Characterisation of Raw Sewage and Design Implications for Household Sewage Treatment Systems For the Review of AS1546.3:2017 For National Onsite Providers

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Document Control

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EXECUTIVE SUMMARY

This review of the characteristics of domestic raw sewage was undertaken to assist the National Onsite Providers Association in their consideration and input to the review of AS1546.3:2017.

Domestic raw sewage characteristics from national and state standards, guidelines and industry standard design texts were collated and presented, with commentary from the author's experience.

It appears evident that the domestic raw sewage characteristics proposed currently to be adopted in AS1546.3:2017 are significantly stronger than documented in state and national standards & guidelines and industry design texts.

The reliance on one test site to inform the revision of AS1546.3:2017 is in the author's opinion flawed and a wider selection of sites across the nation was recommended to inform this standard.

The consequences of adopting the currently proposed domestic raw sewage characterisation in the standard is likely to result in oversizing of onsite household sewage systems, which apart from being wasteful will make them unreliable and/or unstable and unlikely to achieve their required effluent standards.

Domestic raw sewage characteristics for household systems otherwise are suggested as follows:

	Parameter Range Design
Flow L/person/day	

Res 00-150 150-180 50 180

pH (pH Units) 6-8 6.8

Conductivity (uS/cm) 600-1100 900

Suspended Solids (mg/L) 100-400 250 BOD_5 (mg/L) 150-400 250

Ammonia as N (mg/L) 20-40 30

Total Nitrogen as N (mg/L) 40-60 50 Total Phosphorus as P (mg/L) 5-20 10 Total Oil and Grease <100 50 Total Sulphide (mg/L) 1-10 1

Total Heavy Metals (mg/L) <10 <5

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National Onsite Providers Association Characterisation of Raw Sewage and Design Implications for Household Sewage Treatment Systems For the Review of AS1546.3:2017

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National Onsite Providers Association commissioned Simmonds and Bristow to consider the

changes to AS1547.3:2017 with respect of the characteristation of raw sewage and the design implications for onsite household sewage treatment systems as part of the review of the Australian Standard AS1546.3:2017 On-site domestic wastewater treatment units, Part 3 Secondary Treatment Systems.

The purpose of the review was to;

- clarify the definition of domestic strength sewage
- determine if the test parameters in AS1546.3:2017 represent domestic sewage
- determine what strength sewage might be used to certify Secondary Treatment Systems from AS1546.3:2017
- identify the risks of using a single reference site, such as Jimboomba for design or certification.
- identify possible impacts to consumers required to install Sewage Treatment Systems (STS) to conform with AS1546.3:2017

The review covered the following three key factors;

1. The quality specifications, including both inlet and effluent.
2. The daily flow rate
3. The system design capacity.

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2. CHARACTERISATION OF RAW SEWAGE

2. CHARACTERISATION OF RAW SEWAGE

To design and successfully operate any sewage treatment system, it is critical to determine what the flow and strength of the raw sewage is likely to be. This is a critical input to the design process and to set the design capacity of the plant, as both over and under estimation can cause the process to fail to achieve its treatment objectives.

2.1 Flow

The volume of raw sewage that a treatment plant has to treat is typically set based on the demographic of the population the plant is to service. This considers its water use characteristics and the design of its water uses.

It importantly sets the basis for hydraulic and residence design features of the treatment plant, from bio-reactor volumes, settling areas/volumes and disinfection contact volumes.

In Australia for many decades water restrictions have been imposed due to drought, but otherwise water use and hence sewage generation have been generous.

The millennium drought of 2000-2011 saw a significant shift in the respectful use of water and through a combination of education, new design and service standards, penalty, pricing policy and prosecution; community use of water was reduced significantly and so far, permanently.

Design Guidelines and texts prior to 2000 typically quote sewage generation rates of 225-250L/person/day. Regulatory values in some jurisdictions for an equivalent person (EP) still rely on this value for classifying the design size, developer headworks contribution, etc.

Flows of this magnitude are still experienced across Australia where water use is unconstrained. Typically this includes sectors of the resource industry, older resorts and hotels, and indigenous communities that are not under water restrictions and are more profligate in their use of water.

Design & Plumbing standards (AS3500) and building codes have eliminated a significant amount of wastage of water with the adoption of flow restrictors, functional dual flush toilets, 5 star water saving washing machines etc. The reduction in service supply pressure has also significantly reduced water consumption and water waste.

For example the resort industry that sells a luxuriant lifestyle experience to its guests have historically been profligate water users, with flows to sewer typically 300-400L/EP/day or higher. Modern resorts now typically only generate sewage at the half this rate (150-200L/ep/day) as they have been refurbished and rebuilt to modern design standards and practices, understood the cost to their profit resulting from unnecessarily oversized water and sewage infrastructure, and implemented water wise programmes to offer ecotourism experiences or to simply promote their environmentally friendly credentials, which are becoming more important.

The **Sewer Code of Australia** provides a demographic and geographic/climatic based design process to determine sewage flow, but otherwise recommends a design value of **150-180L/ep/day, excluding infiltration**.

AS/NZS1547:2012 – On-Site domestic wastewater management – which deals with land disposal of treated effluents for small systems up to 10EP or 14,000L/week. On a daily basis this is 140L/EP/day. This standard provides for different daily flows based on water supply source, stating

(Appendix H) **120L/ep/day** for onsite roof water tank supply and **150L/ep/day** for a reticulated

supply, with typical provision for the makeup of this flow including allowances for water closets, hand basins, showers, bath and laundry.

Earlier versions of AS1547 provided flow allowances for different facilities, such as caravan parks, restaurants, schools, etc. The current version still provides these allowances, which remain applicable in any jurisdiction, though the standard provides for them for New Zealand use only.

Current **Design Guidelines** issued by major water utilities also provide for sewage generation at a rate of 150-180L/ep/day as do local council planning schemes.

Design texts that set industry design practice such as Metcalf & Eddy equally recognise that modern water flows to sewer have reduced but still provide for 150-300L/ep/day (typically 250L/ep/day) to estimate raw sewage flows based on primarily US experience.

The author's experience is that small on-site systems typically exist in environments, such as rural, rural residential, country living, etc. where block sizes are greater than 1000m^2 and households are more resource conscious. Wasting water in this situation is generally expensive and either unaffordable or impractical.

Measured water consumption, whilst variable, reports between 100-200L/person/day. Under water restrictions, water consumption in regional and remote communities can drop to as little as 50L/ep/day with most going to sewer. Qld Urban utilities report similar ranges across its network suburb to suburb.

The consistent current day **design point** required and/or discussed in guidelines, standards and planning instruments and from our operational experience is that sewage flows in **reticulated** communities are typically circa **150-180L/ep/day** or better and communities on **tank or restricted water supplies** (or water restrictions) are typically bettering **100-120L/ep/day**.

The daily water consumption flows reported most recently in the papers for SE Qld is 180-200L/ep/day and water authorities are asking the community to reduce water use to avoid water restrictions being imposed. Sewage flows can be expected to be lower than this by at least 10-20%.

