Block D: Sewage Treatment Systems

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Plumbing Apprenticeship Program Level 4

SkilledTradesBC

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Competency D1: Install Sewage Treatment Systems and Components

Learning Task 1

Describe Private Sewage Disposal Systems

The handling of human waste has evolved from depositing it on the ground, where it would decompose naturally and be inoffensive due to the absence of population density, to sending it through piping systems to a municipal plant for proper treatment and disposal. History has proven that many of the plagues and diseases that have followed humankind's quest to develop urban areas have been associated with our inability to properly treat and dispose of human waste. This section will concentrate of the description of current sewage treatment systems for residential use in rural areas, with a focus on requirements specific to British Columbia.

Learning Objectives

After completing this learning task, you will be able to:

- Describe the purpose and operation of a residential Type 1 sewage treatment system
- Identify the components found in a residential Type 1 sewage treatment system
- Describe factors affecting the installation of sewage treatment systems

Key Terms

- **AP**: authorized person
- **ASTTBC**: Applied Science Technologists and Technicians of British Columbia
- **ROWP**: registered onsite wastewater practitioner
- **SSR**: Sewerage System Regulation within the *Public Health Act*
- **SPM**: Sewerage System Standard Practice Manual, Version 3
- **BOD** or **BOD_5**: 5-day biochemical oxygen demand
- **TSS**: total suspended solids

There will be other definitions encountered within the text, and the initialisms for them will be provided and used thereafter for brevity.

What is a Private Sewage Disposal System?

A **sewage treatment system** (also referred to within the context of this learning guide as a “sewage disposal system,” “septic system,” or “sewerage system”) is the system of pipes, pumps, tanks, and other equipment used for the collection, transport, and disposal of residential wastewater (sewage).

The **BC Sewerage System Regulation (SSR)** defines a sewerage system as “a system for treating domestic sewage that uses one or more treatment methods and a discharge area but does not include a holding tank or a privy.”

A **holding tank** is defined by BC Interior Health as “a large container that is used to collect and temporarily store sewage from a home or building. The sewage is removed and transported to an approved location for disposal.” Holding tanks are large cement or plastic tanks into which household wastewater flows and is stored until it is pumped out. These tanks are used in place of a septic system due to factors such as:

- restrictive soil conditions and percolation rates
- insufficient field area
- proximity to property boundaries, water tables and wells

According to the BC Sewage Disposal Regulation, a **privy** means “a small building having a bench with a hole or holes through which human excretion may be evacuated into a waterproof vault or into an excavated pit.” Simply stated, it’s an outhouse.

As defined by the SSR, a sewerage system has two components:

- one or more treatment method(s)
- a discharge area

Both components of the sewerage system play a role in treating the sewage but are addressed in different ways in the SSR and therefore, in this learning guide.

The Sewerage System Regulation (SSR) (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/22_326_2004) and Sewerage System Standard Practice Manual, Version 3 (SPM) [PDF] (https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/spmv3-24september2014.pdf) are both available online to download at no cost to the user. You are encouraged to access these publications if you wish to have a more detailed description of the summary information presented in this learning guide.

Who Can Install Septic Systems?

Prior to June 1, 2005, a proposed septic system required a permit which could be obtained from a local BC Health Unit. The permit package went so far as to also include sizing criteria and on-site design parameters for concrete septic tanks and disposal fields; in other words, the “whole how-to.” The permit holder was typically the homeowner, who could choose to do all, some, or none of the work themselves. Plumbers or contractors with a backhoe and dump truck were most often the homeowners' choice for carrying out the installation, and they needed no prior experience or training to do this work. After the system was installed, but before it was backfilled, an inspection by a representative from the local health authority (health inspector) was required. Once the installation was acceptable to the inspector, who also logged and archived the associated paperwork with the Ministry of Health, the system was backfilled, put into operation, and subsequently ignored or forgotten until such time that a problem arose.

Since the stroke of midnight May 31, 2005, installations in British Columbia have fallen under the jurisdiction of the Sewerage System Regulation (SSR) which was legally adopted under the *Public Health Act*. The regulation sets out rules for the planning, installation, and maintenance of onsite sewage systems. Collaboration between BC's Ministry of Health, the **Applied Science Technologist and Technicians of BC (ASTTBC)**, independent contractors and industry stakeholders resulted in the development of the Sewerage System Standard Practice Manual, Version 3 (SPM), which is considered by most to be the "code" for septic systems in British Columbia. Within the SSR and SPM, only an **authorized person (AP)** is allowed to plan, install, and maintain onsite wastewater treatment systems, and they must also file the necessary documentation with the Ministry of Health within 30 days from completion of the installation. As well, the owner of the system must designate an AP to provide the required maintenance of the system.

According to the SSR and SPM, an AP means either a **registered onsite wastewater practitioner (ROWP)** or a professional. Sections 7 (1), (2), and (3) of the SSR spell out in detail the training and background requirements that ROWPs and professionals must meet. The summaries of these sections are:

- an ROWP is certified by the ASSTBC, usually by taking requisite courses of training delivered by accredited trainers
- a professional typically means an engineer accredited by APEGBC (Association of Professional Engineers and Geoscientists of BC)

Further to this, there are three designations of ROWP:

- Planner, responsible for site and soil evaluation and planning of systems
- Installer, responsible for installation of systems
- Maintenance Provider, responsible for maintenance of systems

A fourth designation that is accredited by the ASTTBC, but not addressed in the SSR or SPM is:

- Private Inspector (PI), responsible for the assessment of existing systems, typically to support real estate transactions or building permit applications.

This endorsement is split into two categories:

- Private Inspector Residential (PIR), and
- Private Inspector Commercial (PIC)

Section 6 (1) of the SSR does have an exception wherein a homeowner can do the work of installing a Type 1 or 2 system, but only if being supervised by an AP.

Purpose of the SSR

The primary purpose of the "new" regulations was to protect the public interests by treating sewage to an acceptable level of quality by the time it reaches the "limiting layer" (an aquifer or bedrock). The standards developed for the SPM are based on the effluent being treated to, at minimum, "recreational water quality" at the limiting layer. This is meant to be water that is not considered potable but could be used for swimming or bathing. Secondary to that was the goal to have an installation that, with proper attention paid to maintenance should operate as intended for a minimum of 35 years1. As well, the legislation took the onus of the certification and acceptance of properly installed systems from the shoulders of the local Authority Having Jurisdiction (i.e., the local Ministry of Health officer) and set it squarely upon the shoulders of the AP. Health inspectors no longer visit installation sites unless requested or if problems are encountered.

Bacteria at Work

Sewage is broken down and rendered harmless because of the actions of certain bacteria present within the system. These are anaerobic and aerobic bacteria, and they are associated with the primary and secondary treatment areas of a Type 1 system.

Anaerobic Bacteria

Anaerobic bacteria are present in the septic tank. They operate in environments where it is moist, dark and there is little or no oxygen. They are smaller and less efficient in breaking down the waste than aerobic bacteria, but they are more resilient and can withstand larger changes in their environment. They help in the partial decomposition of the solids and sludge within the tank. The sludge layer is made up of both biodegradable and non-biodegradable solids and so the anaerobic bacteria cannot completely break it down. For this reason, septic tanks must be sized to allow an accumulation of sludge before being pumped at intervals as stipulated by the SPM and SSR (covered later in this learning guide). The bacterial digestion in a septic tank, called "septicization" or "putrefaction," is an anaerobic process.

Aerobic Bacteria

Because there is little to no free oxygen within the tank of a Type 1 system, aerobic bacteria that work best to break down sewage can't survive there. They do, however, thrive in the dispersal field, where the oxygen content in porous soils of properly constructed systems allow these bacteria to complete the process of rendering the effluent harmless by the time it reaches the limiting layer of bedrock or an aquifer. The process whereby aerobic bacteria break down effluent is called "oxidation."

Treatment Methods

The treatment method is the treatment system that precedes the dispersal area. Typically, this consists of a septic tank (Type 1) or a package treatment plant (Type 2 or 3), and is defined in the SSR as:

- *Type 1*: Treatment by a septic tank and dispersal field only.
- *Type 2*: Treatment that produces an effluent consistently containing less than 45 mg/L of TSS and having a BOD_5 of less than 45 mg/L.
- *Type 3*: Treatment that produces an effluent consistently containing less than 10 mg/L of TSS and having:
    - A BOD_5 of less than 10 mg/L.
    - A median fecal coliform density of less than 400 Colony Forming Units per 100 mL.

Prior to the implementation of the SSR and SPM, there were no quantifying terms used to indicate the strength of sewage. Today, sewage strength is indicated by the term **BOD or BOD_5**, which stands for "5-day biochemical oxygen demand." This is the standard for referencing sewage strength and represents the total amount of oxygen, in mg/L, used by microorganisms in decomposing one litre of organic matter in a 5-day period. A higher BOD number means more oxygen is required and indicates water of a lower quality. The lower the BOD, the higher the water quality.

The term "median fecal coliform density," used above in defining Type 3 treatment methods, is another basic chemistry yardstick for determining the biological quality in a water supply, and its explanation or description is unnecessary for the purpose of this learning guide, as we will primarily concentrate on Type 1 systems.

As well, the scope of the SSR covers:

- Systems that process sewage flow of less than 22 700 litres (4 989 imperial gallons) per day
- Single-family dwellings or duplexes
- A combination of sewage systems that addresses different buildings on a single parcel of land
- Structures that serve one or more parcels on strata lots or on a shared interest of land.

The SPM standards are intended to be simple and easy to apply. In general, standards are focused on providing simplest, lowest cost solutions first, which are considered to be Type 1 treatment methods discharging to:

- Gravity distribution systems
- Pressure distribution systems, and
- BC zero discharge lagoons, evapotranspiration (ET) beds and evapotranspiration absorption (ETA) beds (all are limited to application in certain parts of the province)

Small flow, residential systems are considered the main priority of the SPM. The SPM standards are focused on the majority of systems and sites, and do not prioritize the “what if” or “one of” situations that may arise. Larger wastewater systems are addressed by the Ministry of Environment and Climate Change Strategy through the Municipal Wastewater Regulation under the *Environmental Management Act* and will be covered later in this learning guide.

Dispersal Area

Dispersal areas are defined in the SSR as “areas used to receive effluent discharged from a treatment method.” They are responsible for treatment for the wastewater as it travels through the soil column to the base of the vertical separation, known as the “limiting layer,” considered to be either an aquifer or layer of bedrock. The standards of the SPM were developed in recognition of soil-based treatment and aim to achieve the recreational water quality objectives at the base of the vertical separation, while accounting for the long-term acceptance rates of the soil. It is because of these factors the SPM provides differing dispersal area standards for different treatment methods, soil types, and dispersal methods. The SPM refers to the following five methods of distributing Type 1 effluent to the dispersal area:

- Gravity distribution, either:
    - Trickle gravity, or
    - Dosed gravity
- Uniform distribution, meaning either:
    - Pressure distribution
    - Subsurface Drip Dispersal (SDD), or
    - Alternate methods of uniform distribution, provided that they meet the standards set out in the SPM

Choosing an appropriate dispersal method is a complex undertaking and must take into account many factors such as sewage strength, useable land area, installation cost, and equipment availability, but in all likelihood the most difficult factor to deal with is a soil analysis. Therefore, this learning guide will focus on providing broad explanations behind these factors without delving too deeply into their detailed aspects. In-depth study of these factors for certification purposes is the intent of the various courses of training for becoming an AP. Those wishing to explore that route should access the BCOSSA (BC Onsite Sewerage Association) website (https://www.bcossa.com/).

Self-Test 1

Self-Test 1

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://opentextbc.ca/plumbing4d/?p=5#h5p-1 (https://opentextbc.ca/plumbing4d/?p=5#h5p-1)

Type 1 Septic Systems

A conventional Type 1 septic system consists of a septic tank, distribution box, and dispersal field. This has long been the standard system in use for rural residential settings. We'll look at each of the three components separately.

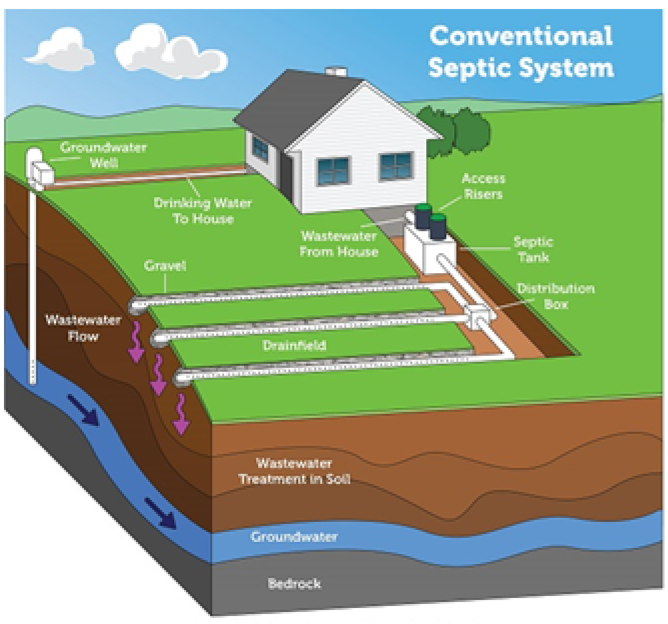

Figure 1. Conventional Type 1 system

The Septic Tank

Septic tanks are the primary treatment component of a Type 1 sewage treatment system. Septic tanks can be rectangular or round and are constructed of steel (for temporary use), reinforced concrete or plastic, with concrete being the material of choice due to its robust design and longevity. Most concrete tanks will likely outlast the house if properly constructed and installed. All septic tanks must conform to CAN/CSA-B66-00 “Prefabricated Septic Tanks and Sewage Holding Tanks,” as set out by the Canadian Standards Association.

Raw sewage from the house sanitary building sewer enters the tank through the inlet baffle. The baffle can either be built into the tank’s inner wall or can simply be a sanitary “T” fitting with the lower outlet extending vertically downward for a short distance. The inlet baffle’s job is to provide “quiescent” flow. This is described as slow-moving flow that doesn’t promote the movement of eddies or liquid currents which could carry solids across the tank toward the compartment’s outlet. The quiescent flow allows the raw sewage to separate into three “layers”:

- Solids, including seeds, peels and other hard-to-digest particles that settle to the tank bottom to form a layer known as “sludge.” Sludge is meant to accumulate and be stored in the tank until pumped out.
- Fats, soaps and oils float on the surface of the liquid to form a layer known as “scum.” Scum forms an insulating barrier above the effluent and, like the sludge, is meant to not leave the tank until being pumped out.
- The wastewater (“effluent”) layer between the scum and sludge leaves the tank through gravity piping or pumping and is directed into the dispersal system.

An outlet baffle, usually a tee, is specified by the SPM at the outlet of each compartment. The lower vertical pipe of the tee extends down into the clearest effluent, preventing floating matter and solids from leaving the compartment. It extends far enough to allow an accumulation of sludge over the intended time between pump-outs. The baffle at the outlet of the final compartment (before the effluent flows to the dispersal system) is fitted with a filter that prevents larger undigested particles from leaving the primary treatment device and passing into the secondary treatment area.

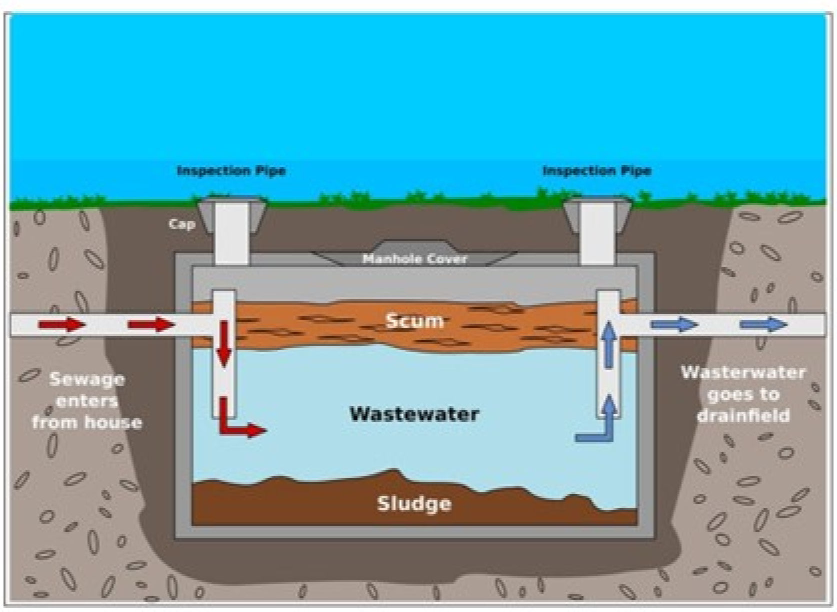

Figure 2. Single compartment tank

Depending on the sizing requirements and dispersal method used, there may be a second compartment or second tank in a Type 1 system. Two tanks allow for better separation of sludge and scum but if sized correctly, a single tank may be used.

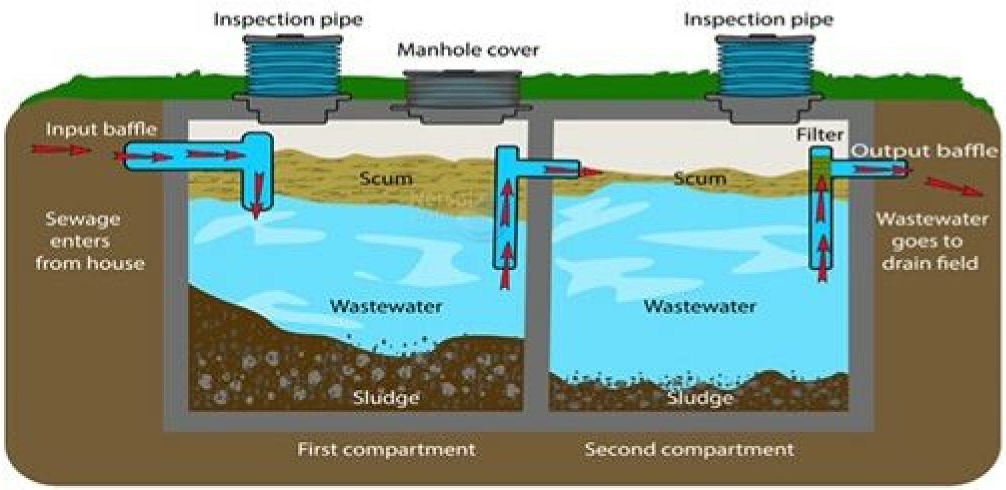

Figure 3. Two-compartment tank

A second compartment or “dosing” tank can also be found in systems where dosing is desired. Dosing is the term given to the process of flooding the disposal field with a high flow rate discharge. Either a siphon or a pump is used to quickly evacuate the dosing tank and utilize the entire dispersal system, rather than just the first few metres of it that a “trickle” system would employ. In a trickle system, effluent leaves the tank at the same rate that raw sewage enters. Most Type 1 systems are of the trickle variety.

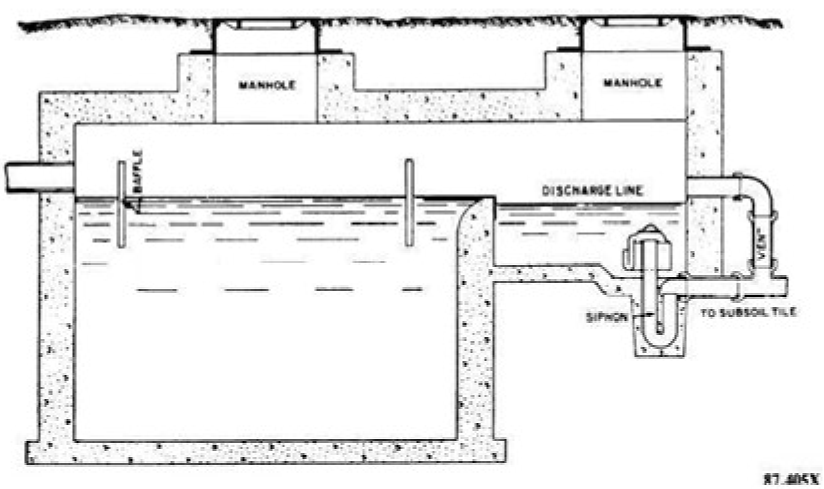

Figure 4. Septic tank with siphon chamber

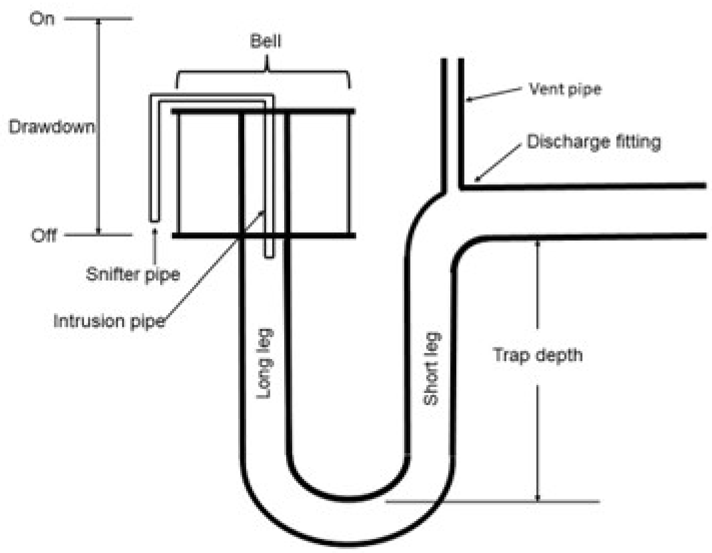

Figure 5. Siphon

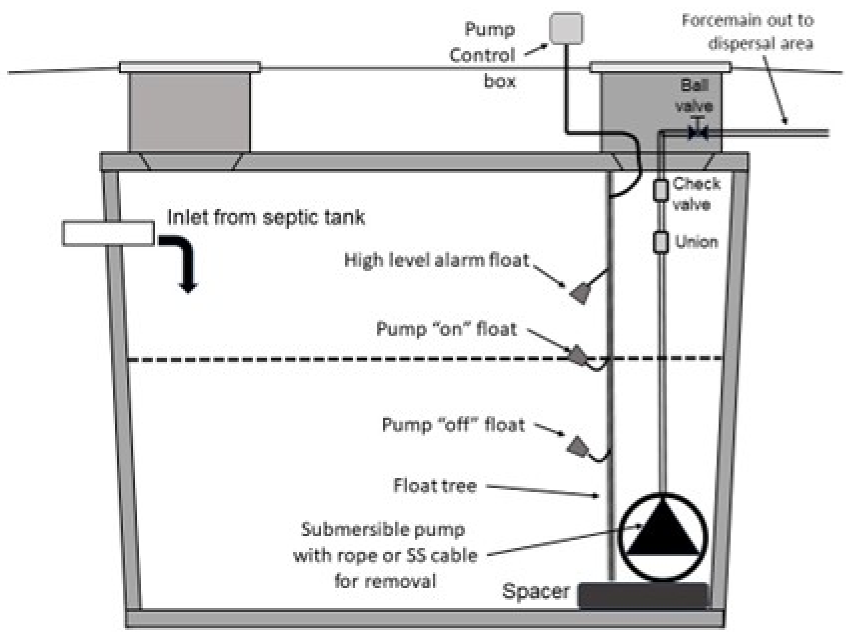

Figure 6. Dosing tank using pump

Package Sewage Treatment Plants

Package sewage treatment plants, also known as aerobic treatment units (ATUs), use many of the same processes as a municipal sewage plant, but on a smaller scale. An aerobic system injects oxygen into the treatment tank through an air pump. The additional oxygen increases natural bacterial activity within the system that then provides additional treatment for nutrients in the effluent, normally taking it to a Type 2 level. Some aerobic systems may also have a pre-treatment ("trash") tank and a final treatment tank including disinfection to further reduce pathogen levels.

