4.2 At-Grade Soil Absorption System

Revision: July 22, 2015

4.2.1 Description

An at-grade soil absorption system is installed with the distribution aggregate placed at the original soil surface. Wastewater is distributed through the aggregate using a pressurized small-diameter pipe distribution system to ensure equal distribution across the infiltrative surface. The aggregate is covered with geotextile fabric and capped with at least 12 inches of soil cover. Figure 4-1 provides a diagram of an at-grade soil absorption system.

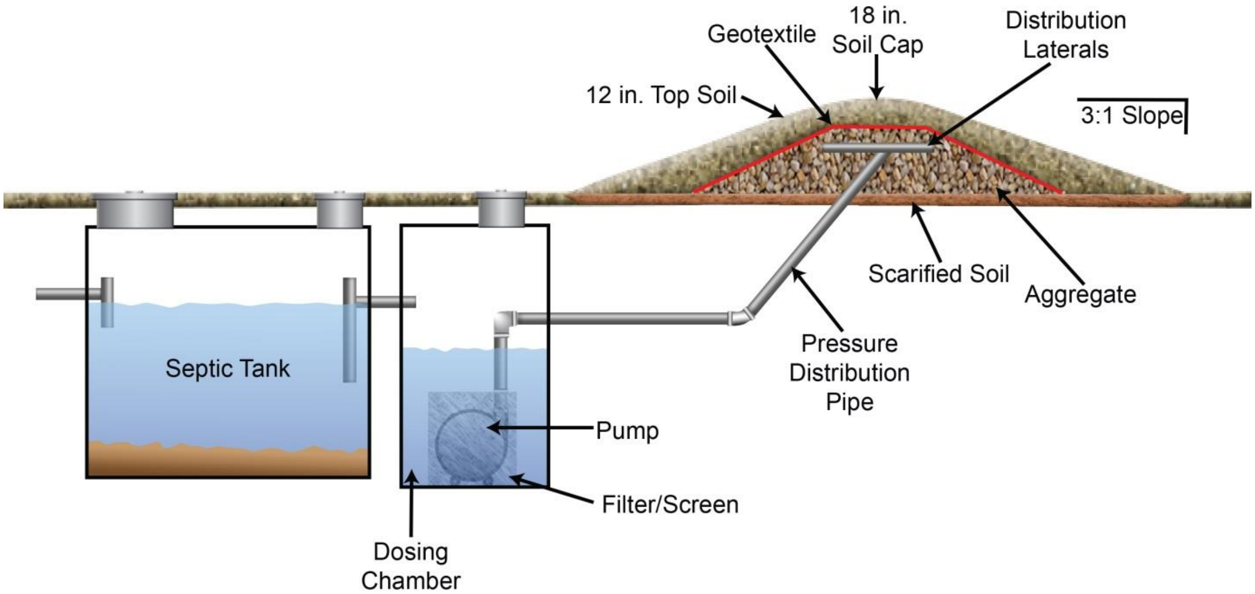

Figure 4-1. Cross-sectional view of an at-grade soil absorption system.

4.2.2 Approval Conditions

1. The system must be designed by a PE licensed in Idaho.
2. Effective soil depth to limiting layers shall meet the requirements of IDAPA 58.01.03.008.02.c. If a secondary treatment system is incorporated into the system design before discharge to the at-grade soil absorption system, the effective soil depth to any limiting layer shall not be reduced to less than 36 inches.
3. The soil application rate used in the at-grade soil absorption system design is based on the most restrictive soil layer within the soil profile's effective soil depth as determined by approval condition 2 except that the application rate shall not be increased for the incorporation of secondary effluent treatment before discharge to the at-grade soil absorption system.
4. Table 4-2 shows the maximum slope of natural ground, listed by soil design group.
5. Drainfield media shall consist of aggregate meeting the specifications of section 3.2.8.1.1.

  a. Gravelless trench components shall not be substituted for drainfield aggregate in the system design.
  b. No reduction is granted for installation of extra drainrock below the distribution pipe.
6. At-grade soil absorption system must not be installed in flood ways, areas with large trees and boulders, in concave slopes, at slope bases, or in depressions.
7. Design flow must be 1.5 times the wastewater flow.
8. The maximum daily wastewater flow to any at-grade soil absorption system must be equal to or less than 500 GPD, not including the required safety factor adjustment.
9. Nondomestic wastewater must be pretreated to residential strength before discharge to the at-grade soil absorption system.
10. Pressure distribution system and associated component design shall conform to section 4.19 of this manual unless otherwise provided within this section.

