Anticompetitive and outdated: The $250 million economic cost of Standards Australia's AS1546.3:2017

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About

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This report has been prepared for Advanced Enviro-Septic (AES) to estimate the economic cost to Australia of excluding advanced passive secondary domestic wastewater treatment systems from the market due to high minimum hydraulic treatment capacity requirement in Standards Australia's AS1546.3:2017.

The opinions in this report are those of the author and do not represent the views of any of their affiliated organisations. Any errors or omissions are the responsibility of the author.

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Summary

1. Adopting the new AS1546.3:2017 standard developed by Standards Australia will exclude low-volume advanced passive secondary wastewater treatment systems from the domestic market because of its 1,200L/day minimum hydraulic treatment capacity requirement.
2. This standard means that many households will require larger systems than needed to meet environmental benchmarks, coming at a significant cost, especially as 1,200 L/day systems will not fit on many small housing lots.
3. Scalable advanced passive systems, like Advanced Enviro-Septic (AES) and other modern alternatives, become much less cost-effective at these unnecessarily high minimum capacities. As such, old style aerated wastewater treatment (AWT) systems will be the main type of system for domestic secondary wastewater treatment in Queensland.
4. Removing access to the market for widely used low-volume advanced passive systems that exceed all environmental standards will raise costs to Australian households, reduce competition, and inhibit the adoption of new technology.
5. **The additional installation cost of a high-volume old style AWT system compared to a low-volume AES system is estimated to be $5,000 per household on average.**
6. Because old style AWT systems have mechanical aeration and pumping, electronic controls, and frequent servicing, these systems have higher ongoing costs of around $1,000 per year per household.
7. In addition, regulatory costs of reporting and monitoring old style mechanical AWT systems are estimated to be $2,200 per system in present value terms.
8. **The total economic cost from installing a larger old style AWT system to meet the minimum hydraulic capacity is estimated to be $22,850 in present value terms.**
9. The total market for on-site domestic secondary treatment systems in Australia is estimated to be approximately 30,000 new and replacement systems per year.
10. We offer a range of scenarios of the total Australia-wide economic cost of AS1546.3. Our low scenario assumes 50% of ST systems are low-volume, and of these, 30% are advanced passive systems. This gives a cost estimate of $106 million per year. Our high scenario assumes 90% low-volume systems, of which all are passive, resulting in a $637 million per year economic cost.
11. **Our central scenario is that the likely annual economic cost is $248 million per year Australia-wide.**
12. This seemingly small change to legislated standards is likely to impose high economics costs while reducing competition and excluding more efficient current (and potential future) technologies from the wastewater treatment market.
13. We also show how in certain situations, like the Southern Moreton Bay Islands, advanced passive systems can offer an economical secondary treatment solution in areas where installing centralised wastewater treatment is enormously costly and small housing lots are common.

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Background

An updated Australian Standard, AS1546.3:2017, is to apply in most Australian states from January 2021 and in Queensland from January 2024.[1] The new standard intends to create a "contemporary, streamlined and flexible legislative scheme for plumbing and drainage."

However, the standard fails to account for the breadth of contemporary technologies being used successfully in domestic secondary treatment (ST) wastewater systems, such as the Advanced Enviro-Septic (AES) and other passive treatment systems. While the Queensland bill notes the administrative costs of implementation, it does not consider costs imposed on the community—either residents, businesses, plumbing professionals, or regulators.

One item of concern is that the revised AS1546.3:2017 requires a minimum hydraulic treatment capacity of 1,200L/day for any complying ST system. The previous standard, AS1546.3 2008, applied only to domestic aerated wastewater treatment (AWT) systems, required no minimum flow, and allowed up to a maximum flow of 2,000 L/day.

The new standard now captures passive ST systems such as AES that are currently operating successfully in Queensland under a Chief Executive Approval per the Queensland Plumbing and Wastewater Code (QPWC) and several other States, except Victoria.[2] No State has undertaken a Regulatory Impact Statement (RIS) to determine the cost to business and consumers of the revised 2017 standard.

