FOREWORD

BY THE MINISTER FOR ENVIRONMENT AND PUBLIC HEALTH

Sarawak has achieved tremendous economic growth during the last few decades. Subsequently, small towns have evolved into cities and municipalities. This high rate of urbanization has brought about a host of environmental issues to the urban centres. The generation, treatment and disposal of domestic sewage is one of the pressing issues.

Septic tanks have been the main sewage treatment system in our urban centres. This system shall remain as the backbone of sewage treatment facility in Sarawak. However, over the years various modifications to the design and construction of the system have been adopted by the industry players and the local authorities.

The Sarawak Sewerage Services Department, in line with the powers and functions conferred upon it under the Sewerage Systems and Services Ordinance, 2005, has taken the initiative to consolidate the various existing design and construction practices and to issue uniform guideline for septic tank design and construction.

The technical details of these Guidelines extensively adopt the Malaysian Sewerage Industry Guidelines - Volume V Septic Tanks. However, established local practices and our legal framework have also been taken into consideration in the formulation of the Guidelines.

These Guidelines are timely because they have also incorporated design features of connection to future Centralised Sewerage System. The Ministry and Sarawak Sewerage Services Department would like to thank all parties involved in the drafting and reviewing of these Guidelines.

Y.B. DATO SRI WONG SOON KOH
MINISTER FOR ENVIRONMENT AND PUBLIC HEALTH
Date: 30 March 2011

SEWERAGE SYSTEMS AND SERVICES ORDINANCE 2005

These Guidelines are issued under Section 4 and Section 9 of the Sewerage Systems and Services Ordinance, 2005.

Dated this 30th day March 2011.

URBAN SEWERAGE SYSTEMS AUTHORITY

Guidelines for the Design and Construction of Septic Tanks in Sarawak

Table of Contents

Part 1 Introduction

Septic tank is the primary treatment facility available for municipal sewage in Sarawak. It must be designed and constructed with the same permanency and quality expected of any long term option.

Adequate measures must be taken during the planning, design and construction to ensure that it can perform effectively with minimal maintenance.

These guidelines shall only be used for developments to be served by individual septic tanks. Septic tanks that are built under these guidelines shall receive and treat both the black water and the grey water from the properties they serve.

The technical details and specifications of these guidelines follow closely with the Malaysian Sewerage Industry Guidelines Volume V: Septic Tank, which is issued by *Suruhanjaya Perkhidmatan Air Negara*.

1.1 Purpose

These guidelines set the design and construction standards of individual septic tanks with a design capacity of not exceeding 30 PEs. Where the design PE is more than 30, other system of treatment shall be provided.

These guidelines shall be used for area where public sewer is not available. However, a by-pass pipe of 150mm nominal diameter from the last manhole before the septic tank shall be provided. This by-pass pipe shall be extended to the outside drain of the premises and end capped for future connection to public sewer.

1.2 Effluent Standards

The Environmental Quality Act 1974, Environmental Quality (Sewage) Regulation 2009 specifies Standard A for effluent discharge located upstream of raw water intake points, and Standard B for effluent discharge located downstream of the raw water intake points. The septic tanks shall be desludged in accordance with The Local Authorities (Compulsory Desludging of Septic Tanks) By-Laws, 1998.

1.3 Reference Materials

- MS1228:1991 Code of Practice for Design and Installation of Sewerage Systems.

- Environmental Quality Act, 1974 - Environmental Quality (Sewage) Regulation 2009.

- Sewerage Systems and Services Ordinance, 2005.

- The Local Authorities (Compulsory Desludging of Septic Tanks) By-Laws, 1998.

- Jabatan Perkhidmatan Pembetungan, Guidelines for Developers:-

  (i) Volume I - Sewerage Policy for New Developments
  (ii) Volume II - Sewerage Works Procedures

- Suruhanjaya Perkhidmatan Air Negara, Malaysian Sewerage Industry Guidelines:-

  (i) Volume III - Sewer Networks and Pump Stations
  (ii) Volume IV - Sewage Treatment Plants
  (iii) Volume V - Septic Tanks

- Building Ordinance, 1994
- Local Authorities Ordinance, 1996

Part 2 Design Guides

2.1 Types of Septic Tanks

2.1.1 Cast-In-Situ Septic Tank

It consists of a tank with a minimum 24 hours hydraulic retention time.

2.1.2 Prefabricated Septic Tank

It is manufactured using polyethylene, glass fiber reinforced plastic or reinforced precast concrete. The up-flow filter chamber is incorporated inside the tank before the outlet section.

2.2 Design Consideration

The design loading of the raw sewage shall be: 250 mg/l of BOD_5 (5days at $20^{\circ}C$) per person per day and 300 mg/l of Suspended Solids per person per day.

The design shall consider the following:-

- Volume of septic tank.
- Quality of constructed septic tank.
- Adequacy of ventilation.
- Siting and access for desludging.
- Compliance with effluent quality requirements.
- Buoyancy during installation and desludging.

2.3 Planning

2.3.1 Site Selection

This siting of septic tank shall meet the following:-

- Future desludging works shall not pose hazard to residents.
- Effluent discharge point shall not affect the structural integrity of building.
- Minimum distance of 0.5 metres from plot boundary and within the boundary of the property served.
- Minimum distance of 15 metres away from underground water storage tank.
- Minimum distance of 6 metres upslope or 3 metres down-slope from swimming or wading pools.
- Minimum distance of 30 metres away from any water body currently being used or has future potential usage for drinking and/or cleaning purposes.
- Location shall not be subjected to heavy vehicle, foundation or other imposed loadings.
- Not subjected to 1 in 10 year flooding.
- Refer to Appendices A and B for typical layout.

2.3.2 Access To Septic Tank

Sufficient access must be provided for desludging and other maintenance works. The septic tanks shall be accessible to allow desludging tanker to operate within the effective range of the suction pump. A minimum 250 mm diameter with clear access passage of 150 mm diameter desludging opening in the septic tank shall be provided for the desludging hose at the sedimentation zone.

2.3.3 Safety Requirements

The septic tank shall not be located in area where it is likely to encounter naked flames. The gases in the septic tanks shall be thoroughly ventilated before entering the tank. Any naked flames must be extinguished, and regulations regarding entry into confined spaces must be observed at all times.

2.3.4 Inspection Chamber

Inspection chambers shall be installed at:

- Upstream of inlet to septic tanks.
- At each bend.
- At every 15 metres interval of sewer length outside the building.
- Inspection chambers shall be located at least 1 metre away from the building lines.

2.4 Design

2.4.1 Future Connection to Public Sewers

A by-pass pipe from the last manhole upstream of the septic tank to the outside drain line of the premises and end capped, or plugged, for future connection, must be provided. The by-pass pipe shall be of Internal Diameter 150 mm of straight pipe. Front and end caps shall be provided. The cap or plug must be easily dismantleable without resulting damages to the piping system, floor, building structures, exterior drain, and backlane. (Refer Appendices C and D)

2.4.2 Volumetric Capacity

The volumetric sizing of septic tanks shall be based on per capita wastewater generation rate of 225 l/day and a hydraulic retention time of 24 hours. This is the effective working volume which is required for the biological degradation of the wastewater and excludes the volume of "head room" of air above the water level, accumulated sludge volume for 2 years and filter media if placed within the septic tank (for septic tanks not exceeding 6 PE capacity the accumulated sludge volume shall be based on 4 years). This minimum volumetric capacity of septic tanks shall not be less than 2000 litres or 2 cubic metres.

The minimum effective working volume shall be calculated excluding filter media volume and accumulated sludge volume over 2 years (for septic tanks not exceeding 6 PE capacity the accumulated sludge volume shall be based on 4 years). This is to ensure the individual septic tank is able to meet the 24 hours hydraulic retention time after 2 years (or 4 years as the case may be) of installation.

Septic tank with capacity up to 6 PE, the minimum effective working volume required shall be 2000 litres including accumulated sludge volume over 4 years period.