Table 4-2. Maximum slope of natural ground.

Design Group	A	B	C-1	C-2
Slope (%)	20	20	12	6

4.2.3 Design

Minimum design requirements for the at-grade soil absorption system are provided below.

4.2.3.1 Effective Absorption Area Design

The effective absorption area dimensions are determined through the daily design flow plus safety factor, assigned soil application rate, and the contour loading rate of the site. Effective absorption areas should be designed as long and narrow as possible to reduce the contour loading rate, increase the effective absorption area, and protect the at-grade soil absorption system from failure.

1. Determine the daily design flow and multiply it by the safety factor of 1.5.

   Example: Three bedroom home (250 GPD). Design flow (250 GPD x 1.5) = 375 GPD.

2. Determine the minimum necessary soil absorption area based on the daily design flow with the safety factor and the effective soil profile's most restrictive soil application rate.

   Example: Three bedroom home (375 GPD) on a site with B-2 soils (0.45 GPD/ft^2). Soil absorption area: (375 GPD/0.45 GPD/ft^2) = 834 ft^2.

3. Assign a contour loading rate. Contour loading rates are the responsibility of the system's design engineer to assign and should take into account soil texture, soil structure, and limiting layers existing in the soil profile.
   a. Contour loading rates shall not be less than 2 gallons per foot or more than 12 gallons per foot for a site and should fall between the values provided in Table 4-3 for each at-grade soil absorption cell.

b. If more than one at-grade soil absorption cell is required for a single system, each cell shall have the same contour loading rate based on the most restrictive rate for the site.

c. Contour loading rates are additive along a site's slope for each at-grade soil absorption cell as shown in Figure 4-2.

d. The following resources provide for more information on designation of contour loading rates:

- Converse, J.C. 1998. *Linear Loading Rates for On-Site Systems*.
- Tyler, E.J. and L. Kramer Kuns. No date. *Designing with Soil: Development and Use of a Wastewater Hydraulic Linear and Infiltration Loading Rate Table*.
- Tyler, E.J. No date. *Hydraulic Wastewater Loading Rates to Soil*.

Table 4-3. Linear loading rate ranges based on soil design subgroups.

Design Subgroup	A-1	A-2a	A-2b	B-1	B-2	C-1	C-2
Contour loading rate range (GPD/ft)	2-8	2-8	2-7	2-6	2-5	2-4	2-3

4. The effective absorption cell width is calculated by dividing the contour loading rate selected for the site by the soil application rate. Effective absorption cell width shall not exceed 15 feet.

   Example: Site with B-2 soils (0.45 gallon/ft^2) and a selected contour loading rate of 4 GPD/ft. Absorption cell width: (4 GPD/ft/0.45 gallon/ft^2) = 8.9 feet, use 9 feet. Round up to nearest half-foot for design purposes.

5. The absorption cell length is calculated by dividing the daily design flow by the contour loading rate.

   Example: Three bedroom home (375 GPD) and a selected contour loading rate of 4 GPD/ft. Absorption cell length (375 GPD/4 GPD/ft) = 93.75 feet round to 94 feet for design purposes.

6. Ensure the at-grade absorption cell dimensions length and absorption area width meet or exceed the minimum soil absorption area calculated in step 2. If the absorption cell dimensions do not exceed the minimum absorption area required, decrease the selected contour loading rate selected in step 3 to achieve the minimum required absorption area.

   Example 4: Required absorption area = 696 ft^2. Design area: (79 x 9 feet) = 711 ft^2.

7. Effective absorption area within an aggregate cell shall be credited based on the following requirements:

   a. Flat sites—The absorption area is credited for the full width of the aggregate cell.

   b. Sloped sites—The absorption area is credited from the downhill side of the pressurized distribution lateral to the downhill edge of the aggregate cell.

