Parts 10 and 11 of the **Building Code** outlines conditions for performance level, for change of use of a building and for the renovation of an existing sewage system.

Change of Use and Renovations

- Reduction in performance levels
- Definitions of changes in occupancy
- Upgrading of sewage systems when necessary

FIGURE 1.1.5 PARTS 10 AND 11 OF THE BUILDING CODE

The OBC is not intended as a textbook or manual of sewage system design, but as a means of providing for a minimum level of public safety through the application of uniform standards.

THE SUPPLEMENTARY STANDARDS

Step 2
Related Publications

Knowing where to find information about planning and designing a sanitary sewage system.

- By virtue of paragraph 34(1)9 of the *Building Code Act,* the Supplementary Standards to the 2012 Building Code are an integral part of the Code. Sentence 8.2.1.2.(2) provides the link to Supplementary Standard SB-6, Percolation Time and Soils Descriptions associated with the Unified Soil Classification System. Sentence 8.6.2.2.(5) provides the connection to Supplementary Standard SB-5, a list of Approved Sewage Treatment Units that meet the concentrations stipulated in Column 2 or 3 of Table 8.6.2.2. that correspond to their listing in SB-5.

  It should be noted that by the end of 2016 the SB-5 will cease to exist and on January 1, 2017 all treatment units that will be used in conjunction with sewage systems have to be certified by to CAN/BNQ 3680-600.

- Appendix A to this manual is a Troubleshooting Guide for On-Site Sewage Systems, produced by the Minnesota Pollution Control Agency – Division of Water Quality. It identifies problems and possible causes. Appendix B is a Guide to Inspection After Backfilling.

2. **Which of the following people are not permitted to design a Class 4 system?**
   a) the inspector
   b) the owner
   c) the installer
   d) a consultant

3. **Who investigates complaints about malfunctioning systems?**
   a) the installer
   b) the designer
   c) the inspector

Group

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

to settle to the bottom, and the lighter oils and greases rise to the top (Figure 1.4.7).

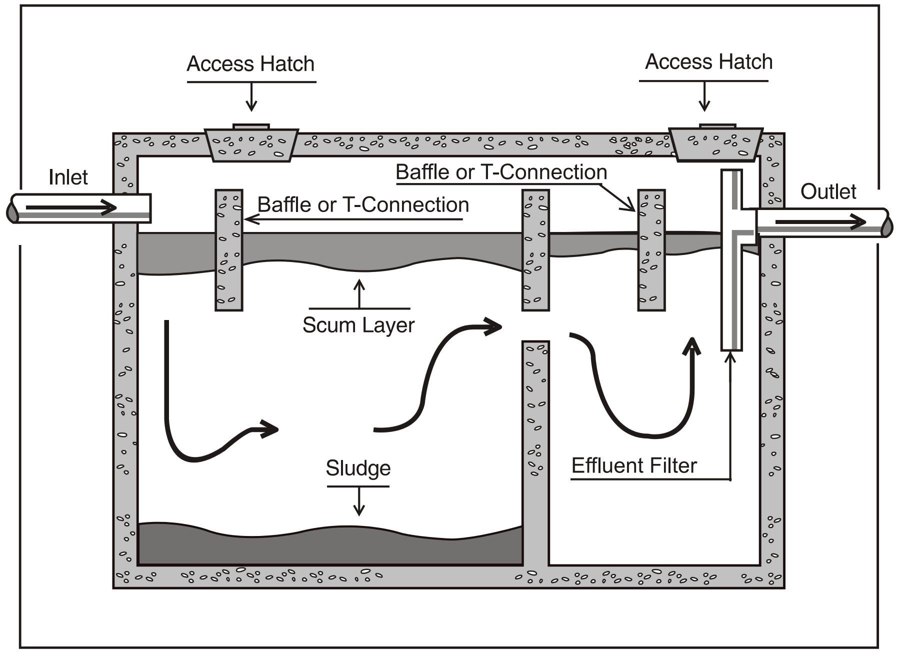

FIGURE 1.4.7 **TYPICAL SEPTIC TANK**

Bacteria in the septic tank decompose or liquefy some of the solid matter retained in the tank. The effluent passes from the tank to the leaching bed, and into the underlying soil where the final treatment occurs.

The receiving soil is the most important component of the septic system. It is the primary means by which the effluent is treated, and helps to minimize contamination of the groundwater. Once the effluent passes into the soil, the remaining nutrients are removed by bacterial action, and any remaining solids and microorganisms are filtered through a combination of physical, chemical, and biological reactions within the soil mass. For example, some of the nutrients may be used by vegetation, such as grasses; some may become fixed to soil particles; and other nutrients, percolating down towards the water table, are gradually diluted to acceptable levels. For treatment in soil to occur, the effluent must pass through unsaturated soils. Therefore, it is very important that there be a sufficiently thick layer of unsaturated soil above the high groundwater table (Figure 1.4.8).

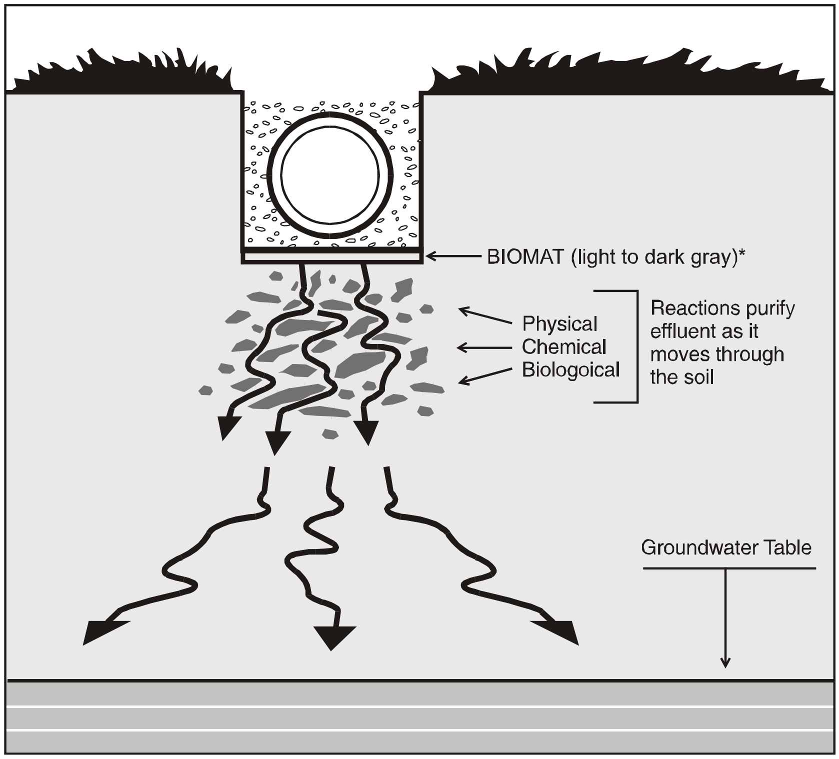

FIGURE 1.4.8 THE TREATMENT OF SEWAGE BY THE SOIL

DESIGN PARAMETERS AFFECTING A CLASS 4 SYSTEM DESIGN

Step 2
Design Criteria

Knowing the criteria contained in the Code that affect the design of on-site Class 4 sewage systems.

The design criteria for Class 4 sewage systems are detailed in Sections 8.6 and 8.7 of the Building Code. The basic design of a Class 4 sewage system depends on the estimated flow (volume of sanitary sewage) from a building, the soil permeability (ability of the soil to accept the effluent) and the effluent quality. The flow volume estimate, called the total daily design sanitary sewage flow, takes into account several factors, such as

- the type and size of building (residential or non residential occupancy)
- the number of bedrooms and fixture units
- the amount of sanitary sewage generated by the occupants of the building (residents, employees, patrons, etc.)

The characteristics of the receiving soil determines its ability to receive the applied effluent. The quality of the effluent applied to the soil (septic tank or other treatment unit's effluent) would affect the size of the leaching bed.

These clearance distances are described in more detail in Modules 2 and 5.

QUESTIONS

Complete the questions below.

1. **Name the two main components of a Class 4 sewage system and state their functions.**

2. **Which of the following occurs in the septic tank?**
   a) Oils and grease float to the top, forming a scum layer.
   b) Solids settle at the bottom forming the sludge.
   c) Solids and liquids are separated.
   d) All of the above.

3. **Explain how the effluent is further treated after it moves out of the septic tank.**

4. **What are the two most important things that affect the design of a Class 4 sewage system?**

Group

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

Step 4
The Septic Tank

Knowing the regulations and other elements that determine tank size and connection of multiple tanks.

INSTRUCTIONS

Read Steps 4 and 5 of Learning Task 1.4, following; complete the questions at the end of Step 5; and then do the group activity. Proceed only to the STOP indicator.

SIZING THE SEPTIC TANK

The minimum size of a septic tank required depends on the total daily design sanitary sewage flow. According to the Building Code *Sentence 8.2.2.3.(1)* , the minimum working capacity of a septic tank cannot be less than twice the total daily design sanitary sewage flow for residential occupancies, three times for non-residential occupancies. In all cases the Code prohibits the installation of a septic tank that has a capacity of less than 3 600 L.

The septic tank is composed of at least two compartments. The size of the first compartment must be at least 1.3 times the total daily design sanitary sewage flow, and not less than 2,400 L. The size of the second compartment must be at least 50% of the first compartment [*Sentence 8.2.2.3.(3)]*.
In addition, the tank should be sized to handle peak sanitary sewage discharges that may occur from time to time during periods of heavy use.

Occasionally, the installation of multiple septic tanks may be necessary to handle estimated high flow volumes. Where several tanks are used, they are connected **in series**. In accordance with the regulations, the first tank must have a working capacity equal to 1.3 times the total daily design sanitary sewage flow or 3,600 Litres as explained by Clause 8.2.2.3.(4)(a) and the second and each subsequent tank shall have a working capacity equal to at least 50% of the first tank, as provided by Clause 8.2.2.3.(4)(b) of the regulations. According to Sentence 8.2.2.2.(1), a tank used as a treatment unit in a Class 4 sewage system must conform to the requirements of CSA-B66, "Design, Material and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks". The referenced standard provides design criteria for liquid level drops between compartments, for partitions within the tank and for tank connections and piping. The criteria are intended to ensure the structural integrity of septic tanks, and to aid movement of sanitary sewage to the outlet.

TYPES OF LEACHING BEDS

Step 5
Leaching Bed Types

Knowing the different types of leaching beds.

The next component of the sewage system is the leaching bed which is the most important component of a Class 4 sewage system. In the leaching bed effluent is further treated to become an acceptable level liquid before it reaches the high ground water table.

A **conventional in-ground leaching bed** is a system of absorption trenches and distribution pipes set in a layer of stone within the native soil into which effluent from the septic tank is distributed.

Conventional in-ground leaching beds are normally installed where

- the high ground water table or bedrock is not close to the ground surface, and to allow for easy maintenance of grass cover. Article 8.7.4.2. specifies the size and the characteristics of soil or leaching bed fell that should be used in the construction of the leaching bed.

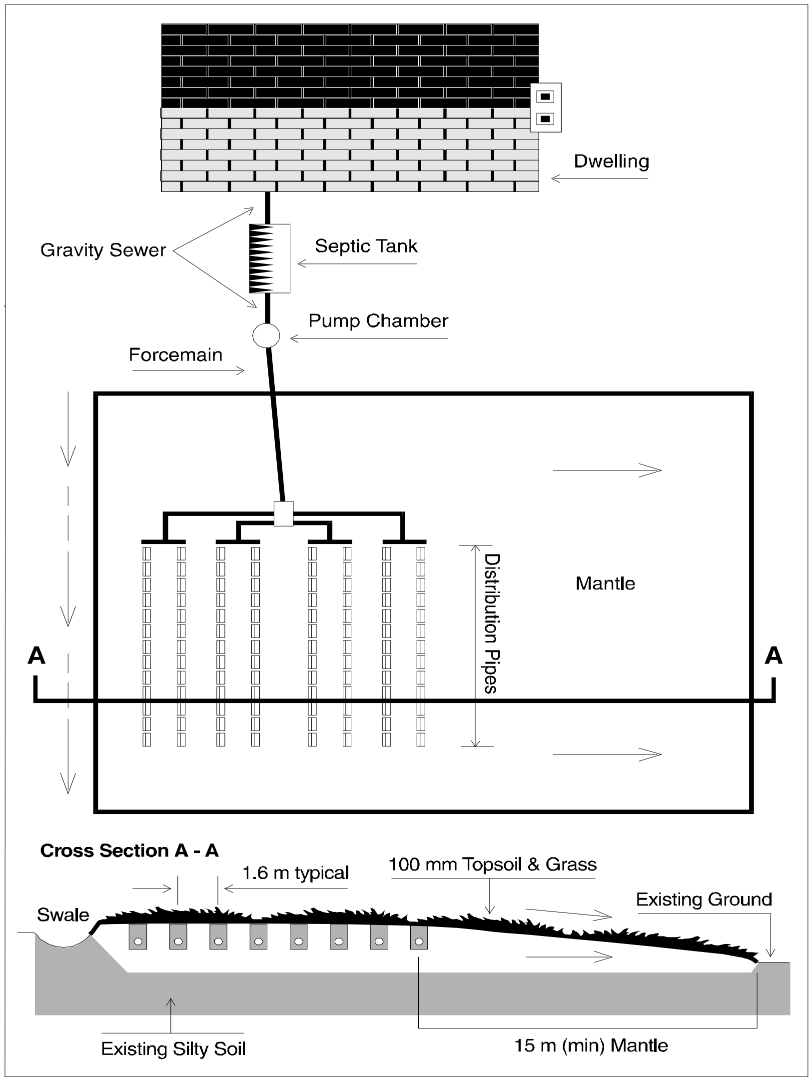

FIGURE 1.4.11 LAYOUT OF A TYPICAL RAISED LEACHING BED

A **filter bed system** is **a type of leaching bed that can be installed** in situations where there is a high ground water table or where soils with slow permeability, such as clay, exist. The Building Code specifies the requirements related to the design and construction of the filter bed. The filter bed is constructed from compacted sand of a specific grain size, with distribution pipes set in a layer of stone to promote uniform distribution of the effluent across the sand filter medium. The bed may be installed in ground (T < 15 min/cm) or raised above the surrounding ground level.

For all raised leaching bed, additional clearances are required for the distribution pipes of a raised filter bed which must be increased by twice the height that the bed is raised above ground level. Filter beds require much less area than raised beds.

Discussion Note:

Does 8.7.3.3(1)(b) adequately describe the stone layer in the case of a filter bed?

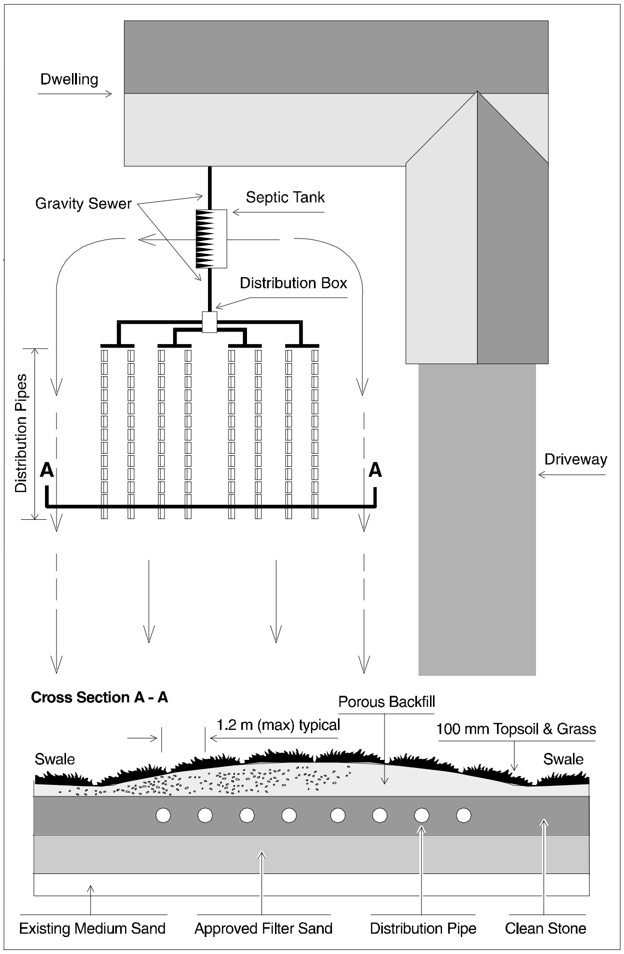

FIGURE 1.4.12 LAYOUT OF A TYPICAL FILTER BED SYSTEM

A **shallow buried trench system** is a pressurized system that forces the effluent through distribution pipes and then sprays it inside a chamber surrounding the pipe.

