



Technical Standard Norms for Septic Tanks. Review of international examples and propose structure outline

Belize



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1 Introduction

1.1 Enhancing Wastewater Treatment: Proposal for National Septic Tank Standards in Belize

Septic tanks play a vital role in wastewater treatment in areas without centralized sewage systems. They remove solids and organic substances from wastewater, allowing for their biological decomposition through anaerobic processes. The effluent can be additionally treated and released into the soil, where additional filtration and purification processes take place. However, the absence of clear and comprehensive standards for septic tank construction and usage can result in issues such as system malfunction, contamination of water resources, environmental degradation, and high costs for users due to operational failures or frequent repairs.

The implementation of national standards for the construction and use of septic tanks is important for Belize to ensure proper treatment of domestic wastewater and environmental preservation.

By examining the standards and manuals from different countries, it is possible to observe distinct approaches and contents, some include Legal Requirements and theoretical definitions and others focus on design and construction criteria and details.

In this context, a proposal for a basic outline for a national standard for septic tanks has been developed, and an analysis of standards adopted in various countries was

executed, including Brazil, Australia, Jamaica, Trinidad and Tobago, among others.

It is important to note that this is **an initial proposal of an outline**, and that it has to **be filled with the specific inputs for Belize**. Based on the international norms available, the necessary information can be **adapted to the Belize context with the specific demands of the country to be discussed together with the stakeholders such as the Central Building Authority, Ministry of Health, and DOE**.

1.2 International septic tank standards

Septic tank standards are mechanisms that establish standards and regulations for the construction, installation, and use of these systems, aiming to ensure efficiency and safety in wastewater treatment. These standards are crucial to guarantee that septic tanks operate properly and meet established quality requirements.

Table 1 provides an overview of standards and guidelines related to septic tanks, showcasing the diversity of approaches and requirements used internationally.

Table 1 - Analysis of the Septic tanks International Standards and manuals

Name	Septic Tanks			Sludge	Effluent disposal		Comments
	Legal Framework/ Requirements	Design	Construction	Desludging	Design	Construction	
Standard for the construction, installation, and operation of septic tank systems in South Australia i	X	X	X	X	X	X	Australia Addresses desludging in a comprehensive manner, establishing a minimum frequency according to legislation.
NBR 7229 - Design, construction, and operation of septic tank systems ii		X	X	X			Brazil Addresses desludging only as a variable to calculate the sludge accumulation rate. The Brazilian standard is an excellent reference, but it lacks clear guidelines on desludging frequency. This aspect is well addressed in the Australian and Trinidad and Tobago standards.
NBR 13969 - Septic tanks - Units for complementary treatment and final disposal of liquid effluents - Design, construction, and operation iii					X	X	Brazil In Brazil, the standards for septic tanks and disposal units are separate. This approach allows for a more in-depth discussion of disposal units and some additional treatment units, which can be a very interesting approach.
Onsite wastewater treatment and disposal systems: design manual iv		X			X	X	United States EPA It is a more theoretical material that can be used as a reference for questions regarding design or on-site treatment in general.
Onsite wastewater systems manual v		X	X	X	X	X	United States EPA It is a supplementary material to the previous one, providing more data on construction-related issues.
Code of practice for domestic wastewater treatment systems (Pop Equiv < 10) vi		X	X	X	X	X	United States EPA It is a comprehensive, more modern guide for onsite systems serving populations below 10 inhabitants.
Minimum Requirements for wastewater treatment systems and excreta management in Jamaica viii	X		X		X	X	Jamaica General guidelines on effluent treatment. It includes some minimum requirements and construction recommendations but is not very specific regarding design.