The flow characteristic can then be estimated based on dwelling design population. A common method is to count the number of bedrooms and allocate the population as – Nº of bedrooms+1. Equally for communities that under and over populate their dwellings, such as affluent holiday or urban communities and indigenous communities respectfully, it is more appropriate to rely on community dwelling occupancy rates such as persons/dwelling – typically 2.2 persons/dwelling for upmarket holiday, 2.8 persons/dwelling for urban and as high as 5-10 for indigenous communities.

The variability of the flow is also important to understand, particularly where it has season and event impacts.

Seasonal impacts, both highs and lows, impact the performance of the plant requiring it to process

the sewage faster (higher flow) or slower (lower flow). Bigger catchments are typically less

impacted by seasonal flow, where small plants servicing single use (e.g. a sport ground) or household catchments are heavily impacted by seasonality, being potentially overloaded or starved during holidays and festive seasons when occupancy varies. Small plants invariably do not respond well to these variations, requiring direct intervention to address plant failures.

Event impacts, typically associated with stormflows, require acute design responses, such as sizing clarification stages for 3 and 5 times average dry weather flows (3-5ADWF). This can be accounted for within the design, making process tanks larger in response.

Bio-reactors are more difficult, as significant over-sizing of a bioreactor can lead to its failure, though modern trends with small systems incorporate increasing use of fixed or suspended media in aerobic bio-reactors to minimise the impact of flow washouts. Flow balance tanks are also used commonly to smooth peak flows and stabilise acute flow variations.

Other flow characterisation techniques can be used, even to the extent of accounting for size of households and each fitting and fixture that generates sewage as well as the number and duration of use. The flexibility of the approach should always be allowed to provide for bespoke designs.

2.2 Physical/Chemical Characteristics (Strength) of Domestic Sewage

The chemical characterisation of domestic raw sewage is an important consideration as it determines the size of treatment components beyond the hydraulic and residence time considerations for flow.

Important physical and chemical constituents of domestic raw sewage include: (a) pH – represents the acidity or alkali condition of the sewage; (b) Alkalinity – represents the buffering capacity or the ability to resist pH changes; (c) Conductivity – affects oxygen demand, osmotic impacts, suitability for irrigation/disposal; (d) Suspended Solids – affects sludge generation and solids handling requirements;

(e) Biochemical Oxygen Demand & Chemical Oxygen Demand – affects oxygen demand & aeration requirements, waste sludge generation;

(f) Ammonia Nitrogen – impacts oxygen and alkalinity demand;

(g) Total Nitrogen – is an essential nutrient, also impacts oxygen demand and sludge generation;

(h) Ortho & Total Phosphorus – is also an essential nutrient and impacts sludge generation;

(i) Total Oil & Grease – impacts residual oxygen demand, scum formation, and sludge

generatıon;

(j) Total Sulphides – Causes odours and impacts oxygen demand;

(k) Heavy metals and Hydrocarbons – impacts effluent toxicity and suitability for irrigation/disposal.

Raw sewage, domestic or otherwise, does not have a stable consistency and these parameters can vary widely hour to hour and day to day.

For good design of a treatment plant it is important to estimate a design average or norm as well as understand and provide for the range of variation to account to for peak capacity; it is not typical to adopt the maximum parameters as the basis of the design; these are generally used for sensitivity analysis and challenge testing.

Whilst it is typical to quote concentration ranges in characterising the physiochemical quality of raw sewage, the design point concentrations are also typically quoted as either a concentration or a mass load in g/day. The design point also informs the bias for strong or weak sewage.

A typical domestic sewage from experience and supported by design guidelines/texts would be: **Table 1: Typical Physiochemical Properties of Domestic Sewage**

Parameter	Range	Design
pH (pH Units)	6-8	6.8
Conductivity (uS/cm)	600-1100	900
Suspended Solids (mg/L)	100-400	250
BOD_5 (mg/L)	150-400	250
Ammonia as N (mg/L)	20-40	30
Total Nitrogen as N (mg/L)	40-60	50
Total Phosphorus as P (mg/L)	5-20	10

Alkalinity is dependent on raw water source but typically would be around 200-300mg/L.

Oil and grease is very dependent on the population diet but would typically be less than 100mg/L and total heavy metals typically less than 10mg/L.

3. DEFINED CHARACTERISATION OF DOMESTIC WASTEWATER

Various standards offer formal definitions of domestic wastewater/sewage. Table 6, provided in Appendix A, summarises the definitions provided from more common standards for ease of comparison..

3.1 Comparison of definitions

As seen in Table 6 in Appendix A, there are several contradictory definitions both within the AS1546.3:2017 and between different standards.

3.2 Toilet Blocks and Urinals

AS1547:2012 and AS1546.3: 2017 both include urinals in the definition of the source for domestic wastewater; however, urinals are excluded explicitly in AS1546.3: 2017.

The exclusion reads, '*The standard does not cover treatment systems for toilet amenity blocks, single toilets (with or without hand basins) or urinals*.'

This exclusion may be a misrepresentation in grammar within AS1546.3: 2017, for example, if the exclusion meant to reference that the standard does not cover a single urinal.

If this is correct, the ambiguity should be rectified to clarify the exclusion to the end-user.

The exclusion for toilet amenity blocks is also

The exclusion for toilet amenity blocks is also

ambiguous as to whether these are only free standing toilet blocks (without additional water source), or whether toilet blocks within facilities or institutions are excluded, leading the reader to their interpretation.

Facilities serving staff/employees/residents in institutional, commercial and industrial establishments often provide toilet facilities in what the general public would define as toilet blocks.

If the exclusion means only to exclude free-standing toilet blocks then this should be rectified to clarify the exclusion to the end-user.

3.3 Design Flows per day

The definitions for the design flow criteria for on-site systems vary significantly between references.

AS1547:2012 provides no minimum criteria, but a non-conclusive statement indicating '*Systems covered in the standard are normally designed for domestic wastewater flows up to 14,000 L/week, from a 10 EP population*.' This flow is equivalent to 2,000 L/day and indicates a maximum of 200 L/p/day.

AS1546.3: 2017 states '*STS covered by this standard are those designed to treat maximum domestic wastewater flows of between 1,200 L/day and 5,000 L/day*', yet in the same standard, the definition of a domestic scale treatment system is a system designed to treat ≤ 3,000 L/day. As AS1546.3: 2017 states a minimum daily flow of 150 L/p/day the range of 1,200 L/day and 5,000 L/day calculates to between an 8 EP and 33 EP populations.

The definition of a domestic scale treatment system designed to treat ≤ 3,000 L/day, which calculates to 20EP and matches with criteria that trigger an Environmental Authority in Queensland (ERA 63 – 21EP – 100EP). However, in other Australian states, these triggers differ and may be the cause of the discrepancy in daily flow rates and Equivalent Persons in various references.

4. SEWAGE QUALITY – PHYSICOCHEMICAL CHARACTERISATION

Different types of wastewater generate a wide variety of constituents, and as such, it is common to characterise wastewater in terms of its physical, chemical and sometimes biological parameters.

