Subchapter 5 – Technical Standards for Wastewater Disposal Systems and Potable Water Supplies

§1-501 Applicability and General Requirements

(a) This Subchapter applies to all soil-based disposal systems with a design flow of less than 6500 gallons per day and sewerage connections of any size. Soil-based disposal systems with design flows of 6500 gallons per day or more may also require permits under the Vermont Indirect Discharge Rules.

(b) This Subchapter applies to design flows for all potable water supplies that are not public water supplies. All the other requirements related to potable water supplies, such as standards for construction and location, are contained in the Vermont Water Supply Rules.

(c) New projects and projects with increases in design flow must be designed and constructed in accord with these rules. A fully complying primary and replacement area shall be identified, except as otherwise provided in these rules. Replacement systems shall be constructed in accord with these rules, but are eligible for variances as provided in §1-308 of these rules.

(d) A soil-based disposal system(s) may be located on the lot to be improved or on other land to which the lot owner has permanent legal access. Proof of permanent legal access will be required prior to issuance of any permit.

(e) When reviewing projects under these rules, the Secretary shall review not only the project itself but also all potable water supplies and wastewater systems, in existence or permitted at the time the permit application for the project is deemed complete, that are potentially affected by the proposed project. This review shall, at a minimum, assure that the project will not adversely affect such potable water supplies and/or wastewater systems and shall assure that the project does not eliminate potential replacement areas for potable water supplies and wastewater systems located on the same lot as the one on which the proposed project is located.

(f) Wastewater systems regulated by this Subchapter may be subject to provisions from several sections and appendixes. Applicants, installers, and particularly designers are encouraged to become familiar with the entire subchapter and the appendixes as there are general requirements, such as isolation distances, that apply to all systems and specific requirements, such as those for mound wastewater disposal systems, that apply to only certain types of systems.

§1-502 Minimum Site Conditions

(a) No site may be improved by the construction of wastewater system unless the site meets one of the following three sets of requirements regarding the minimum requirements for the site. Please note that these are only the requirements for the site and that requirements related to any specific type of leachfield must also be met. (Example: the bottom of any absorption trench applying septic tank effluent must be at least 36" above the seasonal high watertable.)

(b) Prescriptive Approach

(1) Sites that meet the following requirements can be improved using a prescriptive approach.

(A) There shall be at least 24" of naturally occurring permeable soil over bedrock.

(B) There shall be at least 24" of naturally occurring permeable soil above the seasonal high watertable.

(C) The maximum ground slope shall not exceed 30% for wastewater systems on subdivided lots in existence before June 14, 2002. The maximum ground slope shall not exceed 20% for wastewater systems on lots that are subdivided on or after June 14, 2002. The maximum ground slope shall not exceed 30% for replacement wastewater systems no matter when the lot was created.

(c) Enhanced Prescriptive Approach

(1) Sites that meet the following requirements can be improved using the enhanced prescriptive approach.

(A) There shall be at least 18" of naturally occurring soil with a percolation rate of 120 min/inch or less over bedrock.

(B) The site must have at least 12", or the thickness of the "A" soil horizon plus 4", whichever is greater, of naturally occurring soil above the seasonal high water table. Sites with less than 18" of naturally occurring soil above the seasonal high water table must lower the water table as described below:

(i) A site may be approved without pre-testing of the drain when a designer prepares a plan incorporating drainage of the site and asserts that the drainage will lower the seasonal high water table to provide at least 18" of permeable soil below the

surface of the naturally occurring soil, and the Secretary agrees with the designer's assertion; or

(ii) if the Secretary does not agree, the designer may demonstrate through construction of a drainage system and the performance of groundwater monitoring in accordance with §1-506 below, that the seasonal high water table is lowered to at least 18" below the surface of the naturally occurring soil.

(C) The ground slope is at least 3% but does not exceed either 30% (for wastewater systems on subdivided lots in existence before June 14, 2002 and replacement systems on lots created at any point in time) or 20% (for wastewater systems on lots that are subdivided on or after June 14, 2002).

(D) The linear loading rate is not more than 2 gal/day/ft.

(E) The approvable site conditions must continue at least 25' downhill from the system or the toe of any fill used as part of a system.

(d) Performance Based Approach

(1) Sites that meet the following requirements may be improved using the performance based approach.

(A) There shall be at least 18" of naturally occurring soil above bedrock.

(B) Sites that do not meet the above requirements for prescriptive designs or enhanced prescriptive designs for depth to seasonal high water table may demonstrate compliance with the rules, based on a detailed and site specific analysis. The analysis must demonstrate that the system will function during all portions of the year while maintaining at least 6" of naturally occurring unsaturated soil above the calculated level of the effluent plume. The analysis may be based on site specific hydraulic conductivity testing or on a desktop hydrogeologic analysis. All desktop hydrogeologic analyses shall be based on conservative assumptions. The level of information required in order to determine compliance with the rules will be related to site specific conditions with more "limited" sites requiring more detailed information.

(C) The maximum ground slope shall not exceed 20% for wastewater systems that are on lots subdivided on or after June 14, 2002. For systems built on other lots, including replacement systems, the

maximum ground slope shall not exceed 30%, unless the Secretary has granted a specific approval to exceed 30%.

(D) A site specific approval to construct a wastewater system on a subdivided lot in existence before June 14, 2002 with a ground slope exceeding 30% in the area of the wastewater system may be granted by the Secretary upon a request from a designer that:

(i) provides specific instructions on the method of construction;

(ii) Explains how the stability of the site will be maintained during and after construction with specific attention to erosion control; and

(iii) Provides site-specific guidance as needed for safe construction.

(e) Erosion control

An erosion control plan shall be submitted with each application involving construction of a wastewater system when the ground slope exceeds 20%. The plan shall address site stability in the area of the wastewater system before, during, and after construction. The plan shall include specifications for construction, surface water diversions if needed, and re-vegetation to prevent soil erosion.

(f) Restrictions

(1) Notwithstanding the requirements of any other subsection of this section, until July 1, 2007 the enhanced prescriptive and performance based approaches may not be used for wastewater systems on lots that are subdivided on or after June 14, 2002, unless the project is located in a municipality that has:

(A) a planning process confirmed under 24 V.S.A. §4350; and

(B) zoning bylaws.

(2) The enhanced prescriptive and performance based approaches may be used for wastewater systems on lots created after June 13, 2002 but before November 1, 2002 that are ten acres or greater in size without meting the planning and zoning prerequisites listed above.

(3) The Agency of Commerce and Community Development shall maintain a list of all municipalities that meet the criteria of subdivision (f)(1) of this section. Once a municipality has been listed, it shall only be removed from the list if it has repealed its zoning bylaws or the bylaws have otherwise become invalid.

§1-503 Isolation Distances

(a) All wastewater systems that are permitted under this Subchapter shall be designed so that they meet the following isolation distances:

Minimum Isolation Distances	Horizontal Distance (feet)		
Item	Leachfield	Septic Tank	Sewer
Drilled well	(b)	50	50
Gravel pack well, shallow well or spring	(b)	75	75
Lakes, ponds, and impoundments	50	25	25
River, streams	50	25	10
Drainage swales, roadway ditches	25	--	--
Main or municipal water lines	50	50	(d)
Service water lines	25	25	(d)
Roadways, driveways, parking lots	10	5	(c)
Top of embankment, or slope greater than 30%	25	10	--
Property line	25[1]	10	10
Trees	10	10	10
Other disposal field or replacement area	10[2]	--	--
Foundation, footing drains, curtain drains	35[3]	10	--
Public Community Water Supply (e)	(f)	(f)	(f)
Suction water line	100	50	50

These distances may be reduced when evident that the distance is unnecessary to protect an item or increased if necessary to provide adequate protection.

Note: See footnotes and criteria on the following page.

§1-503 Isolation Distances

Footnotes (General Criteria Regarding Isolation Distances)

(a) Isolation distances apply regardless of property line location and ownership.

(b) Separation between potable water supplies and leachfields shall be determined by the methods in the Vermont Water Supply Rule, Appendix 21-A, Part 11, §11.4.

(c) Sewers under roads, driveways, or parking lots may require protective conduits or sleeves.

(d) Separation of pressure water lines considered as "service connections" and sewer lines shall adhere to the Vermont Plumbing Rules. Separation of pressure water lines (considered to be part of a public water system as defined by the Vermont Water Supply Rule) and sewer lines shall adhere to the requirements of the Vermont Water Supply Rule.

(e) This refers to Public Community Water Systems, as defined in the Vermont Water Supply Rule.

(f) Contact the Department of Environmental Conservation's Water Supply Division, 103 South Main Street, Waterbury, Vermont for isolation distances relative to a public community water supply.

Footnotes (Specific Criteria for Isolation Distances)

1. For mound wastewater disposal systems, the limit of mound fill must be 25 feet from any downhill property line and 10 feet from all property lines on the side or uphill.

2. No leachfield or replacement area shall be closer than 10 feet to one another, except as allowed for absorption trench systems in § 1-511(m).

3. If a curtain or foundation drain is downslope of the leachfield, the leachfield cannot be closer than 75 feet to the drain. If the curtain or foundation drain is upslope of the leachfield, it shall be 35' if possible, and a minimum of 20 feet to the leachfield. These distances may be reduced if the designer provides adequate data and analysis to show that effluent from the soil-based disposal system will not enter the drain or the distance may be increased if effluent will enter the drain.

§1-504 Design Flow

(a) Wastewater design flows shall be determined based on Table 1 (pages 70-76). Directions for calculating reductions in design flow based on plumbing fixture type and connection to large wastewater disposal systems are included in the Table. Potable water supply design flows are determined per Subsection 1-504(g) below. It may be possible to add more residential or camping units to an existing potable water supply and/or wastewater system when the supply and/or system conform to design requirements of these rules.

(b) When determining the flows for a particular project, the Secretary may determine that there is sufficient justification for requiring higher or lower flow values. When making this determination, the Secretary shall consider: the nature and design of the project; whether multiple units will be interconnected; past experience on existing projects; metered flows; the design safety factor allowances in Table 1 figures; and potential for fluctuations in flows.

(c) Flow metering used to support a request for an increase in the amount or type of uses for an existing project, or to support new projects, will require at least six months of daily meter readings. The metering period shall include the peak use periods if there is a seasonal variation, such as for a campground or ski area. The strength of the wastewater must also be determined when needed to size the leachfield or any treatment devices, or to determine any adjustments in leachfield loading rates that may be required. Any decision to adjust design flows based on flow metering must consider data concerning peak flow and long term effects on the wastewater system.

(d) For projects without a specific design flow in Table 1, such as food processing plants, the Secretary will determine a design flow for the specific project. The Secretary's determination will be based on available information related to the equipment and from metering information from similar projects that is submitted by a designer or that is available from other sources. The strength of the wastewater must also be determined when needed to size the leachfield or any treatment devices, or to determine any adjustments in leachfield loading rates that may be required.

(e) When collection and building sewers exceed 500 feet in total length, the design flow shall include an allowance for infiltration. New collection systems shall be estimated at 300 gallons/inch of diameter/mile of pipe/day, except when a designer provides project specific information that supports a reduction to not less than 200 gallons/inch of diameter/mile of pipe per day. When a reduction is granted, the acceptable level of leakage for the post construction leakage testing must also be proportionately reduced.

§1-504 Design Flow

(g) For potable water supplies that are not public water supplies, design flows shall be determined using this section of the rules. For potable water supplies that are public water supplies, design flow shall be determined in accord with Section 2.2 and Table A2-1 of the Vermont Water Supply Rules. The design flow for a potable water supply may be different than wastewater design flows if the potable water supply is a public water supply. Note: In the event of a conflict between these rules and the Water Supply Rules, these rules shall govern if the potable water supply is not a public water supply.

Table 1

Design Flow for Residential Units

(a) The design flow for single family residential units shall be calculated on the following requirements:

(1) The design flow for each person shall be 70 gallons per person per day;

(2) the first three bedrooms shall be assumed to have two persons per bedroom;

(3) each additional bedroom may be assumed to have one person per bedroom. When a building will be subject to rental use or when it is likely there will be extended or frequent high occupancy use, the system should be sized for at least 2 persons per bedroom; and

(4) the design flow for a single-family residence on its own individual lot shall be based on a minimum of three bedrooms.

Note: Table 1 continues on the next page

(b) When five or more single family residential units are connected to a single soil-based disposal system, a designer may choose to use the following design flows that are based only on the number of residential units without regard for the number of bedrooms:

Number of Single Family Units	Project Design Flow
5 units	1575 gallons per day
6 units	1830 gallons per day
7 units	2065 gallons per day
8 units	2280 gallons per day
9 units	2565 gallons per day
10 units	2800 gallons per day
11 units	3036 gallons per day
12 units	3264 gallons per day
13 units	3484 gallons per day
14 units	3696 gallons per day
15 units	3900 gallons per day
16 units	4112 gallons per day
17 units	4369 gallons per day
18 units	4518 gallons per day
19 units	4712 gallons per day
20 units	4900 gallons per day
20+ units	# of units X 245 gallons per day

Note: Single family residential units with only one bedroom, such as condominiums and apartment buildings will not benefit from the use of the design flows listed above. Single family residential units, with two bedrooms each, will benefit from use of the table when 11 or more units are connected to a single soil-based disposal system.

Note: Wastewater disposal systems with a design capacity of 6500 GPD or more may also require an Indirect Discharge Permit.

(c) Single family residential units connected to a wastewater disposal system with a design capacity of at least 50,000 gallons per day may use a design flow of 210 gallons per unit per day, regardless of the number of bedrooms.

Campgrounds (also see camps)	Open 7 mo/yr Or Less	Open more than 7 mo/yr
Campgrounds that allow only tents and camping units with no interior plumbing		
Central toilets and showers 4 people per site	75 gpd/site	100 gpd/site
Campgrounds that allow only tents and camping units with no interior plumbing		
Central toilets without showers 4 people per site	60 gpd/site	75 gpd/site
Campground sites that allow camping units with interior plumbing		
Served by central toilet facilities and dumping stations	50 gpd/site for central facilities plus 25 gpd/site for the dumping station	90 gpd/site for central facilities plus 35 gpd/site for the dumping station
Served by an individual sewer hook-up	75 gpd/site	125 gpd/site
Seasonal RV site with individual sewer hook-up		
RV owned by the occupant	75 gpd/site	125 gpd/site
RV not owned by the occupant	125 gpd/site	175 gpd/site
Cabins with RV type plumbing		
4 people per site	125 gpd/site	175 gpd/site
Cabins with conventional plumbing Minimum of 4 people per site		
With or without kitchen	50 gpd/person	50 gpd/person
With or without kitchen but with laundry facilities	70 gpd/person	70 gpd/person

§1-504 Design Flow Table 1 continued

Campgrounds	Open 7 mo/yr Or Less	Open more than 7 mo/yr
Park Model RV		
For first bedroom	140 gpd/site	140 gpd/site
For additional bedrooms	100 gpd/site	140 gpd/site
Mobile home used as vacation facilities		
For first bedroom	140 gpd/site	140 gpd/site
For additional bedrooms	100 gpd/site	140 gpd/site

Table 1 continued

OTHER ESTABLISHMENTS		GALLONS/PERSON/DAY[a,b] (unless otherwise noted)
Assembly Areas, Conference Room ……		5
Airports (per passenger) ……..		5
Bathhouses and Swimming Pools ……		5
Bowling Alley (no food service)(per lane) ……		75
Cafeterias (per seat) ……		50
Camps:	Construction camps (semi-permanent) ……	50
	Day camps (no meals served) ……	15
	Resort Camps (Night & Day) with limited plumbing …	50
Churches:	Sanctuary seating x 25% . ……... . . . . …. . . . . …	5
	Church suppers ……..	8
Country Clubs (per resident member) ……		100
Country Clubs (per non-resident member present) ..……		25

	GALLONS/PERSON/DAY[a,b] unless otherwise noted
Day Care Centers:	
Without meals: …….	15
With one meal:	20
With two meals: ……	25
Dentists:	
Staff Member ……	35
Per Chair ……	200
Doctor's Office:	
Staff Member …….	35
Patient…….	10
Room Rentals:	
Boarding Houses …….	50
Addition for non-resident boarders ……	10
Rooming Houses (per occupant bed space) …….	40
Factories (gallons per person, per shift, exclusive of industrial waste)……	15
Gyms: Per Participant……	10
Spectator ……..	3
Hairdressers: Operator …….	10
Per Chair …… ……..	150
Hospitals (per bed space) ……..	250
Hotels with Private Baths(per person sleeping space) [c] ……. ……	50
Institutions other than hospitals (per bed)……	125
Laundries, self service (gallons per machine) ……	500

	GALLONS/PERSON/DAY[a,b]
Mobile Home Parks:	
For wastewater systems serving 4 or fewer trailers (per space) …….	450
For wastewater systems serving 5 or more trailers (per space) ……..	250
Motels with bath, toilet (per person sleeping space)[c]……	50
Picnic Parks (toilet wastes only/picnicker) ……	5
Restaurants (toilet and kitchen wastes/seat, including restaurant and bar seats) …….	30
Additional per seat for restaurant serving 3 meals per day …… ……...	15
Restaurants (fast food - see cafeterias)…….	50
Schools:	
Boarding …….	100
Day, without gyms, cafeterias, or showers ……	15
Day, with gyms, cafeterias, and showers ……..	25
Day, with cafeteria, but without gyms or showers … .	20
Service Stations (first set of gas pumps) ……..	500
(each set thereafter) ……	300
Sewer Line Infiltration (where applicable)	300 gal/in pipe/dia/mile/day
Shopping Centers/Stores:[c]	
Large Dry Goods ……...	5 GPD/100 ft²
Large Supermarkets with meat department without garbage grinder …….	7.5 GPD/100 ft²
Large Supermarkets with meat department with garbage grinder ……..	11 GPD/100 ft²
Small Dry Good Stores (in shopping centers) …..	100 GPD/store
Theaters:	
Movie (per auditorium seat)…….	5
Drive-in (per car space) ……	5

Table 1 - continued

	GALLONS/PERSON/DAY[a,b]
Veterinary Clinic (3 or less doctors):	
without animal boarding ……..	750/clinic
with animal boarding ……	1,500/clinic
Workers:	
Construction (at semi-permanent camps) ……	50
Day at schools and offices (per shift) …….	15

Note: These rules change design flows for certain categories. It may be possible to add more residential or camping units to an existing potable water supply and/or wastewater system when the supply and/or system conform to current design requirements.

[a] Use eighty (80) percent of design flows for projects to be connected to a wastewater system with a design capacity of 50,000 gallons per day or greater. Note that this design flow reduction applies only to the wastewater flow and DOES NOT apply to a project's associated potable water supply design flows if the water supply is regulated as a public transient, non-transient, or community water supply.

[b] A 10% reduction in the design flow, except for single family residences and campgrounds, may be used when the plumbing includes standard water saving designs. Toilets must be 3.5 gallons per flush or less and showers and faucets must be 2 gallons per minute or less. This reduction does not apply to single family residences or campgrounds as those numbers have already been adjusted.

[c] Does not include laundry or restaurant waste.

Elderly housing may be calculated at 1.5 people per bedroom

§1-505 Building Sewers, Sewer Collection Systems, and Lift Stations

Appendix 1-A contains guidelines that provide acceptable criteria for the design of these components. Other design standards may be used if approved by the Secretary.