Name	Septic Tanks			Sludge	Effluent disposal		Comments
	Legal Framework/ Requirements	Design	Construction	Desludging	Design	Construction	
A guide to the development of on-site sanitation [xvii]		X	X	X	X	X	International -WHO WHO guide, serves as a good reference for design, despite being older.
Guidelines for design and construction of water and wastewater systems in Trinidad and tobago [xv]							Trinidad and Tobago General guidelines on water and sewage. It includes indications for onsite systems starting from page 27. It is very basic but recommends using the "EPA Design Manual 'On-Site Wastewater Treatment and Disposal System" and the "Trinidad and Tobago Bureau of Standards - T.T.S 16 80 400" as references.
Code of Practice for the Design and Construction of Septic Tanks and Associated Secondary Treatment and Disposal Systems (T.T.S 16 80 400: 1991) [x]	X	X	X	X	X	X	Trinidad and Tobago Developed based on the Australian national standard "AS/NZS 1546.1:2008". A good example of a simple and straightforward standard. It could only be clearer regarding the equations to be used for design, which are better specified in the Brazilian and southern Australian standards.
Code of practice for the design and installation of drainage fields for use in wastewater treatment [xvi]					X	X	UK British guidelines on final disposal.
Small wastewater treatment systems for up to 50 PT [xvii]	X	X	X	X	X	X	UK Guidelines on onsite wastewater systems
The septic tank: Basic criteria and guidelines for its best use - Guide for the construction of individual sanitary solution - Cotrisan project [xviii]		X	X				Costa Rica Guidelines and practical technical aspects of septic tanks, including drawings and plans that were prepared for use by builders with explanation comments. Includes checklist.

****The opensource references for the mentioned files are provided as attachments in the References section for further consultation and review.**

After the review and evaluation of the standards, the standards of Brazil, Australia, and Trinidad and Tobago were found to be the most clear and adequate guidelines. These three standards, when considered together, offer a complementary set of guidelines that can serve as a foundation for adaptation to suit the specific context of Belize.

Furthermore, a proposed structure outline for a Septic Tank standard was developed and is presented in the subsequent chapter.



2 Proposed Structure for the Septic Tanks standard

Based on the content of the researched standards, primarily from Brazil, South Australia, and Trinidad and Tobago, the following structure proposal has been developed.

2.1 Definitions/Glossary

It is recommended to include key terms that are present in the developed standard. Some examples are: Decantation; Industrial discharge; Nominal diameter; Sludge accumulation rate; Digestion; Sludge discharge device; Inlet device; Outlet device; Effluent; Septic tank effluent; Scum; Wastewater; Influent sewage; Domestic sewage; Sanitary sewage; Anaerobic filter; Cleaning interval; Sludge; Dehydrated sludge; Digested sludge; Fresh sludge; Sewage retention time; Digestion period; Total depth; Effective depth; Sedimentation; Sanitary drainage system; Septic tank system; Soakaway; Single-chamber septic tank; Series chambers septic tank; Filtration trench; Infiltration trench; Total volume; Effective volume.

2.2 Legal Requirements

- a. **Description of legislation, regulations, or other legislative instruments**

that exist for the regulation of the manufacture/construction, installation, and operation of septic tanks.

b. **Description of administrative procedures** (registrations, forms, provision of plans, etc.) necessary for the installation of a septic tank (if applicable) and under what conditions.

c. **Description of technical procedures** that must accompany the administrative procedures (if applicable), such as inspections and tests.

2.3 Septic tank system

a. **Component parts of the septic tank:** chambers (quantity, size ratio, intercommunication openings), inlet and outlet devices, inspection openings, identification plates, methods of effluent disposal.

b. **Operational principles:** functioning, treatment zones, recommended discharges, and those to be avoided/prohibited.

c. **Design criteria:** minimum daily inflow or hydraulic load per person; minimum detention time; sludge/scum accumulation rate to be considered per person; minimum desludging frequency; ventilation.