QUESTIONS

Complete the questions below.

1. **What is the minimum size of a septic tank, in litres?**

2. **When should you not design an in-ground absorption trench system?**

3. **What is the difference between the fill used in the construction of a raised leaching bed and the sand used in the filter bed?**

4. **What are the systems that require pressurized distribution?**

Group

Compare your answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

plant roots into the soil. Horizontal bedding plains can also occur and should be noted. All of these structures can be potential pathways for liquids to move through the soils. However, effluent may receive only limited treatment while moving along these pathways.

QUESTIONS

Complete the questions below.

1. **Describe a soil mass above the zone of saturation and one below the zone of saturation.**

Above:

Below:

2. **Identification of the soil structure during examination of the subsoil is important because it:**
   a) provides a pathway for small trees roots to penetrate into the ground
   b) provides a pathway for groundwater to rise up from below toward the surface
   c) provides a pathway for liquids to move down through the soil mass

Group

Compare your answers with those of others in your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

Step 3 Identification of Soil Types

Knowing the characteristics of soil and how soil samples should be taken.

STOP

INSTRUCTIONS

Read Step 3 of Learning Task 2.2, following; complete the questions at the end of Step 43 then do the group activity.

When identifying soils in the field you should check the following:

- **soil colour,** which is often a good indicator of the internal drainage characteristics of the soil
- **granular soils**, whether they are loose, firm, dense or very dense
- **silts and clays**, whether they are soft, firm, stiff, or hard
- **particle sizes**

2. **When you are in the test pit, at what elevation should you take a soil sample?**

3. **Why is it important to measure the thickness of the topsoil?**

Group

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 4 of Learning Task 2.2, following; complete the questions at the end of Step 4; then do the group activity.

Step 4
Soil Classification

Understanding the purpose of classifying soils, and how soil composition affects the classification of soils, percolation time and permeability.

The final purpose of examining the subsoils in a test pit is to estimate how long it might take for a liquid to percolate through them. Treatment of effluent happens when it travels through the void spaces in an unsaturated soil mass (see Soil Profile Examination, Step 2 of Learning Task 2.2). If these voids are too large, such as in coarse gravel, the flow will be too fast for proper treatment. If the voids are too small, for example in a clay soil, the effluent cannot pass through the soil mass, and treatment cannot occur. Therefore, the soil mass must have an adequate amount of void spaces to allow the effluent to pass through and be treated as it percolates through the void spaces.

There is a direct relationship between the classification of a soil mass and the measurement of its ability to allow liquids to pass through the soil. This measurement is called permeability (discussed in Step 5 of this Learning Task 2.2). If we can classify the soil mass, then we can predict its permeability. And if we can predict the permeability, we can estimate how long it takes for liquid to move (percolate) through the soil mass. This measurement of time is referred to as T-time (the time, in minutes, required for a liquid to move 1 cm through the soil). This will be discussed in Learning Task 2.3.

INSTRUCTIONS

Read Step 3 of Learning Task 2.3, following; complete the questions at the end of Step 3; then do the group activity.

Step 3
Significance of T-time

Knowing the T-time limits that affect the use of standard in-ground leaching bed.

T-TIME <1 MIN/CM OR >50 MIN/CM

A standard in-ground leaching bed is not allowed when the T-time is less than 1 min/cm, or more than 50 min/cm. This means that you will have to decide on one of the following:

- Consider a system other than a Class 4.
- Use a raised leaching bed.
- Use shallow buried trenches system if the soil has high percolation time.
- Use a raised filter bed.

A standard in-ground leaching bed is not allowed if one of the following is within 900 mm of the bottom of the absorption trench (Figure 2.3.3):

- bedrock
- the high groundwater table
- soils having a percolation time more than 50 min/cm

QUESTIONS

Follow the instructions below, and answer questions that follow.

2

1. **Figure 2.3.4. illustrates four types of Class 4 leaching beds. For each illustration, identify the Ontario Building Code Subsection(s) that govern the respective construction.**
   a) in-ground absorption trenches
   b) raised (filled based) absorption trenches and mantle
   c) raised filter bed
   d) shallow buried (pressurized system) trenches

2. **If the T-time in the soil underlying the proposed leaching bed is 55 minutes per centimeter, which of the following can you do?**
   a) consider the design of a conventional leaching bed
   b) consider the design of a raised leaching bed, (absorption trench or filter bed)
   c) consider the use of shallow buried trenches

3. **Name a site condition that prohibits the installation of an in-ground leaching bed.**

4. **What is the only system that may be constructed in soils with T time that exceeds 50 min/cm?**

Three learning tasks compose this module. The first deals with general conditions of on-site sewage systems, including the requirements that affect the different classes of the systems, their operations, and maintenance. The second task describes how you calculate what the total daily design sanitary sewage flows are for both residential occupancy and all other occupancies. Studying the last task of the module, you will learn some of the characteristics of sanitary sewage that can originate from domestic, institutional, commercial, or industrial sources.

LEARNING OBJECTIVES

By the end of this module you will know

- how the Building Code restrict the operation and maintenance of on-site sewage systems
- how the daily flow of sewage is calculated, and how flow affects the design of a sewage system
- the classifications and composition of different types of sewage

LEARNING TASK 3.1 GENERAL CONDITIONS FOR SEWAGE SYSTEMS

Step 1
Location, Alteration, and Discharge Conditions

Knowing the conditions that restrict the use of different classes of sanitary sewage systems.

Knowing how the Code restricts the operation and maintenance of on-site sewage systems.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

The Building Code (Division A, Article 1.4.1.2., Division B, Articles 8.1.2.2., and 8.1.3.1.) impose certain conditions about the use of the five classes of sewage systems. The following is a summary of these conditions:

1. All sewage systems must be constructed and wholly contained within the lot where the building connected to the sewage system is located, as stipulated in Division A, Article 1.4.1.2.

2. Alteration or repair of any sewage system must be completed in accordance with the requirements of the Building Code about sewage systems.

SYSTEM MAINTENANCE

Step 3 Maintenance

Knowing the conditions for the maintenance of the different types of sanitary sewage systems.,

Article 8.9.1.2. also imposes certain conditions for maintenance of the five classes of sanitary sewage systems:

1. Sentence 8.6.2.2.(6) states that for each unit sold, every operator of a treatment unit shall obtain from the manufacturers or distributors of treatment units literature that include
   - a detailed description of the unit
   - complete instructions for the operation, servicing, and maintenance requirements of the unit, and any related parts necessary to ensure the continued, proper operation of the system in accordance with the original design and specifications

2. A Class 4 (leaching bed) system that utilizes a treatment unit cannot be used unless the owner of the property where the system has been installed has been provided with the appropriate documentation (see point 1). No treatment unit can be used unless servicing and maintenance of the units and related parts are carried out by a person possessing a copy of the appropriate documentation (point 1). The service person must also be authorized by the manufacturer to service and maintain these types of systems.

3. The effluent from treatment units other than a septic tank must not exceed for the level of the treatment unit set out in Column 1 of Table 8.6.2.2. the maximum concentration set out opposite in Columns 2 and 3. A treatment unit used in conjunction with a shallow buried trench Type A or Type B dispersal bed must produce an effluent that does not exceed the maximum concentrations set out opposite a Level IV treatment unit in Columns 2 and 3 of Table 3.1.1 below (Table 8.6.2.2.).

3

5. According to Sentence 8.9.3.2.(1), every sewage system must be serviced and maintained regularly, so that all components of the sewage system function as intended. Construction must remain in accordance with the original permit documents and the manufacturer's requirements.

6. Article 8.9.3.3. of the Building Code indicates that every grease interceptor must be maintained in accordance with CAN/CSA-B481.4, "Maintenance of Grease Interceptors".

7. Article 8.9.3.4. of the Building Code states that septic tanks and other treatment units that form part of a Class 4 leaching bed system must be cleaned whenever the sludge and scum occupy one-third of the working capacity of the tank. The sanitary sewage is removed by a licensed sanitary sewage hauler.

8. Article 8.9.3.5. of the Building Code requires that in pressurized distribution systems, the pressure head (at the furthest point from the pump) in all distribution pipes must be checked for compliance with the original design specification, Articles 8.7.6.1. and 8.7.8.2. at least every 36 months, by a person qualified to conduct the inspection.
The system is in compliance when it maintains a pressure head of not less than 600 mm when measured at the furthest point from the pump.
Sewage systems that utilize treatment units must be inspected at least once every 12 months by a person authorized by the manufacturer to service and maintain these types of systems, to ensure that the sewage system is functioning in accordance with its design. If an inspector determines that the system is not operating in accordance with its design, a report must be immediately submitted to the Chief Building Official.

QUESTIONS

Complete the questions below.

1. **When is a sewage system considered to be unsafe?**

2. **Why is it important for the manufacturer of a treatment to supply the purchaser with appropriate documentation?**

3. **How is grease prevented from entering the leaching bed?**

In most cases, a standard septic tank system will provide the necessary primary treatment of domestic and institutional sanitary sewage prior to discharging to the leaching bed. When sanitary sewage is suspected to have a higher concentration of certain elements (e.g., organic or nitrogen nutrient loadings), a different treatment system may be advisable. For example, a treatment unit other than a septic tank system might be considered when biomat development beneath a leaching bed in low-permeability soils is a concern.

QUESTIONS

Complete the questions below.

1. **Name two classifications of sanitary sewage.**

2. **What makes up the greatest part of sanitary sewage?**

3. **Give four examples of a non-residential source of sanitary sewage.**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 3 of Learning Task 3.2, following; complete the questions at the end of Step 3; then do the group activity.

Step 3
Commercial and Industrial Sanitary Sewage

Being aware of the different types of sanitary sewage generated by the different commercial and industrial sources.

Due to the different elements that may be contained in commercial or industrial sanitary sewage, it is very important to assess each situation individually for possible sanitary sewage treatment and system design opportunities.

COMMERCIAL WASTE

Commercial sanitary sewage comes from facilities such as laundromats, restaurants, shopping malls, bakeries, and medical clinics. Each produces sanitary sewage consisting of different elements that may require special treatment; for example:

QUESTIONS

Complete the questions below. As always, provide Building Code references where applicable.

1. **Why is it important to assess commercial and industrial sources very carefully?**

2. **Name two commercial enterprises that can cause problems to a septic system.**

3. **When are industrial process waste waters allowed into a sewage system?**

GROUP

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 3.3 SANITARY SEWAGE SYSTEM DESIGN FLOWS

Understanding how the daily flow of sanitary sewage affects the design of a sewage system.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
Sizing Sanitary Sewage Systems

Examining how flows are calculated.

The most critical aspects in sizing sewage systems are

- determining the sanitary sewage flows
- determining the hydraulic capacity of the receiving soils

Leaching beds and treatment units must be sized according to the total daily design sanitary sewage flow. Typical flow volumes from various sources are outlined in Tables 8.2.1.3.A and 8.2.1.3.B.

to accommodate these peak flow periods would involve providing a more even distribution of the flows through a balancing tank. By adding such a tank to the system, peak flows could be metered through the system in off-peak periods during low-use times of the day or week.

With normal residential development or with a use that produces about the same amount of sanitary sewage on a regular basis, balancing tanks are not usually needed.

The use of a balancing tank and flow balancing techniques should be discussed with the chief building official prior to incorporation into the design.

QUESTIONS

Complete the questions below.

1. **What are the most critical aspects in sizing a sanitary sewage system?**

2. **How do you obtain the total daily design sanitary sewage flows?**

3. **When might you consider the use of a balancing tank?**

Group

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 2 of Learning Task 3.3, following; complete the questions at the end of Step 2; then do the group activity.

Step 2
Sanitary Sewage Flows for Residential Occupancies

Knowing how to determine flow rate for residential occupancies.

For residential occupancies, sanitary sewage flows are determined from Table 8.2.1.3.A of the Building Code

The flow volumes shown in column 2 of Table 8.2.1.3.A represent daily design sanitary sewage flows. Although these flows should be considered minimums, they do include a margin of safety, as established by various studies that have metered actual residential water consumption. Therefore, they represent design flows rather than average daily flows.

In smaller residences, an allowance of two persons per bedroom is made; but this is reduced in larger homes, as it is unlikely that there will be, for example, 10 persons in a 5-bedroom house.

Note from the table that larger homes (over 200 m^2 or having more than 20 **fixture units**) are shown to generate more sanitary sewage than smaller homes. This is because larger homes are likely to have more water-consuming appliances, such as a Jacuzzi tub, water softener, automatic laundry washer, and automatic dishwasher.

The Building Code [*Div. A, Article 1.4.1.2*.] defines a fixture unit that applies to a drainage system as

> the unit of measure based on the rate of discharge, time of operation, and frequency of use of a fixture that expresses the hydraulic load that is imposed by that fixture on the drainage system.

The hydraulic load from a fixture not listed in Table 7.4.9.3 is the number of fixture units shown in Table 3.3.3 (Table 7.4.10.2 of the Code) for a trap of the size that serves the fixture.

For most residential occupancies, the calculation of the daily design sanitary sewage flow is fairly straightforward. It involves determining the number of bedrooms and/or fixture units in the dwelling, and selecting the appropriate design volumes from the residential occupancy Table 8.2.1.3.A.

Table 3.3.3

Fixture Hydraulic Load, Based on Trap Size

Size of Trap (inches)	Hydraulic Load (fixture units)
1 1/4	1
1 1/2	2
2	3
2 1/2	4
3	5
4	6

The following is an example of the calculations to determine the flow of a four-bedroom, 235 m^2 home with 22 fixture units.

Four-bedroom home larger than 200 m^2
= 2 000 L/d [Table 8.2.1.3.A]
Additional flow
1) From area above 200 m² (35 m²) = 4 × 100 = 400 L/d [Table 8.2.1.3.A]
2) From extra fixture units above 20 = 2 x 50 = 100 L/d
Total daily design sanitary sewage flow = 2000 L/d + 400 L/d (the highest of the additional flow) = 2400 L/d

Assuming a septic tank is used, the example tank must have a working capacity of not less than twice the daily design sanitary sewage flow. This would result in a minimum tank volume of 4 800 L [*Clause* 8.2.2.3.(1)(a)].

Note: The calculation of the total design flow is obtained by adding the base flow to the highest of the flow from the additional bedrooms (above 5), the additional fixture units (above 20) and the floor area (above 200 m²).

QUESTIONS

Complete the questions below.

1. **What is a fixture unit?**

2. **How do you calculate the daily design sanitary sewage flow for a residential occupancy?**

3. **Calculate the daily design sanitary sewage flow for a four-bedroom dwelling, 205 m^2 in area.**

4. **Calculate the daily design sanitary sewage flow for a 30-room motel.**

Group

Compare your answer with your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 3 of Learning Task 3.3, following; complete the questions at the end of Step 3; then do the group activity.

FLOW RATES FOR LISTED NON-RESIDENTIAL OCCUPANCIES

Step 3
Sanitary Sewage Flows for All Other Occupancies

Knowing how to determine flow rate for non-residential facilities.,

Other non-residential facilities, such as schools, churches, and factories, are listed in Table 8.2.1.3.B (see Table 3.3.2) of the Code. The daily design sanitary sewage flow volumes for such facilities are calculated from the data in this table.

When calculating the sanitary sewage flows for non-residential use, all uses must be taken into account. Sanitary sewage flows at these establishments can vary considerably, depending on location and type:

- shopping plaza — housing several types of businesses, and public washrooms
- club — a golf club may be much busier on the weekend than during the week
- restaurant — a small restaurant or coffee shop serving meals is different from a larger one providing evening entertainment as well as meals

- bar or a combination bar and restaurant

The method of calculating daily design sanitary sewage flows from the table may produce conservative results. However, this does not lessen the need to take extreme care to ensure all sources of sanitary sewage are accounted for.

Total daily design sanitary sewage flow is calculated from the values found in Tables 8.2.1.3.A and 8.2.1.3.B of the Code.

FLOW RATES FOR UNLISTED, NON-RESIDENTIAL OCCUPANCIES

If a particular non-residential facility is not listed in Table 8.2.1.3.B of the Code, then an acceptable method to determine the total daily design sanitary sewage flow is to use the highest flow data from at least three similar establishments. [Sentence 8.2.1.3.(4).]