4.1 Influent Standards

The graphs provided in Section 3.1 provide a summary of the review and comparison of Australian Standards, Industry accepted references, state regulators and other guidelines for domestic sewage influent parameters.

The most noticeable difference between the various standards, guidelines and design texts is that waste water that is not described as domestic waste is generally described, in chemical terms, as stronger.

AS1546.3:2017 stands out as describing domestic sewage as high strength sewage, more typical of trade waste or resort wastewater as described by others.

This information is presented in tabular form in Appendix B.

Capacity (L/p/day)

500

Figure 1: Typical Raw Sewage Flow Generation Rates

Raw Sewage

Concentration Values

TSS (mg/L)

800 700 600 500 400 300

200 100 0

BOD (

800 700 600 500 400 300

200 100 0

Figure 3: TSS Typical Raw Sewage Concentration Values

Figure 2: BOD Typical

Figure 5: TP Typical Raw Sewage Concentration Values

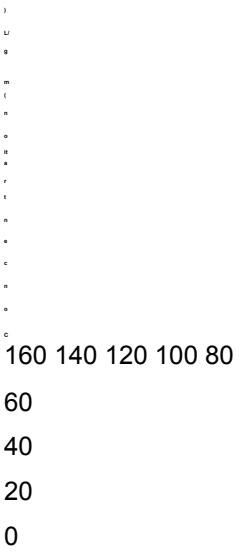


Figure 4: TN Typical

Raw Sewage

Concentration Values

TP (mg/L)

45

Figure 6: BOD, TSS, TN, TP Typical Raw Sewage Loading Rates

The variability in the raw sewage is typically related to diet and management of food waste. The author's experience with communities that that have large portions and rich food diets as well as

author's experience with communities that that have large portions and rich food diets as well as

communities with poor diet but significant fast food or fried food in their diet produce much stronger sewage by a factor of 1.5-2 times.

This is also true with the use of in-sinkerators or in sink macerators for waste food management. These devices can easily increase the strength of the sewage in terms of BOD5, Suspended Solids and Organic Nitrogen by factors of 2-10 times depending on mass and consistency of food being disposed of via the sink. The value of this waste as an energy resource is demonstrated by the embedded community biogas plants that generate sufficient biogas to power public transport (Europe), winter heating (South Korea) and industrial processes (Sydney). Metcalf & Eddy indicate an increase in BOD5 of some 23 g/capita/day or 30-35% due to in-sink macerators in the USA.

The variability of community cultural and dietary practices is clearly demonstrated in review by reference to Metcalf and Eddy (6th Ed Table 3-14 pp 216). The range across countries and cultures is considerable on a mass loading per capita per day, with the US the highest and Asiatic countries the lowest. Richer countries also waste more to sewage. Allowance for these variances is evident.

Table 2 – Typical constituent data for various countries - - Reproduced from Metcalf & Eddy 6th Ed Table 3-14 and flow data for AD2000 from Table 3-10

Country	BOD g/capita/day	TSS g/capita/day	TKN g/capita/day	NH3-N g/capita/day	Total P g/capita/day	Flow L/capita/day
Brazil	55-68	55-68	8-14	ND	0.6-1	ND
Denmark	66-68	82-96	14-19	ND	1.5-2	110-150#
Egypt	27-41	41-68	8-14	ND	0.4-0.6	200^
Germany	55-68	82-96	11-16	ND	1.2-1.6	156
Greece	55-68	ND	ND	8-10	1.2-1.5	350
India	27-41	ND	ND	ND	ND	129
Italy	49-60	55-82	8-14	ND	0.6-1	ND
Japan	40-45	ND	1-3	ND	0.15-0.4	ND
Palestine	32-68	52-72	4-7	3-5	0.4-0.7	200^
Sweden	68-82	82-96	11-16	ND	0.8-1.2	110-150#
Turkey	27-50	41-68	8-14	9-11	0.4-2	200^
Uganda	55-68	41-55	8-14	ND	0.4-0.6	ND
United States		50-120	60-150	9-18	5-12	1.5-4.5 380

Inferred from neighbouring Norway & Germany

^ Inferred from Saudi Arabia & Kuwait data

4.2 Effluent Standards

Effluent standards are generally consistent across State and National standards and guidelines for On-site sewage treatment systems. These results are typical of secondary effluent that would likely to be achieved by modern technology that is well operated and well maintained.

The graphs below provide a comparison between the various standards. This information is presented in tabular form in Appendix C.

35
30
25
20
15
10
5
0

Figure 7: BOD

Effluent Standard

50
45
40
35
30
25
20
15
10
5
0

Comparison TSS

(mg/L)

BOD (mg/L)

c

n

Effluent Standard Comparison

Figure 8: TSS

8

6

4

2

0

AS1546:2017 – Secondary Effluent (Max)

TN (mg/L)

16

14

12

10

AS1546:2017 – Advanced Secondary (Max)

QPWC Advanced Secondary Effluent (90%)

Figure 9: TN Effluent Standard Comparison

for STS's equipped with TN Removal TP (mg/L)

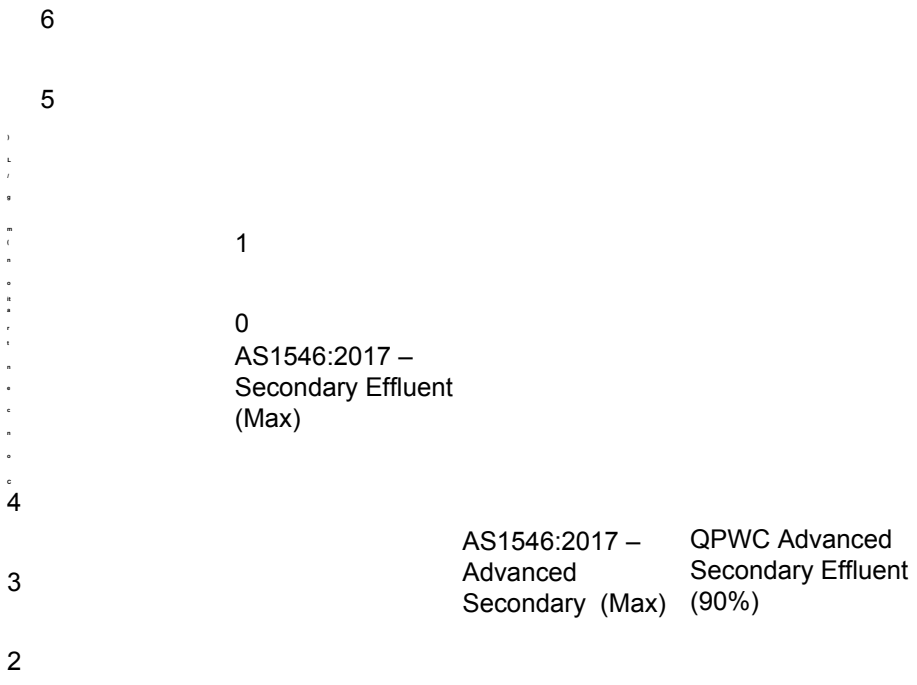


Figure 10: TP Effluent Standard Comparison for STS's equipped with TP removal

Coliforms (org/100mL)