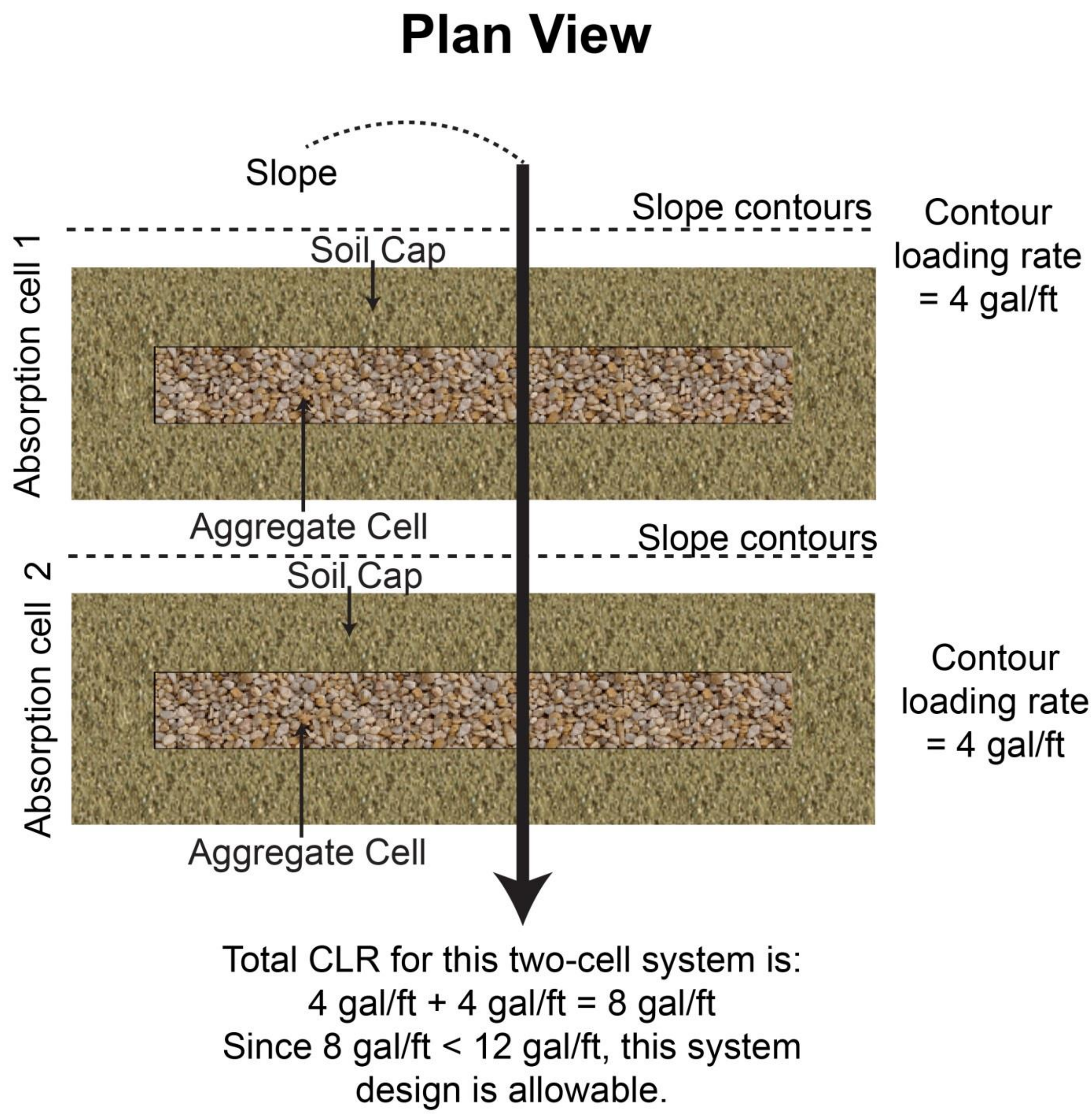

Figure 4-2. Additive contour loading rate example.