The AES system, and most other advanced passive systems, are suitable for low-volume domestic treatment, almost universally below the new 1,200L/day threshold. Only 54 of over 4,000 AES systems installed since 2011 were above this threshold, whereas over 2,500 installed AES systems were sized at 750L/day or less.[3] As such, this change to the standards will eliminate suppliers of advanced passive systems from the market, undermining competition and impeding technological innovation. With these reduced choices, households will face substantial additional upfront and ongoing costs to install ST systems that are compliant with the new AS1546.3 standard.

This report assesses the economic cost to Australian households from adopting the new standard without modification. If States do not choose to independently (a) set a lower minimum hydraulic capacity, or (b) retain alternative approvals to allow low-volume systems access to the market, they will stifle competition and eliminate low-cost, low-risk, advanced treatment plants from the market to the detriment of Australian residents while benefiting suppliers of old style AWT systems.

Briefly, we find that eliminating low-volume advanced passive systems adds $20,650 of costs in present value terms to each household and $2,200 in regulatory costs for

[1] See https://www.parliament.qld.gov.au/Documents/TableOffice/TabledPapers/2018/5618T190.pdf
[2] In Queensland, AES has a Chief Executive Approval that expires on 1 January 2024. https://www.hpw.qld.gov.au/__data/assets/pdf_file/0011/11351/chiefexecutiveapproval15-2019.pdf
[3] Company provided sales and design information.

reporting and monitoring of old style mechanical AWT systems. Across the Australian market as a whole, our central scenario is that this adds $248 million in additional economic cost each year.

Household and regulatory cost scenarios

To establish the potential nationwide economic cost of AS1546.3:2017, household-level costs are first established then applied to estimates of the potential market size of advanced passive ST systems across Australia.

The additional cost to a typical household requiring an on-site ST system (both upfront and ongoing costs) is estimated by comparing the two alternatives.

a. An advanced passive system with low hydraulic volumes to match an average-sized Australian household, and
b. An alternative old style AWT system that meets the 1,200L/day hydraulic minimum standard.

Description

The main economic features of the advanced passive systems that differentiate them from AWT systems are that they

1. Have lower upfront installation costs.
2. Require no electricity to operate.
3. Have no mechanical or electrical parts that need maintenance and replacement.
4. Do not require quarterly servicing and reporting to local councils.
5. Do not require chemicals such as chlorine, which can have detrimental environmental outcomes. [4]

These features, coupled with the ability to handle load variability, have made AES systems an attractive option for schools and National Parks, which suffer variability and have high environmental consequences from poor system performance or failure. Most small-scale domestic applications also suffer such variability issues.

Taken together, it means advanced passive treatment technology is a compelling alternative in the market for secondary/advanced secondary treatment systems for Australian households.[5]

Cost inputs

Installation costs vary and depend on the expected system load, soil type, and the location of the system on a site, amongst other factors. However, typical installation

[4] A full description of the AES system is available on the website https://www.enviro-septic.com.au
[5] A full list of ST systems approved in Queensland is at http://www.hpw.qld.gov.au/construction/BuildingPlumbing/Plumbing/OnSiteSewerage/ApprovedSystems/Pages/AdvancedSecondary.aspx

costs can be assessed based on pricing guides and company advice. Table 1 shows cost ranges and typical savings based on AES advice and price guides of AWT systems suppliers.

While taking an average of this range seems sensible, the fact that the new AS1546.3:2017 requires all systems to have a 1,200L/day minimum capacity means that smaller AWT systems will also be unavailable. Average sized and small households will need larger systems regardless.[6] Therefore, the likely upfront cost impact will be the difference between the average AES system ($8,000-$9,000) for a household of 2.5 people, and the larger AWT systems ($10,000-$17,000), or about $5,000 on average.

