CONNECT WATER

Memorandum

To: Wellington Water Limited

From: Connect Water Limited

Date: 23 September 2020

Subject: Process Options Short List Summary

1. Purpose

The purpose of this memo is to provide a summary of the shortlisted process options taken forward for the multi-criteria assessment (MCA) workshop on 2 July 2020. An overview of these process options has been incorporated in the *Sludge Minimisation Process Options Assessment Report* issued by Connect Water in June 2020.

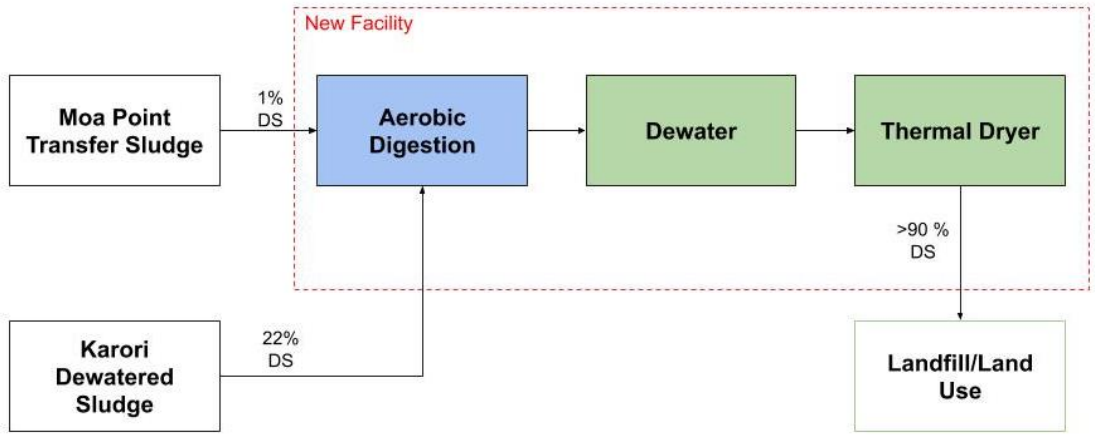
2. Process Options Short List Summary

The following options were taken forward to the MCA workshop:

- Option 7 - Autothermal Aerobic digestion (ATAD) + TD
- Option 8 – Mesophilic Anaerobic Digestion (MAD) + Composting
- Option 10 - Thermal Hydrolysis Process (THP) + MAD + Thermal Dryer (TD), also known as Lysis-Digestion + Thermal Drying (LD + TD)
- Option 12 – Digestion – Lysis – Digestion (DLD) + TD
- Option 17 – MAD + TD
- Option 18 – TD only
- Option 19 – TD + Gasification.
- Option 23 – Wet Air Oxidation (WAO) + upstream MAD
- Option 25 – Incineration (TD optional)

3. Option 7 – ATAD + TD

Moa Point and Karori sludges are mixed and fed to an (autothermal) aerobic digestion facility. After stabilisation the sludge is dewatered and dried in a thermal dryer. The dried product can be applied to land or landfilled.

