GREENE COUNTY

REGULATIONS & STANDARDS
FOR
ON-SITE WASTEWATER SYSTEMS

Greene County Resource Management Department
Environmental Section
940 Boonville
Springfield, Missouri 65802
(417) 868-4147

January 2003

CHAPTER 1

ON-SITE WASTEWATER TREATMENT

A. INTRODUCTION

Improper sewage disposal and treatment is a water quality concern for home owners across the nation. Extensive misuse of individual sewage systems can result not only in water quality problems and nuisance conditions, but also in costly repairs to rehabilitate a failing system. Failing individual sewage systems are not only those that we can see (and smell) but those that do not surface to the top of the ground. Some of these systems fail to properly remove disease-causing organisms and other pollutants before the effluent reaches our groundwater. Some of the common communicable diseases associated with the improper disposal of human wastes are: salmonellosis, shigellosis, giardiasis, amebiasis, hepatitis A, clostridium perfringens, tetanus, diarrhea, yersiniosis, hookworm, cholera, hand-foot and mouth disease, paratyphoid fever, typhoid fever, dysentery, schistosomiasis, poliomyelitis and staphylococcal infections.

Surveys of Missouri's private water supplies and water samples have shown that 39 percent of wells tested are unsafe due to the presence of coliform bacteria. Some counties report contamination of private wells at over 50 percent of wells tested. The large number of failing sewage systems and poorly constructed wells appears to be the main contributing factor towards degradation of groundwater supplies in the state of Missouri.

In 1994 and 1995 there were 316 repairs made to on-site wastewater systems in Greene County. Many of these repairs we initiated due to lending institutions, Realtors, and home buyers requiring that all private water systems and sewage disposal systems be functioning properly before the transfer of real estate.

In this time of population movement to rural and semi-rural areas and the high cost of centralized sewage collection and treatment plants, we are faced with the need for more information and control of the planning, design, construction, and management of on-site sewage systems.

It is vital that we in Missouri, and in this case Greene County, protect the natural resources that we are so fortunate to have at very little expense. In order to keep these resources, air and water, available and at a cost level that is not prohibitive for the average citizen of our County we must and will protect them with all available measures.

The regulations in this booklet are designed to describe and define each step in this process. These are not suggestions. They are laws and will be enforced as the law prescribes.

The requirements are spelled out clearly. In a situation that is questionable, the Resource Management Department has the responsibility to protect the health, safety and well being of the citizens of Greene County and their natural resources.

B. SITE INFORMATION

In general, systems designed to discharge partially treated wastewater to the soil for ultimate disposal are the most reliable and least costly on-site system. This is because little pretreatment of the wastewater is necessary before application to the soil. Through several different chemical and biochemical processes, wastewater can be treated to an acceptable quality for discharge into the groundwater as it passes through the soil, under the proper conditions.

The site investigation is to consider the characteristics of the area for the potential to treat and dispose of wastewater. A system design must consider the treatment of wastewater as high a priority as disposal. In the past, the typical approach was to make disposal the first and sometimes only priority as evidenced by the use of seepage pits and deep trenches.

To understand absorption field design requirements, it is absolutely essential that one understands the importance given to adequate treatment of the effluent before complete disposal.

One basic objective is to distribute the effluent over a wide enough area so as not to overload the soil's capacity for adequate treatment. Another basic objective is designing a system to keep the trench depth as shallow as possible. One advantage of shallow trenches is to promote more evaporation and transpiration of excess water. The fundamental reason for keeping the absorption trenches close to the surface is to provide for better conditions for microbial activity and treatment of the effluent.

C. SOIL TYPES: AN IMPORTANT CONSIDERATION

If the soil type is unsatisfactory, the septic tank absorption field will not function properly no matter how well it is constructed. A system which was designed perfectly and installed properly in one location may not function to any degree in another. Failure of septic systems is most common in the absorption field.

The soil must have the capacity to take up the liquid effluent. If it does not, the sewage may pool on the soil surface or may reach the groundwater below. Unfiltered sewage can quickly pollute groundwater and surface water, give off foul odors, become a Health hazard, and attract disease-carrying pests and annoying insects. Knowing the absorption capacity of the soil will aid in determining the size of the absorption field to adequately handle the volume of waste. Some soils will not work as absorption fields no matter how large the field. A lot size of at least 3 to 5 acres is recommended to handle a system for single dwelling usage. The soils in your area may not be suitable, if you have one of the following soil limitations:

* Soils are wet or poorly drained.
* Soils may be too compact with a subsequently slow absorption rate.
* Land may be too steeply sloped; generally slopes over 15% limits its use as an absorption field.
* The water table may be periodically or constantly too high.
* Soil over the underlying bedrock may be too shallow or have too high of an absorption rate allowing pollutants to reach the groundwater.
* The soil may be too shallow over an underlying cemented soil layer.
* The area may be periodically flooded.

Stony clay soil, such as soil in central and southern Missouri, is permeable and readily permits the movement of wastewater through soil into underlying cavernous bedrock, where it may enter wells, springs, or streams. The connection between a poorly functioning septic system and a water supply well for a typical residence is illustrated in Figure 1-1 (see next page).

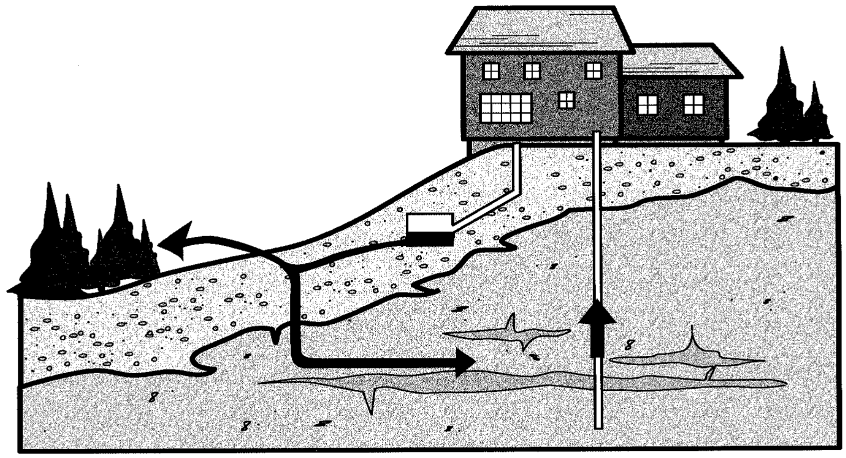


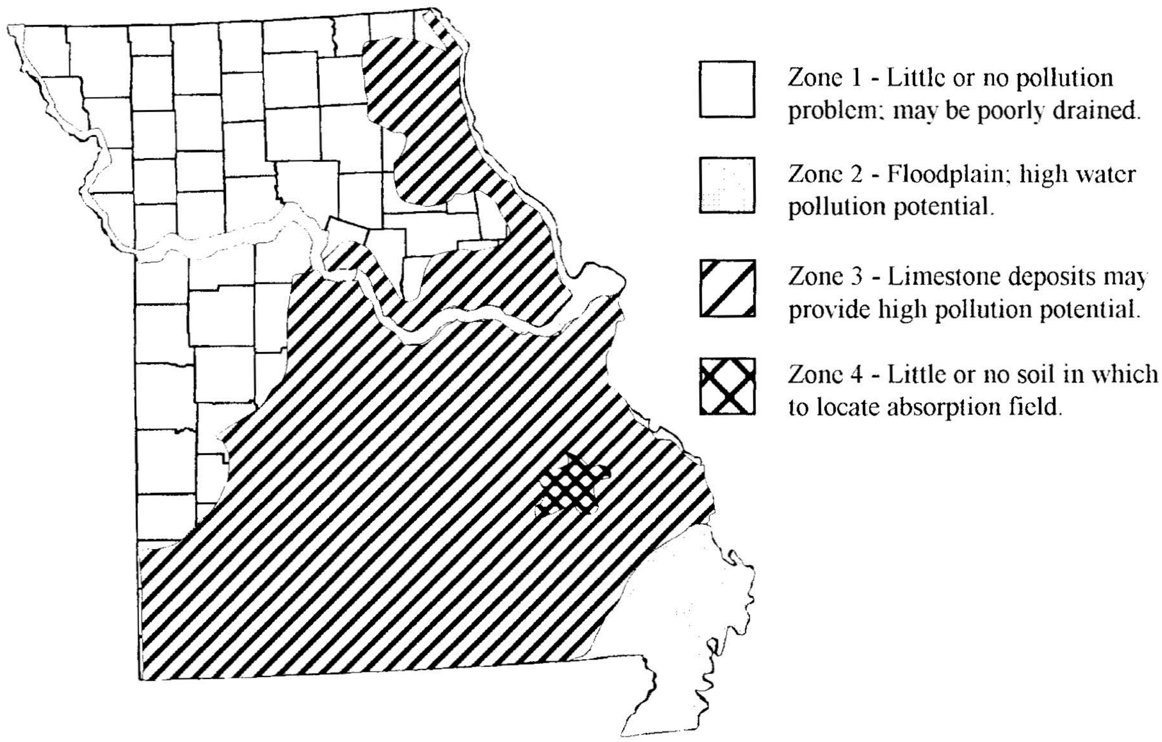
FIGURE 1-1

D. CONSIDER GENERAL GEOLOGICAL CONDITIONS

Septic tanks and absorption fields represent a potential threat to the quality of water above and especially below the ground surface in a large portion (50 percent) of Missouri. Figure 1-2 (see next page) outlines the general areas of the state in which location of absorption fields may be restricted due to potential groundwater pollution problems. It is wise to consult a professional when locating a septic tank; but if you are planning a system in Zones 2, 3, or 4 (see Figure 1-2), never locate a septic tank and absorption system without seeking professional guidance.

