Chapter VII
SOIL ABSORPTION SYSTEMS

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INTRODUCTION

A septic tank followed by an in-ground soil absorption system is the preferred on-site wastewater treatment method in Kansas. Surface discharge of effluent or wastewater or from any on-site wastewater systems is illegal in Kansas without an NPDES discharge permit. However, NPDES permits are not issued for individual on-site systems, and ultimately effluent from these systems must go into the soil or be evaporated. A wide range of options and products are available to distribute effluent throughout the soil for final treatment. In the case of lagoons, seepage and water surface evaporation are the mechanisms for dispersal. Soil beneath a mound or lagoon system is its own absorption field, thus no additional effluent dispersal mechanism is needed for these alternatives.

In a properly functioning septic tank, the composition of raw sewage changes. Solids settle to the bottom for later removal, or float to the surface and are partly digested. Septic tank effluent is still sewage with abundant pollutants and harmful microorganisms. Underground application of effluent in suitable soil at appropriate rates provides good treatment and is safe for the environment. When the absorption field is shallow (near the surface), plant roots will take up some of the nutrients, especially nitrogen, during active growth periods. This helps reduce nitrate movement through the soil to the groundwater. In soils with appreciable clay content, adsorption removes much of the phosphorous in the wastewater.

Inspection of the wastewater treatment system, regardless of the type chosen, is essential for a local permit to be issued. Suggested inspection protocols for both new and existing systems are provided on pages VII-29 and VII-32 later in this chapter.

KDHE Bulletin 4-2 specifies the need for four feet of suitable, aerated soil between the bottom of the wastewater absorption area and the shallowest restrictive layer. Four feet of soil helps ensure adequate treatment and removal of pollutants. As discussed in Chapter IV, *Site and Soil Evaluations*, restrictions such as an impermeable soil layer, high water table, rock, or other feature may limit downward water movement and adequate treatment.

Excessive phosphorous and nitrogen contribute to accelerated eutrophication and degraded water quality in surface water, especially lakes or ponds. Sandy, gravelly, or rocky soils are more limited in capacity to remove nutrients, contributing to excess nutrients at a lake's shore or branches from the main lake body. In these sensitive, ecologically critical areas, greater separation distances or designs that more reliably remove nutrients may be required.

An important consideration for an absorption field location is the possibility of future connection to public sewers. A home's plumbing should be designed to facilitate a future public sewer connection if central systems may be installed in the future. When public sewer service becomes available, the private system should be removed from service and properly abandoned. See the K-State Research and Extension publication *Plugging Cisterns, Cesspools, Septic Tanks, and Other Holes*, MF-2246, for additional information.

Choosing the Soil Absorption System

The most common effluent soil absorption system is a traditional septic tank followed by a lateral absorption field. Traditional absorption fields are well suited to deep, sandy and loamy (medium to coarse texture) soils. Soil profile layers must be moderate or well- drained and have adequate capacity to absorb and transmit water. On relatively flat sites, laterals of the same elevation are commonly supplied by a manifold or distribution box (also called a "D" box). Where surface slopes exceed 1½ percent, use of serial distribution laterals with drop boxes is strongly recommended. Individual absorption laterals should always follow the surface contour, be level, and have a uniform depth of cover, regardless of using a level or serial distribution system.

Advanced treatment, as discussed in Chapter VI, and/or alternative soil absorption systems are used when soil conditions are restrictive due to high groundwater, flooding, slowly permeable soil, shallow bedrock, or inadequate lot size. Alternative soil absorption systems provide fundamentally sound solutions when correctly designed, installed as planned, well managed, and adequately maintained. Consider long-term sustainability, installation and maintenance cost, availability of service, and continued use of the home, as well as public health hazards, environmental pollution, and prevention of nuisance conditions when choosing the system.

On-site wastewater system component features are chosen in respect to the suitability of specific site and soil conditions. Site and soil conditions are primary determinants in selecting the most suitable soil absorption system, as discussed in Chapter IV, *Site and Soil Evaluations*.

Lagoons, discussed in Chapter IX, may be a good choice when poor soil conditions make traditional laterals infeasible and space is available. Alternative soil absorption, as discussed in this chapter, may be an option when a lagoon is unfeasible or the site is unbuildable.

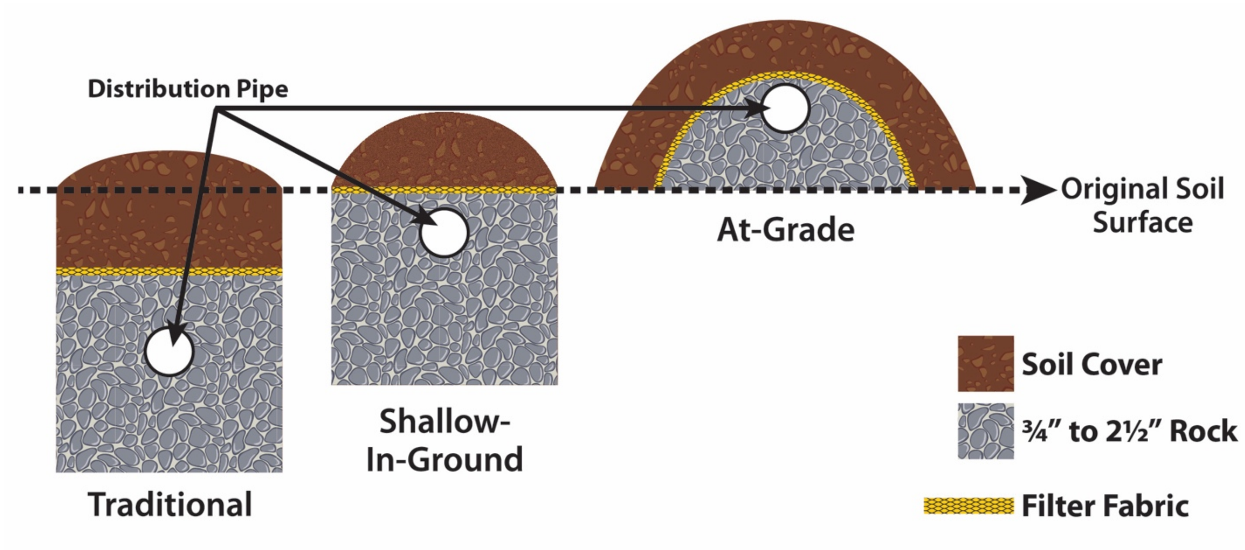
Design and construction must consider management for efficiency and regular service for long life with a minimum of problems. Use an experienced designer and/or installer for an alternative soil absorption system. Traditional tanks and laterals need only simple maintenance. Conversely, service of alternative systems requires knowledge of pumps, controls, timers, and their operation together. Regular field checks are essential. Choose a system that can be constructed properly, has maintenance access, and can be maintained locally.

Alternative Soil Absorption Systems

Alternative soil absorption systems include shallow in-ground, at-grade, bed, low-pressure pipe, drip, and mound systems. Mounds are also a treatment component and are discussed in Chapter VI, *Enhanced/Advanced Treatment*. Design and installation guidelines for alternative soil absorption systems are discussed in this chapter. Traditional, shallow, and at-grade systems, shown in Figure VII-1, are suitable for soil profiles with moderate or greater depths to restrictions. It is essential to know, understand, and comply with the local sanitary code.

Many bacteria and pathogens are filtered out as wastewater percolates through soil pores. Viruses may be adsorbed onto clay or organic particles where they can remain until they are inactivated by harsh environmental conditions. Soil particles also trap other chemicals, including phosphorus and ammonia (a form of nitrogen). Treatment processes are most effective when the loading rate does not exceed the soil's capacity to treat wastewater. Equal distribution of wastewater to the field aids both absorption and treatment.

Figure VII-1. Soil Absorption Options for Moderately Shallow Soil



EQUAL WASTEWATER DISTRIBUTION

All wastewater, both from a septic tank and from enhanced treatment components, must receive final treatment by the soil absorption system. Treatment works most efficiently when the loading is uniformly distributed among laterals and along their lengths. The principles to help achieve uniform distribution include the following:

- level bottom for all lateral trenches
- uniform depth with equal cover for all laterals
- equal distribution of wastewater among all laterals

