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A case for OSET NTP to Performance Test and Assess a range of treatment categories

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This discussion paper has been prepared and submitted by Andrew Dakers in his personal capacity.

In this discussion paper I refer to the **on-site wastewater management community (OWMC).** The **OWMC** includes the following key stakeholders (but not exclusively): the operators (predominantly home and property owners), the system designers (who may be either independent, or in-house), on-site wastewater technology manufacturers and suppliers, installers, regulators and servicing technicians, trainers and educators.

There is a significant difference between on-site wastewater treatment (same as on-site effluent treatment (**OSET**)), and on-site wastewater management systems (**OWMS**). These refer to different "**system** boundaries" with different design and performance requirements. They are, however, clearly interdependent systems. The OSET unit is an embedded sub-system within the OWMS.

Currently the OSET National Treatment Program (OSET NTP) provides a national service to independently performance test and assess secondary and advanced secondary treatment plants. From 2008 to 2018 (Trials 3 to Trial 13 incl) OSET NTP operated in accordance with their own procedures which included reference to only AS/NZS1547:2012 M2.1 (which defined "secondary effluent"). At that time, the relevant standard for secondary effluent treatment plants was AS/NZS 1546.3 2008, however this standard was not applied, in detail, to the OSET NTP performance testing procedures. It was used as a guide only in the development of the testing procedures. At this time, OSET NTP performance testing related only to effluent quality and energy consumption performance. The treatment plants were tested at a consistent 1000 L/day of influent at the test bed, located at the Rotorua city wastewater treatment plant. Each plant was subjected one week of high load (2000L/day) at the end of the trial, but performance results were not included in their performance ratings.

OSET NTP changed their performance testing and assessment procedures in 2019. Unlike the previous 10 years, these procedures now align very closely, in detail, with the new Australian standard AS1546.3:2017. This has resulted in significant changes in the testing programme. For example:

- each treatment plant is tested at the manufacturer's stated plant capacity, rather than just at 1000 L/day;
- each treatment plant is subjected to six different stress tests;

- all test results (other than only those taken during the commissioning period), were included in performance the evaluation;
- manufacturers are required to provide a Certificates of Compliance with AS/NZS 1546.1 or similar, regarding: materials durability, structural integrity, and water tightness, with such results being noted in the OSET-NTP Performance Certificate;
- manufacturers are required to provide a Certificate of Compliance from a suitably qualified acoustic engineer regarding the noise generated at one metre from the plant;
- each treatment plant is assessed in terms of conformance with requirements for plant labelling, access for O&M, and alarms; and
- the assessment includes review of the manufacturer's manuals for Installation and Operations and Maintenance
- two, rather than just one, treatment categories were reported - secondary and advanced secondary.

The above are significant changes to the testing procedures. . Clearly the current test procedures are significantly more rigorous. It has been argued, and I agree, that the new testing regime, as specified in AS1546.3:2017, reflects more accurately, the operating conditions these treatment plants will be required to perform within in the field. I personally support the new and more rigourous procedures, however, would much prefer we think more carefully about how we interpret and report the resultant performance data and assessment results. In this discussion paper I am suggesting OSET NTP consider offering a wider range of treatment categories more appropriate to New Zealand conditions.

Best practice, in terms of on-site wastewater management design and performance, is different in New Zealand to Australia and other countries. In other countries chlorination is permitted, overhead sprinklers are permitted, and discharge to waterways and/or stormwater drains can be permitted in certain circumstances. In New Zealand, chlorination is not acceptable, discharge to surface water bodies is very rarely acceptable, if at all, and overhead sprinklers is very rarely acceptable. Therefore, in New Zealand an on-site wastewater management system almost inevitably includes discharge onto or into land. The use of pressure compensating drip irrigation fields and LPED irrigation fields, are possibly a more common distribution and land application systems in New Zealand than they are in Australia and other parts of the world.

AS1546.3:2017 defines the performance requirements of only two categories of on-site treatment systems; <u>secondary, (BOD/TSS 20/30)</u> and <u>advanced secondary (BOD/TSS 10/10)</u> treatment units). AS1546.3:2017 does not define the performance requirement of <u>primary treatment</u> (e.g.BOD/TSS 150/150) and what some refer to as <u>improved primary</u> treatment (eg BOD/TSS 50/50). On the other hand, AS/NZS1547:2012 defines the performance requirements of the OWMS which can be inclusive of and relevant to a range of treatment plant categories, ranging from primary to advanced secondary/tertiary.