Table 1: Indicative installation costs for AES and comparison AWT system

Home size	**AWT system**		**AES system**		**Installation**
(bedrooms)	Min	Max	Min	Max	Cost saving
1	$ 10,000	$ 14,000	$ 5,000	$ 6,000	$ 6,500
2	$ 10,000	$ 15,000	$ 7,000	$ 8,000	$ 5,000
3	$ 10,000	$ 16,000	$ 9,000	$ 10,000	$ 3,500
4	$ 10,000	$ 17,000	$ 11,000	$ 12,000	$ 2,000
Comparison		**$ 13,500**		**$ 8,500**	**$ 5,000**

Established suppliers provide price guides of $10,000 to $17,000 for an AWT system appropriate for a four-bedroom house.[7]

Operating costs for most AWT systems include servicing, testing, maintenance (including the replacement of mechanical and electrical parts), and electricity costs. By comparison, advanced passive systems have none of these costs, though all ST system types require periodic desludging. To estimate the cost differences between AES and comparable AWT systems, estimates of these component AWT system operating costs are summarised in Table 2.

Table 2: Indicative ongoing costs for comparison AWT systems ($)

Cost type	**Comparison System**		
	Min	**Max**	**Average**
Maintenance	$ 200	$ 400	$ 300
Servicing, inspections, testing	$ 240	$ 400	$ 320
Electricity cost ($/year)	$ 84	$ 818	$ 382
Total			**$ 1,002**

Maintenance cost estimates come from a combination of guidance from industry operators, parts price guides, and system warranties, which are often 2-3 years for

[6] Only large passive systems designed for five-bedroom homes with town water supply will meet the 1,200L/day capacity.

[7] See for example, http://qwastewater.com.au/faq.php, and https://www.septicsystemsaustralia.com.au/pricing-guide/

mechanical and electrical components.[8] Servicing and testing costs also are informed by these inputs and are therefore indicative of the costs for well-maintained systems.

For electricity costs, we rely upon independent testing conducted by OSET NTP in New Zealand under controlled conditions to determine the annual electricity cost of using alternative AWT systems (calculations are in the Appendix). Taking an average of the range of these costs (none of which apply to advanced passive systems) provides an estimate of $1,002 of annual operating cost savings.

Indirect economic costs

A hidden economic cost that we cannot account for in this analysis is that many households on lots in the 600-800m^2 range and below will not be able to fit a 1,200L/day wastewater treatment system of any type on their lot due to area required for on-site water disposal via absorption trenches or irrigation, as well as boundary setbacks. This constraint would result in housing development being either delayed, denied by councils, or requiring expensive wastewater pump-outs.

Figure 1 shows a real example of the difficulty of fitting large domestic wastewater treatment systems on small blocks while meeting setback requirements. In this situation, a 750 L/day wastewater treatment system designed for a three-bedroom house on town water would only just fit on the 600m^2 block. A 1,200 L/day system and its required reserve area would not physically fit on the site.

