Section 1

Introduction

1.1 Purpose of This Volume

This volume sets out the requirements of the National Water Services Commission (SPAN), referred to as the Commission in this document for the design and construction of individual septic tanks within developments.

This volume applies to multi-unit housing; mixed and individual residential or commercial developments with a population equivalent (PE) size up to 150, where the use of individual septic tank is being considered.

Developments of more than 150 PE shall not employ the use of septic tanks.

An individual septic tank can only serve one premise. The largest capacity of individual septic tank shall not be more than 30 PE. Where the design PE is more than 30 for a single unit of building or sub-divided lots, other system of treatment shall be provided. Furthermore, the use of multiple individual septic tanks within a single sub-divided lot is not allowed.

Sewage Treatment Plant shall be used for treatment more than 30 PE developments in single unit type as given in MSIG Volume 4.

The developer shall consult the following MSIG for developments that falls outside the scope of this volume, namely:

- Volume 1 Sewerage Policy for New Developments
- Volume 2 Sewerage Works Procedures
- Volume 3 Sewer Networks and Pump Stations
- Volume 4 Sewage Treatment Plants

The user of this volume of the MSIG shall also refer to Volume 3 of the above guidelines on the provision of oil and grease interceptors to protect sewerage treatment systems from the discharge of these matters from hotels, restaurants, canteens, garage workshops or any premises that collects such matters.

This volume does not cover the installation of internal plumbing systems to buildings. The requirements for internal plumbing systems are managed by the relevant Local Authorities.

1.2 Effluent Discharge Standards and Requirements

The Environment Quality Act (EQA) 1974 specifies two standards for effluent discharge. These are namely 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 current Third Schedule of the *Environmental Quality Act 1974,* under the *Environmental Quality (Sewage and Industrial Efluents) Regulations 1979,* regulations 8 (1), 8 (2) and 8 (3) has been revisited and the Department of Environment (DOE) has proposed 8th Schedule for the Act which stipulate effluent discharge limits for parameters specific to domestic wastewater. The effluent discharge limits in 8th Schedule are summarised in Appendix B.

Due to the limitations in a septic tank in providing primary wastewater treatment only, its treatment performance may not be on a consistent basis to meet the strict DOE absolute standards. Further, its performance is also subjected to quantity of settled solids which has accumulated over time. The settled solids reduce the volume available for sewage treatment and compromises its efficiency of treatment. For these reasons, the design of septic tanks for effluent discharge downstream of water intake points shall be based on an average effluent quality of

BOD5	: 50 mg/*l*
Suspended Solids	: 100 mg/*l*

To achieve a higher quality of treated effluent discharge within catchment located upstream of water intake points, the design of the septic tank must be coupled with further forms of treatment as recommended in Section 4.0 of this Volume.

It is of paramount importance to meet the above treated effluent quality and achieve the overall environmental objectives. Hence, the design of septic tanks must allow for regular desludging at a frequency of **NOT** less than once every two (2) years.

1.3 Who Should Use This Volume

This volume is primarily intended for owners, architects, town planners, suppliers, developers and their consulting engineers, public authorities and others whose developments intended to use septic tanks.

1.4 Related Reference Material

This volume does not cover all aspects of design and construction of septic tanks. Where information is not covered in this volume, the designer shall follow the requirements given in *MS 1228: 1991 Code of Practice for Design and Installation of Sewerage Systems*.

However, the information in this volume shall take precedence over MS 1228, where similar aspects are covered in both these documents or where there is conflicting information between the two documents.

The procedures for certification of sewerage services are given in the MISG Volume 2 Sewerage Works Procedures.

The following documents are also referred to in this volume.

Malaysian Standards

- MS 1228:1991 Code of Practice for Design and Installation of Sewerage Systems or its latest version.

Other Documents

- Environmental Quality Act, 1974
- Water Services Industry Act, 2006

Other Guidelines in This Set

The Malaysian Sewerage Industry Guidelines is also comprised of other 4 volumes:

- Volume 1 Sewerage Policy for New Developments
- Volume 2 Sewerage Works Procedures
- Volume 3 Sewer Networks and Pump Stations
- Volume 4 Sewage Treatment Plants

Section 2

General Guidelines

2.1 Initial Consultation

Before submitting Application for Sewerage Works Planning Approval, the owner shall consult the Commission to determine one of the following forms of sewage treatment appropriate for the proposed development:

- Connect to existing public sewer.
- Individual septic tanks.
- Comply with effluent Standard A or B while meeting with local environmental standards.

It is advised that the matters listed in section 2.2 and 2.3, and 2.4 for homestead developments, are discussed and clarified before making a formal application to the Commission.

2.2 Where a Public Sewer is Available

The development must be connected to a public sewer if it is located within 30 metres of the proposed site. Volumes 2 and 3 of the MSIG provide procedural and design information on sewer connection.

2.3 Where No Public Sewer is Available

Where a public sewer is not available, the developer shall consider the following before proceeding:

a) Investigate if there are existing forms of sewage treatment available in the vicinity of the proposed development.

b) Liaise with the Commission to determine if there are any immediate or future proposals for sewerage works in the vicinity of the proposed development for possible connection.

c) Current guidelines, standards or special requirements with respect to sewerage works and treated effluent standards.

Note: This Guidelines should only be used for developments served by individual septic tank.

2.4 Homestead Developments

2.4.1 Single Development up to 30 Units or 150 PE in Total

Individual septic tanks may be allowed for single developments of up to 30 units or 150 PE in total.

Septic tanks will be regarded as temporary treatment systems.

The owner must provide all septic tanks as part of the owner's infrastructure works. Septic tanks must be constructed to standard design.

The owner must provide a 150 mm by-pass pipe from the last manhole before the septic tank and extended to the outside drain line of the premises. The pipe end shall be capped for future connection. Please refer to Section 3.2.8 of this Volume for further details.

2.4.2 Single Development Over 30 Units in Total with Average Housing Density Greater Than Five Units per Hectare

For single development over 30 units in total with an average housing density greater than 25 persons per hectare, a sewer reticulation and a treatment plant must be provided.

Sewer reticulation must be appropriately designed to achieve acceptable hydraulic conditions within topographic and routing parameters.

2.4.3 Single Development Over 30 Units in Total with Average Housing Density Less Than Five Units per Hectare

For single development over 30 units in total and with an average housing density of less than 25 persons per hectare, a sewer reticulation and a treatment plant is preferred.

Where the terrain of the development is such that installation of an approved treatment system mandating the construction of excessive numbers of intermediate pump stations; individual treatment facilities may be considered, subject to the following conditions:

a) The individual system must be a system approved by the Commission.

b) Where the ground conditions permit, soakaway trenches must be used for disposal of the final effluent from the treatment systems.

c) Developers shall ensure that home owners enter into an agreement with the supplier of the system or licensed contractor approved by the Commission, to carry out operation and maintenance of the system as per design requirements.

d) Tanks shall be desludged by the Services Licensee as per terms of the agreement signed between the Services Licensee and the Government.

e) The Commission and DOE may impose stringent conditions, if they believe that such measures are required to ensure that the sewage from the development will not result in an adverse impact to the environment.

All septic tanks shall be designed in accordance with the requirement of this Guidelines.

2.4.4 Individual Development Outside Local Authority Areas

Owners in rural catchments must be encouraged to use the types of Individual Septic Tanks (IST) approved by the Commission instead of 'Others' type of sanitary system

Local Authorities must liaise with the Commission before approving sewerage plans for developments or individual owners. Local Authorities shall advise the owners on the following:

a) IST suppliers and the product must be approved by the Commission.

b) Must comply with effluent quality standard

c) Where ground conditions permit soakaway, trenches must be provided for disposal of final effluent from their IST

d) Where water table is high, raised soakaway shall be provided

e) Local Authorities must ensure that the ISTs in their jurisdiction must be desludged by desludging contractor registered with the Commission

f) All soakaway must be located at least 5m downstream of wells for domestic consumption.

Section 3

Design Guide

3.1 General

The selection and design of septic tanks is governed to a large extend by the hydraulic aspects of the treated effluent discharge to a suitable watercourse. In situations where the topography is undulating or hilly, the treated effluent maybe discharged readily to a suitable receiving watercourse such as storm drains. However, in generally flat topography there may not be a conveniently located receiving water course or nearby drain for the treated effluent to be discharged to. In these cases, the design of the septic tank must incorporate a method for an on-site final disposal of treated effluent.

Where the discharge of septic tank effluent is located upstream of water catchment areas and/or in certain sensitive receiving water courses, the design standards shall be more stringent in order to achieve an effluent quality higher than standard B. The design of these septic tanks must include additional elements or features of design to ensure that the performances of such septic tanks are able to comply with the relevant Environmental Quality Act requirements consistently. The discussions on these methods are prompted in Section 4.0 of this volume.

Organic loading from the incoming raw sewage shall be based on 250 mg/ℓ of BOD_5 (5 days at 20^{o}C) per population equivalent per day, and 300 mg/ℓ of suspended solids per population equivalent per day.

In Malaysia, there exist two (2) forms of septic tank which have found wide usage. The first type is a cast in-situ septic tank previously promoted by the Ministry of Health. The cast in-situ septic tank consists of a septic tank with a minimum of 24 hours hydraulic retention time followed by a dual size aggregate down flow filter media. The second type is the prefabricated septic tank manufactured locally using polyethylene, glass fiber reinforced plastic or reinforced precast concrete materials. The filter chamber for prefabricated septic tanks is incorporated inside of the septic tank on the outlet section (as opposed to the filter chamber located externally in the cast in-situ septic tanks) to enhance its performance.

One fundamental difference between the cast in-situ and the prefabricated septic tanks is the size of the filter employed. The cast in-situ employs the use of stone filter several orders of magnitude larger than the typical proprietary filter media used in the prefabricated septic tanks. The other distinction is the direction of flow employed. The stone filters employ the use of a down-flow scheme while the proprietary filters use an up-flow scheme. Both of the fundamental differences have some bearing on the treatment performance and the site (topography); where each type of the septic tank may have special niche in its applications.

Prior to the selection of septic tank for adoption in any development, the designer shall pay particular attention to the following:

a) Volume of septic tank required to result in the sedimentation and subsequent biological breakdown of organic solids of the wastewater.
b) Quality of constructed septic tank to prevent leakage of septic tank contents and the ingress of surrounding groundwater.
c) Adequacy of the ventilation aspects to allow for safe operation and maintenance.
d) Siting aspects with respect to public health concerns and the provision of adequate access for desludging works.
e) Compliance of the treated effluent quality as prescribed in Section 1.2.
f) The uplifting effects due to buoyancy during installation and during desludging activities.
g) High water table and poor soil conditions to be considered.

The designer shall also refer to MS 1228.