FLOW RATES FOR MULTIPLE OCCUPANCIES

Where a building contains more than one establishment, the total daily design sanitary sewage flow must be the sum of the total daily design sanitary sewage flow for each establishment. If required, the occupant load in a building can be determined from Subsection 3.1.16. of the Code.

The following is an example of the calculations used to determine the flow for a commercial plaza, containing several different facilities. The example plaza consists of

- a barber shop with two service chairs
- a doctor's office with one practitioner and one employee working weekday 8-hour shifts
- a 75 m^2 variety store with one water closet
- a 20-seat restaurant that is open 10 hours per day

From Table 8.2.1.3.B:

1.	Barber shop	650 × 2 =	1 300 L/d
2.	Doctor's office	275 + 75 =	350 L/d
3.	Variety store — watercloset		
		the greater of 5 × 75 or 1 230	1 230 L/d
4.	Restaurant	125 × 20 =	2 500 L/d

Total daily design sanitary sewage flow = **Q** = **5 380** litres per day

10. what a shallow buried trench system is, when it can be used, and the Building Code requirements related to its construction.

11. What a Type A and Type B dispersal bed are, when they can be used, and the Building Code requirements related to their construction

LEARNING TASK 5.1 GENERAL REQUIREMENT FOR A CLASS 4 (LEACHING BED) SYSTEM DESIGN

Understanding the limitations of Class 4 systems and applying the Building Code to the construction and design of a Class 4 system.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

CLASS 4 SYSTEMS: LEACHING BEDS

Step 1
Class 4 Treatment and Disposal Systems

Knowing the different types of treatment and disposal systems.

Remember to fill in blank spaces with the relevant Code reference, and to back up your answers to questions with the references that apply.

Section 8.7 of the Building Code deals with leaching beds. In a class 4 (leaching bed) system, the sewage is treated in two stages: The initial treatment takes place in a septic tank or other treatment unit (or both), then the final treatment takes place in soil (the leaching bed). The soil performs the final treatment and dispersal of the treated effluent into the environment.

- A septic tank accumulates sanitary sewage. The solids settle to the bottom of the tank, the greases float to the top, and the bacteria begin the treatment process. A septic tank must be equipped with an effluent filter. The filter allows for more bacterial treatment and also captures more of the suspended solids [Sentence 8.6.2.1.(1) and (2)].
- A treatment unit in lieu of or in addition to a septic tank may be used to provide extra treatment to the effluent before it enters the leaching bed for final treatment and dispersal into the soil. The classes of treatment units are listed in Table 8.6.6.6. of the Building Code.

Effluent from the inital stage flows to a leaching bed of the type shown in Figure 5.1.1 based on the level of treatment.

5.1

A **job aid** summarizing different leaching bed systems is included at the end of this module.

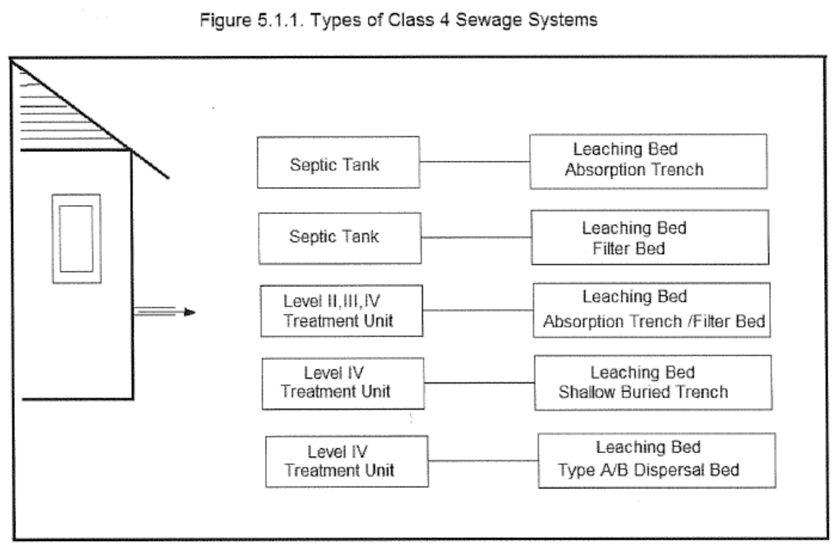

FIGURE 5.1.1 COMPONENTS OF A CLASS 4 SYSTEM

Once the sanitary sewage is treated, it is called effluent, which enters a leaching bed for further treatment and disposal. One of the following types of leaching bed is used, depending on the site conditions.

A conventional in-ground leaching bed can be used if the soil has a T-time between 1 and 50 min/cm and if the bedrock or the high groundwater table is more than 90 cm below the bottom of the leaching bed trenches.

A raised leaching bed can be used if

- the T-time is less than 1 min/cm, or
- the T-time is more than 50 min/cm, or
- the bedrock or the high groundwater table is within 90 cm of the bottom of the trenches.

A filter bed can be used if there is limited space on the lot. In a sand filter bed, the distribution pipes are set on a continuous layer of stone.

A shallow buried trench leaching bed is the only system that can be installed in soils with percolation time that exceeds 50 min/cm up to 125 min/cm. It is a pressurized system, whereby the effluent from a Class IV treatment unit.

The size, the type of components, and the layout of a Class 4 system will be affected by

- sanitary sewage flow
- quality of the sanitary sewage
- soil characteristics
- site conditions and adjacent surface and environmental constraints (such as water courses)
- relative elevations of the system components

In addition, you need to consider site conditions such as

- clearance distances (contained in Article 8.2.1.6.)
- the potential for gravity flow of sanitary sewage from the building to the septic tank and into the leaching bed; in areas where gravity flow is not possible, pumping chambers will be required to dose the leaching bed
- potential layout of the lot, including future structures and amenities
- proper location of the tank to assure accessibility
- location of proposed landscaping

QUESTIONS

Complete the following questions.

1. **Name five factors that will affect the design of a Class 4 system.**

2. **If a Class 4 system is proposed, why should you ask the property owner if there are any future additions or structures planned for the property?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

— through two or more openings through the partition located in a horizontal line, evenly spaced across the width of the partition, centred at approximately 40% of the liquid depth below the surface of the liquid, and having a total area of between three and five times that of the cross-sectional area of the inlet pipe [*Clause 8.2.2.3.(7)(b)*].

- A septic tank must have a construction and design that permits the collection and holding of sanitary sewage to a depth of not less than 1000 mm. However, if the excavation is in rock, or if the designer is trying to avoid rupture or displacement of the tank due to groundwater pressure, then a depth of at least 900 mm is permitted [*Sentence 8.2.2.3.(8)*].

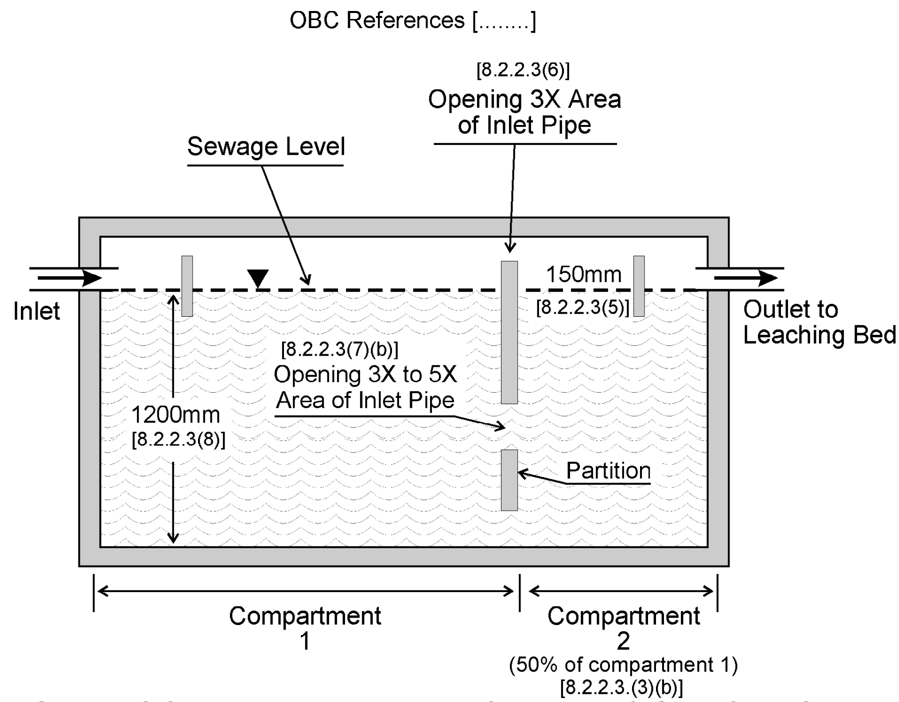

FIGURE 5.2.2 MEASUREMENTS OF A SEPTIC TANK

QUESTIONS

Complete the following questions.

1. **What standard does a septic tank have to conform to?**

2. **Article 8.2.2.3. outlines several stipulations for the particular dimensions and components of a septic tank. Why do you think the requirements are necessary?**

3. **When must a septic tank be securely anchored?**

QUESTIONS

Complete the following questions.

1. **Name two things directly affected by the size of the septic tank.**

2. **What size of septic tank must be provided for the following design daily residential sanitary sewage flows?**
   - 1 800 L,
   - 1 000 L,
   - 1 500 L,

3. **Can a septic tank be located 1.5 m from a reservoir?**

4. **If the system requires multiple septic tanks, how should the tanks be connected? What Sentence in the Code describes how the tanks should be connected?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 4 of Learning Task 5.2, following; complete the questions at the end of Step 4; then do the group activity.

Step 4
Effluent Characteristics

Knowing the acceptable concentration levels for effluent from different treatment systems.

As you learned in Learning Task 5.1, Step 1, there are two pre-treatment systems:

- septic tank, and
- Other treatment units
  - Level II treatment unit
  - Level III treatment unit
  - Level IV treatment unit

Maximum permitted effluent concentrations are different for each of these levels. They are detailed in Subsection 8.6.2., "Treatment Units".

Effluent filters must be sized to filter particles of 1.6 mm, have a minimum flow area of 550 cm^2 and be installed in accordance with the manufacturer's recommendation [*Sentences 8.6.2.1.(1) and (2)*].

The treatment unit, other than a septic tank, shall be designed such that the effluent does not exceed the contaminants' levels in Columns 2 and 3 of Table 8.6.2.2.: [*Sentence 8.6.2.2.(1)*].

Table 8.6.2.2.
Other Treatment Unit Effluent Quality Criteria

Forming Part of Sentences 8.6.2.2.(1) and (2)

Item	Column 1	Column 2	Column 3
	Classification of Treatment Unit(1)	**Suspended Solids(2)**	**$CBOD_5$(2)**
1.	Level II	30	25
2.	Level III	15	15
3.	Level IV	10	10

Note to Table 8.6.2.2.:

(1) The classifications of treatment units specified in Column 1 correspond to the levels of treatment described in CAN/BNQ 3680-600, "Onsite Residential Wastewater Treatment Technologies".

(2) Maximum concentration in mg/L based on a 30 day average.

A treatment unit that is used in conjunction with a leaching bed constructed as a shallow buried trench, Type A dispersal bed or Type B dispersal bed must be designed such that the effluent does not exceed the maximum concentrations set out opposite a Level IV treatment unit in Columns 2 and 3 of Table 8.6.2.2. [*Sentences 8.6.2.2.(2)*].

BOD5 is the five-day biochemical oxygen demand and $CBOD_5$ is the five-day carbonaceous biochemical oxygen demand.

All treatment units, other than septic tanks, must permit sampling of the effluent [*Sentence 8.6.2.2.(4)*].

QUESTIONS

Complete the following questions.

1. **Will the effluent coming from a septic tank and a septic tank with a filter be of the same quality or of a different quality? Give a reason for your answer.**

2. **In what units are maximum effluent concentrations measured?**

3. **What should you know about $CBOD_5$, and suspended solids?**

4. **How should septic tank filters be sized and installed?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 5.3 GENERAL INFORMATION ON LEACHING BEDS

Knowing the treatment and sub-surface adsorption capabilities of the different types of Class 4 leaching bed systems.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
Treatment of Sanitary Sewage

Knowing what affects the operation of a leaching bed.

The leaching bed is a critical part of the Class 4 sewage system. The performance of the leaching bed is measured by its ability to perform the following functions:

- the treatment of effluent in the soil, and
- the absorption of the treated effluent by the underlying and surrounding soils without it breaking to surface.

The application of effluent to a soil surface over a long period of time results in the formation of a biomat at the soil/effluent interface. Bacteria in the biomat feed on the organic matter in the effluent. Therefore, biomat plays an important role in the treatment process.

Treatment of the effluent also takes place in the unsaturated soil layer underneath the biomat as it percolates downward and is exposed to bacterial action in the soil pores (voids). This process must permit sufficient time for effluent to be in contact with soil particles in order to achieve an acceptable level of treatment before effluent reaches groundwater. Inground absorption trench leaching bed could be installed only when the percolation time of the soil is between 1 min/cm and 50 min/cm, as required by Clause 8.7.2.1.(1)(b), unless the leaching bed system is a shallow buried trench where T-time of the soil could be as high as 125 min/cm.

QUESTIONS

Complete the following questions.

1. **What happens in the biomass layer?**

2. **Where is the biomat formed?**

3. **What happens to the effluent when it percolates down into the soil?**

4. **Why are clearance and minimum distances important in this treatment?**

5. **What type of bacteria in soil feed on the contaminant in the effluent, and what do they need to perform this function?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 2 of Learning Task 5.3, following; complete the questions at the end of Step 2; then do the group activity.

Step 2
Inspecting and Evaluating the Leaching Bed Site

Knowing what to look for, when inspecting or evaluating the site of a proposed leaching bed.

INSPECTION CONSIDERATIONS

There are several important considerations to be aware of, when you are inspecting or evaluating a proposed leaching bed site [Article 8.7.2.1.]:

1. The area must be sufficient for the soil to absorb effluent on a continuing basis without breakout of effluent to the surface of the ground.

2. The area of the soil surface is determined by the daily design sanitary sewage flow, the percolation time of the soil, and the effluent quality. Effluent must be applied as evenly as possible over the entire soil surface. Article 8.7.3.1. stipulates the required length of distribution piping according to the sanitary sewage flow and the percolation time of the soil.

3. Effluent usually passes too quickly through coarse-grained soils to receive adequate treatment. A **minimum percolation time** of **1 min/cm** is stipulated in Clause 8.7.2.1.(1)(b). Where natural soils are coarse-grained, it may be necessary to add finer-grained soil to the leaching bed, to increase the percolation time. It may also be necessary to increase clearance distances from the Code minimum, especially when dealing with shoreline properties on sensitive lakes [*Sentence 8.2.1.4.(2)*].

4. In fine-grained soils, percolation of effluent is slow. Once these soils are saturated, they do not drain readily. Replenishment of oxygen in the treatment area is slowed, and treatment is either slowed, or stops altogether. The maximum percolation time for a soil to be used for an in-ground absorption trench system is 50 min/cm, as stipulated in the Code. For shallow buried trench systems, the T-time is increased to 125 minutes [*Clause 8.7.2.1.(1)(b)*].

5. The most suitable soil for a leaching bed should possess the advantages of both fine-grained and coarse-grained soils, and have none of the disadvantages. The advantage of fine-grained soils is their high degree of effluent treatment. However, their disadvantage is their very low permeability, which slows the movement of the effluent through the soil mass. On the other hand, effluent can move quite freely through very coarse-grained soils; however, their treatment performance is very poor. A leaching bed with a percolation time between 10 and 20 min/cm usually represents ideal conditions.

INSTRUCTIONS

Read Step 3 of Learning Task 5.3, following; complete the questions at the end of Step 3; then do the group activity.

Step 3
Subsurface Absorption of Effluent

Knowing what affects the capacity of a leaching bed.

Continued acceptance of effluent by the underlying soil is vital to the continued functioning of a leaching bed. If the input of effluent into the soil exceeds its capacity to receive and transmit the effluent, mushy ground or surface breakout of sanitary sewage will occur. This is a common cause of failure in sewage systems, especially in large systems where the problem increases in proportion to increasing daily sanitary sewage flow. Therefore, it is very important to follow regulations about sanitary sewage flow designs, percolation times, and clearance distances.