Example for Computing the Working Volume and Accumulated Sludge Volume for Septic Tank

Working Volume, C = 225 x PE

Where,

C = Working volume in litres

PE = Population Equivalent

Desludging Period = 2 Years
(4 years for septic tanks ≤ 6 PE capacity)

Hydraulic Retention Time = 24 Hours

Sludge Accumulation Rate = 0.04 m^3/PE.year

Desludging Period (Year) = $\frac{\text{(Accumulated sludge volume, } m^3\text{)}}{\text{(Sludge Accumulation Rate, } m^3\text{/PE.year) x (PE)}}$

Effective Working Volume = Working Volume + Accumulated Sludge Volume

The effective volume for the varies PE for septic tank are shown in table below:-

Working Volume and Accumulated Sludge Volume Requirements for Different Size of Septic Tank

Population Equivalent (PE)	Minimum Working Volume		Accumulated Sludge Volume In 2 Years		Required Effective Working Volume	
	L	m^3	L	m^3	L	m^3
7	1575	1.575	560	0.56	2135	2.135
8	1800	1.800	640	0.64	2440	2.440
9	2025	2.025	720	0.72	2745	2.745
10	2250	2.250	800	0.80	3050	3.050
11	2475	2.475	880	0.88	3355	3.355
12	2700	2.700	960	0.96	3660	3.660
13	2925	2.925	1040	1.04	3965	3.965
14	3150	3.150	1120	1.12	4270	4.270
15	3375	3.375	1200	1.20	4575	4.575
16	3600	3.600	1280	1.28	4880	4.880
17	3825	3.825	1360	1.36	5185	5.185
18	4050	4.050	1440	1.44	5490	5.490
19	4275	4.275	1520	1.52	5795	5.795
20	4500	4.500	1600	1.60	6100	6.100
21	4725	4.725	1680	1.68	6405	6.405
22	4950	4.950	1760	1.76	6710	6.710
23	5175	5.175	1840	1.84	7015	7.015
24	5400	5.400	1920	1.92	7320	7.320
25	5625	5.625	2000	2.00	7625	7.625
26	5850	5.850	2080	2.80	7930	7.930
27	6075	6.075	2160	2.16	8235	8.235
28	6300	6.300	2240	2.24	8540	8.540
29	6525	6.525	2320	2.32	8845	8.845
30	6750	6.750	2400	2.40	9150	9.150

2.4.3 Compartmentalisation

Cast in-situ septic tanks shall be designed with two or more compartments. The capacity of the first compartment shall not be less than two thirds of the total volume. The division wall in a two-compartment tank shall have opening of at least 100 mm with a total area of at least 150 cm^2. Openings shall be located at mid-liquid depth. The division wall shall have a ventilation air space at the underside of the roof slab to allow the free passage of gases.

The prefabricated septic tank could be provided with a baffle wall or scum box to isolate scum, oil and grease from entering the filter media. Prefabricated septic tanks with baffle walls, the filter chamber allows the flow from all directions. The scum, oil and grease will be captured at the inlet section of the baffle wall.

Where baffle wall is not provided in the design, an impermeable filter media chamber could be adopted as a baffle wall as it only allows an up-flow from the bottom end of the chamber. The impermeable chamber acts as a baffle or scum box which helps to prevent the scum, oil and grease from entering the filter media.

For vertical flow septic tank, baffle wall or scum box shall be provided to prevent scum, oil and grease from entering the filter chamber. Wall of filter chamber could be considered as baffle wall if up-flow filter chamber is adopted.

2.4.4 Inlet and Outlet

The inlet and outlet from the septic tank shall be a minimum diameter of 100 mm and shall utilize cast iron, or uPVC with sufficient stiffness and thickness dip-pipes located below the scum level. The inlet section, the invert level of the inlet dip-pipe shall be a minimum of 75 mm above the invert level of the outlet dip-pipe. The minimum distance between the inlet pipe and the outlet pipe shall be 1.3 m. The pipe end of the inlet dip pipe shall be at a minimum of 300 mm below the water level. The pipe end of the outlet dip-pipe shall range from 375 mm to 610 mm below the water level. In both the inlet and outlet dip-pipes, the dip pipes shall be projected at least 150 mm above the water level. To minimize turbulence, the velocity of the incoming sewage may be limited by laying the last 12 m of incoming sewer to a gradient of 1 in 50 or flatter.

2.4.5 Effluent Discharge

The effluent shall be discharged through pumping, where gravity discharge is not possible. Pumped discharge can be accomplished through the use of submersible pumps located in a pump well. The requirements for the submersible pump and pump well are as follow:-

Submersible Pump

- Minimum motor rating of 0.3 kW.
- Minimum Design Life of 10 years.
- Selection to consider economic costs, reliability, pumping curve and compatibility with application.

Pump Well

- Effective working volume to retain one (1) hour peak flow.
- Emergency storage capacity of 200 litres in the event of power or pump failures.
- Minimum diameter of 600 mm.
- Pump sets and control switches shall be installed in accordance with manufacturer's specification and to the requirements of the relevant energy authority.

2.4.6 Head Room

The space between the top water level and the underside of the cover shall be a minimum of 250 mm and must be adequately ventilated or provided with an adequate means of drawing off gases. The pipe (minimum 50 mm diameter) or ventilation duct (minimum 75 mm diameter) provided in the septic tank to the exterior shall be proofed against the entry of mosquitoes by a fine mesh screen. The design of all septic tanks shall prevent mosquito breeding.

2.4.7 Covers

The covers of the septic tank and inspection chamber shall be adequately reinforced to take superimposed loadings. All covers shall be airtight. These covers shall have a minimum dimension of 600 mm x 450 mm for cast in-situ septic tanks; and either 600 mm x 600 mm or 600 mm diameter for prefabricated septic tanks. These covers shall be of the cast iron type. The covers shall be airtight and manufactured in accordance to the relevant British and/or Malaysian Standards.

Covers shall be located where it can be easily removed and accessed during desludging works.

2.4.8 Construction

Septic tanks may be constructed of brickwork, concrete, glass reinforced plastic or polyethylene.

Brickwork shall be of engineering bricks in cement mortar and shall be at least 220mm thick. The mortar shall be a mix of 1:3 cement to sand ratio. In-situ concrete shall be at least 150mm thick of C35A concrete mix. The foundation and floor shall be constructed of concrete, at least 150mm thick of C30 concrete mix. All internal faces of the septic tank shall be coated with sulphate resisting cement mortar or equivalent product.

Where bricks are used to construct septic tanks, the following additional conditions shall apply:-

- The depth of a 220 mm thick brick wall tank shall not exceed 1500 mm below ground surface, and
- The depth of a 300 mm thick brick wall shall not exceed 2000mm below ground surface.

Septic tanks which may be subjected to traffic load or other surcharges shall be of reinforced concrete design.

The installation of proprietary type septic tank shall strictly comply with the manufacturers' specifications.

2.4.9 Principal Dimensions

The principal dimensional requirements for septic tanks are show in the table below:-

(a) Cast-In-Situ Septic Tanks

Requirement	Dimensions
Liquid Depth	Between 1.22 m and 2.0 m
Minimum Width	815 mm
Length: Width Ratio	1.5 : 1
Minimum Free Board	250 mm
Maximum Depth From Ground Level	4.0 m
Ventilation Air Space	150-300 mm above top water level
Minimum Clear Sludge Depth	100 mm
Minimum Pipe Diameter	100 mm
Surface Area: Depth Ratio	Not less than 3 for any compartment

(b) Prefabricated Septic Tank Dimensions

Requirement	Dimensions
Minimum Inlet & Outlet Pipe Diameter	100 mm
Minimum Free Board	250 mm
Minimum Ventilation Pipe/ Ventilation Duct Size	50 mm
Minimum Diameter for Cylindrical Tank	1.3 m
Length: Width Ratio For Rectangular Tank	1.5 : 1
Maximum Depth From Ground Level	Not exceed 4.0 m
Maximum Tank Height	Not to exceed 3.0 m

2.5 Non-proprietary Systems

Typical design drawings are available for two (2) categories of size; less than 12 PE and 12 to 30 PE are provided in Appendices E and F. These drawings shall show the critical dimensions of the septic tank as well as the stone filter chamber design. All non-proprietary septic tanks shall follow the critical dimensions as depicted in these drawing for the design of both the septic tanks and filter.

2.6 Proprietary Systems

Only proprietary septic tanks that the suppliers are registered with *Suruhanjaya Perkhidmatan Air Negara (SPAN)* may be used. A typical design is shown in Appendix G.