3.2 Planning

Careful planning prior to the implementation of septic tanks is crucial to achieve the overall environmental objectives; protection of public health; safety and health of workers and ease of maintenance. As such, the designer must satisfy the following considerations before proceeding with the design, selection and construction of septic tanks.

i) Site Selection
ii) Maintenance Vehicle Access
iii) Safety Requirements
iv) Desludging Works
v) Location of Septic Tank within Premise of Property
vi) Inspection Chamber
vii) Septic Tank Drawings

3.2.1 Site Selection

The siting of the septic tank shall meet the following:

a) Located within 30 m of desludging vehicle access which has a minimum width of 4.5 m.
b) At a suitable land and location to allow desludging works to be carried out without posing hazard to building occupants, maintenance and desludging operators.

c) Effluent discharge point away from building structures to preserve the structural integrity.
d) Minimum distance of 0.5 m away from plot boundary.
e) Minimum distance of 15 m away from underground water storage tank.
f) Minimum distance of 6 m upslope or 3 m downslope from swimming or wading pools.
g) Minimum distance of 30 m away from any water body currently being used or has future potential usage for drinking and/or cleaning purposes.
h) Located in an area not subjected to heavy vehicle, foundation or other imposed loadings.
i) Away from areas subjected to flooding.

The designer is expected to fulfill the above requirements at all times. In conjunction with the above, the designer shall also refer to Section 3.2.5 on the location of septic tanks within premise.

3.2.2 Maintenance Vehicle Access

The Water Services Industry Act 2006 has the following clauses relating to vehicle access for desludging and other maintenance works:

Section 64 Clause (2): If the Commission is satisfied that, due to any obstruction, any premises on which a septic tank is situated does not have adequate access for the purpose of desludging the septic tank, the Commission may issue a direction to the owner, management corporation or occupier of such premises to remove such obstruction within the period specified in the direction.

Section 65 Clause 1.a and 1.d: The owner, management corporation or occupier of any premises having a private sewerage system or septic tank shall

a) grant the service licensee or permit holder adequate access to the septic tank for the purpose of enabling the septic tank to be serviced and desludged;
b) grant the service licensee or permit holder adequate access to the private sewerage system for the purposes of enabling the private sewerage system to be inspected, serviced or maintained.

Sufficient access must be provided to allow desludging and maintenance works to be carried out without undue difficulty to the maintenance workers or compromise the public health and aesthetic impacts. As such, the following should be provided:

a) Minimum width of access road shall be 4.5 m.

b) No undue obstructions in the access road to prevent vehicle movement to reach the intended site.

c) Adequate access to allow desludging vehicle to operate within the range of the suction-lift of the pump and length of hose.

d) Septic tank covers as outlined in Section 3.3.6

3.2.3 Safety Requirements

a) The septic tanks are not to be located in areas where it is likely to encounter naked flames to reduce the likelihood of explosions.

b) Care must be taken when entering septic tanks. Ensure that the gases in the septic tanks are thoroughly ventilated before entry.

c) Any naked flames must be extinguished, and regulations regarding entry into confined spaces must be observed at all times.

3.2.4 Desludging Works

Considering that prolonged settlement of solids in the septic tank would eventually result in the level of solids to build up and subsequently reduce the treatment capacity of the septic tank; desludging is required at the frequency of not less than once every two years to restore the designed treatment capacity.

A minimum opening of 250 mm diameter with clear access passage of 150 mm diameter shall be provided for desludging purposes at the sedimentation zone.

3.2.5 Location of Septic Tank within Premise of Property

The following considerations shall be observed in determining the final location of septic tanks within the premise of property:

a) Within the boundary of property served.

b) Externally located of building(s) served.

c) Open space.

d) Fully accessible.

e) Close proximity to receiving water course for treated effluent discharge.

Septic tanks shall be situated at the rear end of properties to allow for maintenance vehicle movements and to minimise visual impact. However, if this is not possible due to inavailability of backlane access, it shall be located at the front end.

Typical layouts for the various types of development are depicted in Appendices C, D, and E respectively for rear and front vehicle accesses.

3.2.6 Inspection Chamber

Inspection chambers are required where septic tanks are installed for maintenance purposes. It is required at the following locations:

a) Maximum of 1 m and upstream of inlet to septic tank.

b) At each bend.

c) At every 20 m interval of sewer length outside the building.

d) Inspection chambers shall be located at least 1 meter away from the building line.

Detail locations of inspection chamber shall be referred to Section

3.2.7 Septic Tank Drawings

Detailed plans of the proposed septic tank shall provide:

a) The location of the septic tank in relation to:
   - the building and adjacent buildings
   - point of discharge for treated effluent such as drains and soakaways
   - the plot boundary
   - the house drainage system
   - adjacent water supplies
   - the nearest access point for desludging

b) A longitudinal section to a scale of not greater than 1:50 showing the method of construction, materials, access covers, arrangement of compartments, pipework, baffles, media and critical dimensions.

c) A plan of the septic tank and filter to a scale of not greater than 1:50 showing the general arrangement of pipeworks, compartments, baffles and channels and critical dimensions.

d) Point of discharge of final treated effluent to the drain, water course or soakaway system.

e) Details of the proposed subsequent treatment methods such as soil absorption, etc.

f) Where no special conditions are imposed by the Commision, approvals will be facilitated by the use of standard drawings pre approved by the Commision.

3.2.8 Future Connection to Public Sewers from Proposed/Existing Septic Tank

Septic tanks are considered as temporary treatment systems due to its primary treatment capability. Allowance for future connections to a sewer is therefore mandatory. As such, the following conditions must be observed:

a) A 150 mm diameter bypass pipe from the last inspection chamber 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 150 mm diameter bypass pipe and accessories shall comply with the list for sewer pipes as given in MSIG Volume 3. Rubber cap or plug must be easily dismantled without resulting damages to the piping system, floor, building structures, exterior drain and backlane.

b) Allowance of sufficient area at the rear section of buildings, preferably an access road, to lay connecting sewer lines from each house to the main sewer line.

c) Provision for an easy change-over from septic tank treatment to connected system including, simple removal of cap/plug; sealing up of openings and back-filling the emptied septic tank with sand.

See Appendix F and G for the location and typical details of the bypass line.

3.3 Design

3.3.1 Volumetric Capacity

The volumetric sizing of septic tanks shall be based on per capita wastewater generation rate of 225 litres/day and for 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. This minimum volumetric capacity of septic tanks shall not be less than 2000 litres or 2 cubic meters.

The minimum effective working volume shall be calculated excluding filter media volume and accumulated sludge volume over 2 years. This is to ensure the individual septic tank is able to meet the 24 hours hydraulic retention time after 2 years 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 2 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 Equivaleut (refer to Appendix A)

Desludging Period = 2 years

Hydraulic Retention Time = 24 hours

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

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

Effective Working Volume = Working volume + Accumulated sludge volume

The effective volumes for the varies PE for septic tank are shown in Table 3.1

Table 3.1: 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
5	1125	1.125	400	0.40	1525	1.525
6	1350	1.350	480	0.48	1830	1.830
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	2.08	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

3.3.2 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 two compartment tank shall have openings 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 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 direction. 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 filter chamber. The impermeable chamber acts as a baffle or scum box which helps to prevent scum, oil and grease from entering the filter media. Under this arrangement, the impermeable baffle wall shall be extended to level with maximum 150 mm above the top level of accumulated sludge at the bottom of septic tank over period of 2 years.

For vertical flow septic tank, baffle wall or scum box shall be provided to prevent scum and Oil & Grease (O&G) from entering the filter chamber. Wall of filter chamber could be considered as baffle wall if up-flow filter chamber is adopted.

3.3.3 Inlet and Outlet

The inlet pipes to and outlet pipes from the septic tank shall be a minimum diameter of 100 mm and by means of dip pipes made of cast iron, or uPVC with sufficient stiffness and thickness located below the scum level. The inlet dip pipe shall utilise a T-shape pipe and the outlet dip pipe shall utilise a 90° elbow pipe.

The difference in level between the invert level of the inlet pipe and the invert level of the outlet pipe shall be a minimum of 75 mm. The minimum distance between the inlet pipe and the outlet pipe shall be 1300 mm.

The depth of the submerged end of the inlet dip pipe shall be extended to a minimum of 300 mm below the water level. In the outlet pipe section, the depth of the submerged end of the outlet dip pipe shall range from 375 mm to 610 mm below the water level. The non-submerged ends of both inlet and outlet dip pipes shall be projected of at least 150 mm above the water level.

See Appendix H, I and J for graphical presentation of the above description.

To minimise turbulence, provision shall be made to limit the velocity of the incoming wastewater. For steeply laid sewer or drains up to

150 mm in diameter, the velocity may be limited by laying the last 12 m of incoming pipe to a gradient of 1 in 50 or flatter.

3.3.4 Effluent Discharge

In situations where gravity discharge is not possible, the effluent shall be discharged through pumping. Pumped discharge can be accomplished through the use of submersible pumps located in a pump well. The following provides the requirements for the submersible pump and pump well, respectively:

Submersible Pump

a) Minimum motor rating of 0.3 kW to ensure trouble-free operation.

b) Minimum design life of 10 years.

c) Selection to consider economic costs, reliability, pumping curve and compatibility with application.

Pump Well

a) Effective working volume to retain one (1) hour peak flow.

b) Emergency storage capacity of 200 litres in the event of power or pump failures.

c) Minimum diameter of 600 mm.

d) Incorporation of high level alarm light and/or on audible device within the building serve to detect pump failures.

e) Pump sets and control switches shall be installed in accordance with manufacturer's specification and to Energy Commission requirements.

3.3.5 Head Room

The space between the top water level and the underside of the tank shall be a minimum of 250 mm and must be adequately ventilated or provided with an adequate means of drawing off gases. A minimum of 50 mm diameter pipe or a minimum of 75 mm diameter ventilation duct 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. All covers shall be air tight.

3.3.6 Covers

The covers of the septic tank and inspection chamber shall be adequately reinforced to take superimposed loadings. These cover shall be airtight, and may be of light duty if not subjected to vehicular loading. If these cover are subjected to higher loading then suitable covers shall be used based on this higher loading the cover shall come with hinge and lock.

Where bigger cover is required due to deep sited tanks chequered plate of mild steel or ductile iron with protective coating may be used. The chequered plate shall be of reasonable size, having a maximum weight of 16kg/piece, to facilitate its removal and handling. Secondary air tight covers shall be provided at the septic tank opening when chequered plates are provided at ground level. The secondary covers shall be airtight and manufactured in accordance to the relevant standards.

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

3.3.7 Construction

Septic tanks may be constructed of brickwork or concrete while prefabricated septic tanks shall be prefabricated from polyethylene, glass fiber reinforced plastic or pre-cast concrete.

Brickworks shall be of engineering bricks in cement mortar and shall be at least 220 mm thick. The mortar shall be a mix of 1:3 cement to sand ratio. In-situ concrete shall be at least 150 mm thick of C35A concrete mix. The foundation and floor shall be constructed of concrete, at least 150 mm thick of C30 concrete mix on an approved compacted base to avoid settlement. All internal faces of the septic tank should be coated with sulphate resisting materials or approved product to prevent corrosion due to hydrogen sulphite or acid attacks. Where the water table is high, proper measures shall be provided to prevent infiltration and exfiltration situations.

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

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

Where septic tanks are of precast units, all internal surface shall be coated with sulphate resisting material or approved product or epoxy coating materials.