When the percolating effluent reaches the level of the water table, bedrock, or impermeable soil, the sanitary sewage will mound on top of this level. (Refer to Module 2, Learning Task 2.2, Step 5, and Figure 2.2.8). Mounding will continue until sufficient pressure is reached to force a downward or lateral (sideways) movement. The greater the resistance of the underlying soil to this movement, the greater the portion of the liquid that will move laterally, forming a plume (refer to Module 2, Learning Task 2.2, Step 6, and Figure 2.2.10). In addition, the greater the resistance to movement, the higher the sanitary sewage will mound toward the surface. If it mounds to a level that will flood the soil–sewage interface, it will remove the oxygen from the soil and inhibit the natural treatment of the sewage. In extreme cases, it can cause a backup of the sanitary sewage system, and could result in surface breakout of the effluent.

The capacity of the leaching bed to safely receive and transmit the applied effluent, without mounding or breakout, is one of the major factors in the design of either a single leaching bed, or a concentration of separate leaching beds in any one given area, such as in a housing subdivision.

In summary, the following are the major steps in the treatment of sanitary sewage by a properly designed on-site Class 4 sewage system.

1. Sanitary sewage enters the septic tank, where treatment begins. In general, the tanks are designed to retain the sewage for 48 hours, to allow solids to settle and treatment to take place.

2. The sanitary sewage exits the tank as effluent. In some cases, this effluent is given additional treatment by a treatment unit which lowers the suspended solids and $CBOD_5$ in the effluent.

3. Level II, III or IV treatment units are required if the effluent is to be discharged to a filter bed when the total daily design sanitary sewage flow exceeds 5 000 L, and a Level IV treatment unit is required if the effluent is directed to a shallow buried trench system and Type A or Type B dispersal beds. [*Sentences 8.7.5.1.(1) and 8.6.2.2.(2)*].

4. Once the effluent enters the absorption trenches, it percolates down through soil which must be unsaturated for the treatment to take place.

5. If there is at least 900 mm of unsaturated soil above the high groundwater table, the bacteria in the voids of the soil mass will treat the effluent and make it safe to be discharged to the ground water without causing contamination.

6. **Impairment and contamination of the environment** are possible if:
   - the treatment units are not properly designed
   - the treatment units malfunction
   - the leaching bed is not properly designed or constructed
   - the leaching bed malfunctions
   - minimum clearance distances are not maintained
   - minimum vertical separation above the high groundwater table, bedrock, or clay soils are not met

7. In summary, sanitary sewage passes through:
   - a septic tank or a treatment tank unit where the sanitary sewage becomes effluent.
   - a leaching bed where the effluent is transported into the soil
   - the unsaturated subsoil where the effluent is naturally treated to levels acceptable for introduction into the environment.

8. From sanitary sewage → effluent → acceptable liquid.

QUESTIONS

Complete the following questions.

1. **What does mushy ground or surface breakout of sewage tell you about the leaching bed? What might cause these conditions?**

2. **Mounding of the groundwater table beneath a leaching bed may cause**
   a) the effluent from the leaching bed reaches the groundwater without adequate treatment
   b) an increase in the natural treatment by allowing the effluent to be mixed with water, thus diluting the sanitary sewage impact on the groundwater
   c) the effluent to move laterally instead of downward
   d) flooding of the soil/ effluent interface, thus removing oxygen from the soil and inhibiting natural treatment

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 5.4 DISTRIBUTION OF EFFLUENT TO THE LEACHING BED

Knowing the different types of distribution systems and how they work.

INSTRUCTIONS

Read Steps 1 and 2; complete the questions at the end of Step 2; then do the group activity.

Step 1
Distribution System

Knowing the components of a distribution system.

Effluent from a septic tank or other treatment unit flows through the distribution system into the leaching bed. The purpose of the distribution system is to evenly distribute the effluent throughout the leaching bed area. Components of the system may include

- the piping that connects the septic tank to either a distribution box or a header, and from the distribution system to each of the individual distribution pipes

- a pumping system to dose the leaching bed (if utilized)
- distribution boxes or headers to split the flow to segments of the leaching bed or directly to each line of the distribution pipe
- the lines of distribution pipes

Step 2
Gravity, Dosed, and Pressurized Systems

Knowing how the different sanitary sewage distribution systems work.

There are three main types of distribution systems:

- gravity flow
- dosed
- pressurized

GRAVITY FLOW DISTRIBUTION SYSTEM

The **gravity flow distribution system** is the most common method of effluent distribution. The effluent is pushed from the tank by hydraulic displacement, and then trickles by gravitational pull from the septic tank to the individual distribution pipes. Usually, the septic tank is a flow-through design that displaces, to the leaching bed, a volume of effluent equal to the volume of sanitary sewage flowing into the tank. Effluent flows by gravity from the tank to the leaching bed. You will learn about some of the requirements concerning distribution pipes later in this Module.

DOSED DISTRIBUTION SYSTEM

A **dosed distribution system** is required when the total length of the distribution pipe required is 150 m or more. A pump or a siphon is used to send a specified volume of effluent to the leaching bed in a single dose. Article 8.6.1.3. of the Code stipulates the regulations regarding the use of pumps and siphons.

With this type of system, either the pumping chamber or the siphon tank is usually located immediately down gradient of the treatment unit, and generally receives gravity flow from the treatment system. The regulations state that the siphon or pump tank may be a separate compartment within the tank structure [*Sentence 8.6.1.3.(1)*].

Within a 15-minute time frame, the pump or siphon periodically conveys a measured amount of effluent under pressure from the treatment unit to the distribution lines [Sentence 8.6.1.3.(4)]. The distribution lines themselves are not usually under pressure; the effluent flows through them by gravity. The effluent is forced (dosed) into the distribution pipes at a rate equal to 75% of the lines' total

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volume. This periodic dosing of the leaching bed provides a more even distribution of the effluent over the entire bed area than the gravity discharge. It also allows the bed to drain between doses, promoting strong bacterial action in the biomat. Care should be taken to avoid freezing of the distribution lines in the winter.

PRESSURIZED DISTRIBUTION SYSTEMS

A shallow buried trench system and Type B dispersal bed are pressurized distribution systems. In these systems, a minimal pressure is maintained at the terminal end of all the lines of distribution pipe. These systems are the most efficient systems in achieving even distribution of effluent over the entire leaching bed area.

QUESTIONS

Complete the following questions.

1. **What are the distribution system components of a Class 4 System, and what are their purpose?**

2. **Explain how effluent reaches the leaching bed in a gravity flow system.**

3. **What is a dosed system? When is it required?**

4. **What is the purpose of dosing?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 3 of Learning Task 5.4, following; complete the questions at the end of Step 3; then do the group activity.

3. **A distribution box for the distribution of effluent to the absorption bed pipes is preferred when**

   a) the effluent has had additional treatment other than that supplied by the septic tank

   b) there are more than 8 lines of distribution piping

   c) there are more than 10 lines of distribution piping

   d) the effluent has to be pumped up from the tank to the leaching bed

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 5.5 LOCATION AND CONSTRUCTION OF THE LEACHING BED

Knowing the Code requirements that affect the location and construction of a leaching bed.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
General Requirements

Knowing where a leaching bed cannot be installed.

Article 8.7.2.1. of the Code stipulates where leaching beds must **not** be located:

- in an area that has an average slope that exceeds one unit vertically to four units horizontally (to prevent excessive grading and uneven elevations of the bed) [*Clause 8.7.2.1.(1)(a)*];
- in soil or leaching bed fill having a percolation time of less than 1 minute or greater than 125 minutes if constructed as a shallow buried trench (pressurized system), or less than 1 minute or greater than 50 minutes for all other leaching beds (to ensure proper treatment by the soil) [*Clause 8.7.2.1.(1)(b)(i) & (ii)*]; and
- in or on an area that is subject to flooding that may be expected to cause damage to the leaching bed or impairing the operation of the leaching bed [*Clause 8.7.2.1.(1)(c)*].

The regulation goes on to state that:

- a leaching bed shall not be covered with any material having a hydraulic conductivity of less than 0.01 m/day [*Sentence 8.7.2.1.(2)*].

Hydraulic conductivity is a measure of the permeability of the soil. The covering material should be permeable to ensure some percolation from the ground surface, and evaporation through the leaching bed.

Article 8.7.2.1. of the Building Code further stipulates that:

- the surface of the leaching bed shall be shaped to shed water, and together with the side slopes of any raised portion, shall be protected against erosion in such a manner as to not inhibit the evaporation and transpiration of waters from the soil or leaching bed fill, and to not cause plugging of the distribution pipes [*Sentence 8.7.2.1.(3)*].
- no part of a leaching bed shall be sloped steeper than 1 unit vertically to 4 units horizontally [*Sentence 8.7.2.1.(4)*].
- the leaching bed shall be designed to be protected from compaction or any stress or pressure that may result in the impairment or destruction of any pipe in the leaching bed, or that may result in the smearing of the soil or leaching bed fill [*Sentence 8.7.2.1.(5)*].

QUESTIONS

Complete the following questions.

1. **What is the range of percolation time allowed for a shallow buried trench system?**

2. **Why do you think that the regulations stipulate that hydraulic conductivity of the covering material must not be less than 0.01 m/day?**

3. **During construction, how do you prevent the distribution pipes from settling?**

GROUP

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 5.7 CLEARANCE DISTANCES AND LOCATION OF THE LEACHING BED

Knowing the minimum clearance distances from the leaching bed to existing features either on the site, or on an adjacent property.

INSTRUCTIONS

Read Steps 1, 2, and 3; complete the questions at the end of Step 3; then do the group activity.

MINIMUM CLEARANCE TO WATER SOURCES

Step 1
Clearance Distances to a Source of Water

Knowing the different sources of water that are affected by a minimum clearance distance, and why the clearance distance is important.

In accordance with Article 8.2.1.4., distribution pipe must be at least 15 m away from any of the following (Figure 5.7.1):

- a well, that has a watertight casing to a depth of at least 6 m
- a spring, that is used only as a source of water that is not potable
- a lake, pond, reservoir, river, or stream

Distribution pipe must be at least 30 m from a well without a watertight casing to a depth of at least 6 m.

There are also issues of good practice to keep in mind. Although the Code stipulates acceptable minimum clearance distances, there are situations where greater distances are required to provide a safety margin to protect the environment or adjacent users. As Article 8.2.1.4. states,

If T-time is less than 10 minutes per centimetre, greater clearance distances are required unless it can be shown to be unnecessary.

For **example**, if a leaching bed will be installed near the shoreline of a sensitive lake, and the soil (which is over bedrock) consists of coarse sands with a T-time of 3 min/cm, it is expected that the

MINIMUM CLEARANCES TO LEACHING BEDS

Step 2
Clearance Distance to a Building or Other Structure

Knowing what affects clearance distances and why they are important.

Article 8.2.1.6. states that distribution piping must be at least 5 metres [Table 8.2.1.6.B] from any structure. This reduces the possibility of contamination of the basement by the leaching bed, or contamination of the footing drainage tile, which normally discharges to a storm sewer, sump pump, or nearby ditch.

MINIMUM CLEARANCES FOR RAISED LEACHING BEDS

For raised leaching beds, the 5 m clearance distance must be **increased by** twice the height that the leaching bed is raised above the ground between the bed and the structure.

MINIMUM DISTANCES TO LOT LINES

Step 3
Clearance Distances to Property Lines

Avoiding problems on adjacent property.

Distribution piping must be at least 3 m away from all property lines [*Sentence 8.2.1.6.(2)*]. In the case of a raised leaching bed, this distance must be increased by twice the height that the leaching bed is raised above the ground between the bed and the property line [*Sentence 8.7.4.2.(11)*].

The location and construction of a raised leaching bed should not cause any problems to neighbouring properties if Code clearances are followed. The leaching bed must be located wholly within the property to be serviced and within the OBC mandatory clearances; and as a matter of good practice, the bed should not block any natural surface swales or direct water onto any part of a neighbouring property. The Code states that surface drainage must be directed away from the leaching bed.

QUESTIONS

Complete the following questions.

1. **The percolation time for the soil beneath a proposed leaching bed is 25 min/cm. This bed can be located closer than**
   a) 15 metres from an uncased well
   b) 15 metres from a reservoir
   c) 1.5 metres from a property line
   d) All of the above

2. **What is the clearance distance of distribution piping to a structure? Why is it necessary?**

3. **Calculate the clearance distances for a leaching bed that has been raised 1.5 metres above the original grade, from**
   a) a structure
   b) a property line
   c) an uncased well
   d) a river

4. **Can one leaching bed service two adjoining properties located at separate lots?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Steps 4, 5, and 6 of Learning Task 5.7, following; complete the questions at the end of Step 6; then do the group activity.

Step 4
Clearance Distances to Bedrock and Soils with T-time Greater than 50 min/cm

Ensuring adequate percolation time for sanitary sewage treatment.

The Building Code [*Subclause 8.7.2.1.(1)(b)(ii)*] prohibits leaching beds in any soil with a percolation time exceeding 50 min/cm. Soils with percolation times of more than 50 min/cm are unacceptable for the construction of a conventional, in-ground, absorption-trench leaching bed. For shallow buried trench systems, however, the permissible T-time can be increased to 125 min/cm [*Subclause 8.7.2.1.(1)(b)(i)*.]. The bottom of the absorption trench in any part of the conventional leaching bed must be at least 90 cm above bedrock, high groundwater table, or soil with percolation times of more than 50 min/cm [*Clause 8.7.3.2.(1)(e)*].

If the effluent reaches a bedrock surface that is fissured and fractured, before it is completely treated, the effluent will flow through these fractures without adequate treatment. This could result in contamination of the groundwater. Therefore, you should be aware of these rock conditions and ensure that the leaching bed is not the cause of potential contamination, even if the minimum requirements of the OBC are being met.

If 900 mm of soil is not available on the property, a raised leaching bed is an option. However, if a raised bed cannot meet the

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increased clearances necessary, then the property may not be suitable for the installation of a standard Class 4 system. If these conditions are encountered, you should consider consulting a third-party designer to see if there is an alternative Class 4 design that will meet the Code.

Step 5
Clearance Distance to the High Groundwater Table

Knowing what affects the level of the groundwater.

The Building Code states that in all parts of the leaching bed, the bottom of the absorption trench must be at least 900 mm above the high groundwater table. The current groundwater table at any particular location is the upper level of the area of saturation at the time the site evaluation is done.

The groundwater table generally varies with the season: It may be higher in the spring than in the summer. Soils showing a mottled colouring are usually subject to changeable wet-and-dry conditions. Mottling is often an indicator of the high level of the groundwater table, which may be above the current water table. Thus, it is important to determine if the groundwater table is higher at another time of the year, by looking for this mottling.

Vegetation that is common to wet areas, such as bulrushes or cattails, may indicate a high groundwater table. The groundwater table generally follows variations in the topography; therefore, the water table is not always flat. During the site evaluation, any adjacent bodies of surface water should be assessed to determine if the elevation of the water in these bodies is actually the elevation of the groundwater table in adjacent land.

Step 6
Clearance Distance to Trees

Reducing the risk of damage to the leaching bed by trees.

Although the Code does not regulate clearance distances of leaching beds from trees on the property, there are rules of good practice that should be followed:

- Ensure that the leaching bed is free of trees and bushes, so that the bed area is well aerated and sunlight can reach the surface.
- It is recommended that trees be at least 3 m from the leaching bed; this is because tree roots will usually spread into an area where considerable liquid and nutrients are available, and could damage the distribution system or the distribution pipes.
- Trees with rapid growth, high water consumption, and root proliferation, such as willow, silver maple, and poplar, should not be located near the leaching bed.

LEARNING TASK 5.8 RAISED LEACHING BED SYSTEMS

Knowing when a raised leaching bed is required and the Building Code requirements related to the construction of a raised leaching bed.

INSTRUCTIONS

Read Steps 1 and 2; complete the questions at the end of Step 2; then do the group activity.

Step 1
The Raised Bed

Knowing the site conditions that determine the need for a raised bed.

A fill-based absorption trench leaching bed is generally used when the depth of acceptable soil is insufficient for the construction of an in-ground leaching bed. This occurs in soils

- having a percolation time of more than 50 min/cm or less than 1 min/cm,
- in areas of a high groundwater table; or
- in areas where bedrock is close to the surface.

In these cases, acceptable leaching bed fill may be imported to construct the bed, raising it above the existing ground level (Subsection 8.7.4.).

MAXIMUM DAILY LOADING RATE

Step 2
Leaching Bed Fill Materials and Clearance Distances

Knowing the requirements and regulations for raised bed construction.

Raised leaching bed fill consists of the mantle, imported fill that is placed over the area where the leaching bed will be constructed, and the absorption trenches. The mantle extends beyond the absorption trenches to allow for the effluent to seep laterally into the less permeable underlying soils without breakup to the surface.