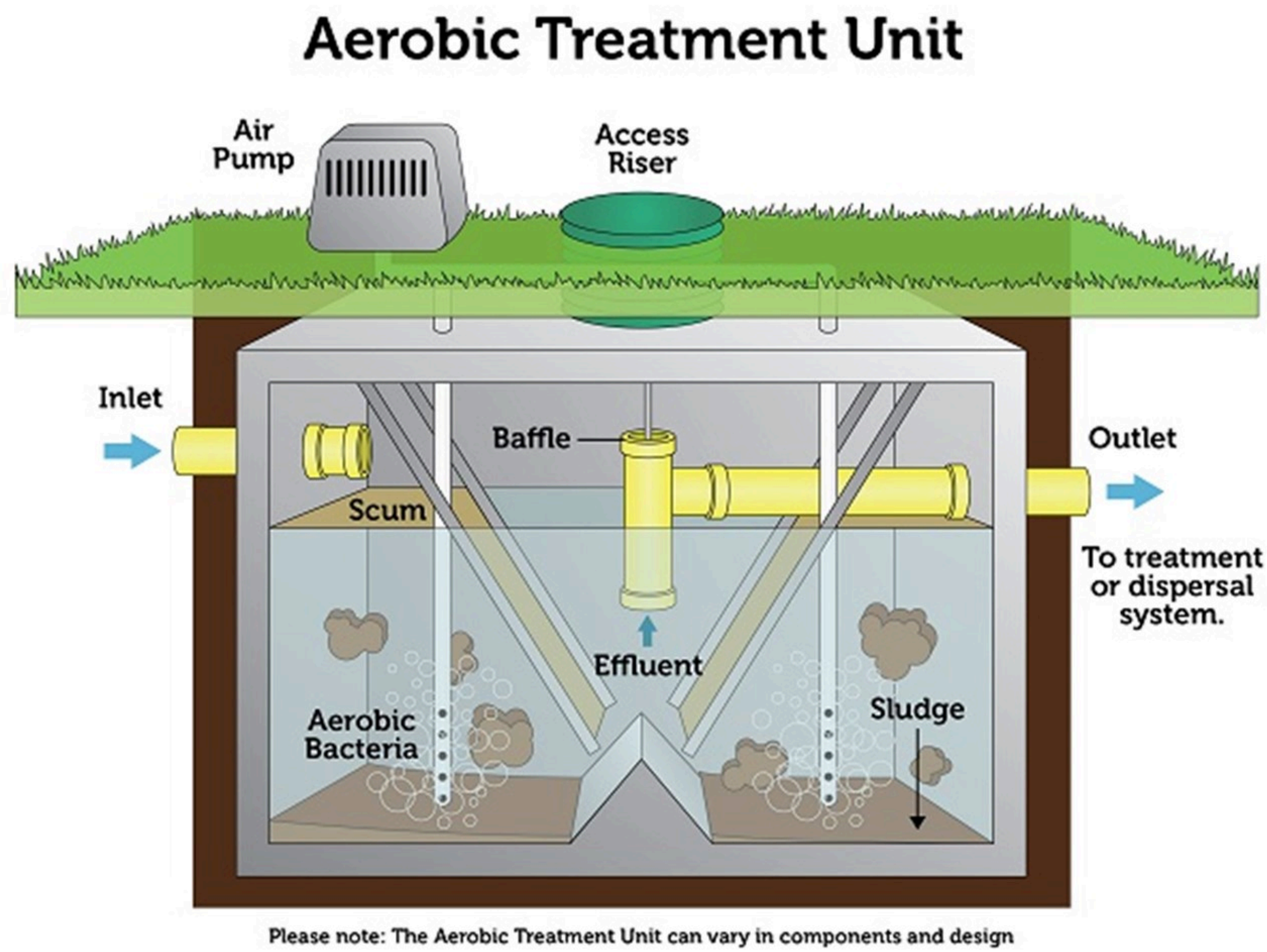

Figure 7. Aerobic treatment unit

The benefits of these systems, categorized as Type 2, are that they can be used in homes with smaller lots, inadequate soil conditions, in areas where the water table is too high, or for homes close to a surface water body sensitive to contamination by pathogens contained in wastewater effluent. The disadvantages are that they require power and routine monitored maintenance and are more costly to initially install and thereafter maintain.

The Distribution Box

The purpose of a distribution box is to spread the flow from the tank equally to all the laterals (single perforated pipes) in a dispersal field of a Type 1 gravity distribution system. They are used with either a trickle or dosed discharge.

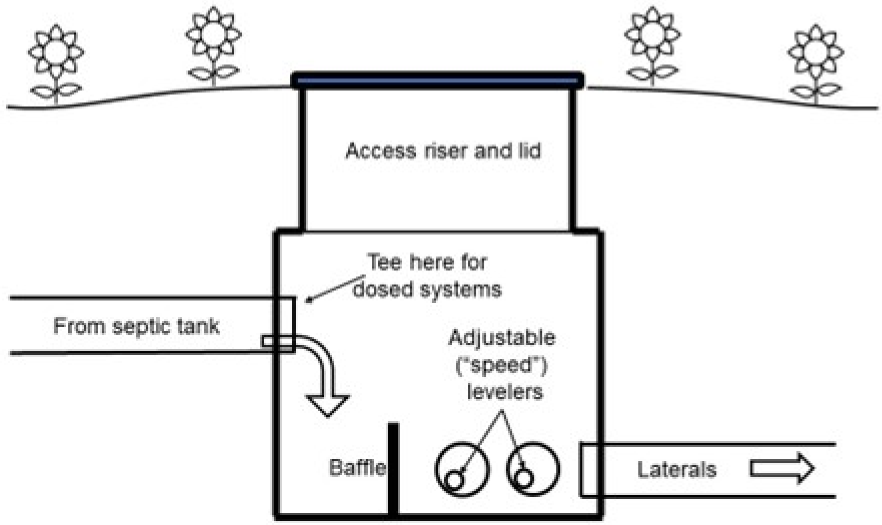

Figure 8. Distribution box (elevation view)

Distribution boxes ("D-boxes") are constructed of either concrete or plastic. Concrete D-boxes have one pipe inlet and multiple pipe outlets, normally of 4-inch diameter, cast into them. A baffle near the inlet helps to ensure "quiescent" flow between the inlet and outlets. D-boxes should be installed as level as possible so that the invert of each outlet is at the same elevation. To compensate for any out-of-level condition, adjustable eccentric levelers, known as "speed levelers," are fitted into the outlet openings and are rotated so that the inverts of the openings are all at the same elevation. An access riser, fitted with a sealed lid, ensures the distribution box's operation can be easily checked and maintained without excavating.

Plastic D-boxes have multiple knockout openings at different elevations, for more control over installation. A plastic pipe is inserted into a rubber grommet in the opening, allowing for a watertight seal between the pipe and D-box. Speed levelers and access risers can also be fitted to the openings of plastic D-boxes.

Figure 9. Plastic D-box

The Dispersal Dystem

Dispersal systems are the secondary treatment component of a Type 1 system. In it, aerobic bacteria break down the effluent into a final quality of discharge that will not harm people or the environment. There are several dispersal systems available for consideration, and the criteria for their selection are exhaustive and complex. Therefore, we will limit our studies to providing descriptions and characteristics of the different types, rather than attempting to go into detail with selection or sizing of any particular dispersal system.

Trench Systems

The most widely-used type of dispersal for a Type 1 system uses horizontal trenches of 18–36 inches in width at the bottom that are dug into native soil. Effluent from a distribution box spill into laterals of perforated pipe that are surrounded by gravel (commonly known as drain rock) and percolate vertically and laterally through the vertical separation. The gravel layer over the lateral is covered with an infiltrative cloth, called a *separation layer*, and native cover soil is replaced on top of it. The cover soil is left mounded to allow for settlement and to thwart groundwater from infiltrating the trench, which could saturate the soil and affect its ability to operate as intended. An observation port allows checking of the trench for issues such as ground saturation, seasonal water table depth, etc.

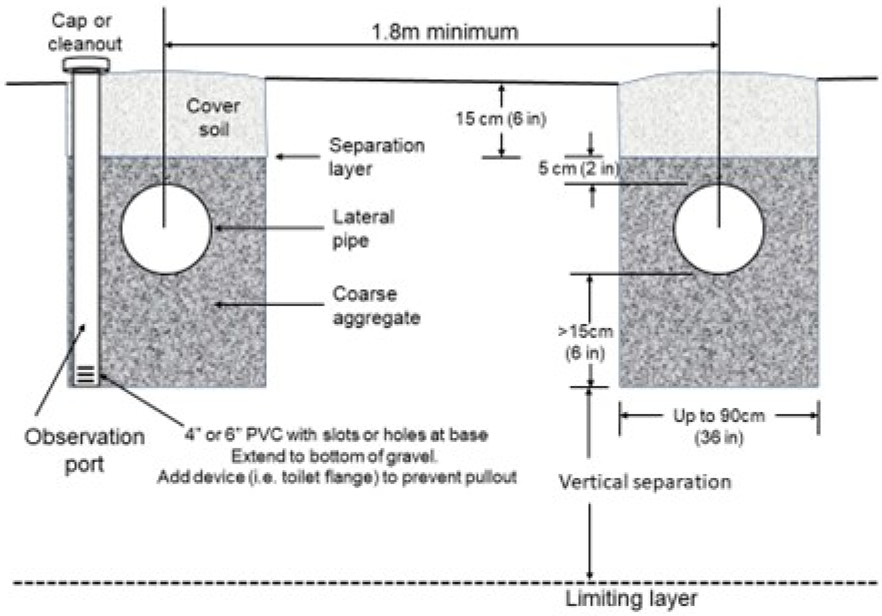

Figure 10. Typical trench with components and dimensions

Gravity Distribution: Trickling Systems

These are the most common systems used. When raw sewage enters the septic tank, it displaces effluent which moves out of the tank to the distribution box and out into the field piping. Low flows, such as from a basin or sink, only discharge enough liquid per use to affect the first few feet or meters of field distribution piping, leaving the rest of the field largely unused. Higher flows, such as from a bathtub or washing machine pump out cycle, will move farther into the distribution system. For this reason, trickling systems more commonly suffer from plugging of the first few feet or metres of laterals.

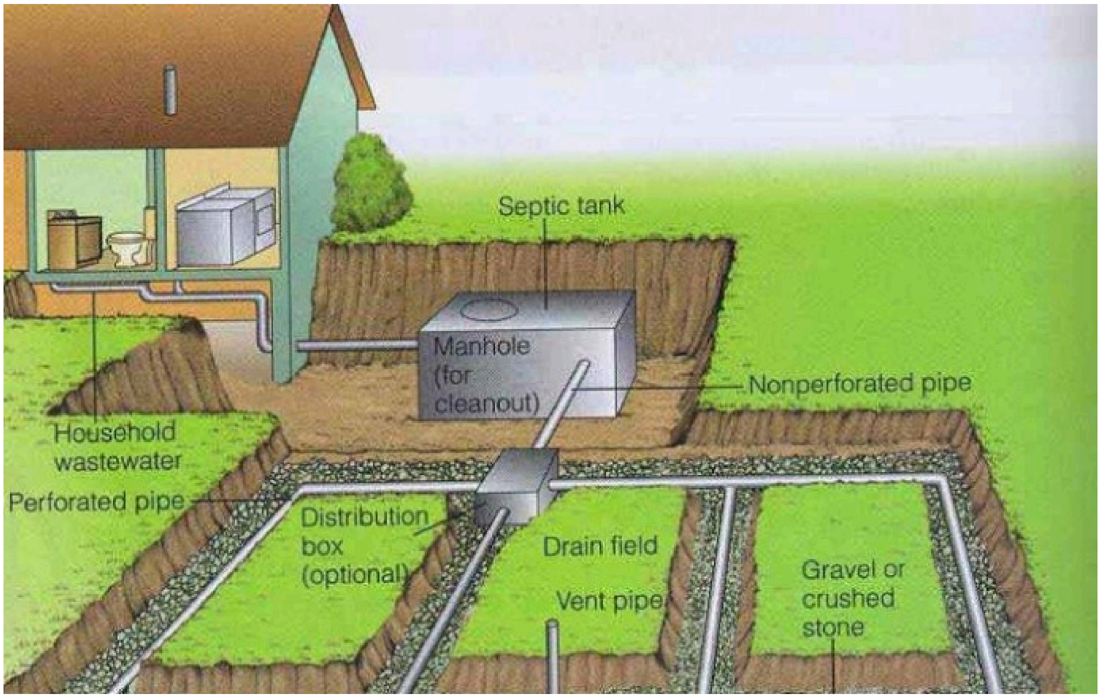

Figure 11. Trickling disposal field

Gravity Distribution: Dosed Systems

When a high flow of effluent is released from the tank to fill the field piping, it is known as "dosing." Dosing a field has a few advantages over trickling, including:

- The entire field gets a workout, rather than just the first few metres of it
- The field is allowed to "breathe" (rest) between doses, promoting aerobic bacterial action
- Freeze up of the field is less likely to occur in cold climates

Dosing can be accomplished by using either a siphon or a pump.

Dosing using a siphon has the advantage of not needing a power supply. When the effluent in the siphon chamber reaches a specific depth, the siphon trips and draws the contents of the chamber through the trap and, by gravity, out to the field.

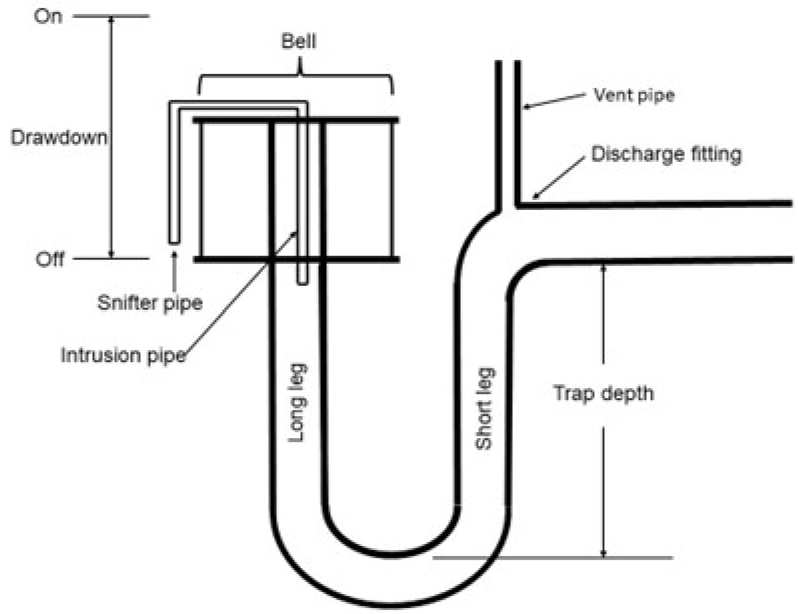

Figure 12. Siphon

In installations where there is not enough room for a single disposal field, two separate smaller fields can be serviced by installing two siphons in a single dosing tank. Because of slight variations in dimension and/or slight variations in the elevation of the two bells (inverted domes over the siphon inlet), one of the two siphons will trigger first. The siphon that triggered first will end the first dosing cycle with its trap full. The siphon that didn't trigger will have lost much of the water in its trap at the end of the first dosing cycle. When the tank fills up a second time, the second siphon will trip first since its trap is only partially full and requires less pressure to trip. The third time the tank fills up, the first siphon, with its trap only partially full, will trip first. This alternating process will repeat itself indefinitely.

Dosing using a pump is fairly straightforward. A submersible pump installed in either a tank's second compartment or a separate tank sends effluent out to a distribution box or to a pipe manifold and into the field piping. A simple float switch can be used to turn the pump on and off, or a more elaborate system using multiple float switches or sensors can be connected to a pump control panel. Regardless of the control system chosen, a high-water alarm should be used so that the owner can be alerted to potential issues before they become problematic.

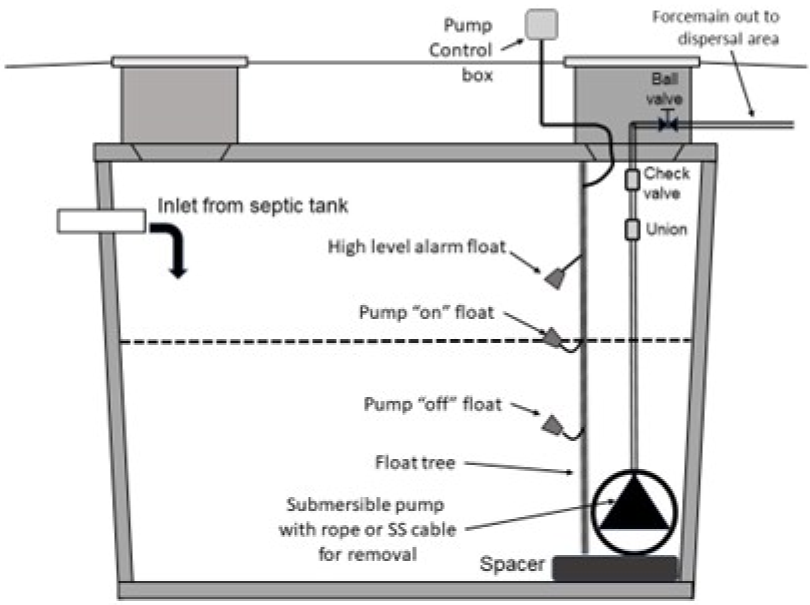

Figure 13. Dosing chamber with pump

A tank vault, sometimes known as a hanging pump vault, is a self-contained, manufactured package that encloses the dosing pump, screen, filter and float controls, and is installed near the tank outlet. The vault allows for easier installation and maintenance of the pump, filter, and controls.

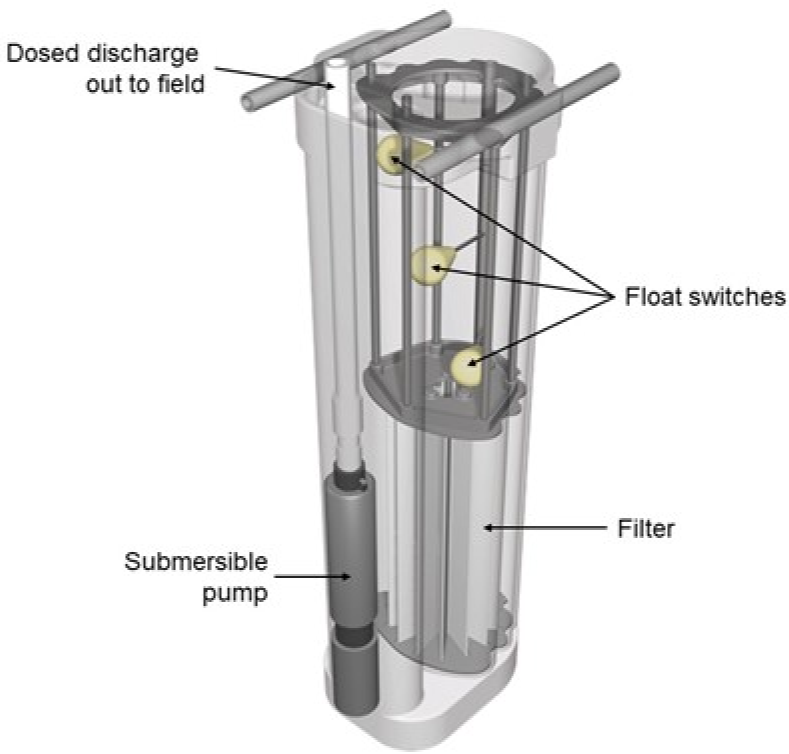

Figure 14. Pump vault

Dosing, either timed or on demand, occurs in all pressurized systems, whether above or below grade.