§1-506 Soil and Site Evaluations

(a) General

A designer shall conduct a soil and site evaluation. The designer shall prepare a soil and site evaluation report including the necessary tests and investigations that may include soil excavation, percolation testing, site and terrain investigation, groundwater levels, water supply investigations, and hydrogeologic investigations.

(b) Soil and Site Evaluations

A designer shall conduct soil excavations in locations chosen to accurately establish the soil conditions across the primary and replacement sewage disposal areas. The minimum number of excavations will be two for the primary and two for the replacement area unless a proposal to use fewer excavations is approved by the Secretary on a site specific basis. More excavations will be necessary to properly evaluate a site for systems with design flows greater than 600 gallons per day or when initial investigation identifies a highly varied soil condition. The Secretary will allow fewer excavations if the designer demonstrates that the soils are uniform. Primary and replacement areas shall be tested to a depth sufficient to demonstrate that, when installed, the proposed soil-based systems will meet the isolation distances to bedrock, seasonal high water table, and impervious soil. The Secretary may require additional investigations and excavations to be conducted within each proposed leachfield area to determine uniform suitability of soils or adequacy of depth over bedrock, impervious soils, and the seasonal high water table. Excavations shall be conducted prior to percolation tests to determine at what depth the percolation test shall be conducted. All soils information derived from excavations for the project shall be submitted including excavations that are not used as the basis of any particular wastewater disposal system design. See §1-302 of these rules for details of what must be submitted with a permit application.

(1) The location of each excavation shall be individually identified and accurately shown on the site plan.

§1-506(b)(2) Soil and Site Evaluations

(2) A soil profile description shall be written for each excavation. The thickness of the different soil horizons shall be indicated. Horizons shall be differentiated on the basis of color, texture, soil mottles, density, structure and bedrock. Depth shall be measured from the ground surface. The estimated elevation of the seasonal high water table shall be specified. Absence of a seasonal high water table shall also be specified. Soil mottles shall be described in accordance with Appendix 2-A.

(2) Percolation tests shall be conducted in representative locations within the proposed leachfield areas using the procedures in Appendix 4-A. At least four percolation tests are required, with two in the primary area and two in the replacement area unless a lesser number is approved by the Secretary. The Secretary may require more tests for systems larger than 600 GPD, or when the soils downslope of the leachfield areas are in question.

§1-507 Groundwater Level Monitoring

(a) Monitoring of the groundwater level may be used in lieu of a determination of the elevation of the seasonal high water table based on soil mottling. Once the elevation of the seasonal high water table is determined, the determination may be used for two purposes. The first is to determine if the site is suitable for wastewater disposal under the rules. If it is determined that the site is suitable, the second use of the information is to help decide what type of system may be used; an in-ground system, an at-grade system, or a mound system. All portions of the monitored area must comply with the rules. Testing must include the most limited portions of the monitored area.

(b) Critical level determination of site suitability - Each monitoring program begins with a determination of the critical level. It must be determined that the seasonal high water table is at or below this level in order to meet the rules. A site to be used for wastewater disposal under the **prescriptive approach** must have at least 24" from the surface of the naturally occurring soil down to the seasonal high water table. A site using the **enhanced prescriptive approach** must have at least 18" from the surface of the naturally occurring soil down to the seasonal high water table. A site using the **performance-based approach** must first determine the amount of rise in the groundwater table that will occur when the effluent from the leachfield is added to the existing water table. This rise is called induced groundwater mounding. The critical level will be 6" plus the calculated induced groundwater mounding. For example, if the induced groundwater mounding in the water table is 8", the critical level will be 14" (based on 6" of unsaturated soil plus an 8" induced rise in the water table).

§1-507 Groundwater Level Monitoring

Figure 5.1 Critical Levels for Site Suitability
Prescriptive and Enhanced Prescriptive Based Designs

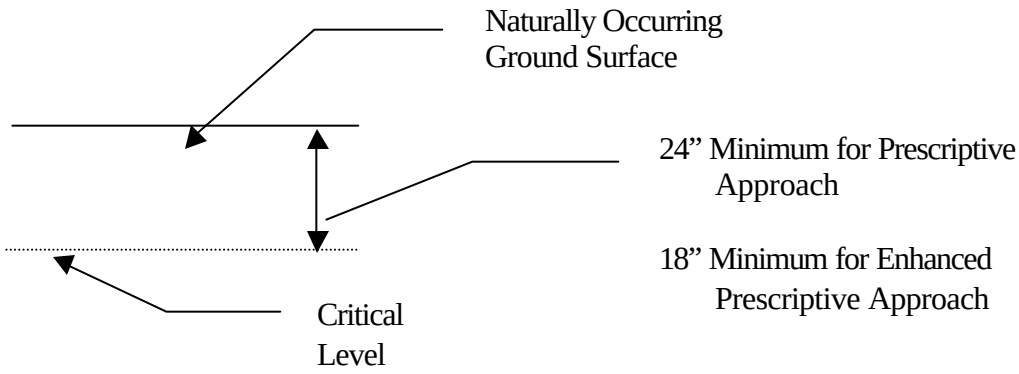
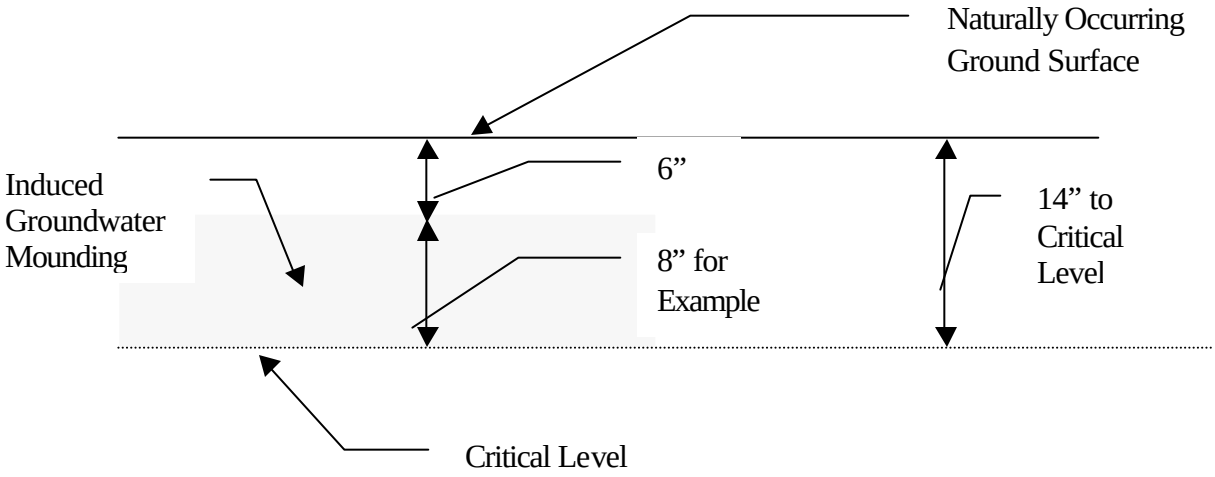


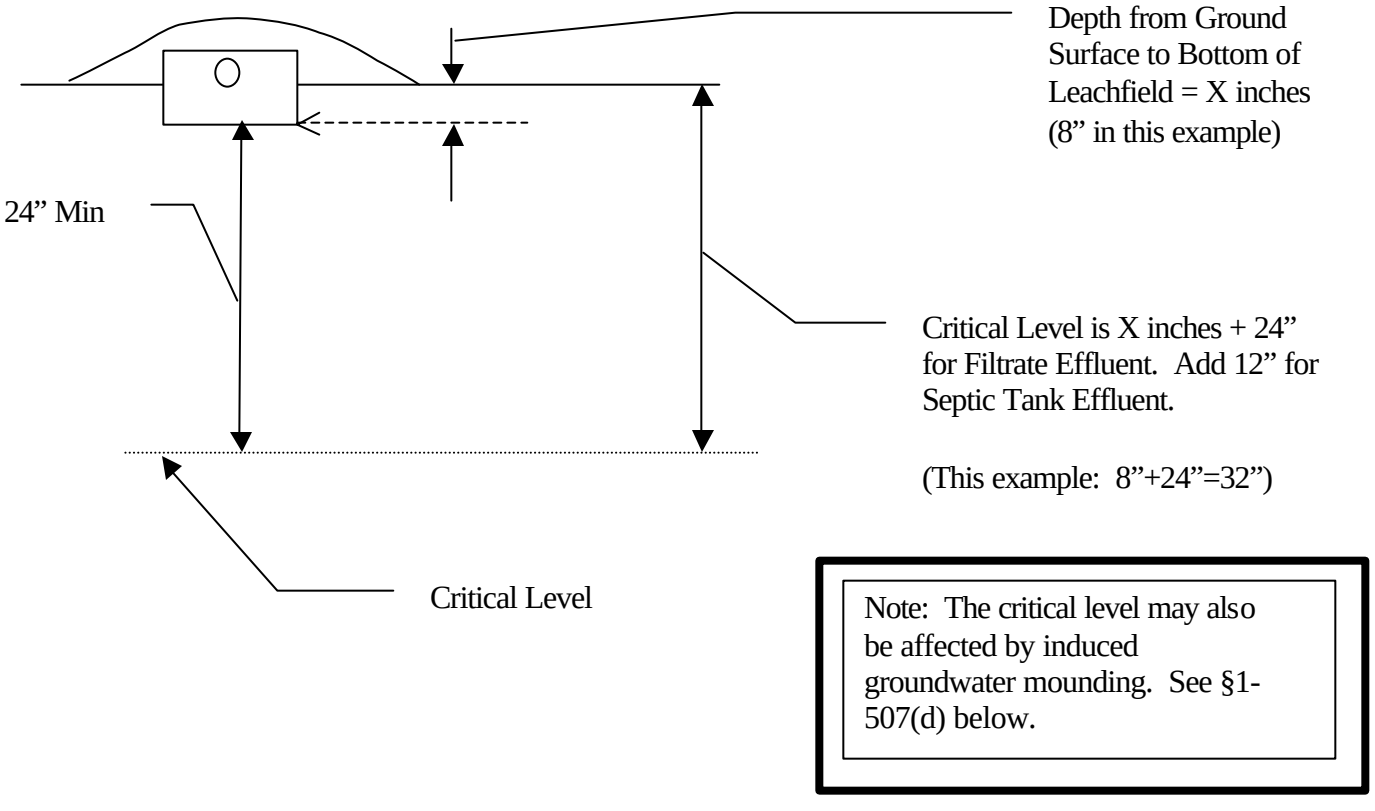
Figure 5.2 Critical Level for Site Suitability
Performance Based Designs



§1-507(c) Groundwater Level Monitoring

(c) While the critical levels noted in (b) are based on meeting minimum site standards, the question is sometimes whether an at-grade system can be used in lieu of a mound wastewater disposal system or an in-ground system in lieu of an at-grade system. For these cases, as shown in figure 5.3 below, the critical level will be 36" below the bottom of the leachfield for a system using septic tank effluent or 24" below the bottom of the leachfield when using filtrate effluent. As an example, if a shallow in-ground system using filtrate effluent with the bottom of the leachfield 8" below ground surface is proposed, the critical level will be 24"+8" = 32" below the ground surface.

Figure 5.3 Critical Level Based on Location of the Bottom of the Leachfield



§1-507(d) Groundwater Level Monitoring

(d) Induced groundwater mounding

(1) Filtrate disposal systems with linear loading rates greater than 4.5 gallons/day/linear foot, and performance based systems shall calculate the induced groundwater mounding under the leachfield. In addition to maintaining at least 2' of permeable soil between the bottom of the leachfield and the seasonal high groundwater table, the system shall maintain at least 18" between the bottom of the leachfield and the top of the induced groundwater mounding. If the induced groundwater mounding is more than 6" above the seasonal high water table level, the critical level will be more than 24" below the bottom of the leachfield. As an example, if the induced groundwater mounding is 8", the critical level will be 26" below the bottom of the leachfield (8"+18" = 26").

(2) Mound wastewater disposal systems with design flows of greater than 1000 gallons/day and in-ground and at-grade systems with design flows greater than 2000 gallons/day shall calculate the induced groundwater mounding under the leachfield. The system shall maintain at least 36" of unsaturated soil between the bottom of the leachfield and the top of the induced groundwater mounding. As an example, if the induced groundwater mounding is 8" the critical level will be 44" below the bottom of the leachfield (8"+36" = 44").

(e) Monitoring Procedure

(1) If a groundwater level monitoring program is proposed by a designer, or required by the Secretary, the Secretary shall be notified prior to beginning the monitoring program so that the Secretary may make periodic site inspections during the monitoring period. It is strongly suggested that a plan of study for the site be prepared by the designer and approved by the Secretary before any work begins to ensure that the results of the testing program will be acceptable. The designer should apply no later than February 1st to allow sufficient lead time for review and approval of a monitoring plan. Any proposal for monitoring groundwater levels must include a property access agreement so that Agency personnel may inspect the site during the monitoring period. Any groundwater monitoring program must consider drainage patterns, soil textures, relief watershed, monitor installation procedures, monitor locations, and monitoring schedule. A minimum of four monitor wells will be required for each area tested unless otherwise approved by the Secretary. Some sites will require more monitor wells to establish compliance with the site requirements.

§1-507(e)(2) Groundwater Level Monitoring

(2) Data collected from groundwater monitoring shall be evaluated against weather conditions over the period of measurement and data from other sites. In years with unusual seasonal groundwater patterns, actual monitoring data may not be representative of long-term seasonal high groundwater.

(3) The monitoring period shall be from March 1 until May 31. Groundwater level readings shall be taken at least once every 7 days during the monitoring period. If the water level reaches or exceeds the critical level the readings shall be taken at least once every 4 days until the water level falls below the critical level. Each reading shall be considered to represent the water level existing for ½ of the time since the previous reading plus ½ of the time until the next reading. For example, if the readings were 7 days apart, each reading would represent the 3 ½ days before and the 3 ½ days after a particular reading.

(4) The Secretary may consider information from a groundwater monitoring program that does not include the entire monitoring period. The results will be accepted only upon a conclusive demonstration by the designer that the results accurately represent the seasonal high water table during the monitoring period.

(5) Each reading shall be recorded as the number of days represented, as described in (3) above. The groundwater monitoring program demonstrates that the critical level is maintained if:

(A) the groundwater level does not rise above the critical level for more than a total of 30 days during the monitoring period,

(B) the groundwater level does not rise more than 6” above the critical level for more than a total of 20 days during the monitoring period,

(C) the groundwater level does not rise more than 12” above the critical level for more than a total of 10 days during the monitoring period,

(D) the groundwater level never rises more than 18” above the critical level, and

(E) the seasonal high water table or, if calculated, the induced groundwater mounding, never rises to less than 6” from the naturally occurring ground surface and, if calculated, the induced groundwater mounding never rises to less than 6” below the bottom of a leachfield receiving filtrate effluent.

§1-507(f) Groundwater Level Monitoring

(f) On some sites, due to low permeability soils, perched water tables may form in upper soil horizons. For the purpose of any wastewater system design under these rules, a perched water table is the seasonal high water table. The designer may analyze these in the same manner as any other type of groundwater table.

§1-508 Septic Tanks

(a) All-soil based disposal systems, including graywater disposal systems, shall include a septic tank. The septic tanks shall be sized as noted below:

Minimum Sizes for Septic Tanks

Design Flow, Gal/Day	Liquid Capacity Below the Invert of the Outlet *
Less than 667 Gal/Day	1,000 gallons
667 - 1500 Gal/Gay	1.5 times design flow
1,500 – 6500 Gal/Day	1,125 + 75% of design flow

* Unless a smaller tank can be justified by the designer.
Note: When an internal pump is installed within the septic tank, the capacity of the tank must be increased to allow for the dose volume and any emergency storage capacity that will be provided within the septic tank.

(b) Use of garbage grinders is strongly discouraged. The septic tank capacity shall be increased by a minimum of 25% if a garbage grinder is used.

(c) All septic tanks shall be installed with access risers to grade. Covers must be tight fitting and must be designed to prevent entry by children.

(d) All septic tanks shall be tested for leakage after installation in accordance with guidance approved by the Secretary. All tanks shall meet the standards for acceptable leakage prior to being placed into service.

(e) All septic tank installations shall include an effluent filter approved by the Secretary. The filter shall prevent passage of solids larger in size than $1/8^{th}$ inch.

(f) Specifications and Maintenance. See Appendix 3-A

§1-509 Grease Interceptor

(a) An approved grease interceptor shall be installed in the waste line leading from sinks, drains, dishwashers, and other fixtures or equipment in restaurants, cafeterias, bars or clubs, hotels, factories, or school kitchens or other establishments where grease would be a particular concern.

§1-509(b) Grease Interceptor

(b) The grease interceptor shall normally be located outside of any building and shall be sized by a designer to account for the volume and temperature of the flow such that the discharge from the grease interceptor will not have an oil and grease concentration of more than 25 mg/l.

Note: The Vermont Plumbing Rules may require installation of an interior grease interceptor. If required, it will not substitute for the grease interceptor required by these rules.

§1-510 Dosing and Pressure Distribution System Design

(a) Dosing is recommended for all soil-based disposal systems and is required when the design flow requires more than 500 linear feet of distribution piping.

(b) Dosing may be accomplished by pumps, siphons, or other devices that can provide sufficient flow and pressure to meet the design requirements of the distribution system.

(c) Any soil-based disposal system using pressure distribution shall be dosed. The system shall be designed to maintain a minimum pressure of 1 psi (or 2.3 feet of head) at the end of each distribution line. There shall be a maximum of a 10% difference in the per-square foot loading rate between any two trenches or beds within a system. No trench or bed shall be loaded at a rate exceeding that permitted based on the percolation rate and any factors associated with advanced treatment except when approved as an innovative or alternative system. There shall be a maximum 10% difference in the discharge rate between any two orifices in a single trench or bed. The design shall provide even distribution throughout the leachfield. The minimum dose volume shall be 5 times the volume of the distribution network that must be filled during each dosing cycle. There shall be at least 4 dosing cycles per day based on the design flow of the soil-based disposal system. There shall be at least one orifice for each 25 SQFT of leachfield area unless there is a specific requirement in these rules for additional orifices.

(d) Pressure distribution pipe shall be smooth, rigid pipe and the pipe network shall be designed to allow for periodic cleaning. The distribution pipe shall be constructed so that there is access to the piping system for flushing of the piping system.

(e) All distribution pipe shall be laid level. Distribution pipe serving separate absorption trenches or absorption beds may be installed at different elevations provided that the design ensures even distribution.

(f) The minimum orifice diameter shall be 1/8". An effluent filter that prevents passage of particles larger than 1/8" shall be used to protect the pump, siphon, or other dosing

device and the distribution piping. The orifices shall be on the upper side of the pipe and shall be protected by orifice shields. One or more additional orifices may be placed in the bottom of the pipe to facilitate drainage in situations where freezing of the distribution pipe is possible.

(g) Alternative designs proposed by a designer that result in equal distribution may be approved by the Secretary.

§1-511 Absorption Trenches

(a) All absorption trench disposal fields shall comply with all isolation requirements set forth in §1-503 in addition to the isolation requirements in this subsection.

