TO MEET OR NOT MEET THE NSW HEALTH GUIDELINES - A FIELD PERSPECTIVE

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Abstract

The NSW Health Guidelines relating to onsite aerated wastewater treatment systems are alarmingly far from applicable to the field situation. The Guidelines place the onus of compliance with effluent based monitoring parameters on the manufacturers, who have little control over the system once installed and passed to the care of the householder. Both initial accreditation and annual accreditation monitoring programs do not relate to the field situation where these systems are required to perform 365 days per year, every year.

A critical review of each section of the Guidelines is presented, looking through *field coloured glasses*. An examination of each phase related to accreditation will be done including:

- the location and setup of the test site
- the test site monitoring regime
- the test site relatedness to the field
- the impacts of the sampling and analysis provider
- how monitoring can change the results
- the purpose of annual testing, and its approach
- statistics and their misuse
- the need for coordination between NSW Health and local Councils.

Keywords

AWTS, accreditation, NSW Health Guideline, compliance, monitoring

1 Introduction

Working with the NSW Health Guidelines over the past several years has proved comical, interesting and painful. Although progression is being made with the likely release of new Guidelines, it seems that some archaic aspects might still be maintained. Today we will take a journey through the Guidelines from a field perspective, analysing their applicability to the real world of the householder's backyard.

2 The Test Site

The Guidelines specify (see section 10.1) that the test site should be located adjacent to a sewage treatment plant (STP) operated by a public utility or corporation, representing raw influent after screening. Alternative locations include a sewer pumping station (SPS), or sewerage main. Using this source of influent should therefore represent domestic sewage strength, equivalent to that being discharged to an AWTS. However this does not account for ingress, infiltration or exfiltration issues, nor seasonal or other changes in a site's sewage

character. This is somewhat overcome by setting minimum concentrations for typical sewage analytes, but does not adequately reflect daily, monthly or other seasonal changes related to aspects as sewage temperature, or industrial activity (such as a cannery or other food processor).

Treatment of winter flows at a facility in southern NSW will be very different to meeting performance criteria in coastal northern NSW at the same time of year. In addition, this prescribed influent character only relates to component / characteristic, and no criteria describing minimum number of samples, type of sample or when collected is provided.

Therefore, a manufacturer is open to collect several samples and only submit the results of those that comply. Weaker influents could therefore be feeding AWTS under test.

Different manufacturers have used different test sites for accreditation, and consistency in conformance cannot be assured. Sewage can vary by day, by week, month and season and this should be accounted for in accreditation across different manufacturers. This could be addressed somewhat by requiring influent character be tested more routinely over the 26 week test period, such as monthly grab random samples. Average, maximum, minimum and 90%ile data interpretation could then be used to ascertain if the influent character was sufficient during the entire test period.

The Guidelines state that the design is to allow for 150 L per person per day (section 7.1.4), for up to ten persons, giving a total wastewater flow of 1500 L d^{-1}. In general, this flow rate will always be excessive for two reasons – firstly, most households use far less water than 150 L per person per day, and secondly very few households contain ten persons for any period of time. However, even if this flow level is held true, the testing regime flow levels during the 'test period' of 28 weeks is operated at far higher rates, as shown in Table 1 below (based on a ten-person system). This therefore represents a major gap between reality, design and testing when applying the Guidelines.

Table 1: Flows during test period, based on ten-person system

Test Period	Flow rate	Duration	Total Flow (Ld^{-1})
Week 1	190 L h^{-1}	• 8 hours per day • 6-11am, 6-9pm	1520
Test period – day 1	225 L h^{-1}	• 8 hours per day • 6-11am, 6-9pm	1800
Test period – days 2 to 5	225 L h^{-1} 300 L h^{-1} 225 L h^{-1}	• 'normal flow' • 150 mins during sampling • 'normal flow'	1987.5
End of day 5	190 L h^{-1}	• 8 hours per day • 6-11am, 6-9pm	1520

Section 7.6.1 of the Guidelines state that a disinfection chamber of not less than 300 L be provided. Sampling on days 2 to 5 occurs over a set 150 minute period, during which the flow rate is 300 L h^{-1}. At this flow rate, and over a 150 minute period, only the last sample will represent influent flow at the time of the collection of all previous samples. Therefore, most test samples will represent flow entering the final chamber the day prior. In this time, chlorine disinfection will have dispersed into the environment via volatilisation and natural attenuation, and it is expected that elevated total chlorine (TCl) and lower free residual chlorine (FRC) will be observed. This will represent poorest quality effluent from the AWTS using chlorine disinfection, and does not relate to a household situation where most night flows would have been pumped to irrigation prior to overnight stagnation.