Pressure Distribution

With the subdivision of large land parcels into smaller rural lots came the need to be able to operate septic systems that occupy a smaller footprint. This has resulted in the development of pressurized dispersal systems known as:

- Pressure distribution, and
- Subsurface drip dispersal

Pressure distribution systems use a pump to send effluent out through small-diameter pipes with orifices drilled in them in a symmetrical pattern to discharge effluent evenly to the infiltration surface. The pump and pump chamber are similar or identical in design to ones that supply dosing to a gravity distribution system, except that the required pump heads will differ. Pressure distribution results in a more uniform application rate through the dispersal area, with no more than a 15% variation between any two orifices in a properly designed system.

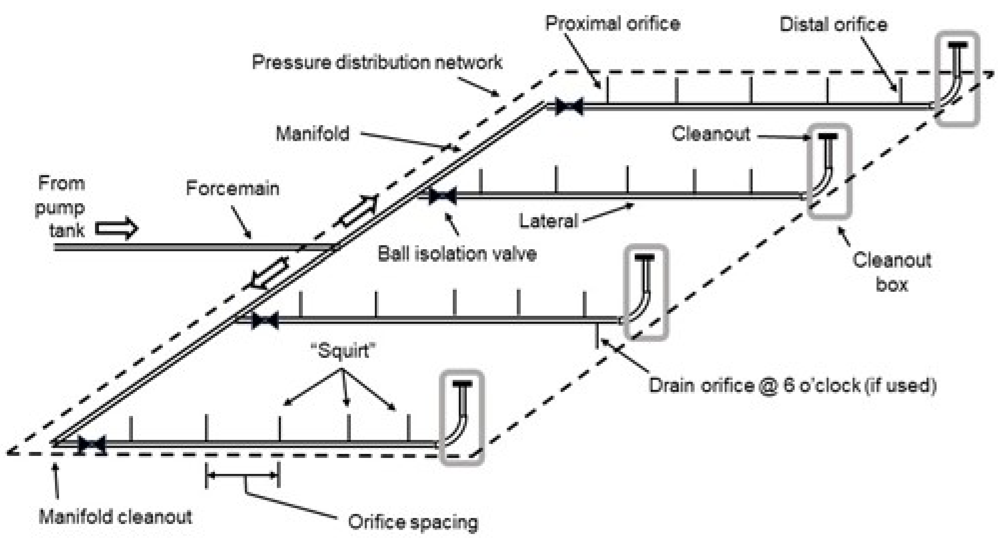

Figure 15. Pressure distribution system

Subsurface Drip Dispersal (SDD) Systems

Subsurface drip dispersal ("SDD") systems use timed dosing of filtered effluent to specially designed small diameter drip tubing, installed in soil close to the ground surface. A fine pressure filter, sized for the system flow and emitter size requirements, is used downstream of the dosing pump. Emitters in the tubing dose the effluent at a low hydraulic application rate to the soil.

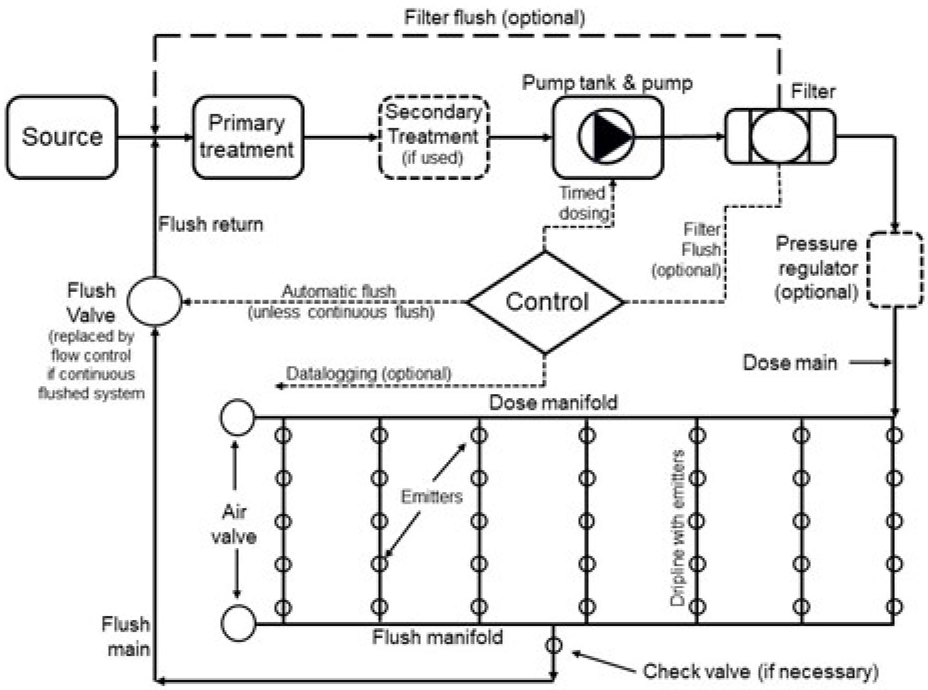

Figure 16. Subsurface drip dispersal system (SDD) [Image description] (#d1fig16_desc)

Alternate Dispersal Methods

While trench-type disposal fields remain the norm for rural sewage dispersal, various factors may require the use of an alternate system, such as:

- Gravelless “Infiltrator®” systems
- At Grade and raised systems
- Seepage bed systems
- Sand mounds and sand-lined trenches
- Evapotranspiration (ET) and evapotranspiration absorption (ETA) beds
- Lagoons
- Combined treatment and dispersal (CTDS)

Gravelless “Infiltrator®” System

Infiltrator® systems were developed in the mid-1980s as an alternative to the decades-old concept of gravel-and-pipe leaching beds. A series of pre-manufactured plastic chambers are connected end-to-end in a level trench wide enough to accommodate them. The effluent enters the chamber through a built-in pipe channel near the top and spills downward through weepholes into the trench bed. Infiltrator® systems have advantages over gravel-and-pipe leaching beds in that they are strong enough to support minor traffic loads caused by farm equipment, need no gravel base, and have a large infiltrative area.

Figure 17. Infiltrator® chamber

At Grade Beds and Raised Systems

In cases where the native soil is too impermeable for percolation of effluent, At Grade and raised systems may be used. The SPM references an At Grade bed as an aggregate bed placed on prepared topsoil of a site, into which effluent is distributed by pressure. This could be Type 1 effluent, whereas an Alberta At Grade system is a gravel-less chamber system (i.e., Infiltrator®) placed on undisturbed native topsoil into which Type 2 or Type 3 effluent is distributed by pressure. Both are restricted in their use to certain sites and soil types.

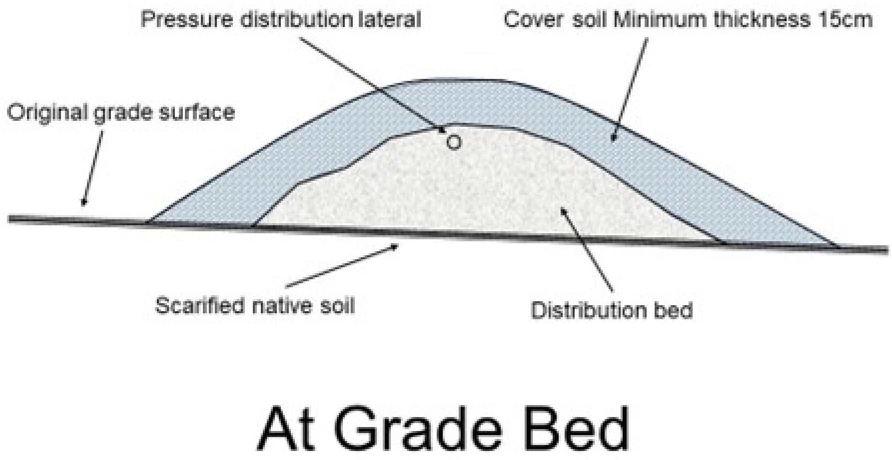

Figure 18. At Grade bed

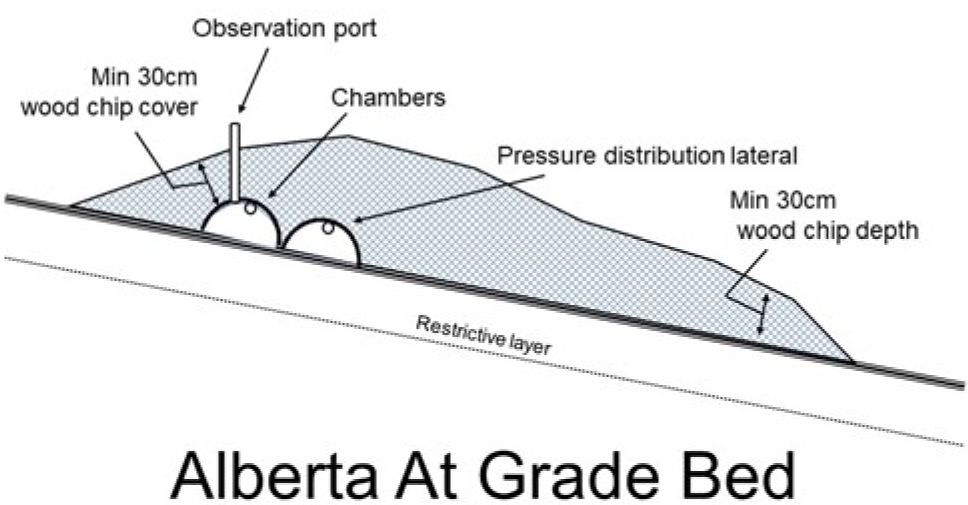

Figure 19. Alberta At Grade bed

Seepage Bed Systems

A seepage bed system is simply a wide infiltration trench (> 90 cm), containing more than one distribution lateral. Seepage beds have less oxygen transfer than trenches due to reduced sidewall area and therefore are limited by the SPM to a maximum width of 3 m. Laterals can be placed fairly close to one another and thus they take up less space than trenches using the same number of laterals. Seepage beds are not allowed where the land slope in the dispersal area is more than 15% and are only allowable for use in more permeable soil types.

Figure 20. Seepage bed

Sand Mounds and Sand-Lined Trenches and Beds

Sand mounds, and sand-lined trenches and beds, are sand-based dispersal systems where the effluent is dispersed to a bed on the sand, using pressure distribution or subsurface drip dispersal and timed dosing. The bed is level and installed long and narrow on contour, with a bed length selected to meet a specified linear loading rate (LLR). A sand mound is installed with the bed above grade on minimum 30 cm of sand media fill. Sand lined trenches and beds are installed with the bed at or below grade on minimum 30 cm of sand media fill. A bottomless sand filter is a sand lined bed in an enclosure and is installed with the bed above grade.

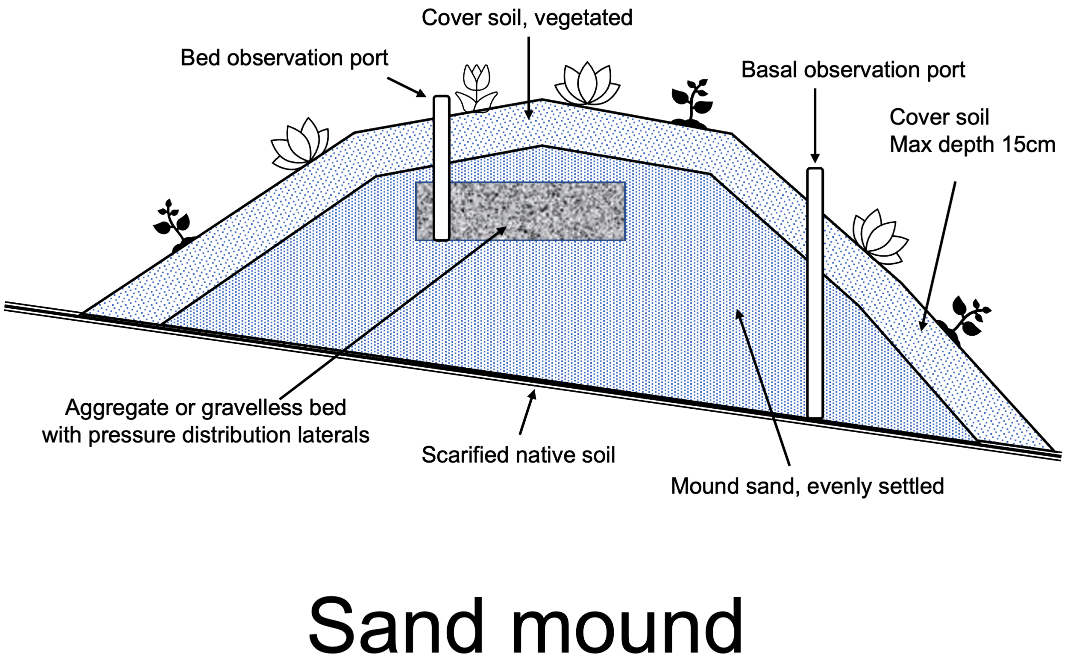

Figure 21. Sand mound

ET and ETA Beds

Evapotranspiration (ET) is the process that removes water from land covered by vegetation through evaporation (loss of water from soil or wet vegetation) and transpiration (loss of water from small openings in the leaves of plants and grasses). Evapotranspiration absorption (ETA) beds reduce reliance on effluent absorption into the soil by maximizing water loss through evaporation and transpiration. Effluent is distributed through the bed by a system of slotted pipes. Capillary action draws effluent up from a lower gravel bed through sand to supply the root zone of vegetation (usually grass) on top of the bed, to optimise evapotranspiration.

Septic tanks are the most common treatment system used with ETA beds. Common problems with ETA beds are:

- bed vegetation cover not well maintained to maximise evapotranspiration
- inadequate exposure to wind, or shading by trees, lowering the rate of evapotranspiration
- uneven distribution of effluent caused by gravity feeding instead of by a pump or pressure dosing
- beds too small for amount of effluent (hydraulic load).

The use of ET bed and ETA bed systems is restricted to certain sites and climates with restrictive soil types and soil permeability limits.

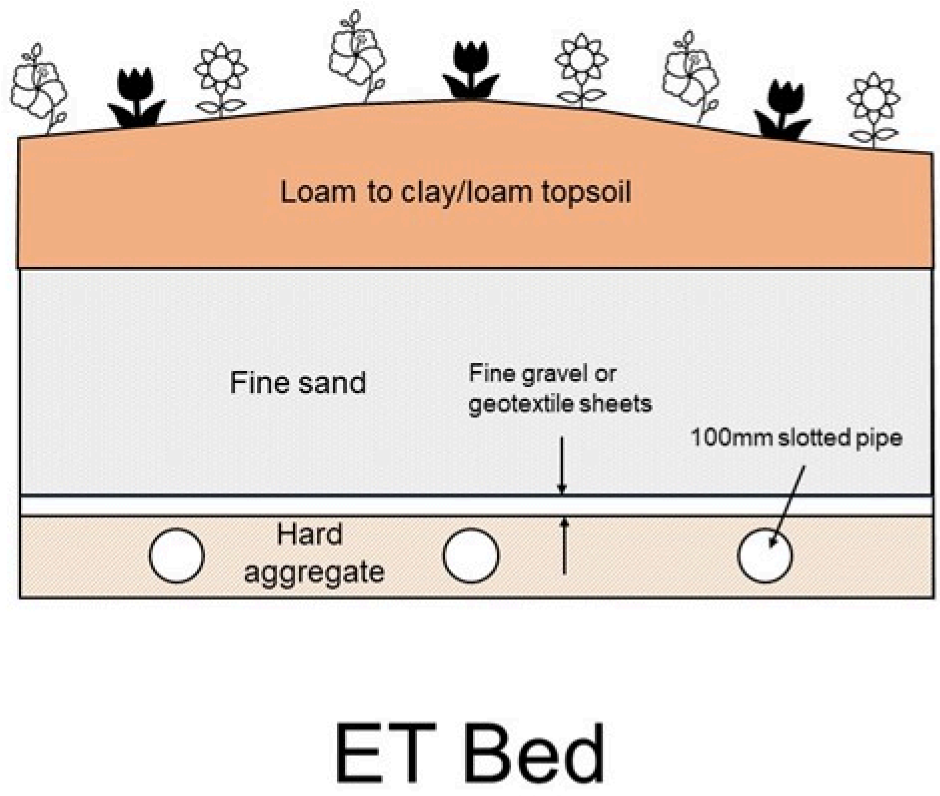

Figure 22. ET bed

BC Zero Discharge Lagoons

The BC zero discharge lagoon is a system unique to BC. The lagoon disperses effluent by infiltration into the soil and by evaporation from the pond surface, similar in concept to an evapotranspiration absorption (ETA) bed. A BC zero discharge lagoon system consists of one or more large, excavated ponds surrounded by a berm. Sewage is fed directly from the dwelling or from a septic tank by gravity — if topography allows — otherwise a septic tank is used, and effluent is discharged to the lagoon by pump, siphon or other dosing device. Excavated clay material is placed and compacted in an elevated berm intended to prevent surface water from entering the lagoon and to provide reserve capacity. Fencing is installed on the berm, or immediately adjacent to the berm to prevent entry of animals and to provide security/safety.

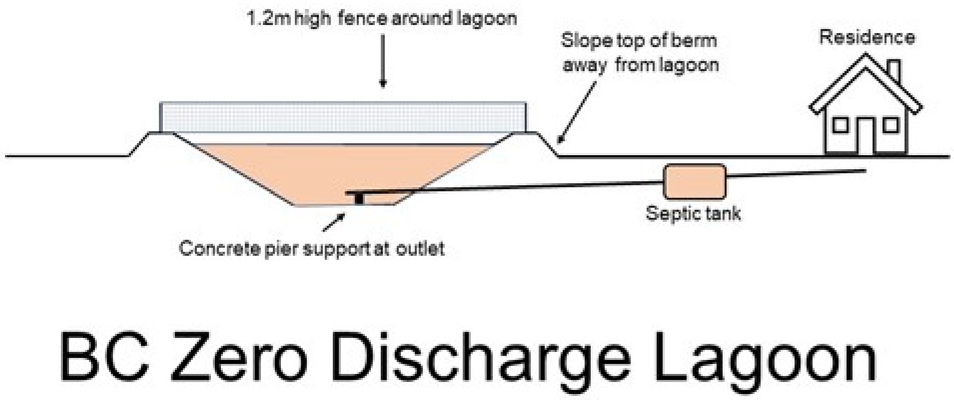

Figure 23. BC zero discharge lagoon

Lagoons can be rectangular or circular and the sides must be particularly sloped to prevent ice from binding against the sides and to allow egress of any persons or animals that may fall into the lagoon.

Combined Treatment and Dispersal Systems

Combined Treatment and Dispersal Systems (CTDS) are passive onsite wastewater treatment systems that treat and disperse wastewater in the same footprint. They provide treatment to Type 2 or 3 standards using media or through other processes in the same cell or unit that disperses effluent to the native soil. These systems discharge effluent at their base (or around an up-flow treatment unit) to native soil, or to sand above native soil. CTDS are typically chosen for larger scale onsite treatment solutions where restrictive factors prevent the use of other methods and where space is at a premium. They can be designed onsite or can be proprietary systems installed to manufacturers’ specifications, while also following the SSR and SPM mandates.

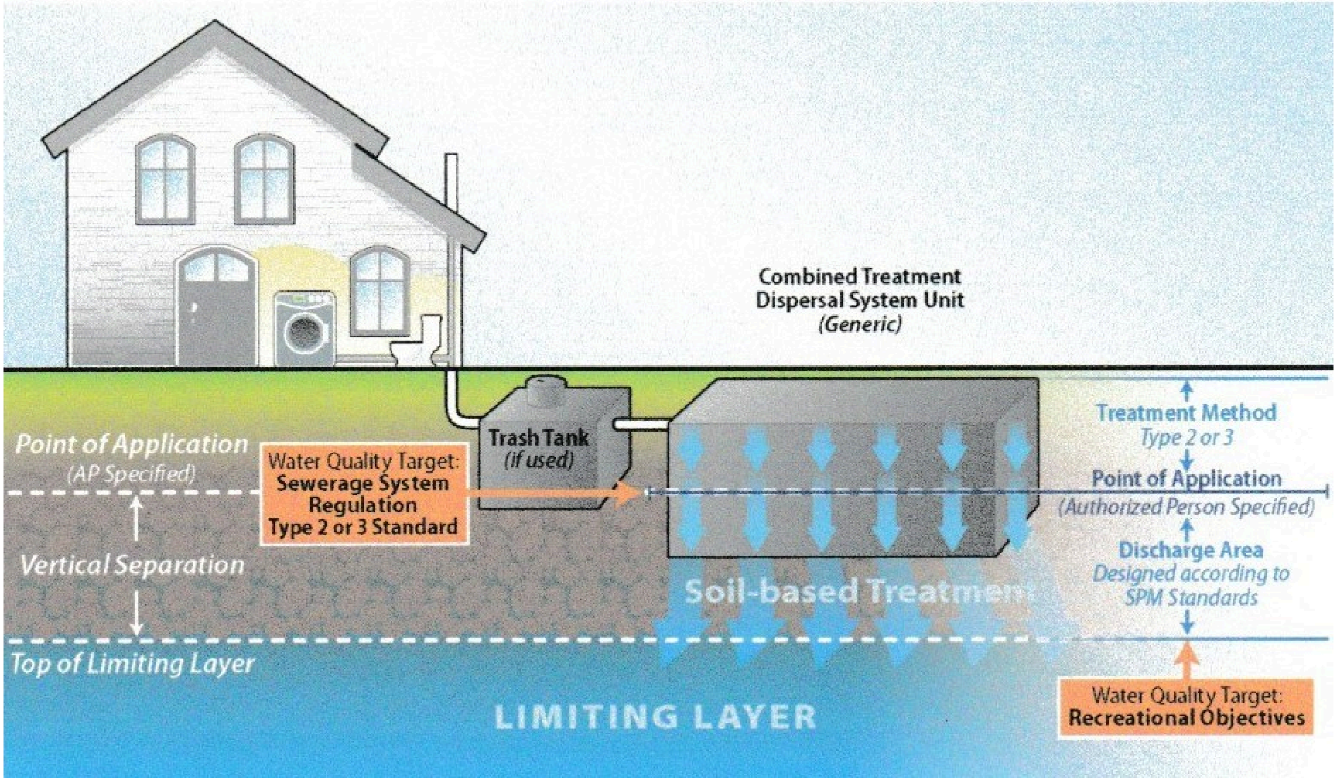

Figure 24. Combined treatment and dispersal system

For the CTDS, the only difference in construction is that the discharge from the treatment system flows directly into the dispersal system, without any piping or pump chambers in between.

