Ohio Environmental Protection Agency

2026 Onsite Sewage Treatment System Guidance Document

Cover Photo Credit:
Josh Herold, REHS, Ohio EPA, 2025

Division of Surface Water

Version 3

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A. Introduction

This Onsite Sewage Treatment System (OSTS) Guidance Document was last updated in 2011 as interim guidance. Since then, Ohio EPA has not promulgated any regulations for OSTS beyond the requirements that new or modified OSTS for commercial facilities obtain a permit-to-install (PTI) in accordance with ORC 3745-42 Permit-to-Install and Plan Approvals for Water Pollution Control. If the design flow of an OSTS is less than 1,000 gpd, local county health departments may have permitting authority for these systems if they have entered into a Small Flows Onsite Sewage Treatment System (SFOSTS) agreement with Ohio EPA. Residential OSTS remain under the regulatory authority of Ohio Department of Health (ODH). The ODH regulations for OSTS are contained in OAC 3701-29 Sewage Treatment Systems. This 2026 revision of the OSTS guidance document used the ODH regulations as guidance, along with industry standards and best practices, to provide users with the necessary information for effective design and installation of OSTS throughout Ohio.

The OSTS Guidance Document provides information and practices for the benefit of Ohio EPA permit staff, design engineers, owners, and operators of onsite wastewater treatment systems. The intent of the OSTS Guidance Document is to present design criteria and best practices that support the development of approvable plans and specifications for OSTS. While this guidance document is not regulatory, certain criteria outlined herein are required to achieve approval, and the technical and regulatory information provided establishes consistency in design and review across the State of Ohio.

All figures included in this guidance are provided solely for illustrative purposes. Their use does not constitute endorsement or recommendation of any specific manufacturer, product, or service.

Ohio EPA Division of Surface Water is willing to discuss alternative methods of complying with applicable statutes, regulations, or requirements. Ohio EPA may approve other designs that deviate from this OSTS Guidance Document if they are adequately justified. It is requested that these deviations be discussed and agreed upon with Ohio EPA prior to submitting the permit application to avoid unnecessary or wasteful expenditure of resources.

A.1 2026 OSTS Guidance Document Committee Members

NAME	OHIO EPA DISTRICT OFFICE
W. WARREN WRIGHT, P.E	PTI Unit – Central Office
STEPHEN LEAR, P.E.	Supervisor, PTI Unit – Southeast District Office
RYAN GIERHART, P.E.	PTI Unit – Northwest District Office
JOSH HEROLD, REHS	Northeast District Office
GLEN VONDEREMBSE, P.E.	Southwest District Office
RICHARD MILLER	Southwest District Office
ARIEL RUTH, REHS	Southeast District Office
BRANDON ATWOOD, REHS	Southeast District Office
WEN-TONG LIN	Central Office
THOMAS BROOMHALL	Central Office
KEITH CUMMINGS	Central District Office
DYLAN DOWNING	Central Office
NICHOLAS HAMMER, REHS	NPDES Compliance Assistance Unit
ANDREW GALL, P.E.	NPDES Compliance Assistance Unit

A.2 Definitions

This document acknowledges all definitions found in OAC 3701-29-01 and OAC Rule 3745-42. Additionally, the following definitions are applicable:

At-grade system: an OSTS where wastewater is conveyed to a soil absorption system that is constructed on in-situ soil at the ground surface and covered by soil.

Combined Treatment and Dispersal (CTD) System: units that combine the treatment and dispersal functions within the same equipment. They are non-electric and capable of treating domestic wastewater to secondary standards (i.e., performance standards for wastewater treatment achieved using aerobic biological processes that remove dissolved organic matter and pathogens) and dispersing the treated water to the native soil within the CTD system footprint.

Designer: an individual responsible for preparing plans related to the installation, alteration, repair, or replacement of an OSTS. If the designer is not a licensed Professional Engineer (PE) in the State of Ohio, the plans must be reviewed, stamped, and signed by a licensed PE as part of the PTI submittal.

Failed System: an OSTS that exhibits one or more of the following, but not limited to:

1. The system is unable to accept wastewater at the rate of the design application, thereby interfering with the normal use of plumbing fixtures;
2. Wastewater discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters;
3. Wastewater is discharged from the system, causing contamination of the potable water supply, groundwater, or surface waters.

Fill: soil other than native in-situ soils. Fill may be evident by one or more of the following, but not limited to:

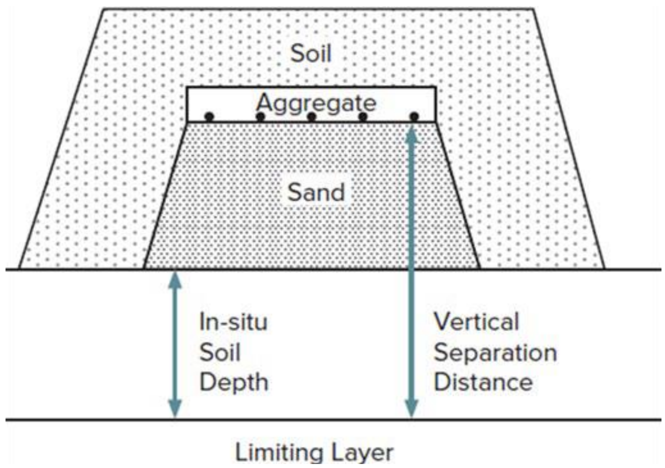
1. No soil horizons or indistinct soil horizons (e.g., surface mine reclamation);
2. Depositional stratification;
3. Presence of a soil horizon that has been covered;
4. Materials in a horizon, such as cinders or construction debris;
5. Position in the landscape.

Onsite Sewage Treatment System (OSTS): a disposal system that treats and disperses wastewater into a soil absorption system.

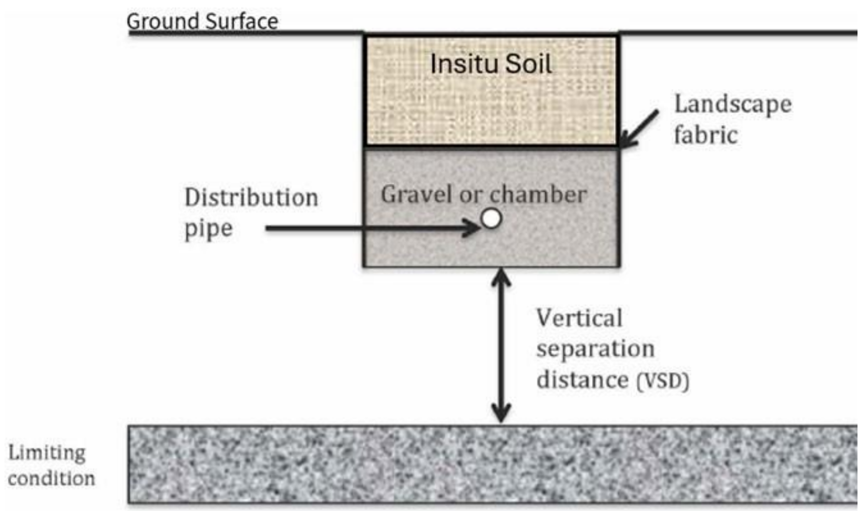
Professional soil scientist (Soil Evaluator): an individual with a baccalaureate degree with a major in agronomy, soils, geology, or a closely allied field, or who is approved by Ohio Department of Health in accordance with OAC 3701-29-07(A) of the Administrative Code. This professional will be able to apply principles of pedology to soil classification, investigation, education, and consultation, and evaluate the effect of measured, observed, and inferred soil properties on the siting of sewage treatment systems, disposal systems, and land application systems.

Vertical Separation Distance (VSD): The distance from the bottom of the infiltrative surface to the top of the limiting layer (e.g., seasonal high-water table, bedrock). See schematics below.

- In elevated systems, the VSD is measured from the bottom of the aggregate layer (or distribution media) to the top of the limiting condition.
- In at-grade or below-grade systems, the VSD is measured from the trench bottom of a soil treatment system to the top of the limiting condition.



Elevated System



Below-Grade System

B. Site Evaluation and Soil Evaluation

The initial step in designing an Onsite Sewage Treatment System (OSTS) is to conduct a comprehensive site evaluation, which includes a detailed assessment of the soils in the areas proposed for the soil absorption system. The components of these evaluations are outlined below.

B.1 Site Evaluation

The components of the site evaluation are identified on Form B12.

B.2 Soil Evaluation

Soil testing and characterization must be conducted at proposed locations for soil absorption systems. The results of these evaluations shall be documented on Form B13. Testing must accurately represent the variability in soil and site conditions across the proposed sewage treatment system absorption areas. This includes the use of test pits, soil borings, and/or soil probes to a sufficient depth to identify all limiting conditions, not to exceed sixty (60) inches.

The locations of test pits, soil borings, and/or soil probes, along with the representative areas for each, must be staked or flagged on-site by the soil evaluator. Staking may be omitted if representative areas can be clearly identified using natural or existing markers.

Soil evaluation Form B13 shall be signed by a Professional Soil Scientist (Soils Evaluator) as defined in OAC 3745-42-01(P)(2).

In addition to Form B13, the soil evaluation must include a site drawing, which needs to be attached to ePlans as part of the plans and documents prepared in accordance with OAC 3745-42-03.

C. Flow Estimation and Waste Strength

(A) The PTI applicant or applicant's agent shall provide information on the sources of sewage to be treated. The Ohio EPA may require the submission of building and plumbing plans, including details of plumbing fixtures and other necessary information.

(B) The daily design flow estimate for an OSTS must be determined in accordance with Table A-1 of OAC 3745-42-05. (Note: water-use-records or other information may be used in place of design flow rule values if done in accordance with the rule).

- For an OSTS with periodic large daily flow, flow equalization may be used to limit the effects of peak flows and improve system efficiency.
- When sewage is stored, the design must use time dosing and the appropriate tank capacity to store effluent during peak flows.

(C) The waste strength estimate for an OSTS shall be documented for design purposes. Waste strength for sewage to be applied to a soil absorption component must not exceed typical domestic sewage strength, such that, after primary treatment, the waste strength does not regularly exceed:

- TSS (Total Suspended Solids) - 300 mg/l
- BOD5 (Biochemical Oxygen Demand, 5-day) - 250 mg/l, or
- FOG (Fats, Oils, and Grease) - 25 mg/l

Notes:

1. Garbage disposals may increase nutrients, total suspended solids, and biochemical oxygen demand loading and are not recommended for installation in buildings utilizing an OSTS.

2. Please contact Ohio EPA Central Office, Division of Surface Water PTI Group, to discuss plans for any OSTS with a design flow of greater than or equal to 2,000 gallons per day.

D. Tanks, Pumps and Controls, and Building Sewers

(A) Tanks, pumps, and controls used in an OSTS shall be manufactured to be watertight, structurally sound, and resistant to corrosion. Grease interceptors and pretreatment components are recommended for OSTS that will receive restaurant-strength wastewater (high BOD/TSS). Local plumbing codes should be consulted for design and installation criteria for grease interceptors. If they are not covered locally, then consult a resource such as the Uniform Plumbing Code online manual (IAPMO 2024 Uniform Plumbing Code), which provides a comprehensive chapter on traps and interceptors. All risers and access lids shall be lockable, child-resistant, and gasketed to prevent infiltration or exfiltration. ODH Regulations for tanks, pumps, and controls, and building sewers can be found at OAC 3701-29-12.

(B) A cleanout should be installed at the building exit, at every change in direction greater than 45 degrees, and at intervals not exceeding 100 feet of straight run.

(C) Septic tanks used in an OSTS shall be labeled in accordance with ASTM C 1227, IAPMO/ANSI Z1000, or CAN/CSA-B66 and shall comply with the following requirements and specifications:

1. Minimum liquid capacities of septic tanks shall be at least 2.5 times the daily design flow. The minimum recommended size is 1,000 gallons.

2. Dual-compartment septic tanks are recommended.

3. In dual-compartment tanks, the first compartment shall not be less than one-half or more than two-thirds of the total capacity of the septic tank, and the transfer port in the center wall shall ensure transfer of liquid from the clear zone only. When using two or more tanks, the septic tanks shall be connected in series.

4. The septic tank outlet, or the outlet of the last septic tank in series, shall include an effluent filter device that retains solids greater than one-sixteenth inch in size. Effluent filter devices shall be certified to ANSI/NSF Standard 46 or be approved by Ohio EPA. Effluent filter devices shall be sized to meet the estimated daily design flow for the system containing the septic tank. Requests for an exemption from this requirement will be evaluated on a case-by-case basis.

5. Tanks shall be bedded, installed, and backfilled in accordance with manufacturer specifications and the product approval to ensure the structural strength and integrity of the tank. The tank shall be reasonably level to ensure the invert of the tank outlet is lower than the invert of the tank inlet. The slope of the watertight outlet pipe shall be a minimum of one-fourth inch per foot toward the pretreatment component or leaching system to prevent clogging.