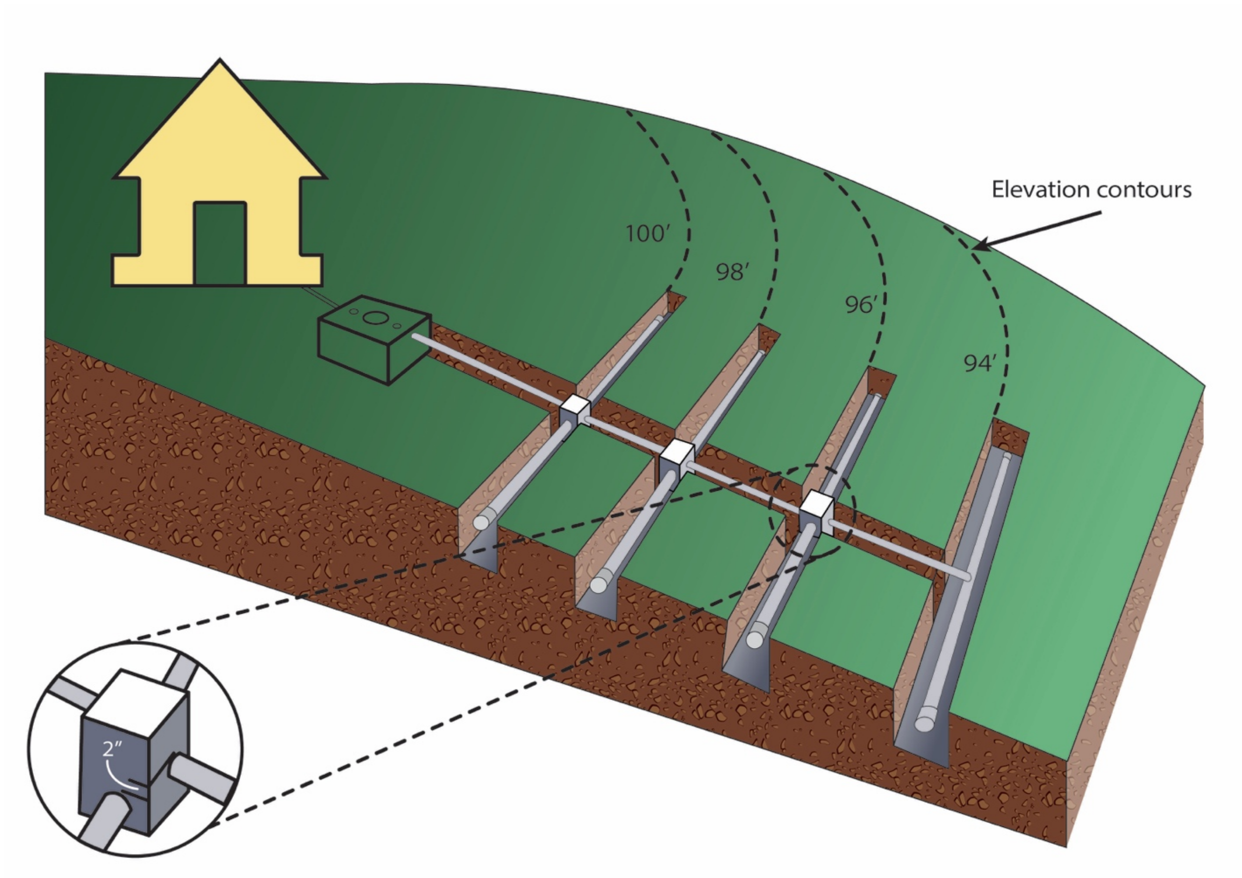
Uniform distribution is aided by the biomat and by intermittent low-pressure dosing of laterals, which is discussed in a later section. Effluent from a septic tank causes a clogging layer (biomat) to form within months at the soil/water interface in laterals. The biomat has a high concentration of microbes that filter suspended solids, such as organic matter and other microbes, from the effluent. Research shows as much as 90 percent of the treatment occurs in the biomat layer. As the biomat develops and becomes thicker, the absorption, or long-term acceptance rate, of the lateral is reduced.

When flow through the biomat is less than the wastewater load, backup into the structure or surfacing in the yard typically results and the absorption field is said to be failing. Saturated soil surrounding the laterals of failed systems limits the oxygen transfer needed for microbial decomposition.

Two types of absorption fields are commonly used. The most common is used for level sites (slope up to 1 percent) with all laterals the same elevation, and supplied by a distribution box or manifold. The other type is a serial distribution or step-down system where the next lateral is lower than the one above and is used when slopes exceed 1.5 percent. Type of soil absorption system, location, design, construction, and maintenance help minimize the chance of failure.

With gravity flow, it is extremely difficult to achieve equal distribution even when using a distribution box. The typical flow from a tank is just a trickle, which cannot practically be equally divided in the D box, even when it is carefully leveled and regularly checked. Flow levelers in each lateral of a D box help equalize flow when they are carefully adjusted several times a year. Thus, a D box or manifold pipe is only suitable for a level site with all laterals at the same elevation.

Figure VII-2. Typical Serial Distribution System for a Sloping Site



Even when flow is equally divided between laterals, wastewater still enters one end, and distribution along the lateral requires a level lateral and development of the biomat.

With the serial distribution or step-down system, the first lateral is filled and fully utilized before excess effluent overflows to the next lateral. Thus, the capacity of each successive line is utilized before flow reaches the succeeding lateral. With this system, to prevent capillary action from causing the soil above the lateral to be saturated, the invert of the overflow line should be at least 2 inches below the top of the lateral rock fill as shown in Figure VII-2.

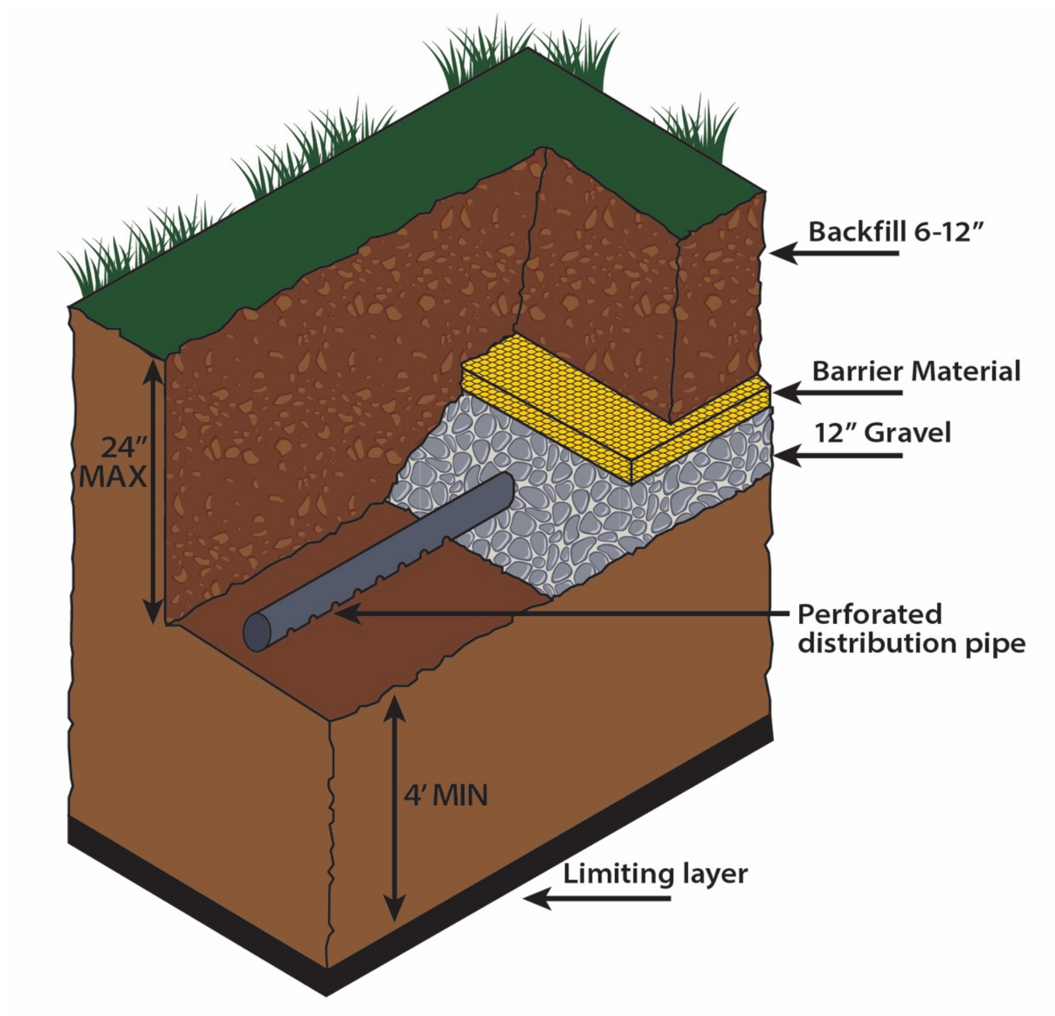
The most accurate way to achieve uniform distribution is by pressure flow. This has been done by small diameter, low-pressure pipes with small orifices; drip lines; and pressure manifolds delivering to gravity laterals. A pump or dosing siphon produces the pressure and hydraulic design assures it will work as required. As with all mechanical and electrical equipment, care of the system is important and maintenance (much more than for traditional laterals) is essential.

TRADITIONAL ABSORPTION FIELD

A traditional absorption field is a system of narrow trenches partially filled with a bed of clean gravel, crushed stone, or similar material surrounding perforated pipe, as in Figure VII-3. In place of gravel, gravelless components are available and are discussed in this chapter. Septic tank effluent is delivered to the field via the perforated pipe, and enters the gravel and then the surrounding soil.

Soil absorption fields should be sited far enough from wells, streams, and impoundments to minimize chances of contamination.

Figure VII-3. Traditional Rock and Pipe Absorption Trench



The design should plan for regular maintenance and construction must provide for easy access so service and repair can be efficient. Minimum and recommended separation distances for absorption fields from other facilities are given in Table VII-1. Also, it is always wise to plan for a replacement field in an accessible area of suitable soil.

In order to achieve minimum separation distances, site features may require pumping septic tank effluent to reach the most suitable soil absorption field location. In this case, as for all onsite systems, provide for easy access for maintenance and repairs during design and construction, including service of the septic tank by the septage pumper/hauler.

Once a soil absorption system has been sited, it is essential for contractors and the owner to understand the importance of preventing site improvements from interfering with the operation of the soil absorption field or replacement area. Driveways, walkways, additions to buildings, a swimming pool, or other improvements should never be constructed over or downslope of the absorption field or replacement area. Also surface water should always be diverted from the vicinity of the soil absorption field. Always avoid utility easements, because future installation or repairs of the utility may damage the field.

Table VII-1. Required and Recommended Separation Distances from Absorption Field

	Required Minimum	Recommended Minimum
Public Well or Pump Intake Line to Field	100	200
Private Well or Pump Intake Line to Field	50	100
Public Drinking Water Line to Field	25	50
Private Drinking Water Line to Field	10	25
Property Line to Absorption Field	10	50
House Foundation to Absorption Field	20	50
Surface Water or Water Course	50	100

**To meet these separation distances, a lot size of at least two acres may be needed. Always comply with local codes. These and other minimum distances are listed in Table IV-7 and KDHE Bulletin 4-2 Table 5.*

Pressure Distribution

Dosed low head pressure pipe is ideal to achieve uniform distribution of wastewater in soil absorption laterals. This dosed, or controlled pumped, distribution also provides the opportunity to do timed dosing with resting cycles. Dosing helps assure the soil stays aerated and helps limit thickness of the biomat. Pumping also allows the absorption field placement at a higher elevation than the septic tank, which maximizes the area and design options on sites. Because the biomat provides much of the treatment, maintain it; do not attempt to eliminate it.