(b) Absorption trenches shall have a maximum width of 48".

(c) The size of an absorption trench is calculated as the bottom area of the trench. The amount of area is calculated based on the second slowest percolation rate in the proposed area of the trench, using the following formula:

$$LR = \frac{3}{\sqrt{t}}$$

where LR is the loading rate in gallons per square foot of absorption trench per day and t equals the percolation rate in minutes per inch. The size of the absorption trench is determined by dividing the design flow in gallons per day by the loading rate in gallons per day per square foot. The result is the number of square feet of bottom area required. The minimum acceptable value for t is 4 min/inch and the maximum acceptable value for t is 60 min/inch. The maximum loading rate is 1.5 gallons per day per square foot.

(d) Absorption trenches shall extend no deeper than 36" below ground surface.

(e) Absorption trenches may be installed on slopes of up to 30% and slopes of more than 30% may be approved on a case by case basis using a performance based approach. (see restrictions in §1-502(f)). When a system is proposed on a slope of more than 20%, the plans shall address how the site stability will be maintained during and after construction with specific attention to erosion control.

(f) When installed, the bottom of any absorption trench shall be at least 36" above the seasonal high water table, 36" above any impervious soil layer, and 48" above bedrock. On sloping sites, the measurements shall be taken from the deepest portion of the absorption trench. For systems with design flows of 2000 gpd or more, it shall be determined that the induced groundwater mounding associated with the system

will be at least 36" below the bottom of the absorption trench. This determination shall be based on a site specific analysis using either the desk top hydrogeologic analysis or a site specific test unless the designer asserts, and the Secretary agrees that a site specific analysis is unnecessary to make the determination. For example, sites with highly permeable soil and with a seasonal high water table significantly more than 36" below the bottom of the absorption trench are possible candidates for such a determination.

(g) The bottom of any absorption trench shall be level.

(h) Absorption trenches shall have crushed stone extending a minimum of 2" above and 12" below the distribution pipe. Exception: Absorption trench systems that use the loading rate calculations for absorption beds shall have a minimum of 6" of crushed stone below the distribution pipe.

(i) Absorption trench systems may be constructed using prefabricated leaching chambers with a minimum H-10 structural loading rating, instead of crushed stone. Distribution pipe must be used in any chamber system.

(j) The distribution piping must be 4" rigid, perforated pipe that is laid level, or small diameter pipe under pressure. If the distribution piping is more than 100' in length, it must be dosed. The ends of all pipes must be capped except for those at the same elevation, which should be connected.

(k) A layer of filter fabric shall be placed over the top of the crushed stone.

(l) Each absorption trench shall be covered with a minimum of 6"and a maximum of 12" of permeable soil, with the uppermost 2"- 4" being topsoil.

(m) Absorption trenches shall be designed at least 6' on center when measured on a horizontal plane, but in no case shall there be less than 4' of naturally occurring, undisturbed soil between adjacent absorption trenches. Primary and replacement absorption trenches may be interfingered. There shall be at least 4' of naturally occurring, undisturbed soil between the primary and replacement absorption trenches.

(n) Absorption trenches on sloping ground shall be laid parallel to the ground contours.

(o) A distribution box shall be installed when multiple absorption trenches are used. Flow equalization devices that can be adjusted to maintain equal distribution during the life of the wastewater system shall be installed in the pipes leading to each absorption trench. The distribution box shall be constructed with an at-grade access. The designer shall consider the need for protection against freezing and shall include design details as needed.

§1-511 (p) Absorption Trenches

(p) A reduction in the leachfield area may be allowed for absorption trenches and chamber trenches , where the depth of crushed stone exceeds the normal 12 inch depth below the distribution pipe, as follows:

PERCENTAGE OF STANDARD DISPOSAL FIELD AREA REQUIRED

For absorption trenches

Depth of Crushed Stone Below Distribution Pipe	Trench Width 12”	Trench Width 18”	Trench Width 24”	Trench Width 36”	Trench Width 48”
18 inches	60%	64%	66%	71%	75%
24 inches (max)	50%	54%	57%	62%	66%

(q) No absorption trench shall be constructed in fill material except in accordance with the site modification requirements in §1-516 or §1-517.

(r) Absorption trenches shall not be constructed in soils with a percolation rate that is slower than 60 min/inch. Construction of absorption trenches in soils with a percolation rate that is faster than 1 min/inch requires a site modification as described in §1-516(e).

(s) All piping from the building or structure to the septic tank, from the septic tank to a distribution box, or to a pump or siphon chamber, and to the absorption trench shall be non-perforated, rigid pipe. The pipe penetrations shall be sealed to prevent leakage.

(t) After the absorption trench area has been excavated, any smeared surfaces shall be scarified with a rake. Construction equipment not needed to construct the leachfield shall be kept off the area to be used to prevent undesirable compaction of the soils. Construction shall not be initiated when the soil moisture content is high. If a fragment of soil from about 9” below the surface can easily be rolled into a wire, the soil moisture content is too high for construction purposes.

§1-512 Absorption Beds

(a) All absorption bed systems shall comply with all isolation requirements set forth in §1-503 in addition to the isolation requirements in this subsection.

(b) Leachfields that are wider than 48" are referred to as absorption beds.

(c) The basis of design is the bottom area of the absorption bed. No reduction in area is allowed for extra stone under the distribution pipe.

(d) The maximum capacity for any single absorption bed is 2000 gallons per day.

(e) An absorption bed shall not be constructed in soils with a percolation rate slower than 60 minutes/inch. An absorption bed constructed in soils with a percolation rate faster than 1 minute/inch requires a site modification as described in §1-516 (e)

(f) Absorption beds shall extend no deeper than 36" below ground surface.

(g) When installed, the bottom of any absorption bed shall be at least 36" above the seasonal high water table, 36" above any impervious soil layer, and 48" above bedrock. On sloping sites, the measurements shall be taken from the deepest portion of the absorption bed. For absorption bed systems with design flows of 2000 gpd or more, it shall be determined that the induced groundwater mounding associated with the system will be at least 36" below the bottom of the system. This determination shall be based on a site specific analysis using either the desk top hydrogeologic analysis or a site specific test unless the designer asserts, and the Secretary agrees, that a site specific analysis is unnecessary to make the determination. For example, sites with highly permeable soil and with significantly more than 36" between the bottom of the absorption bed and the seasonal high water table are possible candidates for such a determination.

(h) The bottom of any absorption bed shall be level.

(i) Absorption beds on sloping ground shall be laid parallel to the ground contours.

(j) A large length to width ratio is recommended.

(k) Absorption beds shall have a minimum of 2" of crushed stone over the distribution piping and a minimum of 6" of crushed stone below the distribution piping.

(l) All distribution piping shall be laid level. The piping shall be 4" rigid, perforated pipe unless small diameter pipe under pressure is used. Any length of pipe greater than 100' shall be dosed.

§1-512 (m) Absorption Beds

(m) There shall be a layer of filter fabric over the top of the crushed stone.

(n) Each absorption trench shall be covered with a minimum of 6"and a maximum of 12" of permeable soil, with the uppermost 2"-4" being topsoil.

(o) Absorption beds shall not be constructed in fill except in accordance with §1-516 or §1-517.

(p) Absorption beds shall be sized on the bottom area only. The design shall be based on the second slowest percolation rate for the site. The loading rate shall be determined by the formula:

$$LR = 0.8 \times \frac{3}{\sqrt{t}}$$

where LR is the loading rate in gallons per square foot of absorption bed per day and t equals the percolation rate in minutes per inch. The size of the absorption bed is determined by dividing the design flow in gallons per day by the loading rate in gallons per day per square foot. The result is the number of square feet of bottom area required. The minimum useable value for T is 4 min/inch and the maximum acceptable value for t is 60 min/inch. The maximum acceptable loading rate is 1.2 gallons per day per square foot.

(q) Absorption beds shall not be installed on land with a slope greater than 10%.

(r) All distribution lines within the absorption bed shall be uniformly spaced no more than 6' apart. The maximum distance from a distribution line and the edge of the absorption bed shall be 3'.

(s) Primary and replacement absorption beds shall be separated by at least 10 feet.

(t) All piping from the building or structure to the septic tank, from the septic tank to a distribution box, or to a pump or siphon chamber, and to the absorption bed shall be non-perforated, rigid pipe. The pipe penetrations shall be sealed to prevent leakage.

(u) After the absorption bed area has been excavated, any smeared surfaces shall be scarified with a rake. Construction equipment not needed to construct the leachfield shall be kept off the area to be used to prevent undesirable compaction of the soils. Construction shall not be initiated when the soil moisture content is high. If a fragment of soil from about 9" below the surface can easily be rolled into a wire, the soil moisture content is too high for construction

§1-513 Spray Disposal Systems

(a) A spray disposal system is a wastewater system disposing of treated wastewater into the native soil by surface application to the land using aerial dispersion (sprinklers) to distribute the sewage evenly. The maximum size wastewater system approvable under these rules is 6499 gallons per day of design flow. Larger systems are reviewed under the Indirect Discharge Rules.

(b) Wastewater shall be treated to provide an effluent with not more than 30 mg/l BOD_5 and 30 mg/1 TSS. Disinfection with 20-minute chlorine contact time immediately prior to spraying and a 1.0 ppm chlorine residual at the spray nozzle, or a 4.0 ppm total residual chlorine (or other equivalent disinfection method acceptable to the Secretary) shall be required.

(c) A soil and site evaluation shall be conducted under the supervision of a designer. The designer shall prepare a soil and site evaluation report in the following specific areas to properly locate and design a spray disposal system. The soil and site evaluation shall also include the designer's written opinion regarding the suitability of the soil and site to satisfactorily treat and dispose of the proposed volume of wastewater.

(1) An acceptable full-time spray disposal site should have a fragipan or other impeding layer (silt or clay) beneath a more permeable overburden to prevent direct recharge to an unconfined aquifer or bedrock. A relatively flat site with impermeable soils at the ground surface may sometimes be utilized for spray disposal at lower than normal wastewater applications. Such application rates should be consistent with seepage and evaporation rates expected in the area.

(2) There shall be sufficient soil investigations on the site to establish that the fragipan or impeding layer is continuous on the site. Investigations shall also indicate the nature of the soil overlying the impeding layer. Soils investigations shall include, but are not necessarily limited to: in-place densities, sieve analysis, horizontal and (when necessary) vertical permeability analysis.

(3) Groundwater recharge areas within bedrock or unconfined aquifer areas shall not be considered acceptable spray disposal sites.

§1-513 (d) Spray Disposal Systems

(d) A hydrogeologic investigation shall be conducted on each spray disposal site by a qualified hydrogeologist. Such an investigation shall include the submission of data in the following specific areas.

(1) The character and thickness of unconsolidated sediments overlying bedrock at the site shall be provided. The saturated zones in the soil profile shall be indicated, including possible perched water tables, and regional or artesian aquifers at the site. Geophysical testing can be utilized.

(2) The direction of ground water movements to and from the site, and points or areas of ground water discharge or recharge shall be determined and located on a contour map for local and regional ground water regimes.

(3) All surface waters and potable and non-potable water supplies within 500 feet of the proposed spray disposal site shall be located on a contour map and, for potable and non-potable water supplies, the following information shall be obtained through house to house survey, well drilling records, observations, or whatever other means are necessary:

(A) owner of the water supply, whether it is in use or not, and its use as to potable, industrial or agricultural;

(B) type of water supply: drilled well, dug well, spring, surface water;

(C) well boring logs when available, depth of casing, depth to aquifer material, and material - i.e., gravel, bedrock, and if available, the predominant bedrock material.

(D) Any possible effects of the spray disposal system on quality or quantity of any local or regional aquifers, and water supplies shall be evaluated. Hydraulic relationships between the spray disposal site and identified water supplies shall also be evaluated and addressed as to the possible effects on the quality or quantity of the supply.

(e) The maximum spray disposal site application shall be 2 inches per week over the actual wetted area, with a minimum of 24 hours of rest between applications. The capacity of full-time spray disposal sites shall be calculated on the basis of lateral flow downslope over the impeding layer while maintaining a minimum of one (1) foot of unsaturated soil between the ground surface and the resulting water table. Calculations of spray field capacity shall be made using recognized subsurface flow equations. The maximum hourly wastewater application rate shall be 0.25 inches per

hour based on the actual wetted area. The maximum acceptable slope for a spray disposal site shall be 25 percent. There shall be a minimum of 5 feet between the wetted area of laterals of sprinklers in the direction of surface water runoff. Spraying during the winter shall be conducted during daylight hours, when air temperatures exceed 10 ° F. The pumping system shall be sized to deliver the average daily wastewater flow to the spray field in not more than eight (8) hours. The spray disposal and storage system shall be sized so that the system can operate effectively without having to spray during the spring run-off months.

(f) There shall be no spray disposal of sewage that discharges to Class A waters. Class A waters are identified and listed in the Vermont Water Quality Standards. Other controls regarding isolation distances for spray disposal systems are:

(1) the wetted area from any sprinkler in a spray disposal system shall not be closer than 100 feet to the edge of any surface water;

(2) spray disposal areas shall be well isolated from road, habitation, and other places open to the general public. Isolation distances are dependent upon the intended use and disposition of the treated wastewater, degree of treatment provided, and local meteorological, vegetative and topographical system. The wetted area shall not be permitted closer than 200 feet from habitation, property lines, roads, or areas frequented by the public;

(3) no portion of a spray disposal area shall be permitted closer than 200 feet to any potable or non-potable water supply; and

(4) the spray disposal area shall be restricted from the public access by fencing and posting of signs, or other means acceptable to the Secretary, so that the public will be warned against entering the area and possible direct contact with the spray area.

(g) Any planned multiple use of the spray disposal area will be evaluated on its own merits, and approvals granted at the discretion of the Secretary, with such conditions and additional controls as required. When waivers to specific requirements of these rules are necessary in order to approve a multiple use, (e.g., waiver of isolation distance requirements for snowmaking on ski trails or irrigation of golf courses), the waiver will be granted upon a showing by the applicant that the environmental and human health concerns, addressed in this section, have been adequately addressed in the multiple use design.

(h) When required by the Secretary, full-time spray disposal systems shall have a storage capacity capable of storing a minimum two months sewage. Seasonal spray disposal system facilities shall have sufficient storage capacity to allow for effective operation with a minimum acceptable storage capacity being 30 days of flow.

§1-513(i) Spray Disposal Systems

(i) A detailed Operation and Maintenance Manual on the complete wastewater system shall be submitted for review and approval. All sludge removed from the wastewater treatment plant shall be disposed of at locations approved by the Residuals Management Section of the Department of Environmental Conservation. The permittee(s) shall comply with the reporting procedures specified in the Certification from the Residuals Management Section or approved Sludge Management Plan. Monitoring and operation for a spray disposal system shall be as required in §1-514.

§1-514 Monitoring and Operations

Monitoring and operation of wastewater systems shall adhere to the requirements of paragraphs (a) and (b) below:

(a) The required operation and maintenance of a wastewater system that depends only on a septic tank shall be those activities considered necessary to maintain an effective wastewater system. At the discretion of the Secretary, the owner may be required to install and maintain a ground water sampling and monitoring program considered necessary to detect contamination and degradation of ground water and surface water and water supplies with the results submitted to the Secretary in accord with the permit conditions.

(b) The treatment facilities of spray disposal systems shall be supervised by an operator licensed under the Vermont Wastewater Treatment Facility Operators Certification Program with the applicable certification and the facilities shall be operated and maintained in a manner satisfactory to the Secretary. Operation reports, including flows received, volumes disposed of, and results of testing necessary to maintain plant efficiency and to demonstrate the reliability of the treatment system, shall be submitted to the Secretary on a monthly basis. Owners of such spray disposal systems where the Secretary has required the installation ground water monitors shall maintain a ground water sampling and analysis program to detect contamination and degradation of ground or surface water and potable and non-potable water supplies.

§ 1-515 Construction

Wastewater systems shall be constructed in accord with the permitted design. The designer or the installer shall provide the installation certification required in §1-303(c) of these rules. When the installation is different from the permitted design, a designer shall specify any deviations from the approved plans, specifications, or permit conditions in "as-built" plans along with recommendations that the project be accepted as is, based on his or her certification of the revised design, or shall specify that alterations must be made to bring the project into compliance with the rules. If alterations must be made, an installation certification must be completed after the alterations are complete. When the Secretary determines that the scope, complexity, or size, of the proposed facility justifies it, construction shall be accomplished under the supervision of a designer.

§1-516 Site Modifications

(a) Depending upon the severity of site limitations, it may be possible to convert marginal or unsuitable sites to sites that comply with the specific requirements of these rules. Applicants may submit plans for the treatment and disposal of sewage that involve modifications to an existing site intended to bring a non-conforming site into conformance with standards applicable for the type of wastewater system proposed. Cuts or fills of 1' or less shall not be considered site modifications for the purposes of this section.

(1) Site conditions that may be improved by some degree of site modification are shallow depth to impervious layer, seasonal high ground water level, shallow depth to bedrock and excessive slope.

(2) Acceptable site modifications may include the installation of curtain drains to lower the water table, mound system construction and regrading of the site.

(3) Restrictions placed on site modifications apply only in cases where the site modifications are necessary to overcome limitations of an otherwise unacceptable site. The restrictions do not apply to modifications designed to enhance the functioning of a system on a complying site.

(b) Application Procedures and Standard Requirements

(1) All site modifications must be designed by a designer.

(2) All plans for site modifications shall be submitted on an accurate contour map with a maximum of two (2) foot contour intervals. A scale of not greater than 20 feet per inch is recommended. A plan may be rejected if the scale is not adequate for review. Existing and proposed ground contours shall be shown along with a permanent benchmark.

(3) Approval for construction of the site modifications will be dependent upon the final site testing and review of the final plans.

(3) Site modifications will not be permitted on sites with less than 24 of native soil over bedrock or ledge or other strata having a percolation rate slower than 120 minutes per inch except in accord with §1-502.

§1-516(b)(5) Site Modifications

(5) Site modifications will not be permitted on sites having a seasonal high water table within two (2) feet of the ground surface. Exceptions:

(A) sloping sites with a seasonal high ground water table 18" or more from the ground surface may be approved for a mound wastewater system no larger than 600 gallons per day, if the designer concludes, and the Secretary agrees, that a curtain drain will lower the seasonal high water table to 24" or more. Mound wastewater disposal systems using trenches shall not use more than two trenches per system; and

(B) wastewater systems using enhanced prescriptive or performance based designs as described in sections §1-502 (c) and (d).

(6) Except where specifically permitted otherwise, site modifications shall be constructed under the supervision of a designer in accordance with the approved plans. Upon completion of construction, the supervising designer shall provide the certification required in §1-303(c) of these rules. Failure to construct the site modifications under the supervision of a designer shall be a basis for revoking approval for the project.

(7) For site modifications involving flows of more than 2,500 gpd, the Secretary may require such additional design or construction specifications as may be necessary to insure the proper functioning of the system.

(c) Curtain or Dewatering Drains.

(1) Curtain or dewatering drains may be used to lower seasonal high water tables, that prevent compliance with the required wastewater disposal system design requirements.