4.2.3.2 Pressure Distribution Design

The design of the low-pressure distribution system shall meet the requirements of section 4.19 with the exception of the requirements contained within this section.

1. Pressurized distribution lateral placement and spacing within the aggregate cell shall meet the following requirements:
    a. Flat sites—The lateral placement shall meet the requirements for beds and spacing shall meet the requirements for distribution laterals in section 4.19.3.1.
    b. Sloped sites—Only one pressurized distribution lateral is required, and it shall be placed on the upslope edge of the aggregate.

2. The maximum orifice spacing shall meet the following requirements:
   a. Flat sites—The orifice spacing shall result in a maximum disposal area of 6 ft^2 per orifice.
   b. Sloped sites—The orifice spacing shall not be greater than 12 inches.
3. Dosing is recommended to be timed but may be demand.
4. Each dose delivered to the infiltrative surface of the at-grade absorption system should not exceed 15% of the daily wastewater flow prior to the addition of a safety factor.

   Example: Three bedroom home (250 GPD prior to the addition of a safety factor). Each dose delivered to the infiltrative surface would not exceed 37.5 gallons total.

4.2.3.3 Aggregate Cell Design

At-grade absorption cells must be filled with aggregate meeting the requirements of section 3.2.8.1.1. The aggregate cell must account for the effective absorption area and meet the additional design requirements below.

1. Aggregate must be placed along the slope contour on the uphill side of the at-grade soil absorption system for sloped sites.
2. Aggregate placement must be at least 6 inches deep below and at least 2 inches above the pressurized distribution pipe (Figure 4-3).
3. Aggregate must be placed in a consistent depth meeting the minimum requirements described in aggregate cell design requirement 2 throughout the entire effective absorption area after which the aggregate shall be tapered to meet native grade at a maximum slope of 3:1.
4. An additional 3 feet of aggregate must be placed as described in design requirement 2 on either end of the aggregate cell that extends past the terminal ends of the pressurized distribution pipe.
   a. This additional aggregate shall not be credited as part of the effective absorption area.
   b. After the additional aggregate placement is met, the aggregate may taper to native grade at a maximum slope of 3:1
5. On sloped sites, the aggregate upslope of the pressurized distribution pipe shall be tapered to native grade at a maximum slope of 3:1 but shall not be shorter than 2 feet.
6. Three observation ports should be installed at the toe edge of the aggregate cell extending from the drainrock/native soil interface through the soil cap at approximately the one-sixth, one-half, and five-sixth points along the aggregate cell.
   a. The observation ports should contain perforations in the side of the pipe extending up 4 inches from the bottom of the port.
   b. Observation ports must be accessible from grade, have a removable cap, and be stabilized to prevent their removal.

   c. On flat sites, the observation ports should be located on both sides of the aggregate cell. On sloped sites, the observation ports should be located on the downhill side of the aggregate cell.

7. The entire aggregate cell shall be covered by geotextile fabric. Geotextile fabric shall only extend to the edge of the aggregate.