A pressure distribution system has the advantage of enabling equal flow between all laterals and also along the lateral length. Regular maintenance is an essential component of pressure distribution. Annual maintenance must include the following:

- check components for damage and blockage
- clean all filters and screens
- clean distribution pipes and orifices
- test floats, controls, and pumps to verify they operate as designed; adjust as needed
- verify correct dosing times and volume

ABSORPTION LATERALS

Wastewater distribution in lateral fields by gravity depends on careful elevation control during construction and few solids in the effluent to limit clogging of absorption lateral pipes. Typically, a maximum gravity-fed lateral does not exceed 100 feet, and is preferred to be less than 60 feet. If a lateral is supplied from the center, total length shall not exceed 200 feet (100 ft to each side) and a maximum of 120 feet is preferred. Longer runs may be feasible when an effluent screen controls solids carry-over to laterals, elevation control is accurate, and there is regular maintenance. All laterals at the same elevation must be connected at each end with a level manifold or connector pipes to avoid dead ends.

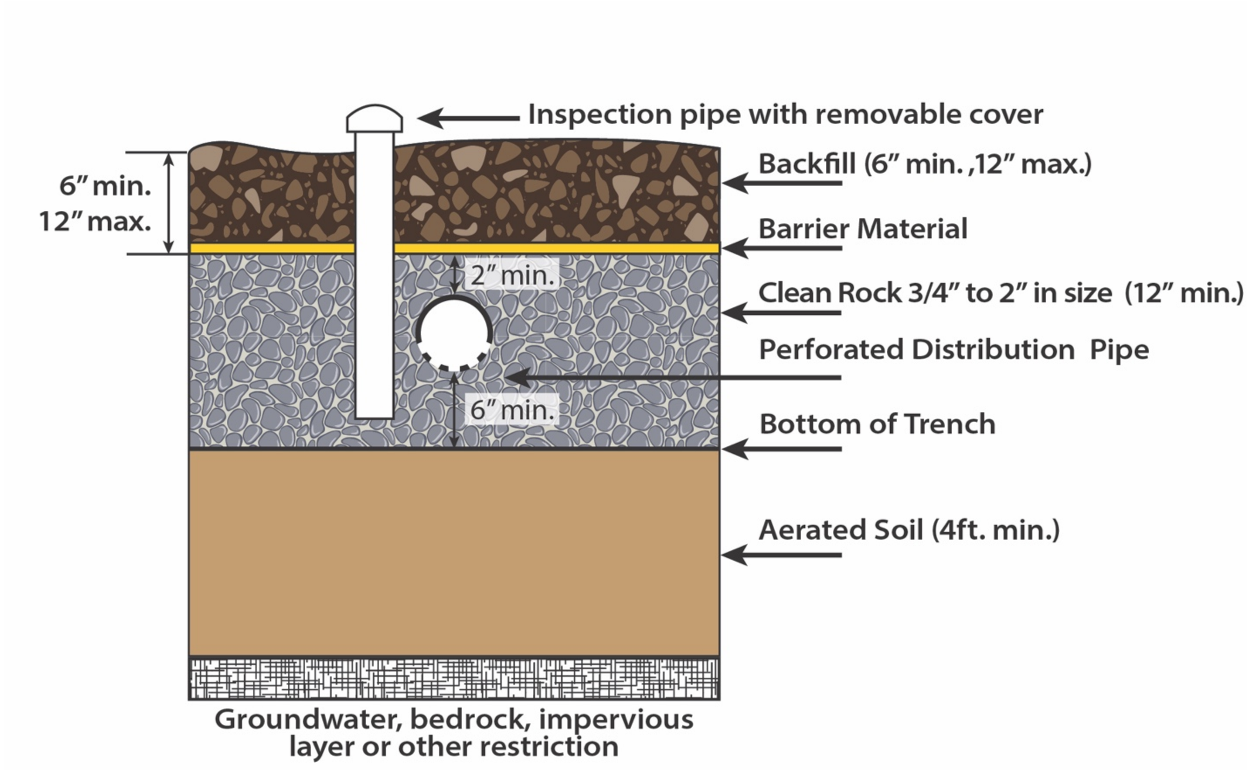
Absorption field area is dependent on two factors: wastewater flow and the soil loading rate discussed in Chapter IV, *Site and Soil Evaluations*. The wastewater flow is based on the house being fully occupied with two persons per bedroom. Thus, the wastewater design flow is based on the number of bedrooms at 150 gallons per day (gpd) per bedroom (75 gpd per person). The absorption lateral bottom area is obtained by dividing the wastewater flow in gpd by the loading rate in gallons per day per square foot (gpd/ft2).

Although absorption trench width may vary from 18-36 inches, 24 inches is the preferred width (see trench design in Figure VII-4). A minimum of 6 inches of gravel is placed under the 4-inch-diameter distribution pipe, followed by enough gravel to cover the top of the pipe by at least 2 inches. Soil cover over the trench should be at least 6 inches to provide adequate rooting depth for perennial grass, and no more than 12 inches to maximize water and nutrient use by vegetation as well as oxygen transfer to the lateral.

To enable aeration and promote plant uptake of water and nutrients, the lateral trench bottom should be as shallow as practical, but at least 18 inches deep unless additional cover is added over the lateral. The lateral should follow a level grade (on contour of the ground surface) rather than a straight line. On sloping sites, a step-down distribution arrangement is preferred. To maintain a level bottom on uneven site surfaces, trench depth may need to vary within a range of no more than plus or minus 2 inches of the average depth.

With shallow lateral depth, lateral lines may freeze during an extreme or prolonged cold period. Freezing is not usually a problem in Kansas for a carefully constructed system with ground cover that continues in daily use during the cold period.

Figure VII-4. Traditional Rock and Pipe Lateral



Freezing is more likely to be a problem when water stands in lines, and may be a problem when no water is used during a cold period. The lines should be designed and constructed to allow water to drain. Use of check valves or other features to retain water in the piping is not recommended unless the pipes are below the maximum frost depth.

When space permits, adjacent absorption laterals should be separated by at least six feet of undisturbed soil. Table VII-2 shows minimum spacing for a range of trench widths to achieve the 6-foot separation. When space is limited, the separation can be reduced, but this may make construction more difficult. Individual laterals should be constructed parallel to surface contours at uniform depth with a level trench bottom and curved to best fit the topography; avoid abrupt changes in direction.

Table VII-2. Trench Separation Distances

Trench Width (In.)	Minimum Distance Between Trenches (Ft.)	Minimum Distance Between Trench Centerline (Ft.)
18-24	6.0	8.0
24-30	6.0	8.5
30-36	6.0	9.0

Absorption Field Materials Guidelines

Perforated distribution pipe is commonly used and, where dosing is not required, 4-inch diameter pipe is standard. Typical designs for absorption laterals are shown in Figures VII-3 and VII-4, and a typical layout for serial distribution is shown in Figure VII-2.

Rigid PVC or corrugated polyethylene plastic pipe, meeting American Society for Testing and Materials (ASTM) standards D2729 and F405 or latest edition, respectively, is the minimum standard for use as gravity distribution lines. All materials used in the plumbing, wastewater line, and lateral fields shall meet standards specified by ASTM. In gravity flow lateral pipes, perforations are round, ½-inch diameter and are located at 4 and 8 o'clock positions on the pipe circumference with 6-inch spacing along the pipe. In no circumstances would slotted pipe be acceptable as the narrow slot openings plug easily.

Washed gravel or washed crushed stone is commonly used as the porous media for the trench. The media gradation shall be ¾ inches to 2 inches in diameter. Smaller sizes are preferred because they reduce masking of the infiltration surface. It is best to have a uniform size because more void space is created. Rock having hardness more than three on the Mohs hardness scale is required. Rock that can scratch a penny without crumbling or flaking generally meets this criterion. Larger diameter and smaller diameter material or soft aggregate such as calcite limestone are not acceptable and shall not be used.

Fines must be eliminated as much as possible to prevent clogging of the void space. Fines shall not exceed 5 percent by volume, so unwashed material is normally not acceptable. A test should be done to confirm the media is adequate. To test for fines, place five inches of material in a clear container. Fill the container with water and wash. Remove the washed gravel and let the fines settle. Five inches of gravel should produce less than one-quarter inch of fines.

The porous media must be covered with a non-woven filter fabric (at least 3-ounce nylon or 5-ounce polypropylene) before backfilling to prevent soil from sifting through the media.

Traditional untreated building paper or a 3-inch layer of straw are not recommended because they deteriorate over time and allow soil to work through the rock media material. Filter fabric (also known as geotextile, geotextile fabric, and landscape fabric) materials shall be fully permeable to air and water.

Geosynthetic aggregate media similar in size to the gravel and inert in wastewater may be used for laterals. Chunks of shredded tires can be a suitable substitute for rock. Ninety percent of the pieces should be ½ to 4 inches in size with no fines. Wire strands shall not extend more than ½ inch from the tire pieces.

When suitable rock or gravel is not locally available, is expensive, or access to the site is restricted, gravelless systems may be a suitable option for laterals. Gravelless options include chambers and large-diameter pipe.

Before using gravelless pipe, consult the local authority to identify requirements.

Field Construction Guidelines

Protection of the absorption field area should begin before any activity on the site. The site and soil evaluation identifies the best soil absorption area and a reserve area. All traffic, especially heavy equipment such as loaded trucks, should be kept away from the absorption fields by marking the site (fencing is preferred). Compaction from weight of such equipment can permanently alter soil characteristics. Excessive traffic from equipment or livestock can compact even relatively dry soils.

Construction of soil absorption field laterals when the soil is too wet causes compaction and smearing of the soil. This destroys soil structure, which greatly reduces the soil's capacity to absorb water and reduces treatment efficiency of the field. A test to determine appropriate soil moisture is to work the soil into a ball and roll between the hands. If it can be rolled into a ¼-inch- diameter rope shape without falling apart, it is too wet and construction should be delayed until the soil is dryer. Depending on season and rainfall, drying may take weeks or even months.

Before beginning construction, contours should be located using a surveyor, contractor, or laser level, and lateral locations should be marked on the contour by paint, flags, or stakes.