QPWC Secondar Secondar Secondar STD, Secondar y effluent
nt Surface y effluent (80%)
) irrigatio (Median)
n NT Health
c NT Health Secondar

Figure 11: Thermotolerant Coliform Effluent Standard Comparison

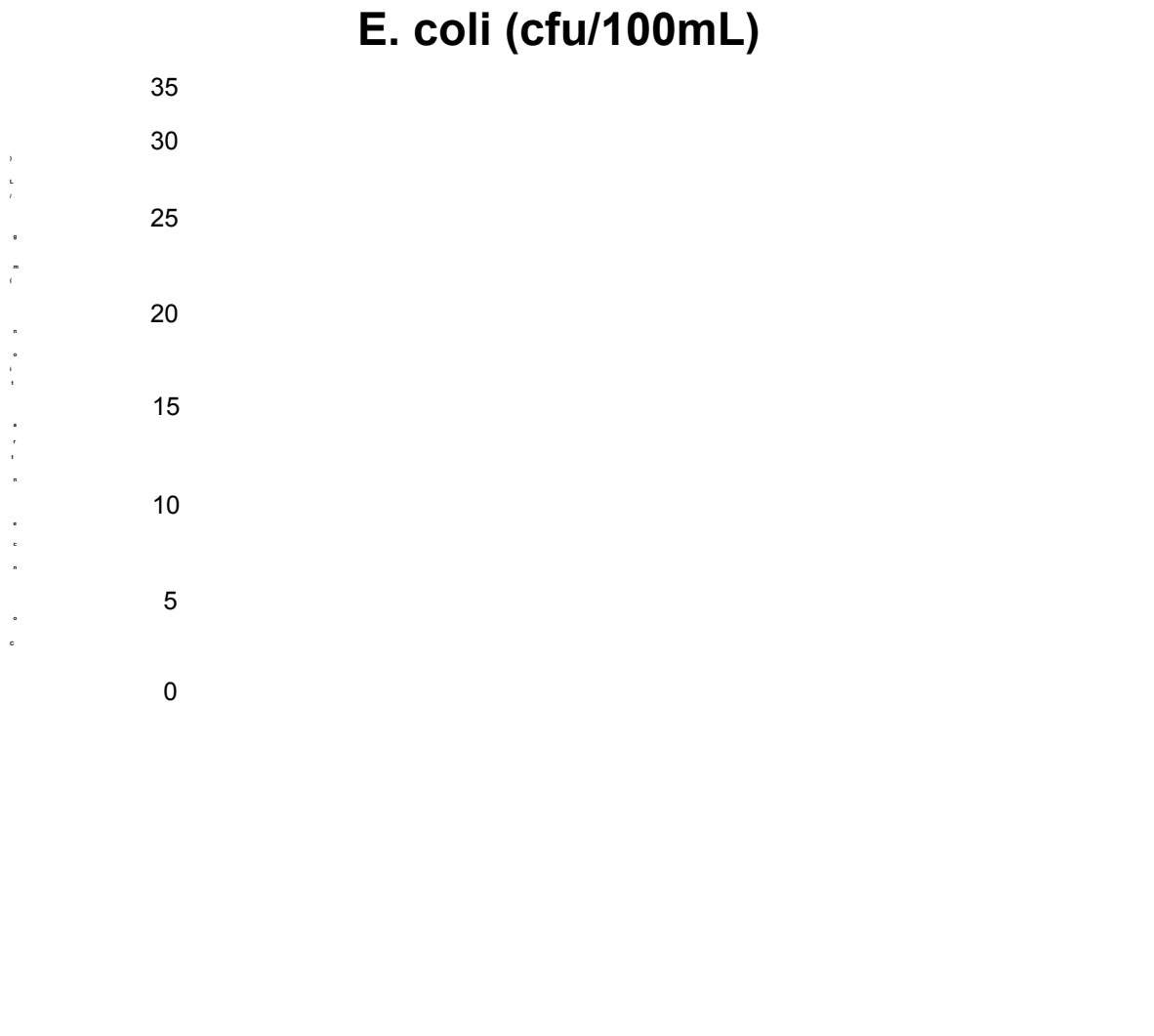


Figure 12: E. coli Effluent Standard Comparison

(FAC, mg/L)2.5

2

1.5

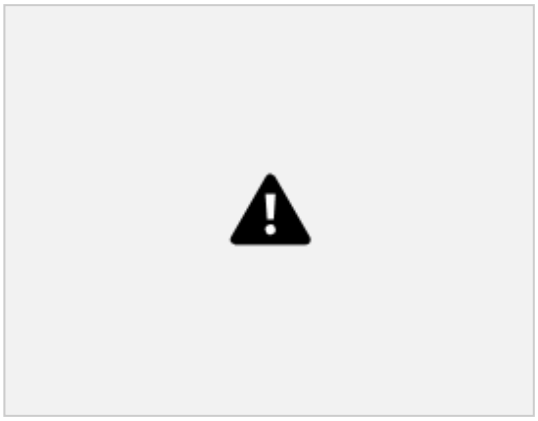
1

0.5

0

Free Chlorine

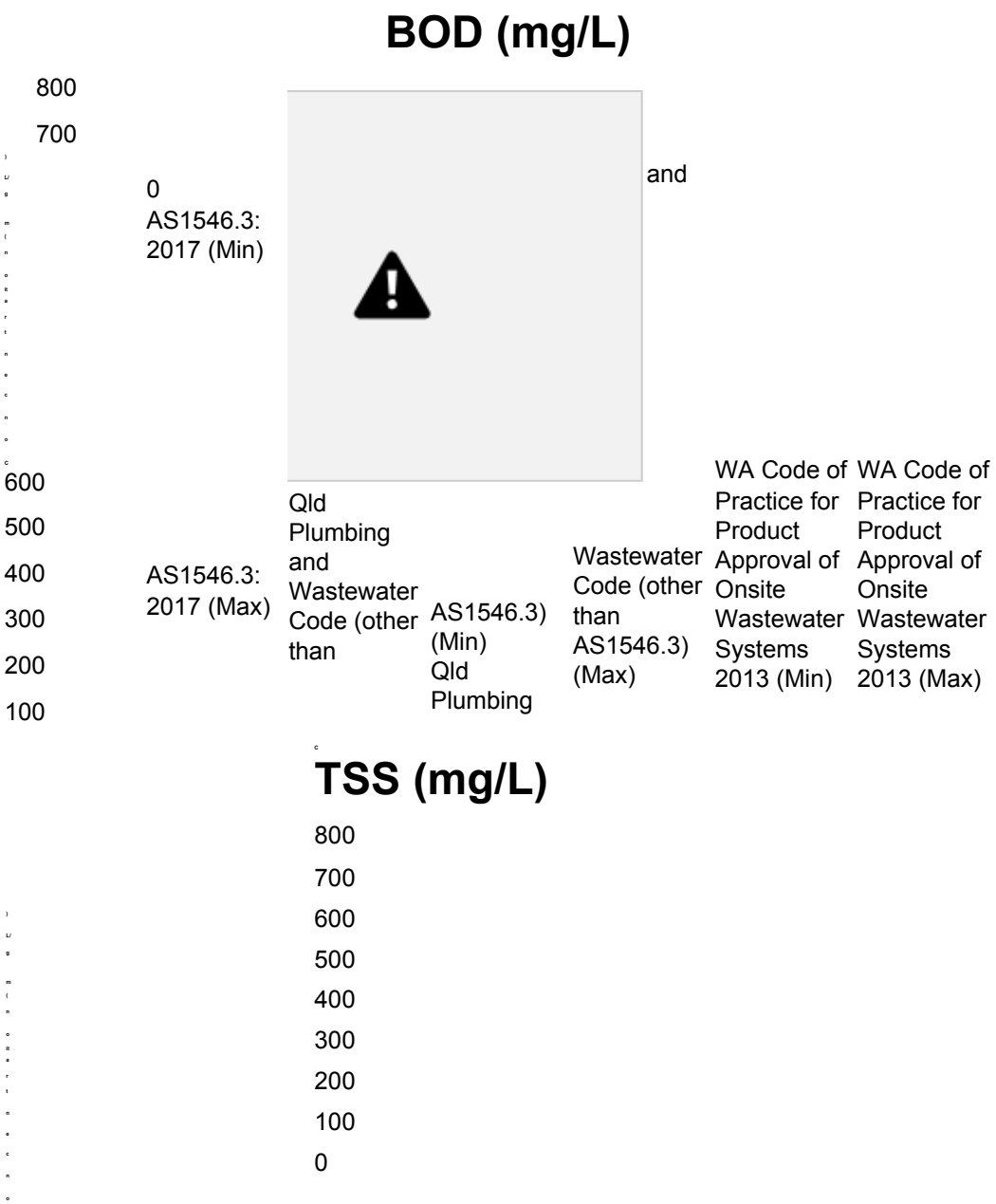
Figure 13: Free Chlorine (Disinfection) Effluent Standard Comparison

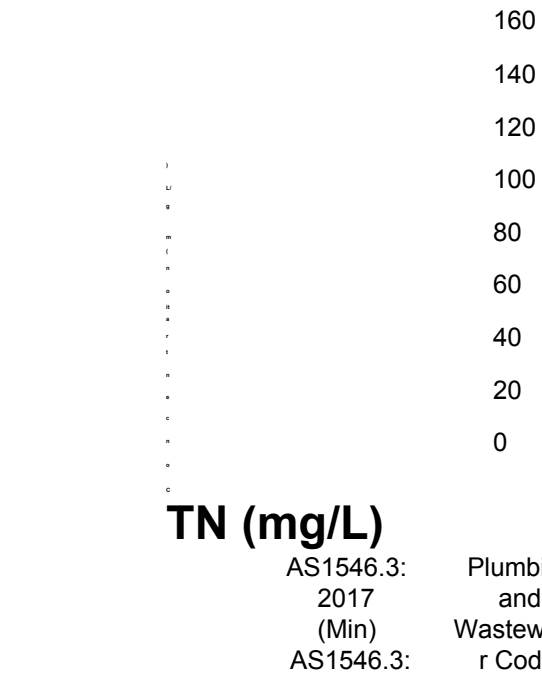


4.3 Test Conditions

Test conditions for assessing the performance of on-site sewage treatment systems are summarised in the graphs below. This data is provided in tabular form in Appendix D.

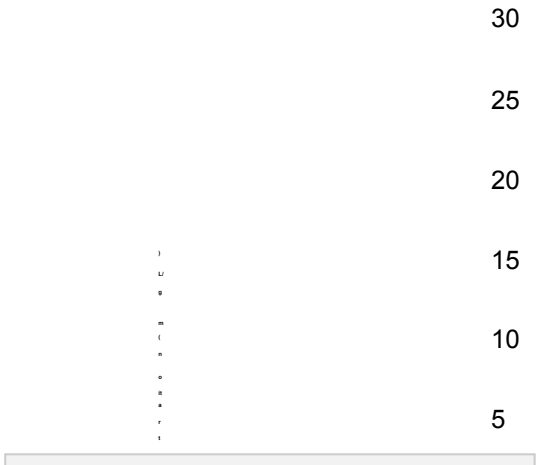
AS1546.3 is notable in having significantly higher raw sewage maximum concentrations than the other two standards that provide concentration requirements. AS1546.3 also requires the longest commissioning time.





TN (mg/L)

AS1546.3: 2017 (Min)
AS1546.3: 2017 (Max) Qld
Plumbing and Wastewater Code (other than AS1546.3) (Min)