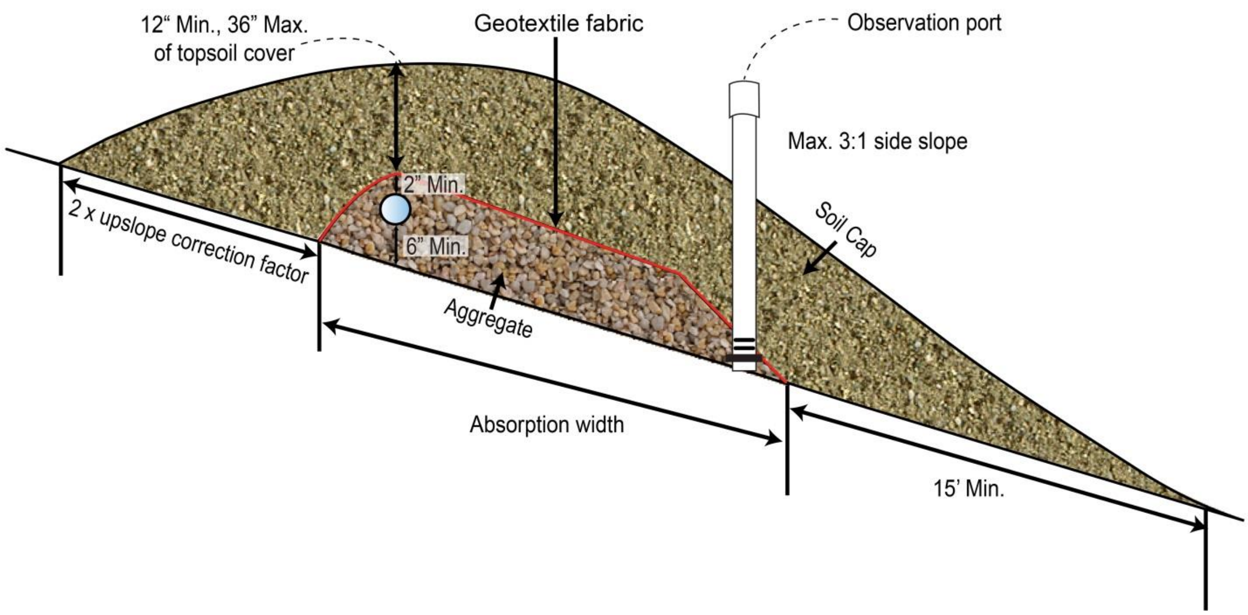

Figure 4-3. Cross section of an at-grade soil absorption system on a slope.

4.2.3.4 Soil Cap Design

The at-grade aggregate cell must have a soil cover meeting the following minimum requirements:

1. A minimum soil cap depth of 12 inches shall be placed over the entire aggregate cell (Figure 4-3). On flat sites, the soil cap at the center of the cell shall be crowned to 18 inches to promote runoff.
   a. Depth of the soil cap shall not exceed 36 inches over any portion of the system.
   b. Maintaining the soil cap depth near the minimum depth requirements is recommended, where practical, to promote evaporation during warmer months.
2. For flat sites, the soil cap width is determined by adding 5 feet to half of the aggregate cell width from the ends of the aggregate cell on all sides, or a minimum of 10 feet, whichever value is greater. The soil cap must maintain a maximum slope of 3:1 or less.

   Example: The aggregate cell has a design width of 9 feet. The soil cap width would be 5 + 4.5 feet, or 9.5 feet. Use the minimum width of 10 feet. The soil cap would extend 10 feet from the edge of the aggregate cell in all directions.
3. For sloped sites, the slope correction factors in Table 4-4 should be used to determine the downslope and upslope width of the soil cap.

a. The downslope soil cap width is calculated by multiplying the height of the at-grade soil absorption system by the correction factor, and adding 5 feet to the total width of the absorption cell, or a minimum of 15 feet. Whichever value is greater is used as the downslope cap width.

   Example: The height of the at-grade soil absorption system (aggregate plus cap) is 1.75 feet (9 inches of aggregate plus 12 inches of soil cover). The downslope soil cap width on a 10% slope would be 1.75 feet x 6.67, or 11.7 feet. Use the minimum width of 15 feet. The soil cap would extend 15 feet from the downslope edge of the aggregate cell.

b. The upslope soil cap width is calculated by multiplying the height of the at-grade absorption system by the correction factor.

   Example: The height of the at-grade soil absorption system (aggregate plus cap) is 1.75 feet (9 inches of aggregate plus 12 inches of soil cover). The upslope soil cap width on a 10% slope would be 1.75 feet x 2.86, or 5 feet. The soil cap would extend 5 feet from the upslope edge of the aggregate cell.

c. The soil cap extending from the ends of the aggregate cell shall be determined by adding 5 feet to half of the absorption cell width or a minimum of 10 feet, whichever value is greater.

   Example: The aggregate cell has a design width of 9 feet. The soil cap width would be 5+ 4.5 feet, or 9.5 feet. Use the minimum width of 10 feet. The soil cap would extend 10 feet from the ends of the aggregate cell.

d. All sides of the soil cap must maintain a maximum slope of 3:1 or less.

Table 4-4. Downslope and upslope correction factors for soil cap width.