In cases where the septic tank may be subjected to traffic load or other surcharges, such as those installed in industrial development, the tank shall be of reinforced concrete design with Engineers approval. In the case of the proprietary type septic tanks, strict adherence to the manufacturers specification must be observed.

3.3.8 Principal Dimensions for Cast In-situ Septic Tank

The principal dimensional requirements for cast in-situ septic tanks are shown in Table 3.2

Table 3.2 Cast In-situ Septic Tank Dimensions

Requirement	Dimensions
Liquid depth	Between 1.22 and 2.6 m
Minimum width	815 mm
Length : Width ratio for rectangular tanks	1.5:1
Minimum free board	250 mm
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
Maximum depth from ground level	Not exceed 4.0 m

Service chamber or extended system's opening on top of tank need to be constructed to control or limit the depth from ground level not exceeding 3 m.

3.3.9 Principle Dimensions for Prefabricated Septic Tanks

The principal dimensional requirements for prefabricated septic tanks are shown in Table 3.3.

Table 3.3 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

Service chamber of extended system's opening on top of tank need to be constructed to control or limit the depth from ground level not exceeding 3.0 m.

3.4 Non-proprietary Systems

All non-proprietary septic tanks shall comply with cast in-situ septic tanks details with a minimum of 24 hours hydraulic retention time followed by a dual size media downflow filter chamber. Typical design drawings are available for two (2) categories of size; less than 12 PE and 12-30 PE are provided in Appendices H and I, respectively. These drawings shall show the critical dimensions of the septic tank as well as the stone filter chamber design.

The designer of all non-proprietary septic tanks is expected to follow the critical dimensions as depicted in these drawings for the design of both the septic tanks and filter without exception.

3.5 Proprietary Systems

A number of proprietary septic tank systems, suitable for individual premises, are available in Malaysia. These designs generally comprise of an integrated septic tank and filter in a single tank.

Only approved proprietary septic tanks from the Commission may be used. The latest list of approved proprietary septic tank systems may be obtained from the office of the Commission.

All proprietary septic tanks shall be subjected to an annual review by the Commission to evaluate its performance before qualifying to be on

the approved list. All tests required by the Commission shall be done in accordance with approved standards/methods.

A typical graphic presentation of prefabricated septic tank can be found in Appendix J.

3.5.1 Tank Material

a) The manufacturer of prefabricated septic tank shall seek prior approval on the materials to be used from the Commission and SIRIM/ IKRAM.

b) The tank shall be made of non-degradable, non-corrodible and of inert and lightweight materials.

c) 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.

d) Polyethylene tanks:

- Preferably no metal parts in the tanks.
- Thickness of the side walls, top, bottom, and covers shall be at least 5 mm. The thickness of the inlet and outlet ends shall be at least 3 mm and the thickness of internal walls and partitions shall be at least 1.5 mm.
- Fastening of internal walls or partitions shall be done by welding or corrosion resistant fastening systems that will hold under standard testing conditions.

e) Glass fiber reinforced plastic:

- Laminates shall contain not less than 30% chopped glass strands and be not less than 3 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.
- 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.

f) Reinforced precast concrete:

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

3.5.2 Tank Fabrication and Construction

To avoid any possible leakage problem of prefabricated septic tank, the body of the septic tank below liquid level shall be fabricated or cast in seamless unit. No joints shall be allowed on the tank's body below the liquid level.

All prefabricated septic tanks shall be fully assembled at manufacturer's factory with QC approved. 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.

3.5.3 Inspection Chamber and Septic Tank Covers

a) Material shall be of cast iron and not other materials which, may warp over time.

b) 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.

c) Cover dimension shall be a minimum of 600 mm x 600 mm for a rectangular opening or a diameter of 600 mm for circular opening.

d) Inspection chambers shall be provided immediately before and after each septic tank for maintenance purposes and where applicable.

Inspection chambers shall be provided not more than 1 m before the inlet from the septic tank for maintenance purposes. The effluent pipe shall discharge immediately into an existing public drain for maintenance purposes, where applicable.

Inspection chamber shall be provided after the septic tank if the discharge point is more than 3 m or change direction of flow.

3.5.4 Ventilation, Inlet and Outlet Pipes

a) The vent pipe shall be made of non-corrodible material, such as uPVC, to ensure corrosion does not occur when subjected to sewage gases.

b) The ventilation pipe should have a minimum diameter of 50 mm and shall be extended to the building/house roof top (provided with mosquitoes proof mesh or equivalent).

c) 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.

d) The inlet to a septic tank shall have a minimum length of 2 m.

e) Both the inlet and outlet diameters shall be a minimum of 100 mm.

f) All fittings through the walls of the tanks, such as the ventilation, inlet and outlet pipes, shall be installed with a permanent watertight seal.

g) The clearance between the crown of the inlet pipe and the underside of the roof of the septic tank shall be at a minimum of 50 mm.

h) The invert of the outlet pipe shall be a minimum of 75 mm below the invert of the inlet pipe.

3.5.5 Filter Chamber and Filter Media

a) Filter media shall provide optimal surface area and texture to promote biological degradation.

b) The minimum surface area to volume ratio of filter media shall be a minimum of 90 m^2/m^3, where the surface area is referred to the total surface area of the individual particles in unit bulk volume of the filter medium when placed inside a well-packed filter chamber

c) A minimum opening of 600 mm x 450 mm or 600 mm diameter shall be provided over the filter media compartment.

d) Filter media shall preferably be of dual or more sizes instead of a single size.

e) The filter media shall be easily accessible and removable for maintenance purposes.

f) The filter media shall be made of non-degradable, non-corrodible and of inert materials which may not warp over time.

g) The BOD_5 loading of filter chamber shall not exceed 1.2 kg/m^3.day

h) The SS loading of filter chamber shall not exceed 1.0 kg/m^3.day

i) The volumetric loading of filter chamber shall not exceed 2.5 m^3/m^3day.

j) The void percentage of filter chamber shall not be less than 80%. The void percentage is referred to the interstitial voids for percolation of the liquor.

3.5.6 Marking/Labelling

Proprietary septic tanks shall be permanently labeled with the following information:

a) Manufacturer's name and trademark.
b) Model of septic tank.
c) Year of manufacture.
d) The working capacity of the tank.
e) The type and volume of filter media used.
f) The minimum liquid depth of the septic tank.
g) The symbol or logo of the certifying agency (e.g, SIRIM, ISO 9000).
h) Permanent warning labeling advising against unauthorised 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.

3.5.7 Base of Septic Tank

a) Soil, sand or aggregates for use in bedding shall be of granular type to achieve adequate compactions.
b) The foundation base for septic tank must be well compacted or piled before a top concrete layer is cast in-situ, especially in high groundwater areas and for septic tanks located outdoors.
c) The septic tank shall sit on a well compacted sand or aggregate with a minimum of 300 mm thickness. This shall be followed by a layer of concrete on top with a minimum thickness of 100 mm and with one layer of BRC 61/BRC A9.

3.5.8 Installation

a) Careful lifting in accordance to manufacturer's instruction is required to prevent structural failures and/or visible cracking.
b) Backfilling shall be conducted in layers of 250 mm thick at one a time.
c) During backfilling, the soil, sand or aggregates shall be uniformly filled around the tank. The practice of backfilling on one side at a time shall be avoided altogether.
d) Preferably, loose soil with an aggregate of not more than 30 mm shall be used for backfilling and bedding.
e) Septic tanks shall be anchored or strapped to the base of the concrete slab prior to backfilling, to resist floating.

3.5.9 Testing of Septic Tanks

a) Care shall be exercised to prevent damage during testing.

b) The septic tank shall be water proofed and checked against leakage.

c) All liquid inside the septic tank shall be completely pumped out and an observation be made. If the tank fails in the buoyancy test due to upthrust pressure or is distorted due to lateral pressure, the septic tank shall be rejected. The failed tank shall be removed and replaced with a new septic tank. The reinstalled septic tank shall then be retested.

Section 4

Septic Tanks Located in Sensitive Receiving Watercourses

4.1 General

According to the Environmental Quality Act (EQA), sewage discharges upstream of water catchment areas shall be treated to meet Standard A water quality parameters. Also, where sewage is discharged into certain sensitive receiving water courses such as bathing beaches, lakes or aquaculture, farming, etc., additional treatment process may be required following the septic tank treatment.

Experience has shown that in most developed countries, where septic tanks are used; it is always followed by further treatment methods to improve the water quality prior to its ultimate disposal into surface or groundwaters. This is due to the inherent performance limitation of septic tanks in providing only primary sewage treatment. For these reasons, if septic tanks are used as a stand-alone unit process, it will NOT perform to achieve an effluent quality better than Standard B.

In these situations where an effluent quality better than Standard B is required, the Commissioner may at his discretion impose additional treatment process following septic tank treatment, including the need for disinfection. Also, due to a higher level of sophistication required for improving the treated effluent quality, the submission of these treatment systems must be certified by a registered professional engineer.

4.2 Further Treatment Methods for Achieving Higher Effluent Quality

Experience existed overseas with further treatment methods following septic tank for achieving higher effluent quality prior to its final disposal. In Malaysia, the use of these types of treatment is virtually non-existent and very little experience in the design, construction, and operation are available locally.

Hence, the proponents of such treatment methods, prior to its implementation, shall demonstrate through the design and actual operational data, that the proposed treatment methods are able to comply with the required effluent standards on a consistent basis. Further, the implementation and approval of such a system shall be subjected to a comprehensive review by the Commission on a case by case basis.

Some examples of further treatment methods following septic tank treatment which have found common usage and success are as follows:

a) Soil Absorption System (See Appendix K and L for a typical sample)

b) Intermittent Sand Filter (see Appendix M for a typical sample)
c) Small Package Mechanical Plants

Proponents and designers who are keen to pursue how, when, and where to design such a system, may consult a list of references as provided in Appendix N.

Careful considerations must be given prior to the selection of the most appropriate treatment methods for adoption in each development due to the large area requirements to install such a system.

An example of such a development that may accommodate these further treatment systems would be a homestead with an average housing density of less than five (5) units per hectare. A typical layout of such an installation in a homestead development is as depicted in Appendix O.

4.3 Disinfection

The need for disinfection shall be at the discretion of the Commission on a case by case basis.

Appendix P provides the design guidelines for disinfection requirements.