6. Septic tanks and their components shall comply with ASTM C1644/ASTM C923 for resilient, watertight pipe-to-tank connectors, and ASTM C1227/ASTM C1244 for vacuum testing of

watertightness. Structural design may refer to ASTM C890 for load-bearing calculations, especially in traffic-rated installations.

7. Septic tanks shall have a 7-inch clearance above the tank baffle to allow proper hydraulic overflow and ensure that the tank vents correctly through the building's main plumbing vent.

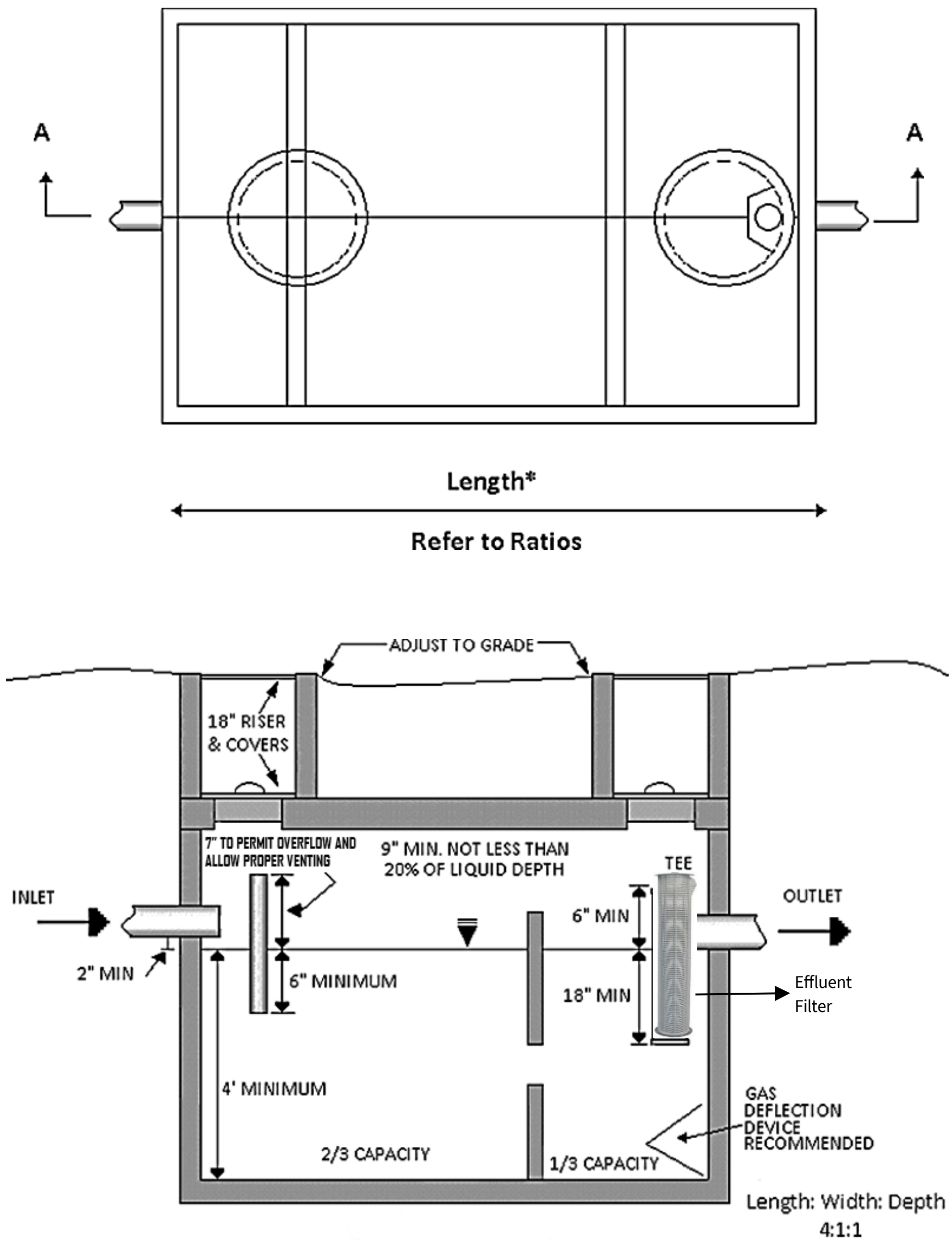


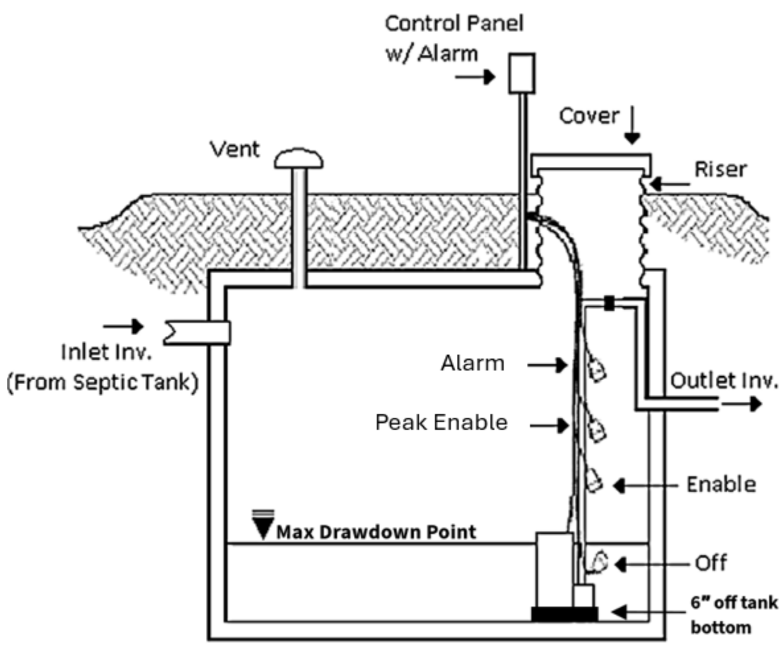
Figure 1. Dual Compartment Septic Tank

(D) Dosing tanks, pumps, and controls shall have the following characteristics:

1. Dosing tanks shall be sized to accommodate the volume required below the maximum drawdown level, the maximum design dose (including any drainback), and the designated portion of reserve and surge capacities, where applicable. For this guidance, reserve capacity is defined as the volume of the tank above the alarm activation level.

    a. OSTS with time or demand-dosed designs shall provide a reserve capacity for high water alarm events that is no less than one-half of the daily design flow.

    b. OSTS with time-dosed designs shall accommodate combined reserve and surge capacities of not less than one hundred fifty percent of the peak daily design flow. For the purposes of this guidance, surge capacity shall be the tank volume between the high-water alarm level (peak enable), and the maximum drawdown point level which should be marked on the detail plans submitted with the PTI application.



Note: The effective volume of the dosing chamber is typically sized based on the system's average daily flow (ADF). Under normal operating conditions, the chamber should fill within 30 minutes unless a flow-equalization strategy is incorporated. The primary (enable) float is ideally set to initiate a dose at approximately 65% of the ADF, promoting shorter, more frequent dosing cycles with adequate rest periods. During peak-flow conditions, the peak-enable setting adjusts the timer to deliver doses equivalent to 100% of the ADF, allowing the system to recover from higher inflows and reducing the likelihood of a high-water alarm.

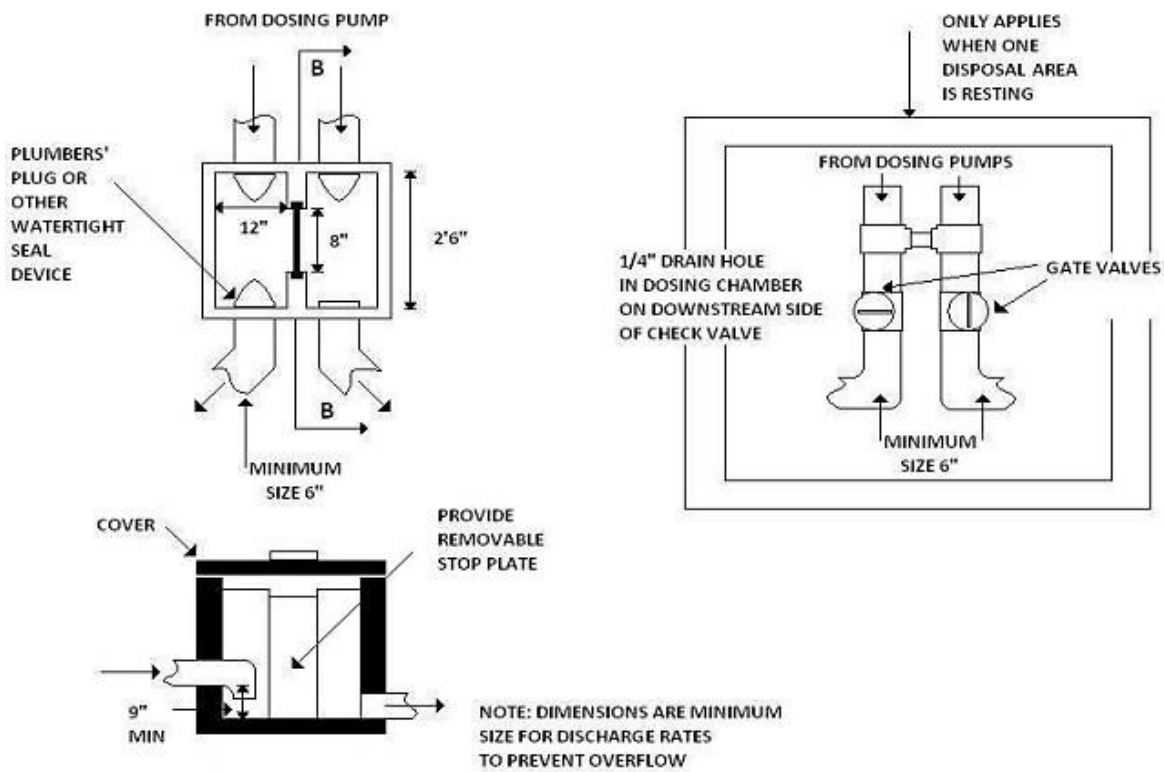


Figure 2. Dosing Tank and Influent Chamber

2. A dosing pump shall be rated for effluent service by the manufacturer and must be third-party or listed to the appropriate UL or CSA standard.

3. The pump shall be properly sized to meet the design flow rate and total dynamic head requirements of the OSTS. The design shall include a pump performance curve with the operating point identified, demonstrating by calculation that the pump can meet the required capacity at the system head, including friction, elevation, and minor losses, as well as accounting for drainback and intended cycle frequency.

4. Pumps shall be elevated to a minimum of 6 inches off the tank bottom to prevent sludge entrainment and clogging. Where appropriate, provide a screened intake, stand, or anti-vortex plate to minimize solids carryover and turbulence.

5. A quick disconnect shall be accessible in the pump discharge piping, and adequate lift attachments (e.g., stainless chains or guide rails) shall be provided for removing and replacing the pump and water level control assembly without entering the dosing tank or pumping down the liquid level. When a check valve is used, a vent hole shall be installed between the check valve and pump to prevent an airlock; the discharge assembly shall be configured to avoid water hammer and facilitate maintenance.

6. If any portion of the pump fittings or transport line is at a higher elevation than the soil absorption component, the system shall be equipped with an air/vacuum release valve or other suitable device at the high point to avoid siphoning. Air release appurtenances shall be protected from freezing and located for safe access.

7. Float switches, when used, shall be mounted independent of the pump and transport line so they can be removed from the dosing tank without disturbing or removing the pump. Controls shall include, at a minimum, distinct pump-on, pump-off, and high-water alarm setpoints. In duplex configurations, provide lead/lag alternation and separate alarms for pump fail/overrides to prevent short cycling and ensure redundancy.

8. Control panels and alarms shall be mounted in an easily accessible location. Alarms should be both audible and visual and readily observable, with labels identifying functions and setpoints; event counters and run-time meters are recommended to support operations and maintenance tracking.

9. Additional considerations for dosing tanks include using duplex pump configurations to ensure redundancy and uninterrupted service or maintaining a spare pump of equal specifications onsite for rapid replacement.

10. Pipe penetrations shall be sealed with flexible watertight connections to prevent infiltration and exfiltration.

11. Control panels should be housed in NEMA 4X-rated enclosures for weather resistance, and electrical circuits should include Ground-Fault Circuit Interrupter (GFCI) protection. All components exposed to moisture shall be corrosion-resistant, and risers shall provide watertight, above-grade access for maintenance purposes. No plugged connections shall be present inside of risers. The current version of the National Electric Code (NEC) shall be met.

