR 0.04 Micron Pore Size (Zeeweed 500D module)

Option 2C Mott MacDonald Dec Report – Membrane Ultrafiltration (UF) Z-PAK UF System – 0.02 Micron Pore Size

ALTERNATIVE TO THE ROTORUA LAND TREATMENT SYSTEM

AGREEMENT ON PREFERRED OPTION (PROPOSED PROGRAMME)