Appendix

A to O

Appendix A: Recommended Population Equivalent

Number of each similar use	Building use					Population for treatment	
						Estimation formula	Estimation unit
1	Participation in gathering place facilities	a	Public assembly hall, assembly hall, theatre, cinema house, ad entertain			n = 0.08 *A*	n : population (man) *A*: total floor area (m^2)
		b	Cycling stadium, racecourse, and motorboat racecourse			n = 16 *C*	n : population (man) C([1]): total number of toilet stools (piece)
		c	Stand, and gymnasium			n = 0.065 *A*	n : population (man) *A*: total floor area (m^2)
2	Participation in housing facilities	a	Dwelling house			$n = 5 + \frac{(A - 100)}{30}$	n : population (man) However, n is 5 men for not more than 100 m^2 in *A* and 10 men for over 220 m^2 in *A*. *A*: total floor area (m^2)
		b	Apartment - house			n = 0.05 *A*	n : population (man) However, n per unit dwelling is 3.5 or 2 men [limited to a case where unit dwelling is composed of only one living room ([2])] for not more than 3.5 men in n per unit dwelling and is 6 men for not less than 6 men in n per unit dwelling *A*: total floor area (m^2)
		c	Lodging house, and dormitory			n = 0.07 *A*	n : population (man) *A*: total floor area (m^2)
		d	School dormitory, Self-Defence Forces camping dormitory, old-age house, and protective institution			n = *P*	n : population (man) *P*: fixed capacity (man)
3	Participation in lodging facilities	a	Hotel , and RYOKAN (Japanese) (Japanese Hotel)	For that with a wedding hall or a banquet hall		n = 0.15 *A*	n : population (man) *A*: total floor area (m^2)
				For that without any wedding hall or banquet hall		n = 0.075 *A*	
		b	Motel			n = 5 *R*	n : population (man) R : number of guest rooms
		c	Public lodging house, boarding house, youth hostel, and SEINEN NO IE (Japanese) (housing for young people)			n = *P*	n : population (man) *P*: fixed capacity (man)
4	Participation in medical facilities	a	Hospital, sanatorium, and in-fectious hospital	For that equipped with kitchen equipment for business use or laundry facilities	For under 300 beds	n = 8 *B*	n : population (man) *A*: number of beds (bed)
					For not less than 300 beds	n = 11.43 (B - 300) + 2400	
				For that without any kitchen equipment for business use or laundry facilities	For under 300 beds	n = 5 *B*	
					For not less than 300 beds	n = 7.14 (B -300) + 1500	
		b	Dispensary, and doctor's office			n = 0.19 *A*	n : population (man) *A* : total floor area (m^2)
5	Participation in shops	a	Shop, and market			n = 0.075 *A*	
		b	Department store			n = 0.15 *A*	
		c	Eating house	For general case		n = 0.72 *A*	n : population (man) *A*: total floor area (m^2)
				For high staining load		n = 2.94 *A*	
				For low staining load		n = 0.55 *A*	
		d	Teahouse			n = 0.80 *A*	

Appendix A: Recommended Population Equivalent (cont.)

Number of each similar use	Building use				Population for treatment	
					Estimation formula	Estimation unit
6	Participation in amusement facilities	a	Billiard room, and table tennis room		n = 0.075 *A*	n : population (man) *A* : total floor area (m^2)
		b	Pinball house		n = 0.11 *A*	
		c	GO club, and mar-jongg saloon		n = 0.15 *A*	
		d	Discotheque		n = 0.50 *A*	
		e	Golf practice range		n = 0.25 *S*	n : population (man) *S* : number of driving seats
		f	Bowling alley		n = 2.50 *L*	n : population (man) *L* : number of lanes (lane)
		g	Batting practice range		n = 0.20 *S*	n : population (man) *S* : number of batting seats (seat)
		h	Tennis Court	For that equipped with night game facilities	n = 3 *S*	n : population (man) *S* : number of courts (court)
				For that without any night game facility	n = 2 *S*	
		i	Recreation ground and bathing resort		n = 16 *C*	n : population (man) *C* (^{2}) : total number of toilet stools (piece)
		j	Pool and skating rink		n = $\frac{20\,C + 120\,U}{8}$ x t	n : population (man) *C* : number of closet bowls (piece) *U* (^{3}): number of urinals (piece) *t* : one day average use time per unit toilet stool (hour) *t* = 1.0 to 2.0
		k	Camp site		n = 0.56 *P*	n : population (man) *P* : number of persons to be admitted (man)
		l	Golf course		n = 21 *H*	n : population (man) *H* : number of holes (hole)
7	Participation in parking area	a	Service Area	Lavatory	n = 6.15 *P*	n : population (man) *P* : number of squares (square)
		b	Stand Parking area and garage		n = 1.50 *P* n = $\frac{20\,C + 120\,U}{8}$ x *t*	n : population (man) *C* : number of closet bowls (piece) *U* (^{3}): number of urinals (piece) *t* : one day average use time per unit toilet stool (hour) *t* =0.4 to 2.0
		c	Gasoline stand		n = 20	n : population (man) per unit business place
8	Participation in school facilities	a	Nursery school, kindergarden, primary school and middle school		n = 0.25 *P*	n : population (man) *P* : fixed capacity (man)
		b	High school, university and college and miscellanous schools		n = 0.31 *P*	
		c	Library		n = 0.08 *A*	n : population (man) *A* : total floor area (m^2)

Appendix A: Recommended Population Equivalent (cont.)

Number of each similar use	Building use				Population for treatment	
					Estimation formula	Estimation unit
9	Participation in office	a	Office	For that with kitchen equipment for business use	n = 0.075 *A*	n : population (man) *A* : total floor area (m^2)
				For that without any kitchen equipment for business use		
10	Participation in workshop	a	Factory, workshop, laboratory and ex-perimental station	For that with kitchen equipment for business use	n = 0.06 *A* n = 0.75 *P*	n : population (man) *A* : total floor area (m^2)
				For that without any kitchen equipment for business use	n = 0.30 *P*	
11	Participation which do not belong to users of 1 to 10	a	Market		n = 0.02 *A*	n : population (man) *A* : total floor area (m^2)
		b	Public bath house		n = 0.17 *A*	
		c	Public lavatory		n = 16 *C*	n : population (man) *C* (^{2}) : total number of toilet stools (piece)
		d	Station, and bus terminal	For *P* < 100 000	n = 0.008 *P*	n : population (man) *P* : number of passengers getting on and off (man/day)
				For 100 000 < *P* < 200 000	n = 0.010 *P*	
				For 200 000 < *P*	n = 0.013 *P*	

Note:

(1) Total number of toilet stools is total sum of the number of closet bowls, the number of urinals and the number of double use toilet stools

(2) The living room herein, which is the living room specified by the definitions of Building Standard Law, means a room continuously used for the purpose of dwelling, execution of one's bussiness, operation, meeting, pleasure or the like. However, a kitchen and a dining room in apartment house are excepted.

(3) In a lady exclusive use lavatory, about one half of the number of toilet stools are considered urinals.

(**Source**: Japanese Industrial Standard, JIS A 3302-1998 Estimation of Population for Wastewater Purifier of Buildings)

Appendix B: Effluent Discharge Standards To Malaysian Inland Waters

The Environmental Quality Act (EQA) 1974 specifies two standards for effluent discharge. Standard A for discharge upstream of any raw water intake and Standard B for discharge downstream of any raw water intake.

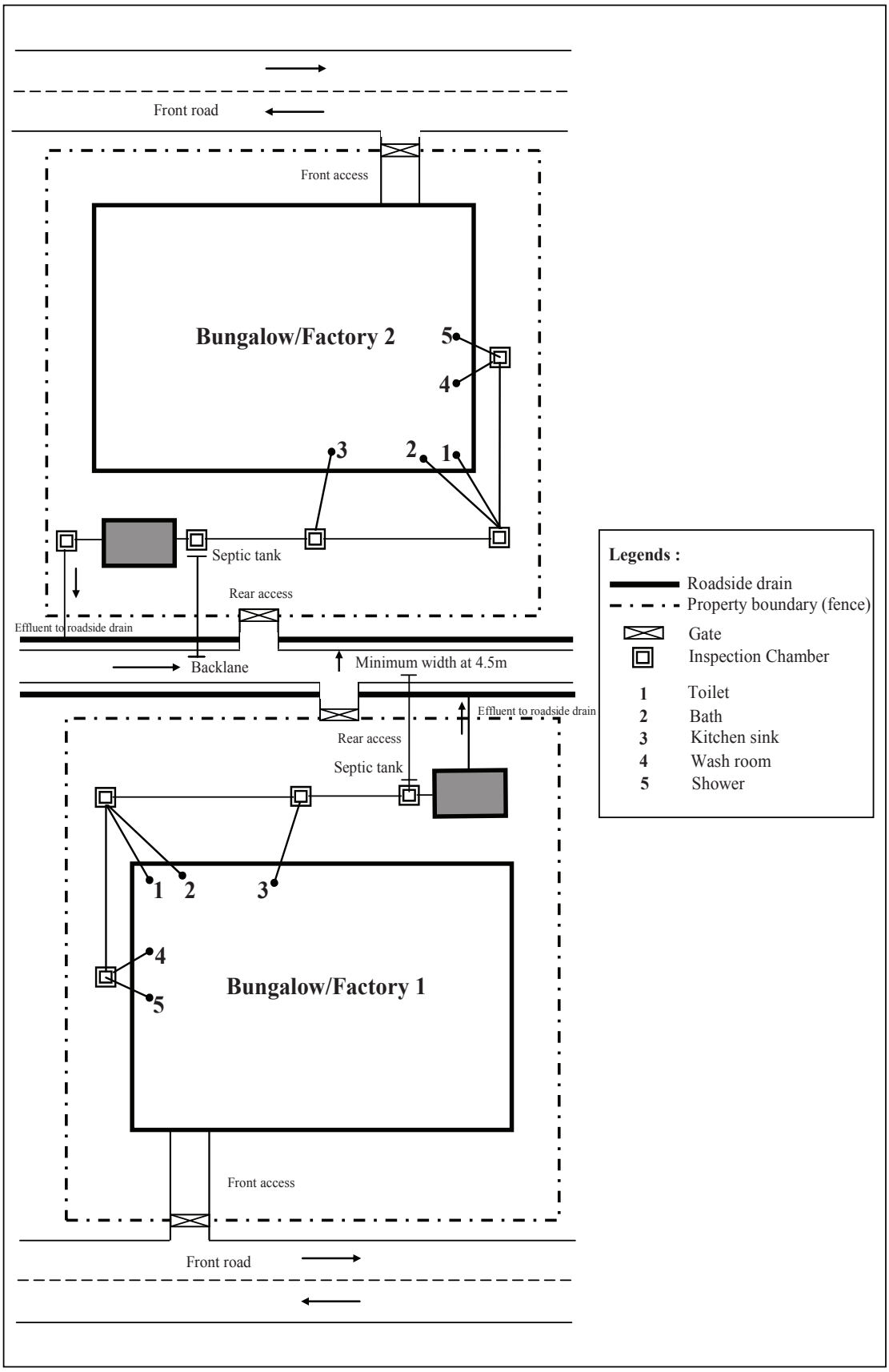
The current Third Schedule of the Environmental Quality Act 1974, under the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979, regulations 8(1),8 (2) and 8 (3) has been revisited and the Department of Environment has proposed 8th Schedule for the act which stipulate effluent discharge limits for parameters specific to domestic wastewater. The effluent discharge limits in 8th Schedule are summarized in Table below. All sewage treatment plants design shall take into consideration of the 8th Schedule and shall comply with the proposed limits.