Areas of shallow residual or variable thickness soil over carbonate limestone bedrock are frequently unsuitable for soil absorption systems because soil properties and thickness may not be adequate to provide proper to removal of pollutants. Further, the carbonate limestone found in Greene County slowly dissolves in water, resulting in formation of numerous caves and sinkholes. Placement of an absorption field over a cave or within a sinkhole could be tantamount to directly dumping into subsurface waters.

Eventually, seeps and springs bring this polluted water to the surface or pollute nearby water wells. Any area where the depth of soil is less than 4 feet, or where impervious strata is less than 4 feet below the bottom of the absorption trench, is generally unsuited for use as a septic tank absorption field. Alternative systems must frequently be used in these areas to prevent ground water pollution.


Zone 1 - Little or no pollution problem; may be poorly drained.
Zone 2 - Floodplain; high water pollution potential.
Zone 3 - Limestone deposits may provide high pollution potential.
Zone 4 - Little or no soil in which to locate absorption field.

<u>FIGURE 1-2</u>

CHAPTER 2

GENERAL REQUIREMENTS

A. GENERAL

1. Scope

These standards apply to construction, repair or modification of all wastewater treatment systems located within the unincorporated areas of Greene County, Missouri which utilize soil absorption for final treatment and disposal of wastewater.

For soil absorptions systems having a daily flow greater than 1500 gallons a conditional use permit must be approved by the Greene County Planning & Zoning Board and the Board of Zoning Adjustment before a construction permit can be obtained. For soil absorption systems having a daily flow greater than 3000 gallons, a construction and operating permit must also be obtained from the Missouri Department of Natural Resources.

These standards provide the minimum requirements for the design and construction of on-site wastewater treatment systems. These standards do not provide detailed designs or recommendations for any particular site and may not be construed for such use.

The purpose of these regulations is to protect the health and welfare of the citizens of Greene County by preventing discharge of improperly treated wastewater into surface and groundwater, to the greatest extent practical. In the event that conditions on any particular site warrant, the Resource Management Department may require additional tests, or designs exceeding the minimum requirements.

2. Authority

These standards have been adopted by the Greene County Building Commission and the Greene County Commission as a part of the Building Code for the unincorporated areas of Greene County in accordance with the provisions of Sections 701.035 and 701.047, RSMo.

As used in this chapter, the word “department” shall refer to either the Resource Management Department or the Greene County Health Department; the word “administrator” shall refer to either the administrator of the Resource Management Department or the director of the Greene County Health Department or the designee of the or director.

Where situations arise which are not specifically addressed herein the administrator may, at his discretion, vary the requirements stated herein or impose additional requirements if deemed necessary to ensure that systems are designed and constructed with reasonable assurance that they will function as intended and at reasonable cost.

3. Violations

Violations of the requirements set forth herein shall constitute a violation of the Greene County Building Code, and shall be subject to enforcement procedures and penalties as set forth in the Building Code.

a. Property owner violations.

1) Whenever sewage, domestic sewage or waste as defined in these regulations enters an adjoining property, contaminates surface waters or groundwater or creates a nuisance as defined in these regulations and as may be determined by reasonable scientific methods, the owner of the property shall be deemed to be in violation of these regulations.

2) Whenever the administrator determines that there are reasonable grounds to believe that there has been violation of these regulations, the administrator shall give notice of such alleged violation to the person responsible as herein provided. The notice shall:

(a) Be in writing;
(b) Include a statement of reasons for the issuance of the notice;
(c) Allow reasonable time as determined by the director for the performance of any act it requires;
(d) Be served upon the owner, operator or contractor, as the case may require, provided that such notice or order shall be deemed to have been properly served upon such person when a copy thereof has been sent by registered or certified mail to the person's last known address, as listed in the [local] property tax records concerning such property, or when such person has been served with such notice by any other method authorized by the laws of this state;
(e) Contain an outline of remedial action which is required to effect compliance with these regulations.

3) Existing systems, as defined in Chapter 3, shall not be inspected unless the administrator determines that there are reasonable grounds to believe that there has been a violation of any provision of these regulations.

4) If an aggrieved person files a written request for a hearing within ten days of the date of the receipt of a notice, a hearing shall be held within twenty days from the date of the receipt of the notice, before the administrator, to review the appropriateness of the remedial action. The director shall issue a written decision within thirty calendar days of the date of the hearing. Any final decision of the director may be appealed to the Building Commission. Any decision of the Building Commission may be appealed to the County Commission.

5) The department may require a property owner to abate a nuisance or repair a malfunctioning on-site sewage disposal system on the owner's property not later than the thirtieth (30th) day

from which the owner receives notification from the department of the malfunctioning system or a final written order from the administrator if a hearing or hearings were held pursuant to of this section. If weather conditions prevent the abatement of the nuisance or repair of the system within the thirty-day period or if the owner is unable, after reasonable effort, to obtain the services of a contractor or repair service within the thirty-day period, the abatement of the nuisance or repair of the system shall be made, weather permitting, no later than sixty days after notification. Such extension for the abatement or repair shall be subject to approval by the department. The may assess an administrative penalty on the property owner of no more than fifty dollars per day for each day that the on-site sewage disposal system remains unrepaired beyond the last day permitted by this section for the abatement or repair. All administrative penalties collected by the department under the provisions of this section shall be deposited in the county treasury to the credit of the general revenue fund.

6) The prosecuting attorney shall, at the request of the department, institute appropriate proceedings for correction in cases of noncompliance with or violation of the provisions these regulations.

7) When it is determined by the department, after receipt of a complaint, that an emergency exists which requires immediate action to protect the health and welfare of the public, the department is authorized to seek a temporary restraining order and injunction. Such action shall be brought at the request of the director of the department by the prosecuting attorney. When such conditions are corrected and the health of the people of Greene County is no longer threatened, the department shall request that such temporary restraining order and injunction be dissolved. For the purpose of this subsection, an “emergency” means any set of circumstances that constitute an imminent health hazard or the threat of an imminent health hazard as defined in these regulations.

4. Appeals

Appeals shall be made in writing to the administrator of the Greene County Resource Management Department and may be heard by the Greene County Building Commission, in the same manner as any appeal of the Building Regulations.

5. Variances

Any person desiring a variance from the requirements of these regulations must submit a written request to the administrator of the Resource Management Department. The administrator will schedule a hearing before the Building Commission. No variance will be granted except as approved by the Building Commission.

6. Complaints

a. The Resource Management Department, County Health Department or any of their agents may not investigate a sewage complaint except when necessary as part of a communicable disease investigation unless the complaint is received from an aggrieved party or an adjacent land owner. The department or any of its agents may enter any adjoining property if necessary when they are making an inspection pursuant to this section. The necessity for entering such adjoining property shall be stated in writing and the owner of such property shall be notified before the department or any of its agents may enter, except that, if an imminent health hazard exists, such notification shall be attempted but is not required.

b. If the department or its agents make an investigation pursuant to a complaint as described in this section and find that a nuisance does exist, the property owner shall comply with state and local standards when repairing or replacing the on-site sewage disposal system.

7. Authority of the Department of Natural Resources

For any subdivision, being served by on-site wastewater systems, containing more than fourteen (14) lots the requirements of the Department of Natural Resources 10 CSR20-6.030 must be met in addition to all Greene County Regulations. (See the memorandum of agreement located in Appendix E.)