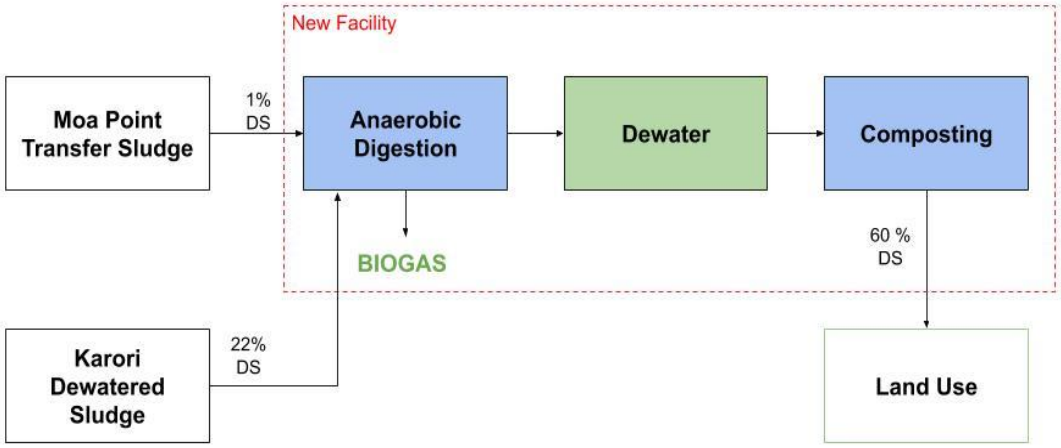


Evaluation Criteria	Option 7 - (Autothermal) Aerobic Digestion + TD	
	Evaluation	**Rating**
Maturity of Technology	ATAD is currently used in Bell Island Nelson for a population of 133,000 people. It is not succeeded by Thermal Drying in Nelson's case, but there is no reason it could not work if it was. Each process individually is established and used in multiple plants globally.	
Dry solid content of End Product	A stand-alone aerobic digestion system with centrifuge can reduce dry solids content to approximately 26%. With a thermal dryer this process can obtain a dry solids content greater than 90%.	
Total plant footprint	A process of aerobic digestion followed by a TD is comparable in footprint to that of anaerobic digestion which is 2,500 m^2	
Recommended Action	Retain for further evaluation	

4. Option 8 – MAD + Composting

Moa Point sludge is thickened. Karori sludge is mixed in and the blend is fed to an anaerobic digestion facility. After stabilisation the sludge is dewatered and composted. The product must be applied to land.

Biogas can be used for heating and/or electricity production.

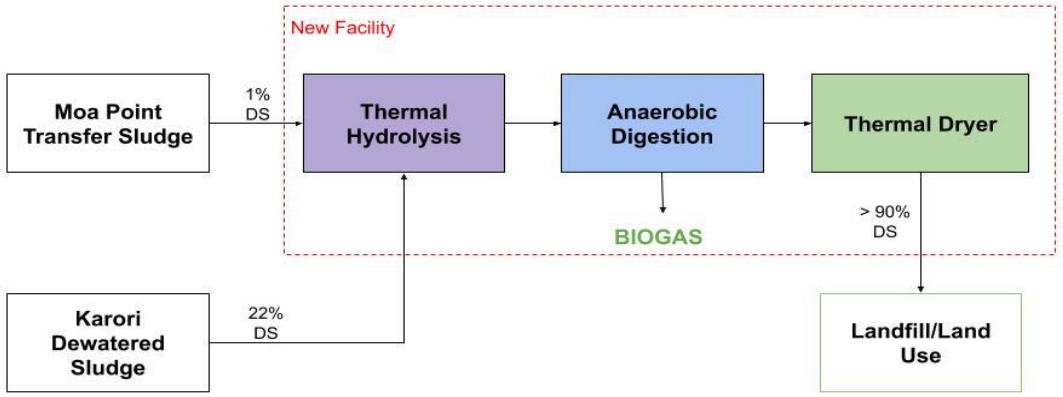


Evaluation Criteria	Option 8 - MAD + Composting	
	Evaluation	**Rating**
Maturity of Technology	This method is used in Palmerston North WWTP, New Zealand which serves a population of 100,000 people.	
Dry solid content of End Product	A dry solids content of approximately 60% is achievable provided a dry bulking agent is used. It has to be noted that the dryness is achieved by adding a dry bulking agent, so the total mass of the end product increases significantly.	
Total plant footprint	In-vessel composting can significantly reduce footprint requirements. An in-vessel composting system typically has a residence time of 16 - 20 days. This would require a similar footprint as MAD shown in Option 6, resulting in a total area of 5,000 m^2 for both the MAD and composting units.	
Recommended Action	Retain for further evaluation	

5. Option 10 – THP + MAD + TD aka LD + TD

Moa Point sludge is thickened. Karori sludge is mixed in and the blend is fed to a THP followed by anaerobic digestion. After stabilisation the sludge is dewatered and thermally dried. Biogas can be used to satisfy the heat requirements of the hydrolysis process and / or the dryer.

Biosolids can be applied to land or be landfilled.