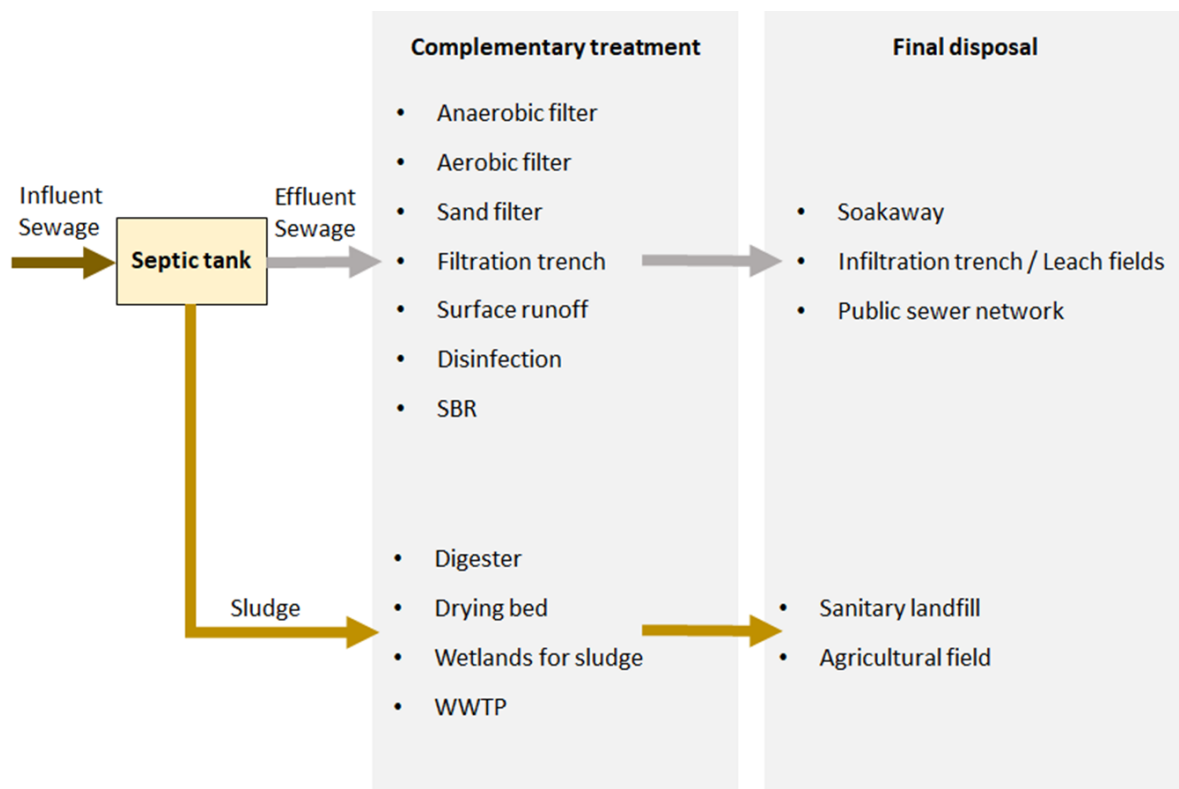
d. **Calculation and considerations regarding effective capacity:** considering the number of people, daily inflow per capita contribution, detention period, sludge accumulation rate, and fresh sludge contribution.

e. **Reference tables:**

i. Wastewater and fresh sludge contribution according to usage conditions

- ii. Detention time according to daily inflow
 - iii. Minimum and maximum effective depth per range of effective capacity
 - iv. Total sludge accumulation rate according to desludging frequency
- f. **Reference drawings:** examples of project plans, including component parts, standard measurements, or standard proportions.
- g. **Complementary treatment and final disposal:** utilization of visual representation to illustrate possible complementary treatment options and methods for final effluent disposal. For example, in the format of a flowchart (Figure 1). This material should be adapted according to the reality of Belize.