8. Severability

If any section, clause, provision, or portion of these regulations is adjudged to be unconstitutional or invalid by a court of competent jurisdiction, the remainder of these regulations shall not be affected thereby.

B. <u>REQUIRED PERMITS</u>

Any person engaged in the construction or renovation of any on-site wastewater system shall obtain a permit from the Greene County Building Regulations Department regardless of the daily wasteflow. This specifically includes soil aeration or other methods of injecting high pressure air into the soil. The following must be submitted in order to obtain a new permit:

1. Construction of New Systems

a. A soil factors evaluation prepared in accordance with the requirements set forth in Chapter 3 Section 2 (C).
b. Plans for the system prepared in accordance with the requirements set forth in Sections D. and E. of this chapter.
c. Legal description of property (copy of recorded deed or tax receipt is acceptable).

2. Modifying or Replacing Existing Systems.

   a. Replacing tank and absorption field or relocating absorption field: A soil factors evaluation shall be prepared in accordance with the requirements set forth in Chapter 3 Section 2(C).

   b. Replacing tank only: The installer shall submit a site sketch and information required on Form EV05 (see Appendix A) .

   c. Adding or replacing absorption field lines: A soil factors evaluation prepared in accordance with the requirements set forth in Chapter 3 Section 2(C).

NOTE: The septic tank must be pumped and inspected within 72 hours prior to the start of construction whenever all or any portion of an existing system is modified or replaced. A copy of the paid receipt from the pumping service must be submitted to the inspector before any modifications or repairs are approved.

3. Re-building, replacing, or remodeling structures.

   a. In cases where home or other structure is destroyed by fire or other cause, and the Owner wishes to rebuild, the existing on-site wastewater system in use at the time the home or structure was destroyed, may be used to serve the replacement structure, provided the occupancy and use of the structure or home is not changed and the existing system was functioning properly at the time the building was destroyed. If the existing on-site wastewater system is not functioning properly, the Resource Management Department may require the system to be repaired or replaced.

   b. When a structure is re-modeled in a manner which would increase the estimated daily wastewater flow, the on-site wastewater system must be modified as necessary to meet the size requirements for septic tanks and area requirements for the soil absorption field.

   c. When an existing residential structure is converted to commercial use, the on-site wastewater system must be replaced with a new system meeting the requirements of these regulations, unless documentation is provided that the existing system was designed for the proposed daily waste flow and the existing septic tank is pumped, inspected by this department and found to be in good condition.

C. <u>FEES</u>

Fees are as adopted by the Greene County Commission. Fee schedules are available in the Building Regulations Department.

D. REQUIRED PLANS & DATA

All plans and data must be prepared on, or in substantially the same format as, Greene County standard forms (see Appendix A).

Soil pit logs and percolation tests are considered valid indefinitely, provided the soil properties at the site are not altered by excavating, filling, tilling, compaction of the soil in place by operation of heavy equipment; provided no dumping of chemicals or other compounds has occurred at the site; and provided the surface of the site has not be altered by construction of pavements.

Data required for permits will be that which was required on the date the field data was obtained. Additional data may be required if site conditions warrant.

1. New Construction and Repairs or Replacing System.

The following items shall be submitted for new construction permits. These items must be prepared by a soil scientist, professional engineer or geologist as set forth below in Section E.

a. Site Evaluation Form (Form EV01).

b. Soil Evaluation - Soil Factors Form (Form EV02),

c. Site Plan: A site plan must be prepared showing the following minimum information. The site plan must be drawn to scale.

1) Lot lines, dimensions, and total lot area, in acres.
2) North arrow.
3) Scale.
4) Location of proposed dwelling or building (show distance from at least two property lines).
5) Location of proposed septic tank and absorption field or other proposed system.
6) Location of soil pits. Location of percolation test holes shall be shown in cases where this data is considered valid in accordance with the provisions of this Chapter or where a percolation test is taken at the discretion of the soil scientist.
7) Slope of ground surface across absorption field area. Spot elevations or topographic contours may be used. Show grade to nearest ½ per-cent.
8) Arrows showing direction of surface drainage.
9) Flowing or intermittent streams or watercourses, ponds or lakes, floodplain boundaries.
10) Location of proposed wells.
11) Location of any existing wells (in use or abandoned) located within proximity to the required setback distances of the proposed system.
12) Location of springs, sinkholes, or caves located within proximity to the required setback distances to the proposed system.

13) Limits of wooded areas, or location of large trees which may affect the location of the proposed system.
14) Existing utility lines and easements.
15) Missouri One-Call utility notification symbol.
16) Existing or proposed buildings or structure within the vicinity of the proposed system.
17) Existing or proposed swimming pools.
18) Existing or proposed drives, parking lots, or other paved or gravel surfaced areas.
19) Any other conditions which may affect the design or performance of the system.
20) Reference mark or bench mark used to establish spot elevations or topographic contours.
21) Location of replacement field area.

d. Details.

1) Typical absorption trench cross section, showing depth and width of trench; depth, diameter, and material for lateral line; and depth of gravel.
2) Typical cross section of septic tank.
3) Details for interceptor drains or other special features specified by the designer. Greene County standard details may be used where available (see Appendix B).
4) Calculations for alternative systems.

2. Repair or Replacement of Existing System.

a. Replacing tank and replacing or relocating absorption field: The requirements outlined in Chapter 2 D 1 shall apply.

b. Adding lateral lines: The requirements outlined in Chapter 2 D 1 shall apply.

c. Soil aeration: The requirements outlined in Chapter 2 D 1 shall apply.

3. Low Pressure Pipe Systems: See Appendix C.

a. Same items as specified above for new construction.

b. Typical cross-section of pump chamber specifying how float switch settings are to be determined.

c. Calculations on Form EV06.

E. PROFESSIONAL QUALIFICATIONS

All new residential on-site wastewater systems shall be designed by a soil scientist, professional engineer, registered sanitarian, or geologist as defined in Chapter 3, Section (1)(B) of these regulations. All commercial or non-residential systems must be designed b a professional engineer meeting the requirements of Chapter 3, Section (1)(B).

Soil factor analyses shall be performed only by a soil scientist. Soil scientist who wish to perform soil factors evaluations for on-site wastewater systems in Greene County shall submit documentation of education and work experience for review by the Resource Management Department.

F. <u>INSTALLER QUALIFICATIONS</u>

1. Any person engaging in the installation, construction, maintenance, or soil aeration of any On-site wastewater system shall be duly certified by the department.

2. An applicant for certification shall demonstrate a thorough knowledge of the department's minimum standards for construction. To become certified, installers are required to complete a training seminar and written examination provided by the department.

3. Term of certification shall be for two (2) years. Certification term will begin on the date of the regularly scheduled training course for that certification period, provided the installer successfully passes the examination. Certifications shall not be deemed to have expired until the date of the next regularly scheduled training course, for that certification period, if greater than 2 years from the date of examination.

   Two make-up training courses will be offered during the year, one during the first quarter (January to March) and one during the third quarter (July to September). Installers who miss the regularly scheduled training course may attend a make-up course. For installers who successfully pass the examination at a make-up course, the certification period will be retroactive to the date of the regularly scheduled training and run for two (2) years as provided above. The Resource Management Department will furnish annually a schedule of training dates and make-up dates. The Resource Management Department may schedule additional make-up training dates if necessary.

4. The procedure and requirements for renewing certifications shall be the same as for obtaining a new certification.

5. Any certified installer failing to comply with any and all regulations, rules, orders, and decisions of the department relative to the type of systems installed, constructed, or maintained shall be subject to termination or suspension of certification.

6. Installers found installing any system without the required permit shall be subject to termination or suspension of certification.

7. The installer shall report promptly to the department any conditions not in accordance with the system permit and shall cease construction of any installation until approval is obtained.

8. Separate training and examination is required for certification to install any of the alternative systems listed in Chapter 3.(6) except for wastewater stabilization ponds (lagoons). Any installer wishing to obtain certification for installation of alternative system must be hold a certification for installation of standard systems.

   Term of certification for alternative systems shall be for two (2) years. Certification term will begin on the date of the regularly scheduled training course for that certification period, provided the installer successfully passes the examination. Certification shall not be deemed to have expired until the date of the next regularly scheduled training course for that certification period, if greater than 2 years from the date of the examination. The Resource Management Department will furnish annually a schedule of training dates and make-up dates. The Resource Management Department may schedule additional make-up training dates if necessary.