Lateral trenches shall not be excavated deeper than the design depth or wider than the design width.

Following excavation, the trench sides and bottom shall be raked to remove any smearing and graded to assure the bottom has less than 1-inch difference in elevation along the full lateral length, or in the complete field for a level system. The lateral pipe and rock cover shall not vary more than 1 inch in elevation along the lateral length when checked by a contractor, surveyor, or laser level.

When the trench bottom has been adequately prepared, it should be promptly filled with at least 6 inches of gravel, or, for a gravelless system, 6 inches from where the gravelless distribution line will be placed. Distribution pipes are carefully placed on the rock and leveled, with perforations aligned at 4 o'clock and 8 o'clock positions for all pipes. Rock is placed around and over the pipe to a cover depth of at least 2 inches. After rock and pipe have been placed into the trench, the filter fabric shall be placed to cover the rock and prevent downward soil movement. If gravelless chambers are used, the backfill along the sides should be compacted following the manufacturer's guidelines.

The lateral should be backfilled as soon as possible after inspection to prevent rainwater from filling it, sidewall collapse, and sediment washing into the trench. Earth backfill shall be carefully placed to completely fill the trench cavity. The backfill shall be mounded 2-3 inches (20 percent of the soil fill height) above the trench to allow for settling. If shallow in-ground or at-grade placement is used, topsoil must be placed between laterals as well as over the lateral to level the site. After settlement, the entire disposal area should be graded and seeded with grass. Heavy equipment should not be used to cover lateral trenches. Grading should be limited to handwork or very small equipment.

ABSORPTION FIELD INSPECTION

Inspection is one of the most important tasks associated with construction of new wastewater absorption fields and evaluation of existing wastewater systems. The sanitarian should inspect the absorption field after the materials have been placed but before the laterals have been covered. In most cases the sanitarian will do the inspection to evaluate whether the system meets minimum standards of the local code. This involves assuring components meet minimum requirements for type, quality of material, dimensions, and construction; the location meets setback distance and configuration requirements (slope, position, elevation); design and sizing have been satisfied; and construction meets requirements.

Existing systems must be evaluated using most of the same requirements used for new systems. Suggested protocols for evaluating new and existing systems are included together with inspection forms at the end of this chapter. A full inspection of an existing septic tank is only practical when it is empty, meaning the tank must be pumped, see Chapter V, *Septic Tanks*.

Evaluation of sludge and scum accumulation in the tank is the responsibility of the owner and is discussed in Chapter V. Figure V-5 depicts how measurements may be done.

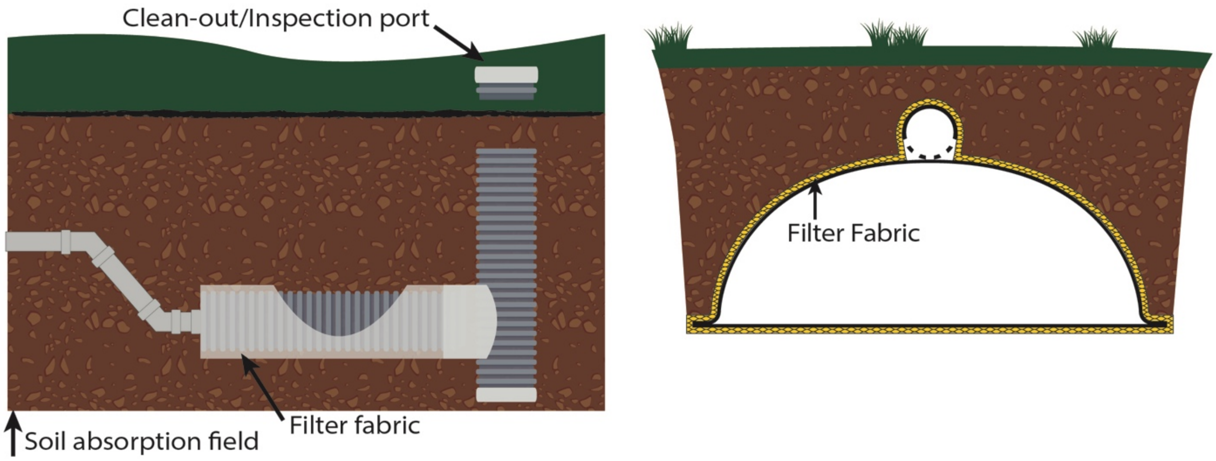
GRAVELLESS SYSTEMS

Gravelless systems typically have an open-bottom structure resembling half of a large-diameter pipe, to create an underground chamber to distribute and “store” effluent. Sidewalls are slotted with louvers to allow lateral movement of effluent. Figure VII-5 shows a typical gravelless chamber diagram. Chamber systems do not require piping to distribute wastewater within the lateral. Gravelless systems do not require rock or gravel to maintain an open trench for contact with the soil. Installation criteria emphasize the trench bottom must be level to allow for even distribution of wastewater. Lack of material in the trench means wastewater is in contact with a greater surface area on the trench bottom compared with a rock-filled trench, and that the effluent contacts the entire bottom surface and not just the voids between the aggregate materials. Absence of rock masks the surface, and thus less bottom area is required for chambers than for rock laterals, allowing for use of an increased loading rate.

Based solely upon use of gravelless systems, KDHE does not recommend a reduction in lateral area. Each local permitting authority should carefully consider any request for reducing the lateral area based upon industry claims, local experience, and available information. Manufacturer claims are typically in the 40-50 percent reduction range. Since 1995, Kansas health departments and local environmental protection groups have granted reductions ranging from 0-40 percent. When given, the most common reduction is 20-30 percent.

Reducing the absorption area for chambers should be done with caution. Wastewater permits typically contain a statement that owners are responsible for future performance of their wastewater system and will be required to make corrections in the case of failure, regardless of the cause of that failure.

Figure VII-5. Typical Configuration of Gravelless Chambers



Before using a gravelless system, the installer should be familiar with the manufacturer's limitations for the use of their system and all recommendations for installation. Some manufacturers recommend a maximum trench depth of 36 inches for their chamber. The type of gravelless system used depends upon factors such as: availability, site considerations, contractor preference, and cost. Some chamber designs allow lateral flexibility, allowing them to be more easily installed along the curved elevation contour of a sloped lot. Manufacturers make or imply claims of lateral reductions that vary by chamber design or model. This claim is based on the increased side-wall area of some designs by making the chamber narrower and taller. At present, KDHE recommends any reduction be based only on the amount of open bottom area for each design; it does not consider the extra sidewall "benefit." This is especially important when considering lateral field sizing between two or more brands and designs.

A small limitation to gravelless chambers is the impermeable top that may limit the evapotranspiration potential of the lateral field. This typically shows up during a dry summer when cool season grass is stressed or goes dormant, and there is a green strip on each side of the chamber but not over the top. In contrast, a rock pipe lateral will typically have green grass across the full width indicating water is available to the grass from the lateral.

A recent modification to gravelless lateral design is use of a narrow chamber (usually less than 24 inches wide) in a full 36-inch wide trench. Spaces on each side of the chamber to the trench sides are filled with clean rock or gravel as in rock laterals. Be sure the manufacturer's warranty is not affected before choosing to do this. The full 36-inch lateral width should be counted when calculating size of the resulting lateral field. Gravel in these laterals must be covered with filter fabric to prevent soil from filling rock void spaces.

Large Diameter Pipe

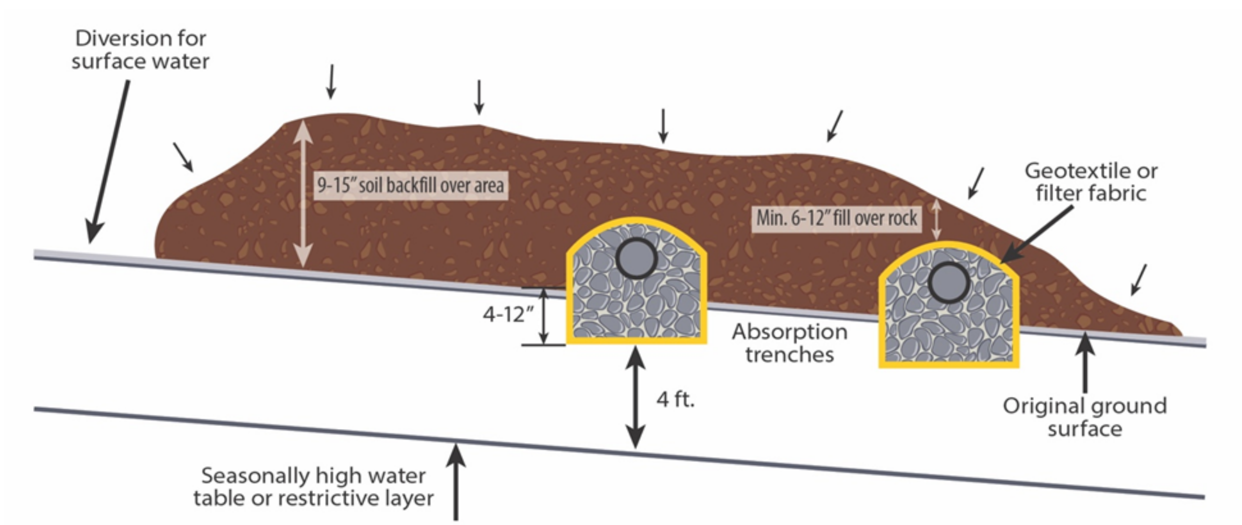
Another gravelless distribution option is large-diameter, corrugated perforated pipe. Manufacturers make this pipe in 8- or 10-inch diameter or larger, similar to distribution lateral pipe, except a larger size. Systems using this pipe have been widely tested by manufacturers, but relatively few tests have been conducted by independent researchers. No design criteria have been developed other than those provided by the manufacturer. The potential user is advised to follow the manufacturer's recommendations. The outside of the pipe is covered with geotextile fabric. Experience suggests this pipe may work better for fine-textured soils than coarse ones.