12. Pump chambers and dosing tanks in areas with high groundwater shall be protected against buoyancy by anchoring or ballast and designed using uplift calculations that consider tank geometry, soil conditions, and groundwater levels to prevent flotation and structural damage.

E. Pretreatment

The tabulated list below represents pretreatment units commonly approved by Ohio EPA. Any pretreatment component not listed may potentially be used in the design of an OSTS. Technical reports/specifications on the proposed component should be submitted to Ohio EPA prior to the submittal of the proposed OSTS PTI. Approvable pretreatment/additional components include, but are not limited to:

PRETREATMENT UNIT	ITEM
SAND FILTER- SPSF (SINGLE PASS SAND FILTER)	(A)
SAND FILTER- RSF (RECIRCULATING SAND FILTER)	(B)
PEAT BIOFILTERS	(C)
FIXED FILM MEDIA FILTERS	(D)
AEROBIC TREATMENT UNIT (ATU)	(E)
ULTRAFILTRATION	(F)
SUBSURFACE FLOW CONSTRUCTED WETLANDS	(G)

The Item letters above are used in Tables F1 and F2 later in this document.

Ultraviolet (UV) Disinfection

UV disinfection is not considered a true pretreatment process. Rather, it is a polishing or disinfection step that may be required when the proposed OSTS has the potential to discharge into a usable aquifer or is located within a sensitive watershed. UV shall be recognized as a supplemental measure rather than a primary pretreatment unit.

More detailed descriptions of the pretreatment technologies can be found in Section J, Appendix B.

F. Soil Absorption Component Design

Soil absorption components shall be designed to minimize the risk of exposure to sewage effluent, contamination of groundwater, and surface water. Effluent is best treated through infiltration and movement through an adequate thickness of unsaturated soil before it reaches the limiting condition of the soil. Dispersal prevents the surfacing or ponding of treated or partially treated effluent. ODH Rules for soil absorption system design appear at OAC 3701-29-15.

General requirements for designing an OSTS soil absorption component include, but are not limited to:

1. A minimum of a 1:1 ratio (lineal feet gravity leach line to gpd) should be included. In instances where an effluent filter exemption is approved, the unfiltered septic tank effluent should have a 2:1 ratio in severe soils if the system is greater than 200 gpd. An alternative loading may be established if a hydraulic linear loading rate is evaluated in accordance with Sections F.2 and F.3 of this guidance.

2. OSTS over 1,000 gpd should incorporate pressure distribution; however, with proper justification, dosed gravity may be recommended. OSTS greater than or equal to 2,500 gpd should only incorporate pressure distribution.

3. The maximum length of any gravity leaching lateral should not exceed 100 feet, unless designed in accordance with OAC 3701-29-15.

4. Trenches should be as high as possible in the soil to maximize the usable soil for treatment.

5. Leach lines shall be a minimum of 6 feet horizontal distance between the centerline of the trench.

6. Gravelless technology may be used in lieu of the requirement for aggregate. No reduction in soil distribution area should be permitted.

7. Clean water connections are prohibited from discharging to an OSTS (including roof downspouts, foundation drains, sump pumps, water softener backwash, and condensate).

8. No more than 2 feet of sand fill should be used for mound systems. On sloping sites, this maximum sand-fill thickness applies specifically at the uphill edge of the gravel/sand interface. The sand layer may exceed 2 feet downslope as required to maintain a level infiltrative surface across the absorptive area.

9. A 100% replacement area is recommended to accommodate future repair or expansion and maintain long-term system performance.

10. The soil dispersal portion of the treatment system should not be placed on fill (unless the certified professional soil scientist determines the fill soil shows signs of proper structure and features of a classified soil).

11. Industrial waste and floor drains are prohibited from entering an OSTS. Only domestic sewage or wastewater that has the same characteristics as domestic sewage should be permitted to go to the soil absorption system. Industrial waste may be directed into an industrial-only holding tank, as indicated on Form B8.

12. A minimum of 50 feet should be maintained between the septic system and groundwater well, and a minimum of 10 feet from buildings and property lines. Other potentially applicable isolation distances, based on system size, are listed in Appendix C.

13. Combined dispersal and treatment trenches may be installed in series or in parallel as determined to be most effective after discussions between the system vendor, engineer, and Ohio EPA District Office PTI Reviewer and Manager, where the system will be located.

14. Construction/installation of the soil treatment and dispersal components should be prohibited when the ground is frozen and/or saturated.

15. Curtain drains should not be used to overcome site limitations for onsite septic systems. If groundwater is a concern, an upgradient drain may be a suitable option. However, the use of downgradient drains is not acceptable.

16. For systems receiving high-strength wastewater, such as from food service or medical facilities, pretreatment shall be used to reduce Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) to secondary standards before soil dispersal.

Supplemental guidance documents suggested for the design of OSTS include:

1. Design Manual: Onsite Wastewater Treatment and Disposal Systems, EPA 625/1-80-012
2. US EPA Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, February 2002
3. Subsurface Flow Constructed Wetlands for Wastewater Treatment (US EPA)
4. Mound Systems for Onsite Wastewater Treatment (OSU Bulletin 813 - 2016)
5. Low-pressure Piping in Onsite Wastewater Treatment Systems (OSU Bulletin ANR e814)
6. Mound System: Pressure Distribution of Wastewater - OSU Bulletin 829
7. Sand and Media Bioreactors for Wastewater Treatment - OSU Bulletin 876
8. Suitability of Ohio Soils for Treating Wastewater - OSU Bulletin 896
9. Ohio EPA Guidance Document "Small Subsurface Flow Constructed Wetlands with Soil Dispersal System
10. Ohio EPA Guidance Document for Drip Distribution Systems
11. Approved Sewage Products | Ohio Department of Health

F.1 Acceptable OSTS Components Based on Vertical Separation Distance, Flow, and Limiting Condition

(A) Table F.1 (p. 19) and Table F.2 (p. 20) provide a matrix for evaluating acceptable OSTS designs based on vertical separation distance, design flow, and limiting condition.

(B) Soils defined as highly permeable materials within infiltrative distance cannot be used to meet the vertical separation and in situ soil requirements.

(C) When no limiting condition or flow restrictive layer is present beneath the infiltrative surface, the soil absorption component shall be placed at a depth to promote oxygen exchange and improved treatment of effluent.

SOIL INFILTRATION SYSTEM	ITEM
GRAVITY TRENCH SYSTEM *(ABOVE GRADE, AT-GRADE, SHALLOW TRENCH)*	**(1)**
PRESSURE TRENCH SYSTEM *(ABOVE GRADE, AT-GRADE, SHALLOW TRENCH)*	**(2)**
GRAVELLESS TRENCH LINES	**(3)**
MOUND SYSTEM	**(4)**
SERIAL DISTRIBUTION *(GRAVITY)*	**(5)**
DRIP DISTRIBUTION	**(6)**
COMBINED TREATMENT AND DISPERSAL (CTD)	**(7)**

The Item numbers above are used in Tables F1 and F2 later in this document.

Table F.1 Limiting Condition: Seasonal High Ground Water

≤ 200 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System [1,3]**
≥ 24	Not required for domestic sewage	(1) - (7)
24 > x ≥ 6	See footnote	(1) - (7)
< 6	No new systems recommended	No new systems recommended

201 gpd - 999 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System [1]**
≥ 36	Not required for domestic sewage	(1) - (7)
36 > x ≥ 12	(A) - (G)	(1) - (7)
12 > x ≥ 6	(A) - (G)	(2 - at-grade), (4), (6) (7)
< 6	No new systems recommended	No new systems recommended

≥ 1000 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System [1,4]**
≥ 24	Required for systems >2500 gpd or sensitive areas (A)(B)(D) (E)(F)	(2 - all grades), (6) and (7)
24 > x ≥ 12	A)(B)(D) (E)(F)	(6)
12 > x ≥ 6	No new systems recommended	No new systems recommended
< 6	No new systems recommended	No new systems recommended

Note 1 If the limiting condition is determined to be seasonal high ground water, soil dispersal system options may be less restrictive for vertical separation distances ≤ 12 inches, but all efforts should be made to keep the point of dispersal above the water table.

Note 2 Pretreatment components should always be required for higher strength sewage (restaurant, facilities with food service, etc.). Also, a minimum of a septic tank effluent filter is recommended for all but very small systems with vertical separation greater than 24".

Note 3 The minimum recommended total lineal feet for a tile field should be 200 feet for any new system.

Note 4 If drip distribution is used, refer to the pretreatment list for recommended components.

Footnote Pretreatment is recommended (A)(B)(C)(D)(E)(F) or (G) as flows increase and vertical separation decreases. Upon discussion and approval, Ohio EPA may permit gravity or pressure distribution CTD systems (7) arranged in series or parallel.

Table F.2 Limiting Condition: Bedrock, Ground Water, Sand & Gravel, Compacted Soils

≤ 200 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System**
≥ 36	Not required for domestic sewage	(1) - (7)
36 > x ≥ 24	(A) - (G)	(1) - (7)
< 24	No new systems recommended	No new systems recommended

201 gpd - 999 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System**
≥ 36	Not required for domestic sewage	(1) - (7)
36 > x ≥ 24	(A) - (G)[5]	(2 - all-grades), (4), (6) (7)
< 24	No new systems recommended	No new systems recommended

≥ 1000 gpd	**Minimum Soil Dispersal Systems (All systems require septic tanks)**	
Vertical Separation (In)	**Pretreatment Component [2]**	**Soil Dispersal System**
≥ 36	Required for systems >2500 gpd or sensitive areas (A)-(G) and/or drip components	(2 - all grades) and (6)
< 36	No new systems recommended	No new systems recommended

Note 2 Pretreatment components should always be required for higher strength sewage (restaurant, facilities with food service, etc.). Also, a minimum of a septic tank effluent filter is recommended for all but very small systems with vertical separation greater than 24".

Note 5 Additional pretreatment may be recommended, especially as the vertical separation distance gets smaller.

Footnote Upon discussion and approval, Ohio EPA may permit gravity or pressure distribution CTD systems (7) arranged in series or parallel.

F.2 Hydraulic Linear Loading Rate (HLLR)

(A) OSTS designs using HLLR are acceptable to Ohio EPA. ODH rules discussing HLLR appear in Section (N)(2) of OAC 3701-29-15. The HLLR can be used to determine the minimum required length of the soil absorption component or basal area parallel to surface contours. The HLLR is based on soil characteristics, land slope, site conditions, infiltrative distance, and the nature and depth to limiting conditions. The soil evaluation information with reference to Table F.3 (p. 22) is used to determine the rate based on the soil conditions, slope, and infiltrative distance. The minimum length of the soil absorption component is determined by dividing the daily design flow by the hydraulic linear loading rate selected from Table F.3.

F.3 Soil Infiltration Loading Rates (SILR)

(A) OSTS designs using SILR are acceptable to Ohio EPA. ODH rules discussing SILR appear in Section (N)(1) of OAC 3701-29-15. The soil absorption component area shall be of adequate size and configuration to disperse the effluent and prevent public health nuisance conditions. Soil infiltration loading rates, including basal loading rates for sand fill systems, can be based on effluent quality and on soil structure, grade and shape, texture, and consistency. SILRs are determined through reference to soil evaluation information, and the loading rate estimates in Table F.3.

Table F.3 Hydraulic Linear Loading Rates (HLLR) and Soil Infiltration Loading Rates (SILR)

Soil Characteristics			Infiltration Loading Rate, gal/da/ft^2		Hydraulic Linear Loading Rate, gal/da/ft								
					Slope								
					0-4%			5-9%			>10%		
					Infiltration Distance (Inches)			Infiltration Distance (Inches)			Infiltration Distance (Inches)		
Texture	Structure												
	Shape	Grade	>30 mg/L *	<30 mg/L *	8-12	12-24	24-48	8-12	12-24	24-48	8-12	12-24	24-48
COS, S, LCOS, LS	--	0SG	0.8	1.6	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0
FS, VFS, LFS, LVFS	--	0SG	0.4	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
CSL **, SL	--	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0
	PL	1	0.2	0.5	3.0	3.5	4.0	3.6	4.1	4.6	4.0	5.0	6.0
		2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.4	0.7	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
		2,3	0.6	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
FSL, VFSL	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.2	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2,3	0.4	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
L	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1,2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.4	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2, 3	0.6	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
SIL	--	0M	0.0	0.2	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.4	0.6	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0
		2,3	0.6	0.8	2.7	3.0	3.3	3.0	3.5	4.0	3.3	3.8	4.3
SCL, CL, SICL	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
		2,3	0.4	0.6	2.4	2.9	3.4	2.7	3.0	3.3	3.0	3.5	4.0
SC, C, SIC	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.0	0.0	-	-	-	-	-	-	-	-	-
		2,3	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4

* 30 mg/L applies to BOD5

** CSL is actually COSL – coarse sandy loam

G. Soil Infiltration Systems

There are numerous ways in which wastewater can be dispersed away from the wastewater treatment system. Below is a list of soil treatment and dispersal components that Ohio EPA has traditionally approved in the past and is comfortable with the approval of these components. A brief description and requirements of each system are presented. The parenthetical number next to each is for use in Table F.1 and Table F.2 to determine when and where these components may be utilized.