For fill based absorption trenches and fill based water beds, the area covered by the leaching bed fill must not receive a daily loading rate of more than the maximum values set in Table 8.7.4.1. Division A, Article 1.4.1.2. of the Building Code defines a loading rate as:

the volume, in litres, of effluent per square metre applied in a single day to the soil or leaching bed fill.

Where the unsaturated soil has a T-Time greater than 15, any additional fill material used to build the mantle must have a percolation time of at least 75% of that of the unsaturated leaching bed soil. The absorption trenches will be placed in this leaching bed

The Code stipulates the requirements for the design and construction of a raised leaching bed [Sentence 8.7.4.2.(1)]:

- Except for shallow buried trenches, which are not to be constructed with fill material, the fill material used in construction of the fill based systems must have a percolation rate of not less than 1 min/cm and not more than 50 min/cm. The depth of the fill material covering the leaching bed area must not be less than 250 mm and must be extended to at least 15 m beyond the outer distribution pipes in any direction in which the effluent entering the soil will move horizontally [*Clauses 8.7.4.2.(1)(a) and (b)*].
- If the percolation time of the underlying soil exceeds 15 min/cm, the percolation time of the fill material or additional leaching bed fill in which the absorption trenches will be constructed may not be less than 75% of the percolation time of the underlying soil. For example, if the percolation time of the soil is 30 min/cm, then the leaching bed fill material should have a percolation time of not less than 75% times 30, which equals 22.5 min/cm. The reason is to avoid placing highly permeable fill material on top of a slowly permeable soil which may result in hydraulic under-sizing of the bed area. [*Sentence 8.7.4.2.(2)*].
- A leaching bed fill that does not meet the 75% rule may be used to form the leaching bed if the depth of this fill material from the bottom of the absorption trench to the native soil is not less than 900 mm. If this depth is less than 900 mm, the "T" time of the least permeable soil or leaching bed fill within the 900 mm from the bottom of the absorption trench should be used to calculate the length of the distribution pipe. [*Sentence 8.7.4.2.(3)]*.
- All leaching bed fill added shall be stabilized against erosion, and the sides of the raised bed shall be sloped to ensure stability, but may not be more than 1 unit vertically for every 4 units horizontally unless measures are taken to prevent erosion and in such case the side slopes could be 1 unit vertically for every 3 units horizontally. The site to which the leaching bed fill is added shall be generally clear of vegetation [*Sentences 8.7.4.2.(5), (6), and (9)*].
- When placing the leaching bed fill, it should be compacted in layers in such a manner as to avoid uneven settlement of the distribution pipes [*Sentence 8.7.4.2.(7)*].
- Any distribution boxes, header lines, absorption trenches, or distribution pipe shall be installed only after the proper compaction of the fill material has been completed [*Sentence 8.7.4.2.(8)*].

- The clearance distances shall be increased by twice the height that the leaching bed has been raised above the original grade [*Sentence 8.7.4.2.(11)*].

QUESTIONS

Complete the following questions.

1. **In which case from those listed below is a raised leaching bed considered?**
   a) When the bed is within 40 m of an uncased well?
   b) When the high groundwater table is less than 900 mm from the ground surface?
   c) When the T-time is 15 min/cm?

2. **What T time should be used to design the trenches for a fully raised leaching bed:**
   a) the percolation time of the raised leaching bed fill
   b) the underlying natural receiving soil

3. **What is the mantle, and what is its purpose in a raised leaching bed?**

4. **If the percolation time of the underlying soil is 30 min/cm, what should be the lowest percolation time of the leaching bed fill material?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 3 of Learning Task 5.8, following; complete the questions at the end of Step 3; then do the group activity.

BETTER BUILDING PRACTICES

**Step 3
Construction
Considerations**

While the following issues are not directly referred to in the Building Code, they are good standards of practice that are recommended in the design and installation of Class 4 systems.

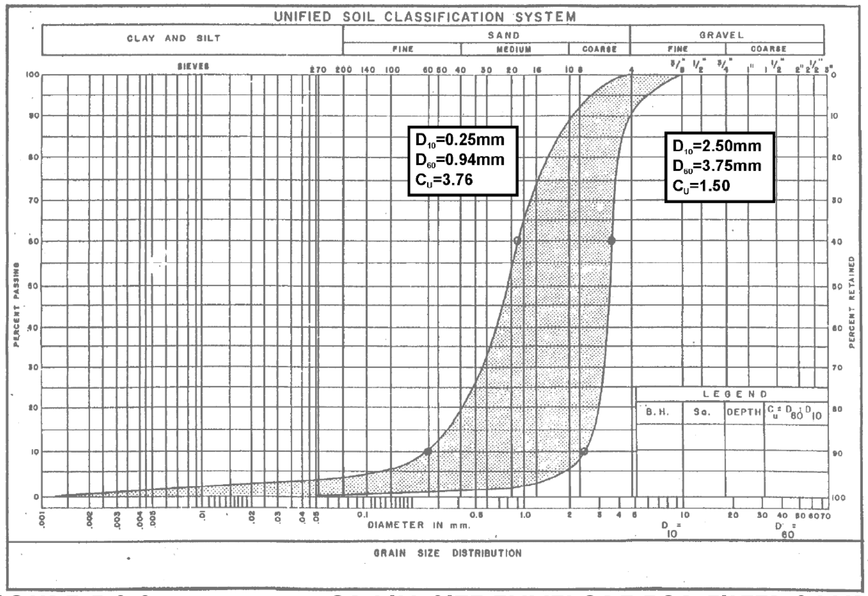

FIGURE 5.9.3. GRAIN-SIZE ENVELOPE FOR FILTER SAND

4. The stone layer at the surface of the filter media must be at least 900 mm above rock and the high groundwater table, or soil with a percolation time greater than 50 min/cm. The sand filter shall be unsaturated for its entire depth [*Sentence 8.7.5.3.(4)*].

5. The base of the sand filter shall extend horizontally a minimum thickness of 250 mm to cover an area meeting the requirements of the following formula:

$$A = \frac{QT}{850}$$

where

A = contact area in m² between the filter media and the underlying soil

Q = the total daily design sanitary sewage flow in litres

T = the lesser of 50 or the percolation time of the underlying soil [*Sentence 8.7.5.3.(6)*]

6. Filter beds must be between 10 m² and 50 m² in size. Where the total daily design sanitary sewage flow exceeds 3 000 L, more than one filter bed is required and these should be spaced so that they are separated by at least 5 m between the distribution pipes of the two filter beds. [*Sentences 8.7.5.2.(1) and 8.7.5.3.(4)*].

Where the total daily design sanitary sewage flow does not exceed 3 000 L, the surface area of the filter bed should be designed based on a loading rate that does not exceed 75 L/m^2 per day [*Sentence 8.7.5.2.(3)*]. Unless a Level II, III or IV treatment unit as described in Table 8.6.2.2. is used, in such case, the loading on the surface of the filter bed shall not exceed 100 L/m^2 [*Sentence 8.7.5.2.(5)*].

Where the total daily design flow exceeds 3 000 L, the surface area of the filter bed should be designed based on a loading rate that is such that the loading on the surface of the sand filter does not exceed 50 L/m^2 per day [*Clause 8.7.5.2.(4)(a)*]. Unless a Level II, III or IV treatment unit as described in Table 8.6.2.2. is used, in such case, the loading on the surface of the filter bed shall not exceed 100 L/m^2 [*Sentence 8.7.5.2.(5)*].

7. When the filter bed is raised, the imported fill shall cover an area that is calculated based on the loading rates given in Table 8.7.4.1.

QUESTIONS

Complete the following questions.

1. **Under what condition is a filter bed usually installed?**

2. **What is the main difference between a conventional absorption bed and a filter bed?**

3. **What is the total daily design sanitary sewage flow above which a treatment unit must be used with a filter bed system?**

4. **What does the following formula represent?**

$$\frac{QT}{850}$$

5. **What are the two main terms that the Building Code uses to define the size of sand filter material?**

5.2

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

Group

At the facilitator's discretion, you may now be called upon to watch a videotape and do an exercise together. Be prepared to discuss your group results with the rest of the class. Use the area below for notes.

STOP

LEARNING TASK 5.10 SHALLOW BURIED TRENCH SYSTEMS

Knowing what a shallow buried trench system is, when it can be used, and the Code requirements that affect the construction of a shallow buried trench system.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
Use Restrictions

Knowing the elements that affect the use of a shallow buried trench system.

The shallow buried trench system is a pressurized system and has the following characteristics:

- designed to receive an effluent quality, as indicated in Table 8.6.2.2.for a Level IV treatment unit;
- the effluent being discharged to the trench is <u>time-dosed</u>; and
- the percolation time of the soil receiving the pre-treated water is between 1 and 125 min/cm.

An important design feature of the system is that the pressure distribution pipes drain after each timed dose, so there is minimal chance of freezing. The system also requires a very small area compared to conventional systems.

QUESTIONS

Complete the following questions.

1. **A Type A dispersal bed receives effluent from what class of treatment unit?**

2. **What are the maximum concentrations of effluent permitted when a leaching bed is constructed as a Type A dispersal bed?**

3. **What is the main components of the Type A dispersal bed?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

INSTRUCTIONS

Read Step 2 of Learning Task 5.11, following; complete the questions at the end of Step 2; then do the group activity.

Step 2
Design and Construction

Knowing the components of the dispersal bed and their design requirements.

A Type A dispersal bed must be backfilled with leaching bed fill so as to ensure that, after the leaching bed fill settles, the surface of the leaching bed will not form any depressions.

The combined thickness of the sand layer and stone layer of a Type A dispersal bed must be not less than 500 mm. The sand layer must;

- be comprised of sand that has,
  - a percolation time of at least 6 and not more than 10 minutes, and,
  - not more than 5% fines passing through a 0.074 mm (no. 200) sieve,
- have a minimum thickness of 300 mm, and
- have an area that is not less than the lesser of,
  - the area of the stone layer determined in accordance with Sentence 8.7.7.1.(6) and,
  - the value determined by the formula,

$$A = \frac{QT}{850}$$

Where,

B = the following amount,

i) 50, if the total daily design sanitary sewage flow exceeds 3 000 litres, or

ii) 75, if the total daily design sanitary sewage flow does not exceed 3 000 litres, and

Q = the total daily design sanitary sewage flow in litres

1. The vertical separation requirements may be satisfied by using leaching bed fill with a percolation time not exceeding 15 minutes, provided the leaching bed fill conforms to the following requirements;

   - extend to at least 15 m beyond the perimeter of the treatment unit, or distribution pipes if utilized, in any direction that the effluent entering the soil will more horizontally and
   - have an area that is not less than the value determined by the formula,

$$A = \frac{QT}{400}$$

Where,

A = the area of contact in square metres between the base of the sand and the underlying soil, or leaching bed fill if utilized,

Q = the total daily design sanitary sewage flow in litres, and

T = the lesser of 50 and the percolation time of the underlying soil.

The stone layer must not be located closer than the minimum horizontal distances set out in Table 8.2.1.6.B. and these distances must be increased when required by Sentence 8.7.4.2.(11). The distances set out in Column 2 of Table 8.2.1.6.B must be increased by twice the height that the leaching bed is raised above the original grade.

- when an existing system is causing unsafe situation and the remediation of this unsafe condition by the installation of Class 4 system is impracticable
- when a sub-standard sewage system needs upgrading and the lot is not large enough to accomodate a Class 4 system
- when a property will eventually be serviced by municipal sewers, provided that the municipality ensures the continued operation of an approved waste haulage service until the municipal sewers are available

In all the above cases, a written agreement must exist with a licensed waste haulage operator for regular removal of the accumulated sanitary sewage from the tank.

QUESTIONS

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **What does a Class 5 sanitary sewage system consist of?**

2. **What must the municipality do if they approve the installation of a holding tank?**

3. **Site conditions are such that a Class 4 sanitary sewage system cannot be installed on a new property. The owner wants to construct a Class 5 sewage system. Would a Class 5 system be permitted under the Building Code in this situation?**

GROUP

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 6.2 DESIGN AND CONSTRUCTION

Knowing what impacts the design and construction of a holding tank.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

CLASS 5 SYSTEM DESIGN CRITERIA

Step 1
Criteria for Design and Construction

Knowing the requirements for the design and construction of a holding tank.

A holding tank must be designed to permit all solid matter that might settle to the bottom of the tank to be removed from the tank.

The holding tank must have

- a minimum 9 000 L working capacity [Sentence 8.2.2.4.(2)]; and
- In residential occupancies; a minimum 7-day holding capacity based on the total daily design sanitary sewage. [Sentence 8.8.2.2.(1)].

The working capacity of the tank must not include any portion of the tank that cannot be completely drained due to the manner in which connection to the tank is made.

When two or more tanks are connected to allow the sanitary sewage to flow between the tanks, they are considered, to be one tank [Sentence 8.2.2.3.(4)]

Construction of a Class 5 sewage system must conform to CSA B66, "Design, Material and Manufacturing Requirements for Pre-fabricated Septic Tanks and Sanitary Sewage Holding Tanks" (Article 8.2.2.2.), which states that:

- there must be an access opening on the tank, located to facilitate the pumping and servicing of the of all compartments of the tank [*Sentence 8.2.2.2.(5)*];
- when installed, the tank must not be covered by soil or fill having a greater depth than the maximum depth or burial that the tank is designed to withstand [*Sentence 8.2.2.2.(6)*]; and

LEARNING TASK 6.4 OPERATION AND MAINTENANCE

Step 1
General

Ensuring that sewage system is operated and maintained in accordance with the Code requirements

The Building Code has certain requirements within which a sewage system must be operated and maintained. These requirements are stipulated in Section 8.9 of the Code. These operation and maintenance requirements apply to all types of *sewage systems* new and existing.

In addition to the general operation and maintenance requirements that apply all *sewage systems*, the Code also provide specific requirements for each system based on its design and function.

General Requirements that apply to all systems stipulated in Article 8.9.1.2. requires that *sewage systems* be operated and maintained such that

- The system shall not emit, discharge or deposit *sanitary sewage* or *effluent* into the surface of the ground,
- The system shall not emit, discharge or deposit sewage or *effluent* from any part other than where the system is designed to do that. For example, *septic tank* cannot discharge *effluent* into the ground surface because it is a watertight vault in which sanitary sewage is collected for the purpose of separating the scum and solids from liquid (See defined terms 1.4.1.2.). The effluent from septic tank must be discharged to the leaching bed through the distribution pipe, therefore, a leak from a septic tank directly to the ground would be contravening the Code
- The system shall not emit, discharge or deposit sewage or *effluent* to a piped water supply, well water supply, water course, ground water or surface water except as the per the design of the system. For example, in Class 4 sewage system, *effluent* percolates from the *leaching bed* and eventually will arrive at the ground water after it is completely treated. This is a normal operation of the sewage system and is not considered violation of the Code requirements. However, if the system is placed directly on the ground water, the effluent will be discharging directly and causing pollution. This is not permitted under this section.

6

QUESTIONS

1. **To what class of sewage systems do the operation and maintenance requirements apply?**

2. **What are the general requirements under which all sewage systems should be operated and maintained?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 6.5 OPERATION

STEP 1
Operation

Ensuring that sewage system is operated in accordance with the Code requirements

- Subsection 8.9.2 addresses the operation requirements related to sewage systems. The article requires that every sewage system be operated in accordance with the basis on which the *construction* and use of the *sewage system* was approved or required under the Building Code Act or the predecessor legislation, as the case may be. The system must also be operated based on the requirements of the manufacturer of the *sewage system*.
- Article 8.9.2.3. addresses the particular requirements related to Class 4 *sewage systems*. The article requires that when a treatment unit is used in conjunction with the system, the owner of the system must obtain a literature that describes the unit in detail and provides complete instructions regarding the operation, servicing, and maintenance requirements of the unit to ensure the continued proper operation in accordance with the original design and specifications (Sentence 8.6.2.2.(6)).

The article also prohibits any person from operating a *treatment unit* other than a *septic tank* unless the person has entered into an agreement to service and maintain the *treatment unit* and its related components. Such an agreement must be with a person who is authorized by the manufacturer to service and maintain the treatment unit. This service provider has an obligation to notify the *Chief Building Official* if the agreement is terminated, or the access for service and maintenance of the *treatment unit* is denied by the person operating the *treatment unit*.