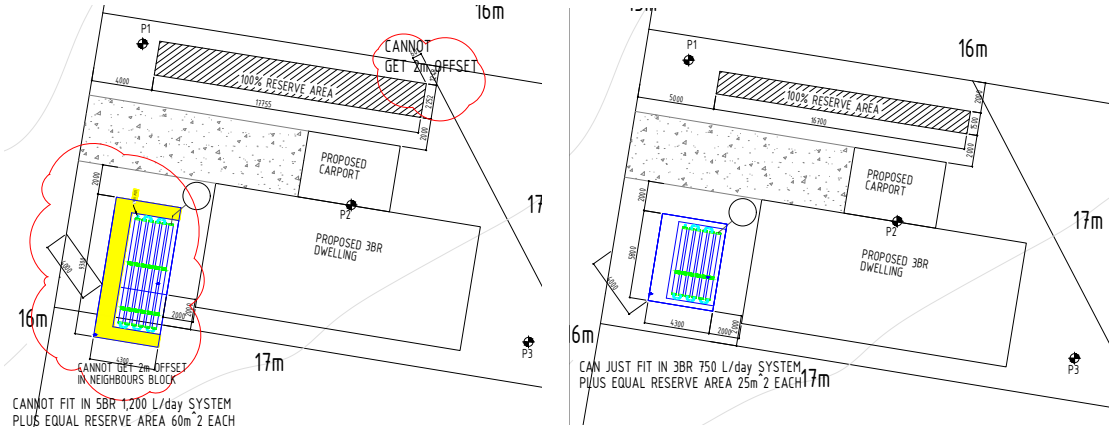

Figure 1: Wastewater treatment area comparison. 600m^2 lot. 1,200L/day vs 750L/day

Regulatory costs

In addition to costs borne by households is the generation of administrative work for councils and the State government from quarterly service reports necessary for the great majority of old style AWT systems. Take Queensland, for example. The

[8] For example, the Taylex tank system has a 3-year warranty on mechanical and electrical components. http://www.taylex.com.au/warranties.html and their cost guidance shows that energy and servicing costs are expected to be $490 per year. http://www.taylex.com.au/Images/Taylex%20ABS%20Energy%20Consumption%20March%202017.pdf

Queensland Building and Construction Commission (QBCC) recovers some of their administration costs at $41.50 per report[9] (or $30.75 for online submission), which over a 25-year period of quarterly reporting is $3,600 nominally per dwelling, or $2,200 in present value terms (taking a $36 average cost).

The total regulatory cost of current old style AWT systems in operation is high. Based on an estimate of 175,000 existing AWT systems in Queensland alone,[10] this implies that 700,000 inspection reports are handled per year, with annual administrative costs of around $25 million. Each new advanced passive ST system means that 100 fewer reports generated over the system lifetime, saving $2,200 in administrative costs.

Demand

Sales data from AES shows the rising demand for lower-cost advanced passive ST systems from households. Company research suggests the reasons for the rapid uptake—now estimated to be 15% of the South East Queensland domestic ST system market—are that the passive systems require no power, no pump, no servicing, and a smaller absorption bed that takes up less area on a property than conventional trenches or irrigation. It is expected that the lower upfront and ongoing costs of these passive ST systems will ensure their continued market penetration.

Total household cost savings

Over a 25-year period[11] these annual costs are around $25,050 in nominal terms, or about $15,650 discounted to present value terms (at a 4% discount rate). Adding on the additional $5,000 in upfront cost savings for each household that could have satisfied their secondary wastewater treatment needs with an advanced passive system rather than an oversized old style AWT system will have avoided costs of $20,650. Regulatory costs to public agencies are an additional $2,200 per system, for a total economic cost of $22,850 per system.

Again, note that indirect costs to small lot owners are not included in these figures.

[9] QBCC form lodgement fees come from http://www.qbcc.qld.gov.au/notifiable-work-plumbing-drainage/manual-lodgement-form-4-notifiable-work

[10] We base this figure on the available Sunshine Coast Council data which shows that 63% of domestic wastewater systems primary, 34% secondary, and 3% holding tanks.

[11] Many AWT system providers provide 15-year warranties on major components such as tanks, suggesting that the typical life of a system is much longer than this if well maintained. Given that our ongoing cost assumption includes recommended maintenance, we have chosen this longer 25-year lifespan. Many systems "in the wild" will not be following strict maintenance guidelines, and hence will often have much shorter lifespans.

Case Study: Moreton Bay Islands

"The biggest fear is sewage. We are on septic here, and we know that when we get to certain levels of density those types of systems can't cope, so we need to look at sewerage and who is going to pay for that."[12]

Queensland's inhabited Southern Moreton Bay Islands—Macleay, Russell, Karragarra and Lamb—grew in population by over 50% in the ten years to 2016 and have continued to develop. These environmentally sensitive islands have no centralised sewer treatment. Each homeowner is required to install their own advanced secondary treatment system.[13]

AES has already installed over 700 residential advanced passive treatment systems on these islands.

