SECTION 5

5. DISPOSAL FIELD DESIGN

5.1 GENERAL

These Guidelines are not intended to be a comprehensive design manual covering every aspect of on site sewage disposal system design. There are numerous references available regarding soil hydraulics and other aspects of on site sewage disposal that can be of value to the designer. It should be remembered that due to the variability of site conditions and the difficulty in estimating the long term effluent acceptance rate of a particular site that system design is not an exact science. In many cases experience with all aspects of on site sewage disposal including: lot assessment, system design, installation, maintenance, and the repair of malfunctions, is the most valuable tool the designer can have.

Section 4 of these Guidelines describes disposal fields that may be selected for single unit residential buildings with an average daily flow of up to 1500 L/day. Determination of design flows is discussed in Section 2 while Section 3 contains general information that can be used in the design of system components other than the disposal field.

This section addresses the design, from first principles, of systems intended for residential flows in excess of 1500 L/day, non-residential flows or unusual site conditions which make the selection of a system from the Guidelines impossible. Most of the calculations involved can be easily carried out in a spreadsheet. Refer to flow tables in **Appendix F**. QP1's shall design based on projected flow, with a minimum residential design flow of not less than 1000 L/day.

The fact that a system can be theoretically designed (or selected) to fit on a lot does not guarantee that this lot will be considered suitable for the installation of a system or that an approval to install the system will be granted. Issues such as the potential for cumulative effects resulting from high density development using on-site disposal and the availability of room to enlarge or replace the system must also be given careful consideration by the designer and the Department. If in the opinion of the Department the proposed system may result in the creation of an adverse effect, an approval to install the system will not be granted.

It should be noted that a QP2 can only "select" a system from these Guidelines and cannot use this section to "design" a system.

The general requirements of Sections 3, 4 and 6 apply to systems designed in accordance with this section.

The designer of a subsurface disposal system should take into account the possibility that wastewater flows, ground water levels, and soil and site conditions could exceed average values, and if not recognized in the design could contribute to system malfunction or failure. For large commercial system designs, the QP 1 should take into consideration micro-organism contaminants and the potential for the increase in nitrates in the ground water.

5.2 DESIGN PRINCIPLES

On the majority of sites, design of disposal fields for soil conditions in Nova Scotia must consider the rate of lateral movement of effluent away from the system, because vertical movement is limited by ground water, bedrock, or soil with unacceptably low permeability.

Design considerations for both vertical and lateral movement of effluent are discussed in this section.

Please note that calculations give theoretical system sizes based on given flow rates. Appropriate safety factors should be applied based on issues such as the level of confidence in the estimated sewage flows, soil permeability, other site features, the sensitivity of the situation to a potential future malfunction, plus financial considerations.

Also note that the temperature of the water moving through the soil can have a significant effect on the measured permeability (K_{fs}) because of the different viscosities of water at different temperatures. Warm water will flow through soil easier than cold water. Therefore, depending on the test and design operating temperatures, it may be necessary to adjust the measured K_{fs} to get a permeability that is more representative of the operating conditions.

The temperature of the water in the permeameter should be close to air temperature when conducting the test. If not as the water temperature increases or decreases, the rate of water drop in the permeameter may vary and the rate will not become constant. If we were to assume that water and soil temperature down slope of the disposal field were approximately 4 ^{o}C in winter and the water temperature was 20 ^{o}C during the test, the value of the adjusted permeability (Ka) would be approximately 0.6 x $K_{fs.}$ Under normal design conditions this difference may be within the design or other inherent factors of safety however the designer must be aware of this temperature effect and be sure that the system has adequate capacity under all operating conditions. See **Appendix C** for further discussion.

5.2.1 Lateral Flow

The rate of lateral flow through soil is estimated by D’arcy’s Law, which can be written as:

(1) Q = L * H * I * K

where Q = average daily flow, m^3/sec

L = length of trench or bed, m

H = the depth of soil that will become saturated in order to move effluent in a lateral direction, m

I = the hydraulic gradient, m/m (usually considered to be equal to the slope of the ground surface at the location of the disposal field).

K = permeability of the soil through which the flow moves, m/sec. This value depends on soil conditions including texture, density, and structure which can be determined during the site assessment described in Section 2. **Table 2.1** lists approximate ranges of permeabilities, for different soil types. For large disposal systems soil permeability should be measured in-situ and all site conditions considered to estimate a value for K.

Equation **(1)** can be rearranged to solve for L which gives:

$$\textbf{(1)} \quad L(m) = \frac{Q(m^3/sec)}{K(m/sec) * I * H(m)}$$

For convenience the units of Q can be converted to average daily flow in litres per day. This equation becomes:

$$\text{(2)} \quad L(m) = \frac{Q(L/day)}{8.64 * 10^7 * K(m/sec) * I\ (m/m) * H(m)}$$

Once the design flow has been calculated and the site assessment is completed all values are known except for L, which can then be calculated.

TABLE 2.1

A GUIDE TO APPROXIMATE SOIL PERMEABILITY
(See Notes Following this Table)

SOIL TYPE	PERMEABILITY (m/sec) x 10^{-6}		
	PERMEABILITY CLASS	APPROXIMATE RANGE	APPROXIMATE AVERAGE
Rock, Clean Gravel	Unacceptably High	>800	
Medium to Coarse Sand	Acceptable	20 - 800(1)	
Fine Sandy Gravel	Acceptable	20 - 80	50
Silty Sand	Acceptable	8 - 20	15
Sandy Silt	Acceptable	3 - 8	5
Clayey Silt	Unacceptably Low	0.8 - 3	1.5
Silty Clay	Unacceptably Low	0.2 - 0.8	0.5
Clay	Unacceptably Low	<0.8	

(1) - acceptable permeability limit is 500* 10^{-6} m/s

NOTE:

- Because of the wide range in permeabilities for sand, it is not appropriate to use an average permeability. Unless the permeability of the material is measured in situ, the lowest permeability for fine sandy gravel, 20 x 10^{-6} m/sec, should be used for system design.
- Because of the low permeability of silty clays and clays the assumptions made regarding the permeability of the clogging mat for more permeable soils may not apply for these soils with low permeability. This combined with the effects of natural precipitation may result in lower effective permeabilities down slope of systems in these soils. Considering these points it is not appropriate to design area, trench or C1 type systems for these soils even if the theoretical calculated size can be fit on the lot.

- These soil types are based on texture, the relative content of rock, sand, silt, and clay. It is extremely difficult to accurately determine the long term acceptance rate of soil, particularly when basing it only on soil texture. Other factors such as soil density, particle gradation, and soil structure combine to give different permeabilities to soils with similar textures. Unless the permeability is established by in- situ measurement, or the designer has extensive experience in soil assessment, it would be advisable to use the lowest permeability in the range given for each soil type.

5.2.2 Vertical Flow

After several months of operation a disposal field will develop a clogging mat that consists mainly of organic debris and of micro-organisms that feed on and digest the organic material.

The clogging mat has a low permeability, which is much lower if it forms in finer textured soils. The permeability of a developed clogging mat is usually the limiting factor in the long term vertical flow rate.

The systems described here assume that filter sand, with a minimum depth of 75 mm, is placed below the gravel in the disposal system. When the clogging mat forms in this material it is expected that the permeability of the clogging mat will be maximized and its hydraulic resistance reduced. The hydraulic resistance is expressed in terms of the loading rate, which is assumed to be 33 (L/day)/m^2 of distribution trench for contour or mound type systems.

All disposal fields must include the 75 mm layer of imported filter sand. **Table 5.1** specifies loading rates for area bed type systems and **Table 5.2** specifies the loading rates for multiple trench type systems.

The loading rates are used to determine the area of the bottom of the distribution trench in the system.

$$\textbf{(3)} \qquad A = \frac{Q}{L_r}$$

where A = bottom area of distribution trench or bed, m^2
L_r = loading rate, (L/day)/m^2
Q = average daily hydraulic load, L/day.

The width of the trench will be:

$$\textbf{(4)} \qquad W = \frac{Q}{L_r * L}$$

where W = width of distribution trench or bed, m
L = length of distribution trench or bed, m
L_r = Loading rate L/Day/m^2

Minimum width of distribution trench should not be less than 0.6m.

5.3 LOT LIMITATIONS

5.3.1 Slope Limitations

As stated in **Table 4.3** if the slope for a contour system exceeds 30 %, the system must be designed to assure the stability of the imported sand fill, and appropriate construction methods must be specified. Slopes less than 3 % are not suitable for C1, C2, C3 type fields. Mound systems, area beds, and multiple trench systems can be placed on slopes of less than 3 %.