Slope (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Downslope Correction Factor	4.17	4.35	4.54	4.76	5.00	5.26	5.56	5.88	6.25	6.67	7.14	7.69	8.26	8.92	9.57	10.24	10.94	11.67	12.42	13.2
Upslope Correction Factor	3.85	3.7	3.57	3.45	3.33	3.23	3.12	3.03	2.94	2.86	2.78	2.7	2.62	2.55	2.48	2.41	2.35	2.29	2.23	2.18

4. The texture of the fill material used for the soil cap shall be the same as or one soil design subgroup finer than the upper layer of the natural site soil, except that no fill material finer than clay loam may be used.
5. The soil cap material shall be free of debris, stones, frozen clods, or ice.
6. Soil cap should be protected to prevent damage caused by vehicular, livestock, or excessive pedestrian traffic. The toe of the soil cap must be protected from compaction.
7. Design considerations for at-grade soil absorption systems on slopes should take surface runoff diversion into account.

4.2.4 Construction

1. Lay out the system with the length following the slope contour.
2. Grass and shrubs must be cut close to the ground surface and removed from the at-grade soil absorption system site.
   a. If extremely heavy vegetation or organic mat exists, these materials should be removed before scarification and replaced with medium sand meeting the specification requirements in section 3.2.8.1.2.
   b. Larger than 2-inch caliper trees and shrubs and large boulders are not to be removed. Trees should be cut as close to ground level as possible and the stumps left in place. If stumps or boulders occupy a significant area in the at-grade soil absorption system placement area, additional area should be calculated into the total basal area of the at-grade soil absorption system to compensate for the lost infiltrative area.
2. When the soil is dry and site vegetation has been cut or removed, the ground in the basal placement area of the at-grade soil absorption system and soil cap should be scarified using a chisel plow or backhoe teeth to a depth of 6–8 inches.
3. Pressure transport line from the dosing chamber should be installed first.
   a. The pressure transport line should slope down to the pump so that the pressure line will drain between discharges.
   b. If a downward slope from the at-grade soil absorption system to the pump chamber is not practical due to the length of run, then the pressure transport line should be laid level below the anticipated frost line for that region.
   c. On a sloped site, the pressure transport line should enter the aggregate cell from the end of the aggregate cell or upslope side of the at-grade soil absorption system; do not enter the aggregate cell from the downslope side of the system.
4. Six inches of clean aggregate will then be placed and shaped before it freezes or rains. No vehicles with pneumatic tires should be permitted on the scarified area to prevent the soils from being compacted. For sloped sites, all work should be done from the upslope side or ends of the at-grade soil absorption system placement area if possible.
5. After shaping the first 6 inches of aggregate, the low-pressure distribution system manifold, laterals, and monitoring ports will be installed. The system should be tested for uniformity of distribution. After uniformity is verified, an additional lift of clean aggregate shall be placed, shaped, and leveled to ensure the aggregate extends at least 2 inches above the low-pressure distribution system.
6. Geotextile fabric must be placed over the aggregate cell and backfilled with the soil cap.
7. Typical lawn grasses or other appropriate low-profile vegetation should be established on the soil cap as soon as possible, preferably before the system is put into operation. Do not plant trees or shrubs on the soil cap, or allow the mature rooting radius of trees or shrubs to reach the soil cap. Trees with roots that aggressively seek water should be planted at least 50 feet from the at-grade soil absorption system and soil cap (e.g., poplar, willow, cottonwood, maple, and elm).

8. At-grade soil absorption systems placed upslope and downslope from each other should maintain a soil cap-toe to soil cap-toe separation distance of 35 feet (Figure 4-4).
    a. The first 15 feet below the upslope at-grade soil absorption system should remain free of vehicular traffic and other activities resulting in soil compaction.
    b. The 20 feet above the downslope at-grade soil absorption system should be maintained for construction of the downslope mound.
9. A separation distance of 15 feet should be maintained from the soil cap-toe of each at-grade soil absorption system when multiple at-grade soil absorption systems are constructed on the same elevation contour.