(2) Drains are highly dependent upon their design and construction and site conditions for continued adequate performance. Prior to designing such drains, it is recommended that the designer consult such references as Drainage of Agricultural Land by the USDA Natural Resources Conservation Service and these rules for design requirements and expected performance standards.

(3) When a drain is proposed to lower a seasonal high water table, it must be installed and tested during spring conditions to demonstrate its effectiveness before approval of the wastewater system, unless the Secretary concludes that the designer has provided sufficient evidence to show that the drain will work effectively and that spring testing is not necessary. Section §1-516 (b)(5)(A) also gives specific guidance for small mound systems.

§1-516(c)(4) Site Modifications

(4) The designer shall submit a plan to the Secretary that shows the drain and the proposed location of the wastewater system. After approval of the design by the Secretary, the drain must be installed and tested before approval will be issued, unless an exception has been granted in accordance with subsection (3) above.

(5) A plan of location of monitoring wells and schedule of measurement shall be approved by the Secretary.

(6) Design Criteria

(A) All design criteria must be detailed as to plan, profile, discharge location, and typical section. When considered necessary to establish the effectiveness of the proposed drain, the Secretary may request supporting information, including permeability and sieve analysis of the soils at the site.

(B) The drain shall be constructed of material sufficient to transmit the water from the site and to prevent clogging of the drain and decrease of its effectiveness. The acceptable material shall be crushed stone, perforated or other porous pipe, and filter fabric material to prevent clogging. Other designs of graded material to prevent clogging may be approved when supported with sufficient information.

(C) If the curtain or foundation drain is downslope of the leachfield, the leachfield shall not be closer than 75 feet to the drain. If the curtain or foundation drain is upslope of the leachfield, it shall be a minimum of 20 feet, 35' if possible, to the leachfield. These distances may be reduced if the designer provides adequate data and analysis to show the effluent from this system will not enter the drain, or increased if effluent will enter the drain.

(D) All sites using drains shall have monitors installed to monitor their effectiveness. The location and design shall be detailed on the plans.

(E) The outlet of all drains shall be constructed to prevent erosion and clogging. Rodent guards are required.

§1-515(d) Site Modifications

(d) Excessive Slope

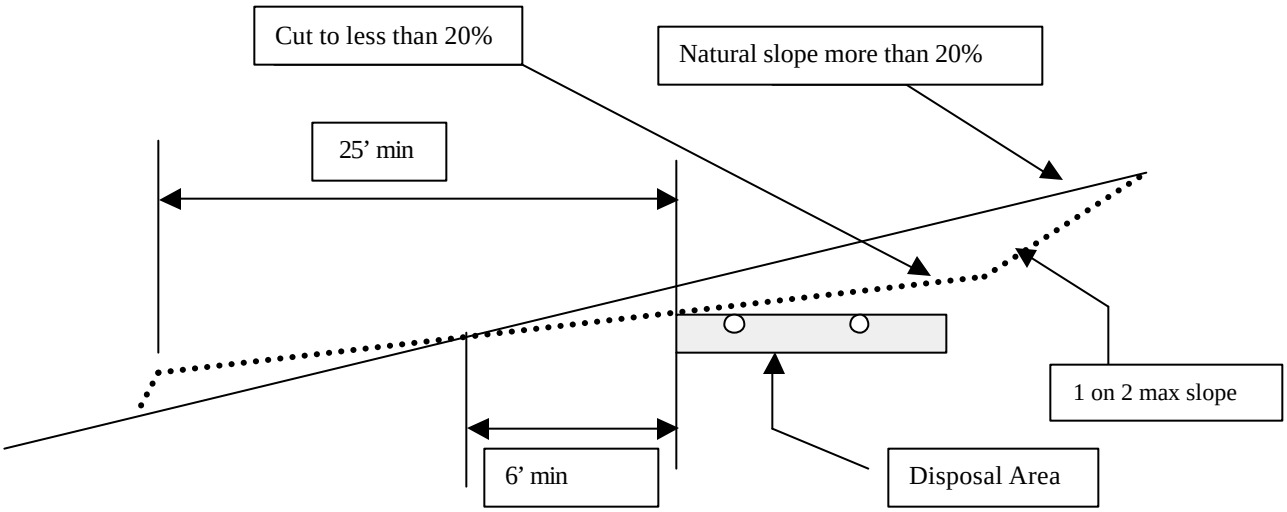
(1) In some cases, sites with slopes exceeding 20% may be regraded and reshaped to provide adequate leachfield sites. Prior to regrading, soil excavations shall be performed to show that will be a sufficient amount of soil over the seasonal high water table and ledge after the regrading (Figure 5.4 page 98).

(A) The modification for primary and replacement area shall be complete and soil excavation and percolation tests performed before any regraded site can receive final approval.

(D) The leachfield shall not be installed in the fill area of a regraded site, though the area of fill may be used as a portion of the required 25 foot separation from the crown of a natural slope. There shall be a minimum of 6 feet of natural soil between the edge of a system and the downslope side of the regraded area.

(C) An erosion control plan per §1-502(e) shall be submitted as part of the application.

Figure 5.4
Natural slope more than 20%



(e) Rapidly Permeable Soils

For soils with a percolation rate of faster than one minute per inch, treatment shall be provided with (1) a mound wastewater disposal system; or (2) an absorption trench or absorption bed system backfilled with at least one foot of sandy fill material between the bottom of the crushed stone and the native soil. The fill shall have a percolation rate of three minutes per inch or slower. The application rate shall be based on the percolation rate of the fill in place.

§1-517 Mound Wastewater Disposal Systems

(a) Mound wastewater disposal systems may be considered whenever site conditions preclude the use of a subsurface system. Due to the nature of a mound wastewater disposal system, the selection of mound location, size of mound, and construction techniques must be thoroughly considered and the criteria established in this section must be carefully followed. See Figure 5.5 on page 101.

(1) All mound wastewater disposal systems must be designed by a designer.

(2) The designer shall prepare a contour map using a contour interval of not more than two feet. A scale of not greater than 20 feet per inch is recommended. All details of the mound wastewater disposal system, including but not limited to toe of slope, surface drains, curtain drains, existing and proposed contours, and trench details shall be shown on the plans.

(3) The plans shall show that there is sufficient area separate from the primary mound site on the lot to allow for construction of a replacement mound that meets all requirements. The toe of the replacement mound shall not be closer than 10 feet to the primary mound on the sides or closer than 25 feet on the uphill or downhill side.

(4) For mound wastewater disposal systems serving projects generating more than 1,000 gallons per day of sewage, a hydrogeologic study of the site must be conducted to demonstrate the capability of the site to dispose of the volume of sewage to be generated. The ground water level at the downhill toe of the mound shall be raised no closer than 12” below the ground surface and the induced groundwater mounding beneath the mound shall be no closer than 36” below the bottom elevation of the leachfield within the mound unless using a performance based design per §1-502 of these rules and /or when disposing of filtrate effluent per §1-520 of these rules. A site specific test may be conducted if a desktop hydrogeologic analysis is insufficient for an approval.

(b) Site requirements

(1) Soils where the seasonal high water table, bedrock, or other strata having a percolation rate slower than 120 minutes per inch occurs within twenty-four inches of natural grade, are not suitable for mound wastewater disposal systems. These limitations may be different if the enhanced prescriptive or the performance based approach is used. The site must be free of these limitations beyond the toe of a mound (primary and replacement) for a distance of twenty-five (25) feet in the downslope direction and ten (10) feet on all other sides.

§1-517(b)(2) Mound Wastewater Disposal Systems

(2) Mound wastewater disposal systems may be constructed upon undisturbed naturally occurring soils. Mounds may also be approved for sites where the naturally occurring soil has been removed or where fill has been placed over the naturally occurring soil. In both cases the remaining naturally occurring soil needs to comply with the soil and siting criteria for mound wastewater disposal systems.

(3) A crest site is preferred; no mound wastewater disposal system shall be located in a depression, which could act as a natural surface or ground water collection area.

(4) Generally, sites with large trees, numerous smaller trees or large boulders are unsuitable for a mound wastewater disposal system because of difficulty in preparing the surface and the reduced infiltration area beneath the mound. Rock fragments, tree roots, stumps and boulders occupy space, within the mound area, thus reducing the amount of soil for proper operation. If no other site is available, then it is recommended to cut the trees at ground level, leaving the stumps. A larger mound area may be necessary if too many stumps are involved, so that sufficient soil is available to accept the effluent.

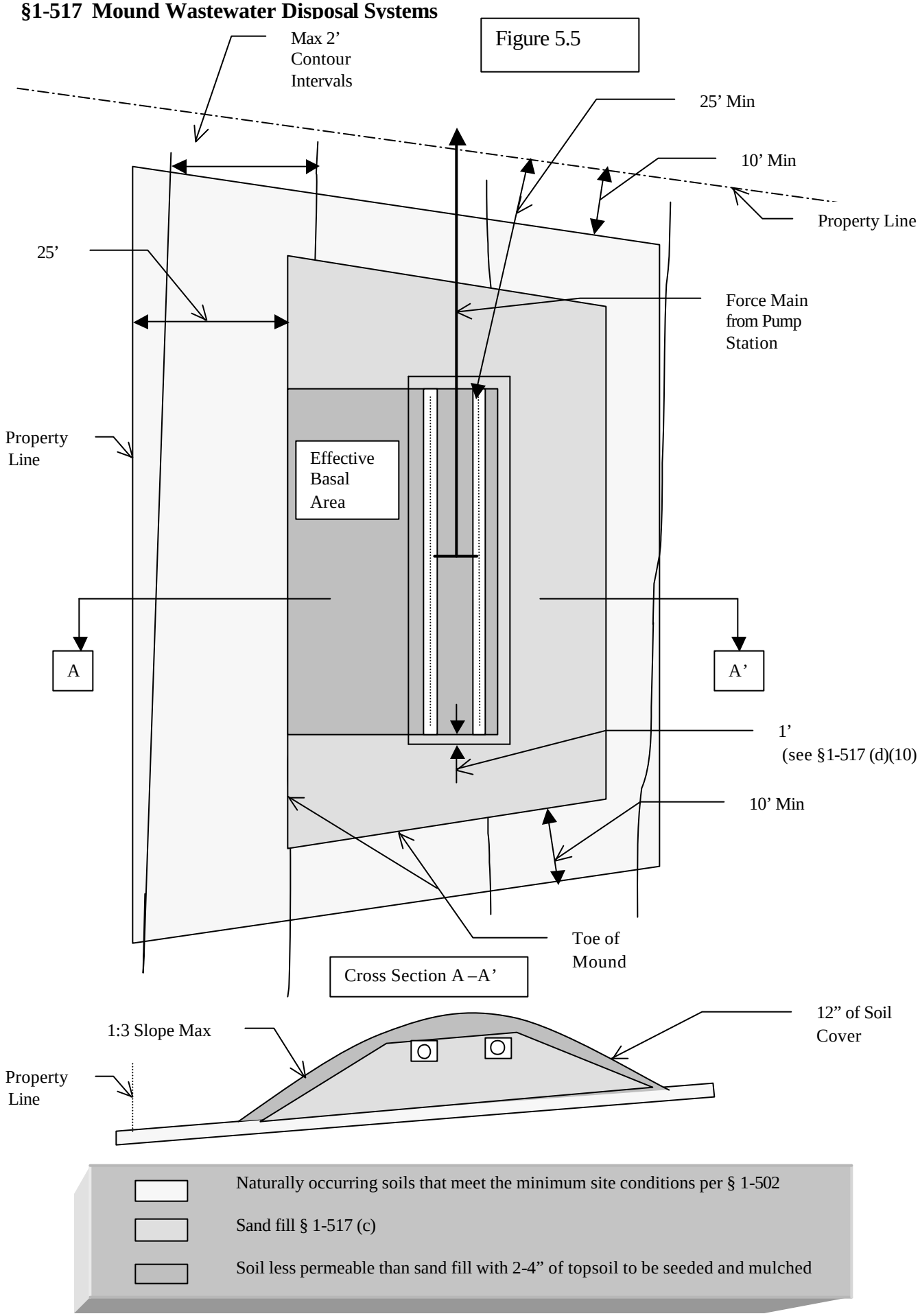
(5) The minimum isolation distance to drinking water supplies, per §1-503, shall be measured from the edge of the minimum required effective basal area of the mound wastewater disposal system.

(6) Mound wastewater disposal systems shall be located at least 50 feet from any surface water, including but not limited to, streams, watercourses, lakes, or impoundments as measured from any toe of the mound.

(7) Mound wastewater disposal systems shall be located a minimum distance of 10 feet, as measured from the toe of the mound, from buildings, driveways, or any other subsurface obstruction except that this distance shall be 25 feet in the downgradient direction from the mound. Mound wastewater disposal systems shall be located a minimum distance of 10 feet, as measured from the toe of the mound or 25 feet as measured from the edge of the leachfield within the mound, whichever is greater, from property lines except that the distance from the downgradient toe of the mound to property lines shall be a minimum of 25 feet. The land area 25' downgradient of the elevated sand mound is the effluent dispersal area and soil in this area may not be removed or disturbed except as specified herein.

(8) Separation may be required between mound wastewater disposal systems to prevent hydraulic interference in the disposal area.

Figure 5.5


Max 2’ Contour Intervals
25’ Min
10’ Min
Property Line
25’
Force Main from Pump Station
Property Line
Effective Basal Area
A
A’
1’ (see §1-517 (d)(10)
10’ Min
Toe of Mound
Cross Section A –A’
1:3 Slope Max
12” of Soil Cover
Property Line
Naturally occurring soils that meet the minimum site conditions per § 1-502
Sand fill § 1-517 (c)
Soil less permeable than sand fill with 2-4” of topsoil to be seeded and mulched

§1-517 (c) Mound Wastewater Disposal Systems

(c) Fill Material: The fill material from the natural soil plowed surface to the top of the trench or bed shall be sand texture with one of the following sieve analyses:

(1)

Sieve Number	Opening (mm)	Percent Passing, by Weight
10	2.000	85 - 100
40	0.420	25 - 75
60	0.240	0 - 30
100	0.149	0 - 10
200	0.074	0 - 5

(2)

Sieve Number	Opening, (mm)	Percent Passing, by Weight
4	4.750	95 - 100
8	2.380	80 - 100
16	1.190	50 - 85
30	0.590	25 - 60
50	0.297	10 - 30
100	0.149	2 - 10

(3)

Sieve Number	Opening (mm)	Percent Passing bv Weight
10	2.000	85 - 100
40	0.420	30 - 50
200	0.074	0 - 10

(4) The fill material must meet the specifications (1), (2), or (3) above. Interpolation of analyses is not permitted. Fill material (2) is ASTM Specification C-33 and is intended for manufactured material.

(5) Mound wastewater disposal systems approved under the September 10, 1982 Environmental Protection Rules may use the fill material allowed under this subsection without redesign.

§1-517(d) Mound Wastewater Disposal Systems

(d) Design

(1) There shall be a minimum of one (1) foot of fill material and sufficient naturally occurring soils to meet the requirements in §1-502 between the bottom elevation of the leachfield within the mound wastewater disposal system and the highest elevation of the limiting soil conditions.

(2) Sufficient depth of fill material shall be placed to provide for 48" of vertical separation between the bottom elevation of the leachfield within the mound wastewater disposal system and creviced or permeable bedrock.

(3) Sufficient depth of fill material shall be placed to provide for 36"of vertical separation between the bottom elevation of the leachfield within the mound wastewater disposal system and the seasonal high water table. For mound wastewater disposal systems with design flows of 1000 gpd or more, a designer shall determine that the induced groundwater mounding will be at least 36" below the bottom of the leachfield within the mound wastewater disposal system. This determination shall be based on a site specific analysis using either the desk top hydrogeologic analysis or a site specific test unless the designer asserts, and the Secretary agrees, that a site specific analysis is unnecessary to make the determination. For example, systems that are only slightly larger than 1000 gpd on sites with highly permeable soil and with low linear loading rates are possible candidates for such a determination.

(4) The effective basal area is the area within the sand fill that is downslope of the long dimension of the leachfield constructed within the mound wastewater disposal system.

(5) The minimum isolation distance to drinking water supplies, per §1-503, shall be measured from the edge of the minimum required effective basal area of the mound wastewater disposal system.

(6) Mound wastewater disposal systems shall utilize pressure distribution. Absorption trench(s) or a seepage bed with a maximum 10' width shall be used. Mound wastewater disposal systems shall not be installed on land with a slope greater than 30% percent, except as approved on a site specific basis (see restrictions in §1-502). The mound systems shall be installed with the long dimension of the system parallel to the land contour. Spacing between trenches shall be no less than 4'. For trench designs, the minimum trench length shall be twice the dimension across the top of the mound from the outside to outside of the trenches.

§1-517(d)(7) Mound Wastewater Disposal Systems

(7) The required absorption trench or absorption bed bottom area shall be based upon a maximum application rate of 1.0 gallons/day/square foot.

(8) The minimum required effective basal area of the mound wastewater disposal system, for soils with a percolation rate of 61 to 120 minutes per inch, is to be calculated using a maximum application rate of 0.24 gallons/day/square foot.

(9) The minimum required effective basal area of the mound wastewater disposal system for soils with a percolation rate of 0 to 60 minutes per inch is to be calculated using a maximum application rate of 0.74 gallons/day/square foot.

(10) The area of sand fill shall be sufficient to extend one (1) foot beyond the edge of the required absorption trenches or the absorption bed before the sides are shaped to the acceptable slope.

(11) The maximum acceptable slope for toe slopes of mound wastewater disposal systems shall be 1 on 3. The mound fill shall extend beyond the effective basal area.

(e) Pressure Distribution System Design

(1) Pressure distribution shall be required for all mound wastewater disposal systems.

(2) The leachfield shall be dosed a minimum of four times per day and not more than once in any thirty minute period. The size of the dosing pump or siphon shall be selected to maintain a minimum pressure of one pound per square inch or 2.3 feet of head at the end of each distribution line. The pump or siphon and the distribution piping shall be protected with an effluent filter that prevents the passage of any particle larger than 1/8".

(3) The pressure distribution pipe shall be rigid plastic pipe, Schedule 40 to 80 with a minimum of diameter of one (1) inch. The pipe shall provide a single row of holes, minimum 1/8-inch diameter, on center along the length of the pipe with the last hole in the end cap. A design that assures uniform distribution throughout the leachfield is required. There shall be a minimum of one opening in the distribution piping per 25 square feet of leachfield area. There shall be a maximum of a 10% difference in the per-square foot loading rate between any two absorption trenches within a system. There shall be a maximum 10% difference in the discharge rate between any two orifices in a single

absorption trench or absorption bed. The design shall provide even distribution throughout the leachfield. The minimum dose volume shall be 5 times the volume of the distribution network that must be filled during each dosing cycle. All joints and connections shall be solvent welded.

(4) The pressure distribution pipe shall be placed in crushed stone with the orifices upward. The holes shall be covered with an orifice shield. One or more additional orifices may be added to allow drainage of the piping when freezing may be a problem. The material used to cover the top of the stone shall be one layer of filter fabric.

(5) The ends of all distribution pipes shall be capped.

(6) The distribution pipe shall be constructed so that there is access to the piping system for flushing of the piping system.