5.3.2 Construction on Filled Lots

As stated in Section 4.1, if fill has been placed on the site after the lot has been subdivided a system shall not be selected for the site. However it may be possible to design a system for the site provided:

- there is insufficient land, that has not been infilled, to allow for the installation of an on-site sewage disposal system that will meet the requirements of the regulations and these guidelines.

- the fill does not contain hazardous material, municipal solid waste, inert construction debris (e.g., concrete, brick, mortar, asphalt, etc.) or material which would be detrimental to the groundwater or a water supply.

- the fill material is of sufficient composition and density, throughout the fill, to provide a stable base for the disposal system. Fill which contains organic material such as root mat, vegetation or decomposable material may not be suitable for the placement of a disposal field. The QP1 must provide sufficient information to confirm that the fill is suitable and that the system will not be subject to differential settlement.

- The fill has not been placed in a watercourse or water resource such as a bog, marsh, etc.

5.4 DESIGN OF C1 SYSTEMS

Design of a C1 system requires the following information:

- average daily design flow (Section 2.6 & **Table 2.3** or from **Appendix F**)
- depth of each permeable soil type (Section 2.5)
- effective depth (H) of unsaturated permeable soil (Section 2.5.4 **&Table 4.2**)
- available length of contour at the proposed location of the trench
- slope of hydraulic gradient.

The design of a C1 contour system should consider the depth of saturation in the distribution trench in order to prevent saturation above the pipe invert. The effective soil depth (H) for the C1 system is taken as the total depth of permeable soil minus the amount of permeable soil required to prevent saturation above the pipe invert.

Although the amount to be subtracted, in determining (H), will vary depending on the total depth of permeable soil, soil type and the depth of the trench, in no case shall the amount be less 150 mm. The amount to be subtracted is always taken from the top layer of permeable soil.

If there is only one soil type, simply insert the permeability of the soil (K) and the effective soil depth (H) into equation $\boxed{3}$ and solve for (L).

For systems with multiple soil types a weighted average of the individual soil permeabilities considering their relative depths can be calculated using $\boxed{2}$ and then used in equation $\boxed{3}$. In many cases it may be appropriate to simply use the lowest permeability of the soils encountered. Remember that the amount of permeable soil required to prevent saturation above the pipe invert must be subtracted from the total depth of permeable soil to get effective soil depth (H).

The required length of C1 trench can then be calculated using equation $\boxed{3}$. This calculation gives the theoretical length of trench required without built in safety factors.

If the lot width permits, the trench length should be increased, to minimize the possibility of surface ponding, breakout during peak flow or adverse weather conditions.

Once the trench length has been determined from equation $\boxed{3}$, the trench width can be determined from equation $\boxed{4}$. The loading rate Lr will be 33 (L/day)/m $^{2.}$

There must be a least 1 m vertical separation between the bottom of the distribution trench and ground water, bedrock, or soil with unacceptably high permeability.

The recommended minimum length for a C1 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters.

Generally it is not recommended to exceed linear loading rate of 60 L/day per m even if calculations indicate that shorter system is feasible.

C1 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate effective soil depth (H) :

$\boxed{1}$ **H = T_d - depth of unsaturated soil required to prevent saturation above pipe invert (not less than 150 mm**)

Where T_d - total permeable soil depth

3. Calculate weighted average horizontal soil permeability

$$\boxed{2}\quad K_{avg} = \frac{\sum_{1}^{n} K_n * H_n}{H_{soil}}$$

Where: K_n - permeability of each soil layer, m/s

H_n - thickness of the respective soil layer, meters

Remember to subtract the depth of soil required to prevent saturation above the pipe invert (minimum 150 mm) from the thickness of the top (1st) permeable soil layer

Note: <u>Instead of calculating a weighted average soil permeability it is advisable to use in the lowest permeability of permeable soil in the test pit and effective depth.</u>

4. Calculate required system length:

$$\boxed{3}\quad L = \frac{Q}{8.64 * 10^7 * H * I * K_{av\,g}}$$

Where : I - slope at the location of septic system, m/m.

Q - sewage flow in litres

H - soil effective depth, meters

$K_{av\,g}$ - soil permeability, m/s

The recommended minimum length for a C1 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters. The use of C1 greater than 60 metres in length is not recommended for single family home. It is not recommended to exceed linear loading rate of 60 L/day per m even if calculations indicate that shorter system is feasible.

5. Calculate width of the distribution trench:

$$\boxed{4}\quad W = \frac{Q}{33 * L} \quad (m)$$

Minimum width should be 0.6 metre

6. Design disposal field cross section. (**See Figure 4.B**)

7. Select depth of the trench at the toe and calculate depth at heel using trench width (W) and slope (I).

$\boxed{5}$ $C_h = W * I + C_t$

Where C_h - depth of the distribution trench at heel (m)

Ct - selected depth of the distribution trench at toe (m)

Check that depth to bedrock, water or soil with unacceptably high permeability at toe and heel is not less than 1 metre. If the depth is less than 1 metre, decrease depth at toe or design a C2 or C3 if necessary.

5.5 DESIGN OF C2 SYSTEMS

A C2 system, described in Section 4.6, transports effluent laterally in the sub-surface soil, and where the hydraulic capacity of the subsoil is inadequate, carries the remaining effluent in a layer of imported sand fill above the original ground surface.

The weighted average of flow that can be carried by the subsurface soil can be calculated as discussed above for a C1. However, where a C2 is being designed, the entire depth of permeable soil from ground surface can be used.

If flow can be handled by the natural soil but the calculated depth of soil saturation will be closer than 150 mm to the surface of the first permeable soil layer/organics interface, a standard C2 can be used (**Figure 4.C**). In this case the pipe is installed with the invert slightly above the downslope lip of the trench. The imported sand fill buffer is placed for frost protection and to insure down slope of the trench does not become soggy and effluent does not come to surface before treatment takes place.

If the natural soil will not carry all the effluent, then a raised C2 may be considered. In a raised C2 some of the effluent will pass through the imported sand buffer (**Figure 4.D**).

Required length of the system can be calculated from the following equation:

$$\boxed{6} \quad \mathbf{L = \frac{Q}{8.64 * 10^7 * I * (K_{avg} * H_{Soil} + K_{fill} * D_{Sat})} \quad (m)}$$

Where: Q - sewage flow in litres/day
I - slope in m/m
K_{avg} - weighted average soil permeability (m/s)
H_{soil} - total depth of the permeable soil (not effective depth) (m)
K_{fill} - permeability of imported sand fill (m/s) (provide only when a raised C2 is used)
D_{sat} - saturation depth in fill (m) (for a standard C2, D_{sat} is 0)

NOTE: It is advisable to use in the calculations the lowest permeability of permeable soil in the test pit instead of K_{avg} to provide a safety factor.

The recommended minimum length for a C2 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters. If the designed system is longer than 60 metres the use of a C2 for single family home is not recommended.

Generally it is not recommended to exceed a linear loading rate of 60 L/day per m for both a standard and raised C2, even if calculations indicate that shorter system is feasible. A saturation depth in imported sand fill should be kept around 0.05 m and generally not exceed 0.10 m. There should be approximately 0.3 m of fill above maximum saturation level in fill.

The length should be greater than the calculated value (L) if the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

After the length of the disposal field has been established, the width can be calculated from the equation 4 using loading rate of $33 L/d/m^2$:

$$\boxed{4} \qquad \mathbf{W = \frac{Q}{33 * L}}$$

A minimum width should be 0.6 metre

Where ground water, bedrock, or soil with unacceptably high permeability occur under a C2 system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the distribution trench and the ground water, rock, or soil with unacceptably high permeability.

The width of the down slope buffer for a C2 system shall be at least 5 m.

C2 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.
2. Calculate weighted average horizontal soil permeability

2 $$\mathbf{K_{avg}} = \frac{\sum_{1}^{n} \mathbf{K_n * H_n}}{H_{soil}}$$

Where: K_n - permeability of each soil layer
H_n - thickness of the respective soil layer
H_{soil} - total permeable soil depth

Note: **Instead of calculating a weighted average soil permeability it is advisable to use in calculations the lowest permeability of permeable soil in the test pit and effective depth.**

3. Calculate required system length:

6 $$\mathbf{L} = \frac{\mathbf{Q}}{8.64 * 10^7 * I * (K_{avg} * H_{Soil} + K_{fill} * D_{sat})}$$

Note: For a Standard C2 design; D_{sat} is normally 0 m
For a raised C2 design; D_{sat} is not to exceed 0.10 m.

The recommended minimum length for a C2 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters. If length of the system is more than 60 metres use of C2 is not recommended for a single family home. It is not recommended to exceed linear loading rate of 60 L/day per m for both a standard and a raised C2.