Design Effluent Values

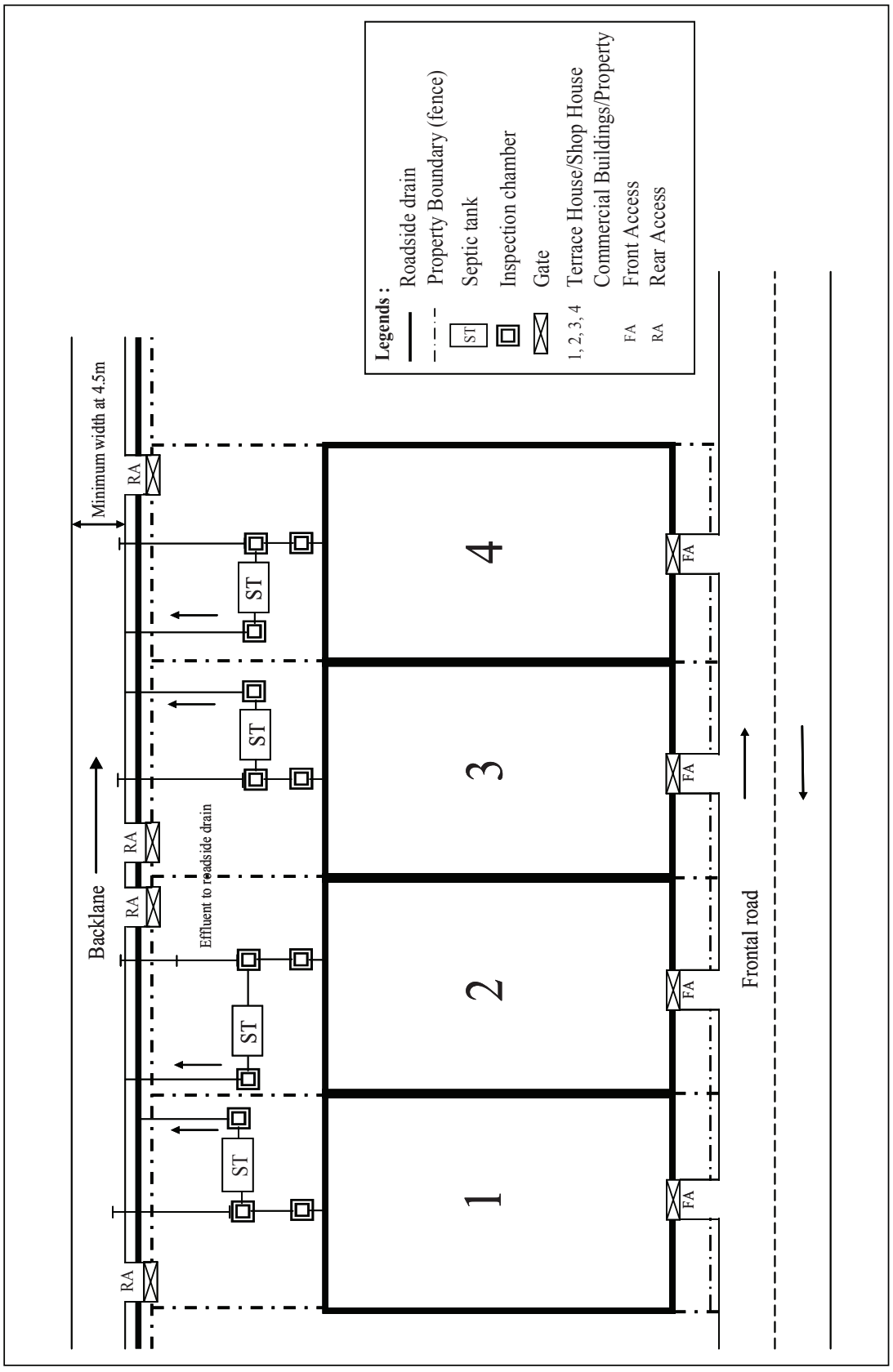
Parameter	Effluent Discharge to Rivers / Stream				Effluent Discharge to Stagnant Water Bodies*			
	Standard A		Standard B		Standard A		Standard B	
	Absolute	Design	Absolute	Design	Absolute	Design	Absolute	Design
BOD_5	20	10	50	20	20	10	50	20
SS	50	20	100	40	50	20	100	40
COD	120	60	200	100	120	60	200	100
AMN	10	5	20	10	5	2	5	2
Nitrate Nitrogen	20	10	50	20	10	5	10	5
Total Phosphorus	N/A	N/A	N/A	N/A	5	2	10	5
O&G	ℓ 5	2	10	5	5	2	10	5

Notes:
NA = Not applicable
All values in mg/l unless otherwise stated.
* Stagnant Water Bodies refer to enclosed water bodies such as lakes, ponds and slow moving watercourses where dead zone occur.

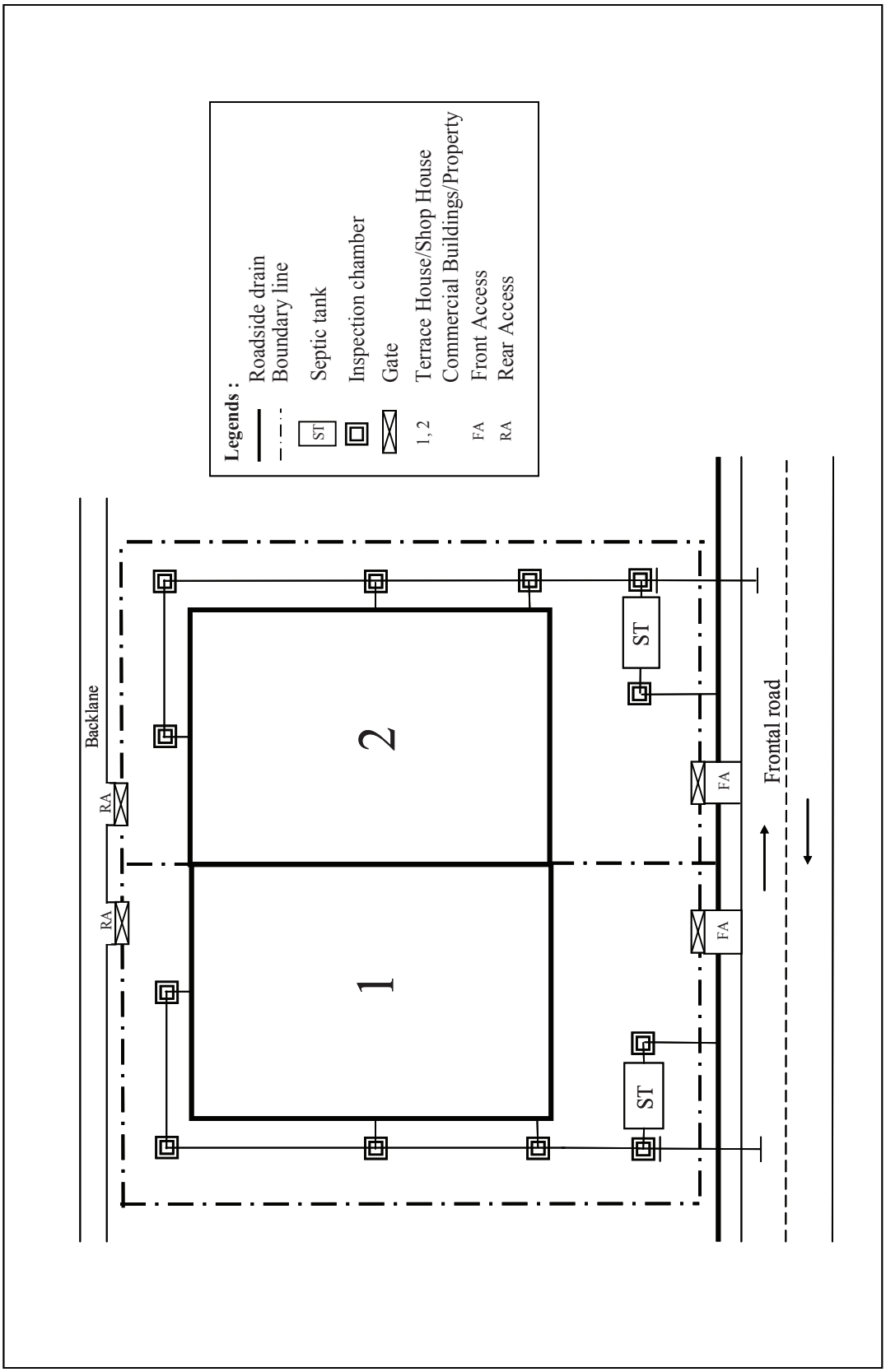
Appendix C : Typical Layout Using Rear Access (Bungalow and Factory)



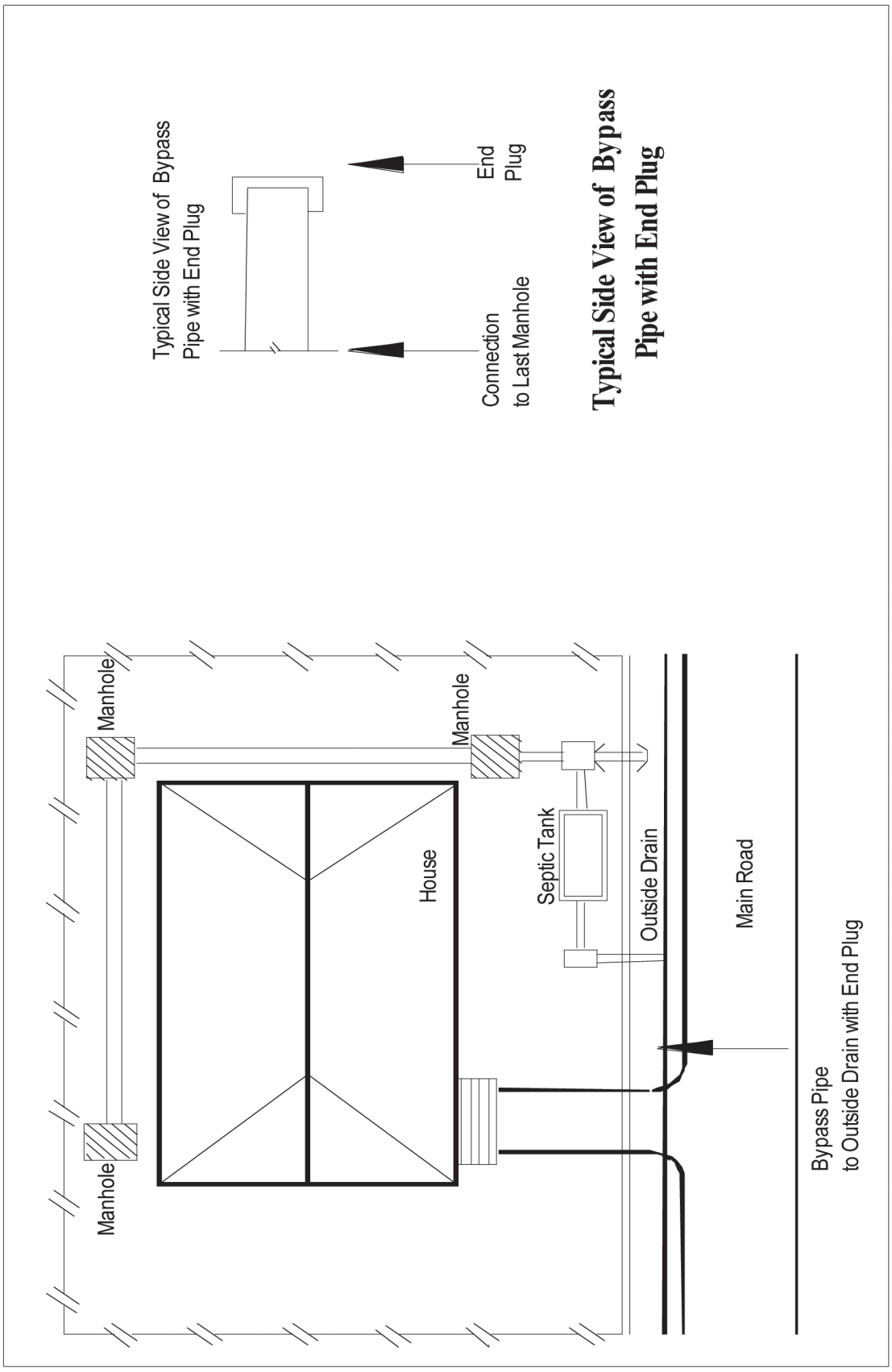
Appendix D : Typical Layout Using Rear Access (Terrace House, Shop House and Commercial Building)