(f) Construction

(1) A designer shall review the mound wastewater disposal system through the critical stages of construction. Upon completion of construction, the designer shall submit a report in writing to the Secretary including the certification required in §1-303(c) of these rules. Upon completion of plowing of the mound area and prior to the placing of the fill material, the designer shall inspect the site preparations. This shall be specifically addressed in the designer's report. Upon completion of the installation of the distribution piping, the network shall be tested with clean water to assure that distribution is complete and meets the requirements in §1-517 (e)

(2) A plan showing the test locations and any calculations shall be included with the designer’s report.

(3) To prevent compaction, construction equipment shall not be moved across the plowed surface or the effluent dispersal area (see §1-517(b)(7)). However, after placement of a minimum of six (6) inches of sand fill over the plowed area, construction equipment may be driven over the protected surface to expedite construction. Construction and/or plowing shall not be initiated when the soil moisture content is high. If a sample of soil obtained from approximately nine (9) inches below the surface can be easily rolled into a wire, the soil moisture content is too high for construction purposes.

§1-517(f)(4) Mound Wastewater Disposal Systems

(4) Aboveground vegetation shall be closely cut and removed from the ground surface throughout the area to be used for the placement of the fill material. The area shall then be plowed to a depth of seven (7) to eight (8) inches, parallel to the land contour with the plow throwing the soil upslope to provide a proper interface between the fill and natural soils. Tree stumps should be cut flush with the surface of the ground and roots should not be pulled. Once plowing is completed, the area should be fenced to prevent vehicles and equipment from entering the plowed area, unless the fill material is going to be in place within 24 hours of the plowing. If the site cannot be plowed, a backhoe bucket fitted with chisel teeth may be used to "till" the site by creating furrows that are parallel to ground contour.

(5) The area surrounding the mound wastewater disposal system shall be graded to provide diversion of surface run-off waters.

(6) Construction should be initiated immediately after preparation of the soil interface by placing the sand fill. After construction of the distribution system, but prior to covering the distribution system, a designer shall direct the testing of the distribution system. After successful testing of the distribution system, filter fabric shall be installed and the system completed, The entire mound wastewater disposal system is to be covered with topsoil native to the site, or of similar characteristics, to support vegetation found in the area. The installer shall crown the entire mound wastewater disposal system with a cover of soil less permeable than the mound fill, covering with 12" on the sides of the mound. Native soil from the site is normally suitable for cover material, though the top 2 - 4" of this cover must be topsoil. The entire mound shall be seeded or sodded to assure stability of the installation. This grass cover shall be maintained and should be mowed on at least an annual basis.

§1-518 At-grade Systems

(a) At-grade systems may be used on some sites that are not suitable for in-ground systems because of inadequate depths to seasonal high water table, bedrock or impermeable soil. At-grade systems are constructed by tilling the ground surface and placing the crushed stone directly on the tilled surface. The crushed stone is not placed subsurface as in an in-ground system and no sand is placed under the crushed stone as in a mound wastewater disposal system. Figures 5.6 and 5.7 (pages 112 + 113) show the layouts of typical at-grade systems.

(b) Site Requirements:

(1) Sites with either a high groundwater level or soil strata having a percolation rate slower than 60 minutes per inch (mpi) or faster than 1 mpi within 36 inches of natural grade are not suitable for at-grade systems. Also, soils that have bedrock within 48 inches of natural grade are not suitable. The site must be free of these limitations beyond the edge of the fill for a distance of 10 feet on all sides. At-grade systems shall not be located in a depression or swale that could act as a natural surface water collection or runoff area.

(2) Generally, sites with large trees, numerous small trees or large boulders are unsuitable for at-grade systems because of the difficulty in preparing the ground surface and the reduced infiltration area. If no other site is available, all trees shall be cut flush with the ground, leaving the stumps. Stumps shall not be removed as removal of the stumps creates channels where the roots existed and may allow inadequately treated wastewater to reach groundwater or bedrock. A larger area shall be designed if numerous stumps and/or boulders are involved so that sufficient soil surface is available to accept the wastewater.

(3) The maximum slope allowable for at-grade systems is 30% percent, except as permitted on a site specific basis (see §1-502).

(4) Cut sites that meet the other site requirements for at-grade systems are acceptable. Sites with excessive slopes that have received approval from the Secretary for cutting shall receive permit approval when the designer submits a written report stating that the cut(s) has been completed as approved.

(5) Filled sites may be approved by the Secretary for at-grade systems on a case-by-case basis where the existing original soil under the fill meets the other site requirements for at-grade systems.

(6) At-grade systems are not allowed on sites having a percolation rate faster than 1 mpi within the 3 feet of soil below the bottom of the system. Replacing the excessively drained soil with filter sand is not allowed for at-grade systems.

§1-518(b)(7) At-grade Systems

(7) At-grade systems shall comply with the isolation distances in §1-503 of these rules with the leachfield measurements taken from the edge of the crushed stone.

(c) Site Evaluation:

The site shall be evaluated in accord with §1-506 of these rules.

(d) Design:

(1) A designer shall prepare a one-foot interval contour map having a scale of 20 feet per inch or less. In addition, all of the information in §1-302 of these rules shall be submitted.

(2) The loading rate shall be based on the second slowest percolation rate using the following formula: (3/√t) (0.8) where t is the second slowest percolation rate in minutes per inch. The maximum loading rate shall be 1.0 gallons per day per square foot. The effective infiltration area is the area upon which at least 6 inches depth of crushed stone is placed. It does not include the downslope area of the crushed stone that is less than 6" thick, the side slope fill areas or the portion of the crushed stone that is upslope of the distribution pipe on sites with slopes of greater than 3 percent. All at-grade system sizing calculations shall be submitted with the application.

(3) At-grade systems shall be laid out parallel to ground contour and should be designed to be long and narrow to minimize the linear loading rate. The maximum width of the effective infiltration area shall be 6 feet and the minimum width of the effective infiltration area shall be 3 feet.

(4) A minimum length to width ratio of 2:1 shall be provided for at-grade systems. The system length and width shall be determined by measuring from the outer edges from the six-inch depth of the crushed stone. The width dimension includes the separation distance (6 ft. minimum) between individual infiltration areas for at-grade systems having more than one infiltration area. The width does not include the two feet of crushed stone upslope from the distribution pipe for at-grade systems on slopes of greater than 3 percent. See figure 5.7 (page 113)

(5) A minimum of 6 inches of crushed stone shall be placed under the distribution pipe and at least 2 inches of crushed stone shall be placed above the crown of the distribution pipe. Filter fabric shall be placed over the top of the crushed stone. The crushed stone shall be covered with a minimum of 12 inches of permeable soil, with a maximum of 18" of soil, the upper 2 to 4 inches of which shall be topsoil and the remainder of a fine sandy loam to medium

sand texture. All four sides of the fill area shall be designed to slope away at a pitch that is not steeper than 1:3. The design shall indicate that a vegetated cover is to be maintained over all portions of the system.

(6) The distribution pipe shall be placed in the center of the effective infiltration area on sites with less than 3 percent slopes (figure 5.6, page 112) and placed at the upper side of the effective infiltration area on sites with slopes that are greater than 3 percent. (figure 5.7, page 113).

(7) On sites with slopes that are greater than 3 percent, only the area directly under the distribution pipe to the downslope limit of the 6-inch depth of crushed stone shall be used to meet the effective infiltration area square footage requirement (figure 5.7, page 113).

(8) All at-grade systems shall be pressurized and dosed by pump or siphon as described in §1-510 of these rules. Pressure distribution hydraulic calculations including but not limited to friction loss, elevation head and pump/siphon sizing shall be included with the application.

(9) Where more than one effective infiltration area is used, there shall be at least 6 feet of separation between the tail edges of the crushed stone in each effective infiltration area (figure 5.7, page 113). Primary and replacement infiltrative areas shall not be interfingered unless the areas are at least 25' apart, as measured from the edge of the crushed stone.

(10) At-grade systems receiving more than 2,000 gpd of design wastewater flow shall require a hydrogeologic analysis showing that a minimum of 36 inches of unsaturated native soil is maintained between the bottom of the crushed stone and the induced groundwater mounding beneath the system. At-grade systems that are closer than 25 feet to each other as measured from the edge of stone aggregate shall be evaluated as one system for purposes of determining the need to conduct a hydrogeologic analysis.

(11) For at-grade systems receiving 3,000 gpd or more of design wastewater flow, dual-alternating at-grade systems shall be required. The dual alternating system requirement applies if either the primary or the replacement systems have design flows of 3,000 gpd or more.

(12) At-grade systems that are closer than 25 feet to each other as measured from the edge of stone aggregate shall be evaluated as one system for purposes of determining the need to have dual alternating at-grade systems. Exception: A hydrogeologic analysis may be used to demonstrate that systems located less than 25' apart are hydraulically independent.

§1-518(d)(13) At-grade Systems

(13) Where primary and replacement at-grade systems are placed next to each other, the systems shall be at least 10 feet apart when placed end-to-end, as measured from the stone aggregate, and at least 25 feet apart when placed in the same flow path as measured from the edge of the filled area.

(14) A surface water diversion swale shall be constructed upgradient of all at-grade systems on sites with slopes that are greater than 3 percent.

(15) The area 25 feet downgradient of the at-grade system as, measured from the lower edge of the fill, shall not be disturbed by any construction activity including, but not limited to, building construction, roadways and parking areas.

(16) Where subsurface drains (including building perimeter drains) are located downslope of an at-grade system, the crushed stone shall be at least 75' from the drain.

(e) Construction Practices:

(1) The surface water diversion swale (mandatory for sites with slopes of more than 3 percent) shall be installed prior to constructing the at-grade system to keep surface water runoff away from the system while it is under construction.

(2) Construction of the at-grade system and/or tilling shall not take place when the soil moisture is high in the system area. If the soil at 9 inches below grade can be rolled into the shape of a wire, the soil moisture content is too high for construction to begin.

(3) To prevent compaction, construction equipment shall not be moved across and downslope of the at-grade system area before or after tilling.

(4) Vegetation shall be cut close to the ground and removed from the area to be tilled. Tree stumps shall be cut flush with the ground and the roots left in place. On wooded sites, the forest litter shall be raked off if more than an inch thick. The at-grade system area shall be tilled, preferably by mold board or chisel plow to a depth of 6 to 8 inches, parallel to the ground contour. During plowing, the soil should be thrown upslope to provide a proper interface between the soil and stone aggregate. If the site cannot be plowed, a backhoe bucket fitted with chisel teeth may be used to "till" the site by creating furrows that are parallel to ground contour.

§1-518(e)(5) At-grade Systems

(5) The forcemain may be installed before tilling or after tilling when the forcemain enters the system at the upslope side of the system. When the forcemain enters the system at the downslope side, the forcemain should be installed before tilling. If practical, forcemains should connect to the distribution pipe from the ends of the distribution pipe or from the upslope side of the system. In either situation, the forcemain shall be installed by working from the upslope edge of the system.

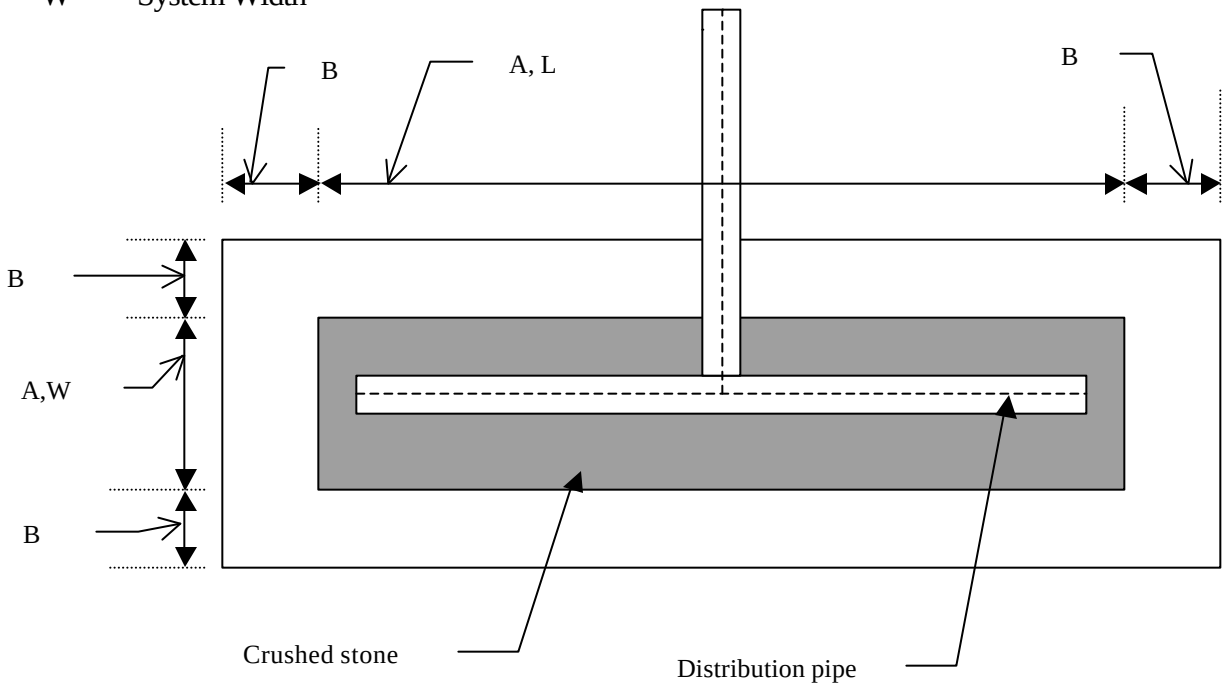
Note: at-grade system diagrams are shown on the next two pages

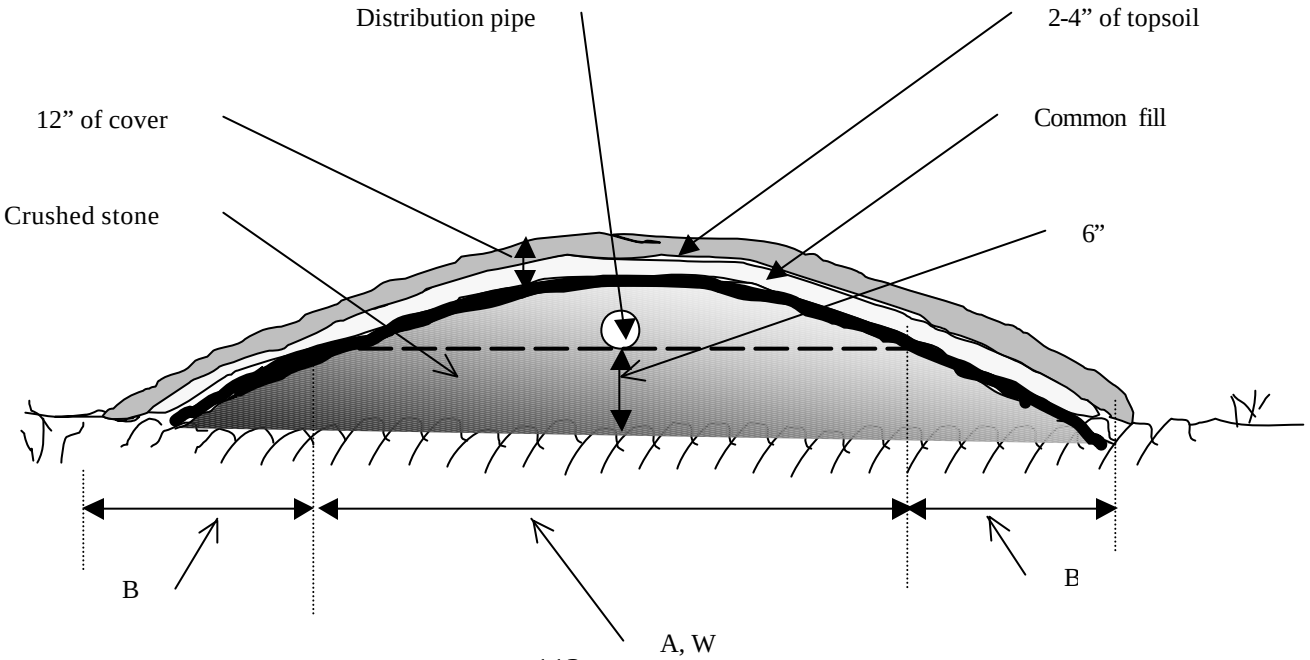
§1-518 At-grade Systems

Figure 5.6

Plan and Cross Sectional Views of an At-Grade System Having One Infiltration Area on a Level Site (less than 3 percent).