QUESTIONS

1. **What are the basis upon which a sewage system must be operated?**

2. **What are the conditions set up by the Code for a person who operates a treatment unit other than a septic tank?**

3. **The person servicing the treatment unit has to contact the Chief Building Official in certain circumstances. What are these circumstances and what is the Code reference?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

STEP 2

Some Class 4 sewage systems require annual sampling of effluent. These systems are shallow buried trench and Type A and Type B dispersal beds. Article 8.9.2.4. of the Building Code requires the operator of the treatment unit to arrange for a grab sample to be taken and analyzed for CBOD and suspended solids in light of the concentrations stipulated in Table 8.6.2.2. The results of these tests must be submitted to the *Chief Building Official*.

The grab sample results represent the concentrations of the contaminants at the time the sample was collected. It may not reflect the 30 days average as required by the table. Therefore Sentence 8.9.2.3.(3) of the Code provided some flexibility in this regard. If the results of the grab samples show that the CBOD and suspended solids concentrations do exceed 20 mg/l for both parameters, these results are deemed to be acceptable and meeting the concentration required in Table 8.6.2.2. However, if the concentration of the BOD or the suspended solids exceeded 20 mg/l, a resampling must occur.

The resampling has to take place within 6 months of the initial sampling and the results have to be re-submitted to the *Chief Building Official*.

A Class 5 sewage system also has specific operation requirements that are in addition to the general requirements shown in Article 8.9.2.2. Sentence 8.9.2.5.(1) requires that a Class 5 sewage system be operated only when there is an agreement with a service provider to ensure the disposal of sanitary sewage. In addition the operation/use of the holding tank must stop once it is filled with sanitary sewage until such time the sanitary sewage is pumped out (Sentence 8.9.2.5.(2))

QUESTIONS

1. **List the systems that require annual sampling of the effluent.**

2. **What are the parameters that should be checked?**

3. **What are the levels of contaminants that are deemed to be acceptable when grab samples are used?**

4. **What is the time frame within which a resampling must occur if the sample results exceed the acceptable concentration?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 6.6 MAINTENANCE

STEP 1
Maintenance

Ensuring that sewage system is maintained in accordance with the Code requirements

Article 8.9.3.2. of the Code requires that every *sewage system* be maintained so that the *construction* of the system remains in accordance with the approval of the system under the BCA or the previous legislation (for systems that precedes the applicability of the BCA. The system also must be maintained as per the requirements of the manufacturer of the system (this is of particular interest when a treatment unit is used in conjunction with the Class 4 system). The Code also requires that the land in the vicinity of a *sewage system* be maintained in a condition that will not cause damage to, or impair the functioning of, the *sewage system*.

The Code also requires that *septic tanks* and other *treatment units* be cleaned whenever sludge and scum occupy 1/3 of the *working capacity* of the tank. It is recommended that septic tank be pumped out every three to five years based on the use of the system. For pressurized systems the Code requires the pressure be measured at the furthest point from the pump in all distribution pipe and checked for compliance with Articles 8.7.6.1. and 8.7.6.2.

QUESTIONS

1. **What is the basis upon which a treatment unit should be maintained?**

2. **At what point must a septic tank and/or a treatment unit be pumped out ?**

3. **How often the pressure head of a pressurized system need to be checked for compliance?**

Group

Compare answers within your group. Write the group answers on the flipchart. Be prepared to discuss your group results with the rest of the class.

STOP

- the installer's certification number
- the location of the test pit
- a copy of any calculations

QUESTIONS

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **As an installer, what would you do if there was no building permit for the Class 4 sewage system that you had been asked to install? State the appropriate legal references.**

2. **When checking the plans and specifications for a system that an installer has been asked to install, what should the installer look for?**

3. **What should plans and specifications for the installation of a Class 4 system contain?**

Group

Compare your answers with those of the others in your group. Write the group answers on the flipchart. Please be prepared to discuss your group results with the rest of the class.

STOP

LEARNING TASK 7.2 MATERIALS

Using materials that meet government and industry standards.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
Septic Tanks and Holding Tanks

Installing a septic tank that has been designed to meet the required standard.

Under Sentence 8.2.2.2.(1), the Code requires that a septic tank in a Class 4 system, and a holding tank in a Class 5 system, must conform to the requirements of Canada Standards Association Standard B66. Tanks are usually prefabricated specifically for Class 4 and 5 systems.

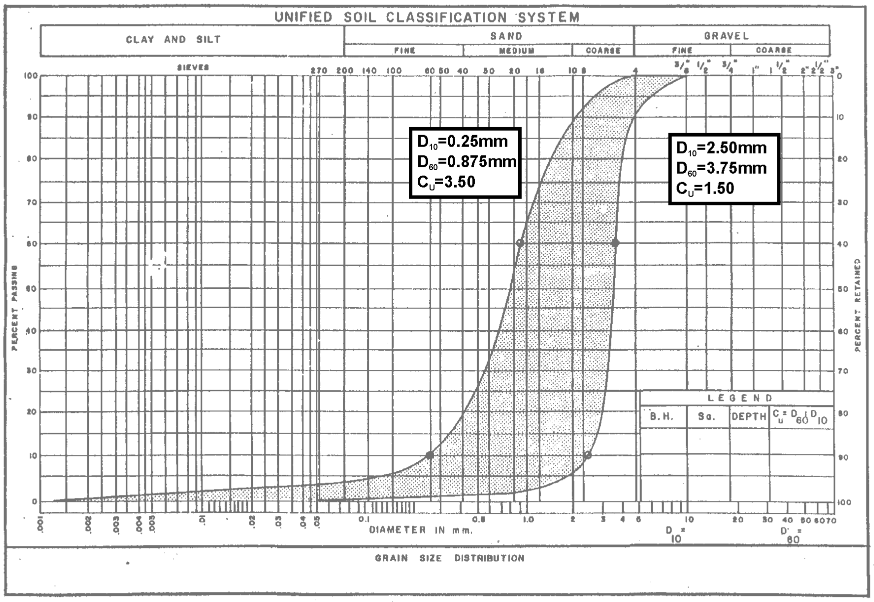

FIGURE 7.2.3 ACCEPTABLE SAND FILTER GRADATION ENVELOPE

QUESTIONS

Complete the questions below.

1. **What do you think is the purpose of placing stone below and immediately above the distribution pipes?**

2. **How do you prevent the fine material in the backfill from entering the stone around the distribution pipe?**

3. **When constructing a raised leaching bed, is it more preferable to use uniform fine sand or well graded medium sand? Why?**

4. **Why is it considered good practice to use the same sand materials for both the mantle and the leaching bed in raised beds?**

5. **Why is it good practice not to use soils with T-times of over 20 min/cm, even though they are allowed in the Building Code?**

7

LEARNING TASK 7.9 INSPECTION

Ensuring that the leaching bed has been installed in accordance with the Code requirements.

INSTRUCTIONS

Read Step 1; complete the questions at the end of Step 1; then do the group activity.

Step 1
Conditions for Inspection

Knowing the areas of the leaching bed that the inspector is required to check.

The sewage system inspector must inspect the leaching bed for a Class 4 system before it is put into service. The installer must be on-site during the inspection and fully co-operate with the inspector. Inspection of the leaching bed is necessary for verification that the sewage system has been installed according to the Building Code. Although the inspection allows spot-checking of the installation, it is the responsibility of the installer to ensure that the installation conforms to all of the regulations contained in the Code.

The leaching bed must be inspected and approved before the leaching bed is backfilled. Therefore:

- all distribution boxes and header pipes must be accessible, to be checked for level installation;
- the perforated distribution pipe in the leaching bed should be accessible in several areas of the bed, to check the grades of the pipes and the depth of the stone drainage layer; and
- the bottom end of the leaching bed should be left open to check the pipe elevations. The difference between the header and bottom-end elevations determines whether the distribution pipes have been installed at the appropriate grade (between 0.3% and 0.5%).

In addition, the inspector should inspect other components of the system, such as the treatment unit.

QUESTIONS

Complete the questions below.

1. **Name the items that should be left uncovered after installing a sewage system and before placing the backfill and topsoil.**

Because of the danger of the accumulated gases generated by the breakdown of organic materials in the sanitary sewage, entry to a septic tank should be avoided and if necessary, should be undertaken in strictly controlled circumstances and under the requirements of OHSA as stipulated in Ontario Regulation 635/05.

The regulation needs to be reviewed to determine whether an entry permit is required. When entry to the tank is necessary, the regulation requires that:

- the air within the confined space be tested prior to entry by a worker.
- the confined space be purged and ventilated to provide an atmosphere that does not endanger workers.
- when a worker is inside the tank, a second person must remain outside of the confined space at all times. If fumes overcome the worker inside the tank, the second worker should not enter the tank to attempt a rescue, unless he/she is wearing a self-contained breathing apparatus.

Step 5
Electrical Work

Taking precautions when working with on-site electricity.

The installer should be aware of electrical codes that may apply when working with electrical components, especially in association with water. The following precautions are recommended to prevent the dangers of shock hazards:

- All equipment must be properly grounded with a third wire.
- All hand tools must be double-insulated or properly grounded.
- Ground fault interrupters should be used on circuits with potential exposure to water.
- The worker must be aware of the location of electrical wires, to avoid cutting through the insulation of a live wire.
- Any wire should be handled as a live wire, unless it is positively known to be dead and it is impossible for it to become accidentally live.
- The worker must never work alone on energized equipment that operates at 440 volts.

Methane gas often forms in septic tanks through the breakdown of organic materials in the waste-water. Methane is colourless, odourless, and explosive in concentrations between 5% and 15%. For this reason, all electrical equipment installed in a confined or enclosed space should be explosion-proof in design. The installer/inspector should verify this with an electrical contractor.

MODULE 1 INITIAL SCREENING AND BACKGROUND

LEARNING TASK 1.1 THE BUILDING CODE

Step 1 Regulations

Step 2 Related Publications

Complete the questions below. As always, note the appropriate OBC reference wherever possible.

1. **What is the Ontario Building Code?**

The Building Code is an Ontario Regulation which provides minimum requirements for the safety of buildings with respect to public health, fire protection, structural sufficiency, and environmental integrity by applying uniform standards.

2. **Which of the following systems can accept both human waste and greywater waste?**

   a) a Class 3 system – 8.5.1.2.(2) From Class 1 8.3.1.2.(1) human body waste only

   b) a Class 5 system – 8.1.2.1.(1)(e) hauled sewage 1.4.1.2.(1) – sanitary sewage includes human body waste and grey water from fixtures.

   c) a Class 1 system – 8.3.1.2.(1) human body waste only

   d) a Class 2 system – 8.1.2.1.(1)(b) grey water only 8.4.1.2.(1)

   e) a Class 4 system

b) and e)

3. **How do Class 1, 2, and 3 systems differ from a Class 4 system in the way they dispose of waste?**

Classes 1, 2 and 3 do not have leaching beds, whereas a Class 4 does have a leaching beds.

2. **Who must sign the application for a building permit for an on-site sanitary sewage system?**
   a) the building inspector
   b) the sanitary sewage system designer
   c) the owner of the property
   d) the agent for the owner

(c) or (d)

3. **You are an agent for a property owner. The owner wants to build a two-bedroom cottage 100 m from the shore of a lake in Muskoka. There will be one complete three-piece bathroom, a double kitchen sink, a washing machine, and a single laundry tub. A Class 4 sewage system constructed as absorption trench system is proposed. On the application form provided (Figure 1.2.1), identify all of the items that you will have to complete in order to have the application considered for a building permit.**

See application form in manual.

LEARNING TASK 1.3 RESPONSIBILITIES

Step 1 Property Owners
Step 2 Installers
Step 3 Inspectors

Indicate your answers to the multiple-choice questions below.

1. **Whose responsibility is it to provide for the design of a Class 4 sewage system?**

The property owner, or the agent of the property owner (installer/designer)

2. **Which of the following people are not permitted to design a Class 4 system?**
   a) the inspector
   b) the owner
   c) the installer
   d) a consultant

a) the inspector

4. **What is the purpose (scope of application) outlined in the following Parts of the Building Code ?**
   - **Part 1 of Division A**
   - **Part 1 of Division C**
   - **Part 8 of Division B**
   - **Part 10 of Division B**
   - **Part 11 of Division B**
   - Part 1 of Division A, Compliance and General (Including Definitions)
   - Part 1 of Division C, Administrative Provisions
   - Part 8 of Division B, Minimum Design Construction and Maintenance Operations for Sewage Systems
   - Part 10 of Division B, Change of Use
   - Part 11 of Division B, Renovations

LEARNING TASK 1.2 THE BUILDING PERMIT

Step 1 Permit Requirements

Step 2 Submission of an Application

Complete the questions below.

1. **When must a building permit for an on-site sewage system be obtained?**
   Provide the appropriate legal references.
   a) before the system can be put into use
   b) after the system is installed, but before the final cover is put over the leaching bed
   c) before installation of a new system on a lot Section 8 of the BCA
   d) before doing a material repair or alteration of an existing system BCA 8(1) and 1(1) construct.

(c) and (d): 8(1) and definition of "construct" in the BCA

Step 4 The Septic Tank
Step 5 Leaching Bed Types

Complete the questions below.

1. **What is the minimum size of a septic tank, in litres?**

The greater of 3 600 L or twice the total daily design flow for residential (three times the total daily design sanitary sewage flow, for non-residential). Sentence 8.2.2.3.(1)

2. **When should you not design an in-ground absorption trench system?**

When there is **a high ground water table** or the soils are **impermeable (>50 min/cm T-time**), or **too permeable (<1 min/cm T-time**). **Clauses 8.7.3.2.(1)(e), 8.7.3.2.(2)(e)** and **8.7.2.1**.

3. **What is the difference between the fill used in the construction of a raised leaching bed and the sand used in the filter bed?**

The filter bed system requires sand of a specific grain size Sentence 8.7.5.3.(3). While the fill material has no specific gradation but has to have percolation time between 1 min and 50 min/cm, Sentence 8.7.2.1.(1).

4. **What are the systems that require pressurized distribution?**

A shallow Buried Trench Sentence 8.7.6.1.(2).

Type B Dispersal Bed Sentence 8.7.8.2.(4).

MODULE 2 SITE EVALUATION

LEARNING TASK 2.1 GENERAL SITE CONDITIONS

Step 1 General Site Evaluation

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **The maximum slope of the area upon which a leaching bed can be built is**

   a) a 20% slope

   b) a slope of 2 vertical units to 1 horizontal unit

   c) a 10% slope

   d) a slope of 1 vertical unit to 4 horizontal units

   d) a slope of 1 vertical unit to 4 horizontal units Clause 8.7.2.1.(1)(a) for all leaching beds except for Type B dispersal bed where the maximum slope should not exceed 1 vertical to 7 horizontal

2. **Drainage around a leaching bed should be**

   a) directed toward the bed to help flush the sanitary sewage into the ground

   b) directed away from the bed

   b) directed away from the bed
   Sentence 8.7.2.1.(3)

3. **The site being evaluated has a natural slope to the land of 12%. To install a conventional leaching bed, the best construction practice may involve:**

   a) grading (cutting) into the ground to level the leaching bed area.

   b) adding fill to even out and provide a level leaching bed area.

   c) a combination of the above

   d) none of the above

   a) grading (cutting) into the ground to level the leaching bed area.

3. **Using the blank grain size chart provided, plot the following "grain size percentages passing" onto the chart, and classify the soil according to the Unified Soil Classification System.**
   - 100% passing the 3/4 inch sieve size
   - 90% passing the #4 sieve
   - 55% passing the #20 sieve
   - 40% passing the #30 sieve
   - 0% passing the #200 sieve

See attached chart. The Unified Soil Classification System is SP, a poorly graded and gravelly sand.

Step 5 Soil Moisture and Groundwater

Complete the questions below.

1. **What is the driving force that moves water through saturated soils, and what does the movement depend upon?**

Gravity, depending on the number, size, and configuration of pore spaces.

2. **What is the driving force behind the flow of water in unsaturated soil?**

Suction or capillary action.

3. **A highly permeable soil indicates that the soil mass has**
   a) large grain size particles
   b) small pore spaces between large particles
   c) large interconnected pore spaces between small particles
   d) large interconnected pore spaces between large particles

d) large interconnected pore spaces between large particles

Step 6 Treatment of Effluent in the Soil

Complete the questions below.

1. **Describe how effluent is naturally treated in a leaching bed.**

As the effluent moves out of the distribution pipes into the gravel bed and then into the underlying unsaturated soil, micro-organisms living in the soil and contained in the effluent effectively treat the effluent.

LEARNING TASK 2.4 FINAL ASSESSMENT OF SITE EVALUATION

Answer the question below.

1. **What is the importance of the final assessment of the site evaluation?**

You will know whether the proposed system is suitable for the site. It will also help to determine if a proposed system may or may not be accommodated on a particular site.