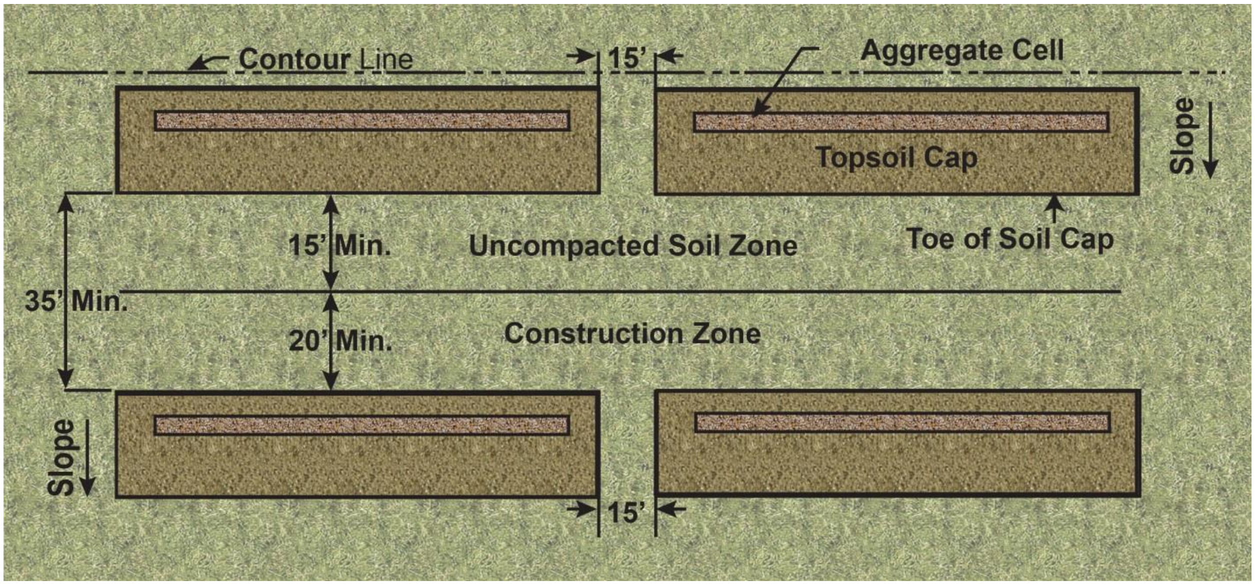

Figure 4-4. At-grade soil absorption systems placed upslope and downslope from one another.

4.2.5 Inspections

1. Site inspections shall be conducted by the health district at the following minimum intervals (IDAPA 58.01.03.011.01):
    a. Preconstruction conference with the health district, responsible charge engineer, complex installer, and property owner (if available) present.
    b. During construction as needed, including scarification, pressure line installation, absorption cell construction, pressure distribution piping construction, and soil cap placement.
    c. Final construction inspection including a pump drawdown/alarm check, pressure test of the distribution network, and soil cap material and placement.
2. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans (IDAPA 58.01.03.005.15).

4.2.6 Operation and Maintenance

An O&M manual shall be developed by the system's design engineer that contains the following minimum requirements and shall be submitted as part of the permit application (IDAPA 58.01.03.005.14):

1. Operation and maintenance is the responsibility of the system owner.
2. Sludge depth in the septic tank should be checked annually, and the tank should be pumped when the sludge exceeds 40% of the liquid depth.
3. All pump and pump chamber alarm floats and controls should be inspected on a regular schedule to ensure proper function.
4. Pump screens and effluent filters should be inspected regularly and cleaned. All material created by cleaning the screen should be discharged to the septic tank.
5. Monitoring port caps should be removed and the monitoring ports observed for ponding. Corrective action should be taken if excessive ponding is present, as specified by the system design engineer.
6. Observation ports for testing the residual head should be inspected regularly to ensure the minimum system design for residual head is met.
7. Lateral flushing should occur annually to ensure any biomat buildup is removed from the distribution lateral. Lateral flushing procedures should be described and include a method to prevent wastewater and sludge from creating a public health hazard (e.g., routing flushed water and sludge back to the inlet of the septic tank via a dedicated hose).
8. Any other operation and maintenance as recommended by system component manufacturers and the system design engineer.