G.1 Gravity Trench System (1)

In a gravity trench system, effluent leaves the septic tank or pretreatment device and drains by gravity through a distribution box to plastic perforated pipes laid in gravel either slightly above grade, at-grade, or in a shallow trench. The subsurface soil is used as the primary treatment media to remove the smaller suspended particles (TSS) and organic material (BOD). Research confirms that 2 to 4 feet of unsaturated soil is needed to completely remove bacteria, viruses, and protozoans from septic tank effluent.

Trenches shall be installed on contours and spaced a minimum of 6 feet center-to-center, with no individual trench exceeding 100 feet in length. Longer trench lengths may be used if using design methodologies prescribed in OAC 3701-29-15. The minimum width of trenches should be 12 inches. Effluent shall be distributed through an approved distribution box designed to provide uniform loading to each trench; leveling devices or flow equalization controls are recommended to prevent preferential flow or trench overloading. Gravity trench bottoms shall be constructed on contour and uniformly graded. The maximum allowable elevation difference along the entire length of any individual trench shall not exceed 3 inches. This corresponds to a maximum fall of approximately 3 inches per 50 feet (0.5% slope) and ensures the trench remains effectively level for uniform distribution. Perforated distribution piping shall be 4-inch diameter PVC meeting ASTM D3034 (SDR-35) specifications, installed with perforations oriented in the lower quadrants. An inspection port should be installed at the terminal end of each trench to allow verification of proper distribution and long-term trench performance. A maximum cover of 6 inches should be provided. Gravel shall be clean, washed, durable aggregate (except no crushed #57 limestone) ranging in size from ¾ inch to 2½ inches, placed both below and above the distribution pipe. A minimum of 12 inches of gravel below the pipe and 2 inches above the pipe is required to ensure proper effluent dispersal and structural stability. A barrier material (such as untreated building paper or geotextile fabric) shall be placed over the gravel before soil placement to prevent fines from migrating into the aggregate.

To minimize frost action and reduce the possibility of movement after installation, distribution boxes should be set on a bed of sand or pea gravel at least 12 inches deep. The drop between the inlet and outlet invert(s) shall be at least 2 inches. A baffle is recommended at the inlet side of the box to prevent short-circuiting, especially when the slope of the pipe entering the box exceeds ½ inch per foot or when pump dosing is used.

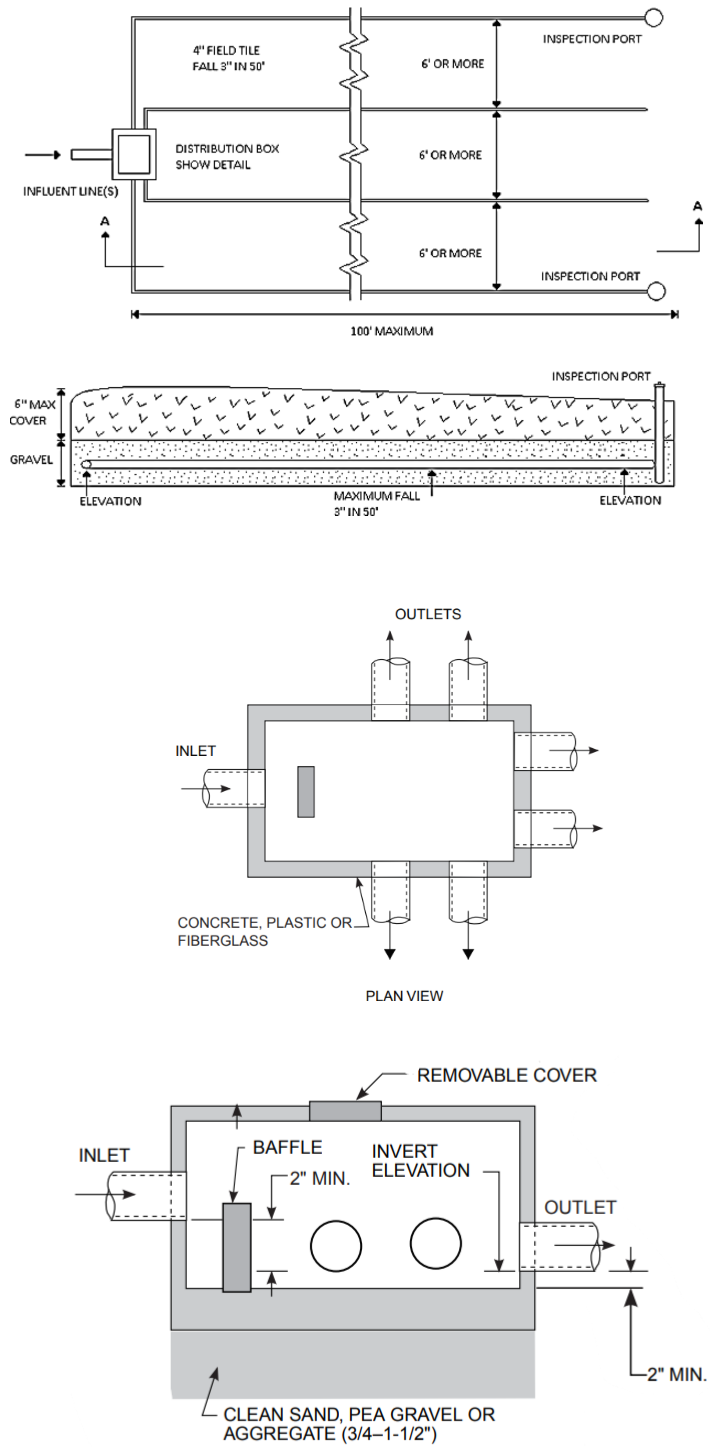


Figure 3. Conventional Leach Field and Distribution Box - Gravity

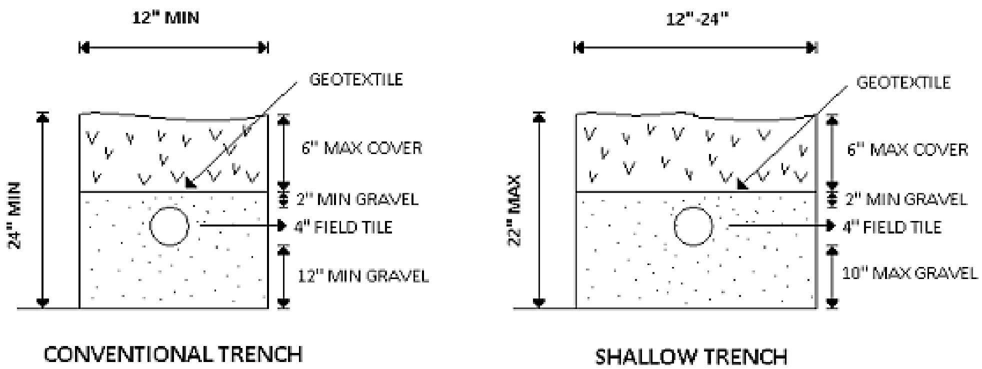


Figure 4. Typical Septic Trench Detail

G.2 Pressure Trench System (2)

A pressure distribution trench system utilizes a dosing tank and pump to convey wastewater to plastic perforated pressurized pipes laid in shallow gravel trenches in the soil. Effluent is pumped in controlled doses, ensuring uniform distribution across the entire trench system. This dosing approach reduces the risk of over-saturation and promotes consistent loading of the soil absorption area.

Trenches shall be spaced a minimum of 6 feet center-to-center, with each trench not exceeding 100 feet in length. Trenches shall have a width of 12 inches. A pressurized manifold or header system shall be used to deliver uniform dosing across all laterals; distribution boxes are not permitted for pressure distribution because they do not maintain equal operating head. Laterals shall be constructed of PVC pressure pipe meeting ASTM D1785 (Schedule 40 or greater), with perforations drilled in accordance with the engineered design to ensure equal discharge along the entire length of the trench. The lateral pipe should be installed level to maintain uniform head conditions. If laterals require freeze protection via drainback, a positive slope on the laterals is necessary to promote drainback. Inspection ports should be installed at the distal end of each lateral to verify dosing performance, observe residual head, and detect ponding. Pump selection, orifice sizing, lateral spacing, squirt height, and dosing volume shall be calibrated to meet the system's approved design flow, operating head requirements, and regulatory dosing criteria.

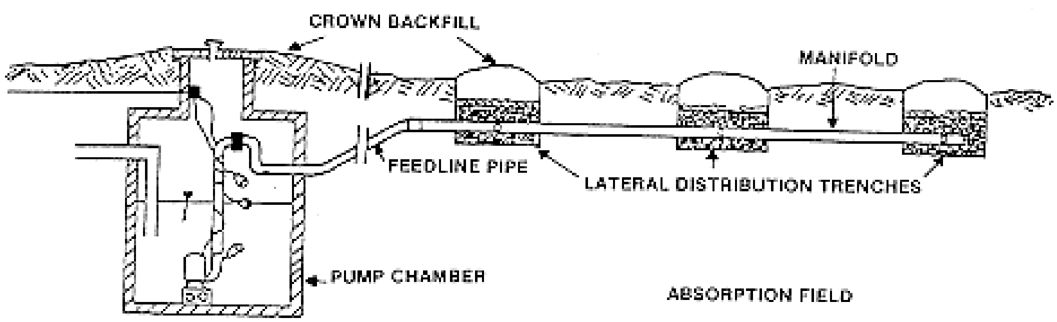


Figure 5. Conventional Leach Field – Pressure

G.3 Gravelless Trench Lines (3)

Gravelless trench systems are available in various configurations, including open-bottom chambers, fabric-wrapped pipes, and synthetic media such as expanded polystyrene. Many gravelless systems are manufactured using recycled materials, contributing to a reduced carbon footprint. It should be noted that no reduction in trench length will be approved for gravelless systems compared to conventional gravel systems.

A common example of a gravelless system is the chamber system, which serves as a design alternative to gravel/stone trenches. The chamber system offers several advantages, including simplified delivery and installation. It is particularly suitable for sites with high groundwater tables, locations with variable wastewater flow (e.g., event centers or seasonal inn), areas where gravel is not readily available, and regions where alternative technologies such as plastic chambers are accessible.

The chamber system comprises a series of interconnected chambers, which are surrounded and covered by soil. Wastewater from the septic tank is conveyed to the chambers via distribution piping. Within the chambers, the effluent comes into contact with the surrounding soil, where naturally occurring microbes facilitate further treatment.

Gravelless absorption trenches, including chamber, geotextile-wrapped, or polystyrene systems, shall be installed using an ODH-approved product or other equivalent product meeting required performance standards and in accordance with the manufacturer's specifications. Trenches shall be spaced a minimum of 6 feet center-to-center, with no individual trench exceeding 100 feet in length. This maximum trench length does not apply to systems designed using OAC 3701-29-15. Trenches should be at least 12 inches and no more than 36 inches wide. There is no reduction in length allowed. Effluent shall be distributed using an approved distribution box or pressurized manifold to ensure uniform loading; leveling devices or flow equalization controls are recommended to prevent trench overloading. Gravity systems shall be constructed with trench bottoms having a maximum fall of 3 inches per 50 feet of length (equivalent to a 0.5% slope), unless OAC 3701-29-15 is used for design. Pressure-dosed systems shall be engineered to provide uniform hydraulic head across all laterals, with inspection ports installed at their distal ends. Soil cover and pipe placement shall conform to manufacturer specifications to ensure durability, reliable performance, and consistent effluent infiltration

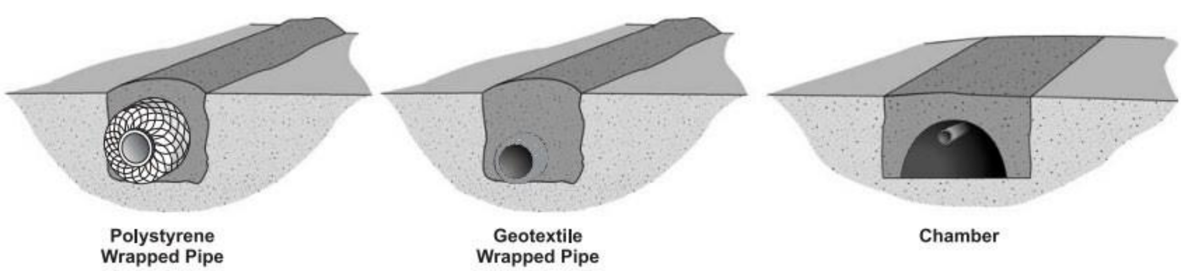


Figure 6. Typical Gravelless Trench System

G.4 Mound System (4)

Mound septic systems utilize pressure-dosed sand filters, constructed as elevated mounds, that discharge directly into the underlying in-situ soil. Their primary function is to provide enhanced treatment of effluent before it enters the environment.