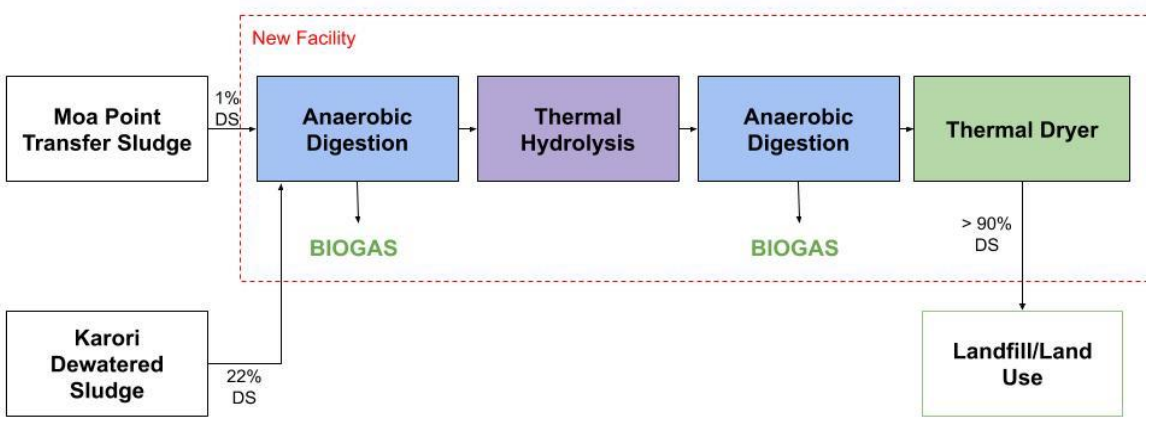


Evaluation Criteria	Option 10 – THP + MAD +TD	
	Evaluation	**Rating**
Maturity of Technology	This process is well established and is currently being constructed in NZ at the Rosedale WWTP serving 235,000 people. It is also used widely in many other regions including but not limited to: • Ljubljana, Slovenia (2018/2019): 572,000 PE • Yeosu, Korea (2018): 140,000 PE • Oberstown, Ireland (2017/2018): 360,000 PE • Versailles, France (2015): 330,000 PE • Marquette-Lez- Lille, France (2015) - 620,000 PE • Hamar Norway: 90,000 PE	
Dry solid content of End Product	This process configuration can obtain a dry solids content greater than 90%.	
Total plant footprint	Based on Marquette-Lez- Lille France WWTP it was determined that 0.0024m^2/people equivalent is required for a THP unit and 0.0058m^2 / people equivalent is required for a thermal dryer unit. For the envisaged future population of 250,000 in Wellington this would require 600m^2 for a THP unit and 1500m^2 for a TD unit. With a MAD unit of 2,500m^2 the total area required is 4,600m^2	
Recommended Action	Retain for further evaluation	

6. Option 12 – DLD + TD

Moa Point sludge is thickened. Karori sludge is mixed in and the blend is fed to a process consisting of two anaerobic digestion steps with thermal hydrolysis in between. After stabilisation the sludge is dewatered and thermally dried. Biogas can be used to satisfy the heat requirements of the hydrolysis process and / or the dryer.

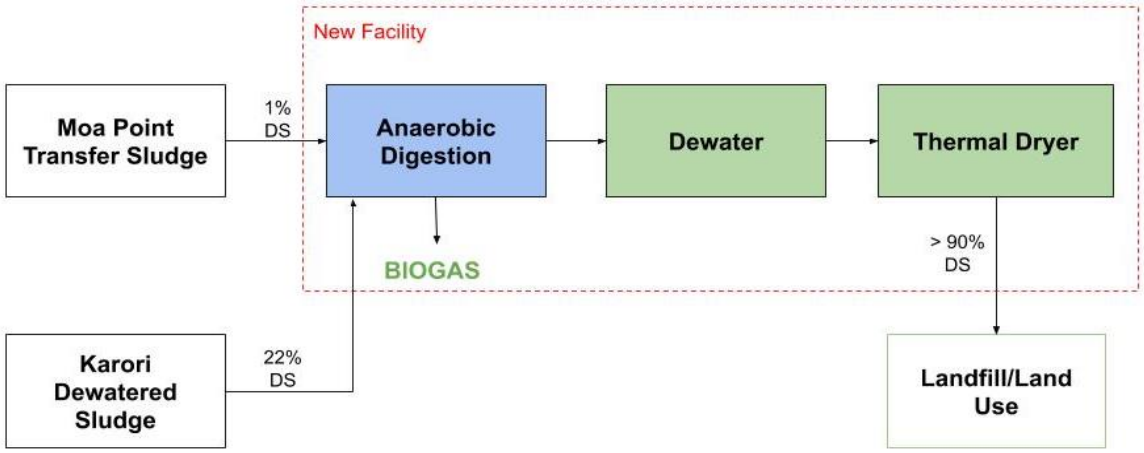
Biosolids can be applied to land or be landfilled.