Self-Test 2

Self-Test 2

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://opentextbc.ca/plumbing4d/?p=5#h5p-2 (https://opentextbc.ca/plumbing4d/?p=5#h5p-2)

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- Figure 24. "Combined treatment and dispersal system Onsite Sewage Inspection Industry Background (http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/Onsite%20Sewage%20System%20-%20Coast%20Mountain%20Background%20and%20Summary.pdf)" is used for educational purposes under the basis of fair dealing.

Image descriptions

Figure 16. "Subsurface drip dispersal system (SDD)" image description: A labelled diagram of a subsurface drip dispersal system (SDD).

We've represented this diagram with an ordered list with links to jump to certain steps to match the diagram. It also has links back to the original figure at key points.

1. Source
2. Inlet *[Return to Figure 16]* (#d1fig16)
3. Primary treatment
4. Secondary treatment (if used)
5. Pump tank & pump *[Return to Figure 16]* (#d1fig16)
6. Filter
    - Diverges to Filter flush 1 (Step 7 (#step7)), Pressure regulator (Step 11 (#step11)), or Filter flush 2 (Step 19 (#step19)) *[Return to Figure 16]* (#d1fig16)
7. Filter flush 1 (optional)
8. Control
    - Diverges to Timed Dosing (Step 9 (#step9)), Automatic flush (Step 10 (#step10)),

or Datalogging (Step 20 (#step20)) *[Return to Figure 16]* (#d1fig16)

9. Timed dosing. Proceed to Step 5 – Pump tank & pump (#step5) *[Return to Figure 16]* (#d1fig16)
10. Automatic flush (unless continuous flush). Proceed to Step 18 – Flush Valve (#step18) *[Return to Figure 16]* (#d1fig16)
11. Pressure regulator (optional)
12. Dose main pipe
13. Dose manifold with 7 driplines connected to it and an air valve on the left-most side
14. 7 Driplines with emitters
15. Flush manifold with an air valve on the left-most side
16. Check valve (if necessary)
17. Flush main
18. Flush valve (replaced by flow control if continuous system), go to Step 2 – Inlet (#step2) *[Return to Figure 16]* (#d1fig16)
19. Filter flush 2 (optional), go to Step 2 – Inlet (#step2) *[Return to Figure 16]* (#d1fig16)
20. Datalogging (optional) *[Return to Figure 16]* (#d1fig16)

Learning Task 2

Describe Municipal Sewage Disposal Systems and Sewage Treatment Plants

Learning Objectives

After completing this learning task, you will be able to:

- Describe the objective of a municipal sewage disposal system
- Identify the components found in a sewage treatment plant
- State the goals of municipal waste treatment

The principal objective of municipal wastewater treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. The *Public Health Act, Environmental Management Act*, and *Municipal Wastewater Regulation* establish the criteria that local government must adhere to the interests of promoting and protecting the health and well-being of the public through the treatment and safe disposal of sewage.

Simply stated, a municipal sewage treatment plant does for a town or city what a private sewerage system does for a single-family residence. The differences are mainly:

- the scale at which the process occurs
- the size and complexity of the components
- the level of treatment achieved
- the chemistry and quality control used
- the end destination of the treated effluent

In a municipal treatment system, raw sewage from homes and businesses travels through a system of underground mains to a processing plant which is usually located near a natural body of water, typically a lake, river, or the ocean. Unlike a residential system, discharging treated effluent into the ground on such a large scale is not an achievable goal due to the sheer volume of waste involved. Consequently, the mechanical, chemical, and biological processes involved demand a high degree of monitoring and adjustments according to variations in the composition of the sewage entering the plant. The following are the four major processes, and a short description of each, that occur within most sewage treatment plants. Note that these processes may differ in their use or order of occurrence between plants. The four major processes are:

- Primary treatment

- Secondary treatment
- Tertiary treatment
- Sludge treatment

Primary Wastewater Treatment

Primary treatment removes solids like silt and plastics, which could cause blockage and damage of valves, pumps, channels, orifices, and other components of the system. The wastewater is first taken into a settling tank, also referred to as a grit removal unit, after which it goes through screening to remove large organic material. Once settled, these materials are held back while the remaining liquid is moved through to the more rigorous secondary phase of wastewater treatment. These large settling tanks are also often equipped with mechanical scrapers that continually drive collected sludge in the base of the tank to a hopper which pumps it to sludge treatment facilities. Non-biodegradables such as plastics are separated and transported to sanitary landfills.

Secondary Wastewater Treatment

Following primary treatment, the organic waste is usually broken down through biological processes. This entails the propagation of cultures and other micro-organisms that continually multiply under the right conditions and feed on organic waste, while also helping in the breaking down of some chemicals. For instance, when ammonia is oxidized, it is converted into nitrogen compounds like nitrate. Inorganic waste can, to a small degree, be treated biologically but for the most part, it will need chemical treatment. If the secondary stage is done properly, the outcome will be treated sewage that has very little toxicity.

The growth of the microbial population needed for secondary treatment is provided by the nutrients contained in the raw sewage. As well, the right temperature, pH, and dissolved oxygen must also be in place for the environment to be optimum for the growth of bacteria. On average, the most ideal environment should be approximately 25–32° Celsius, 5.5–9.5 pH and 2 mg/L of dissolved oxygen.

Tertiary Treatment

Once sewage water has undergone secondary treatment, it is then passed on for a final filtration before it is discharged into a body of water. This tertiary treatment phase typically takes place in a clarifier or settling tank. The settling tank is similar to the one that is used for primary treatment except that it is usually followed by a polishing filter. At this stage, bacteria, viruses, and harmful parasites are also removed from the water, usually by chlorination, but in some cases also by ozonation and ultraviolet disinfection. Chlorine is more cost-effective than UV or ozone disinfection, but chlorine residual in even minute amounts can harm aquatic life, and so de-chlorination of the final product may be necessary before the treated water can be released to the environment.

Sludge Treatment

A sludge treatment plant receives solids recovered from screens, grit traps, surplus sludge, and settling tanks. In old treatment plants, the sludge is passed on to huge ponds where the water is allowed to evaporate slowly and thereby return to the water cycle. The solids that remain are then burned as bio-fuel, buried, or sold as fertilizer. Modern sludge treatment facilities dewater the sludge using filters before passing the sludge to digesters. Anaerobic bacteria flourish in these digesters under the right conditions and help break down the sludge. Methane is produced as one of the main by-products of this process. This methane can be captured and used as fuel to generate electricity for use on the site. The waste sludge is then transferred to sanitary landfills.

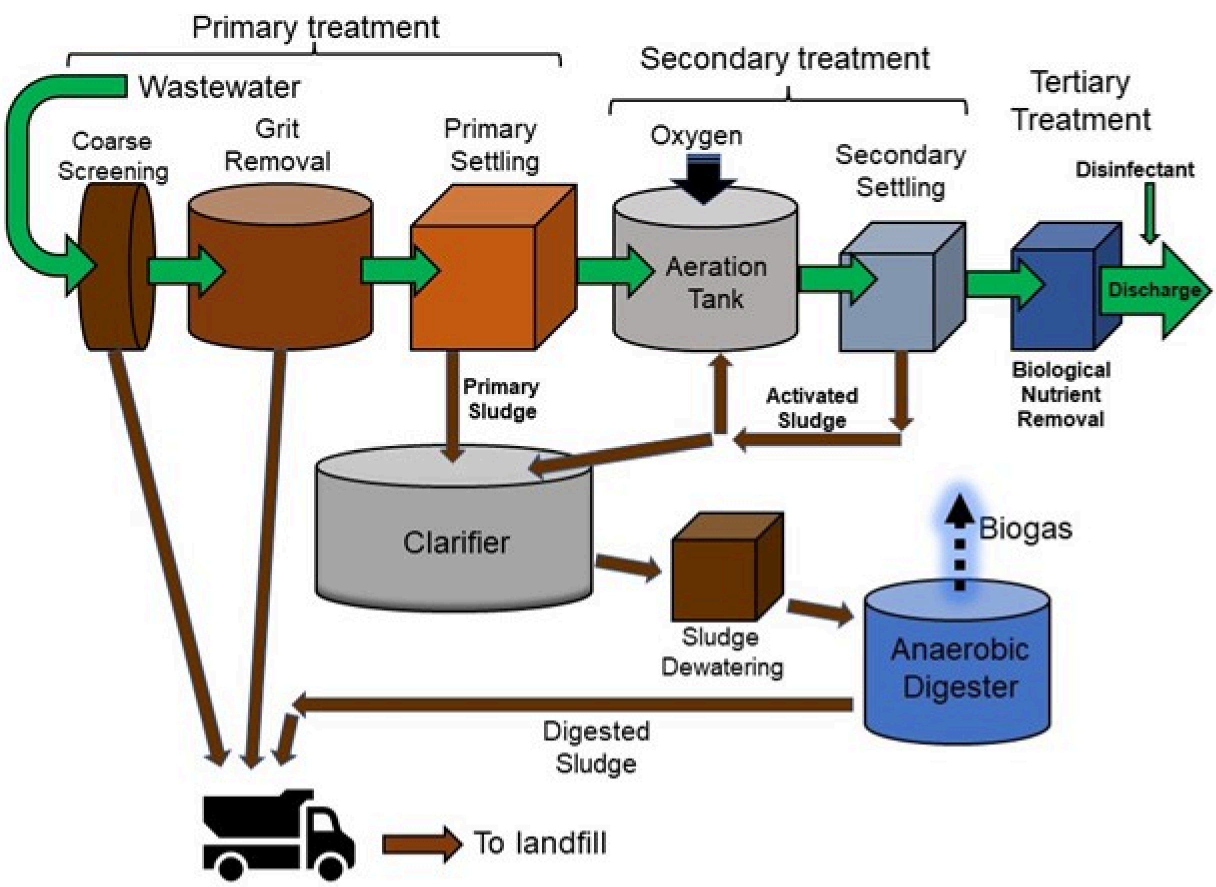

Figure 25. Municipal wastewater treatment flowchart

Self-Test 3

Self-Test 3

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Learning Task 3

Describe a Private Sewage Treatment System Installation

As described in Competency D1, Learning Task 1, the installation of a residential sewage treatment system is a very structured and regulated process. More than one AP (authorized person) could be involved in the different phases of the installation, which are planning, installation and maintenance. This learning task will summarize the steps and processes involved in the installation of a private sewage treatment system for a single-family house with a Type 1 treatment method (septic tank and trickling gravity disposal field). The steps to be followed are similar for commercial or industrial buildings, with the major differences being the volume and strength of the sewage produced, and the dispersal method chosen.

Note: the path to becoming an AP encompasses several courses involving weeks of technical training. The complexity involved in the proper use of the tables and procedures contained within the SPM hinge upon guidance and explanations that are specific to those technical training courses. The intent of this learning task is to give a broad summary of the terms and conditions that an AP would encounter in the design and installation of a sewerage system. There is no expectation that the contents of this publication are able to be used for certification purposes.

Learning Objectives

After completing this learning task, you will be able to:

- Describe the process involved in determining daily design flow (DDS)
- Identify the terms used in describing system components
- Identify factors in the operation of tanks and disposal fields
- Describe considerations for choices of treatment and dispersal methods

Key Terms

- **AIS**: area of infiltrative surface

- **AP**: authorized person
- **BOD** or **BOD_5**: 5-day biochemical oxygen demand
- **DDS**: daily design flow
- **HAR**: hydraulic application rate
- **HLR**: hydraulic loading rate
- **HS**: horizontal separation
- **LLR**: linear loading rate
- **perc rate** or **perc**: percolation rate
- **POA**: point of application
- **ROWP**: registered onsite wastewater practitioner
- **SHWT**: seasonal high water table
- **SPM**: sewerage system standard practice manual, version 3
- **SSR**: sewerage system regulation
- **TSS**: total suspended solids
- **VS**: vertical separation

Planning the Installation

The first step in any installation is for the certified planner to meet with the building owner. Information must be collected and recorded on official documents. The points below are considered minimum required information to be gathered:

- The full legal name of the owner(s), and contact information
- Legal description, civic address, and tax assessment roll number for the subject property
- Current or planned water source (i.e., an approved community water system, an on-site water well or freshwater body such as lake or creek)
- Current and planned uses of the property (i.e., residential only, commercial uses including home based business, or mixed commercial/residential)
- Current or planned size and use of non-residential buildings
- Current or planned water source (i.e., an approved community water system, an on-site water well or freshwater body such as lake or creek)
- Information regarding any wells located on the property, including well logs
- Current or planned residence information including:
    - Living and non-living areas of the residence
    - Number of bedrooms

    - Anticipated number of occupants
    - Water treatment devices (i.e., water softeners, filtration systems, disinfection, or similar devices)
    - Garbage grinders/in-sink garbage disposal units
    - Any other anticipated usage patterns that may affect sewage volume or constituents, which may include:
        - Frequent large numbers of guests (i.e., from social events)
        - Non-typical food processing such as canning, high volume of baking or deep frying, beer or wine making
        - Home-based businesses with associated sewage discharges
        - Hobbies with associated sewage discharges (e.g. photography, painting, pottery
- Information for the owner on their responsibilities under the SSR
- A signed declaration statement by the owner(s) including the following:
    - Identification of ownership (who are the legal owners?)
    - Confirm the accuracy of information provided
    - Understanding that system use (including the design flow) is to be per the filing submitted to the Health Authority

The AP may choose to add a contract or simple letter of engagement to the declaration that specifies project roles, budget, etc. As well, the owner should be informed that any changes to the intended use or occupancy as attested to in the filing may drastically alter the performance and acceptance of the installation.

Determine the Daily Design Flow (DDF)

Once the obligatory information listed above has been collected and before a treatment method is chosen, the next step is to determine the suitability of the site for a conventional disposal field. To do this, an estimate of the daily design flow (DDF) must be made. Daily design flow is the estimated peak daily flow to be discharged and is synonymous with the SSR terms “estimated daily domestic sewage flow” and “daily design domestic sewage flow.”

There are two tables in the SPM to assist in determining the DDF, either of which can be consulted for determining the daily design flow from a residence.

SPM Table II-8: Minimum Daily Design Flow for Residences

Number of bedrooms	Maximum floor area (m^2)	DDF litres/day
1	140	700
2	240	1 000
3	280	1 300
4	330	1 600
5	420	1 900
6	520	2 200
Additional bedroom, add:		300
Additional m^2, add:		3

As an example of using Table II-8 above, a residence with three bedrooms and a floor area of 295 m^2 would have an expected DDF of 1 300 L.

Also, according to Table II-8 for a 3-bedroom home, for every m^2 of house area over 280 m^2, the DDF should be increased by 3 L. This would mean that the calculation would become:

$$1\ 300\ \text{L} + (15 \times 3 = 45\ \text{L}) = 1\ 345\ \text{L}$$

Adjustments to the table values are made wherever special circumstances are encountered, such as when garbage grinders or garburators are used. *Vol. II- 5.1.3.2* of the SPM states “When garbage grinders (garburators) are used, increase the Daily Design Flow by a factor of at least 1.5.” This means that, if a garburator is used in our example, the DDF would be calculated to be:

$$1\ 345 \times 1.5 = 2\ 017.5\ \text{L}$$

Accordingly, the combination of the significant impact on the DDF and the negative effect rotting food can have on treatment, the use of garburators for septic systems is strongly discouraged.

Alternatively, Table II-9 can be used to determine the DDF on a per capita basis. We’ll use it instead of Table II-8 for our example and compare the two results.

SPM Table II-9A: Per Capita Daily Design Flow for Residences

Use	**Per Person Flow (L/Day)**
Single family dwelling	350
Multi-family (apartment)	300
Luxury homes	700
Seasonal cottage	250
Mobile home	300

SPM Table II-9B: Per Capita Daily Design Flow for Residences

Number of bedrooms	**Minimum number of occupants**
1	2
2	3
3	3.75
4	4.5
5	5.5
6	6.5

According to Table II-9, a 3-bedroom home would have an expected minimum number of 3.75 occupants. Multiplying this by 350 L/day/person (from the top row of the table), the expected DDF would be:

$$350 \times 3.75 = 1\ 312.5 \text{ L}$$

Again, if a garburator is used, this would be increased by a factor of 50% to be:

$$1\ 312.5 \times 1.5 = 1\ 968.75 \text{ L}$$

As you can see, regardless of any adjustments made because of the allowance for extra floor area, there is only a slight difference in DDF resulting from the use of either method.

For a luxury home, sewage flow per occupant (700 L/day) is higher than for an average home (350 L/day), as they often include the following:

- Larger overall floor area with larger rooms than an average home
- More water use appliances than an average home
- Large parties, frequent guest use, and the probability of domestic service workers adding to the DDF

Determine Site Conditions for Dispersal

Once the DDF is calculated, the next step in the planning process is to select the type of distribution allowed by the SPM. Factors in this step include:

- site capability standards, as found in *Section II- 4.1.2*
- vertical separation standards from *Section II- 5.3*, as well as
- the standards of *Section II- 6* for the specific type of dispersal system

According to the SPM, the simplest distribution and dosing system which meets site capability should typically be considered first. Once again, for the purposes of explanation, we'll focus on the use of a gravity trickling disposal field.

The SPM contains a great many definitions. Several of them that pertain to the explanations that follow are listed below.

Key Terms

- **area of infiltrative surface (AIS)**: Infiltrative surface area, in m^2, receiving effluent from the distribution system. This is considered to be the bottom area of a trench in a trench-type gravity system.
- **basal area**: For sand mounds, sand-lined trenches, bottomless sand filters, Alberta At Grade systems and CTDS, this is the native soil that the sand will be placed on.
- **blinding layer**: A layer of clean coarse sand or mound sand that is installed between the infiltration surface (bottom of aggregate, base of chamber, etc.) and the native soil, and which is up to 10 cm (4 inches) thick.
- **consistence**: Attribute of soil expressed in degree of cohesion and adhesion, or in resistance to deformation or rupture.
- **gravel**: Rounded or subrounded rock fragment that is between 0.1 inches (2 millimetres) and 3 inches (76 millimetres) in diameter. Often called "drain rock."
- **hydraulic loading rate (HLR)**: A measure of the volume of effluent, in litres, applied each day, per unit area (m^2) of infiltrative surface.
- **infiltrative surface**: In drainfields, the drain rock-to-original soil interface at the bottom of the trench; in mound systems, the gravel-to-mound sand and the sand-to-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-to-sand interface and the sand-to-original soil interface at the bottom of the trench or bed.
- **K_{fs}**: A measurement of the saturated hydraulic conductivity of soil. In theoretical terms, hydraulic conductivity is a measure of how easily water can pass through soil or rock. High values indicate permeable material through which water can pass easily, such as sand or gravel; low values indicate that the material, such as clay, is less permeable.
- **limiting layer**: The shallowest of a **restrictive layer**, water table, seasonal high-water table or

extremely permeable material (e.g., fractured rock, gravel).

- **platy structure**: Laminated or flaky soil aggregate developed predominantly along the horizontal axis.
- **restrictive layer**: A layer of soil or rock that impedes the vertical movement of water, air, and the growth of plant roots. This may include hardpan, some compacted soils, bedrock, glacial till and unstructured clay soils.
- **soil horizon**: Layers of soil or soil material approximately parallel to the land surface and different from adjacent layers in physical, chemical, and biological properties or characteristics such as colour, structure, texture, consistence, and pH.
- **soil structure**: The combination or arrangement of individual soil particles into definable aggregates, or peds, which are characterized and classified based on size, shape, and degree of grade (distinctness).
- **soil texture**: The relative proportions of the various soil separates (e.g., silt, clay, sand) in a soil.
- **vertical separation** in native soil: The depth of unsaturated, original, undisturbed permeable soil below the infiltrative surface and above any limiting layer. This is the vertical depth of soil that the dispersal system is expected to be discharged into.

Determining Soil Characteristics

The soil structure and consistency of the proposed dispersal field must be determined, and this can only be accomplished by performing a soil analysis. To do this, test holes must be dug, and the sides of the holes inspected. The procedure listed in III-3.3.2.1 “Test pits” (observation holes) includes the following points:

- Excavate a minimum of two test pits (observation holes). In some cases, two pits will not be enough to describe the soil conditions. If platy structure is found, site investigation should include a minimum of 4 observation test pits in the dispersal area and two in the receiving area to determine the extent and uniformity of the platy soil layer(s) more accurately. If soils are variable or the area is large, excavate additional test pits
- Augered (bored) holes can be used to investigate soil conditions. This may be preferred on some sites to minimize the number of test pits. A minimum of two observation test pits should be excavated to confirm the auger test results
- The test pit should be dug to a depth that provides the soil and water table information for designing the sewage system. In all cases test pit depth may be limited by refusal, i.e., rock or other layer which cannot readily be excavated. If feasible, considering the hardness of the ground, excavate to:
    - A minimum of 1.2 m depth in total
    - A minimum of 0.9 m below the proposed infiltrative surface
    - A minimum of 1.5 m below the proposed infiltrative surface, if Volume II standards specify a larger vertical separation. This would apply, for example, in the

case of gravity dispersal to gravelly sand soil (the standards specify a vertical separation of 150 cm)

    - A minimum of 3 m overall depth and a minimum of 1.2 m below the planned base elevation, for a proposed BC zero discharge lagoon. If sand lenses or rock outcrops are suspected, consider investigation to greater depth
    - A minimum of 1.2 m below the base of a proposed ETA bed.