9. Special training may be required for other alternative systems at the department's discretion.

10. Any homeowner or property owner wishing to install a system for his own use can obtain certification for this purpose by attending a regularly scheduled training seminar or scheduling a special training seminar with the department. Fee for the training seminar and certification is the same as noted in Section C of this chapter. Examination is not required for homeowner certification.

11. The department shall publish an official roster of registered contractors. The department shall also publish a list of names of the contractors who have had their registration revoked, suspended or denied pursuant to Section G of this chapter.

G. <u>TERMINATION OR SUSPENSION OF CERTIFICATION</u>

1. Any certified installer failing to comply with any and all regulations, rules, orders, and decisions of the department relative to the type of systems installed, constructed, or maintained shall be subject to termination or suspension of certification as provided herein.

2. Installers found installing any system without the required permit shall be subject to termination or suspension of certification as provided herein.

3. A contractor’s registration may be denied, suspended or revoked by the department if the contractor violates these regulations. The contractor may appeal to the department within thirty days of the notice of denial, suspension or revocation by requesting a hearing or written review of the decision. After the hearing or written review, the department shall issue a final decision which the contractor may appeal as provided on page 2-3 of this chapter. If the department’s decision to revoke, suspend or deny is upheld or not appealed, the contractor may reapply for registration one year after the date of the departmental action; OR, the contractor may post a performance bond or letter of credit as provided below.

4. A certified installer who has, within the preceding year, been found guilty of a violation of these regulations may not begin construction, major modification or major repair of an on-site sewage disposal system until the installer has reapplied for and obtained a new certification unless the installer has provided to the department a performance bond or letter of credit as provided under this section.

5. The bond or letter shall be conditioned upon faithful compliance with these standards for on-site sewage disposal systems and shall be in the amount of five thousand dollars.

6. Such performance bond, placed on file with the department, shall be in one of the following forms:

   a. A performance bond, payable to the department and issued by an institution authorized to issue such bonds in this state, or
   b. An irrevocable letter of credit issued in favor of and payable to the department from a commercial bank or savings and loan having an office in the State of Missouri.
   c. A cash bond, or
   d. Other security approved by the administrator.

7. Upon a determination by the department that a person has failed to construct, modify or repair an on-site sewage disposal system in compliance with these regulations, the department shall notify the person that the bond or letter of credit shall be forfeited if that person does not bring the system into compliance with these regulations within thirty days after notice of such determination has been given.

8. If the system is not brought into compliance with these regulations, the department shall, within thirty days of the expiration of the notice period, expend whatever portion of the bond or letter of credit is necessary to hire a certified on-site sewage disposal system contractor to bring the system into compliance with these regulations .

   Forfeiture of the bond or letter of credit will result in an automatic revocation of the installer's certification for a period of one year.

9. The requirement for a person to provide a performance bond or a letter of credit under this section shall cease for that person after two consecutive years in which the person has not been found guilty or pleaded guilty to a violation of these regulations .

H. REVIEW AND INSPECTION PROCEDURES

1. Plan Review

   a. New Systems and Repair or Replacement of Existing Systems

Plans and data submitted with the permit application are assigned to an inspector in the Resource Management Department's Environmental Section. The inspector reviews the information submitted and inspects the site (a "Pre-site Evaluation") to check that the system layout conforms to the conditions of the site.

The environmental inspector then returns any review comments to the design professional. It is the responsibility of the design professional to keep his client informed of the progress of plan review and any revisions to the design. It is the installer’s responsibility to make sure that plans have been approved before proceeding with construction.

Once all of the review comments have been satisfactorily addressed by the design professional and any requested revisions to the plans completed, the system may be constructed.

No excavation for building footings or construction of the on-site wastewater system may be started until review of the plans and data for the wastewater system is complete. Any construction occurring before the plans are approved may be subject to rejection.

b. Repair of existing systems

Information submitted with the permit application is assigned to an inspector in the Resource Management Department's Environmental Section. The inspector reviews the information and inspects the site. The environmental inspector then returns any review comments to the installer. No construction may be started until the proposed modifications are approved.

2. Construction Inspection

An inspection of the septic tank and absorption field by the Resource Management Department shall be conducted before any of the system is covered. The request for an inspection shall be made before 9:00 A.M. the day the system will be ready for inspection.

At a minimum of one location per 100 feet of lateral line the contractor shall leave the trench completely open for a minimum length of 18 inches at the trench bottom.

The inspector will note any items which need correction. Any items noted for correction must be re-inspected. Reinspection must be scheduled in the same manner as the first inspection.

Once the inspector has approved the construction the system may be backfilled.

3. Soil aeration inspection: An inspection request shall be made forty-eight (48) hours prior to the need of an inspection. An Environmental Inspector shall be present the entire time the soil aeration procedure is being performed.

4. When changing out a mobile home connecting to an existing system, the septic tank shall be pumped out and the baffles shall be inspected by an Environmental Inspector.

End of Chapter 2

CHAPTER 3 INDEX

CHAPTER 3
DESIGN AND CONSTRUCTION STANDARDS

(1) GENERAL

(A) Intent

The standards set forth in this chapter have been adopted from 10 CSR 20-8.021 Individual Sewage Treatment Systems Standards and 19 CSR 20-3.060 Minimum Construction standards for On-site Sewage Disposal Systems

It is the intention of these standards to adhere as closely and uniformly as possible to the state regulations, while addressing needs and requirements pertaining specifically to Greene County.

(B) Definitions

Definitions as set forth in the Missouri Clean Water Law and 10 CSR 20-2.010 and 19 CSR 20-3.060 shall apply to those terms when used in these standards unless the context requires otherwise or as noted in subsection (1)(B). For the purposes of these standards, certain standards, certain terms or words used here shall be interpreted as follows. The word shall is mandatory and the words should and may are permissive. All distances, unless otherwise specified, shall be measured horizontally.

1. Administrative authority - The Greene County Resource Management Department.

2. Aeration unit - Any sewage tank which utilizes the principle of oxidation in the decomposition of sewage by the introduction of air into the sewage.

3. Alluvium - Soil parent material which was transported and deposited in a running water setting.

4. Alternative - An individual sewage treatment system employing methods and devices as presented in Section (6) of this chapter.

5. Approved - Considered acceptable by the administrative authority.

6. Baffle - A device installed in a septic tank for proper operation of the tank and to provide maximum retention of solids. This includes vented sanitary tees and submerged pipes in addition to those devices normally called baffles.

7. Bedrock - That layer of parent material which is consolidated and unweathered.

.

8. Bedroom - Any room within a dwelling that might reasonably be used as a sleeping room.

9. Black water - Liquid-carried waste from a dwelling or other establishment produced by toilet waste, or culinary operations and specifically excluding bathing and laundry.

(1)(B)cont.

10. Building sewer - That part of the drainage system which extends from the end of the building drain and conveys its discharge to an individual sewage treatment system.

11. Capacity - The liquid volume of a sewage tank using the average inside dimensions below the outlet.

12. Color - The moist color of the soil based on the Munsell soil color system.

13. Distribution pipes - Perforated pipes or agricultural drain tiles that are used to distribute sewage tank effluent in a soil treatment system.

14. Dosing chamber (or pump pit or wet well) - A tank or separate compartment following the sewage tank which serves as a reservoir for the dosing device.

15. Dosing device - A pump, siphon or other device that discharges sewage tank effluent from the dosing chamber to the soil treatment system.

16. Dwelling - Any building or place used or intended to be used by human occupants as a one or two family unit.

17. Effluent - The liquid discharge of a septic tank or other sewage treatment device.

18. Floor drain - For the purposes of these regulations, floor drain shall apply only to those drains associated with a bathroom or kitchen facility. No other drains shall be connected to the on-site wastewater system.

19. Geologist - A person that meets the requirements of chapter 256 of the Missouri Statutes.

20. Gravelless system - An absorption system comprised of large diameter, eight (8) and ten (10) inch corrugated plastic pipe, perforated with holes on a one hundred twenty (120) degree arc centered on the bottom, wrapped in a sheath of spun bonded nylon filter wrap and installed level in a trench without gravel bedding.

21. Gray water - Liquid waste from a dwelling or other establishment produced by bathing, laundry, floor drains, etc., specifically excluding toilet waste.

22. Grease trap - A device designed and installed so as to separate and retain oils and fats from normal wastes while permitting normal sewage or wastes to discharge into the drainage system by gravity.

23. Ground absorption sewage treatment and disposal system - A system that utilizes the soil for the subsurface disposal of partially treated or treated sewage effluent.

(1)(B)cont.

24. Hazardous waste - Any waste or combination of wastes, as determined by the Hazardous Waste Commission by rules, which, because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, or pose a present or potential threat to the health of humans or the environment.