Qld Plumbing and Wastewater Code (other than AS1546.3) (Max)
WA Code of Practice for Product Approval of Onsite Wastewater Systems 2013 (Min)
Wastewater Systems 2013 (Max)



TP (mg/L)

AS1546.3: 2017 (Min)
AS1546.3:
Qld Plumbing and Wastewater Code (other than
Qld Plumbing and Wastewater Code (other than
WA Code of Practice for Product
Onsite Wastewater Systems 2013

2017 (Max) AS1546.3) (Min) AS1546.3) (Max) Approval of

Coliforms (MPN/100mL

1.20E+09

1.00E+09

8.00E+08

6.00E+08

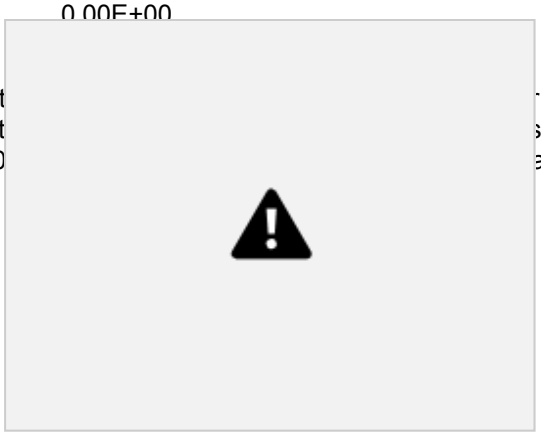
4.00E+08

2.00E+08

0.00E+00

E.Coli or Thermotolerant

WA Code of Pract · Product Approval of Onsit stewater Systems 20 ax)



Period of Testing (weeks)

45

40

35

30

25

20

10	0	
5		
AS1546.3: 2017 Qld Plumbing and Wastewater Code (other than AS1546.3)	Commissioning periods are upward of 8 weeks. WA Code of Practice for Product	Approval of Onsite Wastewater Systems 2013 NSW Domestic greywater treatment system accreditation guidelines 2005

4.4 Jimboomba test facility data

Table 5 below summarises the statistics from test data provided from the Jimboomba STP test site in Queensland.