4. Calculate width of the distribution trench:

4 $$\mathbf{W} = \frac{\mathbf{Q}}{\mathbf{33 * L}}$$

A minimum width should be 0.6 metre

5. Design disposal field cross section.(see **Figure 4.C** and **4.D**)

6. Select depth of the trench at the toe and calculate depth at heel using trench width (W) and slope (I).

5 $$\mathbf{C_h = W * I + C_t}$$

Where C_h - depth of the distribution trench at heel (m)
Ct - selected depth of the distribution trench at toe (m)
I - slope

Check that depth to bedrock, water or too permeable soil layer at toe and heel is not less than 1 metre. If the depth is less than 1 metre, decrease depth at toe or design a C3 if necessary.

5.6 DESIGN OF C3 SYSTEMS

A C3 system, described in Section 4.7, transports effluent vertically and then laterally in a layer of imported sand fill above the original ground surface. A C3 allows effluent to be treated as it passes vertically through the imported sand fill before it reaches ground water, bedrock, or soil with unacceptably high permeability.

The depth of imported sand fill saturation required to carry the flow can be calculated from the following equation:

$$\boxed{7} \qquad \mathbf{D_{sat} = \frac{Q}{8.64 * 10^7 * K_{fill} * I * L}}$$

K_{fill} - permeability of imported sand fill in m/sec
I - Slope in m/m
L - C3 length in m
D_{Sat} - fill saturation in m
Q - flow in L

There shall be approximately 300 mm of fill above maximum saturation level in the downslope buffer of the imported sand fill. Saturation depth in fill should not exceed 150 mm. There should be a minimum of 600 mm of imported sand fill below the distribution trench. The depth of the buffer should be a minimum of 300 mm at a distance of 5 m.

In the design of a C3 system the linear loading rate is 40 to 60 L/day per m. This is to avoid excessive seepage at the toe of the system in wet periods of the year. The length should be as great as the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

The recommended minimum length for a C3 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters.

Where ground water, rock, or soil with unacceptably high permeability occur under a C3 system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the gravel in the distribution trench and the ground water, rock, or soil with unacceptably high permeability.

Once the trench length has been determined width can be calculated from equation $\boxed{4.}$

The minimum width of the distribution trench shall be 600 mm.

The minimum width of the downslope buffer shall be 5 metres. If there is less than 150 mm of available soil, a 150 mm deep and 7 m wide imported sand fill mantle should be added after the downslope buffer (**see Figure 4.E**).

C3 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to Appendix F.
2. Calculate distribution trench length from the following equation:

8 $$\mathbf{L = \frac{Q}{R_{linear}}}$$

Where: R_{linear} - linear loading rate in L/day per m of disposal field (40 to 60 L/day per m)
Recommended R_{linear} is **40 L/day per m**

The recommended minimum length for a C3 system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the available contour can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters. It is not recommended to exceed a linear loading rate of 60 L/day per m.

3. Check saturation level in fill using equation 7,

7 $$\mathbf{D_{sat} = \frac{Q}{8.64 * 10^7 * K_{fill} * I * L}}$$

If the saturation level exceeds 150 mm you should increase length of the system to decrease saturation, or use more permeable fill (within acceptable permeability range) in order to maintain a saturation level of less than 150 mm.

4. Minimum depth of imported sand fill under the pipe must be 600 mm.

5. The minimum depth of imported sand fill at the edge of the 5 m buffer is 300 mm.

6. Calculate width of the distribution trench:

4 $$\mathbf{W = \frac{Q}{33 * L}}$$

A minimum width should be 0.6 metre

7. Design disposal field cross section.

8. Specify downslope width of buffer of 5 metres or more, and upslope width of buffer of 1 metre or more (see standard cross sections in Figure 4E.) If depth of permeable soil is less than 150 mm the downslope buffer should be followed by a 150 mm thick and 7 metres wide mantle, in addition to the normal 5 m buffer. Refer to Table 4.9, Appendix J for systems with lengths less than 38 m for hole spacing requirements. For systems that have a trench length greater than 38 m, the hole spacing must be designed.

9. Design pressure distribution system.

Check that separation to groundwater, bedrock or too permeable soil , at the heel is not less than 1 metre.

5.7 DESIGN OF MOUND SYSTEMS

Design of a mound system assumes that:

- effluent will move vertically into the imported sand fill below the trench
- the basal area of the system is large enough to allow the effluent to enter the soil below the system or in the case of impermeable soil, lateral flows must be calculated
- effluent that emerges at the buffer toe is adequately treated (see Section 4.8).

In the design of a mound system the minimum value of L should be based on a load of 40 to 60 L/day per m of trench and the total design flow, to avoid excessive seepage at the toe of the system in wet periods of the year. The length should be as great as the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

The basal area of the mound should be based on a hydraulic load not greater than 10 (L/day)/m^2, to maximize vertical flow into the soil below the system. If there is a slope on the lot the up slope buffer can be one-half the width of the down slope buffer. On a flat lot the up slope and down slope buffers should be of equal width.

There shall be approximately 300 mm of fill above maximum saturation level in the downslope buffer of the imported sand fill. Saturation depth in fill should not exceed 100 mm. There should be a minimum of 600 mm of imported sand fill below the distribution trench. The depth of the buffer should be a minimum of 300 mm at a distance of 5 m.

The recommended minimum length for a Mound system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the location can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters.

Where ground water, rock, or soil with unacceptably high permeability occurs under a mound system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the gravel and the ground water, rock, or soil with unacceptably high permeability.

Once the trench length has been determined, the width can be calculated from equation 4.

The minimum width of the distribution trench shall be 600 mm.

The minimum width of the downslope buffer shall be 5 metres. If there is less than 150 mm of available soil, a 150 mm thick and 3.5 m wide imported sand fill mantle should be added after the buffer (**see Figure 4.G**).

MOUND SYSTEM DESIGN SUMMARY:

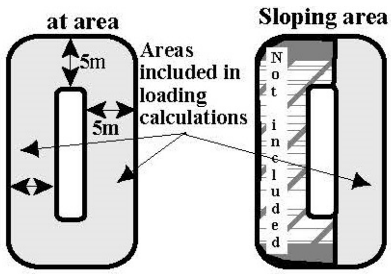
1. Calculate sewage flows (Q) in litres according to **Appendix F.**
2. Calculate distribution trench length from the following equation:

8 $$L = \frac{Q}{R_{linear}}$$

Where: R_{linear} - linear loading rate in litres/day/m of disposal field (40 to 60 litres/day/m)
Recommended $\mathbf{R_{linear}}$ is **40 l/d/m**

The recommended minimum length for a mound system is 25 metres. If existing conditions on the lot preclude the installation of a 25 metre long disposal field, the longest system that the location can accommodate as supported by the design calculations must be installed; however, in no case is the system length to be less than 15 meters. It is not recommended to exceed a linear loading rate of 60 L/day per m.

3. Calculate hydraulic load on basal area. On flat lots use entire area of the mound. On sloping sites use only downslope portion of the mound as shown on the sketch below. Increase buffer if basal loading exceeds 10 l/day/sq.m.



4. Minimum depth of imported sand fill under the pipe must be 600 mm.
5. The minimum depth of imported sand fill at the edge of the 5.0 m buffer is 300 mm.
6. Calculate width of the distribution trench:

4 $$W = \frac{Q}{33 * L}$$

A minimum width should be 0.6 metre

7. Specify buffer width each way of 5.0 metres or more. If there is less than 150 mm of permeable soil specify buffer width each way of 5.0 metres or more and a 150 mm thick imported sand fill mantle 3.5 metres wide. See cross section **Figure 4.G**.
8. Design disposal field cross section
9. Refer to **Appendix J, Table 4.9** for systems with lengths less than 38 for hole spacing requirements. For systems that have a trench length greater than 38 m, the hole spacing must be designed.
10. Design pressure distribution system

Check that separation to groundwater, bedrock or too permeable soil , at the heel is not less than 1 metre

5.8 DESIGN OF AREA BED AND MULTIPLE TRENCH SYSTEMS

5.8.1 General

The use of area or multiple trench systems is generally only acceptable where there is deep permeable soil and little slope on the lot. Design of an area bed or multiple trench systems assumes that effluent will move vertically downward from the system into and through the subsurface soil. The design is intended to make the area of the bed large enough to insure that the hydraulic capacity of the soil can accommodate the expected flow from the system. Designs are based on empirical relationships that define the hydraulic capacity of each system.