2.6.1 Tank Material

- The tank shall be made of non-degradable, non-corrodible and of inert and lightweight materials.
- All fitting, pipe, partition or any other component part shall be made of non-degradable, non corrodible and durable material that is compatible with the tank.
- Polyethylene tanks:-

  (i) Preferably no metal parts in the tanks.
  (ii) Thickness of the side walls, top, bottom, and covers shall be at least 7 mm. The thickness of the inlet and outlet ends shall be at least 5mm and the thickness of internal walls and partitions shall be at least 1.5 mm.
  (iii) Fastening of internal walls or partitions shall be done by welding or corrosion resistant fastening systems that will hold under standard testing conditions.

- Glass fibred reinforced plastic:-

  (i) Laminates shall contain not less than 30% chopped glass strands and be not less than 4 mm thick. All edges of openings and covers of the tank shall be increased to a minimum thickness of 6 mm for a minimum distance of 40 mm and shall have a minimum of 30% glass. No fillers shall be included in the laminate. The laminate thickness shall be uniform. Pigments may be allowed on the outer surfaces.
  (ii) Access opening cover and top portion of the vertical tank shall be of a minimum thickness of 4 mm, and shall have a composition of 30% glass and 70% resin. It shall also be reinforced to withstand a load of 500 kg mass.

- Reinforced precast concrete:-
  All reinforced precast concrete septic tanks shall be capable of passing the cylinder, surface load, and water tightness tests.

2.6.2 Tank Fabrication and Construction

The body of the tank below liquid level shall be fabricated or cast in seamless unit. No joint shall be allowed on the body of the tank below the liquid level.

All prefabricated septic tanks shall be fully assembled at manufacturer's factory. The tank shall be delivered in fully completed unit for installation at site. Any internal assembling works on the septic tank at site is not allowed to avoid any possible sub-standard assembling works of the septic tank.

2.6.3 Inspection Chamber and Septic Tank Covers

- Cover shall be of cast iron only and have a permanent embossment of the brand name of the tank on the cover.
- The invert level of inspection chamber shall be at a minimum depth of 100 mm from the ground level but not to exceed 1000 mm.
- Cover shall be a minimum of 600 mm x 600 mm for a rectangular opening or a diameter of 600 mm for circular opening.
- Inspection chambers shall be provided immediately before and after each septic tank.

2.6.4 Ventilation, Inlet and Outlet Pipes

- The vent pipe shall be made of non-corrode material, with a minimum diameter of 50 mm and shall be extended to the building/house roof top (provided with mosquitoes proof mesh or equivalent).
- If the septic tank is located inside a building, the vent pipe shall be located above the roof top. The vent height shall be at a minimum of 300 mm above the ridge top.
- The inlet to a septic tank shall have a minimum length of 2 m.
- Both the inlet and outlet diameters shall be a minimum of 100 mm.
- All fittings through the wall of the tanks, such as the ventilation, inlet and outlet pipes, shall be installed with a permanent watertight seal.
- The clearance between the crown of the inlet pipe and the underside of the roof of the septic tank shall be at least 50 mm.
- The invert of the outlet pipe shall be at least 75 mm below the invert of the inlet pipe.

2.6.5 Filter Chamber and Filter Media

- The surface area to volume ratio of filter media shall be a minimum of 90 m^2/m^3.
- There shall be provisions to allow for regular servicing and maintenance such as cleaning and replacement of filter media.
- A minimum opening of 600 mm x 450 mm or 600 mm diameter shall be provided over the filter media compartment.
- Filter media shall preferably be of dual or more sizes instead of a single size.
- Filter media shall be of proprietary design with brand name embossed.

- The filter media shall be media of non-degradable, non-corrodible and of inert materials which may not warp over time.
- The BOD_5 loading of filter chamber shall not exceed 1.2 kg/m^3 per day.
- The SS loading of filter chamber shall not exceed 1.0 kg/m^3 per day.
- The volumetric loading of filter chamber shall not exceed 2.5 m^3/m^3 per day.
- The void percentage of filter media shall not be less than 80%. The void percentage is refered to the interstitial voids for percolation of the liquor.

2.6.6 Marking/Labeling

Proprietary septic tanks shall be permanently labeled with following information:

- Manufacturer's name and trademark.
- Model of septic tank.
- Year of manufacture.
- Warranty Period.
- The working capacity of the tank.
- The type and volume of filter media used.
- The minimum liquid depth of the septic tank.
- The symbol or logo of the certifying agency.
- Permanent warning labeling advising against unauthorized entry into the tank and the word **"DANGER"**. The warning shall be located on the access opening lid.

The marking or label shall be located on top of the tank close to the access opening and shall be left exposed and visible after installation.

2.6.7 Septic Tank Foundation

- Soil, sand or aggregates for use in bedding shall be of granular type to achieve adequate compactions.
- The base of the septic tank must be piled before a top concrete layer is cast in-situ, especially in high groundwater areas and for septic tanks located outdoor.
- The septic tank shall sit on a piled reinforced concrete slab of a minimum 100 mm thick. The base to the slab shall be of a well compacted sand or aggregate with a minimum thickness of 300 mm.

2.6.8 Installation

- Careful lifting in accordance to manufacturer's instruction is required.
- Backfilling shall be conducted in layers of 250 mm thickness uniformly around the tank.
- Loose soil with an aggregate of not more than 30 mm shall be used for backfilling.
- Septic tank shall be anchored or strapped to the base of the concrete slab prior to backfilling.

2.7 Commercial Kitchens

The discharge from any kitchen sink and/or dishwashing machine, in a commercial kitchen shall connect to an approved grease arrestor located as near as practicable to the kitchen sink and/or dishwasher.

Part 3 Performance Enhancement for Septic Tanks

3.1 General

Sewage effluent discharges upstream of raw water intake point shall be treated to meet Standard A of the Environmental Quality Act, 1974. If the septic tanks are used as a stand-alone unit process, it will not achieve an effluent quality better than Standard B.

3.2 Enhanced Treatment Methods

The following further treatment methods may be used together with septic tank treatment for achieving higher effluent quality:

- Soil Absorption System (Refer Appendices H and I).
- Intermittent Sand Filter (Refer Appendix J).
- Small Package Mechanical Plants.

3.3 Prohibited Discharges into Septic Tanks

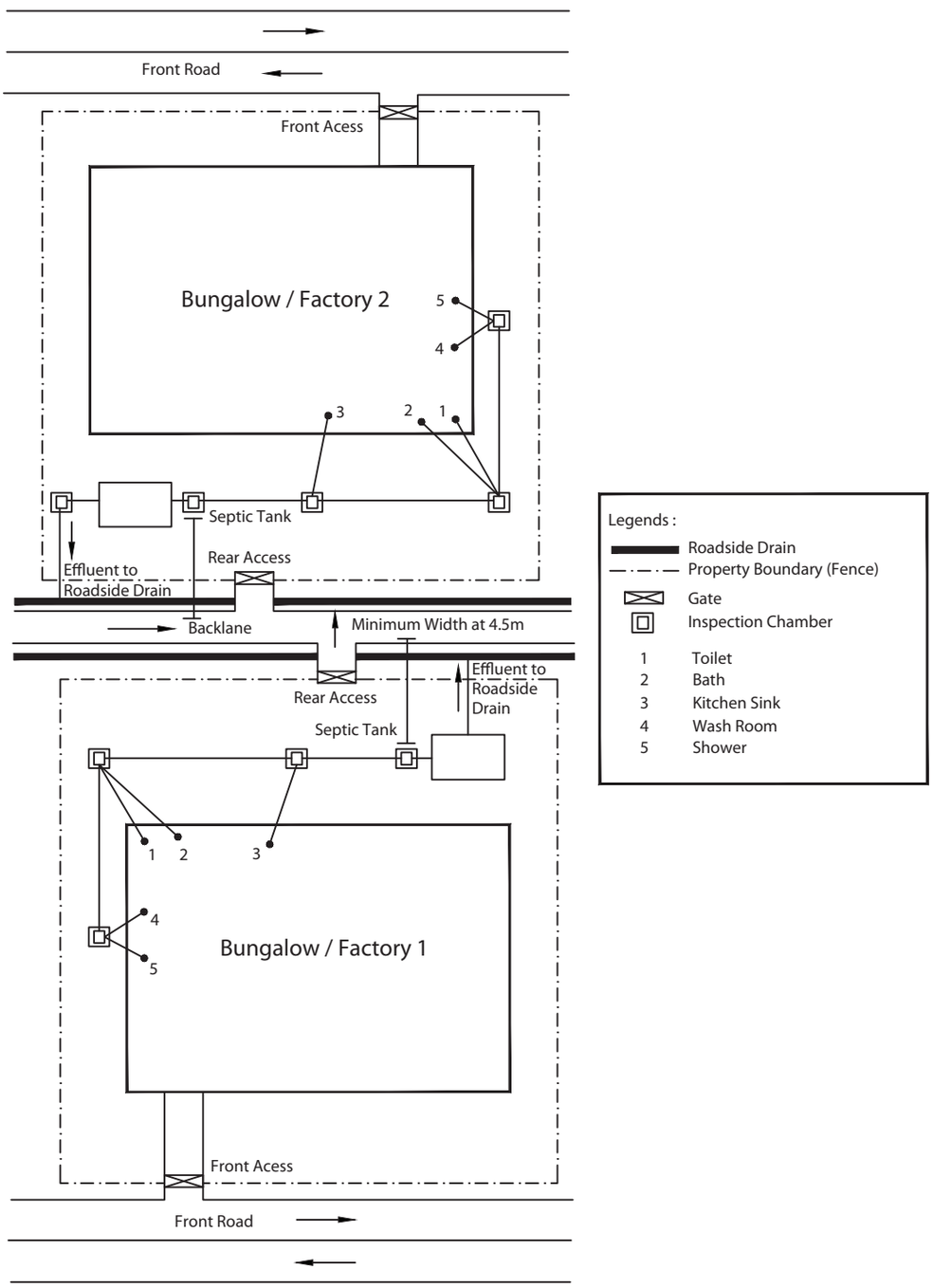
Unless otherwise approved by Urban Sewerage Systems Authority, no person shall permit or cause any of the following discharge into a septic tank system:

- Any storm water, including roof and rainwater tank overflow, and surface drainage waters,
- Any back flush waters from a swimming pool or water softener,
- Any discharge or back flush from spa bath/pool in excess of 680 litres capacity,
- Any sanitary napkin, clothing or plastic material or liner,
- Any trade waste,
- Any petrochemical or petrol or other flammable or explosive substance whether solid, liquid or gaseous,
- Degreaser, bleach, paints, waste chemical, pesticide.

- Any disinfectant or deodorant, antiseptic or germicide powder or fluid, unless specifically stated to be suitable for use in a septic tank,
- Any other matter or substance which, in the opinion of the Urban Sewerage Systems Authority, City Administration or Municipal Council, would impair the effective working of a septic tank.

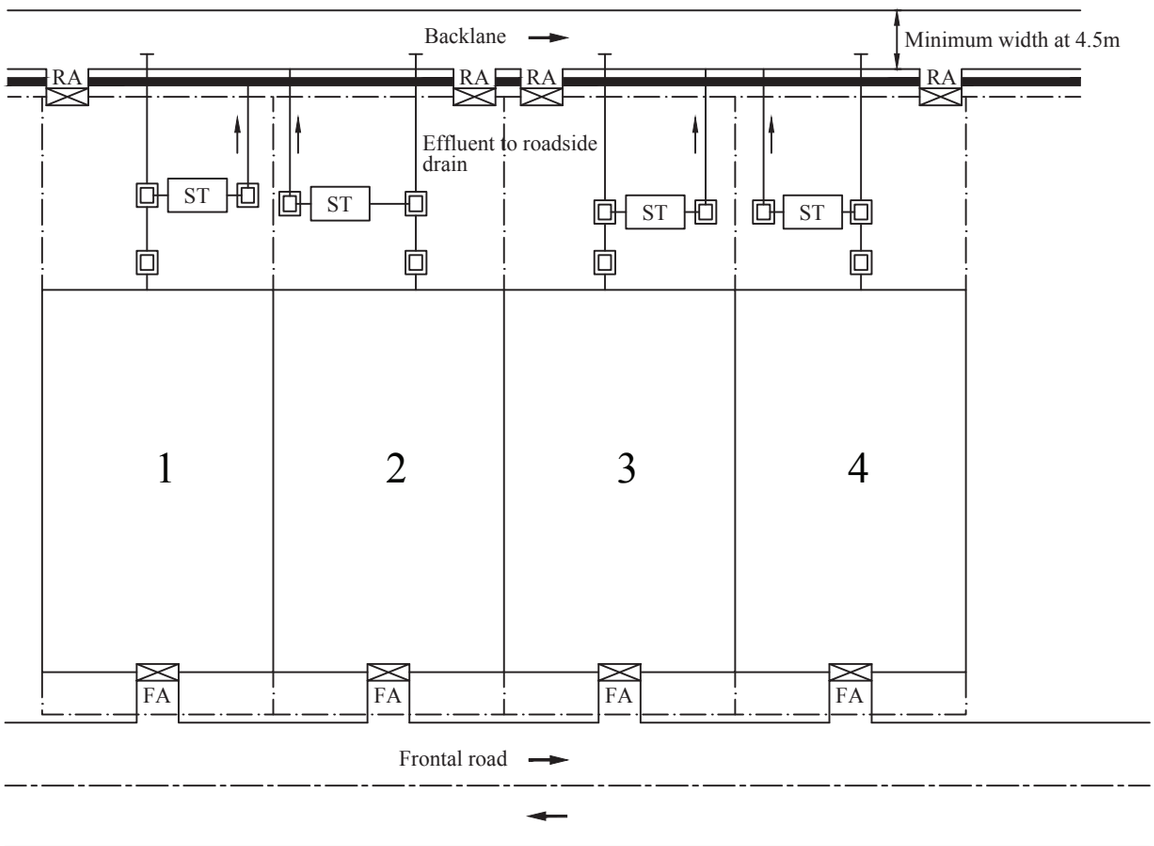
Part 4 Appendices

Appendix A
Typical Layout For Bungalow



Appendix B

Typical Layout For Terrace Houses and Shophouses

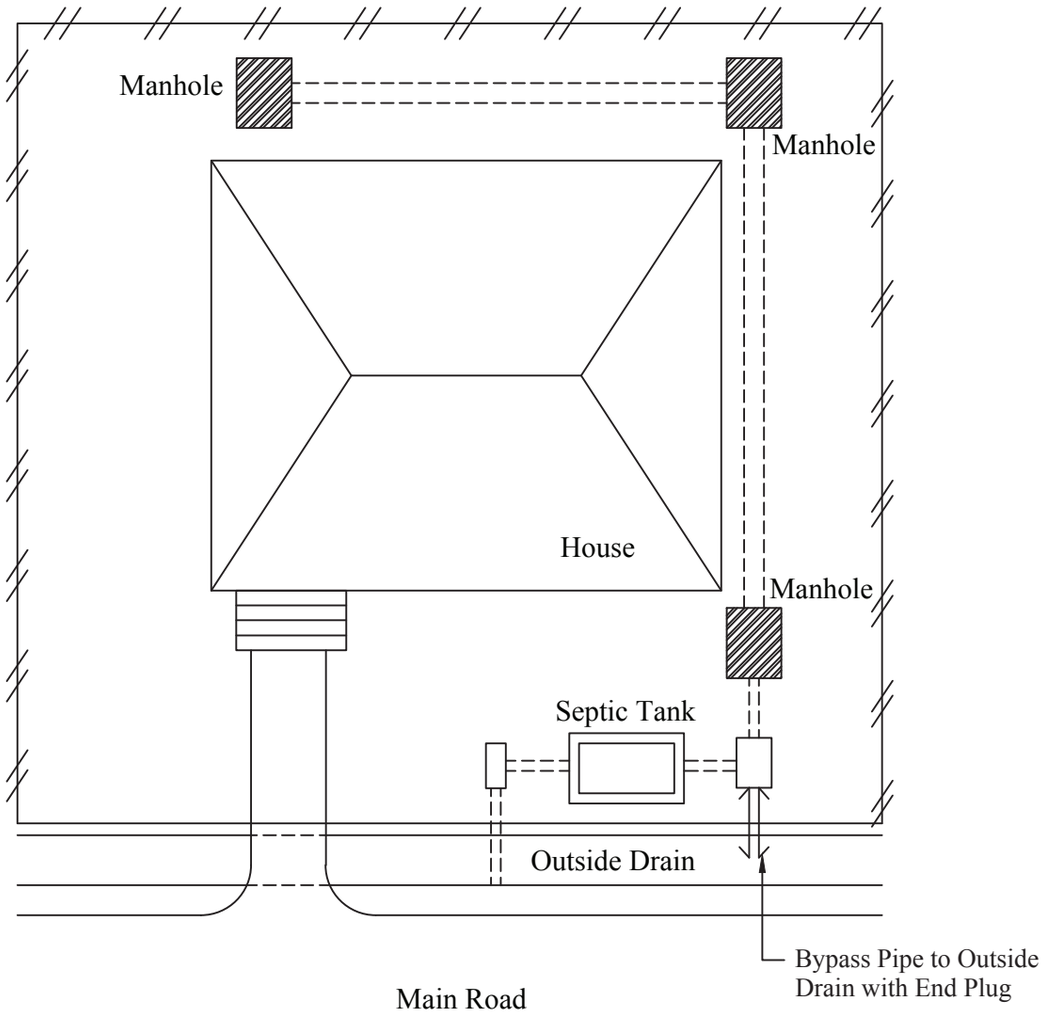


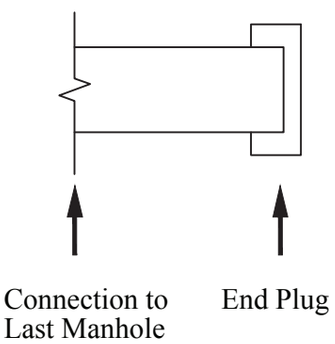
Legends :

▬▬	Roadside Drain
–·—·–	Property Boundary (Fence)
ST	Septic Tank
▣	Inspection Chamber
1, 2, 3, 4	Terrace House / Shop house Commercial Buildings / Property
FA	Front Access
RA	Rear Access

Appendix C

Layout for By-Pass to Public Sewer

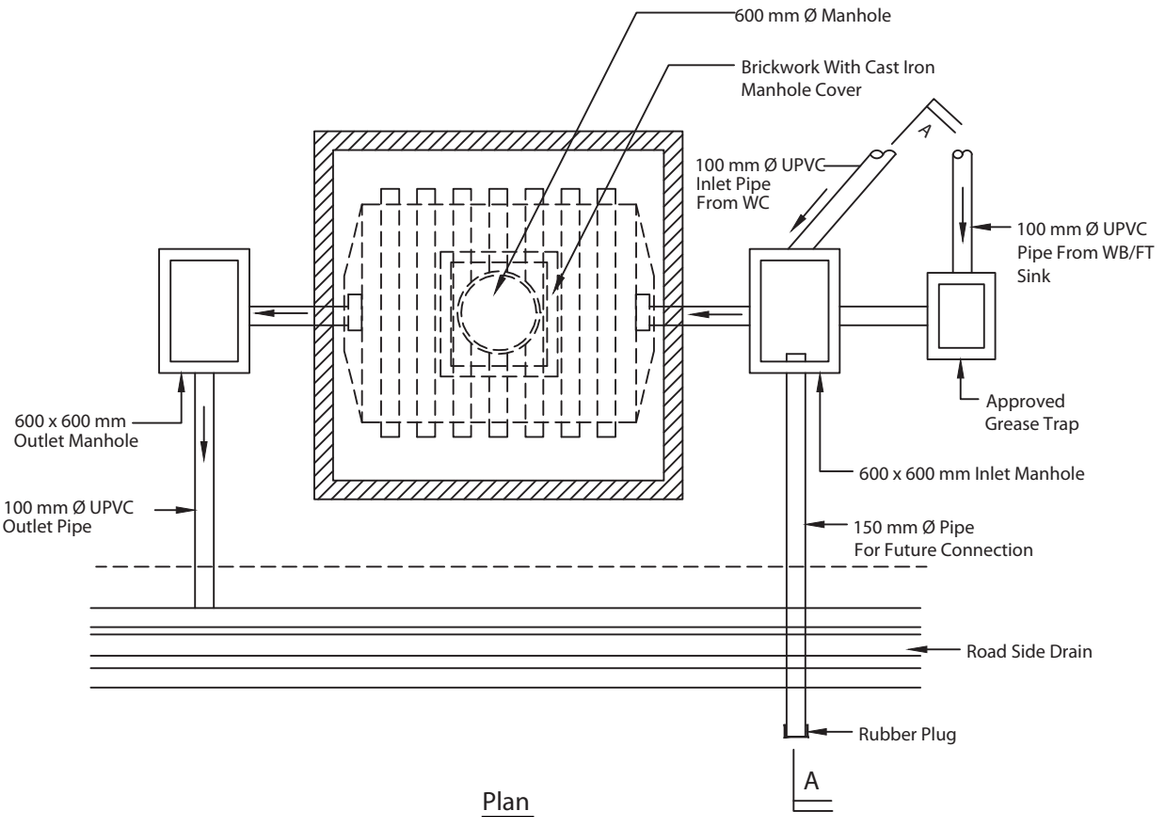




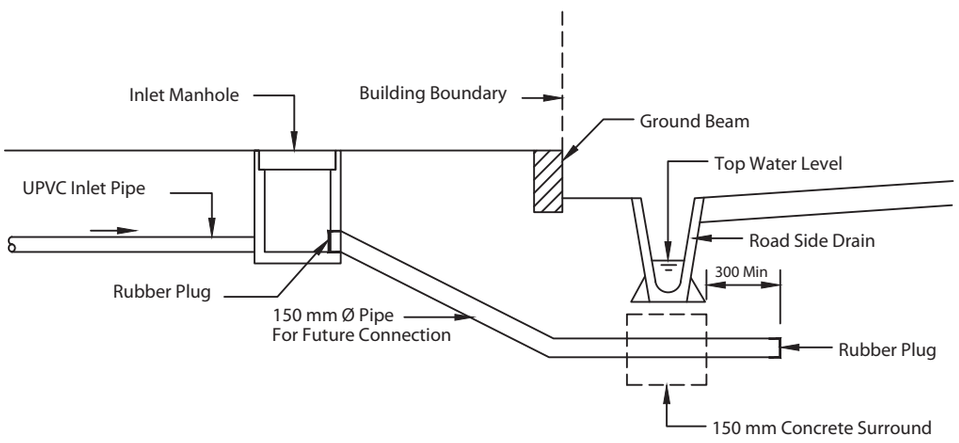
Typical Side View of Bypass Pipe with End Plug