Table 3: Statistics from STP test site Jimboomba Queensland (10/01/17 to 15/05/19)

Standard Flow	**BOD_5**	**TSS**	**Total Ammonia**	**Total Nitrogen**	**pH**	**Total Phosphorus**
Units	**L/day**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**pH**
Average	512	503	60	81	10	8
Median	460	470	62	80	11	8
Minimum	5	68	30.5	37.3	2.22	6.8
Maximum	1190	1590	95	119	17	8

It is evident from these results that the Jimboomba STP influent is, in the author's view, atypical of normal domestic sewage being stronger than otherwise experienced in their experience and documented in standards, guidelines and texts.

The documented strength of the Jimboomba sewage is more typical of resort style raw sewage containing significant liquefied food wastes and urine derived wastewater from day trippers and alcohol consumption.

If this physiochemical characterisation of sewage was relied on for the design of small domestic on-site sewage treatment systems, it is probable that the systems would be significantly over designed and consequently unstable to operate successfully due to tankage and aeration systems being too large.

5. IMPACTS ON ONSITE STP DESIGN AND PERFORMANCE

The design of any aerobic sewage treatment facility relies primarily on basic design parameters being achieved. These include:

a. Hydraulic Detention time – typically 24 hours for extended aeration systems, though can be shorter with high rate and supported media systems

b. Food:Microorganism (F:M) ratio – determined from the mass of food (BOD5) and Volatile Mixed Liquor Solids (MLSS) – typically 0.1 for extended aeration systems but can be more for high rate systems or less for longer sludge age systems

c. Standard Oxygen Transfer Rate – determined from the quantity (mass load) of Raw Sewage (BOD5 + Ammonia + Sulphide) and Volatile Mixed Liquor required to achieve the F:M ratio.

d. Sludge Age – the age of the volatile MLSS in the bioreactor tank typically 20-30 days – if shorter, full denitrification can be inhibited and if longer sludge satiability can be poor due to bulking sludge conditions.

If the mass (volume & concentration) of raw sewage constituents are over estimated, these critical design parameters will not be met and the STP will not operate stability and is unlikely to achieve its effluent standard.

Sewage treatment is a biological process, which relies upon creating optimum conditions for pollutant removal. Whilst under-estimation of the treatment capacity is to be avoided, as over-loading of the process is highly likely to lead to failure, over-estimation of the process size can also cause treatment failure.

There is the obvious issue with the installation of larger than necessary equipment being wasteful, but the

biological process will also run poorly if it is under-loaded. This can lead to poor treatment performance, usually resulting in sludge bulking and poor settlement due to exceedingly low F:M ratios (below figure) and over-sized aeration equipment. This, in turn can cause the process to fail to meet its BOD, TSS and TN objectives.

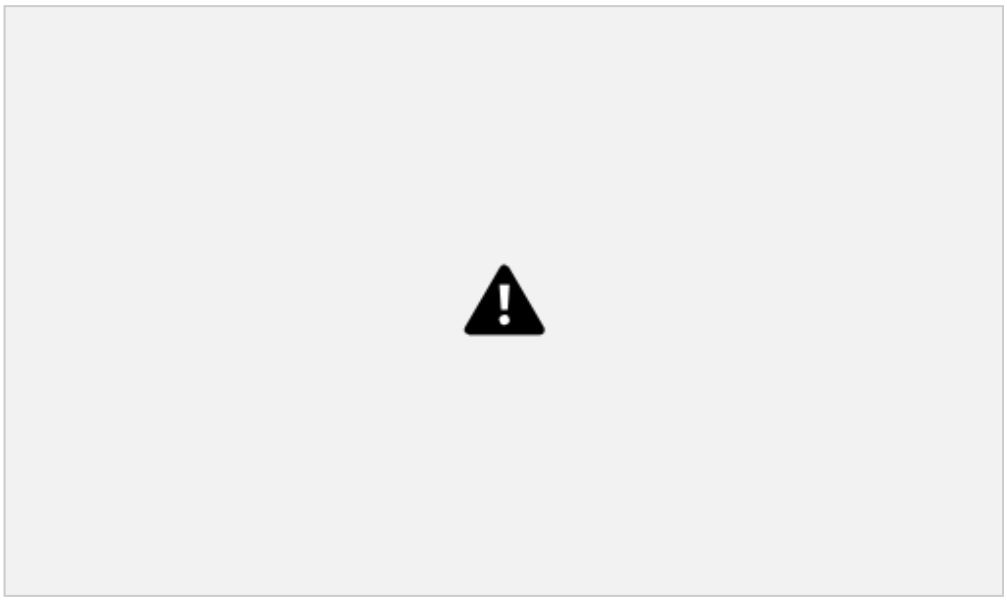


Figure 14: Effects of F:M ratio, sludge age and mixed liquor on biomass baterial populations and sludge flocculation

6. CONCLUSION

The characterisation of raw sewage is an important and critical design input for any design of a sewage or wastewater treatment plant.

If the characterisation under or over estimates that flow or strength (i.e. the physiochemical parameters) of the sewage the plant will not achieve its design effluent standard, be unstable and/or unreliable to operate.

In reviewing the standards and guidelines used to describe and characterise domestic raw sewage for small On-site sewage treatment plant design and specification under AS1547.3:2017 it is evident that flow estimates need to be mindful of the water supply and estimates generally fall within the range of 100-150L/person/day for dwellings on tank water and 150-180L/person/day for dwellings on a reticulated supply.

On review it is also evident that the domestic sewage physiochemical estimates proposed by AS1546.3.2017 are more typical of high strength domestic sewage than typical domestic sewage and there is a clear risk that onsite systems designed to the new standard would be oversized in both tankage and aeration systems, to the point where these systems are likely to not achieve their effluent quality standard and/or be unstable and unreliable to operate.

The use of a single reference site (Jimboomba STP) as reference for this characterisation for a national standard is flawed and data and experience from a range of sites should be used to inform the characteristation for the revised Australian Standard.

It is recommended that test  data from typical household

sites from each state (Country and Urban) be collected and collated to inform the standard.

Domestic raw sewage characteristics otherwise are suggested as follows:

		Parameter Range	Design
Flow L/person/day			
Restricted Water	Supply (Tank water)	100-150	150-180
	Reticulated Supply	150	180

pH (pH Units) 6-8 6.8 Conductivity (uS/cm) 600-1100 900 Suspended Solids (mg/L) 100-400 250 BOD_5 (mg/L) 150-400 250 Ammonia as N (mg/L) 20-40 30

Total Nitrogen as N (mg/L) 40-60 50 Total Phosphorus as P (mg/L) 5-20 10 Total Oil and Grease <100 50 Total Sulphide (mg/L) 1-10 1

Total Heavy Metals (mg/L) <10 <5

7. REFERENCES

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Appendix A:

Domestic Waste Water Definitions

Table 4: Domestic wastewater definitions & inclusions

Standard	Definition	Further information, inclusions or exclusions
AS1547:2012	Wastewater from a domestic source, standard includes; Wastewater originating from household or personal activities including water closets, **urinals**, kitchens, bathrooms (including showers, washbasins, baths, spa baths but not spa pools or hot tubs) and laundries. Such domestic wastewater includes that from facilities serving staff/employees/residents in institutional, commercial and industrial establishments.	**Size Inclusions**
		Systems covered in the standard [illegible] tewater flows up to 14,000 L/week, from a 10 EP
		This is equivalent to **2,000 L/day**
AS1546.3: 2017 Wastewater		originating from

AS1940.3: 2017 Wastewater originating from

household fixtures such as toilets, kitchens, bathrooms (including shower, washbasins, baths, spa baths, but excluding spa pools) and laundries; and wastewater flows from facilities serving staff, employees and residents in institutional, commercial and industrial establishments, but excluding commercial and industrial wastewaters, large-scale laundry activities, and stormwater flows.