In this discussion paper I encourage SWANS-SIG to consider providing OSET NTP the mandate to offer its assessment services to a broader range of <u>treatment plant categories</u>.

Nearly all OWMSs in New Zealand require an appropriate fit-for-purpose land application system. There are several different designs. The type of land application system will commonly determine the level of pre-treatment required. For example, if the land application system is necessarily a PCDI field **AND** the owner of the system requires a PCDI field service life of 15 or more years, then in my experience the treatment category required would be advanced secondary. The other situation that requires advanced secondary would be if UV treatment is required. If the owner was happy to accept a PCDI field with a shorter service life then in my experience the treatment category required would need to be at least secondary. On the other hand, LPED distribution systems to irrigation, trenches, sand beds or engineered mounds, can be appropriate for the distribution of primary effluent or improved primary effluent.

<u>What this discussion demonstrates is that different categories of treatment can inform the treatment plant's fit-for-purpose status for a given on-site wastewater management system designed in accordance with AS./NZS1547:2012. Therefore, the OWMC would benefit from a testing body, such as OSET NTP, providing independent performance testing and assessment services for ALL treatment categories that satisfy AS/NZS1547:2012 performance criteria.</u>

In **Appendix A**, I have provided a (preliminary) rationale for the matching of treatment plant categories to different land application system. What I'm hoping this will demonstrate is that, in the context of raising the standard of on-site wastewater management systems in New Zealand, a significant contribution would be for OSET NTP to provide an independent treatment plant performance and assessment service for up to six treatment categories such as:

1. primary treatment
2. improved primary treatment
3. secondary treatment
4. advanced secondary treatment 1 15/15
5. advanced secondary treatment 2 10/10
6. advanced secondary treatment +UV

This approach would require further research and validation than I have been able to provide in **Appendix A**, however it is the concept I believe that is important.

Performance testing to an increased number of treatment categories takes OSET NTP testing procedures outside the specifications of AS1546.3:2017 brief, but it can remain inclusive of this Standard. The focus of the OSET NTP performance testing will be more about what the plant is designed to achieve under a standard testing protocol (which will include stress loading). **With this approach, treatment plants that fail to meet the secondary standard may still qualify to remain in the market as an OSET NTP approved unit, possibly alleviating the current angst from some treatment plant suppliers under the current OSET NTP procedures**. Assessment of the other performance criteria such as evidence of conformance to AS/NZS1546.1, assessment of supporting manuals (Installation, O&M) and other criteria should apply to all <u>treatment plant categories.</u>

Designers are likely to want to apply due diligence assessment on the technology options. OSET NTP performance reports would provide important and authentic data and performance information for this process should it to be made available to designers.

In summary, my question to SWANS-SIG is: What is the optimum national service that OSET NTP can and should be offering the OWMS industry at a national level? Can it be more inclusive of a wider range of treatment plant performance requirements for sustainable and effective OWMS? If it can I would suggest we can anticipate this would not only be more acceptable to independent designers, TLAs and RCs and end users, but would also provide technology suppliers with greater market clarity at a national level**.**

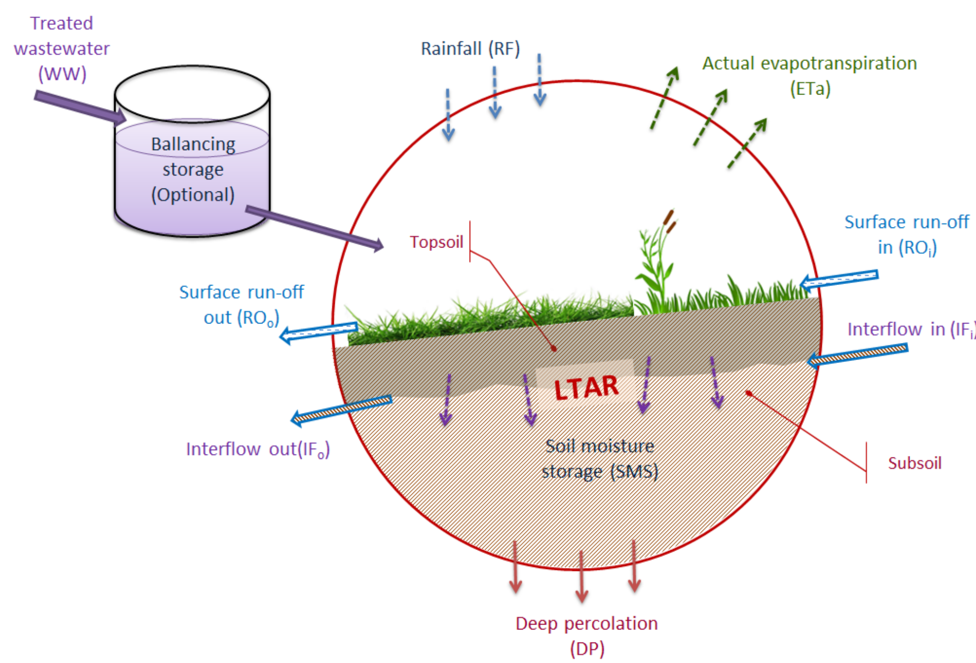
<u>OSET NTP is unique facility</u> in that it is the only active service in NZ contributing at a national level to raising the standard of OWMS. This service is very much needed and needs to be <u>better understood</u> and <u>recognised</u> by all OWMC practitioners.