A Effective Infiltration Area System Length
B. Side Slope (1:3)
L Length
W System Width

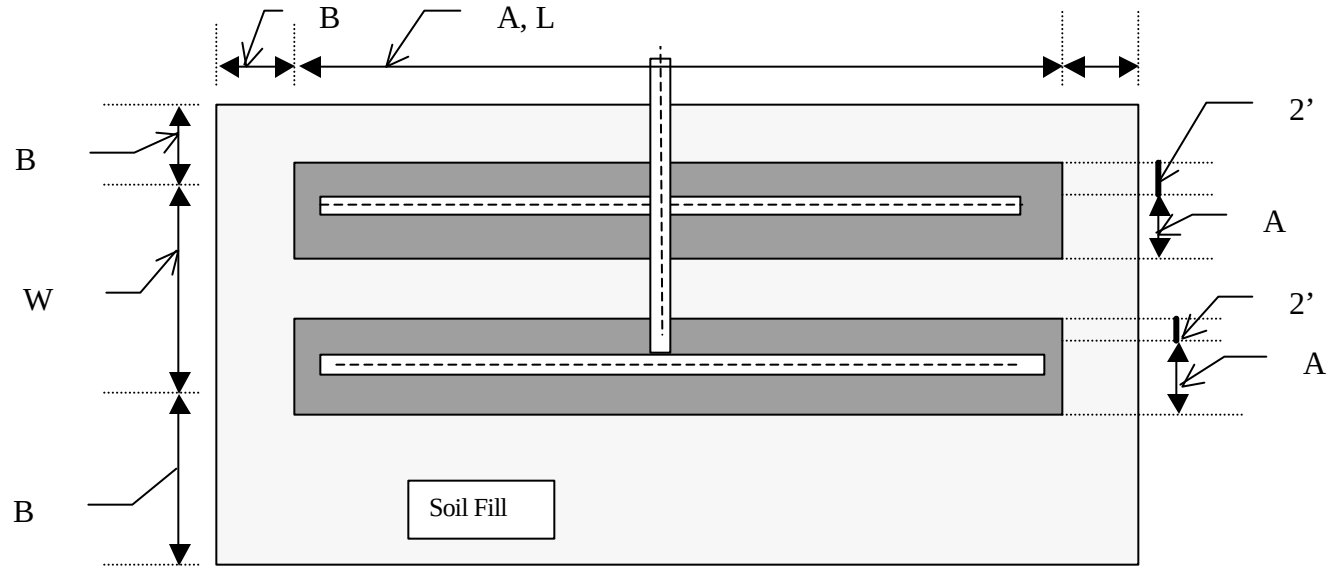


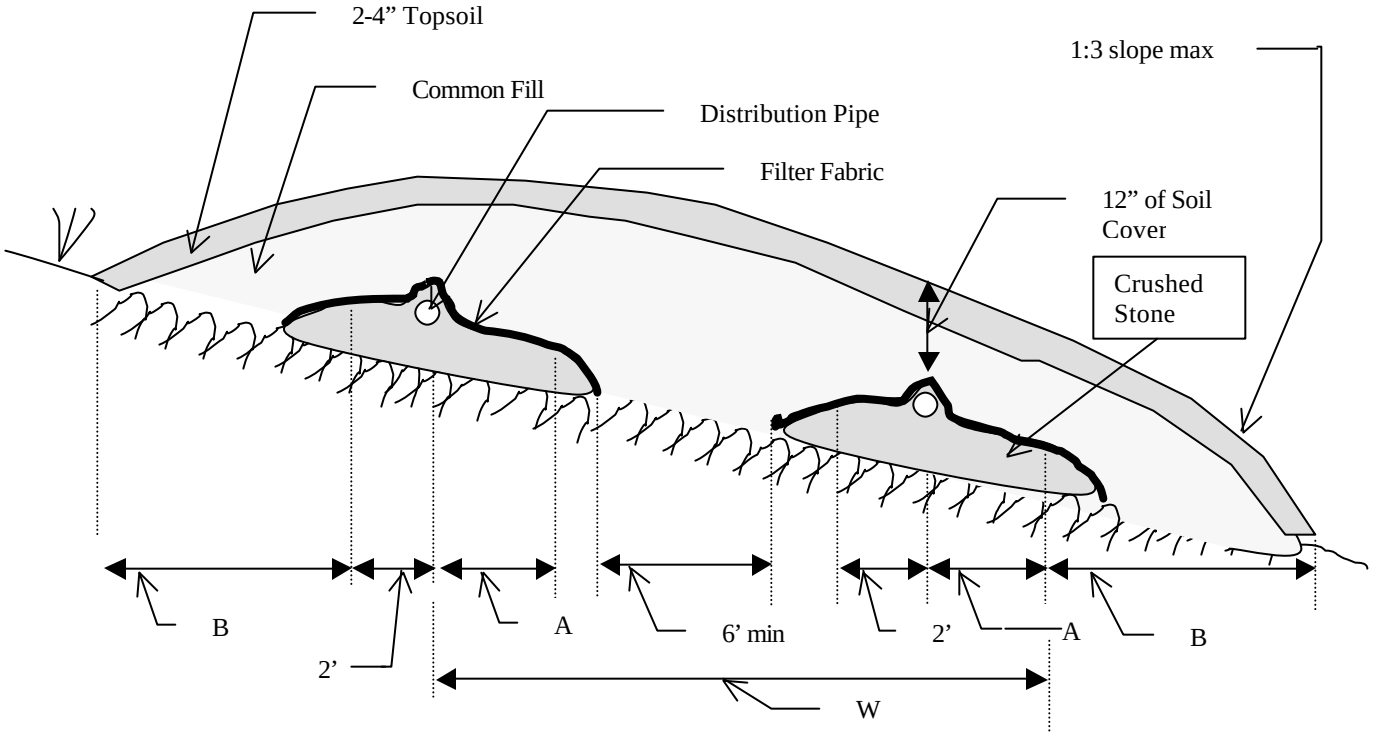


§1-518 At-grade Systems

Figure 5.7

Plan and Cross Sectional Views of an At-Grade System with Two Infiltrative Areas on a Sloping Site (greater than 3%).





A Effective Infiltration Area (min. of 6” of stone)
B Side Slope (1:3)
L System Length
W System Width

1-518(e)(6) At-grade Systems

(6) Upon completion of the tilling and before placing the stone aggregate, a designer shall inspect the site preparations.

(7) Construction should begin immediately after the tilling by placing the stone aggregate. The pressure distribution pipe shall be laid level on top of the stone and caps installed at the ends of the pipe. Upon completion of the distribution piping, the designer shall test the system with clean water. The test shall show that a minimum pressure of 2.3 feet of head is present at the ends of the pipe and that the distribution requirements in §1-510 are met. After connecting the distribution pipe to the forcemain, the distribution pipe shall be covered with at least 2 inches of clean stone aggregate. The stone aggregate shall be covered completely with filter fabric.

(8) The filter fabric shall be covered with a minimum of 12 inches of soil but not more than 18 inches, with the upper 2 to 4 inches of soil being topsoil and the remainder of the fill being of a fine sandy loam to medium sand texture. The soil cover shall be placed at a maximum slope of 1:3. A vegetated cover free of large brush and trees shall be maintained over the system.

(9) Prior to use of the at-grade system, a designer shall submit a written report that includes the certification required by section §1-303(c) of these rules. The report shall specifically address the inspection of the site preparations and include numerical results of the orifice discharge rate comparison and pressure test.

§ 1-519 Sand Filters

Sand filters are intended for use in conjunction with a filtrate disposal system (see §1-520). They allow for a reduction in the final disposal requirements due to the additional treatment of the wastewater. This subsection addresses the use of two different sand filter types: the intermittent sand filter and the recirculating sand (gravel) filter.

(a) General Requirements

(1) Wastewater Strength

(A) Intermittent sand filters may be used for residential and for other low strength domestic wastewater.

(B) Recirculating sand filters may be used for low and moderate strength wastewater.

(C) Wastewater from a septic tank shall be considered low strength when it meets the following standard:

(i) BOD_5<230 mg/l;

(ii) TSS < 150 mg/1; and

(iii) Oil&Grease <25 mg/1.

(D) Wastewater from a septic tank shall be considered moderate strength when it meets the following standard:

(i) BOD_5 <400 mg/1;

(ii) TSS < 150 mg/1; and

(iii) Oil&Grease <25 mg/1

(2) Container Design & Construction

(A) The filter container shall be water tight to prevent groundwater from infiltrating into the filter container and to prevent wastewater exfiltration from the filter container.

(B) Reinforced concrete shall be used, unless other materials having equivalent function, workmanship, watertightness and at least a twenty (20) year service life are specified.

§1-519(a)(2)(C) Sand filters

(C) Flexible membrane liner materials may be used, provided they comply with the following requirements:

(i) they have properties that are at least equivalent to thirty (30) mil un-reinforced polyvinyl chloride;

(ii) they have field repair instructions and extra liner material that are provided to the purchaser with the liner;

(iii) they have factory fabricated "boots" suitable for field bonding onto the liner to facilitate the passage of piping through the liner in a waterproof manner; and

(iv) they are compatible with the wastewater being treated.

(D) All tanks associated with a sand filter, including septic and dosing tanks and any pumping vaults, shall have an at-grade access provided by a watertight manhole or riser not less than eighteen (18) inches in diameter, unless otherwise approved by the Secretary.

(E) After installation all components, including septic tanks, pump chambers, recirculation tanks and filter containers, shall be tested by filling to a point at least two inches, but not more than three inches, above the point of riser connection to the top of the tank, chamber, or container. During the test there shall not be a measurable leakage over a twenty-four (24) hour period.

(F) Notwithstanding subdivision (a)(2)(E) above, the Secretary may approve other leakage testing methods.

(3) Siting Requirements

(A) Filters must be protected from both groundwater and surface water infiltration.

(B) For the purpose of determining the minimum isolation distance to other site features, the filter container shall be comply with the isolation distances set forth in §1-503 for septic tanks.

(4) Monitoring

(A) Wastewater Quality: The sand filter shall be designed for wastewater sample collection before and after the sand filter.

§1-519(a)(4)(B) Sand filters

(B) Wastewater Quantity: All sand filters shall have the capability of measuring and recording the wastewater flow and the flow to the filter.

(5) Annual inspections of each sand filter by a designer are required. A written report shall be submitted to the Secretary within 30 days of the inspection. At a minimum, the following items shall be addressed in the inspection report:

(A) use and age of system including the average daily flows;

(B) the recirculation ratio;

(C) mechanical or electrical malfunctions;

(D) neglect or improper use; and

(E) flushing of the laterals.

(6) Operation & Maintenance Manuals: A user's manual for the sand filter shall be developed and/or provided along with an "as-built" drawing(s) at the time that the sand filter installation is completed. These materials, at a minimum, shall contain the following information:

(A) diagrams of the components and their location;

(B) an explanation of how the sand filter functions, operational expectations, and owner responsibility;

(C) specifications of the electrical and mechanical components installed (occasionally components other than those specified on the plans are used);

(D) names and telephone numbers of the designer, the local health authority, the supplier/installer, and/or the management entity to be contacted in the event of a failure;

(E) information on the periodic maintenance requirements of the sand filter, including the septic tank, the dosing and recirculating/mixing tanks, the sand filter unit, the pumps, the switches, the alarms, the filtrate disposal system, and other information as appropriate;

(F) information on "trouble-shooting" common operational problems that might occur. This information should be detailed and complete as needed to assist the system owner make accurate decisions about when and how to attempt corrections of operational problems and when to call for professional assistance;

(G) information on the disposal of discarded filter media in accord with state and local requirements; and

(H) for proprietary sand filter units, a complete maintenance and operation document shall be developed and provided by the manufacturer. This document shall include all the appropriate items mentioned above, plus any additional general and site specific information useful to the system owner, and/or the maintenance person.

(b) Intermittent Sand Filters: In addition to the applicable requirements of §1-519(a), the following system specific criteria shall apply to the design of intermittent sand filters:

(1) Underdrain system

(A) The base of the filter container shall be level or constructed at a grade of one (1) percent or less towards the underdrain piping.

(B) The underdrain piping shall be installed in the interior of the filter container at the lowest elevation. The piping shall be on a grade of one (1) percent or less to the point of passage through the filter container.

(C) The underdrain piping and filter container bottom shall be covered with a minimum of six (6) inches of clean washed ¾" - 1½" stone.

(D) Other types of underdrain systems may be proposed and approved after review by the Secretary.

§1-519(b)(2) Sand filters

(2) Filter Media

(A) A minimum of twenty-four (24) inches of approved sand filter soil media shall be placed over the underdrain system. The sand filter soil media complying with the specification listed below shall be approvable:

Sieve #	Opening (mm)	Percent Passing Number (by Weight)
3/8	9.500	100
4	4.750	95 - 100
8	2.380	80 - 100
16	1.190	45 - 85
30	0.590	15 - 60
50	0.297	3 - 15
100	0.149	0 - 4

(B) Other filter media may be proposed, provided a designer submits to the Secretary technical justification for the substitution of materials. The Secretary shall review and may approve the proposed substitution.

(C) The size of the sand filter shall be based on a maximum loading rate of 1.25 gallons per day per square foot.

(3) Distribution System

A pressurized distribution system shall be constructed in accord with the following requirements:

(A) above the filter media there shall be a minimum of three (3) inches of washed, clean ¾" to 1½" stone aggregate below the distribution laterals, and sufficient stone above the laterals equal to or covering the orifice shields to provide a smooth even cover;

(B) distribution laterals shall be spaced on maximum thirty (30) inch centers. Orifices shall be placed such that there is at least one orifice for each six (6) square feet of sand surface area;

(C) the ends of the distribution laterals shall be designed and constructed with a means to perform flushing of the piping, collectively or individually, through the operation of a non-corroding and accessible valve. The flushed wastewater must be discharged to the septic tank or into the sand filter;

(D) the diameters of the distribution manifold and laterals shall not be less than one half (1/2) inch diameter and shall be constructed of schedule 40 or 80 (or equivalent) piping;

(E) the orifices shall not be less than 1/8" in diameter. All orifices shall be covered by a removable, protective, durable, non-corroding shield; and

(F) other types of distribution systems may be proposed by a designer and used upon approval by the Secretary.

(4) Filter Dosing

(A) The dose volume shall not exceed ten (10) percent of the daily design flow.

(B) The system shall not dose more than once in a 30-minute period.

(C) Head calculation shall include maximum static lift, pipe friction and a residual head of five (5) feet at the furthest orifice.

(D) There shall be no more than a ten (10) percent flow variation between any two orifices.

(E) The pumping system shall be protected from solids by a filter apparatus that will not allow the passage of solids larger in size than 1/8 inch.

(F) The pump station designed to dose the filter shall be designed with storage equal to the one (1) day design flow above the high water alarm.

(5) Internal Pump Option

(A) Where the effluent from a sand filter is to be discharged by means of a pump to another treatment unit, a distribution unit, or to an leachfield, the design and construction of the filter may include provisions for an internal pump station, providing the following conditions are met:

(i) the location, design, and construction of the pump station do not conflict with the requirements of these rules for design, construction and operation of a sand filter system;

§1-519(b)(5)(A)(ii) Sand filters

(ii) the pump and related apparatus shall be housed in a corrosion resistant vault designed to withstand the stresses placed upon it so that it will not allow the migration of drain media, sand, or underdrain media to its interior. The vault shall have a durable, attached floor. The vault shall provide watertight access to finished grade with a diameter large enough to remove, replace, or service any equipment in the vault shall and be designed to receive treated effluent from an elevation equal to that of a gravity discharging sand filter;

(iii) the depth of underdrain media and the operating level of the pump cycle and alarm shall not allow effluent to come within two inches of the bottom of the sand filter media. The pump off level shall not be lower than the invert of the perforations of the underdrain piping; and

(iv) an internal sand filter pump shall be electronically linked to the sand filter dosing apparatus in such a manner as to prevent wastewater from entering the sand filter in the event the internal sand filter pump fails.

(c) Recirculating Sand (Gravel) Filters

Recirculating Sand Filters are recommended for domestic wastewater of low to moderate strength. They are not recommended for seasonal residences or projects designed for periodic use. Projects that will experience periodic shut downs should take into account the cooling effect on the recirculating effluent and the effect of the filters going anaerobic and becoming odoriferous as a result.

In addition to the applicable requirements of §1-519(a), the following standards apply to recirculating sand filters:

(1) Underdrain system

(A) The base of the filter container shall be level or constructed at a grade of one (1) percent or less towards the underdrain piping.

(B) The underdrain piping shall be installed in the interior of the filter container at the lowest elevation. The piping shall be on a grade of one (1) percent or less to the point of passage through the filter container.

§1-519(c)(1)(C) Sand filters

(C) The underdrain piping and filter container bottom shall be covered with a minimum of six (6) inches of washed clean ¾" - 1½" stone aggregate.

(D) Other types of underdrain systems may be proposed and approved after review by the Secretary.

(2) Filter Media

(A) A minimum of thirty-six (36) inches of approved filter media shall be placed above the underdrain system.

(B) The filter media shall be a soil material complying with the following sieve analysis:

Sieve	Opening (mm)	Percent Passing Number (by Weight)
3/8	9.500	100
4	4,750	60-100
8	2.380	7 - 75
16	1.190	0 - 5
30	0.590	0 - 3
50	0.297	0 - 2

(C) Other filter media may be proposed provided a designer submits to the Secretary technical justification for the substitution of materials. The Secretary shall review and may approve the proposed substitution.

(D) The size of the recirculating sand filter shall be based on either a hydraulic loading rate or wastewater strength as described below. The maximum loading rate is the lesser of subdivision (i) or (ii) below.

(i) The maximum hydraulic loading rate shall be 5 gallons per day per square foot.

(ii) The maximum loading rate based on waste strength, (expressed as gallons per square foot per day) shall be determined using the formula:

$$\text{Loading Rate (gal/sqft/day)} = \frac{5 \text{ gal/sqft/day} \times 230 \text{ mg/l}}{BOD_5 \text{ mg/l}}$$

where BOD_5 equals the wastewater strength of the septic tank effluent for the particular project. In particular, non-residential wastewater may exceed 230 mg/l of BOD_5.

(3) Distribution System

A pressurized distribution system shall be constructed in accordance with the following requirements:

(A) there shall be a minimum of three (3) inches of washed, clean ¾" to 1½" stone aggregate that is below the distribution laterals and above the filter media, and sufficient stone covering the orifice shields to provide a smooth even cover;

(B) distribution laterals shall be spaced on maximum twenty-four (24) inch centers. Orifices shall be placed such that there is at least one orifice for each four (4) square feet of sand surface area;

(C) the ends of the distribution laterals shall be designed and constructed with a means to perform flushing of the piping, collectively or individually, through the operation of a non-corroding and accessible valve. The flushed wastewater must be discharged to the septic tank or into the sand filter;

(D) the diameters of the distribution manifold and laterals shall not be less than one half (1/2) inch diameter and shall be constructed of schedule 40 or 80 (or equivalent) piping;

(E) the orifices shall not be less than 1/8" in diameter. All orifices shall be covered by a removable, protective, durable, non-corroding shield; and

(F) other types of distribution systems may be proposed by a designer and used upon approval by the Secretary.

(4) Recirculation/Dilution Tank and Dosing: The recirculation tank receives septic tank effluent and overflow from the filter. The recirculation tank shall have sufficient capacity to provide one (1) day's emergency storage above a high water alarm level. The recirculation tank and dosing system shall comply with the following requirements:

(A) the system shall be designed with a minimum recirculation ratio of not less than four (4). The recirculation ratio is the daily volume of recycled effluent divided by the design flow;

§1-519(c)(4)(B) Sand filters

(B) the filter should be wetted 48 times per day and not more than once in a thirty (30) minute period. The minimum resting period between doses shall be twenty (20) minutes;

(C) the minimum wet volume in the recirculation tank should be at least eighty (80) percent of the design flow;

(D) the system shall be designed so that one hundred (100) percent of the filter effluent returns to the recirculation tank when the liquid volume of the tank is less than eighty (80) percent of the design flow. In addition to a high water alarm, a low water alarm shall be designed and installed to shut down the pump and notify the owner of the system when the liquid level of the recirculation tank is less than fifty (50) percent of the design flow;

(E) head calculations shall include maximum static lift, pipe friction and a residual head of five (5) feet at the furthest orifice;

(F) there shall be no more than a ten (10) percent flow variation between any two orifices; and

(G) The pumping system shall be protected from solids by a filter apparatus that will not allow the passage of solids larger than 1/8" in diameter.

§1-520 Filtrate Effluent Disposal Systems

Filtrate effluent disposal systems may be used when some form of treatment in addition to that which occurs in the septic tank is used as part of the wastewater system. The loading rates and the isolation distances required from the bottom of the leachfield to bedrock and the seasonal high water table may be reduced when applying treated effluent with less than 30 mg/l of BOD_5 and less than 30 mg/l of TSS.

(a) Filtrate effluent disposal systems shall be designed to hydraulically transmit the filtrate away from the filtrate disposal system. The minimum site conditions for filtrate effluent disposal systems are the same as for wastewater systems using only septic tanks for treatment prior to disposal of the wastewater.

(b) All types of soil-based disposal systems permitted by §1-511, §1-512, §1-517, and §1-518 are acceptable as filtrate effluent disposal systems. Design and construction requirements related to methods, materials, and location are unchanged except as specifically noted in this section.