25. High ground water - Zones of soil saturation which include: perched water tables, shallow regional ground water tables or aquifers, or zones that are seasonally, periodically or permanently saturated.

26. High-water level - The highest known flood water elevation of any lake, stream, pond, sinkhole, or the flood elevation established by a state or federal agency.

27. Holding tank - A watertight tank for storage of sewage until it can be transported to a point of approved treatment and disposal.

28. Impermeable - With regard to bedrock, a bedrock having very few cracks or crevices and having a vertical permeability less than one inch (1") in twenty-four (24) hours shall be considered impermeable. With regard to soils, a soil horizon or layer having a vertical permeability less than one inch (1") in twenty-four (24) hours shall be considered impermeable.

29. Intermittent sand filters - Intermittent sand filters are beds of granular materials twenty-four to thirty-six inches (24-36") deep underlain by graded gravel and collecting tile. Wastewater is applied intermittently to the surface of the bed through distribution pipes or troughs and the bed is under-drained to collect and discharge the final effluent. Uniform distribution is normally obtained by dosing so as to flood the entire surface of the bed. Filters may be designed to provide free access (open filters) or may be buried in the ground (buried filters or subsurface sand filters). Effluent from intermittent sand filters shall be discharged to a soil absorption system.

30. Matrix Color - The dominant color of a soil material.

31. Mottling - A zone of chemical oxidation and reduction activity appearing as splotchy patches of red, brown, orange and gray in the soil.

32. Mound system - A system where the soil treatment area is built above the ground to overcome limits imposed by proximity to water table or bedrock or by rapidly or slowly permeable soils.

33. Non-ground absorption sewage disposal system - A facility for waste treatment designed not to discharge to the soil, land surface, or surface waters, including, but not limited to, incinerating toilets, mechanical toilets, composting toilets and recycling systems.

(1)(B)cont.

34. On-site wastewater treatment system - A sewage treatment system, or part of a system, serving a dwelling(s) or other establishment(s) which utilizes subsurface soil treatment and disposal.

35. Other establishment - Any public or private structure other than a dwelling which generates sewage.

36. Pan - A soil horizon compacted, hard or very high in clay content. These horizons are usually very slowly permeable. Common pans are claypans and fragipans.

37. Perched water table - A saturated zone above and separated from the water table by a horizon which is unsaturated.

38. Percolation rate - The time rate of drop of a water surface in a test hole as specified in subsection (2)(C) of these standards.

39. Permeability - The ease with which liquids and gases move within the soil or rock.

40. Plastic limit - A soil moisture content below which the soil may be manipulated for purposes of installing a soil treatment system and above which manipulation will cause compaction and puddling.

41. Privy - An outhouse or structure used for receiving human excrement in a container or vault beneath the structure.

42. Professional engineer - An engineer holding a current license to practice from the Missouri Board for Architects, Professional Engineers and Land Surveyors, having a background in soils, wastewater, and geology.

43. Restrictive horizon - A soil horizon that is capable of perching ground water or sewage effluent and that is brittle and strongly compacted or strongly cemented with iron, aluminum, silica, organic matter or other compounds. Restrictive horizons may occur as fragipans, iron pans or organic pans and are recognized by their resistance in excavation or in use of a soil auger.

44. Rock fragments - The percentage of rock fragments in a soil that are greater than two millimeters (2 mm) in diameter or retained on a No. 10 sieve which may include chert, sandstone, shale, limestone or dolomite. The amount of rock fragments in a soil is of a concern in areas of residual soils overlying highly permeable bedrock.

45. Sanitarian - A person registered as a sanitarian by the National Environmental Health Association or employed as a sanitarian by the state or local health department.

46. Seepage bed - An excavated area larger than three feet (3') in width which contains a bedding of aggregate and has more than one (1) distribution line.

(1)(B)cont.

47. Seepage trench - An area excavated one to three feet (1-3') in width which contains a bedding of aggregate and a single distribution line.

48. Septage - Those solids and liquids removed during periodic maintenance of a septic or aeration unit tank or those solids and liquids removed from a holding tank.

49. Septic tank - Any watertight, covered receptacle designed and constructed to receive the discharge of sewage from a building sewer, separate solids from liquid, digest organic matter, store liquids through a period of detention and allow the clarified liquids to discharge to a soil treatment system.

50. Setback - A separation distance measured horizontally.

51. Severe geological limitations - Site-specific geologic conditions which are indicative of rapid recharge of an aquifer and likely groundwater contamination. Locations with significant groundwater contamination potential should be investigated by a registered geologist to determine if the site has severe geological imitations. Standardized criteria for determinations of severe geological limitations are available in the form Assessment of Individual On-Site Waste Disposal Geological Limitations from the Department of Natural Resources, Division of Geology and Land Survey.

52. Sewage - Any water carried domestic waste, exclusive of footings and roof drainage, from any industrial, agricultural, OR commercial establishment or any other structure. Domestic waste includes, but is not limited to, liquid waste produced by bathing, laundry, culinary operations, liquid wastes from toilets and floor drains and specifically excludes animal waste and commercial process water.

53. Sewage flow - Flow as determined by measurement of actual water use or, if actual measurements are unavailable, as estimated by the best available data provided in Section (2)(E) of these standards or in 10 CSR 20-8.020 Small Sewage Works Design Guide or 19 CSR 20-3.0690.

54. Sewage tank - A watertight tank used in the treatment of sewage which includes, but is not limited to, septic tanks and aeration units.

55. Sewage tank effluent - That liquid which flows from a septic or aeration unit under normal operation.

56. Significant groundwater contamination potential - Any condition which would cause or indicate rapid recharge of an aquifer. This includes, but is not limited to, the following conditions or parameters: a water sample from an on-site well which exceeds drinking water standards with respect to fecal coliform; a hydrologic connection is established between the on-site waste disposal system and any well; a disposal field to be placed in Class V soils or soils with a percolation rate less than ten minutes per inch (10min./in.); a disposal field within one hundred feet (100') of the 100 year flooding elevation of a sinkhole; or a sewage tank within fifty feet (50') of the 100 year flooding elevation of a sinkhole.

(1)(B)cont.

57. Single dwelling wastewater stabilization pond - A sealed earthen basin which uses the natural unaided biological processes to stabilize wastewater and used on large lots.

58. Sinkhole - For the purpose of these regulations a sinkhole is defined as any natural depression in the surface of the ground with or without collapse of adjacent rock, that provides a means through which surface water can come into contact with subsurface water.

    Sinkhole depressions may be gradual or abrupt; they may or may not have a well defined eye. While most sinkholes can be defined as the area within a "closed contour", some sinkholes, such as those located on the sides of hills and in stream valleys, may not.

    All sinkholes provide discreet points of recharge to groundwater.

59. Site - The area bounded by the dimensions required for the proper location of the soil treatment system.

60. Slope - The ratio of vertical rise or fall to horizontal distance.

61. Soil - The naturally occurring, unconsolidated mineral or organic material of the land surface developed from rock or other parent material and consisting of sand, silt, and clay sized particles and variable amount of organic materials.

62. Soil characteristics - limiting. Those soil characteristics which preclude the installation of a standard system, including, but not limited to, evidence of water table or bedrock closer than three feet (3') to the ground surface and percolation rates slower than one hundred twenty minutes per inch (120min./in.). Also the amount of rock fragments in areas of significant potential for groundwater contamination.

63. Soil saturation - The condition that occurs when all the pores in a soil are filled with water.

64. Soil scientist - A person who has successfully completed a least fifteen (15) semester hours of undergraduate or graduate level soils science course work including at least three (3) hours of course work in soil morphology and interpretations, and has a minimum of two years experience specifically unique to the soil science profession, such as field mapping experience with the USDA-SCS soil surveys or soil factors evaluations for on-site wastewater systems, or has completed a masters or higher degree in soil science with at least one year of field experience as described above.

65. Soil textural classification - Soil particle sizes or textures specified in these standards refer to the soil textural classification in the Soil Survey Manual Handbook No. 18, U.S. Department of Agriculture, 1951.

66. Soil treatment area - That area of trench or bed bottom which is in direct contact with the trench rock of the soil treatment system.

(1)(B) cont.

67. Soil treatment system - A system where sewage tank effluent is treated and disposed of below ground surface by filtration and percolation through the soil. It includes those systems commonly known as seepage bed, trench, drainfield, disposal field and includes mound and low pressure pipe systems.

68. Standard system - An individual sewage treatment system employing a building sewer, sewage tank and the soil treatment system commonly known as seepage bed or trenches, drainfield or leach field.