Treatment within mound systems occurs through a combination of physical filtration, biological activity, and chemical processes as the wastewater percolates through the sand media and native soil. Mound systems are specifically designed to address challenging site conditions, including:

- Slow or rapid soil permeability
- Shallow soil over bedrock
- Perched seasonal water tables

A standard mound system consists of three key components:

1. **Septic tank or pretreatment unit(s)** – responsible for initial solids separation and, in some cases, effluent strength reduction.
2. **Dosing chamber** – equipped with a pump that pressure-doses the effluent, ensuring uniform distribution across the infiltration surface.
3. **Elevated mound** – constructed with a soil cover capable of supporting vegetation and containing a fabric-covered coarse gravel aggregate or gravelless media with a network of small-diameter perforated pipes.

Some designs incorporate pretreatment units to reduce organic loading and/or minimize the required mound size (refer to Appendix A for pretreatment options).

The sand media used in mound construction must meet specific gradation criteria:

- No more than 20% by weight shall be gravel (>2 mm)
- No more than 5% by weight shall be silt and clay (<0.053 mm)
- Effective grain size between 0.15 mm and 0.30 mm
- Uniformity coefficient less than 6

Effluent is distributed through the perforated pipe network into the gravel layer, from which it trickles down into the sand media and ultimately into the plowed basal area of the natural soil, completing the treatment process.

Additional design requirements can be found in OSU Bulletin 813 and OSU Bulletin 829.

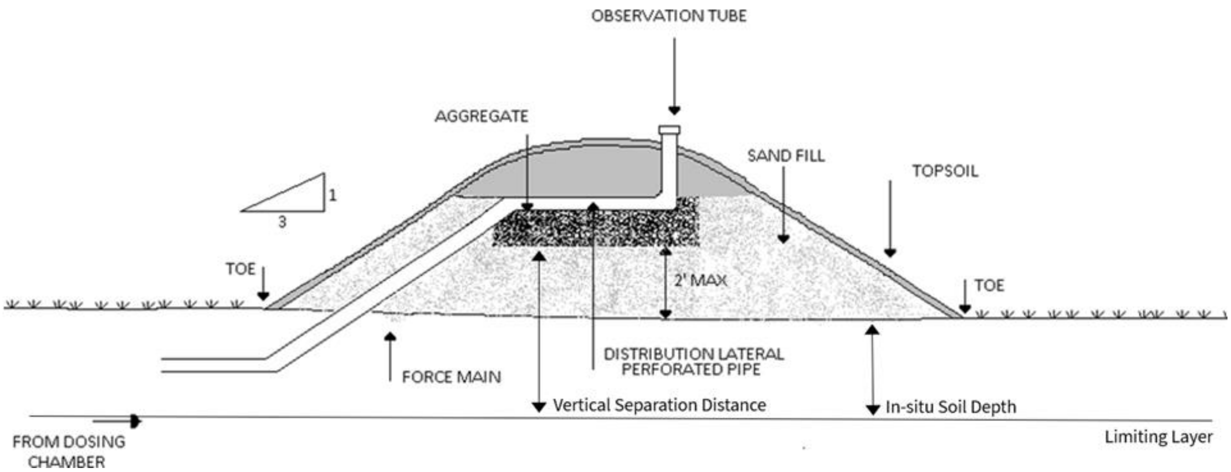


Figure 7. Mound System

G.5 Serial Distribution (Gravity) (5)

A serial distribution OSTS manages wastewater through a series of connected trenches. Effluent first enters the initial trench; once it reaches capacity, overflow is directed to the next trench. This step-by-step loading ensures more uniform distribution across the system. As effluent infiltrates the soil, a bio-mat forms at the trench–soil interface. Over time, the bio-mat slows infiltration, reducing each trench's capacity. The system relies on gravity, with step-down or overflow piping preventing flow to the next trench until the previous one is fully loaded. Because effluent is concentrated in one trench at a time, sections may be heavily loaded until the bio-mat thickens and forces flow onward. If trenches cannot be rested to allow bio-mat breakdown, the system will eventually fail. A drop box can be used to manage sequential distribution, rotate trenches out of service, and extend the septic system's lifespan.

Serial distribution absorption trenches shall be constructed on contour and shall not exceed 100 feet in length per trench. Each trench shall contain a minimum 4-inch-diameter perforated distribution pipe meeting ASTM D3034 (SDR-35) or ASTM F810 specifications, installed level with a uniform trench bottom grade within each individual trench. Trench width shall be no more than 12 inches. Perforations shall be located in the lower quadrants of the pipe, with trench bottoms maintained level to promote uniform infiltration. Step-downs between trenches shall be accomplished using approved drop boxes or relief lines designed to ensure positive gravity flow to each successive trench only after the preceding trench has reached its operational capacity. Inspection ports should be installed at the terminal end of each trench to allow verification of proper distribution and trench performance. The minimum percent slope required for serial distribution is 15% or greater.

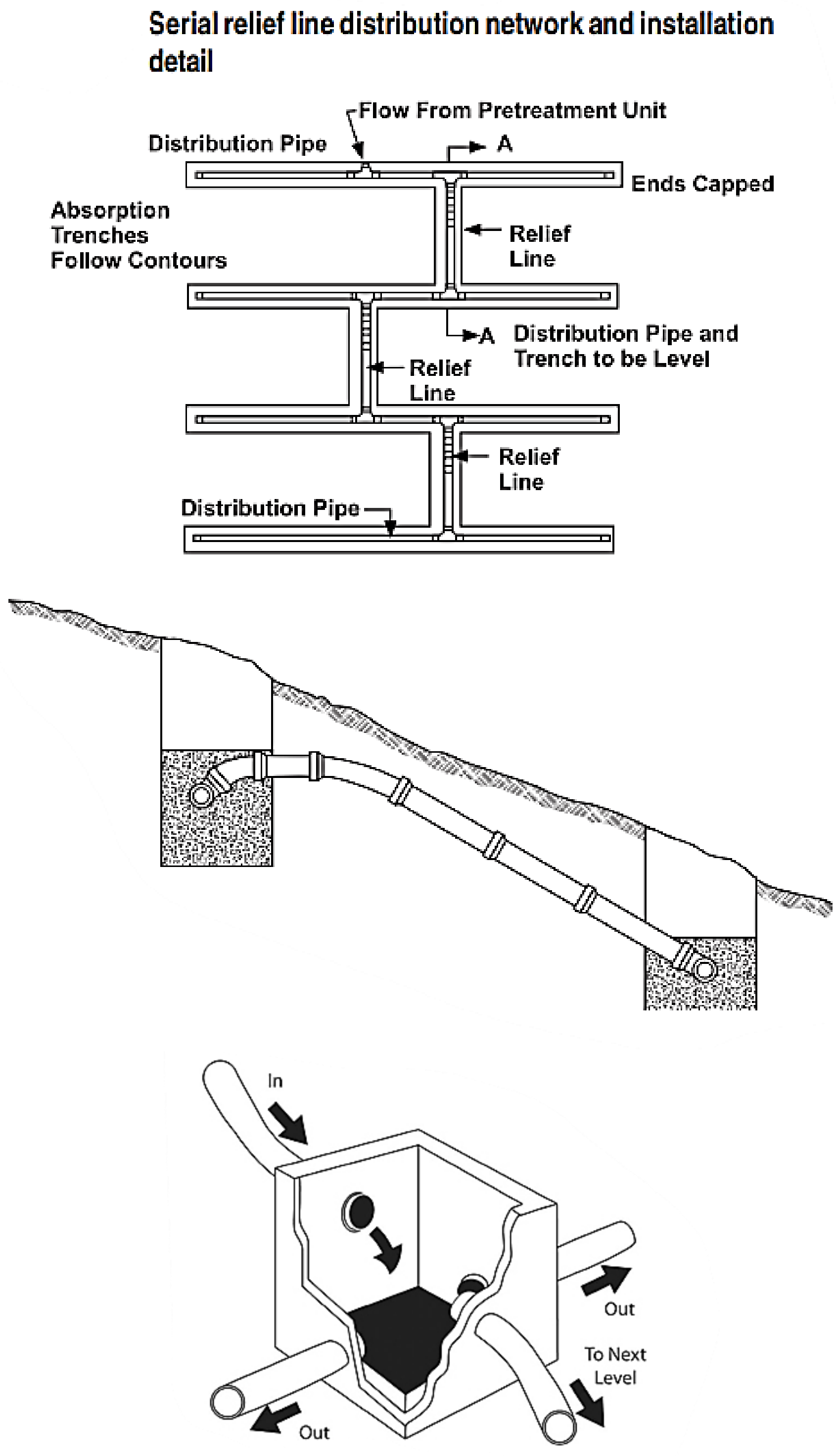


Figure 8. Serial Distribution System and Drop Box

G.6 Drip Distribution (6)

Drip Distribution Systems are installed very shallow in the soil, at the surface of the ground, or on top of a bed of sand, depending on the specific limiting conditions on the property. These systems are pressurized to ensure even distribution of wastewater into the soil. They utilize small-diameter tubing with pressure-compensating emitters to apply wastewater uniformly over an infiltration surface. Drip Distribution systems are typically split into at least two zones and work on the principle of timed micro-dosing to maintain aerobic conditions in the soil. Timed micro-dosing applies effluent to the soil at uniform intervals over a 24-hour period, allowing for improved wastewater treatment. When properly sited, designed, installed, and operated, drip systems can help overcome the typical problems associated with uneven wastewater distribution, which often result in the surfacing of wastewater in the distribution field, sewage odors, and other nuisance conditions.

Drip distribution systems should include measures to prevent emitter clogging. The design of the drip distribution system shall align with the guidelines outlined in Drip Distribution Systems, while also incorporating manufacturer-specific recommendations.

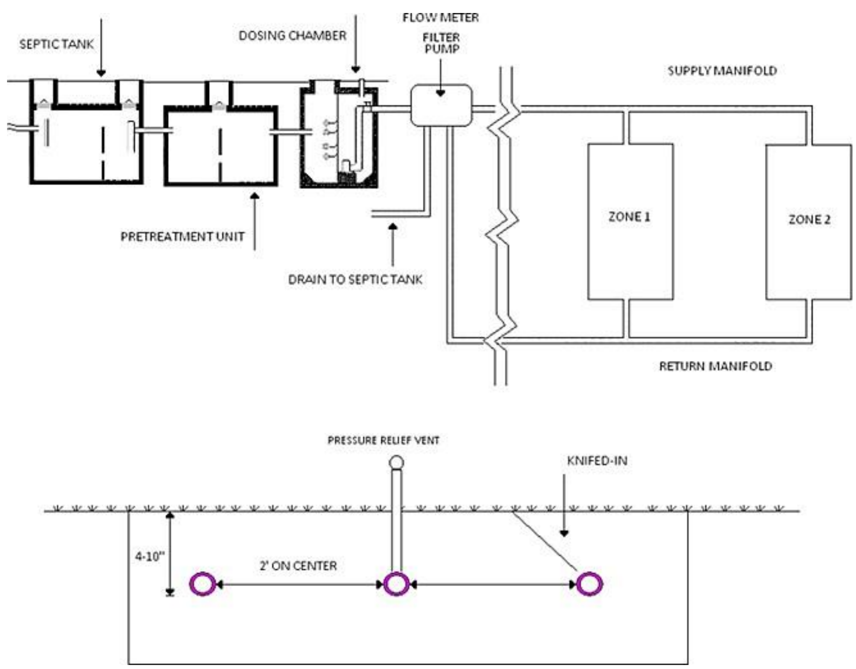


Figure 9. Drip Distribution System

G.7 Combined Treatment and Dispersal (CTD) (7)

Combined treatment and dispersal technology (CTD) is a non-electric, low-impact means of treating domestic wastewater to secondary standards and dispersing the treated water to the native soil within the CTD system footprint. CTD technology uses naturally occurring microflora and chemical processes to degrade wastewater organic matter, potentially achieving NSF/ANSI 40 Class 1 standards for 5-day carbonaceous biological oxygen demand (25 mg/l) and total suspended solids (30 mg/l). CTD technologies typically include a manufactured wastewater distribution device surrounded by system sand conforming with ASTM C33 particle gradation specifications. Septic tank effluent enters the manufactured CTD device, where distribution and filtering occur, followed by additional passive microbial and chemical treatment in the surrounding system sand, resulting in a treated effluent. Rather than discharging primary treated wastewater to native soil like a traditional gravel and pipe drainfield, CTD systems disperse secondary-treated effluent to native soil through an open-bottom design. CTD technology serves both single-family home and large-flow onsite wastewater treatment and dispersal challenges.