While Redland City Council has identified centralised sewerage treatment on these islands as an infrastructure target for over a decade,[14] no works have yet been planned, and residents maintain pressure on the council to deliver these services.[15]

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[12] Ruddick, B. 2020. Coronavirus creates property boom on Southern Moreton Bay Islands as owners take advantage of home-builder grants. ABC Online. 23 September 2020. https://www.abc.net.au/news/2020-09-23/coronavirus-creates-property-boom-on-southern-moreton-bay/12688686

[13] See http://www2.redland.qld.gov.au/FormsPermits/FormsDownload/Documents/Plumbing/CSBPS019%20On-Site%20Sewerage%20Treatment%20Facility%20and%20Guideline.pdf

[14] See these review documents. http://www2.redland.qld.gov.au/PlanningandBuilding/Planning/Studies%20and%20Reports/Documents/SMBI%202030/Draft_SMBI_PLUS_Review_Principles.pdf and http://www2.redland.qld.gov.au/PlanningandBuilding/Planning/Studies%20and%20Reports/Documents/SMBI%202030/Draft_SMBI_PLUS_Review_Strategies_6_to_10.pdf

[15] Whitlock, S. 2019. Petition calls on Redland council to deliver basic infrastructure to the four Southern Moreton Bay Islands. Redland City Bulletin. 7 October 2019. https://www.redlandcitybulletin.com.au/story/6406101/smbi-residents-still-waiting-on-basic-infrastructure-petition/

The estimated $500 million cost of providing a centralised wastewater service has led to the council seeking alternative solutions. A capital cost of this magnitude is approximately $170,000 per current dwelling. Even if a new centralised system could sustain twice the population and all the commercial wastewater, this cost remains orders of magnitude higher than small scale alternatives with a capital cost of less than $10,000 per dwelling.

One way that wastewater is being managed on these islands is to limit dwelling sizes to ensure that matched on-site wastewater systems can manage the load. However, this approach, along with other water-saving initiatives required for development, means that hydraulic loads are unlikely to meet the AS1546.3:2017 minimums for secondary treatment systems.

Another issue on these islands is that many housing lots, especially on Russell Island, are below 600m^2 in size. This means that a 1,200L/day ST system of any type will not fit on many housing lots, quarantining them from development until a centralised wastewater system is built.

As these islands develop, scalable, low-cost advanced ST systems may provide an economical wastewater treatment alternative to single centralised system. Larger advanced passive systems may be able to service multiple nearby dwellings in a space-efficient manner. Functioning with low water volumes, without power, and the ability to scale to suit local needs, advanced passive ST systems may help solve the Moreton Bay Islands wastewater concerns and allow the islands to develop in a clean, efficient, low-risk manner.

Economic costs

Market size

These household-level comparisons can be scaled up in order to understand the total economic cost to Australian households if low-volume advanced passive ST systems are eliminated from the market. The main input necessary for calculation is the total number of households each year that could make cost savings by purchasing currently available passive low-volume ST systems.

There are two main markets that can be serviced—the replacement of existing domestic wastewater treatment systems and the installation of new systems. The size of the replacement market is potentially quite large. Table 3 shows that there are around 1.5 million Australian dwellings relying on on-site wastewater treatment (either primary or secondary).

How many of these existing systems are candidates for replacement with a low-volume advanced passive system is a difficult figure to establish. Replacements and upgrades will depend on (1) the typical life of current systems, (2) the share of systems that are secondary treatment, and (3) the number of primary treatment systems upgraded to secondary treatment systems.

An indicative range can be established by taking reasonable estimates of each input, such as (1) that the typical system life is 25 years,[16] (2) that the share of secondary

[16] Based on reasoning in Footnote 11 about warranties and maintenance.

treatment systems is 34%,[17] (3) that 10% of primary system replacements involve upgrades to secondary treatment.[18] This provides an estimate of a replacement market for domestic ST systems of around 24,000 per year nationally, which we show in Table 3.