SHALLOW IN-GROUND LATERALS

A shallow in-ground lateral system is basically the same as conventional soil absorption laterals, except trench depth is often 6 to 12 inches, which is more shallow than a conventional lateral depth of 18 to 24 inches. The shallow in-ground design raises the laterals about a foot higher than in a conventional trench, increasing soil depth beneath the bottom of the laterals. This design variation is useful for sites having a reduced soil depth to a restricting layer (only 4 ½ to 6 feet instead of the normal 6 feet or more total depth for traditional laterals). It allows normal placement of the rock in a trench beneath and around the lateral pipe. The laterals and the space between them are covered with topsoil comparable to topsoil on the site. As with all rock laterals, it is essential that filter fabric cover the tops and sides of the rock that extends above the top of the trench. Figure VII-6 shows the lateral cross-section for shallow in-ground lateral systems. All other design criteria for this system would be the same as for traditional systems.

In the construction process, the vegetation should be removed from the soil surface to be covered with topsoil. The surface should also be roughened to a depth of 3 to 4 inches as described for mounds in Chapter VI. The contractor should be careful to avoid driving equipment over the absorption field site during construction because traffic on the site will compact the soil and reduces its capacity to absorb water. Mark the site to protect the field and consult with the contractor before beginning the installation. Construction should only be done when the soil is dry enough that when rolled between the palms the soil should not roll out to a rope shape less than ¼-inch in diameter without falling apart.

Figure VII-6. Typical Shallow In-Ground Absorption Bed and Lined Lateral Sections



AT-GRADE LATERALS

As the name implies, an at-grade lateral system is constructed on the natural ground surface; thus, no trench is excavated. This system is ideal for sites where the limiting condition provides only 4 feet of suitable soil below the surface. Protection of the original soil surface from disturbance by equipment during all phases of site construction is essential. The natural soil surface becomes the lateral bottom or soil absorption surface. The maximum site slope should be no steeper than about 6 to 1 (16 percent) to simplify construction, especially aggregate placement. This also enables use of normal construction equipment without excessive hand labor and helps ensure proper long-term operation.

Because water movement into the soil is essential to prevent lateral movement (especially on sloping sites) and seepage at the toe, which is at the natural soil surface, an at-grade system requires greater care during construction than traditional laterals. The soil must be dry enough that equipment does not cause either tracks or compaction. A good rule is that a ¼-inch soil rope cannot be formed without falling apart (soil cannot be rolled into a smaller rope shape). The site must be level along the laterals and the surface must allow water to infiltrate.

Construction of an at-grade system is similar in many respects to construction of a mound, except that no sand fill is used. Prior to installing an at-grade lateral line, all vegetation is removed. All grass, brush, and trees are cut just above ground level and removed; tree stumps are left in place. A tracked vehicle should be used in all phases of construction to help avoid soil compaction.

A level soil surface contour is laid out using a surveying level. Minor cuts and fills along the contour may be used to smooth surface irregularities. The soil surface under the laterals and at least 5 feet to the sides is roughened to a depth of a few inches by using the teeth of the excavator bucket or chisel plow, as is done for a mound (see Chapter VI). The lateral location is carefully marked using a contractor, surveyor, or laser-level to maintain a level grade.

Six inches of aggregate is placed on the prepared soil surface, following the marked contour. The distribution pipe is placed on the rock fill, again using the level to ensure the level grade is maintained. Additional aggregate is placed around and over the pipe covering it by at least 2 inches. Figures VII-1 and VII-7 show a cross-section of an at-grade lateral line for rock and pipe (chambers would be similar). On sloping sites, the pipe should be placed on the upslope side of the aggregate. The aggregate should have maximum side slopes of 1 to 1, minimum thickness of 1 foot (9 inches for low-pressure pipe), and maximum width at the soil surface of 3 feet.

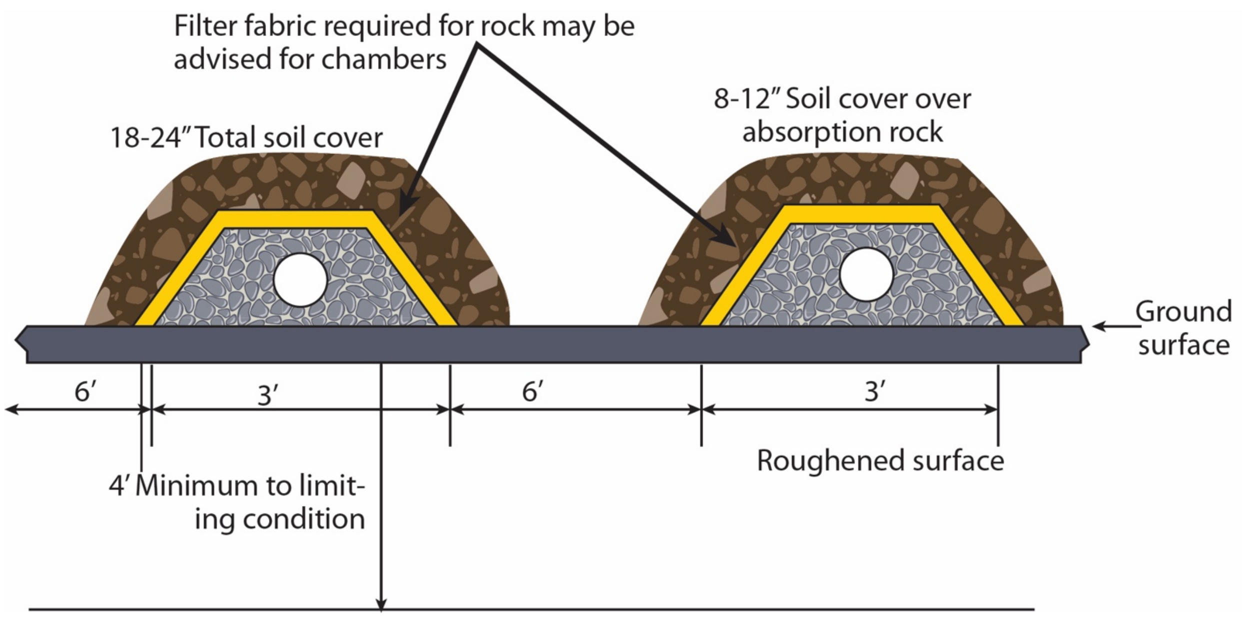
When laterals have been placed with at least one inspection pipe in each, the aggregate is covered with filter fabric as described earlier. Finally, the entire absorption area, including laterals and space between them, is covered with topsoil to a depth of 8-12 inches over the lateral aggregate. Properties of the topsoil used for cover should be similar to the natural topsoil of the site.

The loading rate and design procedures are essentially the same as for conventional laterals. On a level site, laterals would all be level and distribution pipe would also be level with the lateral ends connected by solid pipe. Standard minimum spacing between laterals is 6 ft as shown in Figure VII-7, the same as for a conventional lateral system. On sloping sites, a drop-box system may be used, but is only recommended for slopes up to 1 ½ percent. Low-pressure, dosed distribution lines are recommended for slopes exceeding 1 ½ percent.

A low-pressure distribution system using a few doses per day would be suitable for any site and is strongly recommended for all sloping sites. The improvement achieved by a pressure-dosing system will help assure a long, viable operating life. For sites with slopes exceeding 1 ½ percent, a pumped low-pressure distribution system is essential to assure even distribution of wastewater across the absorption field. When a pressure-dosing system is used on a site where laterals are at different elevations, care must be taken to equalize pressure, and thus equalize the loading rate for all laterals. A simple way of doing this is to put a gate or globe valve at the inlet to each lateral. A standpipe of clear plastic or a sensitive pressure gauge can be used to equalize the pressure when the system is installed. Once the pressure is set, the extra equipment can be removed until it is checked or needs to be reset. The following design example will help the reader understand the application of these principals.

Construction of an at-grade lateral field requires careful procedures. Small tracked equipment (such as a loader) should be used to reduce soil pressure during construction. The topsoil cover must be placed over the aggregate before equipment crosses it. It is best to conduct machine passes parallel with the laterals. Minimize machine traffic as much as possible.

Figure VII-7. Typical At-Grade Lateral Section (rock and pipe shown; chambers would be similar)



At-Grade Design Procedure

Designing an at-grade system is somewhat similar to designing an engineered mound, except that a mound may use a distribution bed while the at-grade system uses multiple laterals. The number of laterals depends on the maximum linear loading rate as discussed in more detail in the engineered mound section of Chapter VI.

Horizontal and Vertical Separation

Horizontal set-backs will be dictated by local code and should be followed for all soil absorption systems receiving septic tank effluent. Most codes have required separation distances between the bottom of the aggregate and the limiting soil condition, such as bedrock or high-water table. In Kansas, the minimum standard for vertical separation distance below the bottom of the absorption lateral is four feet. Thus, the at-grade system would only be suited to sites where there is at least four feet of suitable soil to a restriction.

Slope
The maximum slope on an absorption field site should not exceed 16 percent.

Linear Load Rate
The linear loading rate is defined as the amount of effluent applied (gallons) per day per linear foot (gpd/lf) along the natural contour. The mound section of Chapter VI (p VI-12) has more discussion about linear loading. Table VI-4 and Figure VI-7 illustrate general limiting soil and site conditions and suitable research based linear loading rates. Design linear loading is a function of the soil and geologic material that allows effluent to move vertically through the profile and laterally downslope away from the absorption area. If movement is primarily horizontal, a low linear loading rate (3-4 gpd/lf) is extremely important. If the flow is primarily vertical, then the linear loading rate can be higher, but still should be limited to a maximum of 8-10 gpd/lf. A linear load rate greater than 10 gpd/lf may result in a very wide absorption area, especially when the soil surface limits infiltration into the soil.

Soil Loading Rate
The soil loading rate is based on the surface soil layer that is in contact with the aggregate or the most restrictive layer within 2 feet below the surface. For an at-grade system, the aggregate is in contact with the natural soil surface. Refer to Table IV-4 in Chapter IV for recommended loading rates for various soil texture and structure conditions.