In some cases, nearby water well logs, where available, can provide an indication of the water table elevation and soil conditions below the depth feasibly assessed by test pits. Water well logs are accessible through the BC Water Resources Atlas (https://maps.gov.bc.ca/ess/hm/wrbc/).

In British Columbia, "Onsite Soils Assessment" is one of the requisite courses that an ROWP Planner must take for certification. It is a rigorous, subjective, hands-on 3-day course. This learning guide will not attempt to explain any of the countless variations in soil makeup. With that in mind, a summary of soil structure would be that:

- The more clay there is in soil, the less favourable it is for a trickling gravity system because of clay's low hydraulic conductivity.
- As well, the coarser and grainier the soil, such as gravel or sand, the less favourable it is because the effluent flows quickly through it and will not be retained long enough for proper aerobic bacterial action to take place.
- Soils that have a mixture of sand, loam and a limited amount of clay can usually be suitable for a disposal field. Again, the amounts of each constituent will influence the percolation rate through the soil and affect the hydraulic loading rate.

Once the soil structure and consistence are determined from the test holes, the information gathered is compared to various tables within the SPM to determine if the soil conditions are "favourable," "poor," "very poor," or "NA" (not allowed). These terms refer to the proposed use of a gravity dispersal system and are factors in the use of tables in the SPM. If "NA" is encountered in the tables, a conventional trench system cannot be used, and either an above grade system or a lagoon must be used.

Percolation Test Procedure

Taken from III-8.3.2 of the SPM.

A percolation test is also performed to determine the soil's acceptance rate for the effluent discharge. The following steps are used to conduct a percolation test in BC. Other provinces and states may use a different procedure:

1. Perc test holes should be made at points and elevations selected as typical in the proposed absorption field.
2. Typically, test holes are to be dug at each end of the area of the absorption field and near the centerline. Further holes could be needed, depending upon the nature of the soil, the results of the first tests and the size of the proposed dispersal area. Testing of the receiving area may also be necessary.

3. Test holes should be 30 cm (12″) square or 36 cm (14″) round and excavated to the proposed depth of the absorption field (or as instructed by the designer). It is generally easiest to dig a larger hole part way down, then dig an 18 to 20 cm (7 to 8″) deep accurately sized test hole in the base of the larger hole.
4. To make the percolation test more accurate, any smeared soil should be removed from the walls of the test holes. This is best achieved by digging the hole approximately 5 cm undersized (2″) and then enlarging the hole to the accurate size as follows: using a rigid knife, insert the blade into the top side of the hole opposite you approximately 2.5 cm (1″) deep, holding the blade with its cutting edge vertical. Pull the blade away to break out a chunk of soil, repeat about 2.5 cm (1″) apart around the hole, then repeat for another “ring” below until reaching the base. The result will be a hole with a ragged inner surface which looks like a freshly broken clod of soil.
5. The base of the hole should be cleaned of debris and be approximately flat. Use a metal scoop or similar implement. It should also be picked to present a natural surface. Note that a picking action, using a pointed tool, is needed, not a scratching action (which just produces smears that are indented).
6. Place 5 cm (2″) of clean fine gravel in the bottom of the hole. If the sidewalls are likely to collapse, use a paper basket to support the sidewalls (see note below). Place a piece of white plastic or similar provided with clear marks at 5″ and 6″ from the bottom of the test hole prior to adding the gravel. For greater accuracy a float and pointer arrangement can be set up.
7. If the soil contains considerable amounts of silt or clay, and certainly for any soil with “clay” as part of the texture description, the test holes should be pre-soaked before proceeding with the test. Pre-soaking is accomplished by keeping the hole filled with water for 4 hours or more. The water should be added carefully and slowly to avoid disturbing the soil (including the sidewall soils). The test should be carried out immediately after pre-soaking.
8. To undertake the test, fill the accurately sized test hole with water. The water should be added carefully and slowly to avoid disturbing the soil (including the sidewall soils). When the water level is 5″ or less from the bottom of the hole, refill the hole to the top. No recording of time needs be done for these 2 fillings.
9. When the water level after the second filling in step 8 is 5″ or less from the bottom of the hole, add enough water to bring the depth of water to 6″ or slightly more. Note that these measurements are from the base of the soil bottom (using the marker installed in step 6), not the gravel layer.
10. Observe the water level until it drops to the 6″ depth, at precisely 6″, commence timing. When the water level reaches the 5″ depth, stop timing, record the time in minutes.
11. Repeat steps 9 and 10 until the last two rates of fall do not vary more than 2 minutes per inch or by more than 10% (whichever is less).
12. Report the slowest rate for each hole.
13. Backfill the holes with the excavated soil and flag and label their locations so you can recognize them when creating the plan of the installation.

Table II-5 of the SPM is then consulted to determine whether a gravity distribution system is allowed and is based on the soil type, vertical separation, percolation rate, and expected rainfall.

SPM Table II-5: Situations where gravity distribution systems are allowed or not allowed

Soil type, Site constraint, or Planned Type of System	Other Factors	Gravity Distribution?
Very or extremely gravelly sand or coarse sand		not allowed
Gravelly sand, coarse sand, loamy coarse sand, sand and loamy sand	And where vertical separation (VS) is at least 150 cm in native soil (can include blinding layer)	allowed
Fine sand, loamy fine sand, sandy loam, loam	And Type 1 effluent HLR, where VS is at least 90 cm in native soil (can include blinding layer) And Type 2 effluent HLR, where VS is at least 120 cm in native soil (can include blinding layer)	allowed allowed
Silt loam, silt	And where VS is at least 120 cm in native soil (can include blinding layer)	allowed
Clay loam, sandy clay loam, silty clay loam, sandy clay, silty clay, or clay	And dispersal to an ET bed or ETA bed or to a lagoon And dispersal to any other than an ET bed or an ETA bed or to a lagoon	allowed not allowed
K_{fs} > 17 000 mm/day **Or** perc rate faster than 0.5 min/inch		not allowed
K_{fs} > 1 500 ≤ 17 000 mm/day **Or** perc rate 0.5 min/inch to less than 5 min/inch	And where VS is at least 150 cm in native soil (can include blinding layer)	allowed
K_{fs} ≤ 1 500 mm/day **Or** perc rate 5 min/inch or slower	And Type 1 effluent HLR, where VS is at least 90 cm in native soil (can include blinding layer) And Type 2 effluent HLR, where VS is at least 120 cm in native soil (can include blinding layer)	allowed allowed
K_{fs} < 150 mm/day **Or** perc rate slower than 60 min/inch	And dispersal to an ET bed or ETA bed or to a lagoon And dispersal to any other than an ET bed or ETA bed or to a lagoon	allowed not allowed

Table II-6 identifies key constraints for the contemplated use of various types of dispersal systems.

SPM Table II-6: Key constraints for systems

System type	**This type of system is not allowable if:**
Trench systems	The land slope in the dispersal area is > 45% **Or** > 25% and the vertical separation is < 90 cm
Raised systems, sand mounds & at-grade beds	The land slope in the dispersal area is > 25%
Trickling gravity distribution	The land slope in the dispersal area is > 15% (except ET beds or ETA beds with sequential distribution)
Dosed gravity, close to D-box or splitter tee	The land slope in the dispersal area is > 15%
Alberta At Grade systems	Treatment method is Type 1 **Or** the land slope in the dispersal area is > 15% **Or** the soil profile has < 5 cm of undisturbed L-F-H horizon or equivalent **Or** the site is not forested
Type 1 below-grade seepage beds, Type 1 sand lined beds and Type 1 bottomless sand filters	The soil at the infiltrative surface is loam, silt loam, silt, clay loam, sandy clay loam, silty clay loam, sandy clay, silty clay or clay **Or** the soil at the infiltrative surface is loamy sand, fine sand, loamy fine sand, sandy loam, fine sandy loam, with a structure and consistence category of Poor or Very Poor **Or** the median K_{fs} is < 250 mm/day **Or** the median perc rate is slower than 40 min/inch
Seepage beds, sand lined beds and bottomless sand filters	The land slope in the dispersal area is > 15%

BC zero discharge lagoons	The median K_{fs} is > 150 mm/day **Or** the median perc rate is faster than 60 min/inch The property is smaller than 1.6 Ha The land slope is > 12% There is no annual net positive evaporation The VS is < 90 cm to SHWT or to a soil type or layer with perc or permeability unsuitable for a lagoon
ETA beds	The median K_{fs} is > 150 mm/day Or the median perc rate is faster than 60 min/inch There is no annual net positive evapotranspiration The VS is < 90 cm to SHWT or to a soil type or layer with perc or permeability unsuitable for an ETA bed
ET beds	The annual net positive evapotranspiration is < 600 mm

For the purposes of this area of study, the system type “Trickling Gravity Distribution” would be allowed provided that the land slope in the proposed dispersal area is not > 15% (13.5° from horizontal).

If soil constraints disallow the use of a gravity or dosed gravity distribution system, Table II-7 gives the planner guidance as to other options for dispersal.

SPM Table II-7: Soil constraints summary

Soil	**Structure and consistence category**	**Constraining factor**	**Requirements (in addition to other standards)**
Very or extremely gravelly sand or coarse sand Or Kfs > 17 000 mm/day Or perc rate faster than than 0.5 min/inch	F or P	Very high permeability, risk of bypass flow and reduced treatment	Uniform distribution with timed or micro-dosing
Clay loam, sandy clay loam, silty clay loam	F or P VP	Low permeability and risk of bypass flow Restrictive layer	Uniform distribution with timed or micro-dosing Lagoon, Et bed or ETA bed
Kfs 75 to 150 mm/day Or perc rate 60 to 120 min/inch	Any	Low permeability	Uniform distribution with micro-dosing Or sand mound with timed dosing Or lagoon, ET bed or ETA bed
Sandy clay, silty clay, or clay	F	Low permeability and risk of bypass flow	Uniform distribution with timed or micro-dosing and Type 2 or 3 Or sand mound with timed dosing Or lagoon, ET bed or ETA bed
Sandy clay, silty clay, or clay	P	Very low permeability and infiltration capacity	Uniform distribution with micro-dosing and Type 2 or 3 and minimum 30 cm sand media below infiltrative surface Or lagoon, ET bed or ETA bed
Sandy clay, silty clay, or clay	VP	Restrictive layer	Lagoon, ET bed or ETA bed

Kfs ≤ 75 mm/day Or perc rate 120 min/inch or slower	Any	Restrictive layer	Lagoon, ET bed or ETA bed
Soil with significant amounts of expandable clay minerals		Restrictive layer	Lagoon, ET bed or ETA bed
Organic soils		Limiting layer	ET bed
Soil structure and consistence category shows as “NA”		Restrictive layer	Lagoon, ET bed or ETA bed
High coarse fragment (c.f.) content (in any soil type) (c.f. are soil particles larger than 2 mm)	c.f > 35% c.f. > 60% c.f. ≥ 90%	Reduced soil treatment Reduced soil treatment, risk of bypass flow Limiting layer	Reduce HLR and HAR Reduce HLR and HAR and uniform dosing and timed micro-dosing ET bed

Determine the Hydraulic Loading Rate (HLR), Area of Infiltrative Surface (AIS), and Linear Loading Rate (LLR)

Using the standards tables of the SPM involves selecting a soil type or a representative permeability. Selection of a soil’s hydraulic loading rate (HLR) involves selecting a soil texture class, structure and consistence category and a soil permeability or percolation rate. Once it has been determined that the soil conditions allow the use of a gravity trickling system and a percolation rate has been arrived at, in minutes per inch, the next step is to determine the HLR of the soil. The HLR is a measure of the volume of effluent, in litres, that can be applied each day per square metre of infiltrative surface (AIS). The maximum allowable HLR is based on maintaining the permeability of the infiltrative surface, by not overloading it, while treating the effluent within the unsaturated sand and soil. Two tables in the SPM are consulted using the soil conditions arrived at through the soil analysis and percolation test, and the lower of the two HLR numbers pulled from the two tables is used for the calculation of the minimum AIS. The formula used for that calculation is:

$$\text{DDF (L/day)} \div \text{HLR (L/day/m}^2) = \text{minimum area of infiltrative surface (AIS) needed (m}^2)$$

Again, the explanations in this guide are abbreviated and descriptive only. An explanation of the process and procedures that must be followed in making a certifiable analysis of the soil conditions for the proposed field is far more in-depth and exhaustive than is warranted for the purposes of the explanations in this learning guide. Therefore, to illustrate the procedure used to determine the AIS and explain an example field sizing exercise, we’ll make these assumptions:

- A 3-bedroom house, with no garburator and not > 280 m^2 of living area applied to Table II-8 = 1 300 litres/day DDF
- After a soil test, it has been determined that the soil structure and consistence from Table II-21 (shown below) is considered "favourable" for a gravity trickle dispersal system

Moist consistence	Loose to friable	Firm	Very firm or stronger
Or cementation	Non-cemented Extremely weakly cemented	Very weakly cemented	Weakly cemented or stronger
Or dry consistence	Loose to slightly hard	Moderately hard	Hard or stronger
Structure			
Single grain (structure-less) soils	F	P	NA
Strong or moderate grade: granular, blocky or prismatic	F	P	NA
Weak grade: granular, blocky or prismatic	P	VP	NA
Weak grade platy structure (and sandy loam or loam)	P	VP	NA
Weak grade play structure, all other soils	VP	VP	NA
Moderate or strong grade platy structure	NA	NA	NA
Massive (structure-less) soils	VP	VP	NA
F = Favourable, P = Poor, VP = Very Poor, NA = Not Allowed			

TABLE II-21 [Image description] (#tableII-21_desc)

- The percolation rate, from the percolation test, is found to be **3 minutes/inch**
- The soil type, from the soil analysis, is determined to be **"loamy sand"**

When the two applicable tables are consulted using the **"loamy sand"** determination and the percolation rate of **3 minutes/inch**, the *lesser* of the two values is taken as the HLR for the dispersal area.

Using our assumptions, "loamy sand" and "favourable conditions" from Table II-22 indicate a hydraulic loading rate of **30 litres/day/m^2** for our Type 1 system. When the percolation rate of **3 minutes/inch** is entered into Table II-23, the HLR indicated is **35 litres/day/m^2**. This means that the HLR to be used will be **30 L/d/m^2**, which is the lesser of the two values.

Now that the HLR has been determined, it can be used in the following formula to determine the AIS required:

$$\text{minimum area of infiltrative surface (AIS) needed } (\text{m}^2) = \text{DDF (L/day)} \div \text{HLR } (\text{L/day/m}^2)$$

Using our example residence:

$$1\,300 \text{ litres/day} \div 30 \text{ litres/day/m}^2 = 43.33 \text{ m}^2 \text{ of infiltrative surface}$$

This means that the total trench bottom area in the proposed field must be at least 43.33 m^2.

Determine the Linear Loading Rate (LLR)

The total length of the disposal field can now be calculated and laid out within the area available. Local topography and other determining factors will be analyzed to determine where the trenches are to be dug, and their number, trench bottom width, and length. The total minimum length of the trenches is determined by computing the Linear Loading Rate (LLR).

The soil structure and consistence category are entered into a table to arrive at a linear loading rate. In a different table, just as with calculating the HLR, the soil permeability or percolation rate is entered to arrive at possibly a different LLR. The lesser of these two values is the LLR to be used in the following formula:

$$\text{DDF (L/day)} \div \text{LLR (L/day/m)} = \text{minimum system contour length (m)}$$

As an example, if we were to use the DDF previously calculated as 1 300 L/day and the LLR was found to be 35 L/d/m, the minimum contour (trench) length would be:

$$1\,300 \text{ litres/day} \div 35 \text{ litres/day/metre} = 37.1 \text{ metres of contour length}$$

Longer, narrower trenches have more sidewall area than shorter, wider trenches and are therefore preferred by the SPM if site conditions allow. Also, there will be less water dispersed per meter which helps keep the infiltrative surface from becoming saturated.

Example of Trench Length Needed

Say there is a Daily Design Flow of 1 300 L/day, HLR of 15 30 L/day/m^2, and 0.6 m wide trenches.

The trench bottom area needed is:

$$\text{minimum AIS needed} = \text{DDF} \div \text{HLR} = 1\,300 \div 30 = 43.33 \text{ m}^2$$

Then the total length of trenches would be:

$$43.3 \text{ m}^2 \div 0.6 \text{ m} = 72.2 \text{ m (236 ft)}$$

The dispersal area would be mapped out to accommodate at least 72.2 m (236 ft) of trenches with a trench bottom width of 0.6 m (2 ft).

The figure below is a cross section that represents a conventional distribution trench.

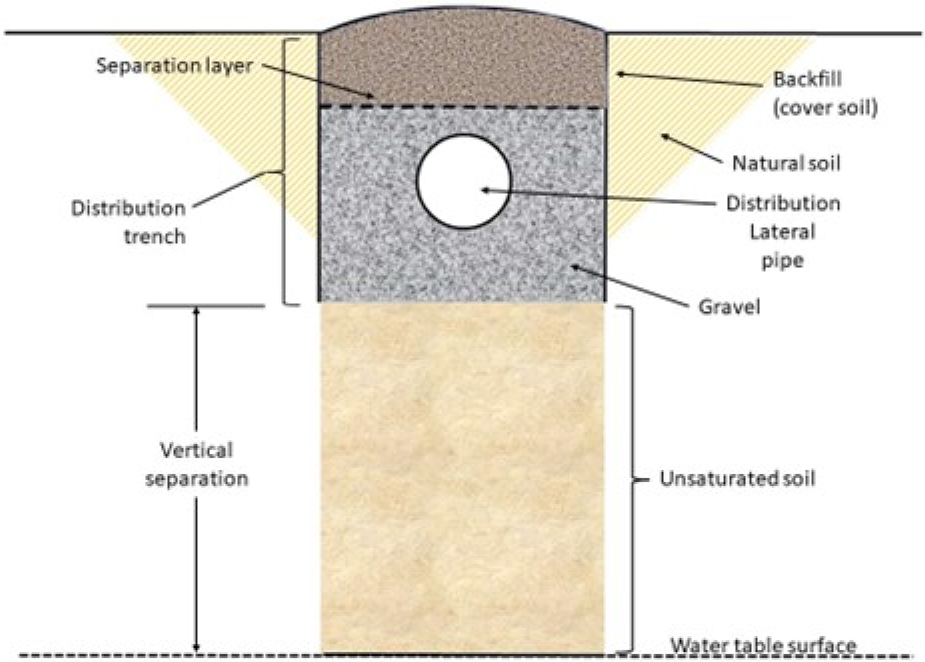

Figure 26. Typical gravity distribution trench

In the figure above, the unsaturated soil is native soil that hasn't been excavated. It separates the "restrictive layer" (in this diagram the water table) and the bottom of the dug trench which is referred to as the "infiltrative surface." The pipe (lateral) is laid into a bed of gravel (drain rock) over which is placed a "separation layer" such as lightweight non-woven geotextile or untreated building paper. The native soil is put back into the trench on top of the separation layer and is mounded to prevent surface water from flooding the field and allow for soil settlement.

The diagram below shows a cross section of a gravity distribution lateral with some minimum distances as mandated by the SPM.

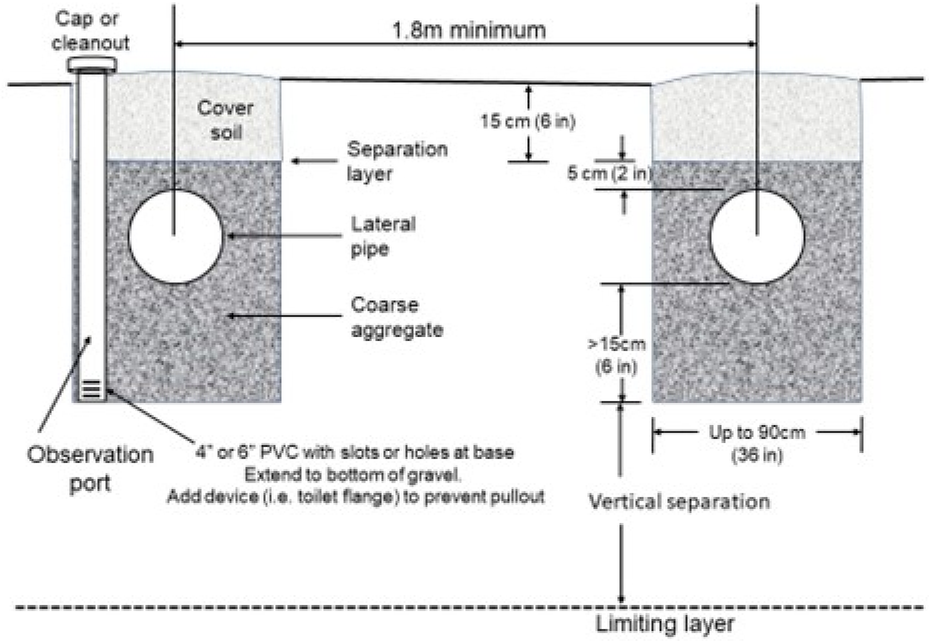

Figure 27. Typical trench installation with observation port

An "observation port" is simply a vertical pipe with a cap, placed in the trench, that allows the depth of water in the field to be easily checked.