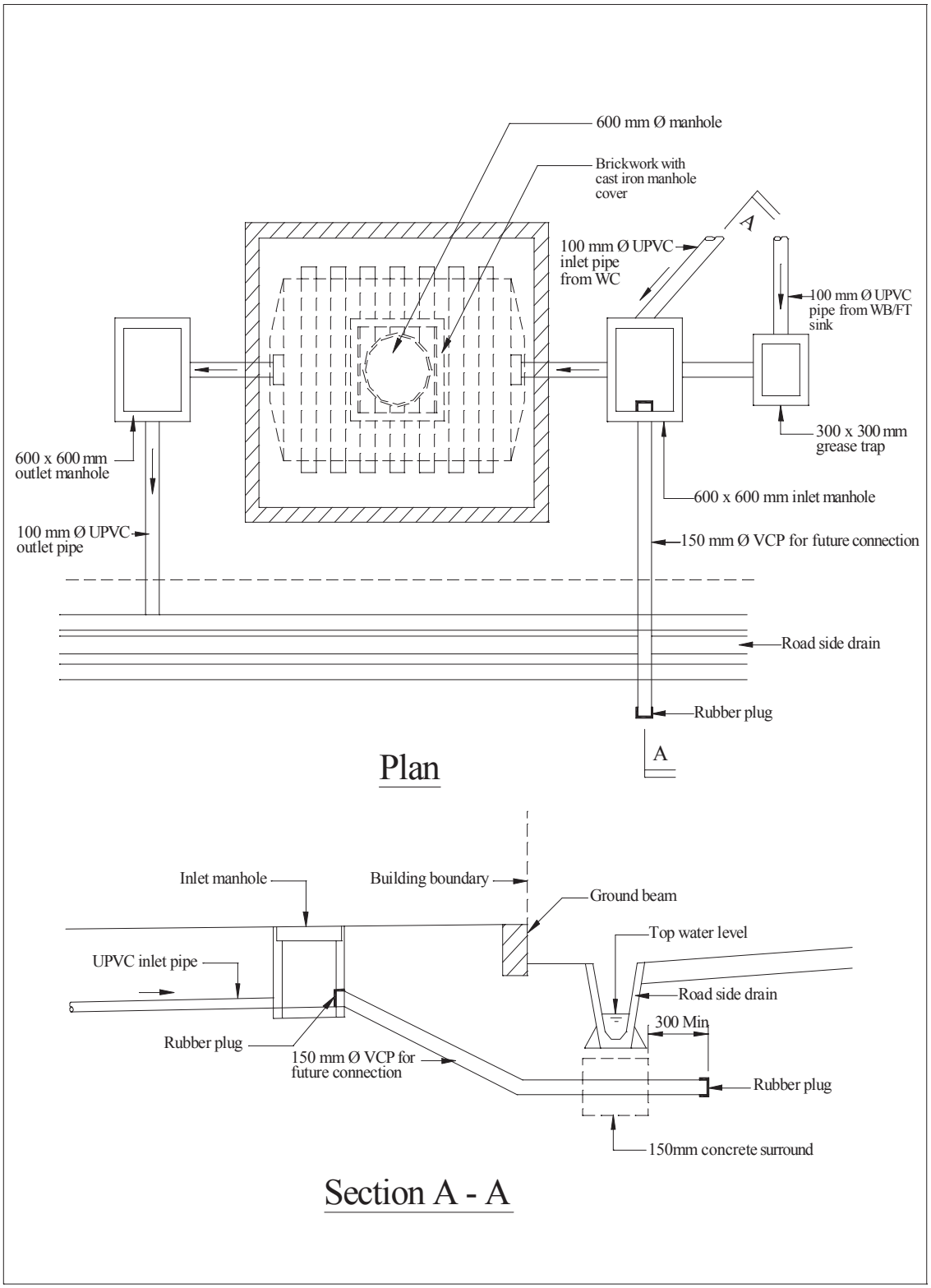
Appendix E : Typical Layout Using Front Access (Bungalow, Terrace House, Shop House and Commercial Building)



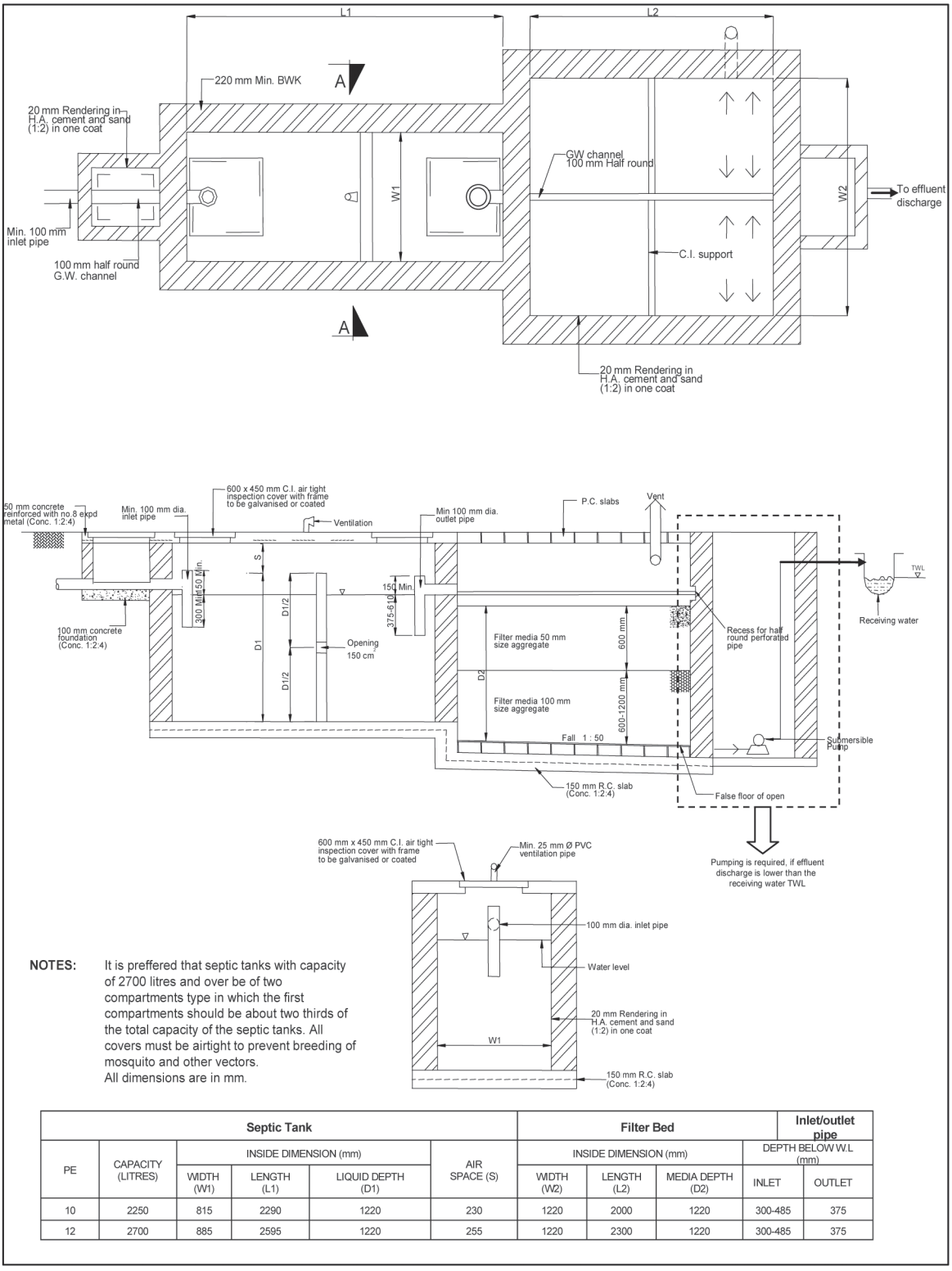
Appendix F: Layout showing Bypass to Public Sewer (for all applicable developments including Terrace Houses)