3 Sampling and Analytical Services

Sampling and analysis can prove the difference between a pass or fail result, and the manner in which both are done can change the final result. For example, thermotolerant coliforms (TC) can be reduced significantly if the samples are frozen or substantially chilled (close to zero) after sampling, and can significantly rise if not maintained at around 4-10°C, or if not analysed within 6-8 hours being preferable, but at least within 24 hours.

BOD_5 can vary significantly across laboratories used, and even within labs. BOD_5should be done using a domestic wastewater seed, such as settled sewage, which is collected routinely and used immediately. Alternatively, seed stock can be purchased in a dry form which provides a more standard stock. Chlorine should be neutralised at sampling using thiosulphate preservative in the bottle for BOD_5 analysis, as BOD can continue to be consumed (and therefore decline in concentration) if chlorine is not inhibited (not applicable for UV disinfection systems). BOD_5should be analysed without inhibiting nitrification, such that a total BOD_5 and not a carbonaceous BOD is analysed. If nitrification is inhibited, a lower BOD result will be reported. Therefore, a lab should provide method details to the manufacturer and accreditation agency to ensure BOD is analysed in a comparative manner across manufacturers.

Sampling method can also contribute to the results obtained and the Guidelines do not specify any minimum data quality objectives (DQO) related to sampling. For example, field blanks and duplicates should be required as a minimum to check the performance of the sampling technician, the sampling method reproducibility, and transport effects. Grab samples can be taken either using a dipper or portable pump, with a pump generally able to collect a more representative sample of the chamber, with minimal disturbance to the settling chamber. The method of equipment washing between samples can also increase results, particularly for total suspended solids (TSS) and TC if residuals of these are persistent in sampling equipment. Field blanks can test this equipment.

Section 10.6 of the Guidelines note that a laboratory be certified by NATA for the parameters to be analysed.. This is important to understand as it does not refer to a NATA lab, but a laboratory accredited by NATA for the test parameters of BOD, TSS, TC and others. This should be checked by the manufacturer, and associated accrediting agency, and relevant proficiency testing reports cited. In addition, no DQO standards are set for the laboratory-produced data to ensure quality. A minimum of spikes, blanks and duplicates should be required to be performed per batch.

4 Chlorine – FRC or Total, and what about UV?

The Guidelines state that FRC should be between 0.2 and 2 mg L^{-1} at the maximum 30-minute flow rate of 10 L min^{-1} (section 7.6.2). All results for FRC must be within this range during both accreditation and annual testing (section 10.7.5). In contrast, the Australian Standard (AS/NZS 1546.3:2001) states (section 2.4.1) that total chlorine be greater than 0.5 mgL^{-1}.

AWTS receive influent that includes ammonia compounds, and some AWTS will nitrify these ammonia compounds to nitrate and nitrite during aerobic treatment. However, nitrification is not a prescribed requirement for most AWTS, and nitrification can be intermittent due to process design and many other factors such as temperature, and influent concentrations.

Where ammonia compounds remain in the effluent during disinfection, chlorine can form chloramine compounds resulting in lowered FRC concentrations at a constant total chlorine level. If efficient nitrification occurs however, chloramines can not form with residual ammonia, thereby driving the FRC levels up at the same constant total chlorine level. Therefore a manufacturer who achieves nitrification can be implicated for exceeding the FRC level of 2 mgL^{-1}.

In addition, no minimum performance criteria relating to UV disinfection systems are included, such as lamp integrity and stability, or alarm levels.

5 The Paradigm of Annual Testing

Section 16 of the Guideline refers to accreditation conditions, including annual testing (section 16.1). It states that at the anniversary of the accreditation date a minimum of 5-10% of the first 100 AWTS model installed and 1% per 100 thereafter for each year installed, but not serviced within 2 months, be submitted to NSW Health. From this, NSW Health randomly select a list of sites to be subject to random grab sampling. Effluent criteria for these grab samples are set as below:

- BOD < 30 mgL^{-1}
- TSS < 45 mgL^{-1}
- FRC 0.2 – 2.0 mgL^{-1}
- TC < 100 cfu/100mL.

This Section does not describe any other related conditions such as sample collection and handling issues, QA of samples or laboratory, or data interpretation. Also, it does not consider if a householder is occupying the site (as most systems are constructed prior to house occupation due to Council requirements), or if the system has been operating sufficiently long enough to allow the anaerobic and aerobic biological populations to stabilise. Most anaerobic sludges require a minimum of 60 days to populate, and around 30 days is appropriate for the aerobic chamber. Some systems may also have not undergone even one system service, at which time most manufacturers adjust the AWTS to suit the particular site conditions. This is particularly done in regard to sludge return rates, and disinfection system setup. A minimum of four months should have passed, post habitation, before a site is allowed to be submitted to NSW Health for potential sampling. This would allow for biological processes to stabilise, and at least one service to have occurred.