Table 3: Size of Australian domestic on-site wastewater treatment market[19]

State	**Domestic wastewater on-site (%)**	**Total private dwellings**	**Total domestic market**	**Potential domestic ST system market**	
				Replacement	**New**
NSW	8.3	3,059,599	253,947	4,124	1,209
VIC	11.1	1,987,313	220,592	3,582	1,050
QLD	20.5	2,520,912	516,787	8,393	2,460
SA	23.4	765,786	179,194	2,910	853
WA	17.8	1,070,962	190,631	3,096	907
TAS	30.1	241,744	72,765	1,182	346
ACT	3.5	163,286	5,715	93	27
NT	38.7	89,959	34,814	565	166
AUS	**14.8**	**9,899,561**	**1,474,445**	**23,945**	**7,018**

For new homes, we can establish the market by knowing the growth rate of the dwelling stock and the proportion of new dwellings requiring on-site ST systems. Between 2011 and 2016 the number of Australian dwellings increased by 7.2%, implying a 1.14% annual growth rate.

If we take the approach of applying the same proportion of on-site ST systems to new dwellings as existing dwellings, this provides an estimate of the new market of 7,000 per year.[20] In total, **it is estimated that the national market is approximately 31,000 new and replacement on-site ST systems per year.**

[17] The majority of on-site domestic wastewater treatment systems are septic (primary). We base this assumption on the available Sunshine Coast Council data which shows that 63% of domestic wastewater systems primary, 34% secondary, and 3% holding tanks.

[18] The replacement market calculation is (stock of domestic systems/25) x (0.34 + (0.66 x 0.1)). Company-supplied information from AES suggests that upgrades from AWT systems are a large part of the passive ST system market. While this assumption is consistent with company information on customer types, it is highly uncertain. However, our results are not particularly sensitive to this assumption—assuming no upgrades generates a central scenario of a $216 million national cost.

[19] Proportion of dwellings relying on on-site treatment comes from the Australian Infrastructure Audit 2019 – Chapter 9: Water https://www.infrastructureaustralia.gov.au/sites/default/files/2019-08/Australian%20Infrastructure%20Audit%202019%20-%209.%20Water.pdf Number of private dwellings is from ABS Census 2016, and is hence likely to be an underestimate of the current market size due to growth in dwellings.

[20] The new market calculation is (stock of domestic systems x 0.34 x 0.014).

Total cost scenarios

With this total market for domestic ST systems in mind, we can now look to estimate the total national economic cost of eliminating low-volume advanced passive ST systems from the market due to the implementation of AS 1546.3:2017.

To apply the previously estimated $22,850 economic cost to the total market requires two assumptions; (1) the share of total domestic ST systems that could be low-volume, and (2) the market share of advanced passive systems amongst all low-volume systems.

These assumptions are unknowable in advance. What we can do, therefore, is conduct a scenario analysis that generates total economic cost estimates across a range of plausible assumptions. A central case is chosen out of this range without committing to this case alone as the only cost estimate.

Table 4 shows these scenarios.

Table 4: Scenario analysis of annual economic costs to households Australia-wide

Passive ST system market share	**Low-volume share of domestic ST systems**		
	50%	*70%*	*90%*
30%	$ 106,000,000	$ 149,000,000	$ 191,000,000
50%	$ 177,000,000	**$ 248,000,000**	$ 318,000,000
100%	$ 354,000,000	$ 495,000,000	$ 637,000,000

Rounded to the nearest one million.

Each column represents an assumption about the share of domestic ST systems that are low-volume, and each row represents an assumption about the market share of advanced passive systems out of the total low-volume ST system market. The lowest scenario, with only 50% of domestic ST system being low-volume, and only a 30% market share for advanced passive systems, still provides over $100 million per year in economic savings compared to the alternative where these systems would otherwise be required to be high-volume systems due to AS 1546.3:2017.