§1-520(c) Filtrate disposal systems

(c) The following requirements refer to design variations based on the type of soil-based disposal system:

(1) filtrate effluent disposal systems may be constructed in soils having a percolation rate faster than 120 minutes per inch. Section 1-516(e) shall be followed for soils with a percolation rate faster than 1 minute per inch;

(2) filtrate effluent disposal systems may be designed with a loading rate of up to twice that permitted for the system when septic tank effluent is applied; and

(3) the linear loading rate of any filtrate effluent disposal system shall be calculated using a site specific hydrogeologic analysis that demonstrates that the separation from the bottom of the leachfield to the induced groundwater mounding is met, except that systems using the prescriptive approach with a linear loading rate that does not exceed 4.5 gallons per day may be permitted without a hydrogeologic analysis. The analysis may be a desktop hydrogeologic analysis or based on site specific testing. The hydrogeologic analysis shall demonstrate that:

(A) the distance between the bottom of the leachfield and the seasonal high water table or induced groundwater mounding, as specified in §1-511(f), §1-512(g), §1-517(a)(6), or §1-518(d)(10) is maintained. This distance may include both naturally occurring soil and approved fill material; and

(B) the induced groundwater mounding is at least one (1) foot below grade at the downhill toe of the filtrate effluent disposal system, except for systems using a performance based design that must maintain at least 6” from the induced groundwater mounding to the ground surface.

Note: Filtrate effluent disposal systems located more than twenty five (25) feet apart may be considered hydraulically isolated from each other for the purpose of this subsection.

§1-521 Disposal of Wastes from Pump-Out Facilities for Marine Sanitary Holding Tanks

(a) Where direct hookup to a wastewater treatment plant is available or site conditions permit, disposal of wastes from pump-out facilities shall be in conformance with the normal operational requirements of this Subchapter.

(b) Where it is not feasible to comply with subsection (a) above, a holding tank may be used.

§1-521 Disposal of Wastes from Pump-Out Facilities for Marine Sanitary Holding Tanks

(c) Holding tank design shall be in accord with §1-522 of these rules.

§1-522 Holding Tanks

(a) The Secretary shall approve the use of sewage holding and pumpout tanks when it has been determined that :

(1) the existing or proposed building(s) or structure(s) to be served by the holding tank are publicly owned;

(2) the plan for construction and operation of the holding tank will not result in a public health hazard or environmental damage;

(3) a designer demonstrates that an economically feasible means of meeting current standards is significantly more costly than sewage holding and pumpout tanks, based on a projected twenty (20) year life of the project; and

(4) the design flows do not exceed 600 gallons per day.

(b) A holding tank may also be used for a project that is eligible for a variance under §1-308, whether or not the project is publicly owned, where the existing wastewater system has failed, or is expected to fail, and in either instance, where there is no other cost feasible alternative;

(c) When a holding tank is proposed for use, a designer shall submit all information necessary to demonstrate that the holding tank will comply with the following requirements:

(1) the holding tank shall be capable of holding at least 14 days of the expected flow from the building;

(2) the tank shall be constructed of durable materials that are appropriate for the site conditions and the nature of the sewage to be stored;

(3) the tank, any piping connected to the tank, and all access structures connected to the tank shall be watertight. The tank shall be leakage tested prior to being placed in service;

(4) the tank shall be designed to protect against floatation when the tank is empty, such as when it is pumped;

(5) the tank shall be equipped with audio and visual alarms that are triggered when the tank is filled to 75% of its design capacity;

§1-522(c)(6) Holding Tanks

(6) the tank shall be located so that it can be reached by tank pumping vehicles at all times when the structure is occupied; and

(7) the analysis supports a claim under subdivision (a)(4) of this section.

(d) The permit application shall specify the method and expected frequency of pumping.

(e) Any building or structure served by a holding tank shall have a water meter, or meters, installed that measures all water that will be discharged as wastewater from the building or structure.

(f) Any permit issued for the use of a holding tank will require a designer to periodically inspect the tank, visible piping, and alarms. The designer shall submit a written report to the Secretary detailing the results of the inspection and any repairs or changes in operation that are required. The report shall also detail the pumping history since the previous report, giving the dates of pumping and the volume of wastewater removed. The frequency of inspections and reports shall be stated in the permit issued for the use of the tank, but shall be no less frequent than once per year. The designer shall also inspect the water meter or meters and verify that they are installed, calibrated, and measuring all water that is discharged as wastewater. The designer shall read the meters and compare the metered flow to the pumping records. Any significant deviation shall be noted in the report and explained to the extent possible.

(g) The owner of a holding tank shall maintain a valid contract with a licensed wastewater hauler at all times. The contract shall require the licensed wastewater hauler to provide written notice of dates of pumping and volume of wastewater pumped. Copies of all such notices shall be submitted with the written inspection reports.

Subchapter 6 - Municipal Regulation of Potable Water Supplies and Wastewater Systems

' 1-601 Applicability

(a) This Subchapter sets forth the minimum standards for municipal ordinances that regulate soil-based disposal systems, the Secretary=s approval process for such ordinances, and the establishment of statewide, uniform, minimum technical standards by July 1, 2007.

' 1-602 Minimum Standards

(a) All ordinances adopted by municipalities under the authority of 24 V.S.A. chapters 59 and 102 that regulate soil-based disposal systems:

(1) shall use the design, construction, operation, and maintenance standards and criteria for potable water supplies and wastewater systems set forth in Subchapter 5 of these rules and the Vermont Water Supply Rules; or a municipality may adopt the standards and criteria for potable water supplies and wastewater systems contained in the Small Scale Wastewater Treatment and Disposal Rules, effective August 8, 1996. Regardless of which set of rules is used, a municipality may not adopt or amend a sewage ordinance or a zoning bylaw that imposes technical standards or criteria that are more stringent than the rules on which they are based,

(2) may allow for variances from the standards and criteria of Subchapter 5, if done in accordance with the criteria of §1-308 of these Rules;

(3) may allow the use of innovative/alternative systems or products that have been authorized for use by the Secretary provided that the municipality has the authority to ensure compliance with all maintenance and operational requirements contained in the Secretary's authorization;

(4) shall specify the municipal officials responsible for implementation and enforcement of the ordinance;

(5) shall regulate all new, modified or replacement soil-based disposal systems located within the municipality; and

(6) shall contain references to the authority to enforce the requirements of the ordinance.

' 1-603 Approval of Ordinances

(a) No ordinance or ordinance amendment adopted under 24 V.S.A chapters 59 and 102 shall take effect until the municipality has submitted the ordinance or amendment to the Secretary for a determination of its compliance with the minimum standards set forth in §1-602 and the Secretary has approved, in writing, the ordinance or amendment.

§1-604 Statewide Uniform Minimum Technical Standards

(a) After June 30, 2007, those provisions of existing municipal ordinances and zoning bylaws that establish technical standards and criteria for the design, construction, operation, and maintenance of potable water supplies and wastewater systems are superceded (i.e. no longer in effect) by the technical standards and criteria of these rules and the Vermont Water Supply Rules,

(b) After June 30, 2007, municipalities that have been delegated the authority to implement the permit program established by these rules may continue to have ordinances and zoning bylaws that regulate potable water supplies and wastewater systems only to the extent that such ordinances and bylaws:

(1) eliminate some or all of the permit exemptions contained in this chapter; or

(2) establish requirements for the processing of permits, including but not limited to, informal appeals of municipal acts or decisions, suspension or revocation of permits, and other procedural requirements, that are consistent with the provisions of these Rules and the Vermont Water Supply Rules.

§1-605 Existing Ordinances

Municipal ordinances relating to wastewater systems that were approved by the Commissioner of the Vermont Department of Health before July 1, 1984 shall remain in effect until amended in accordance with this Subchapter, withdrawn, or superceded by these Rules.

APPENDIX 1-A

DESIGN GUIDELINES

1-A-01 Introduction

Following are guidelines for use in the design of systems subject to the Environmental Protection Rules, Chapter 1. Designers are encouraged to use equally or more effective technologies or practices in the design of systems under these guidelines. The Agency may approve different designs that are based on current technology and that have been demonstrated as effective. The Agency may approve a demonstration project designed to test a different design. The designer must support any request for a different approach. Depending on the degree of difference from the guidelines, approval may be conditioned upon periodic inspections to determine that the project is functioning as designed. Any design for a project where a municipality will ultimately be responsible for the operation and maintenance of the project shall include municipal acceptance of the system. While there are no specific technical requirements for any particular design detail, the Secretary will not approve any design that is not based on accepted scientific and engineering principles, except for a demonstration project.

> Note: Although these guidelines have been subject to review and comment in a rulemaking process, they remain merely guidelines, not binding rules, in order to allow for flexibility in the design of those aspects of sewers, sewage collection systems and lift stations that are addressed in this appendix.

1-A-02 Building Sewers

The building sewer is that part of the drainage system extending from a building drain to a public sewer, private sewer, septic tank system, or other treatment system. A sewer serving one building will be considered a building sewer. All other sewers will be considered a collection sewer.

(a) Materials: The building sewer shall be constructed in a manner that will prevent leaking, breaking or clogging. Acceptable materials for the sewer are rubber-ring-jointed or cast iron (CI) sewer service pipe. Other materials may be proposed for acceptance by the Secretary.

(b) Sizing & Slope: Building sewers shall be sized based on procedures outlined under 1-A-02. Minimum building sewer size is 4 inches and minimum slope is 1/4 inch per foot.

(c) Connection to a collection sewer: Building sewers discharging to a collection sewer shall be connected through a manhole constructed in accordance with 1-A-03(l) or with a wye fitting so as to direct flow and minimize in-line turbulence.

(d) Cleanouts: Cleanouts shall be provided at each horizontal change in direction of the building sewer greater than 45 degrees and at intervals of not more than 100 feet.

Building sewer changes in direction that exceed 45 degrees should be made with two 45 degree ells or long sweep fittings. Manholes are acceptable in lieu of cleanouts. Where building sewers to be installed at a depth of less than 3 feet under driveways are anticipated, extra heavy cast iron or other high strength pipe acceptable to the Secretary shall be required.

(e) Leakage: Building sewers shall meet the leakage standards prescribed in Section 1-A-03(k).

1-A-03 Sewer Collection Systems

(a) A sewer collection system is that system of sewers that transport wastewater from building sewers to the wastewater treatment/disposal system.

(b) No connections of roof drains, area drains, foundation drains, cellar drains or other clean water sources or any storm drains will be allowed to building or collection sewers.

(c) Building and collection sewers carrying raw or untreated wastewater shall be sized as follows:

(1) Collection sewers shall be a minimum of 6" diameter.

(1) The flow rate to be used in sizing the sewer shall be based on the full occupancy design flows for the facilities connected as derived from §1-503

(2) times the following factors.

(A) For design flows less than l0,000 gpd, a factor of 5.

(B) For design flows over l0,000 gpd, a factor derived from Table 1-A-1

TABLE 1-A-1
Peaking Factors

Design Flow	Peaking Factor
10,000 gpd	4.2
100,000 gpd	3.2
500,000 gpd	3.2
l, 000, 000 gpd	3.0

(3) Sewers shall be sized for the above derived flow rate to provide a minimum velocity of 2 feet per second when flowing full using the Kutter formula or other acceptable formulae and friction coefficients appropriate for the pipe materials proposed, considering surface deterioration over the expected useful life of the pipe.

(d) Depth: In general, sewers should be sufficiently deep to receive sewage from basements and to prevent freezing. A bury depth of at least four feet should be maintained. This depth should be increased to at least five feet in areas to be plowed during winter months. When these depths cannot be maintained without significant expense, the designer may propose less depths with mitigating measures to protect the sewer.

(e) Slope, Velocity: All sewers shall be designed and constructed to provide mean velocities, when flowing full, of not less than 2.0 feet per second. Regardless of the formula used or friction factors used in the design of the sewers, all sewers shall be installed with at least the slopes shown in Table 1-A-2

TABLE 1-A-2
Minimum Slopes

Pipe Size (inches)	Slope (feet/l00 feet)
6”	0.60
8"	0.40
10"	0.28
12"	0.22
15"	0.15

Sewers shall be laid with uniform slope and straight alignment between manholes. Where velocities greater than 15 feet per second are attained, special provisions shall be made to protect against displacement by erosion and shock.

Sewers on 20 percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

(1) not over 36 feet center to center on grades 20 percent and up to 35 percent;

(2) not over 24 feet center to center on grades 35 percent and up to 50 percent; and

(3) not over 16 feet center to center on grades 50 percent and over.

(f) When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method

for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

(g) Sewer extensions should be designed for projected design flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension. The Agency may require a schedule for future downstream sewer relief.

(h) Materials: Generally, rubber-ring-jointed PVC, AC or ductile iron (DI) gravity sewer pipe of the proper class is acceptable. Other materials may be approved by the Secretary .

(1) Sewer joints shall be designed to minimize infiltration and to prevent the entrance of roots throughout the life of the system.

(2) All sewers shall be designed to prevent damage from superimposed loads. Proper allowance loads on the sewer shall be made because of the width and depth of trench. Where necessary to withstand extraordinary superimposed loading, special bedding, concrete cradle or special construction may be used.

(i) Trenching: Ledge, rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches below and on each side of all pipe(s).

(j) Bedding:

(1) Bedding classes A, B, or C, as described in American Society for Testing and Materials (ASTM) C12-77 or Water Pollution Control Federation Manual of Practice (WPCF MOP) No. 9* shall be used for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load.

*Note: WPCF MOP No. 9 is a joint publication with the American Society of Civil Engineers (ASCE) which lists it as "Manuals and Reports on ENGINEERING PRACTICE No. 39. " See Appendix 5-A for the address of the ASCE.

(2) Bedding classes I, II, or III, as described in ASTM 0232174(80) shall be used for all flexible pipe provided the proper strength is used with the specified bedding to support the anticipated load.

(3) Backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for backfill within two feet of the top of the pipe.

(k) Leakage Tests: When tested, the leakage inward and outward of a gravity sewer including manholes shall not exceed 200 gallons per inch of pipe diameter per mile

per day. Upon completion of construction, a sewer line shall be tested in accordance with one of the following procedures:

(1) Water testing

(A) Plug or cap all service laterals, stubs, and fittings. Place adequate bracing to withstand thrust forces.

(B) A tapped plumber's plug should be inserted in the downstream manhole inlet sewer. The water supply connection is made at this point, but never directly from a public water supply system or hydrant unless a backflow preventer is used.

(C) A stand pipe is tightly connected at the upstream end of the sewer. The height of the stand pipe shall be at least two feet higher than any point in the sewer or two feet higher than the highest known ground water table, whichever is higher. A manhole may be used as a stand pipe .

(D) Water is added at the downstream connection in order to avoid trapping air bubbles or pockets. The line shall be filled to the elevation designated in the stand pipe.

(E) Allow the line to stand with water for at least a two hour stabilization period or such shorter period as may be required to achieve stabilized readings of water loss over three consecutive 15 minute periods. This allows air to escape and absorption to take place.

(F) Fill the sewer line to the reference mark and continue the test for at least one hour. Maintain the minimum head throughout the test, adding any volume of water required and including that volume in the leakage.

(G) Convert the leakage to the units specified.

(2) Air testing

(A) Procedures

(i) Determine the test time for the section of line to be tested using Table 1-A-3 or 1-A-4 or the formulas in Chart I.

(ii) Plug all openings in the test section.

(iii) Add air until the internal pressure of the line is raised to approximately 4.0 pounds/square inch (psi) greater than the average pressure of any ground water. After this pressure is

reached, allow the pressure to stabilize. The pressure will normally drop as the air temperature stabilizes. This usually takes 2 to 5 minutes depending on the pipe size. The pressure may be reduced to 3.5 psi before starting the test.

(iv) When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi above the pipe, start the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test. If a 1.0 psi drop does not occur within the test time, the line has passed the test.

(B) Test time

(i) Table 1-A-3 shows the required test time, T, in minutes/100 feet of pipe for each nominal pipe size. Test times are for a 1.0 psi pressure drop from 3.5 to 2.5 psi. Table 1-A-3 has been established using the formulas contained in chart 1.

(ii) If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

(iii) It is not necessary to hold the test for the whole period when it is clearly evident that the rate of air loss is less than the allowable.

TABLE 1-A-3 MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

Nominal Pipe Size in inches	T (time) min/100 ft.	Nominal Pipe Size in inches	T (time) min/100 ft.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

CHART I

FORMULAS AND ALLOWABLE AIR LOSS STANDARDS

Calculate the required test time at a given allowable air loss as follows:

$$T = (K) \times \frac{(D)^2(L)}{(Q)}$$

Calculate air loss with a timed pressure drop as follows:

$$Q = (K) \times \frac{(D)^2(L)}{(T)}$$

See next page for symbols

Symbols:

D = nominal size, in.

K = 0.534×10^{-6} for S.I. units

K = 0.371×10^{-3} for inch-pound units

L = length of line of one pipe size, ft.

Q = air loss, ft 3/min.

T = time for pressure to drop 1.0 psi, min

.

(C) An appropriate allowable air loss, Q, in cubic feet per minute, has been established for each nominal pipe size. Based on field experience, the Q value that has been selected will enable detection of any significant leak Table 1-A-4 lists the Q established for each pipe size.

TABLE 1-A-4 ALLOWABLE AIR LOSS FOR VARIOUS PIPE SIZES

Nominal Pipe Size in Inches	Q, ft^3/min	Nominal Pipe Size in Inches	Q, ft^3/min
3	2	21	5.5
4	2	24	6
6	2	27	6.5
8	2	30	7
10	2.5	33	7.5
12	3	36	8
15	4	39	8.5
18	5	42	9

For further information regarding the Air Testing procedures, refer to ASTM Standard C828-80.

(l) Manholes

(1) Location: Manholes shall be installed at the end of each line, at all changes in grade, size or alignment, at all intersections, and at distances not greater than 300 feet unless the designer justifies a greater spacing.

(2) Drop Type: A drop pipe should be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent deposition of solids.

Drop manholes should be constructed with an outside drop connection. Inside drop connections (when necessary) shall be secured to the interior wall of the manhole and provide access for cleaning. Where inside drops are used, the manhole diameter shall be increased to allow adequate access.

Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection shall be encased in concrete and supported by the manhole base.

(3) Diameter: The minimum diameter of manholes shall be 48 inches; large diameters are preferred for connection to large diameter sewers. A minimum access diameter of 22 inches shall be provided.

(4) Flow Channel: Flow channels shall be provided in the base of all manholes and the flow channel through manholes should be made to conform in shape and slope to that of the sewers.

(5) Manholes shall be of the pre-cast concrete or poured-in place concrete type. Manholes shall be waterproofed on the exterior.

(6) Inlet and outlet pipes shall be joined to the manhole with a rubber-gasketed flexible watertight connection that allows differential settlement of the pipe and manhole wall to take place.

Grouting is not an acceptable connection. All manhole connections, including building sewers, shall be constructed to this standard.

(7) Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations where vandalism may be a problem.

(8) All manholes shall be tested for leakage. Leakage testing of gravity sewers utilizing the water testing procedures takes into account the leakage from one

manhole in the test section. Otherwise, manholes shall be tested for leakage in accordance with the following procedure:

After the manhole has been assembled in place, all lifting holes and exterior joints shall be filled and pointed with non-shrinking mortar. All pipes and other openings into the manhole shall be suitably plugged and the plugs placed to prevent blowout.

Each manhole shall be checked for exfiltration by filling with water to the top of the cone section. A stabilization period of one hour shall be provided to allow for absorption. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least six hours begun. At the end of the test period, the manhole shall be refilled to the top of the cone measuring the volume of water added.

This amount shall be converted to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed one gallon per vertical foot for a 24 hour period for exfiltration and there shall be no visible infiltration.