Of more concern, the Guidelines do not state what occurs if the performance criteria are not met at any time during the five year accreditation span. Presently, manufacturers generally perform this annual testing at their cost, with no understanding of the course of NSW Health if results are either favourable or poor. Some statement should be made in the Guidelines of the ramifications of not meeting performance criteria that are set. In addition, after a two-year period in general, householders are under no requirement to continue with routine maintenance under the manufacturers conditions, and there is no provision in the Guidelines to allow for householder abuse. Instead the manufacturer bears both the cost of annual testing and the brunt of poor results, which may very much be dependent on the householder, and not the manufactured system.

The aim of annual testing is not stated, and the intent is not well established. Perhaps a better approach would be to subject selected test sites that are serviced by the manufacturer, or associated with a test site, to annual testing to check performance over a life span.

6 Statistics and Their Misuse

The Guideline does not include or reference any protocols with regard to interpretation of data. Statistics can be manipulated to reflect better or poorer results. For example, there is no discussion on how to deal with non-detect data, less than data or greater than data when determining 90 percentile compliance. If a series of BOD_5 results are 25, 15, < 2, < 2, 5 mg/L the data could be read as 25, 15, 2, 2 and 5 mg/L, or 25, 15, 1, 1 and 5 mg/L depending on statistical protocol used. A reference source should be used as the basis for data interpretation methods.

7 Summary

Table 2 summarises the issues raised in this critical review from a field perspective, and discusses some possible recommendations for NSW Health to consider.

Table 2: Summary of conclusions from a field perspective

Section Number	Section Description	Limitation / Issue	Recommendation
10.1	Test site - location dependent on domestic related sewage of STP or equivalent	Test site conditions can vary dramatically for different systems tested depending on site chosen, time of year, and so on	Recommend test site facility/s for NSW
10.2	Test site – influent character	Influent character concentrations given for parameters, but no reference to minimum data requirements, or sample collection details to be met	Influent character be tested more routinely over the 26 week test period, such as monthly grab random samples
7.1.4	Test period flow rates – vary to design flow rate	Flows during the test period should reflect 'real' conditions, and the design specification flow rates	Test at a flow rate no greater than 1500 L d^{-1}
7.6.1	Test period 150 minute sampling time	Collection of samples during this period mostly represent the day prior effluent	Commence collection of samples only after 1 hour to allow for chamber pump out
10.6	TC – sampling method	No statement as to appropriate sampling, handling or analytical methods are provided or referenced	Include sampling methods conditions in Guidelines, including sample bottles, preservation, holding times
10.6	BOD_5 – preservation at time of sampling and analytical method differences	No statement as to appropriate sampling, handling or analytical methods are provided or referenced	Provide method details to the manufacturer and accreditation agency, and NATA proficiency testing results
10.6	Analytical QA	No statement as to minimum DQO for sample batch	DQO minimum performance should be stated to ensure quality data is produced by the laboratory
10.5	Sampling methods	No statement as to minimum DQO provided, such as field blanks and duplicates, sample volumes	DQO minimum performance and collection requirements should be stated to ensure quality data is obtained by the sampling technician

Section Number	Section Description	Limitation / Issue	Recommendation
16	Annual testing – overall approach	No statement as to minimum requirements for sampling or analysis, or data interpretation	As per section 10 comments above
16.1	Annual testing – random selection of sites for testing	Sites may not be inhabited or have undergone a service and are therefore prone to not being biologically stable or optimised for site specific conditions	A minimum of 4 months should have passed, post habitation, before a site is allowed to be submitted to NSW Health for potential sampling
16.4	Annual testing performance criteria	No statement as to implications if results fail the criteria	Performance standard should be set with consequences of not meeting the criteria
16.4	Annual testing – no householder relatedness	The householder is under no continued obligation to perform routine servicing, and even if this is done, the householder may abuse the AWTS substantially, reflected in poor results	Annual testing report should consider status of household such as is a current service agreement in place, does the site have a history of issues, does the householder significantly contribute to poor performance, are the householders taking significant drugs that may hamper biological performance
10.7 and 16.4	Data interpretation of results	No reference is used on how statistics should be generated, particularly with regard to >, <, non-detect	A reference source should be used as the basis for data interpretation methods

8 Conclusions

Overall the NSW Health Guideline aims to control and monitor the performance of AWTS in the field, to protect public health and the environment. However, the field perspective and the practical application of these objectives are far from what is reflected in the current version of the Guidelines. Significant consideration of the field situation, where these systems are used on a daily basis, should be made in order to meet the aim of the Department.. The Guidelines have avoided best management practice by allowing each of the manufacturers to interpret the sampling procedures, statistical analysis etc, how they see fit to serve purpose.

References

Standards Australia and Standards New Zealand (2001), AS/NZS 1546.3:2001.On-site domestic wastewater treatment units, Part 3, aerated wastewater treatment systems,

NSW Health (1998), Aerated wastewater treatment systems accreditation guideline, September 1998.