Figure 1 - Example of a flowchart showcasing post-treatment alternatives and final disposal options associated with the use of septic tanks. (Source: adapted from Brazilian NBR 7229)



2.4 Septic tank construction

- a. **Construction conditions and features:** maximum size, number of chambers, minimum effective liquid depth, connections, accessories (e.g., baffles at the inlet and outlet), access shafts, soil conditions, signs of identification
- b. **Positioning:** distance from the water table, other constructions and buildings, water wells, pipelines, etc.
- c. **Types of tanks and materials:** precast, cast-in-situ, built-in-situ, manufactured, etc.

2.5 Methods of effluent disposal

- a. **Technological options:** Soakaways and Infiltration Trench/Leach Fields.
 - i. Criteria for choosing between Soakaways and Infiltration trench/Leach fields (some of them suggested in Table 2).

Table 1 - Comparison between Soakaways and Infiltration trench/Leach fields

Characteristics	Soakaways	Infiltration Trench/Leach Fields
Soil Type and Permeability	Suitable for well-drained soils with good permeability. Should not be used where the soil is saturated with water.	Suitable for a wide range of soil types, including moderately drained soils. Should not be used where the soil is saturated with water.
Water Table Proximity	Requires a sufficient distance (e.g., at least 1.5 meters) between the bottom of the disposal unit and the water table to prevent contamination. Soakaways are vertical structures, and therefore reach greater depths. This should be taken into consideration	Requires a sufficient distance (e.g., at least 1.5 meters) between the bottom of the disposal unit and the water table to prevent contamination. Infiltration trenches are horizontal structures and therefore reach shallower depths. This should be taken into consideration

Characteristics	Soakaways	Infiltration Trench/Leach Fields
	when analyzing the position of the water table.	when analyzing the position of the water table.
Available Space	Soakaways are vertical structures that require relatively less horizontal space for installation. Due to their design, they are well-suited for sites with limited available space.	Infiltration trenches are horizontal structures that require more extensive horizontal space for their installation.
Maintenance/Operation:	Requires periodic checks for the accumulation of solids or scum, which may require removal to prevent clogging and maintain optimal performance. The frequency of maintenance depends on factors such as the volume of wastewater generated and the characteristics of the septic tank effluent.	Requires regular inspections to identify any potential obstructions or sediment accumulation within the trenches. These obstructions can hinder the infiltration process and may require corrective measures such as flushing or cleaning.
Treatment Requirements	Provides partial treatment through natural processes like filtration and microbial activity, but additional treatment units may be needed for higher treatment standards.	Provides partial treatment through natural processes like filtration and microbial activity, but additional treatment units may be needed for higher treatment standards.
Local Regulations	Compliance with local regulations is necessary, which may include setback distances from water bodies, minimum distances from buildings, and other requirements specific to the area.	Compliance with local regulations is necessary, which may include setback distances from water bodies, minimum distances from buildings, and other requirements specific to the area.

b. **Site evaluation criteria for each of them:** soil type, permeability, slope, land use, rainfall index.

c. **Percolation test**

- d. **Calculations and considerations:**
 - i. **Leach Fields/Infiltration Trenchs:** Application rate, total required area, distribution pipes (diameter and slope), interval between applications, filling material, distance between leaches.
 - ii. **Soakaways:** Percolation capacity, infiltration area, effective depth, internal diameter, distribution type.
- e. **Assumptions related to application:** residential, non-residential, temporary occupancy.
- f. **Reference drawings:** examples of project plans, including component parts, standard measurements, or standard proportions.

2.6 Effluent disposal construction

- a. **Installation location**
- b. **General criteria:** excavation method, precautions, setback distances.
- c. **Types of soakage and their specifics:** trenches, wells, beds.



3 Annexes

All the opensource guidelines and manuals are available in the following link:

<https://1drv.ms/f/s!AnjK04jQ-GPRga5en5YSHvSdgNK7qA?e=ac1T51>

In order to access the other standards, it is necessary to have a specific license for each one and, therefore, they cannot be shared in this document.

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