Evaluation Criteria	Option 12 - DLD + TD	
	Evaluation	**Rating**
Maturity of Technology	DLD has not been implemented in New Zealand. It is used globally in the following locations: • Billund Denmark – 130,000PE • Marquette-Lez-Lille, France, 2015: 620,000 PE • Hillerod Denmark 80,000PE	
Dry solid content of End Product	This process configuration can obtain a dry solids content greater than 90%.	
Total plant footprint	Based on unit sizes calculated in Option 10, the overall area required for this process will be under 7,100 m^2 because the second digestion step occupies less space than the first.	
Recommended Action	Retain for further evaluation	

7. Option 17 – MAD + TD

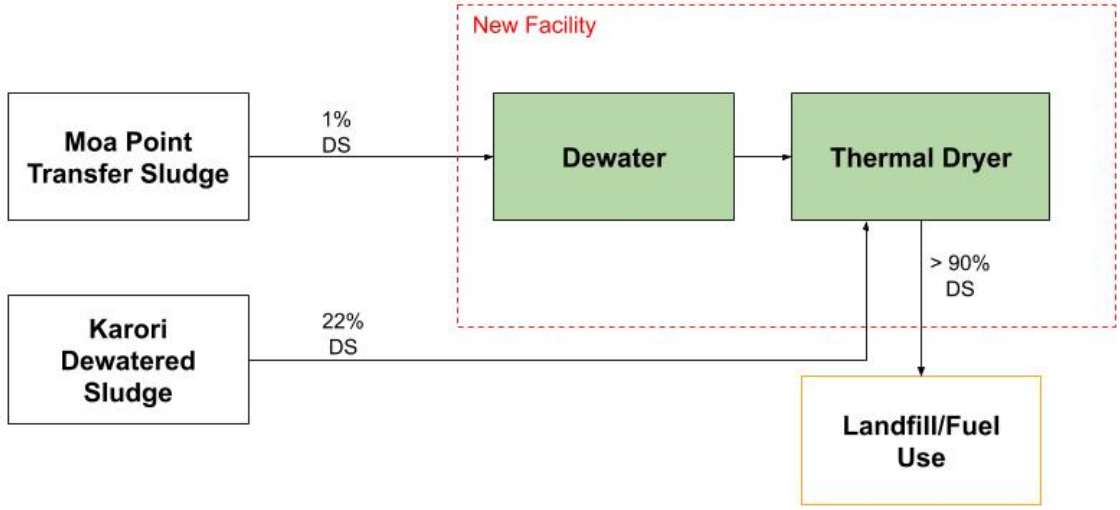
Moa Point sludge is thickened. Karori sludge is mixed in and the blend is fed to an anaerobic digestion step. After stabilisation the sludge is dewatered and thermally dried. Biogas can be used to satisfy the heat requirements of the dryer. Biosolids can be applied to land or be landfilled.



Evaluation Criteria	Option 17 - MAD + TD	
	Evaluation	**Rating**
Maturity of Technology	This configuration is currently being used at the Christchurch WWTP in NZ. sites globally also use this process including the following: • Hatton-Dundee -230,000PE (the thermal dryer is fired using biogas generated from MAD) • Prado – Reunion Island – 175,000PE (the thermal dryer is fired using biogas generated from MAD) • Evry, France – 250,000 PE	
Dry solid content of End Product	Greater than 90% dry solids content is achievable.	
Total plant footprint	Based on previous calculations for an MAD reactor and TD the required area to process the envisaged Wellington population sludge is approximately 4,000m^2.	
Recommended Action	Retain for further evaluation	

8. Option 18 – TD only

Moa Point sludge is dewatered and combined with Karori sludge. The blend is fed to a thermal dryer. The biosolids are a low-grade fuel but can be landfilled.