Designs of these systems should aim to maximize the length of the system along the contour of the site. A long narrow bed will avoid concentrating the flow in the centre of the bed area and reduce the amount of water mounding under the system. Generally length to width ratio should be 3 or more to decrease effluent mounding. Mounding will be greater in soils with lower permeabilities due to the fact that a higher hydraulic gradient must be developed to cause the effluent to flow away from under the trench. As a general guide, the height of mounding should be calculated to make sure that effluent will not mound into the bed and result in a malfunction on systems. There are several methods of calculating this mounding height including an easy to use program developed by *The Centre for Water Resource Studies* at *Dal.Tech*.

Area and trench type systems should have 75 mm filter sand in the bottom of the excavation to maximize permeability of the clogging mat. All other requirements covered in Sections 2 and 4 dealing with suitable site conditions to select an area or trench system also apply when these types of systems are being designed.

5.8.2 Area Bed Systems

When designing area bed systems, the information in Section 4.9.2 should be reviewed as part of the design process. In particular the following requirements must be maintained:

1) The slope on the lot is less than 3%
2) There is at least 600 mm of permeable soil under the bed (bottom of excavation) over impermeable soil.
3) There is at least 1 m separation between the bottom of the area bed and the maximum water table elevation, bedrock or soil with unacceptably high permeability.
4) The bed (bottom of excavation) is not more than 675 mm deep.
5) Where the bottom of the excavation must be raised to maintain the separation distances outlined in 2) or 3), the bottom of the excavation should not be raised above the bottom of the organic layer, i.e., the bed is notched into the organic layer.

Table 5.1 lists maximum hydraulic loading rates for area beds. These rates are based on the permeable soil type immediately below the system.

An area bed system can be designed using the following equations:

$\boxed{9}$ $$\mathbf{A} = \frac{\mathbf{Q}}{\mathbf{L_r}}$$

where:

where:	A	=	area of bed, m^2
	Lr	=	hydraulic loading rate for soil below system **(Table 5.1)** (L/day)/m^2
	Q	=	average daily design flow, L/day

$\boxed{10}$ $$\frac{\mathbf{L}}{\mathbf{W}} = \mathbf{3\ (or\ more)}$$

$\boxed{11}$ $$\mathbf{L} = \frac{\mathbf{A}}{\mathbf{W}}$$

where:	L	=	Length of bed along contour, m (make as long as practical)
	A	=	area of bed from equation $\boxed{9,}$ m^2
	W	=	width of bed in down slope direction (desirable max. 5 m)

AREA BED DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate disposal bed area from equation $\boxed{9}$ using loading rates from Table 5.1. Of the permeable soils below the bottom of the filter sand, use the one with the lowest permeability in establishing appropriate loading rate.

3. Calculate disposal bed length and width using equations $\boxed{10}$ and $\boxed{11.}$ Make sure that disposal bed is elongated as much as possible along contour line. Use length/width ratio of 3 or more. If possible, the width of the disposal bed should be 5 metres or less.

4. Design distribution network and disposal bed cross section

5. Calculate depth of the area bed trench based on a minimum of 600 mm of permeable soil under the area bed trench and a vertical separation of 1 metre to bedrock, groundwater or soils with unacceptably high permeability. Ensure that the bed (bottom of excavation) is not more than 675 mm deep.

6. For large systems and in high groundwater level situations, perform mounding calculations. Make sure that there is 1 metre of vertical separation between bottom of the disposal bed and top of the estimated groundwater mound. Elongate or raise system if necessary.

TABLE 5.1

MAXIMUM HYDRAULIC LOADING RATES FOR AREA BEDS

Permeable Soil Type	Maximum Hydraulic Loading Rate (L/day)/ m^2
Fine Sandy Gravel/ med. to coarse sand	14
Silty Sand	11
Sandy Silt	9

NOTE: Of the permeable soils below the bottom of the filter sand, use the one with the lowest permeability in establishing appropriate loading rate.

5.8.3 Multiple Trench Systems

When designing multiple trench systems, the information in Section 4.9.3 should be reviewed as part of the design process. In particular the following requirements must be maintained:

1) the slope on the lot does not exceed 3%;
2) there is at least 600 mm permeable soil under the trench over impermeable soil;
3) there is at least 1 m separation between the bottom of the trench and the maximum water table elevation, bedrock or soil with unacceptably high permeability; and
4) the trench depth is no more than 675 mm and no less than 150 mm.

Table 5.2 lists maximum hydraulic loading rates for multiple trench systems based on the permeable soil type immediately below the trench. A multiple trench system can be designed using the following equation:

$$\boxed{12} \qquad \mathbf{Lt} = \frac{\mathbf{Q}}{(\mathbf{Wt} * \mathbf{Lr})}$$

where:
- Lt = total length of trench and distribution pipe, m (make as long as practical along the slope)
- Lr = hydraulic loading rate (**Table 5.2)**, (L/day)/m^2)
- Q = average daily design flow, L/day
- Wt = width of trench, m (normally 0.6 m).

TABLE 5.2

MAXIMUM HYDRAULIC LOADING RATES FOR MULTIPLE TRENCH SYSTEMS

Permeable Soil Type	Maximum Hydraulic Loading Rate (L/day) /m^2
Fine Sandy Gravel/ med. to coarse sand	25
Silty Sand	20
Sandy Silt	15

Note: Of the permeable soils below the bottom of the filter sand, use the one with the lowest permeability in establishing appropriate loading rate.

MULTIPLE TRENCH DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate total length of distribution trench from equation $\boxed{12}$ using loading rates from **Table 5.2.** Of the permeable soils below the bottom of the filter sand use the one with the lowest permeability in establishing appropriate loading rate.

3. Design number and length of the individual trenches. Make sure that disposal system is elongated as much as possible along contour line.

4. Design disposal system cross section

5. Calculate depth of the trench based on a minimum of 600 mm of permeable soil under the distribution trench and a vertical separation of 1 metre to bedrock, groundwater or soils with unacceptably high permeability. Ensure that the trench depth is no more than 675 mm and no less than 150 mm. If there is less than 600 mm of permeable soil, a Multiple Trench system should not be designed.

6. For large systems and in high groundwater level situations, perform mounding calculations. Make sure that there is 1 metre of vertical separation between bottom of the distribution trench and top of the estimated groundwater mound. Elongate or raise system if necessary.

7. If trench width is greater than 1 meter it should be sized using loading rates for Area Bed from table 5.1.

8. Spacing between trenches should not be less than the trench width.

5.9 SLOPING SAND FILTER

5.9.1 General Requirements

The sloping sand filter can be utilized as outlined in these Guidelines.

The sand used in a sloping sand filter is not the same as that used in other systems described in these Guidelines. It must have a permeability of $1x10^{-4}$ to $5\ x10^{-4}$ m/sec (also see Appendix B).

The width of the trench is based on a loading rate of not more than 33 L/m^2 per day of trench bottom. **A minimum width should be 0.6 metre**.

The minimum length of a sloping sand filter is 10 metres

The depth of sand below the distribution trench shall be at least 450 mm.

The sloping sand filter shall have a minimum downslope buffer of 5 meters.

The crushed rock and sand must be covered with geotextile, clean local fill and 100 mm of final cover material, and seeded or sodded.

The minimum design flow for a residential structure is 1000 L/day and from a commercial, industrial and institutional building or structure is 500 L/d. In the case of a malfunction replacement, where lot conditions make it impossible to design a system for the minimum design flows stated, the qualified person may demonstrate a lesser flow based on water usage or occupancy. The acceptance of a lesser flow is at the discretion of the Department.

The required length of the sand filter can be calculated from equation (2) with the following changes:

$$\boxed{13} \qquad \mathbf{L} = \frac{\mathbf{Q}}{\mathbf{8.64 * 10^7 * I * K_{fill} * D_{sat}}}$$

The maximum linear loading rate varies based on the intended usage of the system as outlined in subsequent sections (5.9.2, 5.9.3 and 5.9.4) of the Guideline.

Where : Q - sewage flow in (liters)
L - length of the sand filter across the slope (m)
K_{fill} - permeability of the imported sand fill (m/sec)
D_{sat} - saturation of the sand (should not exceed 0.10 m) (m)
I - slope of the filter bottom (this is not necessarily the same as the surface slope at the filter location) (m/m)

NOTE: The minimum slope on the bottom of the sand filter must be 3%.

The size of the sloping sand filter should be as great as the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or periods of heavy rainfall conditions.

The calculation of the required basal area for a sloping sand filter is based on the type of soils located below the bottom of the sloping sand filter. The basal area must be calculated based on the loading rates indicated in Table 5.3 for the soil types listed.