Other suggestions from the SPM:

- Trench widths are 30-90 cm (12-36 in.); on slopes greater than 15%, use/specify a trench width of 30-60 cm (12-24 in.)
- Limit laterals to 15 m (50 ft) or less
- Install trenches level, or sloping in the direction of flow at no greater than 5 cm in 30 m (0.2%)
- Space trenches a minimum 1.8 m (6 ft) from centre line to centre line (c-c)
- On slopes greater than 15%, space trenches at least 3 m (10 ft) c-c
- Provide at least 0.9 m (3 ft) between adjacent trench edges
- Do not compact the soil under or over the lateral
- Use aggregate (drain rock) in the size range of 12 mm-63 mm (½″-2 ½″)
- Install aggregate to at least 15 cm (6 in.) depth below the distribution pipe and at least 5 cm (2 in.) above the pipe
- Install cover soil to at least 15 cm (6 in.) depth
- Install at least two infiltrative surface observation ports per drainfield
- Place observation ports 10–15 cm from the distribution pipe, and near the midpoint of the lateral

- Use 100 mm (4″) or larger diameter pipe

Self-Test 4

Self-Test 4

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://opentextbc.ca/plumbing4d/?p=27#h5p-4 (https://opentextbc.ca/plumbing4d/?p=27#h5p-4)

Treatment Methods

As mentioned previously, there are two distinct components to a sewerage treatment system – the dispersal area and the treatment method. Treatment methods are:

- *Type 1*: Treatment by a septic tank and dispersal field only.
- *Type 2*: Treatment that produces an effluent consistently containing less than 45 mg/L of TSS and having a BOD_5 of less than 45 mg/L.
- *Type 3*: Treatment that produces an effluent consistently containing less than 10 mg/L of TSS and having:
    - A BOD_5 of less than 10 mg/L.
    - A median fecal coliform density of less than 400 Colony Forming Units per 100 mL.

A Type 2 treatment system is typically a package treatment plant, and Type 3 is a municipal treatment facility. This literature will focus on Type 1 treatment method.

Septic Tank Installation

Pre-manufactured tanks must meet the standards found in CAN/CSA-B66-00 “Prefabricated Septic Tanks and Sewage Holding Tanks.” The septic tank process provides settlement of sludge and flotation of fats, oils, and grease, together with some anaerobic treatment and digestion of sludge. Settlement is improved in tanks that have a shallow and long flow path, and flotation is a function of surface area in relation to flow. Therefore, septic tank performance is improved by:

- Larger surface area (higher surface area-to-volume ratio)
- Longer distance between inlet and outlet pipes (higher length-to-width ratio)
- For two compartment tanks, letterbox openings in the compartment divider

Flow rates through the tank should be kept low to improve sedimentation efficiency and to prevent scouring of previously accumulated sludge. The SPM specifies using inlet and outlet baffles to achieve quiescent flow. An effluent filter is provided at the outlet of the tank, drawing effluent from the clear zone. This filter protects the dispersal system as well as improving BOD, TSS and Oil and Grease removal.

The working volume of a tank is its depth (measured from the invert of the outlet to the tank bottom) multiplied by its length and width and converted into a liquid measure.

Although the SSR does not address tank sizing, the SPM points to sizing the tank to meet the following criteria:

- For a daily design flow of up to 9 100 L/day, the tank should have a working volume of at least 3 times the DDF
- For a DDF of more than 9 100 L/day, the working volume should be at least 15 000 L + (DDF in litres × 1.34) or as otherwise determined by a design professional

For example, if a 3-bedroom house has an expected **DDF of 1 300 L/day**, a tank with a working volume of at least **1 300 L × 3 = 3 900 litres** would be the minimum required size.

Septic tanks are available in single chamber and two compartment configurations. For tanks of equal volume and surface area, a single chamber tank will have improved settlement over a two-compartment tank. Conversely, a two-compartment septic tank will commonly have less scum accumulation at the outlet filter than a single compartment tank. The BC regulations no longer mandate the use of a 2-compartment tank, or 2 tanks in series. However, for tanks with 2 compartments or two tanks in series, the SPM specifies the use of tanks with ¾ to ½ of the total working volume in the first compartment.

The SSR recommends using larger tanks than the minimum for various reasons, including:

- To improve oil and grease removal
- To improve suspended solids removal
- To increase interval between pump outs
- To improve flow equalization where large surge flows are expected, such as from sewage sump pumps in basements.

To gain the best advantage from an increased tank volume, it is advisable to specify a tank with larger surface area and greater length between inlet and outlet as well as a larger volume. Treatment and digestion of the accumulated sludge and scum is improved with long sludge retention times. Larger tanks allow greater sludge accumulation which lengthens pump out intervals. According to Vol. III – 6.4.1.1 of SPM, pump out intervals of **5 years or more** are preferred.

The SPM also notes that the use of low flow fixtures, such as ULF toilets, does not reduce the DDF rate for sizing purposes.

Tank Placement

In all likelihood the excavation for a septic tank will be more than 1.2 m deep, so workers in BC must adhere to WorkSafeBC® regulations requiring sloping or shoring when exceeding that depth. In all cases, tanks must be placed on a uniform level surface or bed that will not allow uneven settling, and which does not have rocks or roots that could create point loading on the tank. Bedding sand, drain rock or pea gravel should be used and compacted to an elevation that will allow gravity drainage flow through the building sewer at a minimum grade of ⅛″/ft $\left(\frac{1}{100}\right)$ according to the prevailing plumbing code.

Flotation Prevention

Tanks, especially if made of plastic, are prone to flotation especially when only partly full or empty. If groundwater conditions may lead to tank flotation, the ideal remedy is to drain the area around the tank. If this isn't practical, prevent flotation by anchoring as per manufacturers' recommendations. Water table standpipes, minimum 2″ diameter, can be installed vertically at the edge of the tank, for monitoring purposes. Pumping of the tank should be avoided in periods when the water table is high enough to cause the installed tank to float, as flotation can occur even though the tank is installed with adequate ground cover on it.

Tank Venting

All tanks are required to be vented. This is normally accomplished back through the sanitary building sewer. If this isn't feasible, use a tank vent that is at least equal in cross sectional area to the tank inlet pipe and is installed to the standards found in Vol. II of the SPM.

Tank Access

After installation, there should be access to each chamber or compartment, above the inlets and outlets and for each baffle, tee or effluent filter. This allows for maintenance and helps to accommodate periodic inspections. Access tunnels, called "risers," are sealed to the tank lid which is normally 12 inches or more below ground level.

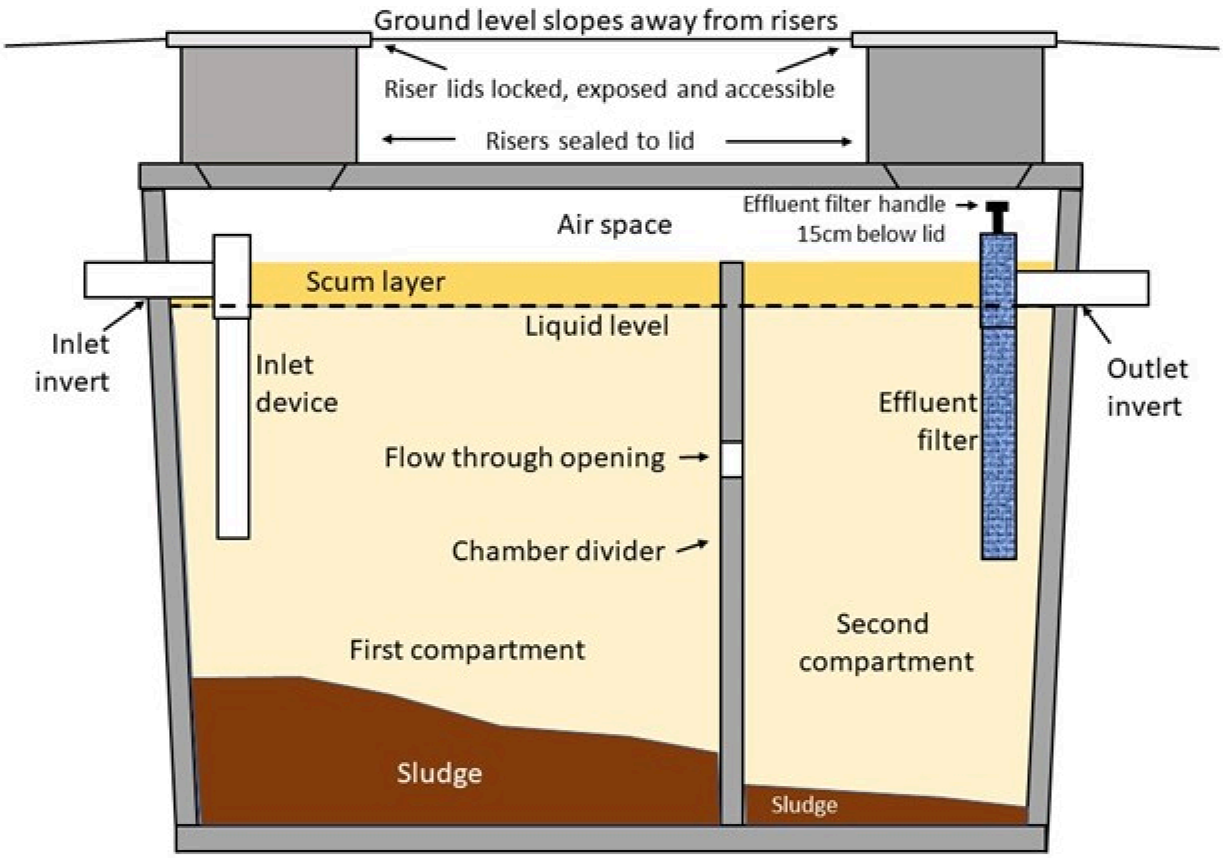

Figure 28. 2-compartment septic tank

The following points regarding access should be considered:

- Any components that need to be accessed or removed should have handles or disconnect fittings located within 15 cm of the riser or access lid.
- Access lids should be exposed and readily accessible. They should be flush with finished grade or above (2.5 cm above is preferred).
- Access lids should be secure, either requiring special tools for removal, or provided with a lock.
- Removable access lids (including any job-built access components) should be capable of supporting at least 150 kg without collapse.
- Risers should be at least 50 cm internal diameter, or 60 cm when over a divider or if needed to access a pump etc.
- For tanks that are installed deeper than normal (over 90 cm of fill over the tank lid), larger access risers with a minimum diameter of 76 cm are preferable.
- Pump chambers will also require access. Provide two risers if one will be largely filled with the pump, connections, and float switches.
- The inlet pipe to the pump chamber should be accessible for visual inspection by the

maintenance provider, or for collecting effluent samples for laboratory testing.

- Extend access risers to finished grade and slope the ground away from the riser lid
- Insulate the riser in cold climates

Backfilling

Backfilling should be done to tank manufacturers' recommendations and guidelines.

Tank Testing

Test all tanks using water, to verify a rate of leakage less than 0.1% of volume per day. Alternately, use vacuum testing as described in the SPM. Test the tank, penetrations, and the lid seal.

Distribution Box Installation

Distribution boxes, if used, should be installed level on compacted fill. Speed levelers should be used in the outlets if the D-box is even slightly out of level. This ensures that the inverts of all laterals get equal flow. Like the septic tank, the D-box should have a riser large enough to accommodate maintenance and inspection, which should be extended to just above the surrounding ground.

Horizontal Separation

Table II-19 of the SPM, shown below, lists minimum clearance distances from wells, drinking water lines and cisterns, and water bodies to septic tanks and dispersal systems.

SPM Table II-19A: Minimum required horizontal separation distances
Water Sources and Wells

Minimum Horizontal Distance to	From dispersal system (metres)	From watertight treatment or pump tank (metres)
Surface source of drinking water	30	15
Domestic water supply well	30	30
Domestic water supply well, high pumping rate	60	30
Domestic water supply well, high pumping rate, in unconfined aquifer	90	30
Irrigation well or open loop geothermal well	15	7.5
Deep monitoring well or closed loop geothermal well	6	6
Shallow monitoring well	3	0

SPM Table II-19B: Minimum required horizontal separation distances
Drinking water lines and cisterns

Minimum Horizontal Distance to	From dispersal system (metres)	From watertight treatment or pump tank (metres)
Drinking water suction line	30	15
Drinking water suction line, sleeved	7.5	3
Drinking water line, under pressure	3	3
Drinking water line, under pressure, sleeved	1	1
Drinking water supply cistern, below ground	15	3

SPM Table II-19C: Minimum required horizontal separation distances
Water bodies and surface breakout

Minimum Horizontal Distance to	From dispersal system (metres)	From watertight treatment or pump tank (metres)
Permanent freshwater body	30	10
Intermittent freshwater body	15	10
Marine water body	15	7.5
Breakout point or downslope drain	7.5	0

As well, Table III-16 of the SPM below provides more suggested distances for horizontal separations.

SPM Table III-16: Guidelines for minimum horizontal separation distances

Distance to	**From dispersal system (metres)**	**From watertight subsurface treatment tank (metres)**
Property lines	3	1
Building or structure (where there is not a perimeter drain)	1	1
Dispersal system (including other dispersal system)	6	3
Buried utility services	1	1
Drinking water supply cistern, at or above ground	1	1

Commissioning the System

The following checklist for system commissioning is general in nature, with most of the points being specific to pressurized dispersal systems.

- Set float switches or transducers, and test the system operation, including alarms
- Set the pump control panel (timers, data loggers and programmable controls) and test operation
- Test pumps, fan, and blower operation, and measure the voltage and run amperage
- Check the force mains, including the pressure effluent collection mains, for leaks
- Flush all lines in the treatment and pumping systems, transport lines and dispersal system
- Test back-flow preventers (i.e., check valves).
- Test and adjust the D-box and outlet controls (gravity system with D-box).

- Test the pressure distribution residual pressures (a.k.a. "squirt test"). This may include the final pressure distribution system, and treatment system distribution piping (i.e., sand and textile media filters). Adjust valves, as required, to equalize pressure. Record distal pressures (squirt heights).
- Test and record pump discharge flow rate or draw down. Record pump run amperage.
- Record the initial control panel settings, system operating parameters, and the start-up data logs. Note any changes to the design or operational settings.
- Complete a general review of the system operation to verify that it is operating as intended, and in accordance with the manufacturer's specifications
- Perform baseline monitoring if applicable (e.g., record water table levels in observation standpipes, collect and test samples of water from drainage system).
- Put the sewerage system into service. Ensure that the breakers, switches and valves are in operating position, the tank lids are secure and that the site has been left in a safe and tidy condition.

Self-Test 5

Self-Test 5

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://opentextbc.ca/plumbing4d/?p=27#h5p-5 (https://opentextbc.ca/plumbing4d/?p=27#h5p-5)

Media Attributions

- Figure 26. "Typical gravity distribution trench" by Camosun College is licensed under a CC BY-NC-SA licence (https://creativecommons.org/licenses/by-nc-sa/4.0/deed.en).
- Figure 27. "Typical trench installation with observation port" by Camosun College is licensed under a CC BY-NC-SA licence (https://creativecommons.org/licenses/by-nc-sa/4.0/deed.en).
- Figure 28. "2-compartment septic tank" by Camosun College is licensed under a CC BY-NC-SA licence (https://creativecommons.org/licenses/by-nc-sa/4.0/deed.en).

Image descriptions

Table II-21 image description:

Table II-21 part 1: Hardness and moist consistence

Moist consistence	**Loose to friable**	**Firm**	**Very firm or stronger**
Or cementation	Non-cemented Extremely weakly cemented	Very weakly cemented	Weakly cemented or stronger
Or dry consistence	Loose to slightly hard	Moderately hard	Hard or stronger

Table II-21 part 2: Hardness to structure

Structure	**Loose to friable**	**Firm**	**Very firm or stronger**
Single grain (structure-less) soils	Poor	Poor	Not allowed
Strong or moderate grade: granular, blocky or prismatic	Favourable	Poor	Not allowed
Weak grade: granular, blocky or prismatic	Poor	Very poor	Not allowed
Weak grade platy structure (and sandy loam or loam)	Poor	Very poor	Not allowed
Weak grade play structure, all other soils	Very poor	Very poor	Not allowed
Moderate or strong grade platy structure	Not allowed	Not allowed	Not allowed
Massive (structure-less) soils	Very poor	Very poor	Not allowed

[Return to Table II-21] (#tableII-21)

Competency D2: Test and Service Sewage Treatment Systems and Components

Learning Task 1

Describe Testing of Sewage Treatment Systems and Components

A septic system cannot be considered ready for use until it has been tested. This learning task outlines the various tests involved in a Type 1 system.

Learning Objectives

After completing this learning task, you will be able to:

- Describe the tests associated with a septic tank installation
- Describe the tests associated with gravity and pressure distribution dispersal systems

Testing the Septic Tank

The **Sewerage System Standard Practice Manual (SPM)**, states that tanks should be leakwatertight tested to meet the standard in Table II-34, which, simply put, says "Test all tanks using water, to verify a rate of leakage less than 0.1% of volume per day. Test the tank, penetrations, and the lid seal. Alternately use vacuum testing."

Water Test

The tank, penetrations, and the lid seal should be subjected to a water test. To do this, plug inlet and outlet pipes. Fill the tank to 5 cm above the top of the tank lid (observe in the riser) with clean water (avoid overfilling to reduce risk of lifting the lid off the tank).

For concrete tanks, fill the tank and let it pre-soak for 24 hours before testing.

To measure leakage, measure water level in a riser, in which a loss of water will be more noticeable than in the tank due to the smaller size of the riser. The following information is provided to translate a drop in water level in a riser to a loss in volume.

Measure leakage

Riser diameter (cm/inch)	Depth (cm) equal to 10 L
46/18	6
61/24	3.5
76/30	2.25
91/36	1.5

Avoid the water freezing during and after testing. For testing plastic or fiberglass tanks, follow manufacturer recommendations. Some manufacturers recommend backfilling around the tank before or during filling the tank with water.

When performing hydrostatic testing in cold climates, consider that:

- Water is its densest at about 4°C (just above freezing), so water put into a tank at 10 to 20°C (typical of groundwater) and left in the tank overnight at freezing temperatures will drop the level in the tank a substantial amount (about 0.2% or 11 litres in a 5 600 L tank). A “loss” of 11 litres (0.2%) in the risers will look like a leak.

Vacuum Test

As an alternative to water testing, a vacuum test may be used. The 2003 National Precast Concrete Association (US) standard states: “The recommended (vacuum test) procedure is to introduce a vacuum of 4 inches of mercury. Hold this pressure for 5 minutes. During this initial 5 minutes, there is an allowable pressure equalization loss of up to one half inch of mercury. If the pressure drops, it should be brought back to 4 inches and held for a further five minutes with no pressure drop.”

Testing the Dispersal System

The piping in a gravity distribution system piping, whether it is of the trickling or dosing type, will not be capable of holding any type of pressure test. Anything resembling a test for the parts of such a system downstream of the outlet of the tank effluent chamber would be done through the installation process, such as ensuring the laterals and distribution headers are level and correctly connected, etc.

Testing of a dosing siphon can be accomplished by filling the dosing chamber with water and observing the level as the siphon trips, ensuring that the appropriate amount of liquid is discharged to the field. Any adjustments as to the height of the bell can then be made if needed. The dose volume should be at least 67% of the field’s volume.

For systems that pump effluent from a septic tank, such as in dosing through gravity or pressure distribution, Section II-6.4 of the SPM specifies:

- A filtered (screened) vault with the inlet at the centre of the clear zone

- A maximum pumping rate of 190 L/min (50 USGPM).
- A maximum drawdown of 10% of the tank working volume.
- An alarm reserve volume of at least 50% of the daily design flow (DDF), measured to the tank lid base (without backup into building).

The points listed above should have been part of the design at the time of installation, however these can be part of the testing process as well. The pump and alarm are controlled by sensors or float switches. These should be manipulated to test the operation of the pump and alarm to properly react to the “pump off,” “pump on,” and “alarm” settings.

If the pump is part of a pressure distribution system, a “squirt” test is required to ascertain that the pump is delivering enough pressure and volume to operate the system as designed. This is done prior to the field piping being backfilled, so it could be considered as part of the installation process as well. The pump chamber is filled with water, and the pump is turned on. Minimum 3.2 mm $\left(\frac{1}{8}''\right)$ diameter holes (orifices) are drilled into the top of the small diameter lateral pipes, and these will be covered with orifice shields before being backfilled. Water must squirt to a minimum height of 60 cm (24 inches) for orifices that are 4.8 mm $\left(\frac{3}{16}''\right)$ or larger, and at least 1.5 m (60 inches) for orifices smaller than 4.8 mm $\left(\frac{3}{16}''\right)$ diameter. All squirt columns must be within 15% height of each other along the network, and within 10% along any lateral. Valves placed on the distribution mains and laterals can be adjusted to accomplish the above if needed.

Other dispersal systems will have required tests particular to them. These are covered in the SPM and their descriptions will not be undertaken in this learning guide.

Learning Task 2

Describe Maintenance of Private Sewage Treatment Systems

As maintenance is critical to the proper functioning of a sewerage system, the owner of the system is responsible under the SSR to ensure that the appropriate maintenance and monitoring is carried out for all components of the system. This requires the designation of an AP as a system maintainer on the permit documents. This learning task will cover the standard expectations for maintenance of a septic system.

Learning Objectives

After completing this learning task, you will be able to:

- Describe routine operations for maintenance of a septic systems and components

Maintenance Plan

The maintenance plan should specify the initial schedule of system maintenance. Table II-62 of the SPM shows minimum intervals for maintenance visits and testing for the first 12 to 14 months of operation depending on system or treatment type. Thereafter, the AP and owner would agree on an appropriate maintenance schedule over the next 5–10 years.

Table II-62 of SPM: Minimum initial frequencies for maintenance and monitoring

System or treatment type	Inspection (By AP)	Flow	BOD_5 and TSS	Fecal coliforms	NOTES
Type 1	12 months	12 months			
ET or ETA	6 months	6 months			During the wet season
Type 2	6 months	6 months	6 months		
Type 3	1 month 7 months 13 months	1 month 7 months 13 months	1 month 7 months 13 months	1 month 7 months 13 months	
Lagoon	12 months				Flow monitoring for diagnosis only

The maintenance plan furnished to the customer by the AP should include:

- An operation manual for the system
- A schedule for maintenance and monitoring including prescribed maintenance tasks
- A statement of the allowable average flow for any 30-day period
- Contact information and emergency contact information for the AP who filed the system, the installer, a maintenance provider and the electrician
- Information and advice for the system owner, and
- Sign off by owner that they have received and understood the requirements of the plan

Pump Outs

Pumping of sewage and effluent involves a pumper truck. They are trucks that vary in size from single-axle units meant for servicing small tanks such as found in a portable toilet, to large tandem-axle units meant to service septic and holding tanks. A vacuum pump at the top of the onboard tank creates a partial vacuum within it, which is transferred to a hose connected to the lower portion of the onboard tank. The hose is inserted into the septic tank, and the liquefied contents are drawn into the onboard tank through it. The contents of the truck's onboard tank are emptied at a municipal sewage treatment facility.