MODULE 3 SEWAGE SYSTEMS: CHARACTERISTICS AND DESIGN FLOWS

LEARNING TASK 3.1 GENERAL CONDITIONS FOR SANITARY SEWAGE SYSTEMS

Step 1 Location, Alteration and Discharge Conditions

Complete the questions below. *Allow **5 minutes**.* As always, note the appropriate OBC reference wherever possible.

1. **If I have a single system designed to serve myself and also my neighbour on a separate lot, and we meet all of the regulations about system design, can I expect to get a building permit for an on-site sanitary sewage system?**

No, because the system cannot be shared between two properties, and must be completely contained within one lot. Clause 1.1.3.2.(1)(h)

2. **What must be done to wastewater from an industrial establishment to make it acceptable for discharge into a leaching bed?**

It must be treated to the levels found in domestic sanitary sewage (see Figure 3.3.1, Sentence 8.1.3.1.(3)

3. **You can connect a downpipe from a roof eave into the inlet pipe to the septic tank**

   a) if you use properly sized piping

   b) if the annual average precipitation in the area is below a specified amount

   c) if the septic tank size is enlarged to take the extra liquid

   d) you cannot connect it. Sentence 8.1.3.1.(7)

d) you cannot connect it. Sentence 8.1.3.1.(7)

Step 2 Operation
Step 3 Maintenance

Complete the questions below.

1. **When is a sewage system considered to be unsafe?**

When sanitary sewage or effluent seeps or discharges to the surface of the ground. Article 8.9.1.2.

If the system is not maintained or not operated in accordance with the BCA or the regulations. BCA. s 15.(2.1) & Article 8.9.3.2.

2. **Why is it important for the manufacturer of a treatment to supply the purchaser with appropriate documentation?**

To educate the homeowner about the factors affecting the operation and maintenance of the treatment unit so the homeowner can operate the unit within the parameters set out by the manufacturer to avoid the unit malfunction and achieve the required performance.

3. **How is grease prevented from entering the leaching bed?**

By a properly installed grease interceptor which is maintained so that the amount of grease retained in the interceptor is in accordance with CAN/CSA-B481.4 standard and for a restaurant the sewage system has been designed in acordance with good engineering practice, Sentences 8.9.3.3.(1) and 8.1.3.1.(4) & (8).

LEARNING TASK 3.2 CHARACTERISTICS OF SANITARY SEWAGE

Step 1 Types of Sanitary Sewage

Step 2 Domestic and Institutional Sanitary Sewage

Complete the questions below.

1. **Name two classifications of sanitary sewage.**

1. of industrial or commercial origin Division A, Article 1.4.1..2.
2. of domestic origin

2. **What makes up the greatest part of sanitary sewage?**

Water.

3. **Give four examples of a non-residential source of sanitary sewage.**

A school, church, nursing home, or medical clinic.

Step 3 Commercial and Industrial Sanitary Sewage

Complete the questions below. As always, provide OBC references where applicable.

1. **Why is it important to assess commercial and industrial sources very carefully?**

The industrial and commercial wastes must be assessed carefully to determine the appropriate method to treat the waste to the domestic level before this waste can be directed to a sewage system.

2. **Name two commercial enterprises that can cause problems to a septic system.**

A laundromat, a bakery, dairy operations.

3. **When are industrial process waste waters allowed into a sewage system?**

When the waste is treated to the levels of contaminates found in domestic sanitary sewage, and when the treatment unit and the sewage system are designed for this purpose. Sentence 8.1.3.1.(3)

LEARNING TASK 3.3. SANITARY SEWAGE SYSTEM DESIGN FLOWS

Step 1 Sizing Sanitary Sewage Systems

Complete the questions below.

1. **What are the most critical aspects in sizing a sanitary sewage system?**

Determining the total daily design sanitary sewage flow and the capacity of the soil to accept the sanitary sewage.

2. **How do you obtain the total daily design sanitary sewage flows?**

From Table 8.2.1.3.A or 8.2.1.3.B of the Code and making the calculation as required, or from Sentence 8.2.1.3.(4) for non-listed occupancies.

3. **When might you consider the use of a balancing tank?**

When there are significant daily differences in the sanitary sewage flows. Sentences 8.2.1.3.(1) and (2). See also "Appendix "A".

Step 2 Sanitary Sewage Flows for Residential Occupancies

Complete the questions below.

1. **What is a fixture unit?**

The unit of measure based on the rate of discharge, time of operation and frequency of use of a fixture that expresses the hydraulic load that is imposed by that fixture on the drainage system. Divison A, Article 1.4.1.2..

2. **How do you calculate the daily design sanitary sewage flow for a residential occupancy?**

From Table 8.2.1.3.A.

3. **Calculate the daily design sanitary sewage flow for a four-bedroom dwelling, 205 m² in area.**

From Table 8.2.1.3.A, the flow is 2 000 + 100 = 2 100 litres per day.

4. **Calculate the daily design sanitary sewage flow for a 30-room motel.**

From Table 8.2.1.3.A, the flow is 250 × 30 = 7 500 L/d.

LEARNING TASK 4.3 CLASS 3 SEWAGE SYSTEMS (CESSPOOLS)

Step 1 Use of a Class 3 System

Step 2 Construction of Class 3 Systems

Complete the questions below.

1. **Class 3 systems usually have a very short time of efficiently operating because:**
   a) the sewage can quickly clog the soil surrounding the system
   b) the cesspool chamber fills up quickly
   c) greywater from kitchen use fills the system quickly
   d) none of the above, because Class 3 systems usually last a long time

   a) the sewage can quickly clog the soil surrounding the system

2. **What can go into a Class 3 system?**

Sanitary sewage from a Class 1 system. Sentence 8.5.1.2.(2)

3. **What would you do if the daily (design) flow exceeded 1000 L/day?**

Not use a Class 3 system. **Sentence 8.5.1.2.(1)**

4. **When do you need a lockable access cover?**

When the cesspool extends to ground surface. Sentence 8.5.2.1.(5)

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MODULE 5 CLASS 4 SEWAGE SYSTEMS

LEARNING TASK 5.1 GENERAL REQUIREMENTS FOR A CLASS 4 (LEACHING BED) SYSTEM

Step 1 Class 4 Treatment and Disposal Systems

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **How does a shallow buried trench system of disposal differ from a conventional in-ground system?**

The shallow trench system is a pressurized system, and the effluent quality is controlled. Table 8.6.2.2.; Sentences 8.7.6.1.(1) and (2). It is the only system that can be installed in soils with percolation time that exceeds 50 min/cm up to 125 min/cm.

2. **Name two things that a filter in a septic tank can accomplish.**
    - Captures more suspended solids than a tank without one.
    - Prevents solids from getting into the leaching bed.

3. **Name three conditions governing when you would use a raised leaching bed.**
    - When the T-times are greater than 50 min/cm or less than 1 min/cm.
    - When bedrock is within 900 mm of surface.
    - When the high groundwater table is within 900 mm of the ground surface.

4. **How does a Level II treatment unit differ from a Level IV treatment unit?**

A Level IV contains less suspended solids and lower concentrations of $CBOD_5$ Table 8.6.2.2.

Step 4 Effluent Characteristics

Complete the following questions.

1. **Will the effluent coming from a septic tank and a septic tank with a filter be of the same quality or of a different quality? Give a reason for your answer.**

A different quality, because the filter allows for the retention of more solids in the septic tank, thus it will be clearer than effluent from a septic tank without an effluent filter.

In what units are maximum effluent concentrations measured?

Milligrams per litre (mg/L), 30-day averages. Table 8.6.2.2.

2. **What should you know about $CBOD_5$, and suspended solids?**

Their concentrations. Note that the lower the numbers, the better the effluent quality Article 1.1.4.2.

3. **How should septic tank filters be sized and installed?**

To filter particles 1.6 mm and have a minimum flow area of 550 cm^2. Sentence 8.6.2.1.(2)

LEARNING TASK 5.3 GENERAL INFORMATION ON LEACHING BEDS

Step 1 Treatment of Sanitary Sewage

Complete the following questions.

1. **What happens in the biomass layer?**

Bacteria in the biomass feed on the effluent, effecting treatment.

2. **Where is the biomat formed?**

At the soil–effluent interface, which is basically at the bottom of the trench

3. **What happens to the effluent when it percolates down into the soil?**

Bacterial action in the soil pores (voids) takes place where aerobic bacteria feed on the contaminants in the effluent providing the final treatment of the effluent.

4. **Why are clearance and minimum distances important in this treatment?**

They allow enough time for the effluent to be in contact with soil particles so adequate treatment can take place before effluent reaches water sources.

5. **What type of bacteria in soil feed on the contaminant in the effluent, and what do they need to perform this function?**

Aerobic bacteria feeds on the contaminants in the effluent and need oxygen to survive.

Step 2 Inspecting and Evaluating the Leaching Bed Site

Complete the following questions.

1. **How do the soil characteristics affect the area of the leaching bed?**

For the same effluent volume and quality, fine grained soils would require a larger area than those required by course grained soils because they are slower in the absorption of the effluent.

2. **How might you slow down the percolation time in coarse-grained soils?**

By adding finer-grained soils to the coarse-grained soils.

3. **Why are fine-grained soils not necessarily good soils for the construction of leaching beds?**

They resist percolation because of their small pore spaces, and therefore, require a larger area to affect treatment without breakouts.

4. **What percolation time will provide the best treatment of sewage in the soil?**

Between 10 and 20 min/cm.

Step 3 Subsurface Absorption of Effluent

Complete the following questions.

1. **What does mushy ground or surface breakout of sewage tell you about the leaching bed? What might cause these conditions?**

It indicates that the absorption of the effluent into soil is impaired which may have been caused by any of the following:

- Bad design or poor construction practice
- Malfunction of the treatment unit that caused excessive biomat formation on the soil surface

2. **Mounding of the groundwater table beneath a leaching bed may cause**

   a) the effluent from the leaching bed reaches the groundwater without adequate treatment

   b) an increase in the natural treatment by allowing the effluent to be mixed with water, thus diluting the sanitary sewage impact on the groundwater

   c) the effluent to move laterally instead of downward

   d) flooding of the soil/ effluent interface, thus removing oxygen from the soil and inhibiting natural treatment

(c) and (d)

LEARNING TASK 5.4 DISTRIBUTION OF SANITARY SEWAGE EFFLUENT TO THE LEACHING BED

Step 1 Distribution System

Step 2 Gravity, Dosed and Pressurized Systems

Complete the following questions.

1. **What are the distribution system components of a Class 4 System, and what are their purpose?**

1. Piping that connects the septic tank to a distribution box or a header.
2. A pumping system to dose the bed.
3. Distribution box or headers to split the flow.
4. Lines of the distribution pipes.

3. **Name two requirements for the absorption trenches that are the same for conventional/raised leaching beds as for shallow buried trench systems.**

The trenches must be approximately the same length and not more than 30 m in length and must be at least 90 cm above the high groundwater table. Sentences 8.7.3.2.(1) and (2)

LEARNING TASK 5.7 CLEARANCE DISTANCES AND LOCATION OF THE LEACHING BED

Step 1 Clearance Distance to a Source of Water
Step 2 Clearance Distance to a Building or Other Structure
Step 3 Clearance Distances to Property Lines

Complete the following questions.

1. **The percolation time for the soil beneath a proposed leaching bed is 25 min/cm. This bed can be located closer than**

   a) 15 metres from an uncased well

   b) 15 metres from a reservoir

   c) 1.5 metres from a property line

   d) All of the above

(b) Table 8.2.1.6.B

2. **What is the clearance distance of distribution piping to a structure? Why is it necessary?**

5 m. It is necessary to reduce the possibility of contamination of basements or footing drainage tiles. Table 8.2.1.6.B

3. **Calculate the clearance distances for a leaching bed that has been raised 1.5 metres above the original grade, from**

   a) a structure

   b) a property line

   c) an uncased well

   d) a river

   a) a structure, 5 m + (2 × 1.5) = 8 m

   b) a property line, 3 m + (2 × 1.5) = 6 m

   c) an uncased well, 30 m + (2 × 1.5) = 33 m

   d) a river, 15 m + (2 × 1.5) = 18 m
   Sentence 8.7.4.2.(11)

4. **Can one leaching bed service two adjoining properties located at separate lots?**

No. The leaching bed must be located wholly within the property to be serviced. Div. A., Article 1.4.1.2.

Step 4 Clearances Distances to Bedrock and Soils with T-Time Greater than 50 min/cm

Step 5 Clearance Distance to a High Groundwater Table

Step 6 Clearance Distance to Trees

Complete the following questions.

1. **When should you advise an owner to approach a third-party designer?**

When the site conditions are complicated because of unacceptable soil conditions and/or small lot measurements.

2. **Describe three conditions where a 900 mm clearance distance is necessary.**

If the bottom of the leaching bed trenches are less than 900 mm from

- the high groundwater table
- the bedrock surface
- soils with a percolation time of more than 50 min/cm Clause 8.7.3.2.(1)(e)

3. **What condition in the soil indicates that the natural groundwater table has changed?**

Mottled colour of the soil above the current groundwater level, caused by oxidation.

4. **Where the surface contours of a property vary from high to low, the groundwater table depth is expected to:**

a) remain at a constant depth

b) be closer to the surface at the high contours as opposed to the low contours

c) vary with the ground elevations

d) to always be on surface where there are topographic low points on the property

c) vary with the ground elevations

5. **What types of vegetation might indicate a high groundwater table?**

Bulrushes and cattails.

6. **What types of vegetation should not be located adjacent to a leaching bed?**

Trees with rapid growth, high water consumption, and root proliferation, such as willow, silver maple, and poplar, as well as other vegetation having extensive root systems.

LEARNING TASK 5.8 RAISED LEACHING BED SYSTEMS
Step 1 The Raised Bed
Step 2 Leaching Bed Fill Materials and Clearance Distances

Complete the following questions.

1. **In which case from those listed below is a raised leaching bed considered?**
   a) When the bed is within 40 m of an uncased well?
   b) When the high groundwater table is less than 900 mm from the ground surface?
   c) When the T-time is 15 min/cm?

b) Clause 8.7.3.2.(1)(e)

2. **What T time should be used to design the trenches for a fully raised leaching bed:**
   a) the percolation time of the raised leaching bed fill
   b) the underlying natural receiving soil

a) Subclause 8.7.2.1.(1)(b)(ii)

3. **What is the mantle, and what is its purpose in a raised leaching bed?**

The mantle is the fill that is placed beyond the trenches. Its purpose is to allow additional area for the effluent to be absorbed into the less permeable underlying soils without breakout to the surface.

4. **If the percolation time of the underlying soil is 30 min/cm, what should be the lowest percolation time of the leaching bed fill material?**

The T-time should be 75% of the mantle percolation time, or 0.75 × 30 = 22.5 min/cm. Sentence 8.7.4.2.(2)

LEARNING TASK 5.10 SHALLOW BURIED TRENCH SYSTEMS

Step 1 Use Restrictions

Complete the following questions.

1. **Under what conditions should a shallow buried trench system be considered?**

While the system could be used in soils with percolation time between 1 and 125 min/cm, typically the system is considered in slowly permeable soil. Clause 8.7.2.1.(1)(b)(ii)

2. **A shallow buried trench system is the only system that can be used when:**
   a) the treatment unit has been designed to produce a Level IV effluent.
   b) the percolation time of the soil is between 1 minute and 125 minutes per centimetre.
   c) the wastewater being discharged is fed by gravity to the distribution pipes.

(b) Sentence 8.7.2.1.(1)

Step 2 Operation of the System

Complete the following questions.

1. **Why would biomat formation be reduced using a shallow buried Why would biomat formation be reduced using a shallow buried trench system?**

Because the effluent from the treatment unit used in conjunction with this system contains fewer elements that form the biomat.

2. **Why do you think that the Code requires that the orifices of the distribution pipe be spaced equally along its length?**

To allow for an even distribution of the waste-water along the trench. Sentence 8.7.3.3.(4)

3. **What is the purpose of the timer on the pump in a pressurized system?**

To switch the pump on and off at specified times so that the effluent discharged to the trench will not saturate the receiving soil.

4. **What is the minimum pressure head required on a shallow buried trench system?**

600 mm, to the most distant point from the pump. Sentence 8.7.6.2.(2)

Step 3 Construction

Complete the following questions.

1. **What is the advantage of pressure distribution of effluent?**

Pressure distribution ensures that effluent is evenly distributed over the entire leaching bed area.