System Configuration
The system configuration must meet the soil site criteria and should typically be laid out along the contour and narrow parallel with the slope. A system that is too wide may leak at the downslope toe or at any toe on a level site. Other factors, such as oxygen transfer and exchange beneath the absorption area, are also affected by the width of the system. If there is not sufficient length along the contour, but there is sufficient distance along the slope, more than one at-grade system can be used to achieve the desired or required effective absorption area. As for all lateral fields, a terrace should be installed on the upslope side to prevent upslope runoff from entering the field area.

Effective Absorption Area
The effective absorption area is that which is available to accept effluent. The effective length of the absorption area is the actual length of the aggregate along the contour. The effective width on sloping sites is the distance from the distribution pipe to the downslope toe of the aggregate, and on level sites it is the total aggregate width.

Total Length and Width
Once the effective length and width of aggregate/soil contact area is determined, it is

necessary to add about 6 feet to each side and at the end of the absorption area to shape the cover soil into the existing soil surface. Greater widths are acceptable if additional landscaping is desired. Recommended maximum slope for the sides of the absorption area cover is 4 to 1 (4:1), but flatter is more desirable.

Pressure Distribution

To assure uniform effluent distribution and to avoid leakage at the toe, pressure distribution is recommended for dispersing effluent in at-grade systems. With site slopes greater than 12 percent, pressure distribution should always be used. Pressure dosing distributes the effluent evenly along the lateral through the small-diameter orifices. After it is dosed, the water moves vertically downward through the aggregate to the soil surface. As effluent comes into contact with the soil, it will move laterally (downslope on sloping sites and in all directions on level sites) as needed to infiltrate the soil. The pressure distribution network configuration will vary depending upon the size and dimensions of the absorption area. For level sites with absorption laterals up to 3 feet wide, a single lateral pipe in the center along the system length will suffice. Though not recommended, a wider absorption bed could be used on a level site. For a bed, equally spaced lateral pipes fed by a center manifold are used.

On sloping sites, the distribution network may consist of a single perforated pipe on the upslope edge of the aggregate lateral with a center feed preferred. The lateral pipe is installed nearest the upslope edge and water will move downslope by gravity. Multiple laterals, spaced parallel and 6 feet apart, as shown in Figure VII-7 and supplied by a short manifold, are recommended when the linear loading allows more water than a single lateral can supply.

Cover

After the aggregate, distribution pipe, and observation tubes have been installed, a synthetic geotextile fabric (or filter fabric) is placed over the aggregate. Approximately one foot of soil cover is placed on the fabric and extended/tapered to a distance of at least six feet beyond the aggregate edge. The surface is seeded with perennial, cool season grass to control erosion and maximize evapotranspiration

At-grade Design Example

Because an at-grade system involves more detailed site-specific design than traditional laterals, an example is presented here to help readers understand the design steps and calculations.

Information given:

- Typical three-bedroom house with standard features and no unusual uses
- Soil and site criteria
  - Site slope is 8 percent in proposed absorption field area
  - Proposed absorption area is 175 ft along the contour and 30 ft with the slope
- Soil profile description
  - 0-12 in. silt loam; 10YR 2/1 color; moderate, blocky structure; friable consistence

- 12-24 in. silty clay loam; 5YR 3/1 color; moderate, blocky structure; firm consistence
- 24-48 in. silty clay; 10YR 5/3 color; strong, blocky structure; very firm consistence
- 48 plus in. silty clay; massive structure; very restricted drainage; many medium, prominent mottles indicates a seasonal perched water table in this zone

Design Step 1

Determine the design flow rate (DFR). Because this is a typical three-bedroom house, use 150 gallons per bedroom per day (based on occupancy of two people/bedroom) to calculate the design flow rate. Use: 3 x 150 ***DFR = 450 gpd***

Design Step 2

Select the linear loading rate (LLR) based on evaluation of the sites soil profile. Because the profile consists of a permeable surface soil horizon over a slowly permeable subsoil horizon with a seasonal perched water table, the subsurface flow must be primarily horizontal with negligible vertical flow below 4 feet. Since the slope is moderate, a narrow lateral is most appropriate. The perched water table and very restricted drainage in the area necessitates a low LLR as discussed in the engineered mound section of Chapter VI. Therefore use: ***LLR = 4.0 gpd/lf***

Design Step 3

Choose the soil loading rate (SLR) for laterals on the site based on the properties of the soil layer that is the infiltrative surface. Use Table IV-4 (page IV-7) for selecting the appropriate SLR that matches the soil conditions. Because this is a silt loam texture with moderate structure and friable consistence, use the value: ***SLR = 0.6 gpd/ft2***

Design Step 4

Determine the required width (W) of the absorption surface. This is obtained first by dividing the linear loading rate by the soil loading rate to find the effective width (EW) or

EW = LLR / SLR

On a level site or one with very slight slope (less than 12 percent), the effective width (EW) is the required width (W) of the aggregate. On a sloping site, aggregate upslope of the distribution pipe is not effective for infiltration. On slopes, total aggregate width must be about 1.5 ft wider to support the upslope side of the distribution pipe network and to allow for the natural slope of the aggregate. When the width is more than 4 feet, it should be divided into multiple laterals with a separation space between them to approximate standard lateral spacing. Using the linear loading rate of 4 gpd/lf and the soil loading rate of 0.6 gpd/ft2 from steps 2 and 3, then:

EW = 4 gpd/ft / 0.6 gpd/ft2 = 6.7 ft **and** ***W = 6.7 + 1.5 ft = 8.2 ft.***

To maintain the desired narrow lateral, this would best be done using two laterals with a six-foot spacing between them so each lateral would be ***EW = 3.4 ft*** **and** ***W = 3.4 +1.5 ft = 5 ft.***

Design Step 5
Determine the required length (L) of the absorption area by dividing the design flow rate (DFR) by the linear loading rate (LLR) as follows.

L = DFR (gpd) / LLR (gpd/lf)

For this at-grade example, the design flow rate is 450 gpd from step 1 and the linear loading rate is 4 gpd/lf from step 2, so the required length is

L = 450 / 4 = 112.5 use 113 ft.

Thus the effective absorption area is 113 ft by 3.4 ft times 2, or 768 square feet.

Design Step 6
Determine the system configuration that best fits the site. Once the effective width and length of the absorption area are determined, the designer must determine if and how it will best fit on the site. When there is not sufficient length along the contour on the site, it may be possible to divide the absorption area into multiple zones. The required length of the absorption area is less than the available 175 ft along the contour so it fits the site.

Design Step 7
Determine the height of the lateral. Design for a minimum of 6" of aggregate beneath the distribution pipe and about 2" covering the pipe. Using small-diameter low-pressure pipe, the aggregate would be 9 to 10 inches deep. The aggregate will taper to zero at the edges. Place synthetic fabric over the aggregate and 8 inches of soil cover over the fabric. Total fill height over the lateral above the original grade will be about 1.5 foot at the distribution pipe and taper to zero at the edges of the dispersal field.

Design Step 8
Determine the total length (TL) and total width (TW) of the absorption field by adding the sloping fill to each side and each end of the absorption area. This allows the soil cover to slope gradually from the top of the soil covered lateral to the natural surface. A standard 5 feet can be added to each side and each end of the area. However, it is preferable to calculate the upslope and downslope width additions using design steps 12 and 13 in the engineered mound section of Chapter VI, pages VI-19 and VI-20, respectively. When desired, wider slope widths can be used to achieve flatter slopes for landscaping purposes.

TW = absorption width (W) + upslope width + downslope width

TW = 2 x (lateral width) + space between laterals + upslope width + downslope width

= (2 x 5) + 6 ft + (4 x 1.5 x 0.76) ft + (4 x 1.5 x 1.47) ft

TW = 10 + 6 + 4.6 + 8.8 = 29.4 ft; use 29 ft.

TL = absorption length (L) + average of upslope and downslope widths.

Simply adding the upslope and downslope widths together is the same as two times the average of these widths.

TL = 113 + 4.6 + 8.8 ft = 126.4 ft; use 126 ft.

Total width and total length calculated in this step are less than the 175 ft length and 30 ft width of the available area for the wastewater system. Thus, no adjustment in the system design is needed.

Design Step 9

Design a pressure distribution network. Because the absorption laterals are relatively narrow and on a moderate slope, a single distribution line along the length of each lateral is adequate. The distribution line would be located 3.4 ft upslope of the aggregate downslope toe. On a level site, the distribution pipe would be located in the center of the lateral aggregate. The pressure distribution will be designed according to the procedure discussed in Chapter X, *Pumps and Hydraulics*.

At-Grade System Construction

Construction Step 1
Check for proper soil moisture prior to construction. When the soil can be rolled between the hands to form a rope shape ¼-inch in diameter without falling apart, it is too wet for construction. Do not begin construction until the soil dries out.

Construction Step 2
Cut all grass, brush, and trees as close to the soil surface as practical. Do not remove tree stumps. Rake clippings and loose organic debris from the absorption area. Avoid heavy vehicle traffic, especially over and downslope of lateral absorption areas. Using a contractor or laser level, mark the level lines for the lateral locations.

Construction Step 3
Bury the force main (or delivery pipe) from the pump tank to the upslope side of the absorption area, ideally prior to roughening the soil surface. Bring the pipe in at a right angle to the absorption area and connect to the upslope end of the manifold, the line connecting to all laterals. Avoid traffic on the tilled area, especially beneath and downslope of the laterals.

Construction Step 4
Working from the upslope side to avoid compaction of the absorption area and downslope side, roughen the soil surface using the teeth of the backhoe. If a backhoe is not practical, use a chisel plow at a 4- to 6-inch depth. Avoid doing this step if the soil is too wet as identified in Step 1. If compaction or ruts occur in the upslope or downslope area during construction, re-till the compacted or rutted area. Minimize subsoil disturbance beneath and downslope of the absorption area.

Construction Step 5
Install at least one observation tube in each lateral to observe the condition at the infiltrative surface. Use two observation tubes for long laterals fed from a center manifold. Observation tubes are usually 3- or 4-inch PVC pipe extending from the infiltrative surface (aggregate – soil interface) to a few inches above the ground for easy access. They should be placed at points approximately one-quarter and three-quarters along the length of the absorption area. The observation tubes provide easy access to verify that effluent is reaching the area and to detect any ponding. The bottom six inches of the observation tubes must have perforations (holes or slots) in the sides to allow ponded effluent to enter.