Appendix G : Details Showing Bypass to Public Sewer



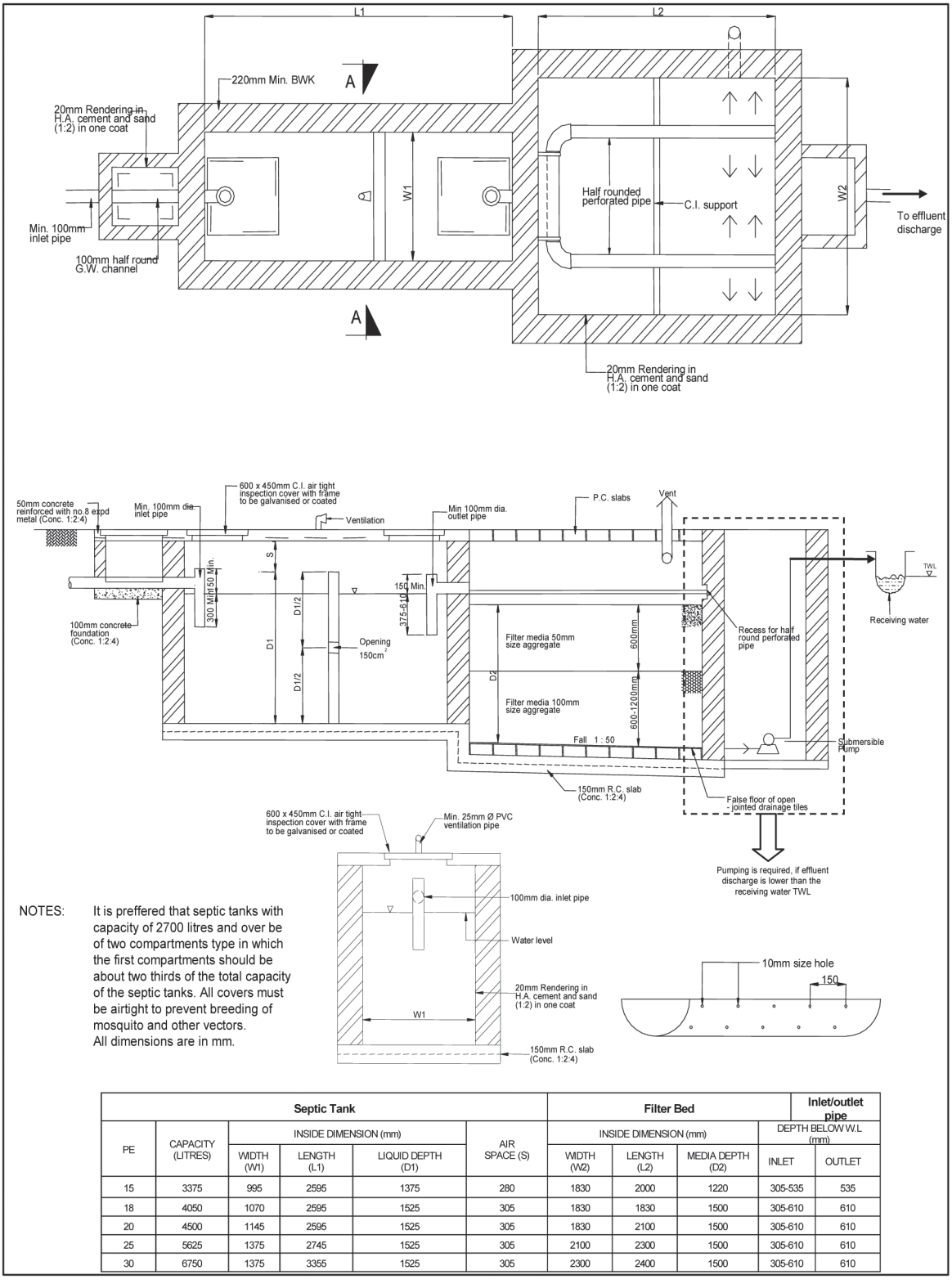
Appendix H – Typical Concrete Septic Tank Diagram (PE<12)



NOTES: It is preffered 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 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
10	2250	815	2290	1220	230	1220	2000	1220	300-485	375
12	2700	885	2595	1220	255	1220	2300	1220	300-485	375

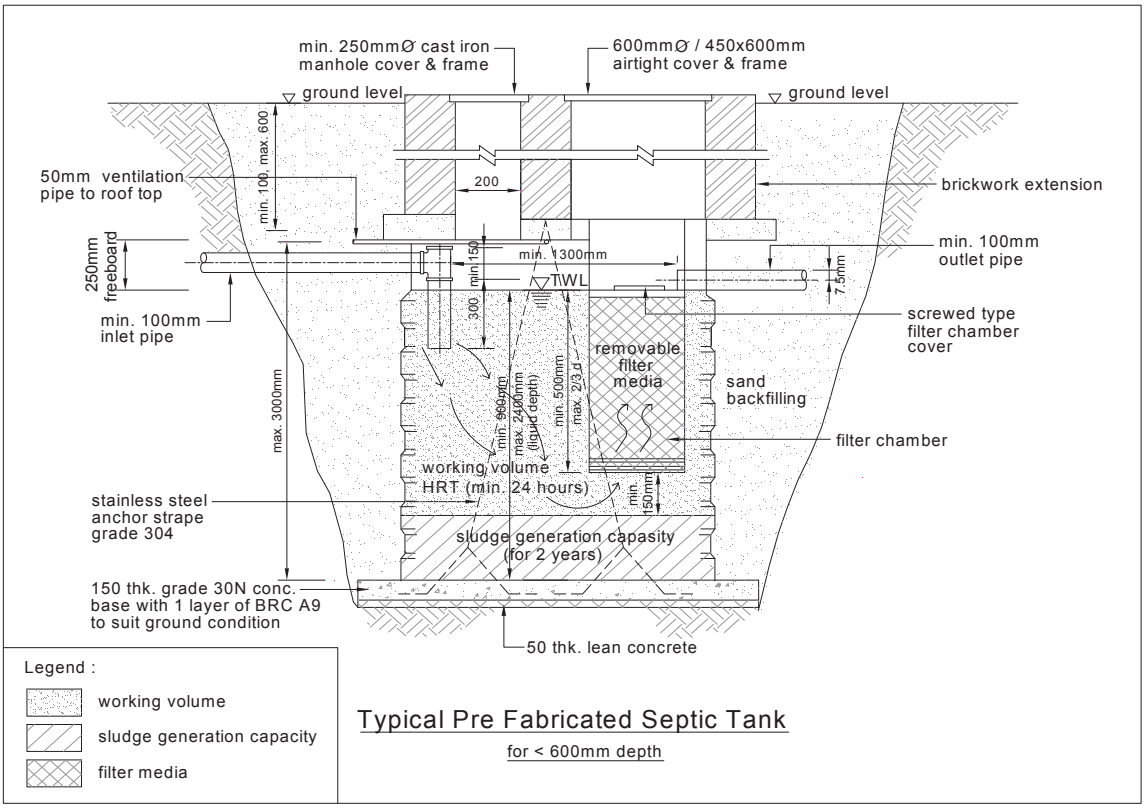
Appendix I – Typical Concrete Septic Tank Diagram (12<PE<30)



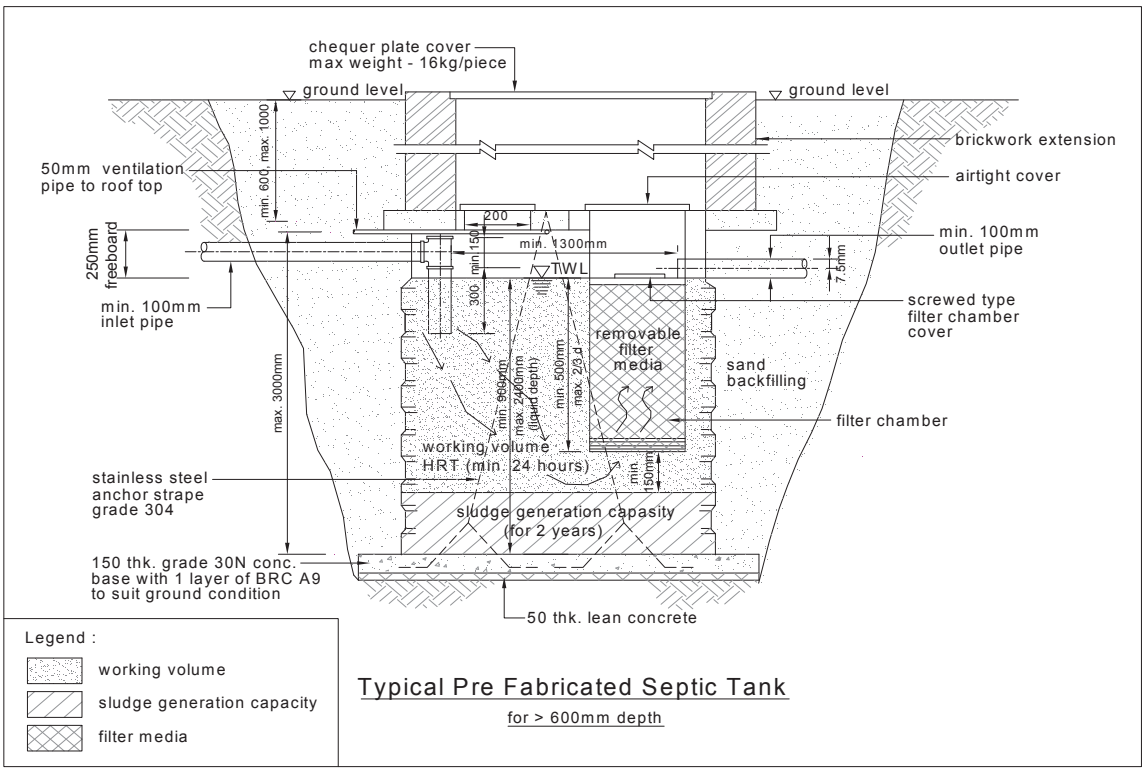
NOTES: It is preffered that septic tanks with capacity of 2700 litres and over be of two compartments type in which the first compartments should be about two thirds of the total capacity of the septic tanks. All covers must be airtight to prevent breeding of mosquito and other vectors.
All dimensions 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	5625	1375	2745	1525	305	2100	2300	1500	305-610	610
30	6750	1375	3355	1525	305	2300	2400	1500	305-610	610