Appendix D

Details of By-Pass to Public Sewer

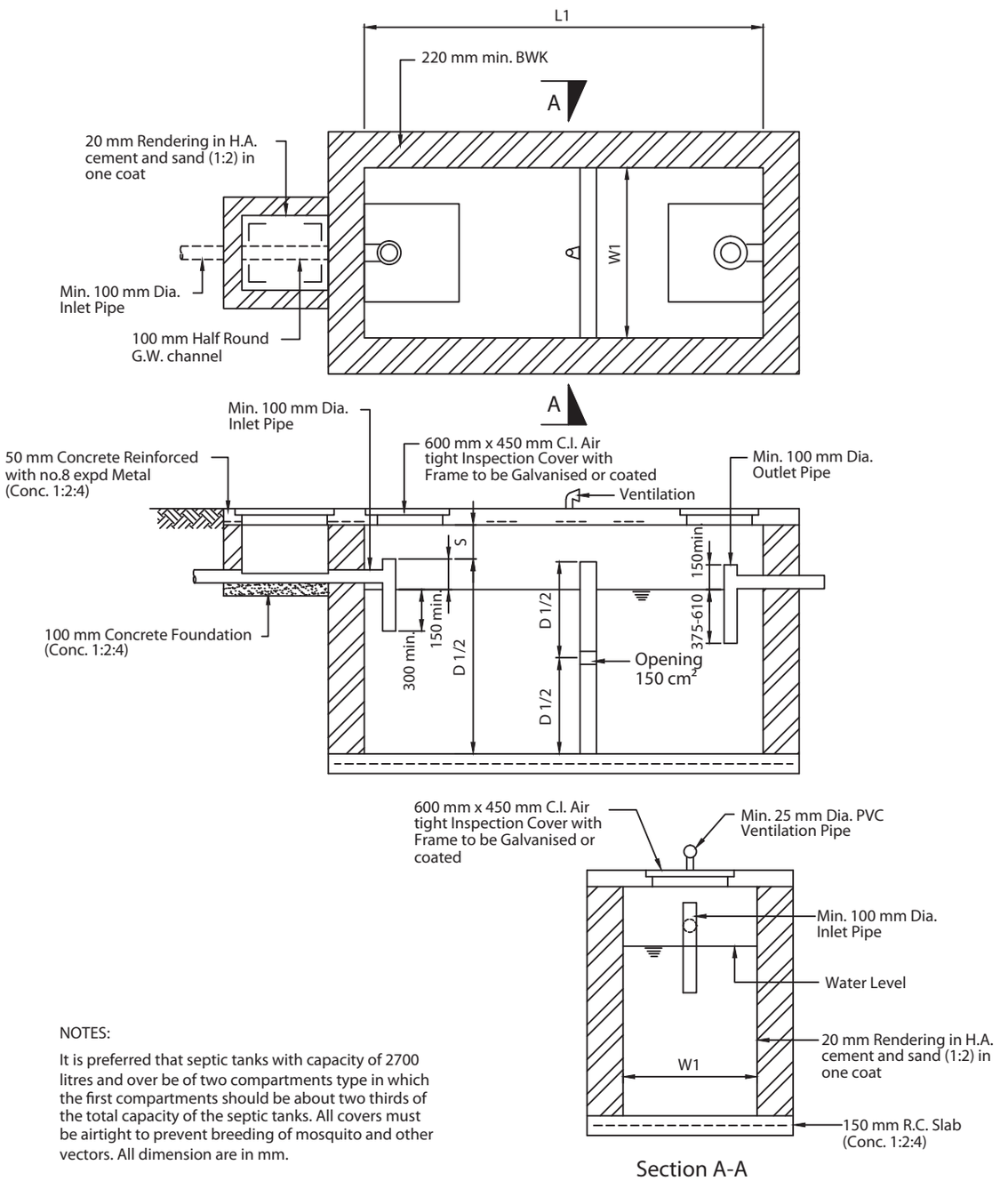


Plan



Section A-A

Appendix E
Non-Proprietary Septic Tank (≤12PE)



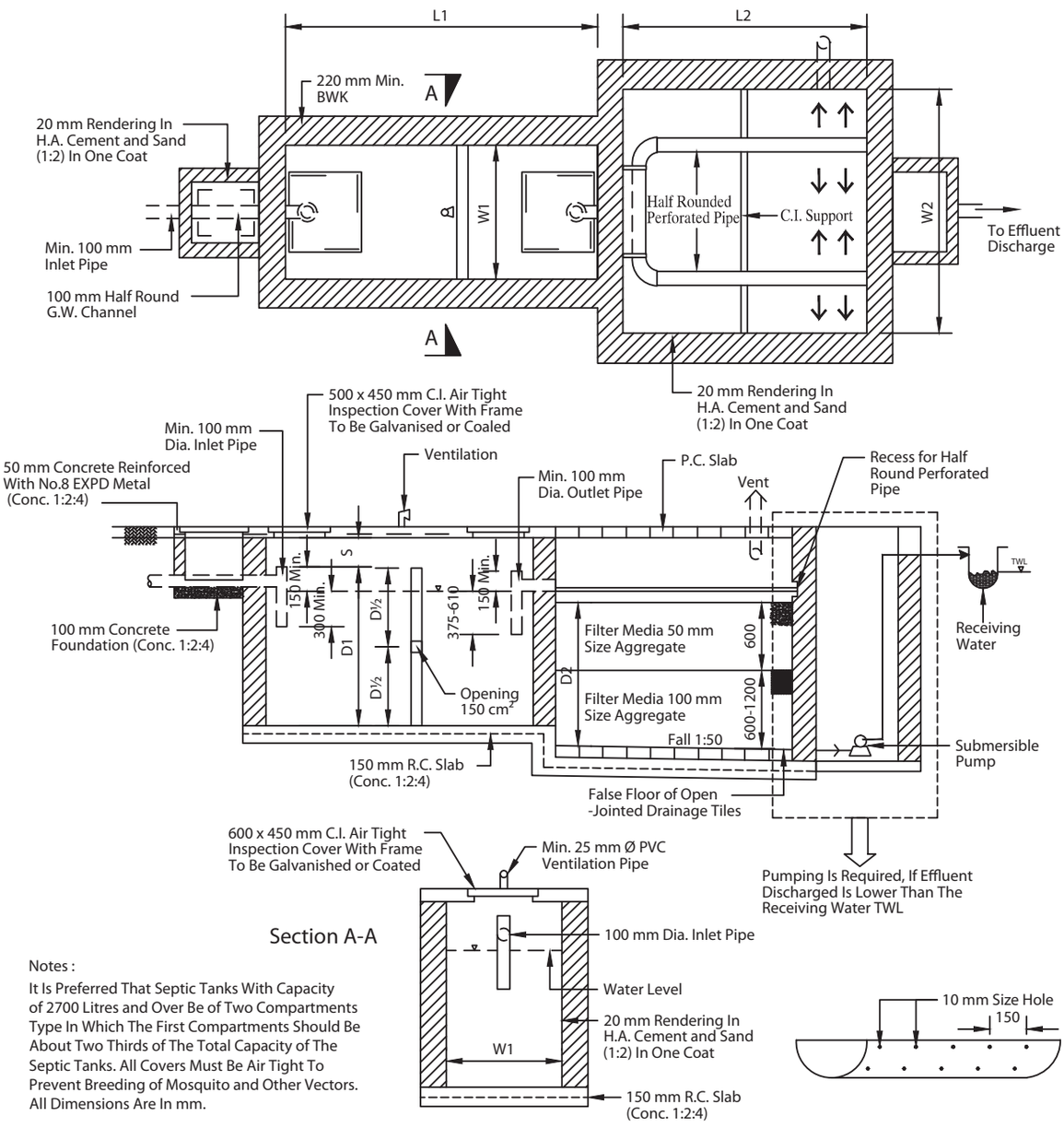
Section A-A

NOTES:

It is preferred that septic tanks with capacity of 2700 litres and over be of two compartments type in which the first compartments should be about two thirds of the total capacity of the septic tanks. All covers must be airtight to prevent breeding of mosquito and other vectors. All dimension are in mm.

SEPTIC TANK					
PE	CAPACITY (LITRES)	INSIDE DIMENSION (mm)			AIR SPACE (S)
		WIDTH (W1)	LENGTH (L1)	LIQUID DEPTH (D1)	
10	2250	815	2290	1220	230
12	2700	885	2595	1220	255

Appendix F
Non-Proprietary Septic Tank (12<PE≤30)

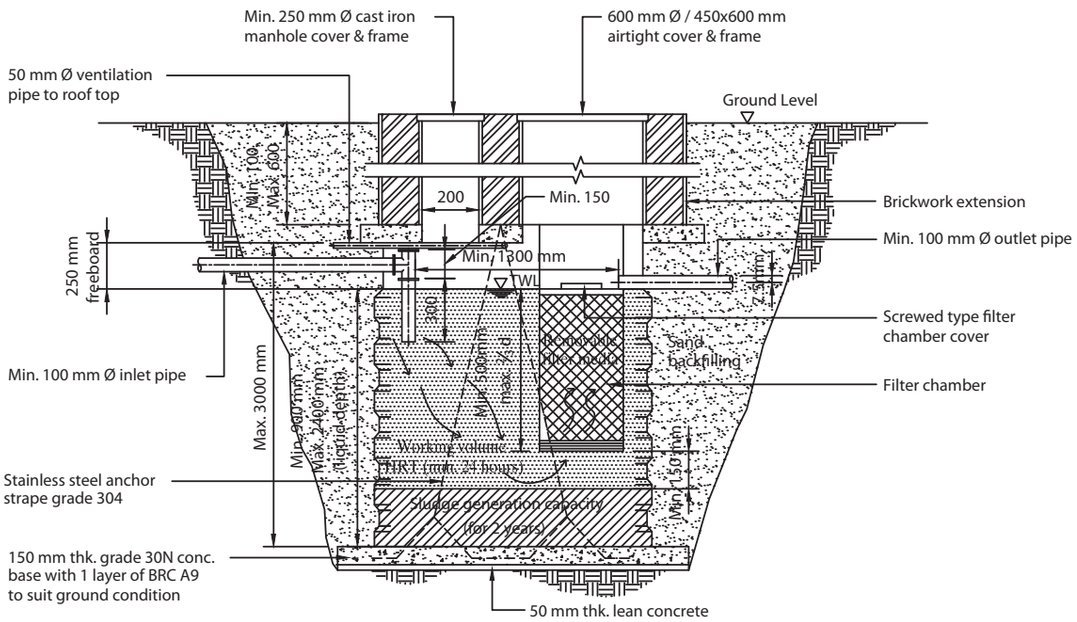


Notes :

It Is Preferred That Septic Tanks With Capacity of 2700 Litres and Over Be of Two Compartments Type In Which The First Compartments Should Be About Two Thirds of The Total Capacity of The Septic Tanks. All Covers Must Be Air Tight To Prevent Breeding of Mosquito and Other Vectors. All Dimensions Are In mm.