TABLE 5.3

MAXIMUM HYDRAULIC LOADING RATES FOR SLOPING SAND FILTER BASAL AREA

Permeable Soil Type	Maximum Hydraulic Loading Rate (L/day) /m^2
Med. to coarse sand	45
Fine Sandy Gravel	45
Silty Sand	22
Sandy Silt	15
Clayey Silt	11
Silty Clay	8
Clay*If deemed permeable	8

Refer to Section 6.11 for the construction details.

5.9.2 Use of Sloping Sand Filter as a Replacement for a Malfunctioning System

The maximum linear loading rate should not exceed 100 L/day per m.

Where possible the sloping sand filter must be designed such that there is no direct discharge from the system to the surface and all effluent is discharged to the subsurface. The effluent from the sloping sand filter can be introduced into the existing soils or root mat via the use of a mantle and a dispersion trench or other method of introducing the effluent into the soil.

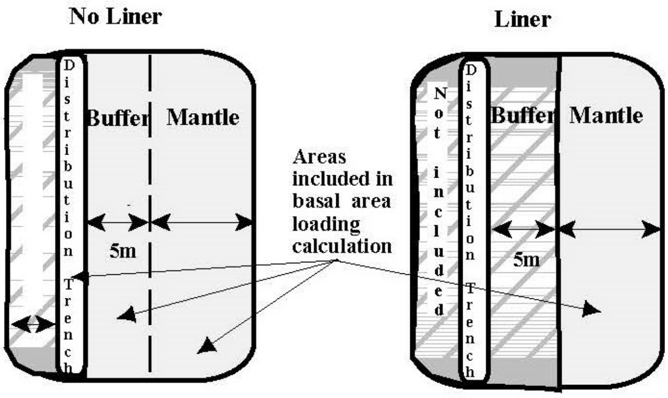
The total basal area for the buffer and mantle can be calculated using the loading rates in Table 5.3. The minimum width of the downslope buffer shall be 5 metres. If this buffer does not meet the calculated basal area, a 150 mm thick imported sand fill mantle should be added after the buffer as required to achieve the calculated total basal area. When a mantle is utilized it must extend the full length of the sand filter and be located down gradient of the buffer. If lot conditions preclude the installation of a mantle as described above, then the Department may consider other arrangements. An example utilizing the buffer and a mantle and dispersion trench is given in **Figure 5B**.

The sloping sand filter (bottom of excavation) shall be not more than 1300 mm deep at the heel of the sand filter. If any portion of the sloping sand filter is above grade than the sides of the sloping sand filter must be lined to ensure that the effluent is contained within the sand filter.

Local conditions may require the installation of a disinfection system and/or a liner. If the filter is being installed and discharged at a sensitive site such as freshwater bodies or near high population areas, etc. then effluent disinfection is required, and a collection pipe and discharge line can be installed at the toe of the sand. An appropriate method of disinfection can be utilized. If chlorination is used for disinfection then dechlorination may be required to prevent damage to aquatic life. This type of system with a piped point discharge cannot be considered on site sewage disposal but is rather treatment and as such may require approvals other than the approval to install an on site sewage disposal system. **Figure 5A** shows examples of a sloping sand filter that may be utilized on lots where a discharge cannot be avoided.

In the case of a liner, it should be part of the design in situations where there is less than 1 m of separation between the bottom of the distribution trench and bedrock, groundwater or soil with unacceptably high permeability.

The basal area is the total area under the distribution trench, filter, dispersion trench and mantle, except in those cases where a liner is utilized in which case the area covered by the liner (distribution trench and buffer) is not to be included in the basal area calculation as shown in the sketch below.



Care must be taken to assure that the soil under the filter does not contain sections of old disposal fields which could allow effluent to bypass the sand fill.

Figure 5A & 5B shows examples of different types of the sloping sand filters that may be utilized as replacements for malfunctioning systems.

If the sloping sand filter is being used as a replacement system for a malfunctioning system and the space determined by equation 13 is not available, other designs will be reviewed.

5.9.3 Use of Sloping Sand Filter on Lots Created Prior to August 6, 1984

The lot must have been created prior to August 6, 1984. Proof of this must be provided. In addition to the requirements in section 5.9.1, the following are additional minimum requirements for the design of a sloping sand filter in this case:

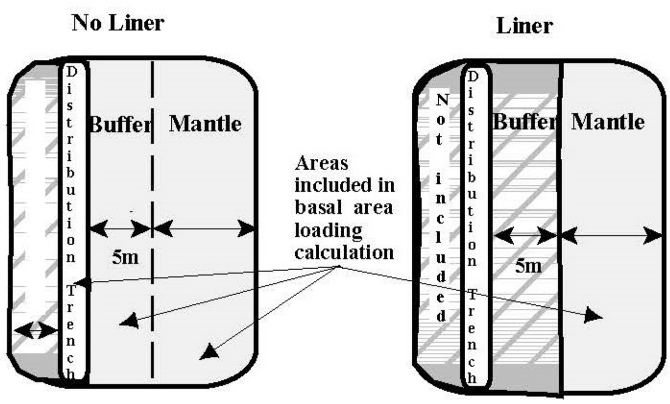
1) The maximum linear loading rate shall not exceed 100 L/day per m.
2) There is at least 1 m separation between the bottom of the sloping sand filter distribution trench (crushed rock) and the maximum water table elevation, bedrock or soil with unacceptably high permeability.
3) The sloping sand filter (bottom of excavation) is not more than 1300 mm deep at the heel of the sand filter. If any portion of the sloping sand filter is above grade than the sides of the sloping sand filter must be lined to ensure that the effluent is contained within the sand filter.
4) Where the bottom of the excavation must be raised to maintain the separation distances outlined in 2) or 3), the bottom of the excavation should not be raised above the bottom of the organic layer, ie. the sloping sand filter is designed such that the toe of the filter is notched into the organic layer.
5) The use of a liner system is permitted but it cannot be utilized to overcome the minimum vertical separation requirements. When a liner is utilized the minimum vertical separation of 1 metre is measured between the sloping sand filter distribution trench and maximum water table elevation, bedrock or soil with unacceptably high permeability (i.e., even if a liner is utilized, the 1 metre vertical separation from the bottom of the distribution trench to maximum water table elevation, bedrock or soil with unacceptably high permeability must be maintained).

The sloping sand filter must be designed such that there is no direct discharge from the system to the surface and all effluent must be discharged to the subsurface although there may be some discharge into the organic root mat during peak flow or periods of heavy rainfall conditions.

The total basal area for the buffer and mantle can be calculated using the loading rates in Table 5.3.

The minimum width of the downslope buffer shall be 5 metres. If this buffer does not meet the calculated basal area, a 150 mm thick imported sand fill mantle must be added after the buffer as required to achieve the calculated total basal area. When a mantle is utilized it must extend the full length of the sand filter and be located down gradient of the buffer. An example utilizing a buffer, a mantle and dispersion trench is given in **Figure 5B**.

The basal area is the total area under the distribution trench, filter, dispersion trench and mantle, except in those cases where a liner is utilized in which case the area covered by the liner (distribution trench and buffer) is not to be included in the basal area calculation as shown in the sketch below.



5.9.4 Use of Sloping Sand Filter on Lots Created On or After August 6, 1984

In addition to the requirements in section 5.9.1, the following are additional minimum requirements for the design of a sloping sand filter in this case:

1) The maximum linear loading rate shall not exceed 85 L/day per m.
2) There is at least 1 m separation between the bottom of the sloping sand filter distribution trench (crushed rock) and the maximum water table elevation, bedrock or soil with unacceptably high permeability.
3) The sloping sand filter (bottom of excavation) is not more than 1300 mm deep at the heel of the sand filter. If any portion of the sloping sand filter is above grade than the sides of the sloping sand filter must be lined to ensure that the effluent is contained within the sand filter.
4) Where the bottom of the excavation must be raised to maintain the separation distances outlined in 2) or 3), the bottom of the excavation should not be raised above the bottom of the organic layer, i.e., the sloping sand filter is designed such that the toe of the filter is notched into the organic layer.

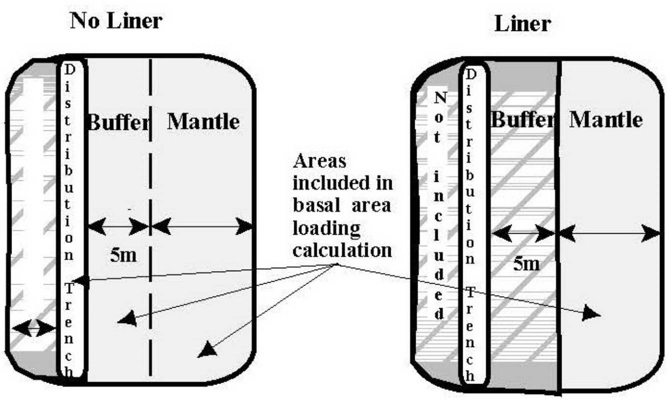
5) The use of a liner system is permitted but it cannot be utilized to overcome the minimum vertical separation requirements. When a liner is utilized the minimum vertical separation of 1 metre is measured between the sloping sand filter distribution trench and maximum water table elevation, bedrock or soil with unacceptably high permeability (i.e., even if a liner is utilized, the 1 metre vertical separation from the bottom of the distribution trench to maximum water table elevation, bedrock or soil with unacceptably high permeability must be maintained).