2. **Why can the piping in a shallow buried trench system be less than in a conventional leaching bed?**

Because the effluent is highly treated and there is no biomat formed; therefore, the soil can accept more effluent compared to septic tank effluent.

LEARNING TASK 5.11 TYPE A DISPERSAL BEDS

Step 1 Use Restrictions

Complete the following questions.

1. **A Type A dispersal bed receives effluent from what class of treatment unit?**

Class IV treatment unit

2. **What are the maximum concentrations of effluent permitted when a leaching bed is constructed as a Type A dispersal bed?**

A unit that is used in conjunction with a Type A dispersal bed must be designed such that effluent does not exceed the maximum concentrations of 10 mg/L for suspended solids and 10 $CBOD_5$ mg/L. both based on a 30 day average.

3. **What is the main components of the Type A dispersal bed?**

- A treatment unit
- A gravel layer
- A sand layer

Step 2 Design and Construction

Complete the following questions.

1. **What is the minimum thickness of the sand layer and stone layer of a Type A dispersal bed?**

Minimum thickness of the sand layer is 300 mm

Minimum thickness of the stone layer is 200 mm

2. **The stone layer is required to be what shape and how is it to be positioned?**

The stone layer should be rectangular in shape and installed perpendicular to the slope

3. **What is the formula to determine the area of the sand layer when the underlying soil has a percolation time of more than 15 minutes?**

QT/400

LEARNING TASK 5.12 TYPE B DISPERSAL BEDS

Step 1 Use Restrictions

Complete the following questions.

1. **A Type B dispersal bed receives effluent from what type of treatment unit?**

Level IV treatment unit as described in Table 8.6.2.2. of Division B.

2. **What are the maximum concentrations of effluent permitted when a leaching bed is constructed as a Type B dispersal bed?**

10 mg/L Suspended Solids, and 10 mg/L CBOD

3. **List the components of a Type B dispersal bed.**

1) A Class IV treatment unit.

2) A pressurized distribution system.

3) A stone bed.

Step 2 Design and Construction

Complete the following questions.

1. **What is the minimum thickness of the stone layer of a Type B dispersal bed?**

The stone layer must have the following depth:

not less than 250 mm below the distribution pipe, and

not less than 50 mm above the distribution pipe.

2. **Where the underlying soil has a percolation time of 20 minutes, what is the minimum area of a Type B dispersal bed if the total daily design flow is 1 600 L?**

A= QT/400 = 1 600 x 20/400 = 80 m^2

3. ***What shape is required by the Code for a Type B dispersal bed and how should the bed be installed with respect to the site slope?***

Type B dispersal beds must be rectangular in shape with a width that is calculated and must not exceed 4 m. The bed must be installed perpendicular to the site slope.

4. **List some of the differences between Type A and Type B dispersal beds.**

Type B requires pressure distribution; Type A does not

Type B has a maximum bed width; Type A does not

Type B cannot be installed in a slope that exceeds 15% while Type A can be installed in slopes up to 25%

5. **What is the advantage of using pressure distribution and what advantages are there to imposing a maximum width of the bed?**

1) Pressure distribution ensures even application of the effluent over the entire bed area and avoids localized overloading which negatively impact the treatment.

2) Limiting the width of the bed results in expanding the length of the trench perpendicular to the slope, hence taking advantage of a larger area and minimizing the potential of breakout of effluent.

MODULE 6 CLASS 5 SEWAGE SYSTEMS

LEARNING TASK 6.1 CLASS 5 SANITARY SEWAGE SYSTEM (HOLDING TANK)

Step 1 Class 5 Systems

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **What does a Class 5 sanitary sewage system consist of?**

A holding tank designed, sized, and positioned to accept sanitary sewage. Clause 8.1.2.1.(1)(e)

2. **What must the municipality do if they approve the installation of a holding tank?**

The municipality must undertake to ensure the continued operations of the system by way of a contract between the property owner and a licensed hauler to regularly pump out the sewage. Clause 8.8.1.2.(1)(e) and Sentence 8.8.1.2.(2).

3. **Site conditions are such that a Class 4 sanitary sewage system cannot be installed on a new property. The owner wants to construct a Class 5 sewage system. Would a Class 5 system be permitted under the Building Code in this situation?**

No, because the installation of a Class 5 sewage system is prohibited except in certain conditions listed in the Code. This case does not meet any of those conditions. Sentences 8.8.1.1.(1) and 8.8.1.2.(1)

LEARNING TASK 6.2 DESIGN AND CONSTRUCTION

Step 1 Criteria for Design and Construction

Complete the questions below.

1. **Why must there be access to the inside of the tank?**

To enable sanitary sewage to be pumped from the tank, and to service the components. Sentence 8.2.2.2.(5)

2. **If the tank is to be installed in an area with a high groundwater table, what special precautions must be taken?**

The tank must be secured (i.e. anchored) against the hydrostatic pressures. Sentence 8.2.2.2.(7)

LEARNING TASK 6.3 INSTALLATION OF THE HOLDING TANK
Step 1 Location of the Holding Tank
Step 2 General Requirements

Complete the questions below.

1. **What must happen when a holding tank is almost full?**

An audible alarm and a light must come on to warn the occupants of the dwelling that they must call the hauler to pump the tank out. Sentence 8.8.2.1.(1)

2. **Name three things that you must take into consideration when determining the elevation of the float switch of the alarm for a Class 5 sewage system.**
   - The total daily design sanitary sewage flow, Clause 8.8.2.1.(2)(a)
   - The location of the tank, Clause 8.8.2.1.(2)(b)
   - The response time of the hauler, Clause 8.8.2.1.(2)(c)

3. **Should an inspector approve the following system? A holding tank is sited on a property with the following clearances:**
   - **10 m from an uncased water supply well**
   - **7 m from the house**
   - **5 m from the property line, and**
   - **35 m from a natural spring source.**

No, since it is located too close to the uncased water supply well. **Table 8.2.1.6.C**

LEARNING TASK 6.4 OPERATION AND MAINTENANCE
Step 1 General

1. **To what class of sewage systems do the operation and maintenance requirements apply?**

The operation and maintenance requirements apply to all classes of sewage systems, Sentence 8.9.1.1.(1)

2. **What are the general requirements under which all sewage systems should be operated and maintained?**

The sewage system shall not emit or discharge effluent onto the surface of the ground, a piped water supply, a well water supply, a watercourse, ground water, or surface water.

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LEARNING TASK 6.5 OPERATION
Step 1 Operation

1. **What are the basis upon which a sewage system must be operated?**

Every sewage system must be operated in accordance with the basis on which the construction and use of the system was approved or required under the Act or predecessor legislation, and with the requirements of the manufacturer of the sewage system. Sentence 8.9.2.2.(1).

2. **What are the conditions set up by the Code for a person who operates a treatment unit other than a septic tank?**

This person must enter into an agreement with an authorized person to service and maintain the treatment unit and its related components. Sentence 8.9.2.3. (2).

3. **The person servicing the treatment unit has to contact the Chief Building Official in certain circumstances. What are these circumstances and what is the Code reference?**

The person operating the treatment unit shall notify the Chief Building Official if the agreement is terminated or if the access for service and maintenance of the treatment unit is denied. Sentence 8.9.2.3.(3).

Step 2 Sampling

1. **List the systems that require annual sampling of the effluent.**

Shallow buried trench

Type A dispersal bed

Type B dispersal bed

2. **What are the parameters that should be checked?**

$CBOD_5$ and suspended solids

3. **What are the levels of contaminants that are deemed to be acceptable when grab samples are used?**

20 mg/l $CBOD_5$,

20 mg/l suspended solids

4. **What is the time frame within which a resampling must occur if the sample results exceed the acceptable concentration?**

Resampling the effluent must be carried out within 6 months after the previous sampling has been completed.

LEARNING TASK 6.6 MAINTENANCE
Step 1 Maintenance

1. **What is the basis upon which a treatment unit should be maintained?**

The sewage system shall be maintained in accordance with the basis on which the system was approved, and the requirements of the manufacturer of the sewage system

2. **At what point must a septic tank and/or a treatment unit be pumped out ?**

Septic tanks and other treatment units shall be cleaned whenever sludge and scum occupy one-third of the working capacity of the tank.

3. **How often the pressure head of a pressurized system need to be checked for compliance?**

At least every 36 months.

MODULE 7 CONSTRUCTION

LEARNING TASK 7.1 PLANS AND SPECIFICATIONS
Step 1 The Building Code Regulations

Complete the questions below. As always, note the appropriate Code reference wherever possible.

1. **As an installer, what would you do if there was no building permit for the Class 4 sewage system that you had been asked to install? State the appropriate legal references.**

Do not proceed without a permit. Building Code Act 8.(1)

2. **When checking the plans and specifications for a system that an installer has been asked to install, what should the installer look for?**

The installer should look to ensure that a building permit is being issued and that the drawings and specifications comply with the Building Code requirements pertaining to on-site sewage systems.

3. **What should plans and specifications for the installation of a Class 4 system contain?**

They should contain sufficient detail to allow the installer to locate the components of the system on the lot, to know their relative elevations, and list the materials to be used in the installation.

LEARNING TASK 7.2 MATERIALS

Step 1 Septic Tanks and Holding Tanks

Complete the questions below.

1. **What is common between a Class 4 septic tank and a Class 5 holding tank?**

They must both conform to the requirements of Standard CAN3-B66 of the Canada Standards Association. Sentence 8.2.2.2.(1)

2. **State one reason why a septic tank could be damaged after it is put into the ground. How can damage be avoided?**

If it is placed too deep, soil pressures could damage the tank. The damage can be avoided by not installing the tank deeper than recommended by the manufacturer Also, the tank should be placed so as not to be subjected to an uplifting pressure. Sentences 8.2.2.2.(6) and 8.2.2.2.(7)

Step 2 Piping

Complete the question below.

1. **State two reasons why polyethylene is often used for piping in a pressurized system.**
   - It is flexible and can be easily rolled into place
   - These long rolls require few fittings; the fewer the fittings, the less chance of a failure when the system is under pressure.

LEARNING TASK 7.6 CONVENTIONAL LEACHING BED INSTALLATION

Step 1 Stripping and Pre-Grading

Complete the questions below.

1. **What do you do when you strip a site?**

You remove the topsoil.

2. **Why is it a good idea to pregrade the site of a conventional leaching bed to an elevation some 300–400 mm below the finished grade?**

To permit the placement of backfill and topsoil, so as not to create too high a mound on the site.

Step 2 Trenching and Piping

Complete the questions below.

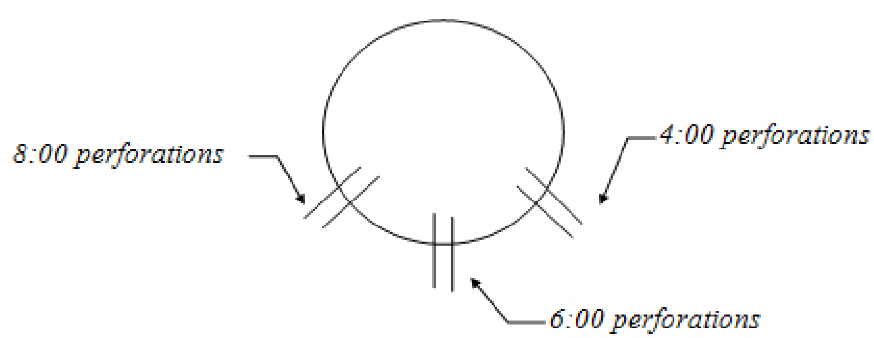
1. **What is placed below and on top of the distribution pipes?**

Septic stone Conforming to Sentence 8.7.3.3.(5).

2. **If you smear the sidewall of a trench during excavation, what should you do?**

Rough it up (i.e., scarify it) with the teeth of the backhoe, to try and remove the smeared soil.

3. **In a simple drawing show what is meant by having the perforations of the distribution piping at 4, 6, and 8 o'clock when the pipe is laid in the trench.**



5. **At 5 o'clock in the afternoon, when you have just finished placing the backfill over the leaching bed, it starts to rain very lightly. Should you**
   a) finish for the day and allow the rain to saturate the bed overnight
   b) cover the bed with plastic or tarps to help protect the bed from the rain
   c) spend the extra time in the light rain to spread the topsoil layer
   d) stop work because the Occupational Health and Safety Act prohibits using equipment in the rain

   c) spend the extra time in the light rain to spread the topsoil layer

6. **What might be the purpose of shaping a swale (a channeled depression) around the finished leaching bed?**

To divert surface drainage away from the finished bed.

LEARNING TASK 7.7 LEACHING BED FILL CONSTRUCTION
Step 1 General Conditions, Stripping and Pre-Grading

Complete the questions below.

1. **What might happen if you did not remove the topsoil beneath a raised leaching bed?**

The organic material in the topsoil may form a clogging layer that will impede the natural treatment processes.

2. **What is the reason for excavating the area under the raised leaching bed to a depth of about 25 cm?**

This depression will allow for maximum infiltration of the effluent into the underlaying soils.

Step 2 Sub-grade Preparation

Complete the questions below.

1. **What is the next task in the construction of a raised leaching bed, after you have removed the topsoil and dug a slight depression?**

Scarify the subgrade to a depth of about 150 mm.

- topsoil and backfill Sentences 8.7.2.1.(2) and (3)
- permeable geo-textile or unsaturated building paper Clauses 8.7.3.3.(2)(a) & (b)
- 50 mm of stone Clause 8.7.3.3.(5)(d)
- the distribution pipe Clause 8.7.3.3.(1)(a)
- 150 mm of stone Clause 8.7.3.3.(5)(c)
- minimum of 750 mm of filter sand Sentence 8.7.5.3.(3)
- soil or leaching bed fill Clauses 8.7.2.1.(1)(b)(ii), 8.7.4.2.(1)(a),(b) and Sentence 8.7.4.2.(2)

3. **Why should the final grade of the filter bed be at a slightly higher elevation than the surrounding ground?**

To divert surface runoff away from the bed.

LEARNING TASK 7.9 INSPECTION

Step 1 Conditions for Inspection

Complete the questions below.

1. **Name the items that should be left uncovered after installing a sewage system and before placing the backfill and topsoil.**
    - Distribution boxes and header pipes
    - Perforated distribution pipes
    - Bottom end of the leaching bed

2. **Who is ultimately responsible for the proper installation of the sewage system, the installer or the inspector?**

The installer.

3. **Aside from over-capacity of the hydraulic capability of the soil, what is another cause of liquid sanitary sewage ponding on the ground surface?**

A distribution pipe or a header pipe may have been damaged due to settlement or frost action.

4. **When investigating a sanitary sewage breakout, what is one of the first things you might do?**

Dig up the distribution piping in several areas of the bed, to determine whether the entire leaching bed is saturated or just a localized area.

Step 4 Groundwater and Surface Water Contamination

Complete the questions following.

1. **State three possible ways that a groundwater contamination plume can be formed beneath a leaching bed.**
   - Mounding of the groundwater table into the leaching bed
   - Bed installed in soils with a T-time of less than 1 min/cm
   - Bed installed less than 90 cm from the high groundwater table

2. **What constitutes evidence of a contaminated groundwater plume?**

Such contamination becomes evident when it contaminates a water supply well or affects surface water quality.

3. **In groundwater or surface water, what parameters should you test for, to indicate groundwater pollution?**

Nitrates, bacteria, and phosphates.

4. **What does an excessive growth of aquatic vegetation in a lake suggest to you?**

The water of the lake is receiving waste-water high in phosphorous and nitrates. One source of phosphorous and nitrates is leaking sewage systems around a lake.

1. **What is one of the first things to do if you suspect a hydraulic overload to a leaching bed? Why would you do this?**

Assess the total volume of water being discharged to the sewage system. You would do this to see if additional water, such as that from leaking faucets, stormwater, or other sources, is entering the system and causing the overload.

2. **What is the name of the formation that may cause soil clogging?**

Biomat

3. **What is the most natural way to unclog the soil pores of a malfunctioning leaching bed?**

To take the bed out of service for a few weeks, months, or longer, and allow the bed to receive oxygen and naturally break down the clogging (biomat).

4. **What, in many instances, is the cause of hydraulic overloading of a leaching bed? What must be done to fix it?**

The system was under sized. The system has to be either extended or removed and replaced.

Step 4 Groundwater Contamination

Complete the questions below.

1. **What is the biggest cause of contamination of the groundwater by a leaching bed?**

Installing the leaching bed too close to the high groundwater table.

2. **What is the best solution to groundwater contamination from leaching beds?**

Prevention of contamination is best, by installing the bed properly.