69. Toilet waste - Fecal matter, urine, toilet paper and any water used for flushing.

70. Valve box - Any device which can stop sewage tank effluent from flowing to a portion of the soil treatment area. This includes, but is not limited to, caps or plugs on distribution or drop box outlets, divider boards, butterfly valves, gate valves or other mechanisms.

71. Very slowly permeable - Soils, bedrock and soil horizons or layers having a vertical permeability less than one inch (1") in twenty-four (24) hours.

72. Water table - The highest elevation in the soil where all voids are filled with water, as evidenced by presence of water soil mottling or other information. This includes perched and zones of saturation for long periods of time.

73. Watertight - Constructed so that no water can get in or out below the level of the outlet.

(C) <u>Applicability</u>

For these standards, on-site wastewater treatment and disposal system means all equipment and devices necessary for proper conduction, collection, storage, treatment and disposal of wastewater from a dwelling or other facility having an average daily flow of three thousand (3000) gallons per day, or less. Included within the scope of this definition are building sewers, septic tanks, subsurface absorption systems, mound systems, intermittent sand filters, gravelless systems, single family wastewater stabilization ponds and aeration unit wastewater treatment systems.

(D) <u>Minimum Set Back Distances</u>

All onsite wastewater treatment and disposal systems shall be located in accordance with the distances shown in Table I on page 3-8.

Table 1-Minimum Set-Back Distances

Minimum Distance From	Sewage Tank (1)	Disposal Area (2)	Lagoons
Private water supply well	(Feet) 50	(Feet) 100	(Feet) 100
Public water supply well (Community or Non-Community)	300	300	300
Classified stream, lake or impoundment*	50	50	50
Cistern	50	50	50
Faults, photo lineaments, or fracture trends (5)	100	100	100
Ground source heat pump well	50	100	100
Spring	200	200	200
Stream or open ditch	25	25	25
Property line	10	10**	75
Building foundation	5	15	see section 6(D)
Basement	15	25	see section 6(D)
Deck	5	15	see section 6(D)
Other soil absorption systems except repair areas	–	20	20
Sinkhole rim (4)	100	100	100
Suction water line	50	100	100
Swimming Pool	25	25	25
Top of slope of embankments or cuts of two feet (2') or more vertical height	–	20	20
Upslope interceptor drains	–	10	10
Water line under pressure	10	10	10
Electric or other utility lines	5	5	5

(1)(D) cont. Table 1 Minimum Setback Distances

Footnotes to Table 1

* A classified stream is any stream that maintains permanent flow or permanent pools during drought periods and supports aquatic life.

** Recommended twenty-five feet (25') of down slope property line initially, but repair may be allowed to ten feet (10') of down slope property line.

(1) Includes sewage tanks, intermittent sand filters and dosing chambers.

(2) Includes all systems subsurface absorption systems. Does not include wastewater stabilization ponds.

(3) Unplugged abandoned wells or wells with less than eighty feet (<80') of casing depth shall have one-hundred-fifty feet (150') minimum distance from the above.

(4) Setback distance from sinkholes refers to the horizontal distance from the rim of the sinkhole, which is defined as the perimeter of the sinkhole depression.

Where the required setback distance from the sinkhole rim cannot be reasonably met on an existing tract of land which is in conformity with the Greene County Zoning Regulations the following requirements shall apply:

a) The absorption field shall be located a minimum of 100 feet from the sinkhole flooding area. The sinkhole flooding area is defined as the area below the elevation of the lowest point on the sinkhole rim OR the areas inundated by runoff from a storm with an annual exceedance probability of 1% (100-year storm) and a duration of 24 hours (8 inches of rain in Greene County).Volume of runoff shall be calculated according to the methods set forth in USDA Soil Conservation Service Technical Release No. 55 Urban Hydrology for Small Watersheds.

b) A soil factors evaluation shall be performed.

c) The size of the absorption field shall be based upon the minimum wastewater application rate of 0.2 gallons per day per square foot of absorption area.

d) A low pressure pipe (LPP) system or other alternative system allowed in these regulations may be required depending upon soil conditions.

e) The Department may require that absorption trenches be sand lined.

(5) Location of faults, photo lineaments, and fracture trends are as shown on Plate 2 of "Hydro geologic Mapping of Unincorporated Greene County, Missouri", by Aley and Thomson.

(6) Septic tanks and lateral fields may be located within the required setbacks of abandoned wells if the well has been abandoned and plugged in conformance with the requirements of Missouri Department of Natural Resource Standards 10 CSR 23.3110.

(7) For system rehabilitations where setback distances are unattainable, the maximum attainable setback will be required with no part of the new repair having a lesser setback distance than the original system.

(8) No portion of the system may be located within an existing easement, without approval of this Department and the utility owner.

(9) All portions of the system must be located on the property where the wastewater is generated unless an easement is provided for the portion of the system located off the property. The easement must be recorded in the office of the Recorder of deeds before the system can be installed.

(1) cont.
(E) Sewage Flow Rates

1. Single family dwellings (including mobile homes).

In determining the volume of sewage from single family dwellings, the minimum flow rate shall be one hundred twenty (120) gallons per day per bedroom.

The minimum volume of sewage from each single family dwelling shall be two hundred forty (240) gallons per day and each additional bedroom above two (2) bedrooms shall increase the volume of sewage by one hundred twenty (120) gallons per day.

When the occupancy of a single family dwelling exceeds two (2) persons per bedroom, the volume of sewage shall be determined by the maximum occupancy at a rate of sixty (60) gallons per person per day.

The maximum wastewater flow for on-site wastewater systems serving single family residential dwellings is fifteen hundred (1500) gallons per day.

For two-unit patio homes, each unit shall be considered a single family residence.

2. Other residential dwellings.

A. Duplexes: 120 gallons per day per bedroom, minimum 240 gallons per day per unit

B. Apartments and condominiums: 120 gallons per day per bedroom

3. Other establishments.

For establishments or developments other than residential dwellings Table II shall be used for determine sewage flow rates

Table II Quantities of Sewage Flows

Type of Establishment (1)	Flow Rate Gallons per day per unit unless otherwise indicated
Residential Units	
Single Family Dwelling	120/bedroom
Multiple Family	120/bedroom
Commercial Facilities	
Transportation terminals (airports, bus stops, railroads etc.)	5/passenger
Laundromats	580/machine
Beauty Shops (Style Shops)	125/chair
Bowling Lanes	50/lane
Business (other than those listed elsewhere in this table)	25/employee

Type of Establishment	Table II cont.	Flow
Commercial Facilities (cont.)		
Factories (exclusive of industrial waste)		25/person/shift
add for showers		10/person/shift
Marinas		10/boat slip
with bathhouse		30/boat slip
Motels/Hotels		120/room
with cooking facilities		175/room
Offices		25/person/shift
Service Stations		250/water closet or urinal
24-hour Service Stations		325/water closet
Theaters: Movie.		5/seat
Drive-in		15/vehicle space
Warehouses		30/Employee
Public parks (toilets only)		5/user
Public parks with bath house		15-25/user
Camps		
Construction or Work Camps		60/person
		40/person (chemical toilet)
Summer Camps		60/person
Campgrounds-with comfort station (without water and sewer hookups)		100/campsite
Travel trailer/recreational vehicle park (with water and sewer hookups)		120/campsite
Assembly & Mercantile		
Retail stores		120/1000 sq. Ft. of retail sales area
Stadium or Auditorium		5/seat
Swimming pools, Spas, or Bathhouse		10/person
Churches (not including a kitchen, food service facility, Day care or camp)		3/seat
Churches (with a kitchen but not including a food service facility, day care or camp)		5/seat
Country Club		20/member
Food or Drink Establishment**		
Bar (not serving food)		20/seat
Restaurants		40/seat or
		40/15 sq. ft. of dining area whichever is greater
24-hour restaurant		75/seat
Food Stands		
1) per 100 sq. ft. of food stand floor space		50
2) add per food employee		25
Other food service facilities		5/meal
Meat Market		
1) per 100 sq. ft. of market floor space		50
2) add per market employee		25

Table II cont.