The sloping sand filter must be designed such that there is no direct discharge from the system to the surface and all effluent must be discharged to the subsurface although there may be some discharge into the organic root mat during peak flow or periods of heavy rainfall conditions.

The total basal area for the buffer and mantle can be calculated using the loading rates in **Table 5.3**.

The minimum width of the downslope buffer shall be 5 metres. If this buffer does not meet the calculated basal area, a 150 mm thick imported sand fill mantle should be added after the buffer as required to achieve the calculated total basal area. When a mantle is utilized it must extend the full length of the sand filter and be located down gradient of the buffer. An example utilizing a buffer, a mantle and dispersion trench is given in **Figure 5B**.

The basal area is the total area under the distribution trench, filter, dispersion trench and mantle, except in those cases where a liner is utilized in which case the area covered by the liner (distribution trench and buffer) is not to be included in the basal area calculation as shown in the sketch below.



SLOPING SAND FILTER DESIGN SUMMARY

1. Calculate sewage flows (Q) in litres according to **Appendix F**.
2. Calculate length from the following equation:

13 $$\mathbf{L = \frac{Q}{8.64 * 10^7 * I * K_{fill} * D_{sat}}}$$

D_{sat} is not to exceed 0.10 m.

3. Check the linear loading rate to confirm that the calculated length will result in a linear loading rate which is less than or equal to the following:

- R_{linear} - linear loading rate for malfunction replacement in L/day per m of disposal field is 100 L/day per m)
- R_{linear} - linear loading rate for lots created prior to August 6, 1984 in L/day per m of disposal field is 100 L/day per m)
- R_{linear} - linear loading rate for lots created on or after August 6, 1984 in L/day per m of disposal field is 85 L/day per m)

If calculated length does result in a linear loading rate which is less than or equal to the linear loading rates indicated above; increase the length of sloping sand filter until the required linear loading rate is achieved.

The minimum length of a sloping sand filter is 10 metres

4. Calculate width of the distribution trench using the following equation:

4 $$\mathbf{W = \frac{Q}{33 * L}}$$

A minimum width should be 0.6 metre

5. Minimum depth of imported sand fill below the distribution trench must be 450 mm.

6. Specify downslope buffer width of 5 metres or more. The minimum depth of imported sand fill at the edge of the 5 m buffer is 300 mm.

7. Calculate hydraulic load on basal area. If hydraulic loading on basal area exceeds the values listed in Table 5.3; a 150 mm thick imported sand fill mantle must be installed downslope and along the full length of the buffer. The width of the mantle must be such that the hydraulic loading on the basal area (distribution trench + buffer + mantle in the case of an unlined system and mantle only in the case of a lined system) is equal to or less than the values listed in Table 5.3.

8. Design disposal field cross section. See **Figure 5A and 5B** for a typical cross section.

Check that separation to groundwater, bedrock or too permeable soil , measured from the distribution trench (bottom of gravel) is not less than 1 metre unless it is a malfunctioning system and a liner is being utilized.

FIGURE 5 A

SLOPING SAND FILTER - MALFUNCTION REPLACEMENT ONLY

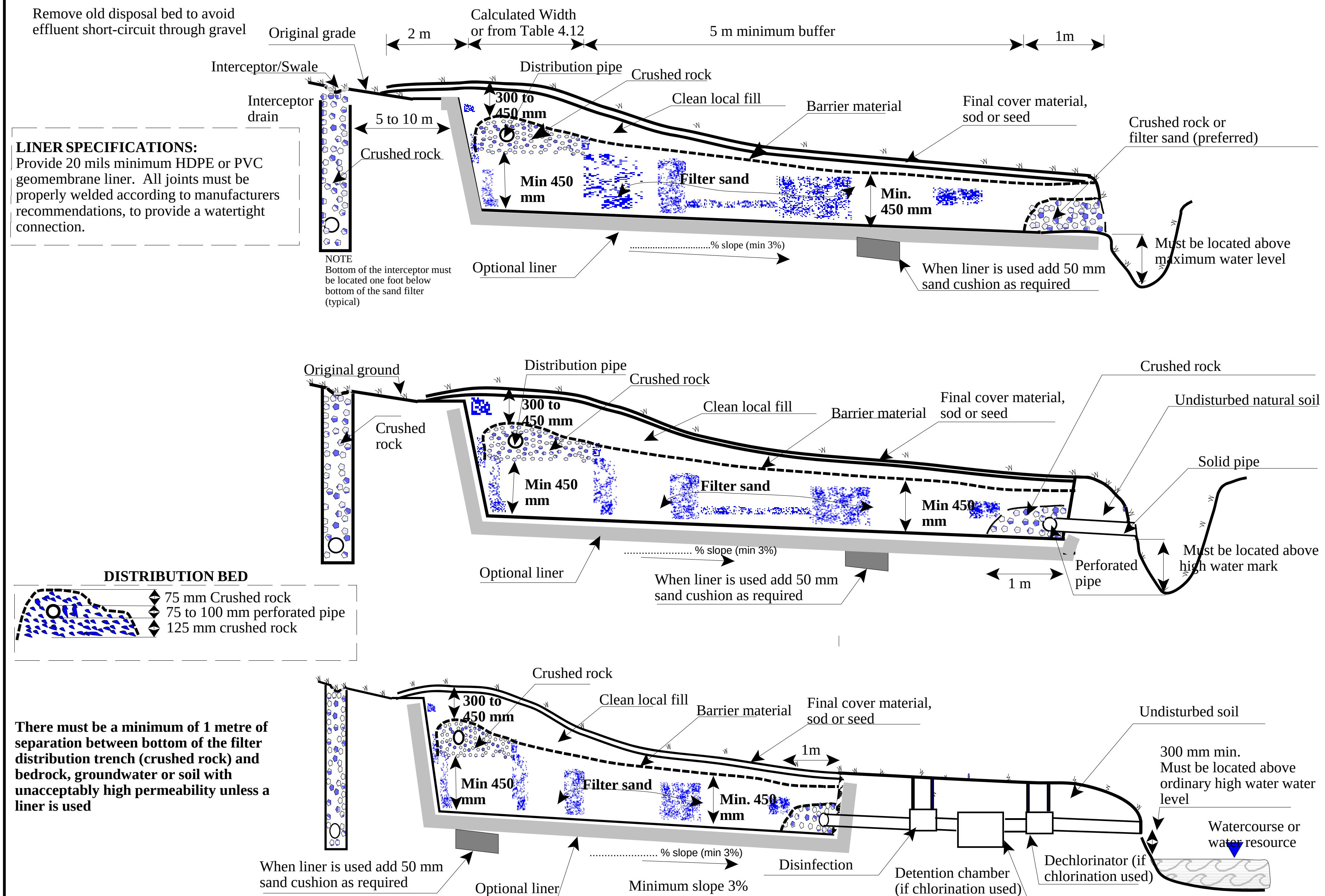
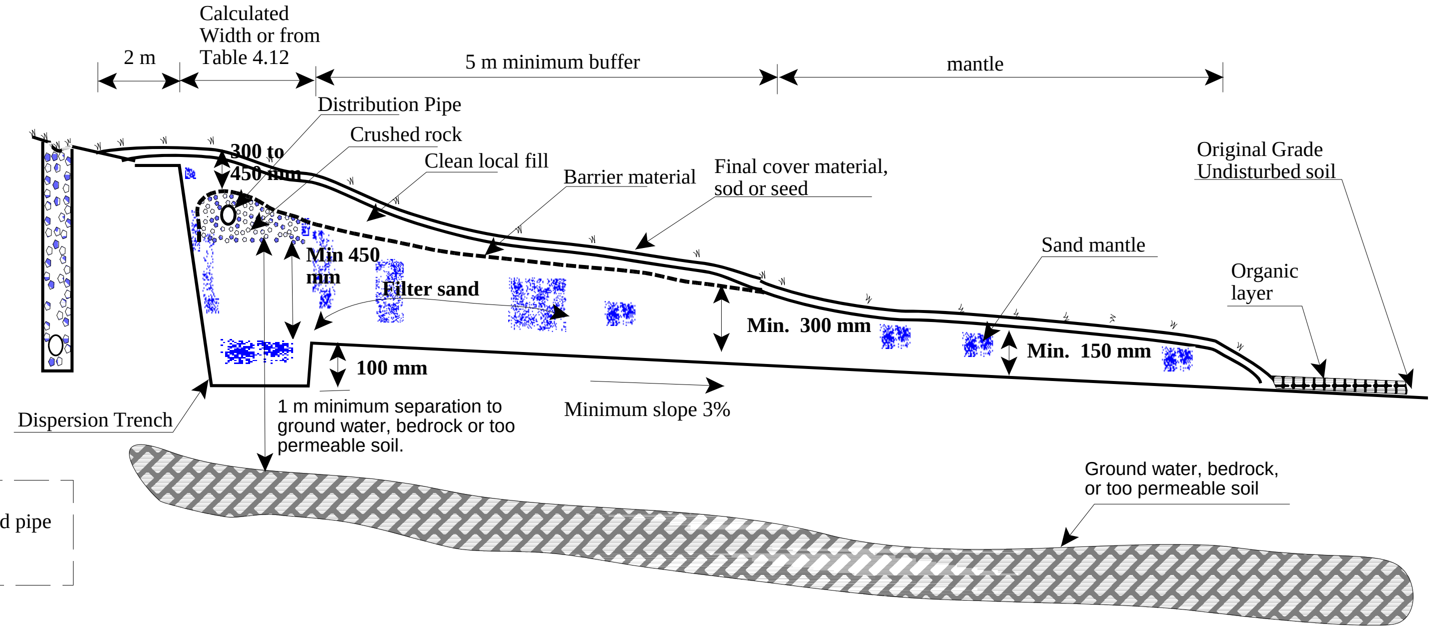