The manufactured device in a typical CTD system may include combinations of pipe, cuspated plastic, synthetic aggregate, or filter fabric and other geosynthetics. Core components may be surrounded with filamentous plastics, synthetic aggregate, and layered geosynthetics, each of which provides surfaces capable of supporting fixed-film aerobic bacterial growth. It is the growth and proliferation of aerobic bacteria within both the manufactured system and the surrounding and underlying system sand that allows for the biological consumption and breakdown of organic compounds in septic tank effluent, resulting in the attainment of secondary wastewater treatment standards. The consumption of organics and lowering wastewater strength by aerobic bacteria is supported in part by the permeable coarse-grained system sand, which allows oxygen to naturally recharge from the atmosphere above the CTD system and migrate into the CTD components and system sand, thereby supporting microbially mediated aerobic treatment processes. System sand is also a liquid-transfer medium, facilitating vertical and horizontal infiltration of treated effluent for release to the native soil around the CTD system.

Upon discussion and approval of Ohio EPA District office where the system will be located, Ohio EPA may permit gravity or pressure distribution CTD systems arranged in series or parallel. Gravity and series arrangements are more acceptable for smaller flows (< 1,000 gpd), with pressure or gravity parallel and combined parallel/series arrangements at flows greater than 1,000 gpd, and pressure parallel arrangements required at flows greater than 2,500 gpd. With each system, the design goal is even distribution of flow for effective treatment within the system.

Additional design requirements can be found by the manufacturers.

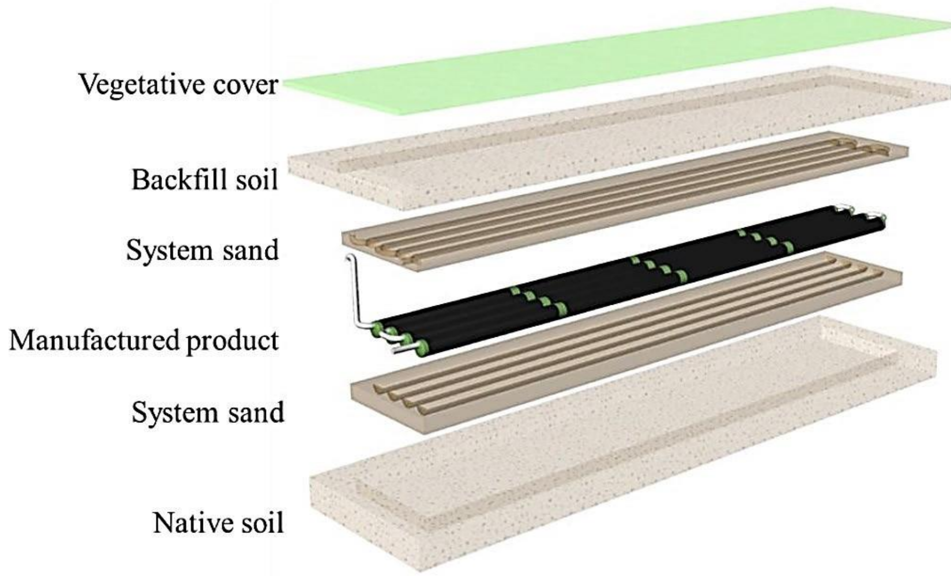


Figure 10: CTD System Components

H. Innovative Treatment Technologies

Innovative treatment technologies shall be evaluated on a case-by-case basis, provided that the following information is submitted to Ohio EPA:

1. The criteria that will be used to design the treatment system.

2. Manufacturer's literature that explains or supports the design, operation, maintenance, or reliability of the treatment system to be viable in Ohio's climate and in Ohio's site-specific soils.

3. A list of other similar installations in Ohio or installations in other states with similar climate and soil conditions as Ohio, with the name, address, and other phone numbers of the appropriate regulatory agencies and up-to-date performance data.

4. If there are special operation or maintenance requirements that would be required for this system, these requirements should be specified in writing.

5. Proposed staffing levels, man-hours, and process sampling frequency.

6. Periodic reports concerning operation, maintenance, and performance of the treatment system will be required to be submitted to the appropriate district office and/or central district office staff as specified in the permit. For design criteria not specifically addressed in this chapter, generally accepted design standards and methodologies should apply to the treatment, conveyance, and storage facilities.

7. Submit the PTI Report after one year of operation.

8. After the innovative treatment technology has been operating under design conditions for three years or in continuous operation for five years, the engineer or manufacturer may petition the Director to remove the Innovative designation. The Director can take this action independently at any time.

I. References

- Lentz, P.E., David, *Achieving Secondary Wastewater Treatment Standards Using Zero-Energy Combined Treatment and Dispersal Technology.* Presented at the NOWRA 2022 Onsite Wastewater Mega-Conference, Springfield, Missouri. Paper_Lentz_NOWRA2022_Zero_Energy.pdf
- Chapter 3701-29 - Ohio Administrative Code | Ohio Laws
- Ohio EPA DSW, 2007. Guidance Document for Small Subsurface Flow Wetlands with Soil Dispersal
- STS Components, Systems and Maintenance | Ohio Department of Health Website
- US EPA Onsite Wastewater Treatment Manual
- OSU Extension Publishing Website
- Septic System Guide, Deschutes OR Community Development Department, Bend OR
- NPCA - Advanced Treatment
- New York State Department of Health Design Handbook
- LG QuantumFlux™ MBR/Submerged UF Membrane
- Purdue Extension ID-164-W (Pressure Distribution Septic System)

J. Appendices

J.1 Appendix A | Septic Installation

(A) In counties where SFOSTS are not authorized, commercial facilities should contact Ohio EPA Division of Surface Water regarding permit-to-install requirements. These requirements are outlined earlier in this document.

(B) Obtain a site and soil evaluation as described above, if applicable.

(C) Work with a registered sewage treatment system designer to evaluate the different system types available for your property.

(D) Submit a PTI application for the OSTS under the guidance of a licensed Professional Engineer in the State of Ohio, utilizing Ohio EPA's ePlans system.

(E) Obtain quotes and bids from registered Sewage Treatment System (STS) contractors after PTI approval has been received.

(F) Once a contractor is selected and work begins on your system, observe as much of the construction process as possible and document the installation, including with pictures. Ohio EPA District Office may perform a final inspection of your system and approve or disapprove the installation. If installation problems occur, work with the system contractor and your Ohio EPA District Office to resolve installation issues.

(G) If minor changes were made to the approved plans during installation, the STS contractor/design engineer must contact Ohio EPA to determine if as-built drawings should be submitted. However, in accordance with Ohio Administrative Code 3745-42-02, a new PTI must be submitted when field changes significantly alter the approved system's design, location, or capacity, or if Ohio EPA determines a new PTI is necessary after evaluation.

(H) Proper operation and maintenance of your new OSTS is essential to ensure the system works, does not create odors or other nuisance conditions, and prevents exposure to sewage effluent. Depending on the complexity of your system, a service contract may be required. Proper operation and maintenance of your system protect the investment you have made in your property and your system.

J.2 Appendix B | Pretreatment Technologies

1. Single-Pass Sand Filters (A)

Single-pass sand filters, which include surface and subsurface sand filters, consist of a stratified bed of washed, graded sand. Effluent is dosed intermittently across the surface, promoting unsaturated flow and aerobic microbial activity. The design typically includes a distribution system, underdrain collection, and ventilation to maintain aerobic conditions.

Design Requirements include:

(A) A minimum of two beds, each capable of independent operation. Generally, for a two-sand filter bed system, one-half the total filter area is to be intermittently dosed while the other half is not in service.
(B) The sand filter beds shall be hydraulically loaded at 1.2 – 2.0 gal/ft^2.
(C) The maximum size of a sand filter bed with a single distribution point is 625 square feet.
(D) The filter sand must be clean, washed, and at least 18 inches in depth. It should have an effective size ranging from 0.4 mm to 1.0 mm, with a uniformity coefficient not exceeding 4.0. Additionally, no more than 4% of the sand should pass through a #100 sieve.
- This sand specification is recommended for sand filters. When selecting sand for sand filters, sand that is too coarse does not provide adequate filtering. Sand that is too fine can clog easily. Sand with excessive fines can pass through into the underdrain and diminish capacity. Unwashed sand can have particulates that pass through.

(E) Surface sand filter: Walls shall be constructed of reinforced precast or reinforced poured-in-place concrete. Particular attention should be made to ensure water tightness at corners and joints. An 18-inch freeboard is required.
(F) The bottom of the beds shall be provided with an impervious liner with a maximum permeability rate of 1.0 x 10-7 cm/s; acceptable materials include concrete, synthetic liner, or clay.
(G) The gravel layer shall include 3 inches of ⅛" to ¾" gravel, 3 inches of ¼" to ¾" gravel, and 3 inches (minimum) of ¾" to 1.5" gravel.
(H) Surface sand filter: An emergency overflow notch or transfer pipe should be installed on the common wall between adjacent filters. This would prevent a clogged filter from overflowing to the ground and instead overflow to the standby filter.
(I) Clean-outs within the sand beds are not permitted.

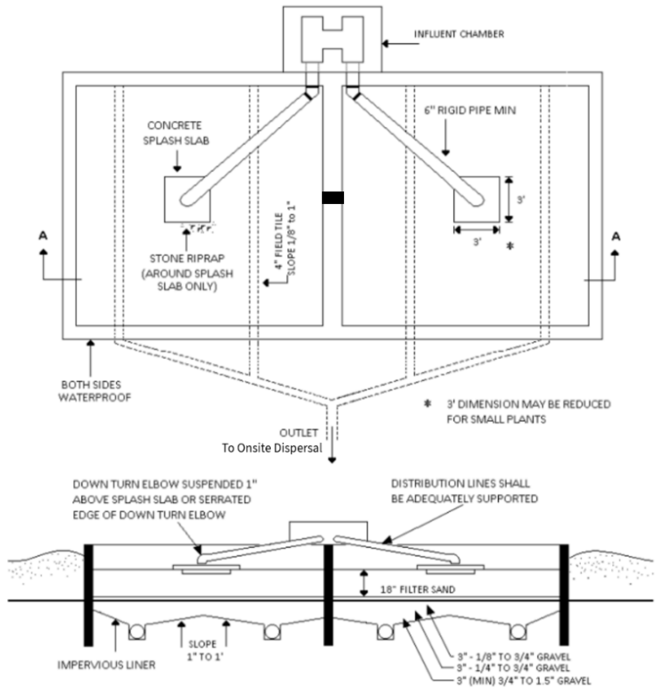


Figure 11. Surface Sand Filter

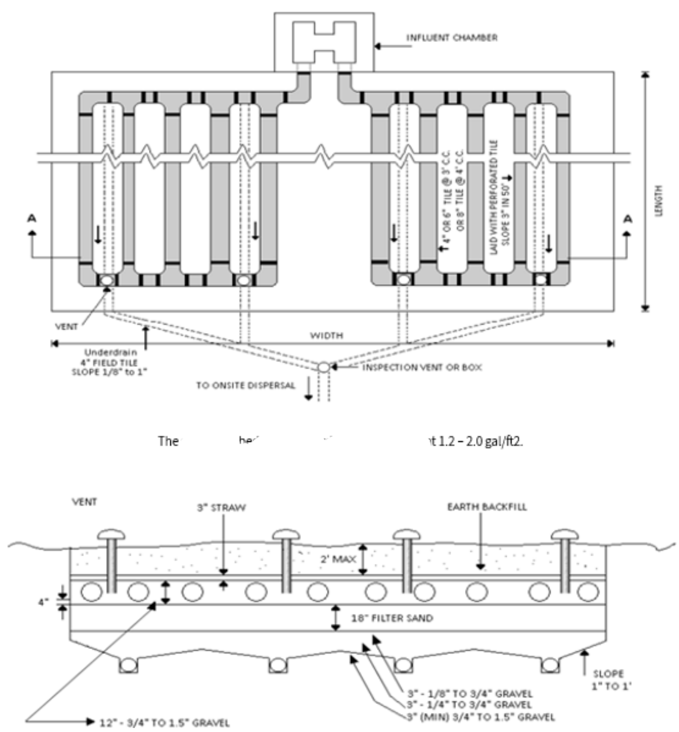


Figure 12. Subsurface Sand Filter

2. Recirculating Sand Filters (B)

Recirculating sand filters (RSFs) are aerobic, fixed-film bioreactors. They consist of a lined (e.g., impervious PVC liner on sand bedding) excavation or structure filled with uniform washed sand that is placed over an underdrain system. The wastewater is dosed onto the surface of the sand through a distribution network and allowed to percolate through the sand to the underdrain system. The underdrain system collects and recycles the filter effluent to the recirculation tank for further processing or discharge. Other treatment mechanisms that occur in sand filters include physical processes, such as straining and sedimentation, that remove suspended solids within the pores of the media. Additionally, the chemical sorption of pollutants onto media surfaces plays a significant role in the removal of certain chemical constituents (e.g., phosphorus). Bioslimes from the growth of microorganisms develop as films on the sand particle surfaces. The microorganisms in the slimes absorb soluble and colloidal waste materials in the wastewater as it percolates over the sand surfaces. The absorbed materials are incorporated into a new cell mass or degraded under aerobic conditions to carbon dioxide and water.