Appendix A: Rationale for increasing OSET NTP performance testing treatment plant categories

For the purpose of this discussion paper, I have categorized the different treatment levels in terms of BOD and TSS, while being aware that other parameters such as TN, TP and bacterial concentration can be equally relevant when evaluating risk mitigation capabilities.

As noted earlier, current OSET NTP outputs are only part of the OWMS assessment picture. There are other aspects that can and should be included in the OWMS design and performance assessment. A key component is the land application system (LAS), which may be any of; PCDI fields, LPED irrigation, LPED trenches and beds, engineered mounds, gravity or pump flooded trenches and beds and various other configurations. Different LAS should or should not be matched up with a particular category of treatment plant, ranging from primary treatment (BOD/TSS 150/150) to advanced secondary (BOD/TSS 10/10) and the other categories within this range. A key design requirement of the LAS is an assessment of the overall wastewater hydraulic balance (**Figure A1**) which will inform the required LAS land area requirement. A key consideration is the appropriate site-specific design loading rate at the infiltration zone and in particular the **hydraulic loading rate** based on the long-term acceptance rate (**LTAR)**, and for some designs, the **organic loading rate**, based on BOD, and for some sites, nutrient loading. The long-term acceptance rate (LTAR) informs the recommended DLR and DIR values as presented in AS/NZS1547. LTAR has been shown to be a function of applied effluent BOD and TSS. (Laak, (1986)[1] and more recently Siegrist (2017)[2]).

Figure A1 . LAS wastewater hydraulic balance components



[1] Laak, R.H. 1986. Wastewater engineering design for unsewered areas. Technomic Publishing, Pennsylvania).
[2] Siegrist R.L. 2017. Decentralized Water Reclamation Engineering, A Curriculum. Springer International Publishing.

For the purposes of demonstrating a point, **Table A1** below offers LTAR values for different BOD/TSS values for the applied wastewater. Column 1 is the **DLR** as defined in AS/NS1547:2012 (p13). This is the LTAR for primary effluent (BOD/TSS 150/150). In columns 2 to 6 inclusive, I have calculated the corresponding LTAR (based on Laak, 1986) for other values of effluent BOD/TSS. Secondary wastewater is Column 3.

I have also calculated the corresponding organic loading rate as BOD kg/m^2.day. According the Crites et al 1998 p661[3], a BOD areal loading rates in excess of 0.05 kg/m^2.day is considered too high for sustained performance of a soil soakage system.

Note that **Table 1** relates to DLR. A similar table could be developed for DIR as referred to in AS/NZS1547:2008 Table M1.

It needs to be noted that, in addition to other water balance considerations, a designer of an OWMS may need to consider more than the hydraulic and organic loading to soil as in the above table. For example, if risk mitigation requires UV treatment, we will need advanced secondary pre-treatment. As noted earlier I am of the view that if the land application system is to be a PCDI field we should be requiring a mean treatment plant effluent BOD/TSS of at least 15/15 to ensure a long service life (15+yrs) of the dripper line field. If the LAS distribution system is an LPED system, it can be acceptable practice to pre-treat to a lower standard such as primary or improved primary.