Observation tubes must be anchored securely. A toilet flange, tee, or reinforcing rods through the pipe can be used as illustrated on Figure VI-9, page VI-25 in Chapter VI.

Construction Step 6
Place a 6-inch depth of lateral aggregate on the level contour in the designated tilled area. Work from the upslope edge of the system being careful to avoid compaction of the absorption or adjacent areas. A conveyor mounted on a truck or a mixer tank on a truck have been used to deliver the rock.

Construction Step 7
Place the distribution network pipe level along the length of the absorption lateral aggregate and

connect it to the distribution manifold pipe. On sloping sites, place lateral pipe as close as practical to the upslope edge. On level sites, place lateral pipe in the center of the aggregate. Place aggregate to the sides and cover the distribution pipe with at least 2 inches of rock.

Construction Step 8
Place the geotextile fabric to completely cover the lateral aggregate surface. Where needed, trim or fold back the fabric so it does not extend more than 2 inches beyond the edge of the aggregate.

Construction Step 9
Cover laterals to a depth of 8 to 12 inches over the absorption rock with topsoil having properties similar to natural topsoil on the site. Where multiple laterals are used, the soil cover must fill the space between laterals so no depression remains to collect water. Taper the soil fill on all sides of the absorption area lateral to the design distance from design step 8 above, or at least 5 feet. Finish grading around the system to divert surface runoff away from the upper edge and away from the site.

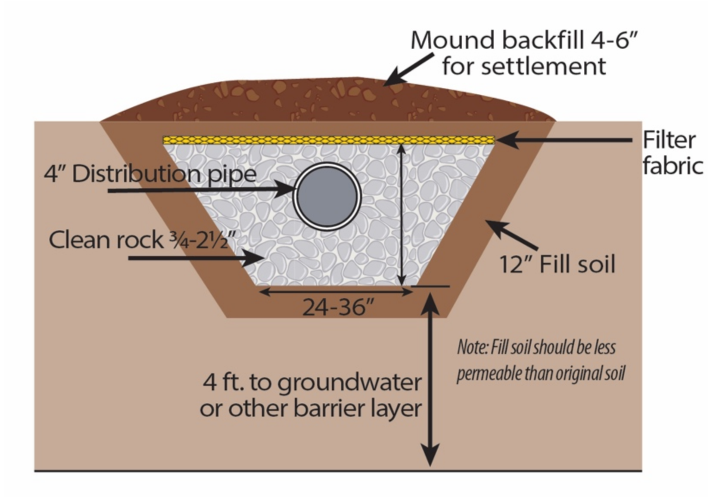
Construction Step 10
Immediately after construction, seed permanent cool season grass over the entire disturbed area and mulch the site for erosion control.

SOIL LINED LATERALS

Some sites may have such coarse soil (sand and/or gravel) that water may infiltrate and percolate too rapidly through the profile. The biomat may not form, or would form slowly, and not be consistent throughout the area. There is little chance of failure because of surfacing or backup in the facility. However, coarse soils are not suitable for traditional gravity absorption systems because they may produce inadequate treatment and do not protect groundwater. Alternative absorption designs are recommended for coarse-textured soils that provide inadequate treatment. A finer textured soil lining across the bottom and sides of the lateral has been used to slow infiltration and help distribute the wastewater evenly. A lined lateral works with gravity distribution and has the low maintenance of a traditional lateral system. The key to the successful longevity of lined laterals depends on the lining selection. As water moves from a fine-textured soil to an underlying coarser one, the fine-textured soil must be nearly saturated before water can move into the coarser material. This means the fine-textured soil will be continuously wet, and this may cause changes in soil structure and low oxygen transfer. A good lining might be a sandy soil with little structure that is not too permeable. It would not be as subject to damage by continually wet conditions and would have some spaces for oxygen transfer. Of course, the lateral must be over excavated by at least a foot in depth with sloping sides to allow placing the lining.

Some of the lining soil should be mixed with the top several inches of the natural soil to avoid an abrupt transition. Place at least a foot of the lining soil on the bottom and sides of the lateral as shown in Figure VII-8.

Figure VII-8. Soil-Lined Lateral Cross Section

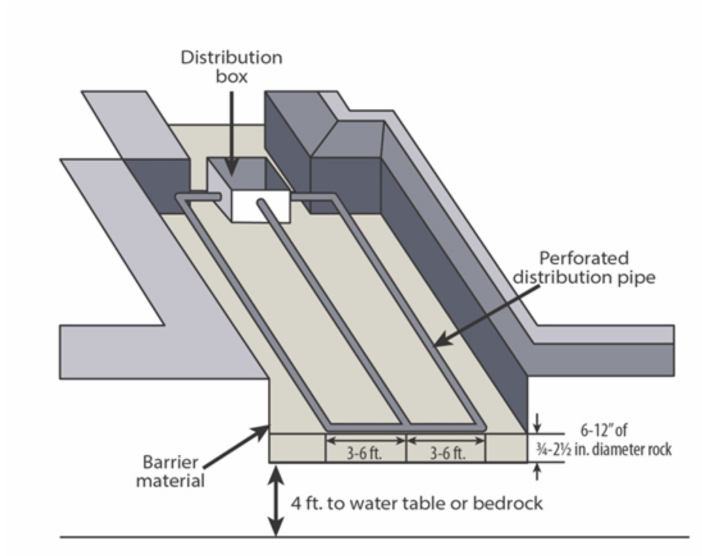


Other suitable alternatives could also include an enhanced pretreatment component and/or time-dosed pressure distribution. Using enhanced pretreatment reduces the amount of treatment the soil needs to do. Time-dosing maximizes wastewater contact with the soil enabling treatment. These alternatives require considerably greater attention to maintenance as well as greater detail during design and construction. In rural areas, it may be difficult to find service providers who can provide maintenance that is essential for alternative treatment or alternative absorption systems.

ABSORPTION BEDS

Absorption beds are typically much wider and shorter than laterals and contain multiple distribution pipes as shown in Figure VII-9. The primary advantage of absorption beds is that less surface area is required for a bed than for a traditional lateral absorption field. However, a lateral system is preferred because it provides a greater sidewall area with increased absorption surface and oxygen transfer under the laterals is much improved compared to the bed. A bed should only be installed on a level site for an existing home. The site should not be leveled to permit the construction of the bed. Laterals are more easily adapted to the contour of the land surface and can be used on steeper sites. Laterals may be constructed with less damage to the soil structure. Absorption beds are not recommended for permanent systems following a septic tank because of inferior treatment and shorter life expectancy compared to laterals.

Figure VII-9. Typical Absorption Bed Layout



A major limitation of a wide soil absorption area is that oxygen transfer is inadequate to the middle of the area under the bed. As a result, the soil often becomes anaerobic (septic) beneath the bed and treatment efficiency is substantially reduced. With oxygen more limited in areas away from the edges, the biomat growth becomes thicker and of a different consistency. With a thicker biomat growth, percolation through the bottom of the bed is proportionately reduced. The long-term outcome can be such low long-term acceptance rates that the bed system ultimately fails. For this reason, absorption beds are discouraged in favor of laterals no wider than 3 feet.

A bed system may be suitable for locations where central sewers are not presently available but are expected in the near future. When beds are used for dispersal of septic tank effluent, a larger bottom area is recommended than would be used for laterals. Recommendations vary widely and some state and local codes or regulations prohibit absorption beds because of deficiencies of this option. In Kansas when beds are used for septic tank effluent, a 50 percent greater bottom area is recommended.

Comparing 600 square feet of lateral trench 2.5 feet wide with a 900 square foot bed 20 feet wide shows slightly more total bottom plus sidewall area for laterals. The lateral system would have 4 trenches each 60 feet long making a total length of 240 feet. Using a rock depth of 1 foot the lateral system would have 600 square feet of bottom and 500 square feet of sidewall area for a total of 1100 square feet. The bed system would be 20 feet by 45 feet and would have 900 square feet of bottom area and 130 square feet of sidewall for a total of 1030 square feet. Thus, even when a bed is 50 percent larger, the laterals have more absorptive surface (bottom plus sidewall) and would be expected to have better aeration. The lateral system would be expected to provide better treatment and greater absorptive capacity through a longer life.

An at-grade bed system is very similar to at-grade laterals and can be used for level sites when soil conditions similar to those for at-grade laterals exist. Low pressure, time-dosed distribution should always be used for an at-grade bed system. The design of this type of system would have many similarities to a mound system design.

SUBSURFACE DRIP DISPERSAL

Subsurface drip dispersal (SDD) is a method of applying effluent to the soil at very low rates, and that may be used in place of traditional soil absorption systems. Drip systems are well-adapted to sites that have a severely limited soil absorption capacity, shallow soil, or a very restricted area for soil absorption. Drip systems typically receive enhanced treatment effluent from an aerobic treatment unit (ATU) or another pretreatment component. Drip lines are placed quite shallow (no more than 8-10 inches) and can easily be installed around trees, shrubs, and other landscape features with minimal disturbance to them. For more information about subsurface drip systems, please refer to KDHE's Subsurface Drip Dispersal Bulletin.

REFERENCES AND READING MATERIAL

Publications Soil Absorption Systems and Related Topics

Available from K-State Research and Extension, Distribution Center, 34 Umberger Hall, Manhattan, KS, 66506-3402, https://bookstore.ksre.ksu.edu/ (search by title or number).