The standard does not cover treatment systems for **toilet amenity blocks, single toilets** (with or without hand basins) or **urinals**.

STS covered by standard are those designed to treat maximum domestic wastewater flows of between **1,200 L/day and 5,000 L/day**.

Domestic scale treatment system is defined as a system designed to treat **≤3,000 L/day** of wastewater generated by domestic premises.

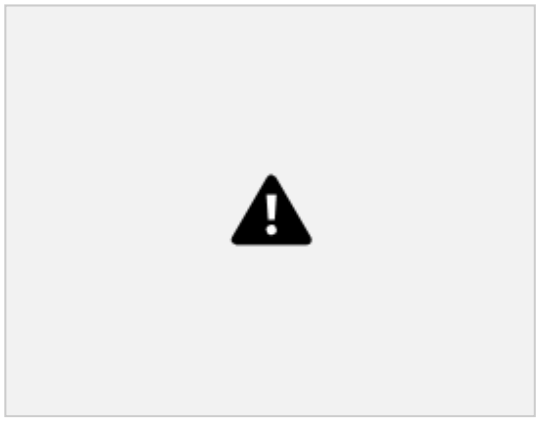
Metcalfe & Eddy 5th Ed

Wastewater discharged from residences and from commercial, institutional and public facilities.

Standard Definition Further information, inclusions or exclusions

AS1547:2000 Wastewater originating from household or personal activities including water closets, **urinals**, kitchens, bathrooms (including shower, washbasins, baths, spa baths, but excluding spa pools) and laundries. Includes such wastewater flows from facilities serving staff, employees and residents in institutional, commercial and industrial establishments, but excluding commercial and industrial wastes, large-scale laundry activities, and any stormwater flows.

Size Inclusions

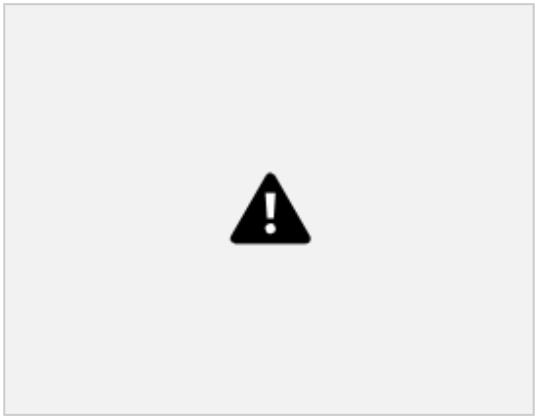
Victorian EPA Code of Practice  This Code applies to wastewater (containing sewage) generated by a single domestic household or by multi dwelling residential, commercial, industrial or institutional facilities. In this context, commercial and multi-dwelling premises include, but are not limited to: schools, camping areas, food premises, wineries, government buildings, reception centres, housing complexes, conference centres, retail, business and public facilities which generate wastewater containing toilet water and/or greywater of human origin.
This code provides standards and guidance to ensure the management of onsite wastewater up to **5,000 L/day**.

Standard Definition Further information, inclusions or exclusions
Size Inclusions

South Australia - On-site
Wastewater
Systems Code

Western Australia - A Code of Practice for Product
Approval of Onsite Wastewater
Systems 2013
the wastewater collected and managed is predominantly

(i) human waste either alone or in combination with water;
(ii) water that has been used in washing, laundering, bathing or showering;
(iii) water containing food or beverage waste; (iv) a combination of the above



Wastewater generated in a domestic premise, including refuse liquids, wastewater or

waste matter (including both greywater and blackwater).
On-site wastewater systems for residential premises must be designed for a minimum capacity of six equivalent persons (EP). This Code applies to a maximum on-site wastewater system capacity of 40 EP unless otherwise permitted by the DHA.

Using the Maximum daily flow specified this calculates to **900 L/day to 6,000 L/day.**

Flow based on 150L/ep/day

Standard Definition Further information, inclusions or exclusions

Size Inclusions

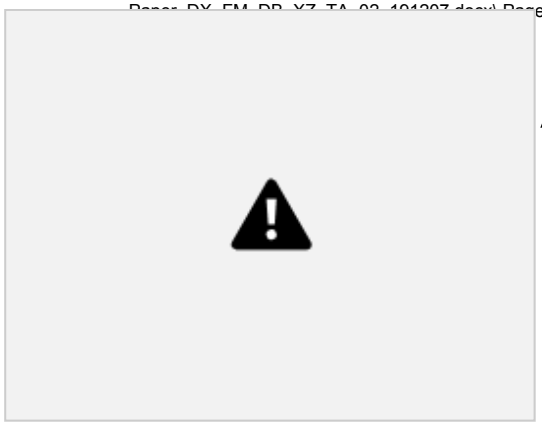
New South Wales - Environment & Health Protection Guidelines

On-site Sewage Management

for Single
Households -1998
Domestic wastewater is derived from four main waste streams:

- kitchen
- bathroom (basin, bath and shower)
- laundry
- toilet

Household wastewater flows in Australia are usually in the range of 150 - 300 litres per person per day (L/p/d) in areas provided with a reticulated water supply and 100 - 140 L/p/d in areas without a reticulated water supply



Appendix B:

Sewage Influent Parameter Comparison Table

Table 5: Comparison of typical untreated domestic wastewater / Design capacity

BOD TSS TN TP Capacity

Standard mg/L g/p/day mg/L g/p/day mg/L g/p/day mg/L g/p/day L/p/day Reference Low Strength

133 130 23 3.7

155 -
Wastewater Engineering, Metcalfe &

Eddy 5th Ed 2014 Medium Strength 200 195 35 5.6 223[1]

High Strength 400 389 69 11.0

Daily Average 180 Sewerage Code of Australia WSA 02 – 2002 V2.2

AS1546.3:2017

Average 460 100 17 AS 1546.3:2017 On-site domestic wastewater treatment units Secondary treatment systems AS1546.3:2017 150-750 70 150-750 70 20-150 15 4-25 2.5 150 AS1547:2000

(Appendix 4.2D).

AS1547:2000 145 / 180 AS1547:2012 –

System size covered in the standard are up to 14 kL/week for up to 10EP. This is equivalent to 200 L/p/day

Tank water supply [120] AS1547:2012. System size covered in the standard are up to 14 kL/week for up to 10EP. This is equivalent to 200 L/p/day – Reticulated water [150] AS1547:2012

[1] Based on 6EP household size, range covers water conservation to standard water use.