The treated water is not permitted to be discharged and shall be directed to the final soil dispersion system.

Additional design parameter requirements can be found in Section TSF-61, US EPA Fact Sheet 11 - Recirculating Sand/Media Filters.

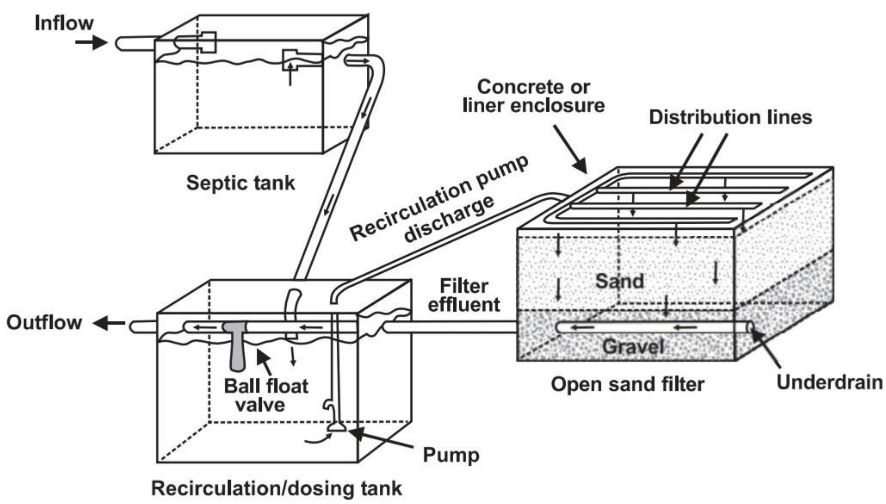


Figure 13. Recirculating Sand Filter

3. Peat Biofilters (C)

A peat filter provides secondary treatment of septic tank effluent by filtering it through a layer of approved sphagnum peat before directing it to the soil absorption system. Peat, which has a high water-holding capacity and effective chemical properties, is contained in modules that can be above ground or at ground level.

Wastewater first enters a septic tank, where large solids settle to the bottom. The liquid effluent is then either gravity-fed or pumped to the peat filter for pretreatment before going to the soil absorption system. If gravity distribution is used, wastewater may pond on the peat, potentially compressing it and reducing flow. A pressure distribution system, however, applies wastewater evenly over the surface, allowing for quicker infiltration.

Additional design specifications can be found from the manufacturer.

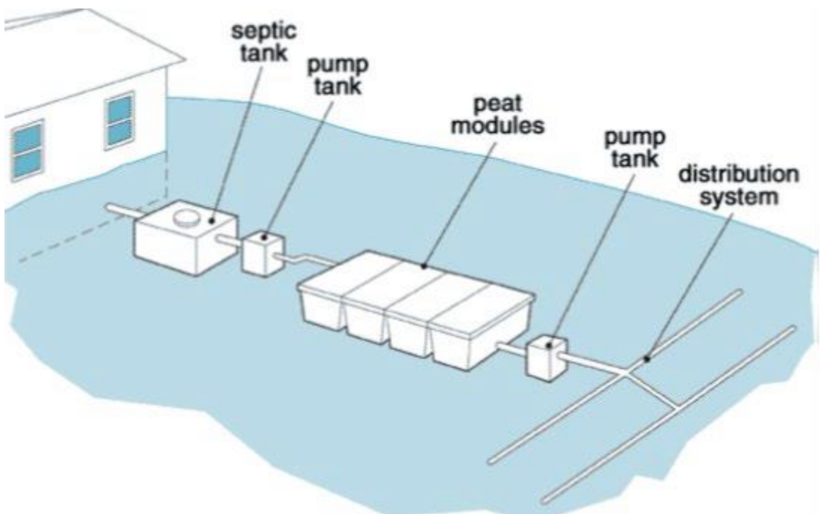


Figure 14. Peat Biofilter

4. Fixed Film Media Filters (D)

The Fixed-film Media Filter utilizes a porous surface that provides a medium to support the biomass film, which digests the waste material in the wastewater. Designs for fixed-film systems vary widely but fall into two basic categories. The first is a system where the media is moved relative to the wastewater, alternately immersing the film and exposing it to air. The second system uses a stationary media and varies the wastewater flow, so the film is alternately submerged and exposed to air. In both cases, the biomass must be exposed to both wastewater and air for aerobic digestion to occur. The film itself may be made of any suitable porous material, such as formed plastic, fabric, Styrofoam, or gravel. This would also have a second settlement chamber.

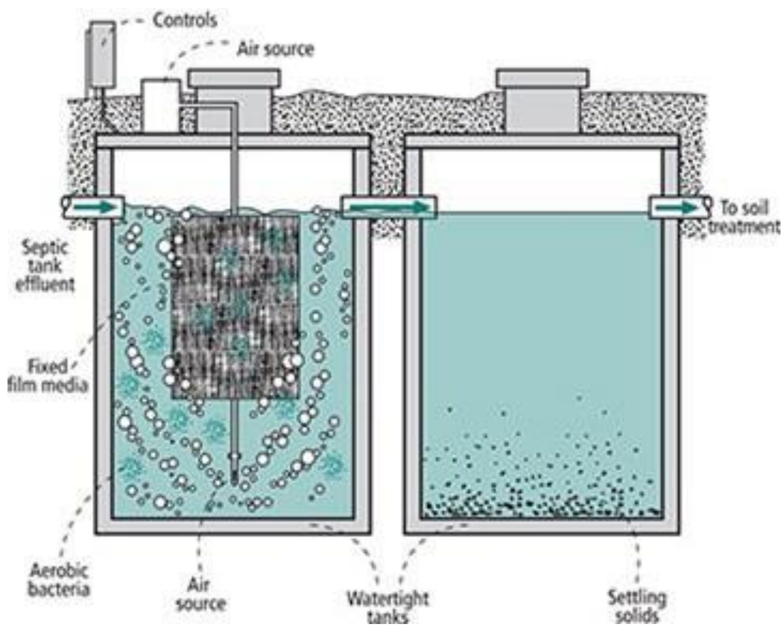


Figure 15. Fixed Film Media Filter

5. Aerobic Treatment Units (E)

Suspended-Growth Systems (ATUs): Suspended-growth systems, such as an ATU, have a primary compartment known as the aeration chamber, where air is actively mixed with wastewater. Since most ATUs are installed underground, air must be delivered into the chamber using a blower or compressor. Unlike fixed-film systems, ATUs do not include surfaces for bacterial attachment. Instead, they rely on free-floating (suspended) bacteria within the wastewater to break down organic matter. A secondary compartment, the settling chamber, allows solids to separate and settle out. These two chambers are interconnected, enabling settled bacteria (sludge) to recirculate back into the aeration chamber, enhancing biological treatment efficiency.

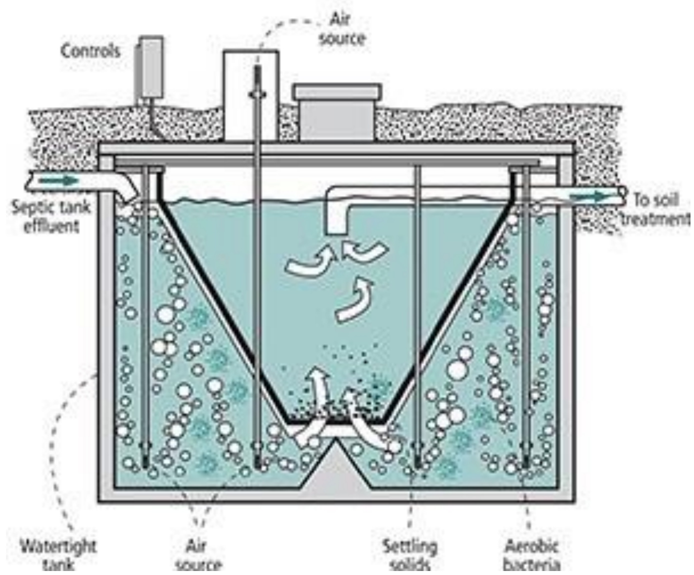


Figure 16. Aerobic Treatment Unit

6. Ultrafiltration (F)

Ultrafiltration (UF) is a pressure-driven membrane filtration process used to remove suspended solids, bacteria, and some viruses from wastewater. UF membranes typically have pore sizes ranging from 0.01 to 0.1 microns, enabling separation of contaminants while allowing water and low-molecular-weight solutes to pass through.

Types of UF Membranes:

1. Hollow Fiber Membranes: Composed of bundles of straw-like fibers, these membranes offer a high surface area within a compact footprint.
2. Flat Sheet Membranes: Arranged in plate-and-frame modules, these membranes are robust, easy to clean, and commonly used in membrane bioreactor (MBR) setups.
3. Tubular Membranes: Designed to handle high-strength or industrial wastewater, tubular membranes accommodate higher solids content and are well-suited for challenging environments.
4. Spiral-Wound Membranes: Known for their efficient packing density, these membranes are less favored in septic pretreatment due to their vulnerability to fouling.

Common materials include polyvinylidene fluoride (PVDF), polyethersulfone (PES), and cellulose acetate. Selection should prioritize durability and resistance to fouling.

Hydraulic Loading Parameters:

1. Flux: Typically maintained between 10–30 liters per square meter per hour (LMH).
2. Transmembrane Pressure (TMP): Optimized within the range of 0.1–0.5 bar to balance throughput and membrane longevity.

Regular maintenance, including backwashing and chemical cleaning, helps preserve membrane performance and integrity.

UF systems can also be integrated with biological treatment processes, such as membrane bioreactors (MBRs), to enhance overall wastewater treatment performance. The treated water is not permitted to be discharged and shall be directed to the final soil dispersion system.

Additional design specifications can be found from the manufacturer.

If you are considering ultrafiltration, please consult your local district office before submitting the PTI Application.

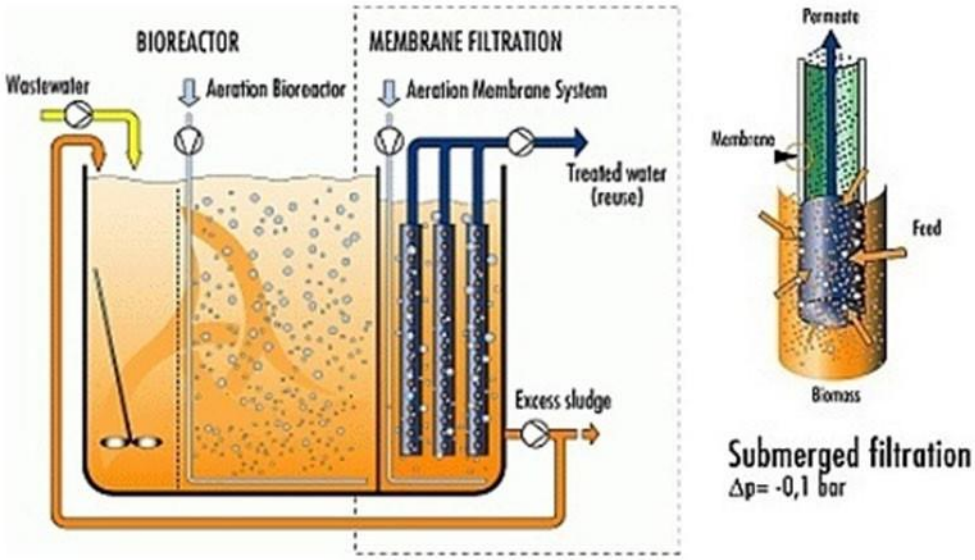


Figure 17. Submerged Membrane Bioreactor (MBR) with Ultrafiltration

7. Subsurface Flow Constructed Wetlands (G)

There are two types of constructed wetland systems:

1. Free Water Surface (FWS)
2. Subsurface Flow Constructed Wetlands (SSFCW)

This guidance document will discuss SSFCW with soil dispersal.