Appendix J – Typical detail of a proprietary septic tank

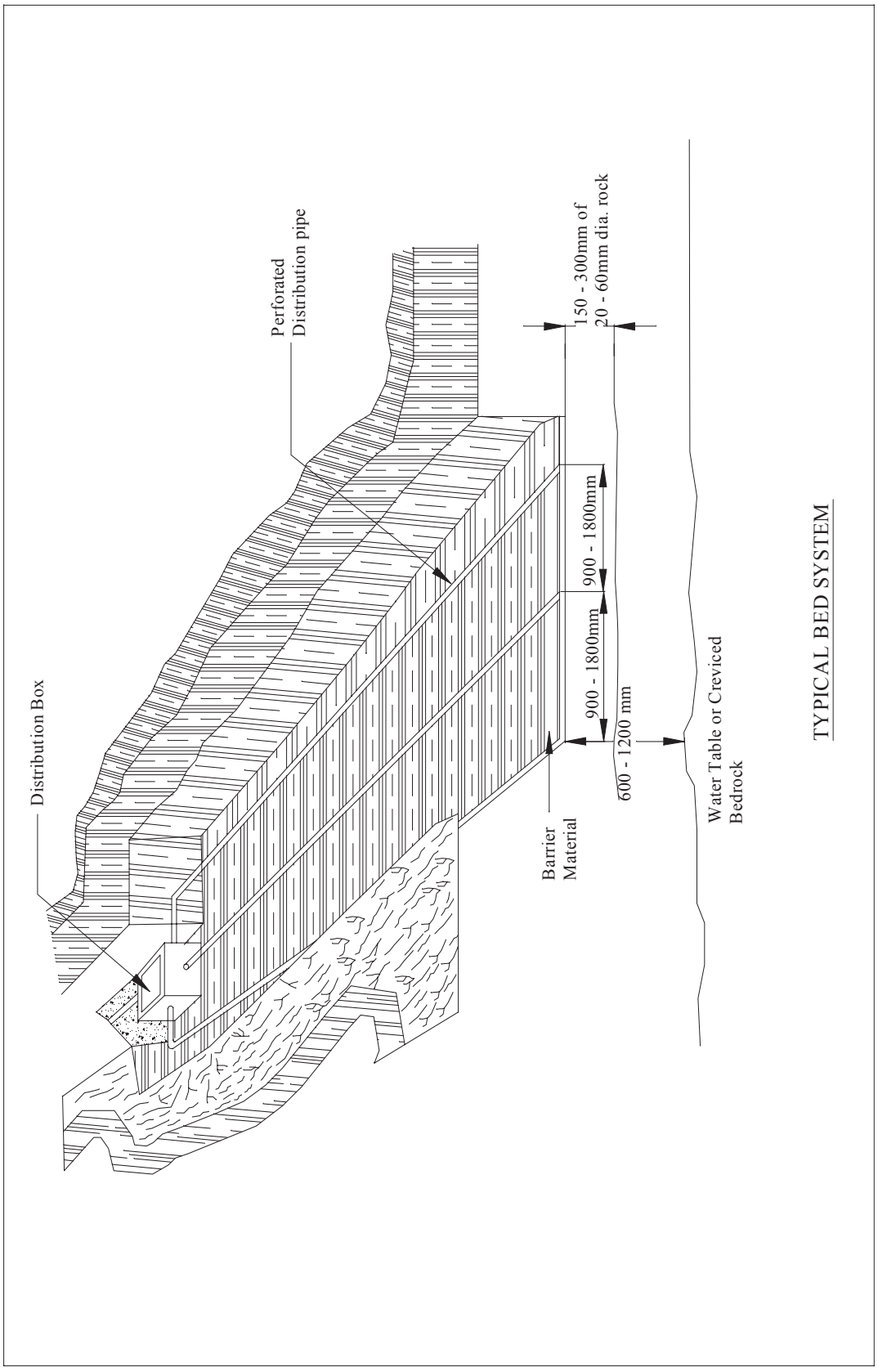


a) for < 600 mm depth

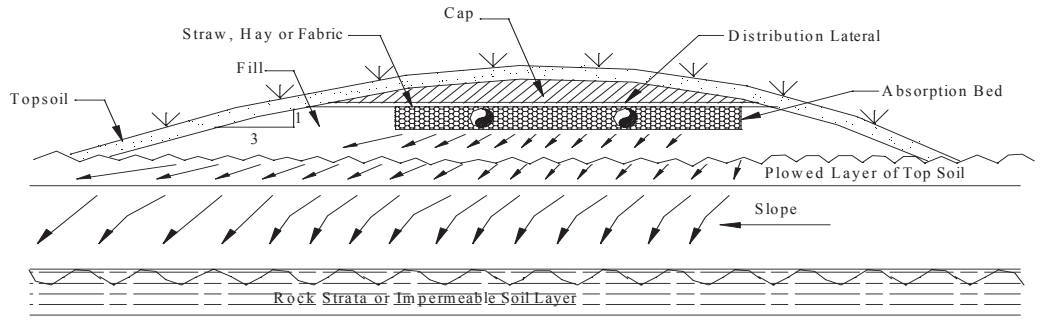


b) for > 600 mm depth

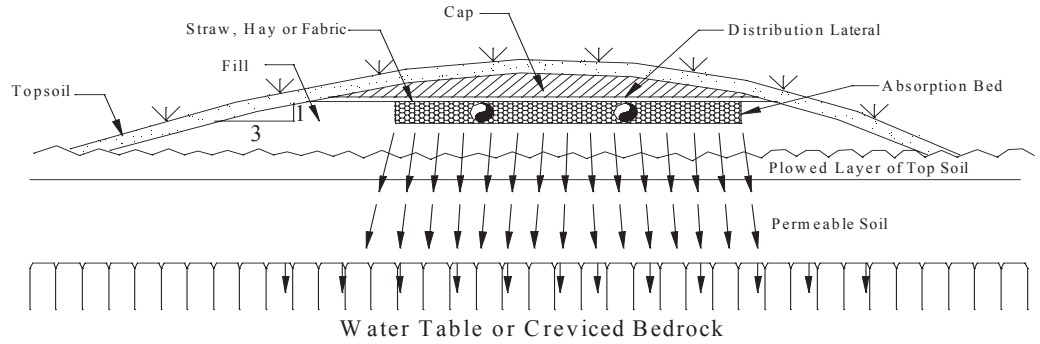
Appendix K : Typical Bed System for Soil Absorption



Appendix L : Typical Mound System for Soil Absorption

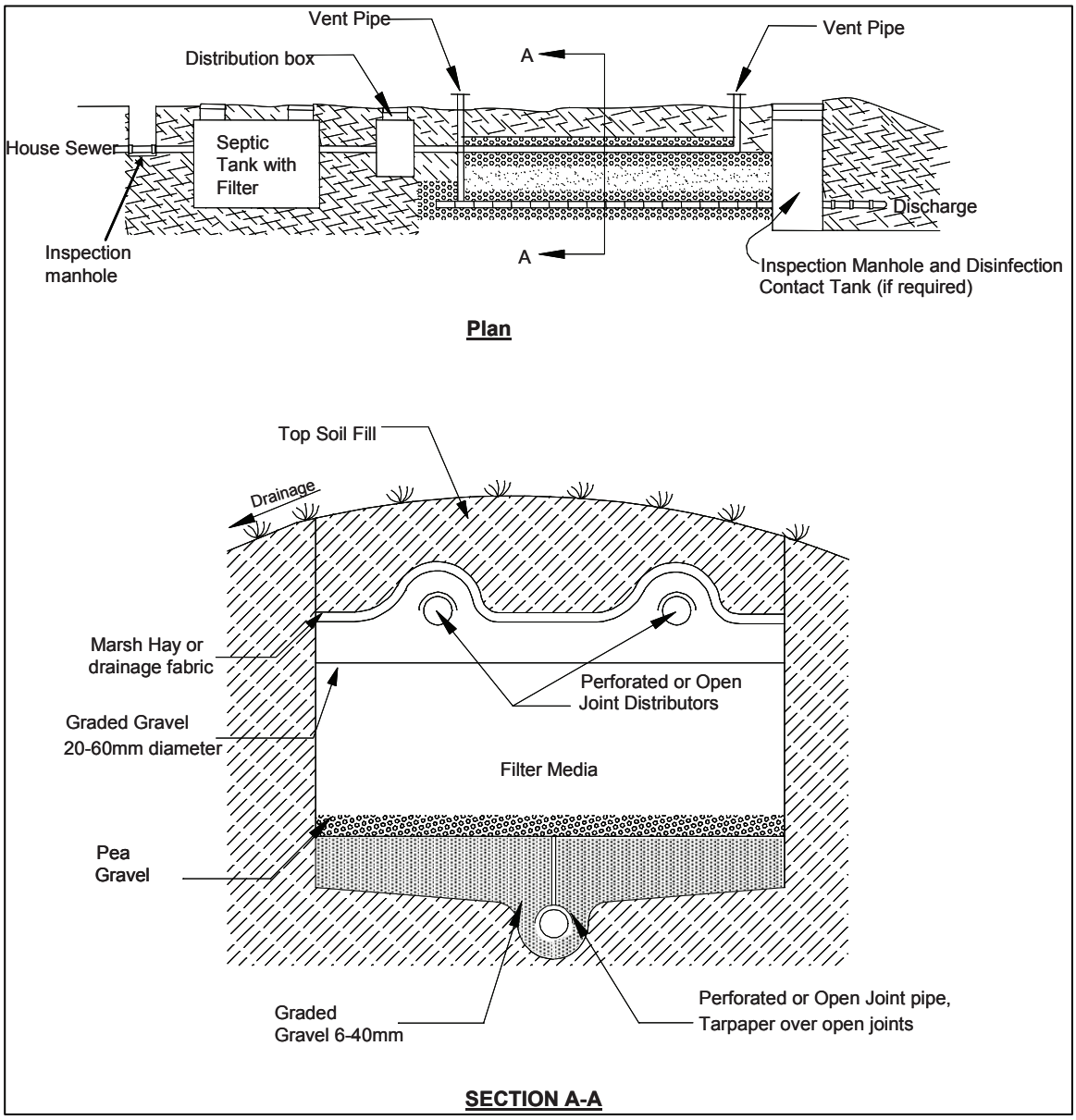


(a) Cross Section of a Mound System for Slowly Permeable Soil on a sloping site



(b) Cross Section of a mound System for a Permeable Soil, with High Groud Water or Shallow Creviced Bedrock

Appendix M – Typical Buried Intermittent Sand Filters for Effluent Polishing



Appendix N : List of Reference on Further Treatment Methods

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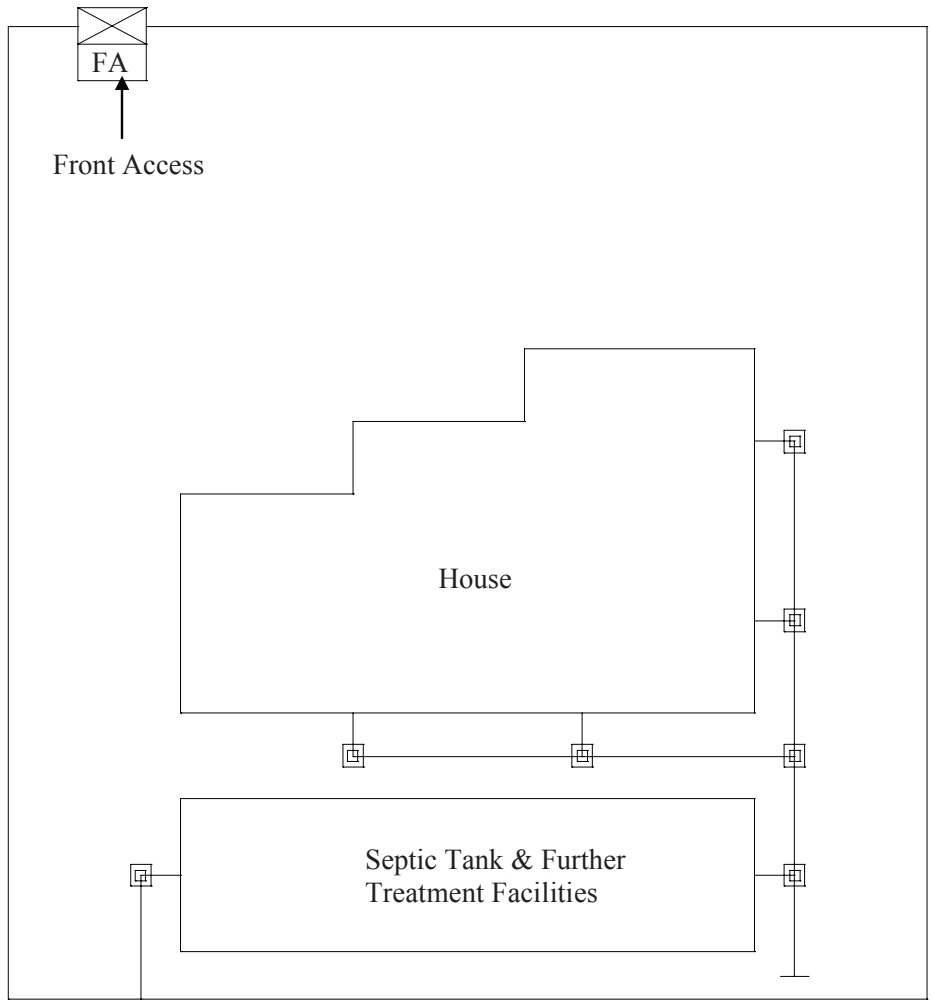
Appendix O : Typical Layout for Homestead Unit with Septic Tank & Further Treatment Facilities

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