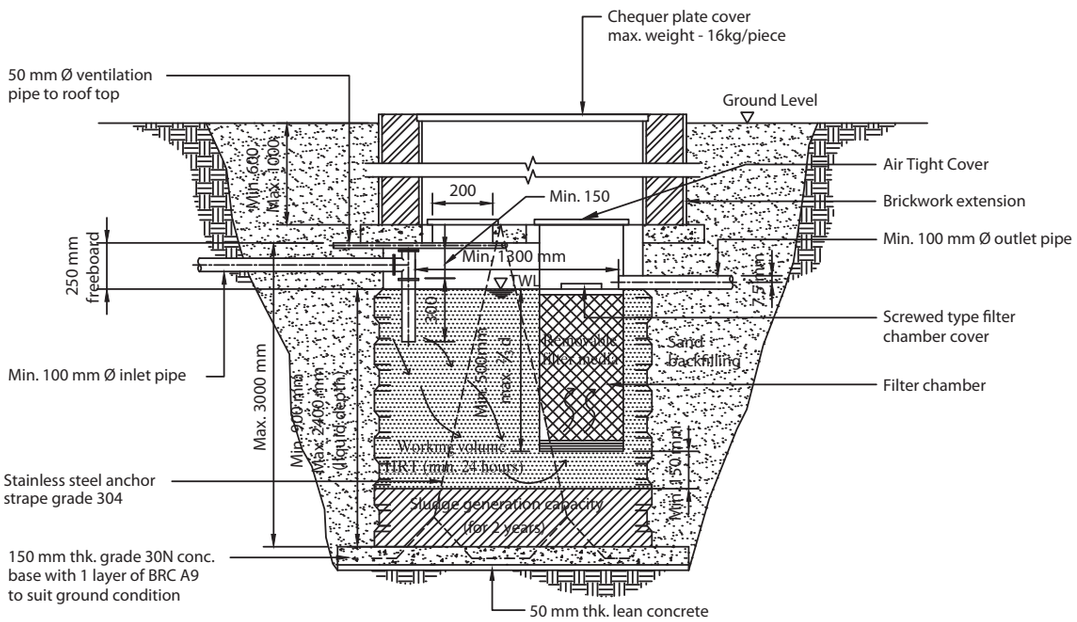
Septic Tank						Filter Bed			Inlet/Outlet Pipe	
PE	Capacity (Litres)	Inside Dimension (mm)			Air Space (S)	Inside Dimension (mm)			Depth Below W.L (mm)	
		Width (W1)	Length (L1)	Liquid Depth (D1)		Width (W2)	Length (L2)	Media Depth (D2)	Inlet	Outlet
15	3375	995	2595	1375	280	1830	2000	1220	305-535	535
18	4050	1070	2595	1525	305	1830	1830	1500	305-610	610
20	4500	1145	2595	1525	305	1830	2100	1500	305-610	610
25	5525	1375	2745	1525	305	2100	2300	1500	305-610	610
30	6750	1375	3355	1525	305	2300	2400	1500	305-610	610

Appendix G
Typical Pre Fabricated Septic Tank



Typical Pre Fabricated Septic tank

(For < 600 mm depth)



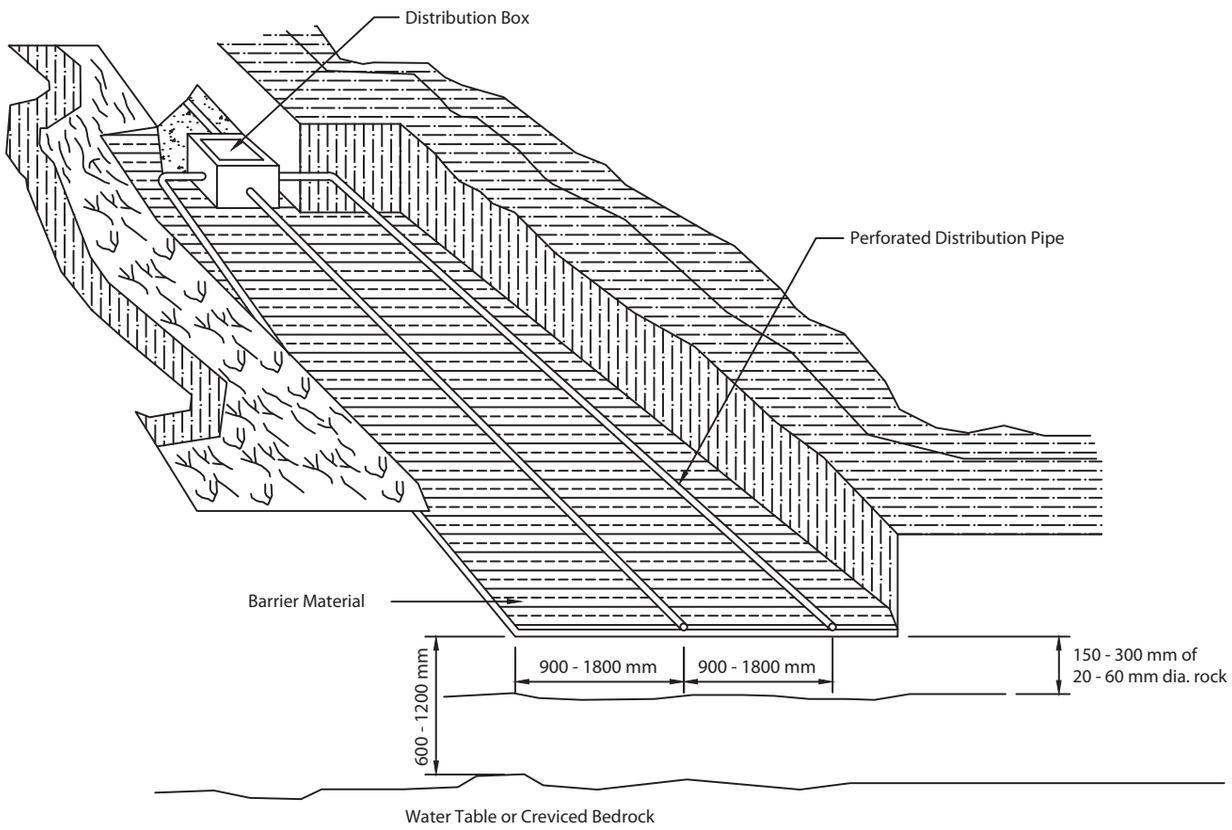
Typical Pre Fabricated Septic tank

(For > 600 mm depth)

Legend :