BOD TSS TN TP Capacity

Standard mg/L g/p/day mg/L g/p/day mg/L g/p/day mg/L g/p/day L/p/day Reference

QLD Municipal Low 140 140 [20] as Ammonia [6] 150

QLD Municipal High

*incl trade waste

480 410 [60] as Ammonia [30] 275
The Planning Guidelines for Water Supply and Sewerage April 2010 (Amended March 2014) – Dept of Energy and Water Supply (DEWS) Table 5.12

QLD Resort 450 400 SA – Roof tank

60 – 120 as Ammonia 10-20 [180-450]

supply [125] On-site Wastewater Systems code (DHA) SA 2013 SA – Bore or Reticulated supply [70] 150

SA Health Commission Code Aerobic Wastewater Treatment Systems NSW (Hunter Water)

300 50 150
Standard for the Construction, Installation and Operation of Septic Tank System in South Australia

*trade waste guidelines

500 500 150 20 Standard Trade Wastewater, Hunter Water, 2016

BOD TSS TN TP Capacity

Standard mg/L g/p/day mg/L g/p/day mg/L g/p/day mg/L g/p/day L/p/day Reference

NSW Environment & Health Protection Guidelines - On site Sewage Management for Single Households

200-300 200-300 20-100 10- 25
Non retic supply

100-140

Retic
Supply

150-300
Environment & Health Protection Guidelines

On-site Sewage Management for Single Households

DLG;NSWEPA;NSW Health; L&WC NSW; DUAP

VIC 150-250 60 40-140 150[2] / 180[3]

NT 50150 / 300[4]

WA 100-500 70 70 20-100 15 0.04- 42 2.5 150

Code of Practice – Onsite Wastewater Management EPA Vic 2016

Code of practice for on-site
wastewater management, NT Health, 2014

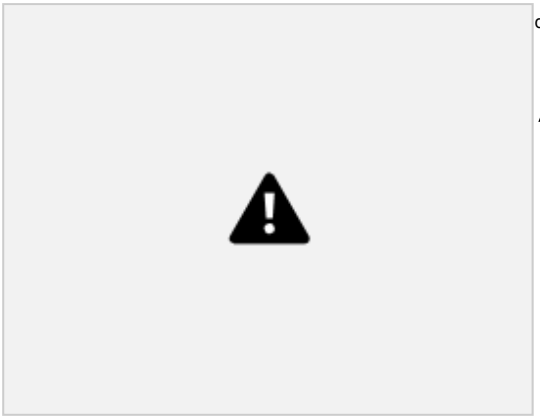
Code of Practice for Product Approval of Onsite Wastewater Systems does not relate specifically to domestic sewage

TAS As per AS1547, relies heavily on EPA VIC Guidelines Directors Guidelines for on-site wastewater management systems

[2] Water-reduction fixtures

[3] Standard water fixtures

[4] For aboriginal housing in remote area communities



Appendix C:

Sewage Effluent Parameter Comparison Table

Table 6: Comparison of typical untreated domestic wastewater / Design capacity

	Thermo tolerant							
	BOD	TSS	TN[5]	TP	Coliforms	E.coli	FAC[6]	
Standard	mg/L	mg/L	mg/L	mg/L	Org/100mL	cfu/100mL	mg/L	Reference
AS1546:2017 – Secondary Effluent								

Advanced Secondary Secondary Effluent

30 (Max) 45 (Max) 15 2 30(Max) 0.5 (Min)
20 (90%) 30 (90%) - - 10 (90%)

20 (Max) 20 (Max) 15 2 30(Max) 0.5 (Min)
10 (90%) 10 (90%) - - 10 (90%)

30 (Max) 45 (Max) 1000 (max) 0.5 (Total Cl_2) and 4/5
AS 1546.3:2017 On-site domestic wastewater treatment units Secondary treatment systems

20 (90%) 30 (90%) 200 (90%)
samples <2 Queensland Plumbing and

Advanced Secondary Effluent
20 (Max) 20 (Max) 200 (max) 0.5 (Total Cl_2) and 4/5
10 (90%) 10 (90%) 10 (90%) 5 (90%) 10 (90%) samples <2
Wastewater Code

Standard for the Construction,
Surface irrigation 20 30 10 0.5 (min)
Installation and Operation of Septic Tank System in South Australia

Secondary Standard 20 30 10 Code of Practice – Onsite Wastewater

5 Only for STS with nutrient reduction facilities

6 Free Available Chlorine

BOD TSS TN[5] TP
Thermo tolerant Coliforms
E.coli FAC[6]

Standard mg/L mg/L mg/L mg/L Org/100mL cfu/100mL mg/L Reference Advanced Secondary 10

10 10 Management EPA Vic 2016

Secondary effluent 20 30

							10 (Median) with 4/5 samples <20	0.5 - 2.0
								Code of practice for on-site wastewater management, NT Health, 2014
								[Code of Practice for Product Approval](#)
In house reuse	10	10					1	0.2-2.0

[7] Additional criteria for pH, Clostridia and Coliphages also required.

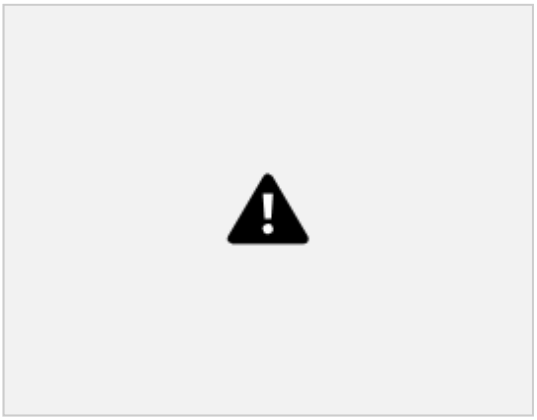
[of Onsite Wastewater Systems[7], otherwise stipulates against AS1546.3](#)

Appendix D:

Testing Conditions Requirements Comparison Table

Table 7: Test conditions specified	**Total**							
Standard Flow	**BOD_5**	**TSS**	**Total Nitrogen**	**Total Phosphorus**	**E.coli or Thermotolerant Coliforms**	**Period of Commissioning weeks**		
Units	**L/day**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**MPN/100 mL**		
AS1546.3: 2017	150-750	150-750	20-150	6-25	42			
Qld Plumbing and Wastewater Code (other than AS1546.3)								
VIC EPA Code of Practice 2016								
SA On-site Wastewater Systems Code								
WA Code of Practice for Product Approval of Onsite Wastewater Systems 2013								
NSW Domestic greywater treatment accreditation guidelines 2005								
Represent ative of operationa l loading								

treatment
system



As per
AS1546.3

100 - 500 100 - 500 20 - 100 0.04 -

42 10^6 – 10^8 26

720L/day (8EP)
810L/day (9EP)
900L/day (10EP)
150 - 300 150 - 300 20 - 100 6-25

26

26