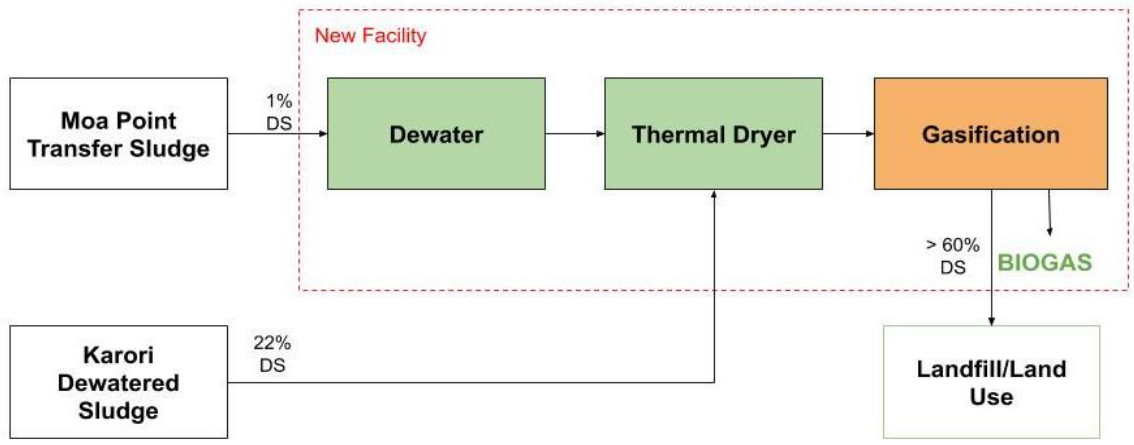


Evaluation Criteria	Option 18 - Thermal Dryer	
	Evaluation	**Rating**
Maturity of Technology	This sludge processing technique is currently used in NZ at Hutt Valley, New Plymouth, Christchurch and Whanganui WWTPs. It is an established process applied globally in multiple plants including but not limited to the following: • Marquette lez Lille, France (2015) - 620 000 PE • Alderwood, USA (2013) - 100 000 PE • Pomorzany, Poland (2011) - 420 000 PE • Draguignan, France (2006) - 70 000 PE • Ballarat North, Australia (2008)	
Dry solid content of End Product	Greater than 90% dry solids content is achievable.	
Total plant footprint	The area required for a thermal dryer is 1500m^2, as shown in Option 10.	
Recommended Action	Retain for further evaluation	

9. Option 19 – TD + Gasification

Moa Point sludge is dewatered and combined with Karori sludge in a thermal dryer. The dried solids are gasified. Syngas can be used to partially satisfy the thermal dryer energy needs.

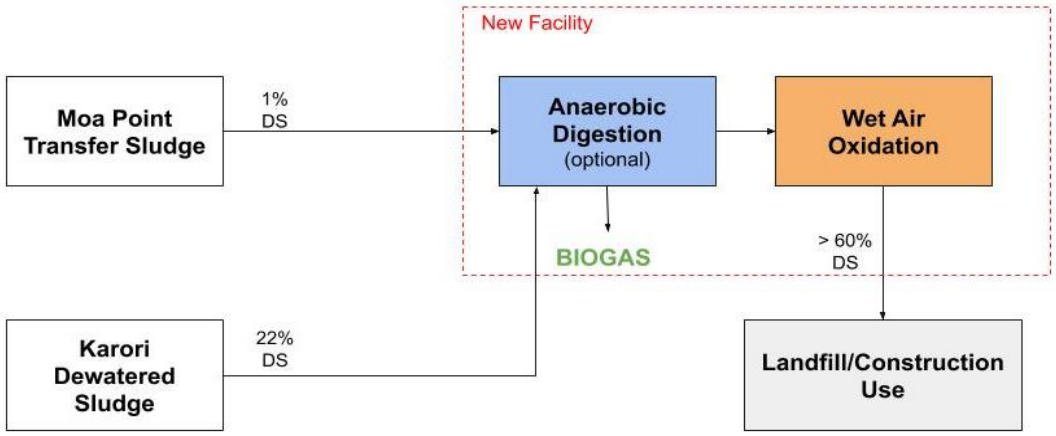
The biosolids can applied to land or be landfilled.