The highest cost scenario is where 90% of ST systems are low-volume, and the market is fully met by advanced passive systems. Compared to this alternative, implementing AS 1546.3:2017 and eliminating low-volume advanced passive ST systems from the market comes at an economic cost of over $630 million per year.

While it is certainly the case that advanced passive technologies may completely replace old-style mechanically aerated systems over many decades, in the immediate future the market share is likely to remain much lower. Advanced passive systems are estimated to have already captured around 15% market share in South East Queensland within the past ten years. Therefore, we expect a scenario of where advanced passive systems meet 50% of the market for low volume systems, and where low-volume systems meet 70% of domestic requirements, to be a plausible central case for the near-term future.

The central estimate by State

For completeness, we estimate the low and high limits of our scenario range for each State individually, as well as our central estimate, in Table 5.[21] Queensland and New South Wales are likely to face the highest economic cost of AS 1546.3:2017, making up around half of the national on-site domestic ST system market.

Table 5: State scenarios of annual economic costs

State	**Low limit**	**Central estimate**	**High limit**
NSW	$ 18,000,000	$ 43,000,000	$ 110,000,000
VIC	$ 16,000,000	$ 37,000,000	$ 95,000,000
QLD	$ 37,000,000	$ 87,000,000	$ 223,000,000
SA	$ 13,000,000	$ 30,000,000	$ 77,000,000
WA	$ 14,000,000	$ 32,000,000	$ 82,000,000
TAS	$ 5,000,000	$ 12,000,000	$ 31,000,000
ACT	-	$ 1,000,000	$ 2,000,000
NT	$ 3,000,000	$ 6,000,000	$ 15,000,000
AUS	**$ 106,000,000**	**$ 248,000,000**	**$ 637,000,000**

Conclusion

Like many regulations, the devil is in the detail of AS 1546.3:2017. The interaction between the rules pertaining to minimum treatment capacities and the available technologies for small-scale on-site secondary wastewater treatment are in conflict.

We have shown that each low-volume advanced passive system excluded from the market by this new standard will cost individual households around $20,650 in lifetime costs, as well as $2,200 in lifetime regulatory costs (both in present value terms).

The total cost to Australia is around $250 million per year in our central case where low-volume passive systems are able to capture 50% of the market for low-volume domestic secondary treatment systems. However, the potential economic cost range is quite large across our range of plausible scenarios—from $106 million to $637 million per year.

Additionally, we note there are specific cases, such as the Southern Moreton Bay Islands, where scalable advanced passive ST systems offer a potentially more economical advanced secondary wastewater treatment solution than centralised wastewater treatment.

[21] We assume the national average growth rate of dwellings in each state.

Appendix

Electricity use assumptions

Electricity usage figures come from On-site Effluent Treatment National Testing Programme (OSET NTP) of the industry body Water New Zealand, for compliant ST systems.[22] Not all of these systems are available in Queensland, but it is the best source of electricity use figures for systems operating correctly and meeting their quality standards. To estimate the annual electricity cost the regulated Queensland Tariff 11 (off-peak residential) of 23.9c/kWh (in 2020-21 including GST) is applied to the usage figures.[23] Table 6 summarises.

Table 6: Electricity use and costs of AWT systems from OSET trials

Brand	**Model**	**kWh/day**	**kWh/year**	**Cost/year ($)**
Maxitreat	MV-C 3000	8.4	3,066	733
Ecocycle	6300	2.5	913	218
Humes	FR1	5.2	1,898	454
Airtech	7000	2.7	971	232
Supertreat	NZ12	9.6	3,504	837
Aquanova	AWTS	2.4	876	209
Clearstream	TXR1	1.0	358	86
Biocycle	8000	1.4	511	122
Biocycle	8200	6.3	2,300	550
Average				**382**

[22] All OSET NTP results are available at https://www.waternz.org.nz/OSETresults.
[23] Queensland electricity tariffs are taken from the regulatory authority https://www.qca.org.au/project/customers/electricity-prices/regulated-electricity-prices-for-regional-qld-2020-21/