As noted there are treatment plants on the market that will produce a range of mean effluent qualities in terms of parameters such as BOD, TSS, FC, TN, TP….other. Depending on site circumstances (risks, constraints, attributes……) a competent designer can apply best practice engineering principles to determine the level of pre-treatment appropriate for the specific risk mitigation and amenity requirements and resultant OWMS design. There is no reason why a BOD/TSS of 150/150 could not be an appropriate and optimal fit and consistent with AS/NZS1547:2012 requirements for the specific site circumstances. A critical part of the information the competent designer requires is credible, and preferably independent, treatment plant **performance data for their design and risk assessment modelling**. And this is the service OSET NTP is well set up to offer.

[3] Crites, R and G Tchobanoglous. 1998. *Small and decentralised wastewater management.* McGraw Hill.

Table A1

		Longterm acceptance rates LTAR		Max BOD loading		0.05	kg/m².day
		1	2	3	4	5	6
		150/150 DLR 1°	BOD/TSS 50/50	20//30 DLR 2°	BOD/TSS 15/15	BOD/TSS 10/10	**BOD/TSS 5/5**
			Calculated using Laak (1986)				
1	L/m².day	5	7	9	11	12	16
	BOD kg/m².day	0.00075	0.00036	0.00018	0.00016	0.00012	0.00008
2	L/m².day	8	12	15	17	20	25
	BOD kg/m².day	0.0012	0.00058	0.00029	0.00026	0.00020	0.00012
3	L/m².day	10	14	18	22	25	31
	BOD kg/m².day	0.0015	0.00072	0.00036	0.00032	0.00025	0.00016
4	L/m².day	15	22	27	32	37	47
	BOD kg/m².day	0.002	0.00108	0.00054	0.00048	0.00037	0.00023
5	L/m².day	20	29	36	43	49	62
	BOD kg/m².day	0.003	0.0014	0.00073	0.00065	0.00049	0.00031
6	L/m².day	25	36	45	54	62	78
	BOD kg/m².day	0.00375	0.0018	0.00091	0.00081	0.00062	0.00039
7	L/m².day	30	43	54	65	74	93
	BOD kg/m².day	0.0045	0.0022	0.00109	0.00097	0.00074	0.00047
8	L/m².day	35	50	64	75	86	109
	BOD kg/m².day	0.00525	0.0025	0.00127	0.00113	0.00086	0.00054
9	L/m².day	40	58	73	86	99	124
	BOD kg/m².day	0.006	0.0029	0.00145	0.00129	0.00099	0.00062
	Where 150/150, 50/50 etc refers to BOD/TSS						
		Primary	**Advanced Primary**	**Secondary**	**Advanced secondary C**	**Advanced secondary B**	**Advanced secondary A**

Reference: Laak, R.H. 1986. Wastewater engineering design for unsewered areas. Technomic Publishing, Pennsylvania).

AS/NZS1547:2012

TABLE L1

RECOMMENDED DESIGN LOADING RATES FOR TRENCHES AND BEDS

Soil category	**Soil texture**	**Structure**	**Indicative permeability** (K_{sat})(m/d)	**Design loading rate (DLR)** (mm/d)			
				Trenches and beds			**ETA/ETS beds and trenches**
				Primary treated effluent		**Secondary treated effluent**	
				Conservative rate	**Maximum rate**		
1	Gravels and sands	Structureless (massive)	> 3.0	20 (see Note 1)	35 (see Note 1)	50 (see Note 1)	(see Note 4)
2	Sandy loams	Weakly structured	> 3.0	20 (see Note 1)	30 (see Note 1)	50 (see Note 1)	
		Massive	1.4 – 3.0	15	25	50	
3	Loams	High/ moderate structured	1.5 – 3.0	15	25	50	
		Weakly structured or massive	0.5 – 1.5	10	15	30	
4	Clay loams	High/ moderate structured	0.5 – 1.5	10	15	30	12
		Weakly structured	0.12 – 0.5	6	10	20	8
		Massive	0.06 – 0.12	4	5	10	5
5	Light clays	Strongly structured	0.12 – 0.5	5	8	12	8
		Moderately structured	0.06 – 0.12		5	10	5 (see Notes 2, 3, & 5)
		Weakly structured or massive	< 0.06			8	
6	Medium to heavy clays	Strongly structured	0.06 – 0.5	(see Notes 2 & 3)			
		Moderately structured	< 0.06				
		Weakly structured or massive	< 0.06				