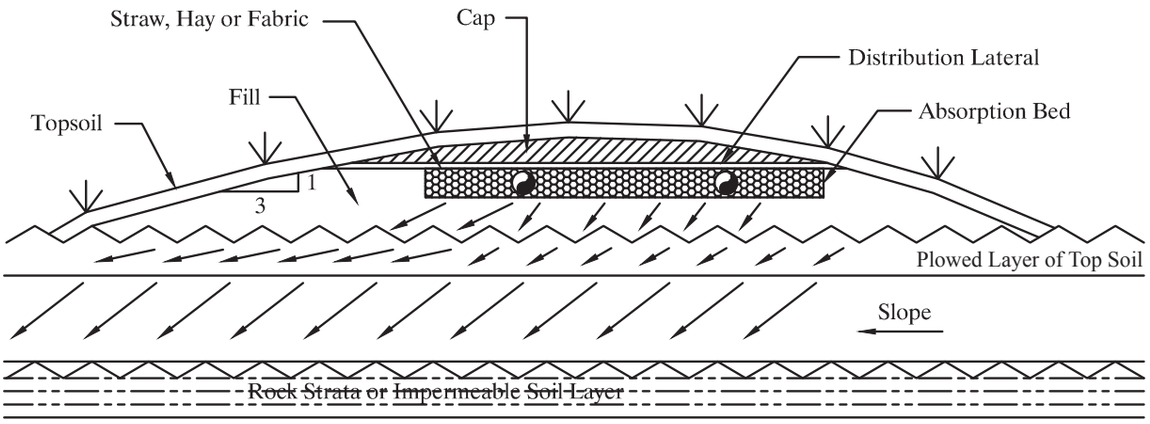
- Working Volume
- Sludge Generation Capacity
- Filter Media

Appendix H
Typical Bed System for Soil Absorption

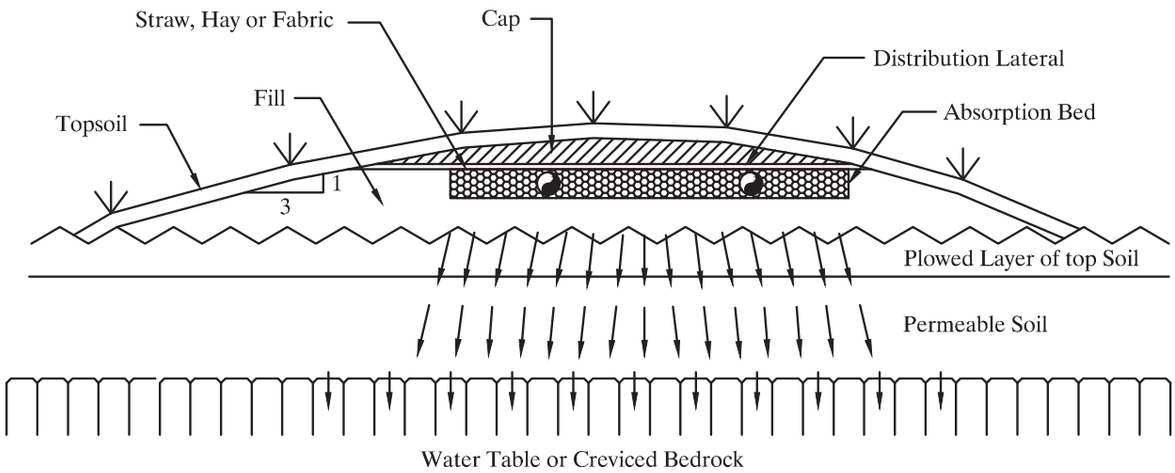


Appendix I

Typical Mound System For Soil Absorption

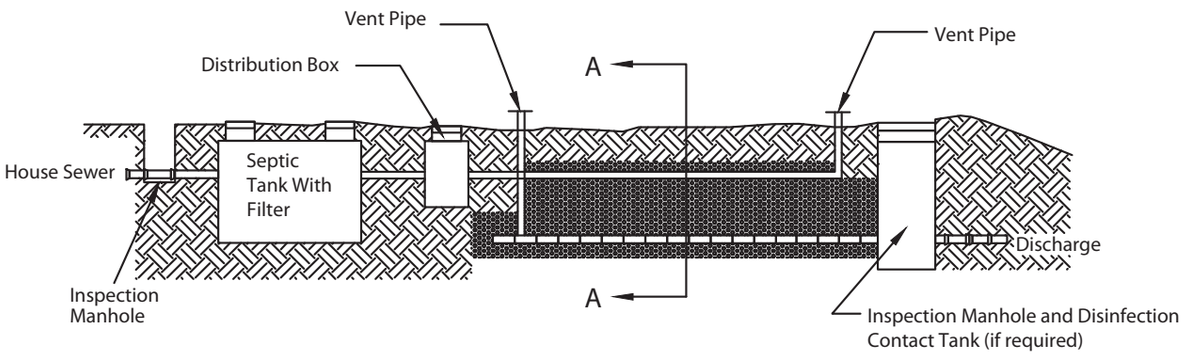


(a) Cross Section of a Mound System for Slowly Permeable Soil on a Sloping Site

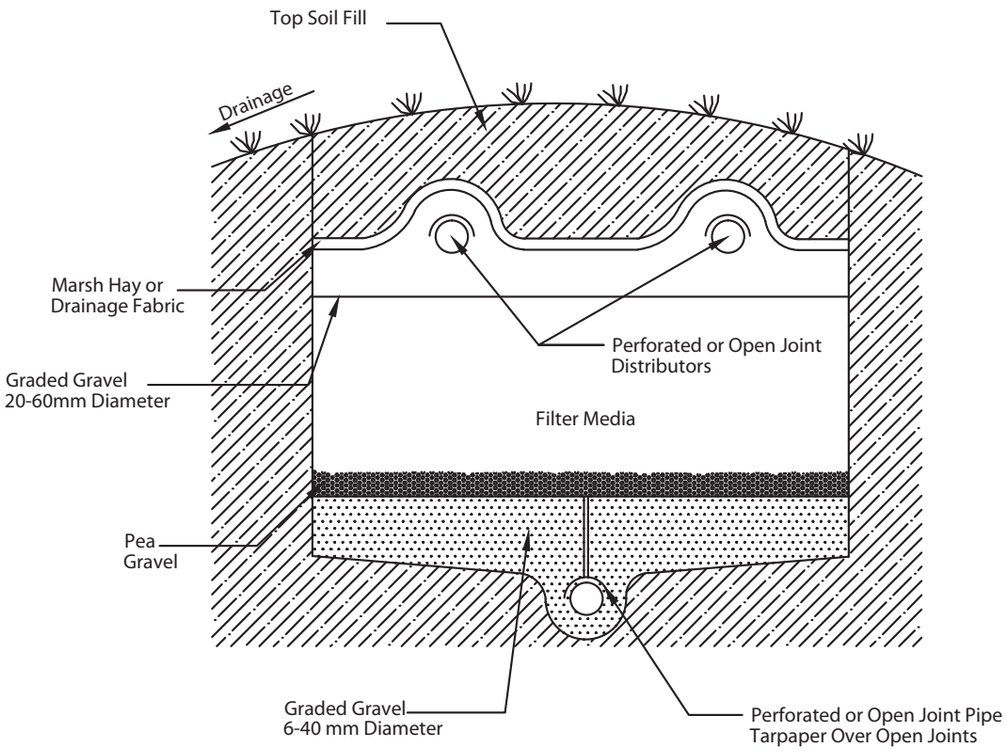


(b) Cross Section of a Mound System for a Permeable Soil, with High Ground Water or Shollow Creviced Bedrock

Appendix J
Typical Buried Intermittent Sand Filtration



Plan



Section A-A

Appendix K
Recommended Population Equivalent

Type of Premises/Establishment	Population Equivalent (Recommended)
Residential	5 per house
Commercial: Includes offices, shopping complex, entertainment/recreational centres, restaurants, cafeteria, theatres	3 per 100m^2 gross area
Schools/Educational Institutions: - Day schools/Institutions - Fully residential - Partial residential	 0.2 per student 1 per student 0.2 per non-residential student 1 per residential student
Hospitals	4 per bed
Hotels with dining and laundry facilities	4 per room
Factories, excluding process water	0.3 per staff
Market (wet type)	3 per stall
Market (dry type)	1 per stall
Petrol Kiosks/Service stations	15 per toilet
Bus terminal	4 per bus bay
Taxi terminal	4 per taxi bay
Mosque/Church/Temple	0.2 per person
Stadium	0.2 per person
Swimming pool/Sports complex	0.5 per person
Public toilet	15 per toilet
Airport	0.2 per passenger 0.3 per employee
Laundry	10 per machine
Prison	1 per person
Golf course	20 per hole

(Ref: Malaysian Standard 1228)