Evaluation Criteria	Option 19 - TD + Gasification	
	Evaluation	**Rating**
Maturity of Technology	Gasification of sludge has not been implemented in NZ. It is used globally in the following WWTPs: • Balingen WWTP, Germany (2001) – 125,000PE • Mannheim WWTP, Germany (2010) -725,000PE • Koblenz WWTP, Germany (commissioning) • Loganholme WWTP, Australia (construction phase) – 300,000PE	
Dry solid content of End Product	Biochar is produced therefore greater than 60% dry solids content is achieved.	
Total plant footprint	Based on the gasification unit in Mannheim WWTP it was determined that 0.0007m^2/ people equivalent is required. For the envisaged future population of 250,000 in Wellington this would require 200m^2. With the addition of a TD the footprint would be approximately 1,700 m^2.	
Recommended Action	Retain for further evaluation	

10. Option 23 – WAO + upstream MAD

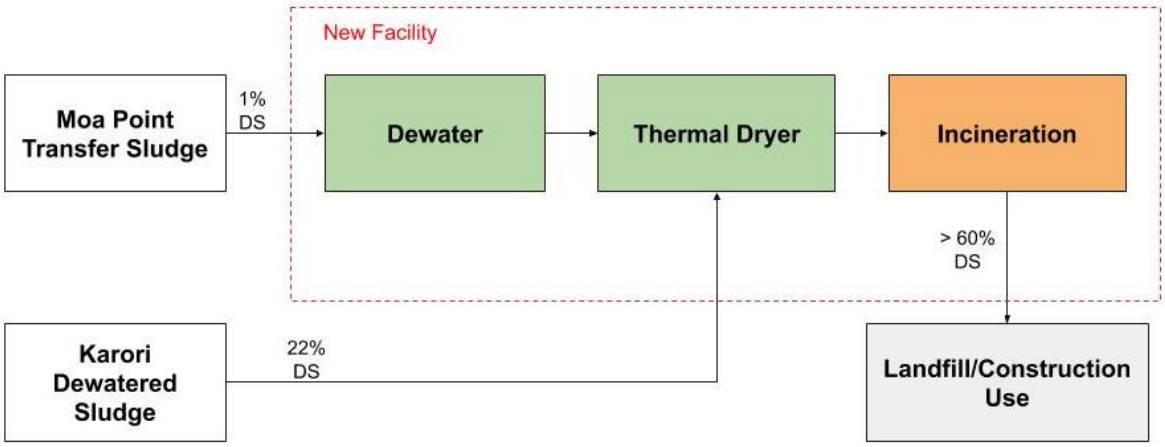
Moa Point sludge is dewatered and combined with Karori sludge in an anaerobic digester. The stabilised solids are fed to a WAO unit. The biosolids can be landfilled or used as construction material. Biogas can contribute to the WAO energy need.



Evaluation Criteria	Option 23 - WAO + upstream MAD	
	Evaluation	**Rating**
Maturity of Technology	A pilot plant was tested in Rotorua and Palmerston North however neither was carried through to full scale. Hence there are no current wastewater treatment facilities using this process in NZ. However, WAO is used extensively worldwide including in the following WWTPs amongst others: • Trucazzanno, Italy (2004) – 300,000 PE • Aix-en- Provence, France (2011) – 150,000 PE • Epernay, France (2006) – 175,000 PE • Rennes Beaurade, France (2012) – 360,000PE	
Dry solid content of End Product	Technosand produced, therefore greater than 60% dry solids content is achieved.	
Total plant footprint	Based on the WAO unit in Rennes Beaurade (MAD in process line) it was determined that 0.006 m^2/ people equivalent is required. For the envisaged future population of 250,000 in Wellington this would require an area of 1500m^2.	
Recommended Action	Retain for further evaluation	

11. Option 25 - Incineration (TD optional)

Moa Point sludge is dewatered. Karori sludge is mixed in and the blend is fed to an incinerator. Potentially a thermal drying step is required for partial drying of the sludge blend. Residual ash can be partially used for construction purposes but must otherwise be landfilled.



Evaluation Criteria	Option 25 - Incineration (TD optional)	
	Evaluation	**Rating**
Maturity of Technology	Incineration is an established technology currently used in Dunedin's Tahuna WWTP, NZ – 80,000PE. It is also used extensively worldwide including but not limited to the following locations: • Noisy le Grand – Marne Aval, France -300,000 PE • Toulouse Ginestous France -950,000 PE • La Cartuja WWTP, Spain – 1.2 million PE	
Dry solid content of End Product	Ash is produced therefore, greater than 60% dry solids content is achieved.	
Total plant footprint	Based on the incineration unit in Tahuna WWTP it was determined that 0.02m2/ people equivalent is required. This would result in an area of 5,000m^2 for a 250,000 people population. As shown in Option 10 a TD would require 1,500 m^2 for the envisaged Wellington population. Therefore, the total footprint of this process is approximately 6,500m^2.	
Recommended Action	Retain for further evaluation	