Ohio EPA recommends SSFCW over FWS systems because:

1. Mosquitoes are less problematic, usually negligible, with SSFCW compared to FWS.
2. SSFCW pose smaller threats for human contact with partially treated wastewater compared to FWS.
3. SSFCW tend to have fewer odor issues compared to FWS.
4. The media provides a greater surface area, which supports the development and retention of attached-growth micro-organisms.
5. SSFCW provides the wastewater with better thermal protection in cold climates.

A properly designed SSCFW system should generally follow the same principles that affect the performance of naturally occurring wetlands. Constructed wetland systems with soil dispersal can effectively treat and disperse wastewater safely back into the environment. Additional design requirements can be found at the Ohio EPA Small Subsurface Flow Constructed Wetlands Guidance Document (November 2007). The outlet structure emergency overflow is not permitted to be discharged without an NPDES permit. The final outlet structure of an OSTS must be directed to the final soil dispersion system.

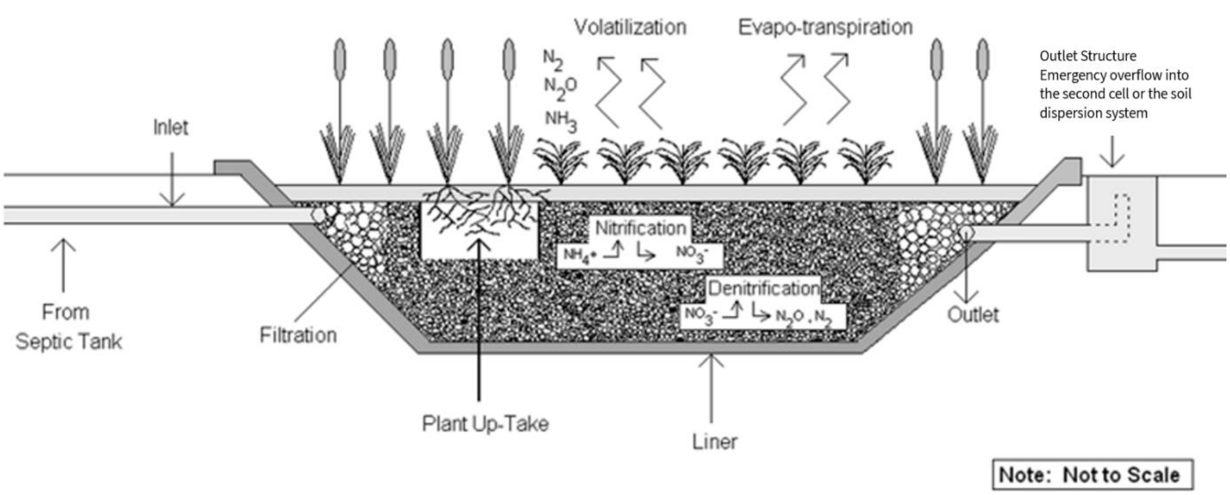


Figure 18. Subsurface Flow Constructed Wetland

Ultraviolet (UV) Disinfection

Ultraviolet light (UV) is an effective means of disinfecting water. Ultraviolet light disinfects water by striking a microorganism with a 254Å (nm) wavelength of electromagnetic radiation at a specified intensity. This action disrupts the DNA, preventing the microorganisms from reproducing and thus effectively killing them. Sunlight can disinfect water the same way.

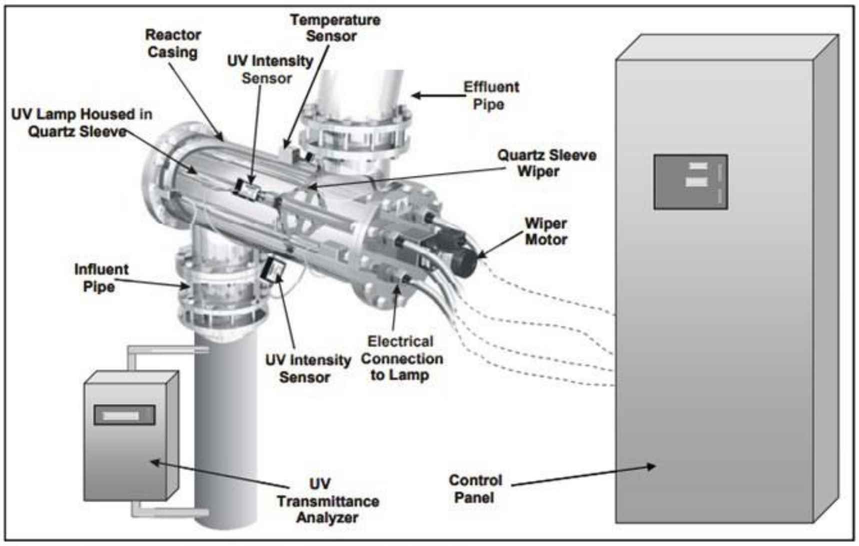
Transmitted UV light dosage is affected by water clarity. Water treatment devices are dependent on the quality of the raw water. When turbidity is 5 NTU or greater and/or total suspended solids exceed 10 ppm, pre-filtration of the water is highly recommended. Install these filters prior to the cyst filter. This will also help extend the life of the more expensive cyst filters. Dissolved iron and hardness will also affect the transmittance of UV light as build-ups occur on the quartz sleeve. When dissolved iron levels are 0.3 ppm or above, and hardness is 103.0 ppm (6 GPG) or higher, treat the water prior to UV disinfection.

The effective life of a UV bulb for adequate disinfection is about 1 year. Even though the bulb may still appear to be functioning, it will have lost much of its intensity. It should be replaced annually before the automatic warning or shut-off devices are activated.

Note: UV should be considered when the proposed OSTS has the potential to discharge into a usable aquifer or is located within a sensitive watershed.

Design Criteria:

1. UV disinfection shall be sized to be effective at the peak flow rate.
2. All UV system electronics vulnerable to water damage shall be installed above grade or housed in a flood-resistant, weatherproof electrical enclosure.
3. The system shall include an alarm or indicator that activates immediately upon UV lamp failure or burnout to alert the owner and/or operator.
4. The design shall allow the owner and/or operator to determine whether the UV light is operating properly without having to disassemble the unit.
5. For single-lamp UV systems, a replacement bulb should be kept onsite or readily accessible to minimize downtime during maintenance.
6. The UV unit shall maintain a minimum UV transmittance of 65% to ensure effective pathogen inactivation.



Source: Courtesy of and adapted from Severn Trent Services
Note: Not to scale

Figure 19. Flow-Through Disinfection System

J.3 Appendix C | Isolation Distances

Table J.3.1 - Siting septic tanks and sewage collection systems.

<table>
<tr><th colspan="2">These recommendations apply to:</th><th>These recommendations cover:</th></tr>
<tr><td colspan="2">Siting new septic tanks and sewage collection systems.</td><td>Sewage collection systems (excluding service lines);
Lift stations and other devices which may hold wastewater;
and Household sewage storage or treatment tanks.</td></tr>
<tr><th colspan="3">Recommended setbacks:</th></tr>
<tr><td></td><td colspan="2">Public Water System Drinking Water Supply Wells

• The location meets all sanitary isolation standards a public water system must maintain for its drinking water supply wells as established in Rule 3745-9-04 - Ohio Administrative Code | Ohio Laws. This provision applies to service lines.</td></tr>
<tr><td rowspan="4">Drinking Water Supply</td><td colspan="2">Drinking Water Source Protection Area for a Community or Non-transient, Non-community Public Water System Using Ground Water

• No additional setbacks beyond the sanitary isolation radius unless the sewage collection system is pressurized. Pressurized sewage collection systems should not be located within an inner management zone determined to be highly susceptible to contamination.</td></tr>
<tr><td colspan="2">Transient, Non-community Public Water System Drinking Water Supply Wells

• No additional setbacks beyond the sanitary isolation radius.</td></tr>
<tr><td colspan="2">Private Water Systems

• The location is at least 50 feet from a private water system drinking water supply well.</td></tr>
<tr><td colspan="2">Drinking Water Supply Intakes

• No additional setbacks.</td></tr>
<tr><td>Other</td><td colspan="2">Known Sinkholes and Drainage Wells

• The location is at least 100 feet from a known sinkhole or drainage well.
• The location is at least 50 feet from a known sinkhole or drainage well if additional engineering and management</td></tr>
</table>

Table J.3.2 - Siting soil absorption systems handling 1,000 gallons per day or less.

<table>
<tr><th colspan="2">These recommendations apply to:</th><th>These recommendations cover:</th></tr>
<tr><td colspan="2">Siting new soil absorption systems handling 1,000 gallons per day or less.</td><td>Soil absorption systems handling 1,000 gallons per day or less.</td></tr>
<tr><th colspan="3">Recommended setbacks:</th></tr>
<tr><td></td><td colspan="2">Public Water System Drinking Water Supply Wells
• The location meets all sanitary isolation standards a public water system must maintain for its drinking water supply wells as established in Rule 3745-9-04 - Ohio Administrative Code | Ohio Laws.</td></tr>
<tr><td rowspan="4">Drinking Water Supply</td><td colspan="2">Drinking Water Source Protection Area for a Community or Non-transient, Non-community Public Water System Using Ground Water
• The location is outside of an inner management zone determined to be highly susceptible to contamination unless additional engineering and management controls are included in the system’s design and operation.</td></tr>
<tr><td colspan="2">Transient, Non-community Public Water System Drinking Water Supply Wells
• No additional setbacks beyond the sanitary isolation radius.</td></tr>
<tr><td colspan="2">Private Water Systems
• The location is at least 50 feet from a private water system drinking water supply well.</td></tr>
<tr><td colspan="2">Drinking Water Supply Intakes
• No additional setbacks.</td></tr>
<tr><td>Other</td><td colspan="2">Known Sinkholes and Drainage Wells
• The location is at least 100 feet from a known sinkhole or drainage well.
• The location is at least 50 feet from a known sinkhole or drainage well if additional engineering and management</td></tr>
</table>

Table J.3.3 - Siting soil absorption systems handling 1,001 to 10,000 gallons per day.

These recommendations apply to:	These recommendations cover:
Siting of new soil absorption systems handling 1,001 to 10,000 gallons per day.	Soil absorption systems handling 1,001 to 10,000 gallons per day.

Recommended setbacks:	
Drinking Water Supply	Public Water System Drinking Water Supply Wells • The location meets all sanitary isolation standards a public water system must maintain for its drinking water supply wells as established in Rule 3745-9-04 - Ohio Administrative Code | Ohio Laws.
Drinking Water Supply	Drinking Water Source Protection Area for a Community or Non-transient, Non-community Public Water System Using Ground Water • The location is outside of an inner management zone determined to be highly susceptible to contamination unless additional engineering and management controls are included in the system's design and operation. • The location is outside of a protection area determined to be highly susceptible to contamination unless additional engineering and management controls are included in the system's design and operation.
Drinking Water Supply	Transient, Non-community Public Water System Drinking Water Supply Wells • The location is at least 300 feet from a transient non-community public water system drinking water supply well unless additional controls are included in the system's design and operation.
Drinking Water Supply	Private Water Systems • The location is at least 300 feet from a private water system drinking water supply well unless additional controls are included in the system's design and operation.
Drinking Water Supply	Drinking Water Supply Intakes • No additional setbacks.
Other	Known Sinkholes and Drainage Wells • The location is at least 300 feet from a known sinkhole or drainage well. • The location is at least 100 feet from a known sinkhole or drainage well if additional engineering and management controls are included in the system's design and operation.

Table J.3.4 - Siting soil absorption systems handling more than 10,000 gallons per day.

These recommendations apply to:	These recommendations cover:
Siting of new soil absorption systems handling 10,000 gallons per day or less.	Soil absorption systems handling more than 10,000 gallons per day.

Recommended setbacks:

	Public Water System Drinking Water Supply Wells • The location meets all sanitary isolation standards a public water system must maintain for its drinking water supply wells as established in Rule 3745-9-04 - Ohio Administrative Code | Ohio Laws.
Drinking Water Supply	Drinking Water Source Protection Area for a Community or Non-transient, Non-community Public Water System Using Ground Water • The location is outside of an inner management zone determined to be highly susceptible to contamination. • The location is outside of an inner management zone determined to have a moderate or low susceptibility to contamination unless additional engineering and management controls are included in the system's design and operation. • The location is outside of a protection area determined to be highly susceptible to contamination unless additional engineering and management controls are included in the system's design and operation.
	Transient, Non-community Public Water System Drinking Water Supply Wells • The location is at least 300 feet from a transient non-community public water system drinking water supply well unless additional engineering and management controls are included in the system's design and operation.
	Private Water Systems • The location is at least 300 feet from a private water system drinking water supply well unless additional engineering and management controls are included in the system's design and operation.
	Drinking Water Supply Intakes • No additional setbacks.
Other	Known Sinkholes and Drainage Wells • The location is at least 300 feet from a known sinkhole or drainage well.