Type of Establishment	Flow
Institutional**	
Hospitals	300/bed
Day care facilities	15/person
Residential care facilities	60/person
Rest homes and nursing homes	
with laundry	120/bed
without laundry	60/bed
Day schools	
with cafeteria, gym and showers	15/student
with cafeteria only	12/student
with neither cafeteria nor showers	10/student
Boarding schools	60/student

NOTES:
(1) Number of customers or patrons assumed in determining the daily wastewater flow will be subject to verification by the Greene County Health Department from use at similar facilities.
(2) Number of persons is assumed to be 3 times the number of parking spaces.
(3) Office buildings are assumed to have one employee per 300 square feet of gross floor area.
(4) Gallons per person per day includes normal infiltration for residential systems.
(5) Population to be served -- unless satisfactory justification can be given for using lower per-unit occupancies
(6) For Convenience stores or service stations with food preparation an additional 100 gallons per day shall be added to the daily waste flow.
Table II-B shall be used in determining the population for which to design the sewage works.
** Establishments processing food may be required to provide grease interceptors in an accessible location prior to the sewage treatment system.

Table II-B

Unit	Persons/unit
Apartments or Condominiums	
(1) bedroom	2.0
(2) bedroom	3.0
(3) bedroom	3.7
Camper trailers with sewer hookup	3.0
Camper trailers without sewer	2.5
Mobile Homes	3.0-3.7
Motels	3.0
Residences	3.7

3. Reduction in sewage flow.

Reductions in design sewage flow rates for non-residential facilities may be approved if water efficient plumbing fixtures are provided. Reduction will be based upon the usage rate of the fixtures provided.

4. Gray water/Black water systems

Separate systems may be used for gray water and black water systems. Forty percent (40%) of the average daily waste flow shall be considered black water. The remaining sixty percent (60%) of the average daily waste flow shall be considered gray water.

(1)(E) cont.
Septic tank size for black water will be as required in Section (4). Minimum size for gray water tank shall be two hundred (200) gallons with five hundred (500) gallons being preferred.

Minimum absorption field area for gray water systems shall be sixty percent (60%) of the total area required based upon the daily waste flow and the allowable soil loading rate or three hundred (300) square feet of absorption field whichever is greater. Minimum area for blackwater systems shall be forty percent (40%) of the total area required based upon the design daily waste flow and the allowable soil loading rate, or four hundred fifty (450) square feet of absorption field, whichever is greater.

(2) SITE EVALUATION

(A) Procedure

All proposed sites for onsite sewage treatment and disposal systems shall be evaluated for the following:

1. Topography and landscape position.
2. Soil characteristics.
3. Soil drainage.
4. Soil depth.
5. Restrictive soil horizons.
6. Available space.

(B) Soil Factors Evaluation

This evaluation for determining site suitability and design is done by determining the soil morphological characteristics. This evaluation shall be conducted by a professional soil scientist.

Section (2)(D) through (2)(J) and Appendix D of these standards contain criteria for this type of site evaluation. Since this type of soil analysis pertains to the factors that relate directly to permeability, no percolation test is required, however the Resource Management Department may require a percolation test for comparison or the soil scientist may perform percolation test at his/her discretion.

One (1) soil pit shall be provided for each absorption field. The Department may require additional soil pits, up to a maximum of three (3) pits for each absorption area, if soil characteristics do not appear to be reasonably uniform across the absorption area.
Soil pits shall be a minimum of 30 inches wide by 36 inches long (30" x 36"), and shall be excavated to a depth of four (4) feet below the proposed trench bottom or 72" (6 feet), whichever is less.

(2)(B)cont.
1. Percolation Test **-** percolation tests shall be performed according to the following procedure:

<A> Each test hole shall be six to eight inches (6-8") in diameter and have vertical side walls.

<B> Test holes shall be located thirty feet (30') from the nearest tree. If this distance cannot be attained, the hole shall be located as far from the nearest tree as possible.

<C> One (1) test hole shall be bored or dug to a depth of twenty-four inches (24") or to the bottom of the proposed soil absorption system, whichever is less. The second hole shall have a depth of thirty inches (30") or six inches (6") below the bottom of the proposed trench, whichever is less.

<D> A wooden stake, measuring no less than thirty-six inches (36") long shall be placed vertically in each hole when it is backfilled, for verification of hole depth by the inspector.

<E> The bottom and sides of the hole shall be carefully scratched to remove any smearing and to provide a natural soil surface into which water may penetrate. All loose material shall be removed from the bottom of the test hole and two inches (2") of one-fourth to three-fourths inch (1/4-3/4") gravel shall be added to protect the bottom from scouring;

<F> Presoaking. The hole shall be carefully filled with clear water to a minimum of twelve inches (12") over the soil bottom of the test hole and maintained for no less than four (4) hours. The hole shall then be allowed to swell for at least sixteen (16) but no more than thirty (30) hours.

<G> Field Measurement of Percolation Rate. Adjust the water depth to six inches (6") over the gravel at the bottom of the test hole. At thirty (30) minute intervals, measure and record the drop in water level. After measuring, refill the water level to six inches (6"). Continue taking readings at thirty (30) minute intervals until two (2) successive measurements differ by no more than one-sixteenth inch (1/16").

At least three (3) readings must be made. The last water level drop is used to calculate the percolation rate.

<H> Calculation of Percolation Rate - Percolation rate shall be calculated as follows:

a. Divide the time interval by the drop in water level to obtain the percolation rate in minutes per inch;

b. The slowest percolation rate of the two (2) tests shall be used to determine the final soil treatment system design. Where the slowest percolation rate varies by more than twenty (20) minutes per inch from the other tests, a soil factors evaluation must be conducted to justify a design based upon the faster percolation rates; and

c. All calculations and measurements shall be submitted on the standard worksheet Form EV04 (see Appendix A).

(2)cont.
(C) Site Suitability Rating
Each of the factors listed in paragraph (A) above shall be classified as Suitable (S), Provisionally Suitable (PS), or Unsuitable (U). Criteria for rating each factor are set forth in this section.

The most restrictive classification will determine the overall site classification.
Note: Requirements and recommendations provided herein represent the most reasonable and practical means available to overcome site limitations which have been identified. They do not give any guarantee that the absorption field system will function properly.

1. Suitable

A suitable classification indicates that soil and site conditions are favorable for installation and operation of a soil absorption field. Sites may have slight limitations which can be readily overcome by proper design and installation.

2. Provisionally Suitable

Site classified as provisionally suitable may be utilized for soil absorption systems, but have moderate limitations. Sites classified as provisionally suitable require some modifications and careful planning, design, and installation for a soil absorption field to function satisfactorily.

3. Unsuitable

Sites classified as unsuitable have severe limitations for installation and operation of soil absorption systems, and may not be used for soil absorption systems.

A site originally classified as unsuitable may be reclassified as provisionally suitable in accordance with the criteria set forth below in subsections (D) through (J).

(D) Topography and Landscape Position

Uniform slopes under fifteen percent (15%) shall be considered suitable with respect to topography. When slopes are less than two percent (2%), provisions shall be made to insure adequate surface drainage. When slopes are greater than four percent (4%), the absorption lines shall follow the contour of the ground.

Uniform slopes between fifteen and thirty percent (15-30%) shall be considered provisionally suitable with respect to topography, if the soil depth is thirty-six inches (36") or more. Slopes within this range may require installation of interceptor drains upslope from the soil absorption system to remove all excess water that might be moving laterally through the soil during wet periods. Usable areas larger than the minimum are ordinarily required in this slope range.

Slopes greater than thirty percent (30%) shall be considered unsuitable except when a thorough study of the soil characteristics indicates that a soil absorption system will function satisfactorily and sufficient ground area is available to properly install such a system. Slopes greater than thirty percent (30%) may be classified as provisionally suitable when:

(2)(D) cont.

1. The slope can be terraced or otherwise graded or the absorption lines located in naturally occurring soil to maintain a minimum ten foot (10') horizontal distance from the absorption trench and the top edge of the fill embankment;

2. The soil characteristics can be classified as suitable or provisionally suitable to a depth of at least one foot (1') below the bottom of the absorption trench;

3. Surface water runoff is diverted around the absorption field so that there will be no scouring or erosion of the soil over the field;

4. If necessary, groundwater flow is intercepted and diverted to prevent the water from running into or saturating the soil absorption system; and

5. There is sufficient ground area available to install the septic tank system with these modifications.

Complex slope patterns and slopes dissected by gullies and ravines shall be considered unsuitable with respect to topography.

Areas subject to frequent flooding shall be considered unsuitable to landscape position.

Depressions or sinkholes shall be considered unsuitable with respect to landscape position except when the site complies essentially with the requirements of this chapter and is specifically approved by the Resource Management Department.

The surface area on or around a ground absorption system sewage treatment and disposal system shall be landscaped to provide adequate drainage if directed by the Resource Management Department. Interception of perched or lateral groundwater shall be provided where necessary to prevent soil saturation on or around the soil absorption field.