Onsite Wastewater Publications

Environmental Health Handbook, 2nd Edition, on KDHE web site at https://www.kdheks.gov/nps/lepp/EHH.html

Get to Know Your Septic System (Onsite Wastewater Treatment), MF-2197, October 2000

Minimum Standards for Design and Construction of Onsite Wastewater Systems, KDHE Bulletin 4-2 (also K-State Research and Extension, MF-2214), November 1997

Plugging Cisterns, Cesspools, Septic Tanks, and Other Holes, MF-2246, July 1998

Selecting an Onsite Wastewater or Septic System, MF-2542, August 2004

Septic Tank Maintenance: A Key to Longer Septic System Life, WMS 18-947, January 2018, on KDHE web site at https://www.kdheks.gov/nps/lepp/download/KDHE_SepticTankMaint-MF-947-FINAL.pdf

Site and Soil Evaluation for Onsite Wastewater Systems, WMS 18-2564, March 2018, on KDHE web site at https://www.kdheks.gov/nps/lepp/download/KDHE_SiteSoilEvalOnsiteWW-MF2564-Final.pdf

Soil Compaction Problems and Solutions, AF-115, July 1996

Subsurface Drip Dispersal, KDHE Bulletin, June 2020

Why Do Onsite Waste\water (Septic) Systems Fail?, MF-946, November 2005

Your Wastewater System Owner/Operator Manual, S-90, September 2004

Available from MidWest Plan Service, 122 Davidson Hall, Iowa State University, Ames IA 50011, phone 800-562-3618, web address www.mwps.org

Residential Onsite Wastewater Treatment Systems: An Operation and Maintenance Service Provider Program, Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT), January 2006.

PROTOCOL
INSPECTION OF A NEW ONSITE WASTEWATER (SEPTIC) SYSTEM

GOAL: Ensure system integrity to protect drinking water supplies, to prevent contamination of ground and surface water of the state, and to treat and disperse human waste in a sanitary manner to protect public health and meet state standards.

POLICY: Evaluation of the installation of a new wastewater system (pretreatment and soil-absorption field) will be completed as requested when the necessary paperwork has been completed and essential fees paid by the landowner, contractor, lending agency, or their representative. The inspection shall address all evaluation points listed here and will occur before the backfill of the underground portions are completed. An assessment report summarizing the inspection shall be provided to all persons who have legal interest in the outcome. A file of all original documents including letters, data, supporting information, etc. shall be maintained by the administrative agency.

EVALUATIONS:

1) Septic tank: verify the tank condition and that dimensions, capacity, manufacturer, and model are approved by KDHE, and meet state and local standards for septic tanks.

   a) Check to ensure tank manufacturer's name, phone number, month and year of manufacture, capacity, and model are displayed on the tank. Verify this model meets state minimum standards and is approved by KDHE.

   b) Check the tank for possible damage from handling.

   c) Using a contractor's or carpenter's level, check to see that the tank is set level on a gravel base in the excavation as specified in EHH, Chapter V, Septic Tanks.

   d) Check to see that the tank access ports and manhole risers meet all requirements. Ensure access ports and manholes extend to surface grade for easy access, and are watertight.

   e) Check dimensions of length, width, and depth below outlet invert, and verify tank capacity.

   f) Check distance to the bottom of inlet and outlet tees, or baffles from the bottom of the tank.

   g) Check the effluent filter (if present) to be sure it is easily accessible for service via riser at the surface.

   h) Use a contractor's or laser level to measure and record elevations of the sewer pipe where it exits the building, inlet to the tank, outlet from the tank, and absorption-field lateral(s). Verify the slope on the sewer pipe from the house to the tank is 1/4-inch per foot or 2 percent. Verify the elevation difference from the tank inlet to the outlet has a minimum 3-inch fall.

i) It is appropriate to verify the tank is water-tight by filling it with water and measuring loss over several hours.

2) Other tank related items

a) Inlet and outlet pipes of the tank meet minimum standards (Schedule 40), and are properly installed, adequately supported, and are either securely connected to Ts or terminate on the outlet side of the baffle.

b) Two-way cleanouts are provided every 100 feet along sewer lines that exceed 100 feet in length and carry solids from the building to the tank. It is easier to clear clogs when these cleanouts are no more than 100 feet apart.

c) Two-piece tanks are joined with an approved sealant so the joint does not leak, and is grouted inside and outside to make a smooth durable finish.

d) When the soil cover over the tank exceeds 12 inches, extension risers to the ground shall be installed over all openings. When tanks have multiple compartments, each one must be accessible for service and inspection. The manhole for each compartment must have a minimum dimension of 20 inches and should be centered.

e) When backfill is complete, use a probe to verify fill around tank is adequately compacted.

3) Absorption field area - verify field condition, dimensions, and capacity, and that quality of materials used meets minimum standards. If conditions are suitable (sufficiently dry, no compaction, and no traffic), proceed to verify the following:

a) Measure and record for each lateral — length, width, and undisturbed distance between laterals.

b) Approved perforated distribution pipe or chambers are used for all laterals.

c) Material separation (filter) fabric covers aggregate and meets the required minimum.

d) Inspection ports (observation pipes) installed appropriately in laterals as required.

e) Fill around piping, distribution box, manifold pipe, and drop boxes is compacted.

f) If a subsurface perimeter drain is used, measure and record the separation distance from absorption field, depth, length of drain lines, and location of lines and outlets.

i. Check and record the following elevations (where possible, use the pipe invert):
ii. Check elevation of distribution manifold pipe at each lateral tee or elbow, and at least one point between. Elevations should vary no more than ½ inch or 0.05 feet.

g) Check lateral trench and distribution pipe (elevation of trench bottom, top of distribution pipe, and top of rock). For trenches shorter than 50 feet, check at least two locations. For trenches longer than 50 feet, check at least three locations.

Note: It is difficult to check elevation of a trench bottom after rock has been placed. Recommend requiring contractor to make a record of trench-bottom elevations and having inspector make a random check for minimum depth of rock under pipe.

h) Ensure absorption field area with length, width, and all setback distances is defined, and has been protected during house and septic system construction on the site.

Additional requirements for stepdown (serial) distribution system.

- Determine that drop-box (or crossover pipe used in place of preferred drop-box) inlet invert elevation is at least 1 inch higher than the overflow invert, and lateral outlet inverts are at least 3 inches below overflow invert.
- Top of the gravel in laterals is 2 inches above that of the drop-box overflow invert elevation.
- Check drop-box or crossover pipe elevations as follows (use the pipe invert when possible or top of pipe when it is the same diameter): drop-box inlet invert, trench lateral pipe outlet invert, overflow pipe invert, and top of lateral gravel.

4) Measure and record setback or separation distances as follows: (Note: make drawing of system layout on the site, including measurements, and calculate square footage of absorption and reserve field.)

a) Septic tank to building foundations (existing and planned buildings)

b) Septic tank to all existing (and unused) wells or planned new water well locations

c) Absorption field to existing (and unused) wells or planned new water well locations

d) Absorption field to buildings (existing and planned)

e) Absorption field to property line

f) Absorption field to any surface water or water course

g) Absorption field to important topography features such as a drop-off

h) Reserve absorption area available for replacement of existing system in the event of failure or expansion. Also, verify all setback measurements for the reserve area.

PROTOCOL
EVALUATION OF AN EXISTING ONSITE WASTEWATER (SEPTIC) SYSTEM

GOAL: Ensure system integrity to protect drinking water supplies, prevent contamination of the ground and surface water of the state, and treat and disperse human waste in a sanitary manner to protect public health and meet state standards.

POLICY: Evaluation of an existing septic tank and soil absorption system will be completed at request of the landowner, lending agency, complainant, or other interested party. The inspection should address the evaluation points listed below. An assessment describing the evaluation should be provided to all individuals who have legal interest in the outcome of the evaluation. A file of all letters, data, supporting evidence, and documents shall be maintained by the administrative agency.

EVALUATION:

1) Obtain all known information about the system from the file, property owner, contractor, and/or complainant. Supplement this with all available information from other readily available sources, especially the County Soil Survey (web soil survey).

2) Conduct a visual survey of the site. Note any discharge areas, effluent surfacing, or evidence of previous effluent surfacing. Note any odors, wet soil, vectors, and damaged or burned vegetation.

3) Locate the point where the household sewer pipe(s) leaves the house. This can be aided by the following:

    a) In the basement, trace the sewage pipes to the point where they exit the house.

    b) Where there is no basement or where household sewer lines are not visible, locate the household sewer stack vent on the roof; it is often above the pipe exit.

    c) Look for a cleanout just outside of the house foundation.

4) Locate the septic tank and absorption field using the office file, information provided by the property owner, grass patterns, and surface depressions. If possible, verify the location with a probe. Radio operated tank location devices may also be used to locate septic tanks.

5) All household wastewater must enter the septic tank. The only exceptions are potable water, backwash of potable water filter (including water softener recharge), or air-conditioner condensation. Roof drains and sump pump must never enter the wastewater system. These can be surface discharged.

6) Perform a dye test, if necessary, to verify source of surfacing flow. Monitor the absorption field and surrounding area, including nearby streams, tilled fields, ditches, and embankments for surfacing of dye. There shall be no discharge of wastewater to the ground surface, or any surface in the absorption field area or downslope from it.

7) Septic tank evaluation

   a) Record tank construction, size, condition, and if possible, age from records. If necessary, determine tank size from measured dimensions or from tank pumping records.

   b) Record the last date the system was pumped and the name of the septage pumper/hauler. If the tank has not been pumped within the last three years, pumping is required.

   c) Open the tank and observe the contents. If the water level is below the outlet pipe invert, suspect leakage — this represents a cause to replace the tank.

   d) When tank is pumped, inspect its condition and components — baffles, tees, and effluent filter, and check that lids are in place and in good condition. Measure and record the dimensions, construction, and size of the tank.

8) Using visual indicators and probe, attempt to locate absorption field and verify length, width, number of laterals, and total square feet. Probe for rock/gravel and observe vegetation changes to help identify lateral locations.

9) If a map of the system on the site does not already exist, sketch a map of it showing locations, setbacks, and dimensions. Clearly show date and mark that this is based on field probing and may not be accurate.

10) If necessary, obtain the required registration permit application and fee from the owner and properly record this in the county files.

11) To complete the evaluation, avoid any written statement regarding expectations for future performance. Remember to compare all conditions with local code, state minimum standards, and recommendations. The evaluation should note any inconsistencies and state whether the system was in active use and the number of users at the time of evaluation.

12) Notify owner and other interested parties in writing of final evaluation and of any necessary course of action.

13) File copies of all pertinent information with the local permitting agency.