(9) Location of Sewers on Streams

(A) Cover Depth: The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, the following cover requirements must be met:

(i) One foot of cover is required where the sewer is located in rock;

(ii) Three feet of cover is required in other material. In major streams, more than three feet of cover may be required; and

(iii) In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

(B) Horizontal Location: Sewers located along streams shall be located outside of the stream bed and sufficiently removed therefrom to provide for future possible stream widening, minimize pollution by siltation during construction, and allow future access for repair and maintenance of sewers.

(C) Structures: The sewer, manholes, gate boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream. No manholes or other access structures shall be located within the normal flow channel of the stream.

(D) Alignment: Sewer crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.

(E) Construction - Materials: Sewers entering or crossing streams shall be constructed of cast or ductile iron pipe with mechanical joints and they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials that will not cause siltation.

(10) Aerial Crossings: Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning and settlement.

Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of pipe should be placed no lower than the elevation of the fifty (50) year flood.

(11) Water Line Separation

(A) Horizontal Separation: Sewers shall be laid at least ten feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge.

Where impossible or impracticable, due to ledge, boulders or other unusual conditions, to maintain the ten foot sewer - water pipe horizontal separation between sewer and water lines, the water line may be in a separate trench or on an undisturbed earth shelf in the sewer trench provided that the bottom of the water line is at least 18 inches above the top of the sewer. Wherever impossible or impractical to maintain the 18 inch vertical separation, the sewer line shall be constructed to normal water line standards and pressure tested to 50 psi for 15 minutes prior to backfilling. No leakage shall be allowed for this test.

(B) Crossings: Sewers crossing water mains shall be laid beneath the water main with at least 18 inches vertical clearance between the outside of the sewer and the outside of the water main. When it is impossible to maintain the 18" vertical separation; 1) the crossing shall be arranged

so that one full length of sewer is centered above or below the water line with sewer joints as far as possible from water joints; 2) the sewer pipe must be constructed to water main standards for a minimum distance of 20 feet either side of the crossing or a total of three pipe lengths, whichever is greater; 3) the section constructed to water main standards must be pressure tested to maintain 50 psi for 15 minutes without leakage prior to backfilling beyond one foot above the pipe to assure water tightness; 4) where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

1-A-04 Sewage Lift Stations

(a) Flooding: Sewage pumping station structures and electrical and mechanical equipment shall be protected from physical damage from the one hundred (100) year flood. Sewage pumping stations should remain fully operational and accessible during the twenty-five (25) year flood.

(b) Equipment Removal: Provision shall be made to facilitate removal of pumps, motors, and other mechanical and electrical equipment.

(c) Pump Removal: Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

(d) Construction: Submersible pumps and motors shall be designed specifically for raw sewage use, including totally submerged operation during a portion of each pumping cycle.

(e) Pumping Units: Lift stations receiving an average daily flow of less than 2,000 gal/day may be equipped with a single pumping unit, provided that replacement pumps are readily available, and one day's emergency storage is provided above the alarm level in the wet well. All other lift stations shall contain alternating duplex pumping units with each unit capable of pumping the maximum flow the station is expected to receive.

(f) Pump Openings: For pumps handling raw sewage, except where grinder pumps are used, pumps shall be capable of passing spheres of at least three inches in diameter, and pump suction and discharge piping should normally be at least four inches in diameter. Pumps handling only settled wastewater shall be capable of passing 1½" spheres. However, the Agency will entertain proposals for smaller pumps where the engineer can demonstrate that such pumps are satisfactory for the particular wastewater to be pumped, based on actual operating experience.

(g) Priming: Generally, the pump shall be so placed that, under normal operating conditions, it will operate under a positive suction head.

(h) Electrical Equipment: Electrical systems and components (e.g., motors, lights, cables, conduits, switchboxes, control circuits; etc.) in raw sewage wet wells, or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors may be present shall comply with the National Electrical Code R, 1981 Edition, requirements for Class I, Group D, Division 1 locations. In addition, equipment located in the wet well shall be suitable for use under corrosive conditions. Each flexible cable shall be provided with watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for all pumping stations. When such equipment is exposed to weather, it shall meet or exceed the requirements of weatherproof equipment as specified by the National Electrical Manufacturers Association (NEMA). Standard 3R shall be used as a minimum and is specified in Publication #250-1979, "Enclosures for Electrical Equipment - 1,000 Volt Maximum." See Appendix 5-A for the address.

(i) Intake: Each pump should have an individual intake. Wet well design should be such as to avoid turbulence near the intake. Intake piping should be as straight and short as possible. Where turned-down bellmouth inlets or submersible pumps are used the bottom of the inlets should be placed a sufficient distance above the wet well floor to minimize inlet head losses, but close enough to the wet well floor to assure inlet velocities sufficient to prevent solids deposition.

(j) Pumping Rates: The pumps selected shall be capable of providing the following pumping rates:

(1) The minimum pumping rate shall not be less than 5 gallons per minute

(2) For average daily flows less than 10,000 gallons per day, the maximum rate shall be 5 times the average design flow.

(3) For average design flows greater than 10,000 gallons per day, the maximum flow rate shall be determined by multiplying the average design flow by the appropriate peaking factor from Table 1-A-1 (Peaking Factors) (page 131.

(k) Pump controls

(1) Location: The pump control system shall be located away from the turbulence of incoming flow and pump suction.

(2) Setting: The '2nd pump-on' level and 'alarm-on' level shall be at the same elevation.

(l) Valves

(1) Suction Line: Suitable shutoff valves shall be placed on the suction line of each pump except on submersible pumps.

(2) Discharge Line: Suitable shutoff and check valves shall be placed on the discharge line of each pump. The check valve shall be located between the shutoff valve and the pump. Check valves shall be suitable for the material being handled. Valves shall be capable of withstanding normal pressure and water hammer.

(3) Location: Valves may be located in wet wells only where single pump units are allowed. On all duplex unit pumping stations, the valves shall be in a separate valve pit adjacent to the wet well. This valve pit shall also contain a valved connection to allow the use of a portable pump for lift station bypassing during emergency conditions. The valve pit shall be provided with a drain to the wet well. An effective method of preventing sewage from entering the pit during surcharged wet well conditions shall be provided.

(m) Wet Wells

(1) Size: For lift stations handling raw sewage and receiving more than 20,000 gallons per day average design flow, the size of the wet well shall be such that with any combination of inflow and pumping the cycle of operation of each pump will not be less than 5 minutes and the retention time in the wet well should not be more than 30 minutes at average design flow. For raw sewage lift stations receiving less than 20,000 gallons per day, the retention time in the wet well will not be more than 30 minutes at average design flow. These requirements do not apply for lift stations handling only settled wastewater.

Emergency storage or emergency power must be provided at all lift stations for power outage. Storage should be provided above the high water alarm level of the wet well, in the wet well or in an adjacent tank. The volume of storage should equal the design wastewater flow for a period in excess of the longest power outage in the last five years that would have affected the proposed site, or four hours, based on a 16 hour delivery rate, whichever is greater.

The emergency storage volume may overflow into the connecting sewer lines providing that the sewage does not back up into building basements or fixtures, back up into septic tanks or over top manholes or the wet well.

Emergency storage will be a minimum of one day of wastewater design flow for all lift stations with a single pump.

(2) Floor slope: For all raw wastewater pump stations except submersible pump types, the wet well floor shall have a minimum slope of one to one to the hopper bottom. The horizontal area of the hopper bottom shall be not greater than necessary for proper installation and function of the inlet.

(3) Ventilation

(A) Dry Wells: Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least six complete air changes per hour, if intermittent, at least 30 complete air changes per hour.

(B) Wet Wells: For lift stations receiving less than 20,000 gallons per day design flow gravity ventilation is acceptable. For flows greater than 20,000 gallons per day design flow, forced ventilation shall be used. Forced ventilation may be either intermittent or continuous. Ventilation, if continuous, shall be capable of providing at least 12 complete air changes per hour, if intermittent, at least 30 complete air changes per hour. Air changes shall be forced into the wet well rather than exhausted from the wet well.

(n) Alarm Systems: Alarm systems shall be provided for pumping stations. The alarm shall be activated in cases of pump failure, use of the lag pump, high water in wet well, or other evidence of pump station malfunction. Audio and visual alarms shall be provided. Alarms shall be located in a normally frequented area.

1-A-05 Force Mains

(a) Velocity: The force main shall be sized to maintain a minimum hydraulic velocity of 2 feet per second with one pump on. The minimum force main size shall be 1 ½ inch diameter.

(b) Air Relief Valve: An automatic air relief valve shall be placed at high points in the force main to prevent air locking.

(c) Termination: Force mains should enter the gravity sewer system at a point not more than 2 feet above the flow line of the receiving manhole

(d) Design Pressure: Force mains and fittings, including reaction blocking, shall be designed to withstand normal pressure and pressure surges (water hammer).

(e) Design Friction Losses: Friction losses in force mains shall be based on the Hazen-Williams formula or other acceptable method. Selected friction factors shall be representative of pipe materials selected, considering surface deterioration over the expected useful life of the pipe.

Hazen-Williams Formula

$V = 1.32\ C\ R.63\ s.54$
R is the hydraulic radius
S is the slope of the energy grade line
C is the coefficient of roughness

(f) Separation from Water Mains: There shall be a minimum 10-foot horizontal separation between water mains and force mains. A minimum 18 inch vertical separation between the outside pipe surfaces shall be maintained where force mains cross water mains. Force mains shall cross water mains at or near right angles with one full length of water pipe centered on the force main so both end joints are at maximum separation from the force main. Special structural support for the water main and the force main may be required.

(g) Pressure Test: Upon completion of construction of a force main the line shall be pressure and leakage tested. All newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 x the highest working pressure in the section in accordance with the following procedure:

(1) Test pressures shall:

(A) not be less than 50 psi at the highest point along the test section.

(B) not exceed pipe or thrust restraint design pressures.

(C) be of at least 2 hour duration.

(D) not vary by more than 5 psi.

(E) not exceed twice the rated pressure of the valves when the pressure boundary of the test section includes closed gate valves.

(2) Pressurization. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to test gauge, shall be applied by means of a pump connected to the pipe.

(3) Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe and valves.

(4) Examination. All exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, or valves, that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated.

(h) Leakage Test

(1) A leakage test shall be conducted concurrently with the pressure test.

(2) Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled.

(3) Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{(N)(D) \times \sqrt{P}}{7400}$$

L is the allowable leakage, in gallons per hour
N is the number of joints in the length of pipeline tested
D is the nominal diameter of the pipe, in inches
P is the average test pressure during the leakage test, in pounds per square inch gage.

Appendix 2-A
Soil Mottling

2-A-01 Soil Mottling

(a) Mottling indicates the average seasonal high water table over many years produced by the seasonal fluctuation of the water table. The presence of mottling is a definite indication of the seasonal high water table. However, mottling does not occur in all soils. The absence of mottling does not necessarily indicate that the seasonal high water table is not a problem.

(b) The soil mottling should be described in abundance, size, contrast, and color of the mottles in the following manner:

(1) Abundance. Abundance shall be described as "few" if the mottled color occupies less than 2% of the exposed surface; “common,” if the mottle color occupies from 2% to 20% of the exposed surface; or "many" if the mottled color occupies more than 20% of the exposed surface.

(4) Size. Size refers to the length of the mottle measured along the longest dimension and shall be described as "fine" if the mottle is less than 5mm; "medium" if the mottle is from 5mm to 15mm, or "coarse" if the mottle is greater than 15mm.

(3) Contrast. Contrast refers to the difference in color between the soil mottle and the background color of the soil and is described as "faint" if the mottle is evident but recognizable only with close examination; "distinct" if the mottle is readily seen but not striking; or "prominent" if the mottle is obvious and one of outstanding features in the soil horizon

(4) Color. The color(s) of the mottle(s) shall be given.

(c) Observed Groundwater: Groundwater shall be observed and reported at the highest level the ground water rises in the soil excavation or at the highest level of sidewall seepage in the excavation. Measurements shall be made from the ground surface. Soil above the water level in the excavation shall be checked for the presence of mottles or color patterns indicative of soi1 saturation.

(d) Color Patterns Not Indicative of Seasonal High Groundwater: One-foot exception. Soil profiles that have an abrupt textural change with finer textured soils overlying more than 4 feet of unmottled, or coarse sand can have a mottled zone in the finer textured material. If the mottled zone is less than one foot thick and is immediately above the textural change, then a soil-based system may be installed in the loamy sand or coarser material below the mottled layer.

(e) Other Color Patterns: Soil mottles can occur that are not due to zones of seasonal or periodic soil saturation. Examples of such soil conditions not limited by enumeration are:

(1) soil mottles formed from uneven weathering of glacially deposited material. Glacially deposited material may also be naturally gray in color. This may include concretionary materials in various stages of decomposition;

(2) deposits of lime in a profile derived from highly calcareous parent materials;

(3) soil mottles that are usually vertically oriented along old or decayed root channels with dark organic stain usually present in the center of the mottled area.

Appendix 3-A

3-A-01 Septic Tank Specifications and Maintenance

(a) Specifications

(1) Materials: Septic tanks shall be watertight, structurally sound, and constructed of materials not subject to extensive corrosion or decay. Heavy gauge steel, reinforced concrete and fiberglass are considered the normal construction materials. Steel tanks shall be continuous and watertight. Precast concrete tanks shall have a minimum wall thickness of 3 inches and shall be adequately reinforced to facilitate handling. When precast slabs are used as covers, they shall be watertight, have a thickness of at least 3 inches, and be adequately reinforced. For fiberglass tanks, the manufacturer may be required to substantiate the structural soundness of the tank by submitting an approved laboratory report, that relates to structural testing of the tank.

(2) Tank Properties: Adequate tank capacity is required above the liquid tank level to provide for that portion of the scum that floats above the liquid. Although some variation is to be expected, on the average, about 30 percent of the total scum will accumulate above the liquid line. In addition to the provision for scum storage, one inch is usually provided at the top of the tank to permit free passage of gas back to the inlet and house vent pipe.

For tanks having straight, vertical sides, the distance between the top of the tank and the liquid line should be equal to approximately 20% of the liquid depth. In horizontal, cylindrical tanks, an area equal to approximately 15 percent of the total circle should be provided above the liquid level.

(3) Access to Tank: Adequate access must be provided to each compartment of the tank for inspection and cleaning. Both the inlet and outlet devices shall be accessible. Access shall be provided to each compartment by means of either a removable cover or a manhole of at least 16 inches in diameter. Each tank shall have one manhole access to grade. Covers should be tight fitting and designed to prevent entry by children.

(4) Inlet: The inlet invert shall enter the tank at least 3 inches above the liquid level in the tank to allow for momentary rises in liquid level during discharges to the tank. A vented inlet tee, or baffle, shall be provided to direct the incoming wastewater downward. It shall penetrate at least 6 inches below the liquid level, but in no case shall the penetration be greater than that allowed for the outlet device.

(5) Outlet: It is important that the outlet device penetrate just far enough below the liquid level of the septic tank to provide a balance between sludge and

scum storage volume. The outlet device retains scum in the tank, but at the same time, it limits the amount of sludge that can be accommodated without scouring, which results in sludge discharging in the effluent from the tank. The outlet device should generally extend to a distance below the surface equal to 40 percent of the liquid depth. For horizontal, cylindrical tanks, this should be reduced to 35 percent.

(b) Maintenance

(1) At least once a year, the depth of sludge and scum in the septic tank should be measured. The tank should be pumped if:

(A) the sludge is closer than twelve inches to the outlet baffle, or

(B) the scum layer is closer than three inches to the septic tank outlet baffle.

(C) Following septic tank cleaning in units over 5,000 gallons, all interior surfaces of the tank should be inspected for leaks and cracks).

(2) At least once a year, dosing tanks and distribution boxes should be opened and settled solids removed as necessary and the dosing tank or distribution box checked for levelness.

(3) Toxic or hazardous substances should in general not be disposed of in septic systems. These substances may pass through the system in an unaltered state and contaminate groundwater or remain in the septage and subsequently contaminate the soil or crops at the site of ultimate disposal.

Appendix 4-A Percolation Test Procedures

The following procedure is to be used for determining the percolation value required by these rules.

(a) Depth of Test - Tests shall be taken entirely within the most dense, least permeable soil identified within one (1) to three (3) feet below the bottom of the infiltrative surface of the proposed leachfield.

(b) Type of Test Holes - The test hole will be unlined, shaped like a vertically oriented cylinder with a diameter of 6 - 8 inches and a depth of 10 inches.

(c) Preparation of Test Hole - Using a sharp instrument, carefully scrape the sidewalls of the hole to remove any smeared soil surface. This is particularly important in soils that have a significant silt or clay content. Place one (1) inch of clean crushed stone in the bottom of the hole to reduce scouring. When possible, instead of pouring water directly from a bucket into the hole, use a hose to siphon water out of a suitably located reservoir to provide a high degree of control over the rate of water entering the hole, to minimize scouring.

(d) Percolation Test Measurements - To begin the test, fill the hole with water up to a level six (6) inches above the stone and allow it to drop the distance specified in the table below for seven (7) consecutive runs. After each run, bring the water up to the six (6) inch level. The time of each run, the refill time between each run, and the total elapsed time must be accurately recorded.

WATER LEVEL DROPS FOR EACH TEST RUN OF THE PERCOLATION TEST PROCEDURE

Soil Texture:	Coarse to Medium Sand	Fine Sand to Silt Loam	Silts to Clay Loam
Anticipated Percolation Rate (min/in)	1 - 10	10 - 60	60 - 120
Drop (inches)	2	1	1/2

(e) Determining the Percolation Rate - The rate of drop for each run is plotted, on graph paper with logarithmic scales on both axes (log/log graph paper), against the cumulative time of the seven runs, including the refill times. The best straight line is fitted to the seven data points and extrapolated out to one (1) day (1440 minutes) of cumulative time The rate of drop after 1440 minutes is the percolation rate.

Appendix 5-A

ORGANIZATIONS THAT PUBLISH THE CODES AND MATERIAL STANDARDS REFERRED TO IN THE GUIDELINES CONTAINED IN APPENDIX 1-A

ASCE American Society of Civil Engineers
345 East 47th Street
New York, NY 10017
Tel: 212-705-7496 (for WPCF MOP #9)

ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
Tel: 215-299-5450

BOCA Building Officials and Code Administrators International, Inc
1990 National Plumbing Code
4051 W. Flossmoor Road
Country Club Hills, Illinois 60478-5795

CISPI Cast Iron Soil Pipe Institute

1499 Chain Bridge Road
McLean, VA 22101
Tel: 703-827-9177

Manas National Plumbing Code, Illustrated, 1968 Edition
Manas Publications Shore Tower #205
1868 Shore Drive South
St. Petersburg, FL 33707
Tel: 813-343-1428

National Electrical Code, 1990 Edition * (NFPA #70)
National Fire Prevention Association, Inc
Batterymarch Park
Quincy, MA 02269
Tel: 617-328-9290

*The National Electrical Code is a Registered Trademark
of the National Fire Prevention Association, Inc. of Quincy, Mass.

NEMA National Electrical Manufacturers Association
Order Department
Suite 300
2101 L Street, N.W.
Washington, D.C. 20037

Tel: 202-457-8496

Recommended Standards for Sewage Works, 1983 Edition
Health Education Service, Inc.
P.O. Box 7126
Albany, NY 12224