Figure 1. Pumper truck

Regular monitoring of the scum and sludge levels is the best way to determine a pump out frequency for a specific installation. Assess the sludge and scum accumulations and pump out when any of the following are noted:

- Total solids accumulations are more than ⅓ of the internal height of the tank
- The scum layer reaches the top of outlet T in a one compartment tank

- The scum layer reaches the top of inlet T in a two-compartment tank
- Any obvious carry-over of solids to the second compartment
- Premature effluent filter clogging
- An increase in TSS or FOG (fats, oils and grease) noted in downstream components

There is no longer a suggested minimum pump-out interval for all tanks, due to the requirement to have the maintenance of systems overseen by a designated AP. Because some digestion of sludge and reduction of sludge volume occurs after approximately 3 years, it is not appropriate to pump out tanks when scum/sludge accumulations do not warrant it. As noted earlier in D1, pump-out intervals of at least 5 years or longer are preferred.

The table shown below, Table III-35, is from the SPM and is an estimate only. In this table, entries that are shaded, which are also indicated by asterisks after their value, show septic tank sizes that are not recommended. (Table III-35 is based on year-round occupancy, and accumulation rates taken from T. R. Bounds "Design and Performance of Septic Tanks," Site Characterization and Design of On-Site Septic Systems, p. 217, 1997.)

SPM Table III-35: Estimated septic tank pumping frequencies in years

Tank Volume (Litres)	**Tank Volume (Imp. Gals.)**	**Household Occupancy (Number of people): 2**	**Household Occupancy (Number of people): 4**	**Household Occupancy (Number of people): 6**	**Household Occupancy (Number of people): 8**	**Household Occupancy (Number of people): 10**	**Household Occupancy (Number of people): 12**
2300	500	8.0*	2.9*	1.6*	1.0*	0.7*	0.6*
2700	600	10.5*	3.7*	2.1*	1.31*	1.0*	0.7*
3405	750	14.6	5.2	2.9*	1.9*	1.3*	1.0*
4100	900		6.8	3.7	2.4*	1.8*	1.3*
4500	1000		8.0	4.4	2.9*	2.1*	1.6*
5000	1100		9.2	5.0	3.3*	2.4*	1.8*
5900	1300		11.8	6.5	4.2	3.0*	2.3*
6800	1500			8.0	5.2	3.7	2.9*
7300	1600			8.8	5.7	4.1	3.1*

Vegetation and Dispersal Systems

In many cases the natural ecosystem of a site is important for maintaining the soil characteristics that made the site usable for a dispersal system. Tree and shrub cover in the dispersal and receiving area can improve system performance by:

- Reducing effective rainfall (the amount of rain that actually soaks into the soil)
- Maintaining soil structure and organic matter content in the long term
- Reducing temperature extremes, and particularly reducing risk of freezing

However, depending on the system type, tree roots may harm the dispersal system. In general, the recommended procedure is to leave trees and stumps in place. For trees with highly invasive roots (i.e., willow, aspen, bamboo, and maple), it may be best to remove the tree and stump or to kill the stump if it is left in place. Reestablishment of natural vegetation cover should be encouraged after system installation, in as far as is practical. Choose trees and shrubs to suit the area and which are known to not have invasive roots. For BC zero discharge lagoons it is important to prevent tree growth on or near lagoon berms.

Biomat: Good, Bad, or Both?

The SPM lists the following definition for “biomat”:

> Soil clogging layer at and below the infiltrative surface to soil or to sand or other media. The layer of biological growth, organic compounds (including polysaccharides and polyuronides produced by bacteria in the mat) and inorganic residue that develops at the wastewater soil interface and extends up to about 25 mm into the soil matrix. The term is used loosely to include all soil “clogging” affects, including pore size reduction, alteration of soil structure and gas production by the micro-organisms. Also referred to as Biocrust, Clogging Mat, and Clogging Zone.

From the above definition, it suggests that biomat buildup clogs the soil and will cause the dispersal system to fail over time. This is partially true, if there is not a calculated and stringent adherence to the planning and execution of procedures as laid out in the SSR and SPM. The following excerpt is taken from the blog post *Understanding The Biomat in Septic Systems (https://www.bio-sol.ca/en/understanding-the-biomat/)* and may help in explaining the importance of biomat and its function in a properly designed, installed, and maintained septic system:

> A black, jelly-like permeable layer forms in the soil just below or around the drain field trenches where the septic effluent is discharged. This layer is what is referred to as biomat, clogging mat, biocrust, or clogging zone, and it plays an important role in the processing of pathogens and biological solids. Without biomat, the septic system would be releasing partially treated effluent into the soil thereby resulting in pollution of groundwater and any nearby wells, ponds, and streams. As the wastewater from the septic tank is fed into the soil absorption system for further treatment, bacteria grow under the distribution lines where they meet the soil or gravel. This biological mat forms on the sides and bottom parts of a leach field trench, helping to reduce the infiltration rate of water into the soil and thereby giving bacteria more time to treat the water before it is released, which translates to a “good thing.”
>
> Biomat is made up of live and dead anaerobic bacteria and their by-products which attach themselves to the soil particles. These microorganisms usually rely on the organic matter in the effluent for sustenance and therefore biomat is often referred to as the actual site for treatment of effluent. In a new system, biomat will start forming at the trench bottom where the effluent discharges from and then it will slowly grow along the trench walls. Because biomat is not as permeable as soil, effluent will trickle along the trench looking for a place with little or no biomat and this helps to slow down the infiltration of wastewater. Biomat slows down the flow rate of wastewater thereby giving it time to filter out viruses and other pathogens.

How to Prolong the Biomat Lifetime (Extend the Life of the Dispersal System)

The “bad thing,” as far as biomat formation goes, is that the hydraulic application rate might exceed the infiltration rate due to too much biomat growth, and that is when ponding starts, indicating the system is failing. In such a case, wastewater could back up into the house or gush out on the soil surface. Biomat plays a vital role in the purification of wastewater, and it should therefore not be prevented from forming. However, there are some steps that can be taken to ensure it doesn’t overgrow to the point of causing backups. The simple steps to avoid the overgrowth of biomat include the following:

- **Proper maintenance**. Taking good care of a septic system will help to avoid many issues including ponding in the leach field area due to the overgrowth of biomat. The AP Maintainer designated for the system will ensure that routine maintenance in the official Maintenance Plan is performed.
- **Avoid hydraulic overload**. Hydraulic overloading is one of the main causes of the overgrowing of biomat. Through the force of gravity, effluent is distributed somewhat evenly across the drain field area from where it slowly sips through the trenches and back into the groundwater. As has already been established, biomat slows down this process which is a good thing. In an ideal scenario, this process continues day in day out. However, when too much water is sent into the disposal field at one time, the field will become waterlogged. When the field gets too wet, the rate of breaking down organic matter reduces greatly and the waste products that are produced by the bacteria get more time to settle. This ultimately leads to unprecedented growth of biomat. To avoid this, it is a good idea to avoid sending too much water to the septic tank all at once. If there are lots of people living in a household, space out showers instead of taking all of them in a row. Also, spread out laundry across the week instead of doing a huge load of laundry in a single day.
- **Septic tank filter system**. Septic tanks filters help trap suspended solids from going into the drain field. Because the bacteria rely on organic waste for sustenance, giving them too much food around the clock will increase their numbers exponentially and will, in turn, increase their waste which will increase the rate at which the biomat grows. Proper maintenance of filters avoids this.
- **Don’t flush harmful products**. When harmful products are flushed, they can deplete the number of bacteria in the septic tank as well as in the dispersal system. This will mean that organic waste will not be properly digested in the tank and much of it will end up in the field. When too much of the suspended solids flow into the field, they contribute to the excessive growth of biomat. To avoid this, do not flush anything apart from human waste and tissue paper. Installing washing machine filters can also help to prevent fibres from clogging the effluent filter in the tank. Additionally, avoid any substance that might harm bacteria. These include:
    - bleach and disinfectants
    - antibacterial soaps
    - antifreeze
    - chlorinated backwash from hot tubs, swimming pools, R/O units, water treatment filters, etc.

Additionally, the SPM advises that floor drains should not be connected to the sewerage system.

Conclusion

Biomat plays a vital role in the treatment of wastewater. Without biomat, conventional septic systems would be sending partially treated water into the environment, so its formation shouldn't be stopped. That said, biomat that grows too fast can cause problems usually exacerbated by poor septic tank care and maintenance. A properly functioning septic system, designed to the soil conditions that is well-maintained, shouldn't pose any biomat problems for at least 25 years.

Additives

There is much debate over the introduction of additives or treatments commonly called "starters," and the SPM does not address them at all. Their exclusion from commentary in the SPM suggests that they are frowned upon and should not be used. However, there is much written on the internet that suggests the use of biological (not chemical) additives can assist in the formation and propagation of "good" bacteria in the tank and field and may be beneficial for the long-term health of the system. Much of that information is offered by the manufacturers of these products, and so the points presented should be considered carefully. In conclusion, it must be said that the "jury is still out" on the use of additives to help maintain the system.

Media Attributions

- Figure 1. "Pumper truck"by Mitchell Schultheis is under a CC BY-SA 3.0 licence (https://creativecommons.org/licenses/by-sa/3.0/deed.en).

Learning Task 3

Describe Troubleshooting Procedures for Sewage Treatment Systems and Components

When sewage treatment systems fail, it is often difficult to determine where the problem lies and how to overcome it. This learning task will cover common issues, their indicators, and offer acceptable solutions.

Learning Objectives

After completing this learning task, you will be able to:

- Identify common indicators related to problems with septic systems
- Describe acceptable remedies for septic issues

With routine maintenance, most septic systems will be trouble free. However, when problems arise, they originate in areas of a system that can't be seen or easily accessed. The following are not a complete list of issues that could be encountered — they are the most common ones.

Slow or Stopped Drainage

Fixtures that drain slowly or not at all are an indicator that the piping downstream is partially or fully blocked. Check first to see that the problem is not in the house piping or the building drain. If not, assume that the tank is not draining as it should. Firstly, check the observation ports in the field trenches, as these should be easy to find and access. See if the field is saturated. If so, this could be the result of a high seasonal water table, unusually high recent rainfall, or a plugged field due to excessive biomat formation. Remedies to consider would be to firstly reduce the house water use as much as possible, to give the system time to recover. In the case of excessive biomat, consider the use of biological additives to help break down the biomat and restore the permeability of the soil. Alternatively, the field may have to be abandoned and replaced, and this should be considered a last resort. If the field is dry after checking the observation port, check the liquid level in the tank. If sludge buildup is too high, it can plug the outlet pipe or the inlet to the pump if using a dosed system. In that case, have the tank pumped and clean any filters at the outlet. If a pumped system is in use, check that the pump and all float switches and sensors are operating properly, and replace any that are found to be faulty.

“Ponding” over the Dispersal Field

Soggy, wet ground or puddles forming on the ground above a dispersal field is evidence that there is either a leak or break in the piping somewhere between the house and the field piping, or that the soil is not absorbing the effluent fast enough.

In the first case, check the piping between the house and the tank, the tank and distribution box (if used), and the distribution box and field piping to ensure that there is flow at these points, and if not, work back upstream to determine where the break in the piping may be. Once the leak location is identified, the ground will have to be excavated and the pipe break repaired.

For the latter case, once the pores in the infiltrative surface within the field trenches become plugged by biomat, effluent will find its way upward, rather than downward, through the soil. Again, the use of biological additives may correct the situation, but this will not happen immediately. Reduce water use in the building to allow sufficient time to see if the additive(s) are working. Again, a more immediate albeit costly fix would be to replace the dispersal field piping.

Contaminated Drinking or Surface Water

If the system has otherwise been operating properly up to this point, it can be assumed that untreated sewage is making its way to these water bodies. Septic tanks can develop cracks that cause raw effluent to leak into the surrounding soil. This is a serious issue that must be corrected immediately. An AP or professional would be consulted in any case, who would determine whether it can be repaired or must be replaced.

Proximity to a neighbouring septic system or source of contamination that isn’t on the owner’s property should also be investigated, especially if there has been recent groundwork done there.

Overall Troubleshooting

In every case, especially when the house drains into a septic system, use as little water as possible. Repair any drips from faucets and replace old wasteful fixtures with ones that are of the low or ultra-low consumption variety. Avoid discharging the waste or rinse water from softeners, iron filters and such into the system. This adds unnecessary volume and may introduce harmful chemicals. In all cases, whenever problems are encountered, always try the simplest, most cost-effective remedies first.

Learning Task 4

Describe the Repair of Sewage Treatment Systems and Components

The discovery and identification of defects and issues in septic systems is one of the intended benefits of the requirement in the SSR and SPM to have routine maintenance performed by an Authorized Person. When septic systems fail, there is an urgency to make repairs in a timely fashion due to the health hazards associated with them. This learning task will outline the nature and common procedures involved in repairing an existing Type 1 septic system.

Learning Objectives

After completing this learning task, you will be able to:

- Identify situations where repairs would be warranted
- Describe the procedures involved with common repairs

Damaged Concrete Septic Tanks

If properly constructed and installed, concrete septic tanks should last as long as the buildings they serve. If a problem occurs, it is usually due to one of the following reasons:

- Poor installation techniques: improper bedding and compaction can cause the tank to settle unevenly and develop cracks
- Manufacturing defects: These can sometimes occur and may not be visible upon pre-installation inspection
- Mechanical damage: rough handling when being installed or heavy traffic over the installed tank can cause it to crack or collapse
- Corrosion: the anaerobic process inside the tank emits hydrogen sulfide gas, and when this mixes with oxygen from the air, hydrochloric acid is produced. This forms at and above the waterline and causes the concrete to spall or flake off over a prolonged period. This continues until the tank wall is so badly compromised that repair or replacement is required.

Concrete Tank Repair

If repair is warranted, the tank must first be exposed, and the lid removed. It is pumped out, cleaned, and allowed to dry. A ladder should be used to allow easy access and egress. An empty tank, even with the lid removed, can be considered a “confined space,” and WorkSafe regulations for confined space entry must be strictly adhered to. Cracks or defects in the tank are then filled with cement or crack filler and allowed to cure. The tank’s inlet and outlet should also be inspected at this time for possible damages needing repair. Once repaired, the tank can be put back into operation.

Damaged Plastic and Fiberglass Septic Tanks

Polyethylene and fiberglass tanks are lighter and easier to handle than are concrete tanks. They are built to withstand normal handling in transportation and installation, and if installed and cared for properly, should last decades. When damage occurs, it can usually be attributed to:

- A manufacturing flaw
- An event in handling, such as a puncture from a forklift
- An installation event, such as improper backfill, uneven compaction under it, or being dropped from a crane

Polyethylene Tank Repair

Before any repairs are contemplated, the tank manufacturer should be consulted. Any repairs must follow their recommendations for safety and liability purposes. Regulations may require that repairs made to plastic tanks should be performed by qualified technicians using specialized equipment. Fusion (heat) welding can effectively repair cracks in polyethylene tanks, as can an epoxy adhesive.

Fibreglass Tank Repair

Repairs to fibreglass tanks can be fairly easy because fibreglass resin bonds to itself quite readily, as this is the same procedure that created the tank to begin with. Repair kits containing resin, a catalyst, rollers, fibreglass sheet material and instructions are available in many sizes. The repair process is quite messy, so appropriate PPE is a must, especially proper gloves that protect the worker from harmful activated resin and sharp glass fibres that must be manipulated by hand. As with the concrete and polyethylene tank repairs, the tank must be pumped out, cleaned, and allowed to dry before repairing. Plastic and fibreglass tanks have access openings rather than removeable lids, so confined space entry procedures will need to be followed.

Regardless of the type of tank, repairs should only be attempted by qualified people after consulting with the manufacturer. If a tank cannot be reliably repaired, it must be replaced.

Damages to a Distribution Box

Because of their size and relative cost, distribution boxes are more likely to be replaced than repaired. Minor cracks in a large concrete D-box may prove less costly and onerous to repair than replace, and if so, follow the same procedures as for concrete septic tank repairs. Damaged plastic D-boxes will most commonly be replaced.

Damages to Field Piping

Field pipe failures are difficult to pinpoint. A careful examination using a pipe camera is usually a necessity, and if used in conjunction with a sonic locating device, any issue such as a break or a root intrusion can be accurately located. Repair of those issues is usually accomplished by replacement of the piping, so excavating equipment will be a must. If the issue at hand is a result of improper installation, much piping and possibly the entire field may have to be replaced. If only a localized issue, a short section of replacement pipe may be all that is required. Shovels and possibly larger excavating equipment may be needed, as well as replacement pipe and clean gravel, as the excavation process may result in contaminating the gravel with cover soil.

If the drain field has become blocked by the accumulation of excessive biomat, the two choices possible for repair are to either dig up the field and replace it, or to "shock" the field. Shock treatment entails the introduction of biological additives into the septic system to help fast track the digestion of organic waste. The products will introduce billions of specific bacteria and enzymes that can clean and restore the drain field by consuming the biomat. This would be the most cost-effective way to restore the field, but water flushed into the system from the house would have to be severely restricted in order to give the enzymes and bacteria the time needed to get the field working again. This option may not be viable if the age of the system suggests that the field has reached the end of its expected life, and field replacement is warranted.

Remember that any repairs to septic tanks or components will involve an AP, who must endorse and record the repair, although not all repairs will require the AP to file (report) them to the local Health authority.

Self-Test 1

Self-Test 1

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://opentextbc.ca/plumbing4d/?p=35#h5p-6 (https://opentextbc.ca/plumbing4d/?p=35#h5p-6)

Appendix 1: Self-Tests

This chapter contains all of the Self-Tests in a text format. Answers can be found in Appendix 2: Self-Test Answer Keys (#back-matter-self-test-answer-keys).

Self-Test 1

Found in Competency D1, Learning Task 1

Self-Test 1

1. Which of the following choices does the SSR (Sewerage System Regulation) *not* address?
    a. Lagoons
    b. Type 1 septic systems
    c. Holding tanks and privies
    d. Type 2 and 3 septic systems
2. Which of the following is *not* allowed to plan, install, or maintain a sewerage system in British Columbia?
    a. A plumber
    b. An ROWP
    c. A professional
    d. An authorized person
3. Which of the following is a designation of ROWP that is *not* addressed in the SSR?
    a. Planner
    b. Installer
    c. Private Inspector
    d. Maintenance Provider
4. The SSR expects what quality of water from the septic system by the time it reaches the limiting layer?
    a. Useable
    b. Potable

c. Seasonal
d. Recreational

5. In which part of a sewerage system are anaerobic bacteria mainly found?
   a. The field piping
   b. The septic tank
   c. The distribution box
   d. The house plumbing
6. In which part of a sewerage system are aerobic bacteria mainly found?
   a. The field piping
   b. The septic tank
   c. The distribution box
   d. The house plumbing
7. Which of the following indicates sewage strength and represents the total amount of oxygen, in mg/L, used by microorganisms in decomposing one litre of organic matter in a 5-day period?
   a. ASTTBC
   b. BOD_5
   c. SPM
   d. TSS
8. Which of the following is *not* included in the scope of the SSR?
   a. Duplexes
   b. Single family dwellings
   c. 2 houses on a single parcel of land
   d. Houses discharging > 22 700 litres/day
9. What does “areas used to receive effluent discharged from a treatment method” describe?
   a. Disposal areas
   b. Dispersal areas
   c. Discharge areas
   d. Displacement areas
10. Which of the following is considered the most difficult and complex factor in choosing an appropriate dispersal method?
   a. A soil analysis
   b. A cost analysis

c. A property survey
d. Equipment availability

Self-Test 2

Found in Competency D1, Learning Task 1

Self-Test 2

1. A septic tank, distribution box and dispersal field is known as what type of system?
    a. Type 1
    b. Type 2
    c. Type 3
    d. Type 4
2. All prefabricated septic tanks must be constructed to standards found in what document?
    a. CAN/CSA B149.1
    b. CAN/CSA B66-00
    c. BC Plumbing Code
    d. National Plumbing Code of Canada
3. Which one of the following choices is *not* a "layer" associated with the contents of a septic tank?
    a. Scum
    b. Sludge
    c. Septics
    d. Effluent
4. What component is fitted to the baffle at the outlet of a septic tank that prevents large particles from leaving the tank and passing into the dispersal system?
    a. A float switch
    b. A screen
    c. A sieve
    d. A filter
5. What is the term given to the act of flooding the dispersal field with a high flow rate of effluent

from the primary treatment component?

   a. Dosing
   b. Saturation
   c. Evacuation
   d. Bombardment

6. Aerobic treatment units (ATUs) produce effluent that is typically categorized as what type?
   a. Type 1
   b. Type 2
   c. Type 3
   d. Type 4
7. Which one of the following choices would use a distribution box?
   a. At Grade system
   b. Pressure distribution
   c. Alberta At Grade system
   d. Trickling or gravity distribution
8. What can be installed in the pipe outlets of a distribution box to ensure that the invert openings are all at the same elevation, thereby allowing equal flow to all the laterals?
   a. Speed levelers
   b. Quick openings
   c. Pipe invert rotators
   d. Elevation equalizers
9. What component is fitted to both septic tanks and distribution boxes to allow easy entry and assist in periodic maintenance and inspection without the need for excavating?
   a. Ladders
   b. Access risers
   c. Inspection ports
   d. Egress openings
10. What is the width of the bottom of a typical Type 1 distribution trench?
   a. 12–18 inches
   b. 15–30 inches
   c. 18–36 inches
   d. 48–84 inches