FIGURE 5 B

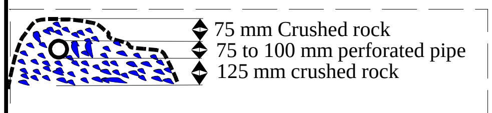
SLOPING SAND FILTER

LINER SPECIFICATIONS:
Provide 20 mils minimum HDPE or PVC geomembrane liner. All joints must be properly welded according to manufacturers recommendations, to provide a watertight connection.

NO LINER

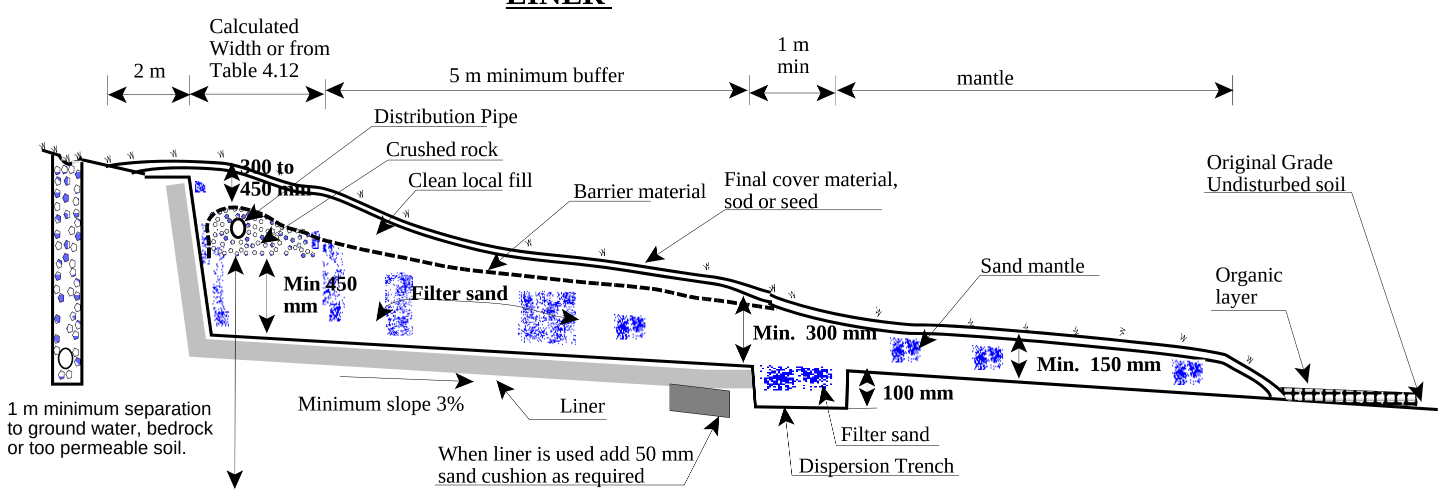


DISTRIBUTION BED



LINER

There must be a minimum of 1 metre of separation between bottom of the filter dispersion trench (crushed rock) or end of liner and bedrock, groundwater or soil with unacceptably high permeability unless it is a malfunction replacement and a liner is utilized



5.10 SEPTIC TANK AND GREASE CHAMBER DESIGN SUMMARIES

SEPTIC TANK

For average daily flows up to 9000 l/day:

Vtank(1) = 2Q

Where: Q - average daily flow in litres

Vtank - tank volume in litres

For average daily flows 9000 l/day or more:

Vtank(2) = 9000 + Q

Where: Q - average daily flow in litres

Vtank - tank volume in litres

The minimum required septic tank size is 2800 L. Septic tank sizes larger than the required minimum may reduce problems and extend the life of an on-site system.

GREASE CHAMBER

For Restaurants:

V_{grease} = **D * (HR/2) * GL * ST * LF**

Where: D - number of seats in dining area

HR - number of hours open per day

GL - gallons of wastewater per meal (2 or more)

ST - Storage capacity (normally 2)

LF - Loading factor depending on restaurant location

- 1.25 - central locations
- 1.0 - recreation areas
- 0.5 to 0.8 - other locations

For Cafeterias or Institutional kitchens:

V_{grease} **= M * GL * ST * LF**

Where: M - Total number of meals served per day

GL - Gallons of wastewater per meal (2 or more)

ST - Storage capacity (normally 2)

LF - Loading factor

- 1.0 with dishwasher
- 0.5 without dishwasher

For details regarding septic tanks and grease chambers refer to Section 3.

5.11 OTHER APPROVED TECHNOLOGY

5.11.1 Under section 2(q)(iv) of the *On-site Sewage Disposal Systems Regulations*, a system other than what has been described in these guidelines may be considered to be an on-site sewage disposal system provided it meets specifications established or adopted by the Department. In these cases, the use of such a system must be in accordance with the specifications established or adopted by the Department recognizing it as an on-site sewage disposal system under the regulations.

5.11.2 When submitting information in support of an application for an on-site sewage disposal system using a system as described in section 5.11.1, it must be clearly indicated that the design or selection meets the specifications established or adopted by the Department for the system.

5.11.3 Unless clearly stated otherwise by the Department, another approved technology system is required to meet the minimum requirements of the *On-site Sewage Disposal Systems Regulations* and any guidelines, standards, and policies issued by the Department.

5.11.4 Any system which proposes a discharge to ground surface, watercourse, ditch or drainage pattern, shall be accompanied by a clear determination that a system which discharges subsurface cannot be accommodated on the property. This shall include reasons why a subsurface discharge cannot be recommended.

5.11.5 Any discharge to a watercourse shall be accompanied by a sensitivity analysis of the watercourse which shall include, but not be limited to, the expected quality of the treated effluent, the assimilative capacity of the watercourse, and the proximity of the discharge point to sensitive receptors such as drinking water intake lines, other use water intake lines, public swimming areas, shellfish harvesting areas, and aquaculture sites. Any other sources of pollution should be considered as well.

When doing the analysis, the potential effect of the expected levels of fecal coliforms, BOD, and suspended solids in the treated effluent shall be looked at with respect to potential receptors. Disinfection may be required. The design of the disinfection equipment shall take into account the special challenges in disinfecting small flows. For further direction, please refer to the latest edition of the **Atlantic Canada Standards and Guidelines Manual for the Collection, Treatment and Disposal of Sanitary Sewage**.

5.11.6 Any discharge to a ditch located on property owned by the Department of Transportation and Public Works or the Municipality shall be in accordance with any policies and memorandums of understanding in place at that time and with the approval of the Department of Transportation and Public Works or the Municipality. The applicant and/or Qualified Person should contact the Department of Transportation and Public Works or the Municipality regarding such discharge and provide the approval for the discharge into the ditch with the application.

5.11.7 Subdivision proposals made with the intent of using other approved technologies shall be required to meet minimum lot sizes as described in Section 7 of the *On-site Sewage Disposal Regulations*. Other approved technologies being considered for subdivision proposals must use subsurface disposal of treated effluent.

5.12 OTHER SYSTEMS

5.12.1 Greywater

Greywater, which includes any household wastewater except that from toilets, can be a serious aesthetic and health problem if not disposed of in an acceptable manner.

In certain cases such as isolated hunting camps where the lot has been assessed as suitable for on-site sewage disposal and a privy or other suitable non-water carrying system is proposed, a system of some type is still required for greywater, i.e., sink wastes disposal. The details of the required system will be shown on the approval. It must be stressed that this type of system will not handle waste from washing machines, dishwashers, etc. but it is only intended for infrequent use of sinks and possibly showers. If the Department feels the installation of such a system could contaminate ground water or create a health or aesthetic problem, approval of such a system will not be recommended.

In the case of a full time residence which has a non-water carrying toilet, a standard on-site disposal system would be required for greywater. The size requirements for this type of system would be the minimum required for a single unit detached dwelling.

5.13 CLUSTER SYSTEMS

5.13.1 Definitions

The following definitions are applicable to this section of the guidelines.

1. "cluster system" means a system intended to service more than one building, structure or dwelling;

2. "Condominium Development" means a development on property owned and registered in accordance with the *Condominium Act* and *Condominium Regulations*.

3. "dwelling" means:
   - a single family residential unit or
   - each unit or apartment in a multiple unit structure or
   - a commercial, industrial or institutional facility.

4. "municipal system" means a sewage collection system owned and operated by or on behalf of a municipality;

5. "Qualified Person Level 1" means a person who meets the requirements of Section 25 of the *On-site Sewage Disposal Systems Regulations*.

6. “municipal development” means the servicing of more than one individual lot by a municipal system, located on a separate property.

7. “system” means, except where the context requires otherwise, an on-site sewage disposal system, or any part of an on-site sewage disposal system.

5.13.2. Application

This section of the guidelines provides direction to Qualified Persons Level 1, and other interested parties regarding the requirements for the design and use of a cluster system.

This section of the guidelines will apply where application for Approval is made under the *On-site Sewage Disposal Systems Regulations* to install or create a cluster system to serve:

1. Buildings, structures or dwellings located on an existing lot,

2. The creation of a new lot which will be serviced by a cluster system on that lot;

3. The construction or installation of more than one system on a lot where at least one of the systems is a cluster system;

4. A municipal development;

5. A condominium development;

With the exception of “municipal development” and “condominium development”, a cluster system shall only be installed on the same lot as the buildings, structures or dwellings it services.

5.13.3 Minimum Requirements for All Cluster Systems or the Creation of a Lot to Be Serviced by a Cluster System

A person applying for an approval to construct, install or create a cluster system or to create a lot to be serviced by a cluster system must meet the following minimum requirements:

1. The design must be completed by a Qualified Person Level 1.

2. The minimum lot requirements shall be as stated in Section 5.13.8 of this guideline.

3. Sufficient land must be reserved to locate a replacement system.

4. The design and submission must be in compliance with the *On-site Sewage Disposal Systems Regulations*, these guidelines and any policies established or adopted by the Department.

5. The design flows for the cluster system shall be based upon projected sewage loading as shown in Appendix F of these guidelines.

6. For cluster systems that may have components susceptible to future infiltration and inflow, consideration should be given to increasing the design flow appropriately.

7. The cluster system disposal fields shall not be located on a property such that one disposal field is downslope of another unless the Qualified Person Level 1 can demonstrate that the up slope field will not saturate the downslope field. If this condition can be demonstrated; the minimum separation distance between the disposal fields shall be no less than 15 m (50 ft) if there is 600 mm or more of permeable soil and no less than 30 m (100 ft) for all other cases.

8. In the case of a cluster system being proposed to immediately address any adverse effects, the system may be considered a malfunctioning system under the *On-Site Sewage Disposal Systems Regulations* and these Guidelines provided the design does not incorporate any increase in flow over what was legally in place at the time of the malfunction. If the cluster system incorporates an increase in design flow, the system must meet the *On-site Sewage Regulations* and *Guidelines* (i.e. cannot utilize section 21(2) of the *Regulations*).

5.13.4 Cluster to Service Buildings, Structures or Dwellings Located on an Existing Lot

In addition to the requirements set out in section 5.13.3; a person applying for an approval to construct, install or create a single cluster system on an existing lot shall meet the following additional requirements:

1. Demonstration that the property and buildings are owned by an individual or a business (entity) registered and in good standing with the Registry of Joint Stock Companies. One individual cannot own a structure and a different individual own a second structure served by the system, unless they are part of the entity that owns the system (e.g., A Condominium Incorporation);

2. A copy of any legal agreements indicating that the entity (individual, government or business) has been established and is responsible for the common system;

3. Where an applicant wishes to create a cluster system by connecting additional buildings, structures or dwellings to an existing sewage disposal system, a detailed site assessment of the lot and existing system must be conducted by a Qualified Person Level 1 which states;

    i. the minimum lot requirements established in Section 5.13.8 of this guideline are met and,

    ii. the existing system is capable of handling the design flow as established by the requirements of Appendix F of these guidelines, or

    iii. the existing system will be modified or replaced, resulting in a system which will meet the new design flow requirements as established by Appendix F of these guidelines.

5.13.5 Construction, Installation or Creation of More than One System on a Lot Where at Least One of the Systems Is a Cluster System:

In addition to the requirements set out in section 5.13.3; a person applying for an approval to construct, install or create more than one system on a lot where at least one system will be a cluster system shall meet the following additional requirements:

1. Comply with Section 9(5) of the *On-site Sewage Disposal Systems Regulations*

2. For the purposes of Section 9(5) of the *On-site Sewage Disposal Systems Regulations*, it must be demonstrated that a separate lot can be created containing the building, structure or dwelling and the system. The minimum lot requirements for each lot containing a cluster system shall be as stated in Section 5.13.8 of this guideline.

5.13.6 Cluster for Municipal Development:

In addition to the requirements set out in section 5.13.3; a person applying for an approval to construct or install a cluster system or to create a lot to be serviced by a cluster system for a **municipal development** shall meet the following additional requirements:

1. (i) Provide proof of ownership or easement of all parts of the system beyond the building sewer (i.e., sewer lines, disposal field and land on which the field is located); and

   (ii) Provide proof that the municipality owns the property where the disposal system is located; or

   (iii) Provide a copy of a legal agreement which indicates the Municipality will assume ownership for the system upon installation or construction of the system.

2. The septic tanks may be located on each individual lot or on the property under the ownership or control of the Municipality.

3. Sizing of the individual development lots is to be based upon the minimum lot sizes for the municipality in which they are located.

4. Sizing of the municipally owned lot containing the cluster system disposal field shall be in accordance with the minimum lot size requirements in section 5.13.8 of this guideline.

5.13.7 Cluster for Condominium Development:

In addition to the requirements set out in section 5.13.3; a person applying for an approval to construct, install or create a cluster system or to create a lot to be serviced by a cluster system to service a **condominium development where all the building, structures or dwellings it will service are located on the same property as the system(s), but the property is divided into lots for the individual condominium units,** shall meet the following additional requirements:

1. Provide proof that the Condominium is Registered in accordance with the *Condominium Act and Regulations*

2. Sizing of the individual condominium unit lots is to be based upon the minimum lot sizes for the municipality in which the condominium is located and the requirements of the *Condominium Act* and *Condominium Regulations*.

3. Sizing of the condominium lot containing the cluster system disposal field shall be in accordance with the minimum lot requirements in section 5.13.8 of this guideline.

5.13.8 Minimum Lot Requirements for Cluster Systems:

The minimum lot requirements for the **installation of a cluster system on an existing lot or for the creation of a lot to be serviced by a cluster** system shall satisfy the following:

(i) For the first 1500 liters per day of design flow, lot size requirements shall satisfy Section 7 of the *On-site Sewage Disposal Systems Regulations*.

(ii) For every design flow increase of 1500 liters per day, or part thereof, the lot area shall be increased a minimum of one-half the lot size requirement found in Section 7 of the *On-site Sewage Disposal Systems Regulations*;

(iii) Notwithstanding (i) and (ii) the lot must have sufficient area and width to accommodate the proposed cluster system, a location for a replacement field, roadways, structures, water supply(s).

(iv) All minimum clearance distances as prescribed in Section 13 of the *On-site Sewage Disposal Systems Regulations* shall be met.

5.13.9 Municipal Wastewater Management District By-Law Option

Municipalities have the option to develop a Wastewater Management District (WMD) By-Law where the Municipal Government is designated as the responsible entity. A WMD by-law can provide a mechanism for continued on-site septic system management and address limitations around cluster system type developments.