11. What type of bacteria are at work in a dispersal system, that render the effluent harmless to people and the environment?
    a. *E. coli*
    b. Aerobic
    c. Anaerobic
    d. *Legionella*
12. Which type of dispersal system may suffer from plugging of the first few feet or metres of the laterals over time?
    a. Subsurface distribution
    b. Pressure distribution
    c. Trickling
    d. Dosing
13. What device turns a dosing pump on and off?
    a. A float switch
    b. A manual switch
    c. A moisture meter
    d. In infrared scanner
14. Which of the following types of dispersal systems would be well suited for smaller urban lots that may not have enough space for a conventional septic field?
    a. Pressure distribution
    b. Trickling gravity
    c. Dosed gravity
    d. Lagoon
15. Which type of system uses premanufactured plastic chambers for the dispersal of effluent?
    a. At Grade
    b. Sand mound
    c. Gravelless Infiltrator®
    d. Subsurface drip dispersal
16. What type of dispersal system uses a trench that is more than 90 cm but less than 3 m wide?
    a. Trench
    b. Seepage bed
    c. Subsurface drip
    d. Pressure distribution

17. What is the process known as whereby water is lost from small openings in the leaves of plants and grasses?
    a. Respiration
    b. Perspiration
    c. Evaporation
    d. Transpiration
18. Which of the following uses wood chips in its construction?
    a. Gravity distribution
    b. Alberta At Grade
    c. ETA bed
    d. ET bed
19. Which of the following systems must be fenced?
    a. ETA bed
    b. Alberta At Grade
    c. Pressure distribution
    d. BC Zero Discharge Lagoon
20. Which of the following is a system that treats and disperses wastewater in the same footprint?
    a. ETA
    b. HLR
    c. CTDS
    d. ROWP

Self-Test 3

Found in Competency D1, Learning Task 2

Self-Test 3

1. Which one of the following processes separates silt and plastics from the wastewater?
    a. Sludge treatment
    b. Tertiary treatment

    c. Primary treatment
    d. Secondary treatment

2. Which one of the following treatments uses biological processes that break down the organic waste by using nutrients provided in the raw sewage?
    a. Sludge
    b. Tertiary
    c. Primary
    d. Secondary
3. Which one of the following choices represents a final process that municipal sewage may have to undergo to ensure that aquatic life in the final destination of the wastewater will not be harmed?
    a. Chlorination
    b. De-chlorination
    c. UV Sterilization
    d. Ozone disinfection
4. Which one of the following processes uses anaerobic digesters, with the production of methane gas as a main by-product?
    a. Sludge treatment
    b. Tertiary treatment
    c. Primary treatment
    d. Secondary treatment
5. What is the common destination for the waste sludge obtained through the processing of wastewater in a modern municipal sewage treatment plant?
    a. A body of water
    b. A sanitary landfill
    c. A secondary clarifier
    d. A tract of agricultural land

Self-Test 4

Found in Competency D1, Learning Task 3

Self-Test 4

1. What is the first step in the planning process for the installation of a residential onsite sewage treatment system?
    a. Perform a soils analysis
    b. Select a dispersal method
    c. Select the treatment method
    d. Gather information from the owner
2. What is the term used that defines the estimated peak flow that will be discharged to the septic system and for which the system is designed?
    a. Sewage output
    b. Daily design flow
    c. Weekly wastewater
    d. Yearly flow average
3. Refer to Table II-8. What would be the DDF for a residence that has 4 bedrooms and a living area of 345 m^2?
    a. 1 300 litres/day
    b. 1 345 litres/day
    c. 1 600 litres/day
    d. 1 645 litres/day
4. What is to be the increase in the DDF if a garbage grinder or garburator is used?
    a. 50%
    b. 40%
    c. 30%
    d. 5%
5. Refer to Table II-9. What would be the DDF for a seasonal cottage with 3 bedrooms?
    a. 1 312.5 litres/day
    b. 1 300 litres/day
    c. 937.5 litres/day
    d. 750 litres/day
6. Arrange the following criteria in the proper order:
    1. Determine the DDF

2. Meet with the owner
3. Select the dispersal method
4. Select the treatment method

a. 2, 1, 3, 4
b. 4, 3, 2, 1
c. 2, 1, 4, 3
d. 3, 4, 2, 1

7. What term defines the measure of the volume of effluent, in litres, applied each day, per unit area (m^2) of infiltrative surface?
   a. Area of infiltrative surface
   b. Hydraulic loading rate
   c. Vertical separation
   d. Restrictive layer
8. What term defines a layer of soil, rock, hardpan, glacial rock and unstructured clay soils?
   a. Limiting layer
   b. Blinding layer
   c. Restrictive layer
   d. Vertical separation
9. What term defines the depth of unsaturated, original, undisturbed permeable soil below the infiltrative surface and above any limiting layer?
   a. Soil horizon
   b. Blinding layer
   c. Infiltrative surface
   d. Vertical separation
10. What term defines the layers of soil approximately parallel to the land surface and different from adjacent layers in physical, chemical and biological properties?
    a. Soil horizon
    b. Limiting layer
    c. Blinding layer
    d. Vertical separation
11. What term defines a layer of clean coarse sand or mound sand that is installed between the infiltrative surface and the native soil, and which is up to 10 cm (4 in.) thick?

a. Limiting layer
b. Blinding layer
c. Restrictive layer
d. Vertical separation

12. Why is heavy clay not favourable for a disposal field?

a. Clay is too hard to dig through
b. The clay will block flow through it
c. The clay will allow too much flow through it
d. The clay will stick to tools when trying to excavate

13. Why is coarse, grainy soil, such as gravel or sand, not favourable for a disposal field?

a. Flow through it will be too fast
b. Flow through it will be too slow
c. There will be no flow through it
d. Sand and gravel will compact too much

14. If "NA" is encountered in any of the tables for determining soil conditions for a conventional trench system, what is the expected outcome?

a. Use a seepage bed system
b. Double the length of the field piping
c. Use an above grade system or a lagoon
d. The soil cannot support the use of any type of dispersal system

15. What is the expression of the flow rate associated with a percolation test?

a. Minutes per inch
b. Minutes per foot
c. Hours per inch
d. Hours per foot

16. Which table from the SPM will determine whether a gravity distribution system is allowed or not allowed?

a. Table II-5
b. Table II-6
c. Table II-7
d. Table II-21

17. If soil constraints disallow the use of a gravity or dosed gravity distribution system, which table would provide guidance as to other options for dispersal?

a. Table II-5
b. Table II-6
c. Table II-7
d. Table II-21

18. Which of the following determines the length of trenches needed for a dispersal field?
    a. AIS divided by trench width
    b. DDS divided by perc rate
    c. HLR multiplied by DDF
    d. DDS divided by HLR
19. What is meant by a “separation layer” in a distribution trench?
    a. A layer of sand over the gravel
    b. The cover soil layer over the pipe
    c. The gravel over the unsaturated soil
    d. Lightweight, non-woven geotextile over the gravel
20. What is the suggested minimum distance between laterals in a typical trench installation?
    a. 3 m
    b. 1.8 m
    c. 1 m
    d. 90 cm
21. What is the suggested depth of gravel below a lateral in a trench?
    a. No more than 5 cm
    b. More than 15 cm
    c. More than 90 cm
    d. At least 1.8 m
22. What is the suggested minimum depth of cover soil over a trench?
    a. 5 cm
    b. 15 cm
    c. 90 cm
    d. 1.8 m
23. What is suggested to be installed at the base of an observation port, to prevent pullout?
    a. Nothing
    b. A coupling

c. A pipe plug
d. A toilet flange

24. What is the suggested maximum width of a trench bottom?
    a. 15 cm
    b. 60 cm
    c. 90 cm
    d. 1.8 m
25. What are the suggested sizes of pipe for the observation ports?
    a. 2″ or 3″
    b. 3″ or 4″
    c. 4″ or 6″
    d. 6″ or 8″

Self-Test 5

Found in Competency D1, Learning Task 3

Self-Test 5

1. Which of the following is *not* a contributor to good septic tank performance?
    a. Larger surface area
    b. Shorter distance between inlet and outlet pipes
    c. Longer distance between inlet and outlet pipes
    d. Smaller, letterbox-sized openings between the first and second compartment
2. What type of desired flow through a septic tank is achieved using an inlet baffle?
    a. Violent
    b. Turbulent
    c. Quiescent
    d. Excessive
3. What would be the minimum working volume of a septic tank if the DDF was not > 9 100 litres/day?

a. 1 000 litres
b. 1 500 litres
c. 15 000 litres
d. 3 times the DDF

4. For 2-compartment tanks, or 2 tanks in series, what does the SPM specify as to the volume of the first tank or compartment?

    a. 100% to 75% of the total working volume
    b. 75% to 50% of the total working volume
    c. 67% to 50% of the total working volume
    d. 50% to 25% of the total working volume

5. What is the minimum suggested interval between pumpouts for a septic tank?

    a. 1 year
    b. 2 years
    c. 3 years
    d. 5 years

6. Which of the following is *not* listed as a reason for the use of a larger tank rather than one of minimum size?

    a. Lower cost of pumpouts over time
    b. Improved oil and grease separation
    c. Improved suspended solids removal
    d. Increased intervals between pumpouts

7. What is the minimum grade allowable, by most plumbing codes, for a 4-inch building sewer?

    a. $\frac{1}{16}''/\text{ft}\ \left(\frac{1}{200}\right)$
    b. $\frac{1}{8}''/\text{ft}\ \left(\frac{1}{100}\right)$
    c. $\frac{1}{4}''/\text{ft}\ \left(\frac{1}{50}\right)$
    d. $\frac{1}{2}''/\text{ft}\ \left(\frac{1}{25}\right)$

8. How is mandatory venting of a septic tank normally achieved?

    a. By a 2-inch vent at the bottom of the tank

   b. By a 4-inch vent at the top of the tank
   c. Through a vent in the dispersal field
   d. Through the building sewer
9. What are access “tunnels” from ground level to the septic tank known as?
   a. Drops
   b. Risers
   c. Vaults
   d. Chambers
10. Within what distance from risers or access lids should components that may need to be periodically checked or maintained be?
    a. 5 cm
    b. 15 cm
    c. 90 cm
    d. 1 m
11. What is the suggested minimum internal diameter of a riser that is not over 90 cm long?
    a. 15 cm
    b. 50 cm
    c. 76 cm
    d. 90 cm
12. What is the minimum horizontal separation distance from a septic tank to a domestic water supply well?
    a. 25 ft (7.5 m)
    b. 50 ft (15 m)
    c. 100 ft (30 m)
    d. 200 ft (60 m)
13. What is the minimum horizontal separation distance from a dispersal system to a drinking water line that is under pressure?
    a. 3 ft (0.9 m)
    b. 10 ft (3 m)
    c. 25 ft (7.5 m)
    d. 50 ft (15 m)
14. What is the minimum horizontal separation distance between a dispersal system and a lake?
    a. 33 ft (10 m)

b. 50 ft (15 m)
c. 100 ft (30 m)
d. 200 ft (60 m)

15. What is the minimum horizontal separation distance between a septic tank and a dispersal field lateral?
    a. 0.9 metres (3 feet)
    b. 1.5 metres (5 feet)
    c. 1.8 metres (6 feet)
    d. 3 metres (10 feet)

Self-Test 1

Found in Competency D2, Learning Task 4

Self-Test 1

1. If, during a water test of a tank, a loss of 10 litres of water was reflected in the water level in the riser dropping 3.5 cm, what size would the riser be?
    a. 46 cm (18 in.)
    b. 61 cm (24 in.)
    c. 76 cm (30 in.)
    d. 91 cm (36 in.)
2. If a vacuum test is used instead of a water test, what is the expected loss of vacuum within the first 5 minutes?
    a. ½ inch of mercury
    b. 1 inch of mercury
    c. ½ inch of water column
    d. 1 inch of water column
3. A dosed gravity distribution system should have at least how much of its volume filled on every dose?
    a. 50%
    b. 67%

c. 75%
d. 100%

4. To what minimum height should the water columns in a squirt test rise if the orifices are 4.2 mm $\left(\frac{11}{64}''\right)$ in diameter?
    a. 60 cm (24 in.)
    b. 90 cm (36 in.)
    c. 120 cm (48 in.)
    d. 150 cm (60 in.)
5. Which of the following must an AP check for during the first 12–14 months of operation of a Type 1 sewerage system?
    a. Fecal coliforms
    b. BOD_5 and TSS
    c. Sludge level
    d. Flow
6. According to the information in Table III-35, what is the suggested pump out frequency for a 4 500 litre (1 000 Imp. Gal.) septic tank that serves a household occupancy of 4 people?
    a. 3.7 years
    b. 5.2 years
    c. 6.8 years
    d. 8 years
7. What is the black, jelly-like permeable layer that forms in the soil in the drain field's trenches known as?
    a. Biomat
    b. Effluent
    c. Field tar
    d. Septic jelly
8. What effect does the formation of the substance in the previous question have on the flow rate and filtration of viruses and pathogens in the wastewater?
    a. It slows the flow and cuts filtration time down
    b. It speeds the flow and cuts filtration time down
    c. It slows the flow and gives more time for filtration
    d. It speeds the flow and gives more time for filtration

9. Which of the following would *not* be a contributor to maintaining a healthy septic field?
    a. Perform routine maintenance
    b. Avoid hydraulic overload
    c. Flush bleach periodically
    d. Maintain filters
10. Which of the following choices is *not* listed as a common issue with a malfunctioning septic system?
    a. "Ponding"
    b. Slow fixture drainage
    c. Contaminated drinking water
    d. Frequent dosing pump failure
11. What causes the corrosion of a concrete septic tank at points at and above the waterline?
    a. The formation of scum
    b. The formation of sludge
    c. The formation of effluent
    d. The formation of hydrochloric acid
12. Fusion (heat) welding can be a repair used on what type of permanent tank?
    a. Polyethylene
    b. Fiberglass
    c. Concrete
    d. Steel
13. Why would plastic and fibreglass tanks always need confined space entry procedures followed, whereas concrete tanks may not?
    a. Concrete tanks normally have larger volumes
    b. Fibreglass tanks don't have harmful atmospheres
    c. Plastic and fibreglass tanks don't have removeable lids
    d. Plastic tanks are usually removed for periodic inspections
14. Why are damaged distribution boxes replaced rather than repaired?
    a. Their repair isn't possible
    b. The SPM mandates replacement
    c. Their cost and size are relatively small
    d. If they are damaged, it is because of their age

15. What is the process known as, whereby biological (not chemical) additives are introduced into the system to consume excessive biomat that may be clogging the system drainfield piping?
    1. Jolting the system
    2. Shocking the system
    3. Cleaning the system
    4. Eating up the system

Appendix 2: Self-Test Answer Keys

Competency D1

Self-Test 1

1. c. Holding tanks and privies
2. a. A plumber
3. c. Private Inspector
4. d. Recreational
5. b. The septic tank
6. a. The field piping
7. b. BOD5
8. d. Houses discharging > 22 700 litres/day
9. b. Dispersal area
10. a. A soil analysis

Self-Test 2

1. a. Type 1
2. b. CAN/CSA B66-00
3. c. Septics
4. d. A filter
5. a. Dosing
6. b. Type 2
7. d. Trickling or gravity distribution
8. a. Speed levelers
9. b. Access risers
10. c. 18-36 inches
11. b. Aerobic
12. c. Trickling
13. a. A float switch
14. a. Pressure distribution
15. c. Gravelless Infiltrator®
16. b. Seepage bed
17. d. Transpiration
18. b. Alberta At Grade
19. d. BC Zero Discharge Lagoon
20. c. CTDS

Self-Test 3

1. c. Primary treatment
2. d. Secondary
3. b. De-chlorination
4. a. Sludge treatment
5. b. A sanitary landfill

Self-Test 4

1. d. Gather information from the owner
2. b. Daily design flow
3. d. 1645 litres/day
4. a. 50%
5. c. 937.5 litres/day
6. a. 2, 1, 3, 4
7. b. Hydraulic loading rate
8. c. Restrictive layer
9. d. Vertical separation
10. a. Soil horizon
11. b. Blinding layer
12. b. The clay will block flow through it
13. a. Flow through it will be too fast
14. c. Use an above grade

system or a lagoon

15. a. Minutes per inch
16. a. Table II-5
17. c. Table II-7
18. a. AIS divided by trench width
19. d. Lightweight, non-woven geotextile over the gravel
20. b. 1.8 m
21. b. More than 15 cm
22. b. 15 cm
23. d. A toilet flange
24. c. 90 cm
25. c. 4” or 6”

Self-Test 5

1. b. Shorter distance between inlet and outlet pipes
2. c. Quiescent
3. d. 3 times the DDF
4. b. 75% to 50% of the total working volume
5. d. 5 years
6. a. Lower cost of pumpouts over time
7. b. $\frac{1}{8}$”/ft ($\frac{1}{100}$)
8. d. Through the building sewer
9. b. Risers
10. b. 15 cm
11. b. 50 cm
12. c. 100 feet (30 m)
13. b. 10 feet (3 m)
14. c. 100 feet (30 m)
15. d. 3 metres (10 feet)

Competency D2

Self-Test 1

1. b. 61 cm (24 inches)
2. a. ½ inch of mercury
3. b. 67%
4. d. 150 cm (60 inches)
5. d. Flow
6. d. 8 years
7. a. Biomat
8. c. It slows the flow and gives more time for filtration
9. c. Flush bleach periodically
10. d. Frequent dosing pump failure
11. d. The formation of hydrochloric acid
12. a. Polyethylene
13. c. Plastic tanks don’t have removeable lids
14. c. Their cost and size are relatively small
15. b. Shocking the system

Glossary

area of infiltrative surface (AIS)

Infiltrative surface area, in m^2, receiving effluent from the distribution system. This is considered to be the bottom area of a trench in a trench-type gravity system.

ASTTBC

Applied Science Technologists and Technicians of British Columbia

authorized person (AP)

A registered onsite wastewater practitioner or professional.

basal area

For sand mounds, sand-lined trenches, bottomless sand filters, Alberta At Grade systems and CTDS, this is the native soil that the sand will be placed on.

blinding layer

A layer of clean coarse sand or mound sand that is installed between the infiltration surface (bottom of aggregate, base of chamber, etc.) and the native soil, and which is up to 10 cm (4 inches) thick.

BOD

5-day biochemical oxygen demand

consistence

Attribute of soil expressed in degree of cohesion and adhesion, or in resistance to deformation or rupture.

DDS

daily design flow

dispersal area

An area used to receive effluent discharged from a wastewater treatment method.

gravel

Rounded or subrounded rock fragment that is between 0.1 inches (2 millimetres) and 3 inches (76 millimetres) in diameter. Often called “drain rock.”

HAR

hydraulic application rate

HLR

hydraulic loading rate

holding tank

A large cement or plastic tank into which household wastewater flows and is stored until it is pumped out.

HS

horizontal separation

hydraulic loading rate (HLR)

A measure of the volume of effluent, in litres, applied each day, per unit area (m^2) of infiltrative surface.

infiltrative surface

In drainfields, the drain rock-to-original soil interface at the bottom of the trench; in mound systems, the gravel-to-mound sand and the sand-to-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-to-sand interface and the sand-to-original soil interface at the bottom of the trench or bed.

K_{fs}

A measurement of the saturated hydraulic conductivity of soil. In theoretical terms, hydraulic conductivity is a measure of how easily water can pass through soil or rock. High values indicate permeable material through which water can pass easily, such as sand or gravel; low values indicate that the material, such as clay, is less permeable.

limiting layer

The shallowest of a restrictive layer, water table, seasonal high-water table or extremely permeable material (e.g., fractured rock, gravel).

LLR

linear loading rate

perc

percolation rate

perc rate

percolation rate

platy structure

Laminated or flaky soil aggregate developed predominantly along the horizontal axis.

POA

point of application

privy

A small building having a bench with a hole or holes through which human excretion may be evacuated into a waterproof vault or an excavated pit. Also known as an outhouse.

registered onsite wastewater practitioner (ROWP)

A person who is qualified to act as a registered onsite wastewater practitioner under section 7 (1) or (2) of the Sewerage System Regulation.

restrictive layer

A layer of soil or rock that impedes the vertical movement of water, air, and the growth of plant roots. This may include hardpan, some compacted soils, bedrock, glacial till and unstructured clay soils.

sewage treatment system

A system of pipes, pumps, tanks, and other equipment used for the collection, transport, and disposal of residential wastewater (sewage). Also known as a sewage disposal system, septic system, or sewerage system.

SHWT

seasonal high water table

soil horizon

Layers of soil or soil material approximately parallel to the land surface and different from adjacent layers in physical, chemical, and biological properties or characteristics such as colour, structure, texture, consistence, and pH.

soil structure

The combination or arrangement of individual soil particles into definable aggregates, or peds, which are characterized and classified based on size, shape, and degree of grade (distinctness).

soil texture

The relative proportions of the various soil separates (e.g., silt, clay, sand) in a soil.

SPM

Sewerage System Standard Practice Manual, Version 3. Access a PDF version of the SPM (https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/spmv3-24september2014.pdf) online.

SSR

Sewerage System Regulation (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/326_2004/) within the *Public Health Act*

TSS

total suspended solids

vertical separation

The depth of unsaturated, original, undisturbed permeable soil below the infiltrative surface and above any limiting layer. This is the vertical depth of soil that the dispersal system is expected to be discharged into.

VS

vertical separation

Versioning History

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.01. If the edits involve substantial updates, the version number increases to the next full number.

The files posted by this book always reflect the most recent version. If you find an error in this book, please fill out the Report an Error (https://open.bccampus.ca/browse-our-collection/reporting-an-error/) form.

Version	Date	Change	Details
1.00	May 6, 2025	Book published.	