(E) <u>Soil Characteristics</u>

The following important soil characteristics shall be considered in making a site evaluation for a soil absorption system:

1. Soil Texture

The relative amount of the different sizes of mineral particles in a soil are referred to as soil texture. All mineral soils are composed of sand (2-0.05 mm in size); silt, which includes intermediate-sized particles that cannot be seen with the naked eye but feel like flour when pressed between the fingers (0.05-0.002 mm in size); and /or clay, which is extremely small in size and is the mineral particle that gives cohesion to soil (less than 0.002 mm in size). The texture groups of the different horizons of soils may be classified into five (5) general groups according to the criteria set forth in Appendix D.

(2)(E)1.cont.
The soil loading rates shall be determined according to the soil textural group as set forth in Tables D-I and D-II in Appendix D.

2. Soil Consistence.

Soil consistence comprises the attributes of soil material, typically clay , that are expressed by the degree and kind of cohesion and adhesion, or by the resistance to deformation or rupture.

Determination of soil consistence will be required only for site evaluations performed on the basis of soil factors, and shall be done according to the criteria set forth in Appendix D.

3. Organic Soils.

Organic soils shall be considered unsuitable.

4. Soil Structure.

In many soils, the sand, silt and clay particles tend to cling or stick to one another to form a ped or a clump of soil. This is known as soil structure. Soil structure may have a significant effect on the movement of effluent through a soil.

Evaluation of soil structure shall be done according to the criteria set forth in Appendix D.

(F) <u>Soil Drainage</u>

Soils with seasonally high water tables are of major concern in evaluating sites for sewage effluent disposal. These are the soil areas that may give good sewage absorption rates during dry seasons of the year, but force sewage effluent to the surface during the wetter seasons.

1. The depth of the seasonal high water table can commonly be recognized by those examining soil profiles. The criterion for recognition of high water tables is that of soil color.

   Subsurface horizons that are in colors of reds, yellows, and browns generally indicate good soil aeration and drainage throughout the year.

   Subsurface horizons that are in colors of gray, olive, or bluish colors indicate poor aeration and poor soil drainage. These dull or grayish colors may occur as a mass of soil or may be in mottles of localized spots. The volume of grayish color is indicative of the length of time that free water stands in that soil profile.

   There are soils that have light colored mottles which are relic from the light colored rock from which the soils have weathered. These soils would not have high water tables, so one must distinguish between a true soil composed of sand, silts and clays, or the rock material that may still exist in the soil profile.

(2)(F)cont.

2. Any soil profile that has the grayish colors of chroma 2 or less (Munsell color chart) indicative of high water tables, or is subject to periodic high water, within thirty-six inches (36") of the surface shall be considered unsuitable as to drainage.

   Soils where the seasonally high water table is less than forty-eight inches (48") and more than thirty-six inches (36") below the naturally occurring surface shall be considered provisionally suitable for soil drainage.

   Soils where the seasonally high water table is greater than forty-eight inches (48") below the naturally occurring surface shall be considered suitable for soil drainage.

   Where the soil is considered suitable in structure and texture (soil groups I and II) and modifications can be made to maintain the groundwater table at least twelve inches (12") below the bottom of the absorption trench at all times, the soils may be reclassified provisionally suitable for drainage.

   Drainage systems installed for groundwater lowering shall be maintained so that a minimum separation of one foot (1') occurs between the absorption trench bottom and the seasonally high water table.

   For extensive drainage systems, such as groundwater lowering in subdivisions, easements shall be recorded and shall have adequate width for reasonable egress and ingress for maintenance.

(G) <u>Soil Thickness</u>

The thickness of soils to rock which are classified as suitable or provisionally suitable in texture and structure shall be at least forty-eight inches (48") when conventional soil absorption systems at conventional depths are to be utilized.

Soil thicknesses greater than forty-eight inches (48") shall be considered as suitable as to soil thickness. Soil thickness less than forty-eight inches (48") and greater than thirty-six inches (36") shall be considered provisionally suitable.

Soil thickness less than thirty-six inches (36") is considered unsuitable for standard absorption trenches at standard depths. Where special design and installation modifications can be made to provide at least two feet (2') of naturally occurring soil below the bottom of the absorption trench, these soils may be reclassified as provisionally suitable in thickness.

(H) <u>Restrictive Horizons</u>

Restrictive horizons in soils are recognized by their apparent resistance in excavation or in using a soil auger. Restrictive horizons may occur as fragipans or claypans.

The fragipan is a layer that owes its hardness mainly to extreme density or compactness as opposed to high clay content or cementation. The latter is typically dense and brittle. Although fragments are friable when removed, when in place the material is so dense water moves through it very slowly.

(2)(H)cont.
Unlike fragipans, the claypan is a compact, slowly permeable layer in the subsoil having a much higher clay content than the overlying material. A sharply defined boundary exists between the claypan and the overlying material. Claypans are typically hard when dry and plastic and sticky when wet.

Restrictive horizons that are greater than six inches (6") thick severely restrict the movement of water and sewage effluent and do not adequately respond to groundwater lowering drainage systems.

Where these horizons are less than six inches (6") thick they do not severely restrict the movement of water and sewage effluent, but rather indicate the presence of a seasonally high water table and, after special investigation, may be modified.

1. Soils in which restrictive horizons are six inches (6") or more in thickness and at depths greater than forty-eight inches (48") below the ground surface shall be considered suitable as to depth to restrictive horizons.

2. Restrictive horizons six (6) or more inches thick and at depths between forty-eight inches (48") and thirty-six inches (36") shall be considered provisionally suitable as to depth to restrictive horizons.

3. Restrictive horizons six (6) or more inches thick and at depths between thirty-six inches (36") and twenty-four inches (24") shall be considered unsuitable as to depth to restrictive horizons, but may be classified to provisionally suitable by shallow placement of trenches, or other approved modifications or alternative designs.

4. Restrictive horizons six (6) or more inches in thickness encountered at depths less than twenty-four inches (24") below the ground surface shall be considered unsuitable as to depth to restrictive horizons.

(I) <u>Other Factors</u>

The following considerations shall also be made in designing and locating the absorption field:

1. The existence of lowlands, local surface depressions, rock outcrops and sinkholes;

2. All required setback distances as required in 10 CSR 20-6.030 and subsection (1)(D) of these standards;

3. Surface water flooding probability;

4. Location of easements and underground utilities; and

(2)(I) cont.
5. Amount of area available for a replacement field.

6. The proximity of a large capacity water supply well, the cone of influence of which would dictate a larger separation distance than the minimum specified in subsection (1)(D).

(J) USDA Soil Survey Information

Information contained in the Soil Survey for Greene and Lawrence Counties, Missouri prepared by the USDA Soil Conservation Service provides valuable information which can be used in making preliminary studies and general screening of potential sites for suitability.

Final absorption field design must be based upon actual tests taken at each absorption field location.

(3) BUILDING SEWERS

(A) General

Building sewers used to conduct wastewater from a building to an on-site wastewater treatment and disposal system shall be constructed of plastic pipe meeting the minimum requirements of American Society for Testing and Materials (ASTM) Standards F789-85 and D3034-81, schedule 40 PVC, cast iron or ductile iron and all with approved type joints.

1. Size. Building sewers shall not be less than four inches (4") in diameter.

2. Slope. Building sewers shall be laid to the following minimum slope:

4-inch sewer ---- 12 inches per 100 feet
6-inch sewer ---- 8 inches per 100 feet

3. Cleanouts. A cleanout shall be provided no closer than two feet (2') or more than five feet (5') from the building foundation. Additional cleanouts are required at least every one hundred feet (100') and at every change in direction or slope if the change exceeds forty-five degrees (45).

4. Connection to sewage tank. The pipe going into and out of the sewage tank shall be schedule 40 PVC, cast iron or equivalent and shall extend a minimum of two feet (2') beyond the hole of excavation for the sewage tank or five (5) feet, whichever is greater.

5. Building sewers shall not be located in a common trench with or located closer than ten feet (10') horizontally or two feet (2') vertically to water lines.

6. Building sewers shall have a minimum of twelve inches (12") of cover from the top of the pipe to finished grade.

7. Building sewers laid under drives or paved traffic areas shall either be encased in metal conduit, or shall be schedule 40 PVC with a minimum of four inches (4") of cleaned crushed rock bedding

(3)(A)7 cont.
(nominal size not less than ½" or greater than 1") on all sides of the pipe; or shall be cast iron, ductile iron, or galvanized steel pipe.

(4) SEWAGE TANKS

(A) General

All liquid waste and washwater shall discharge into the sewage tank. Roof, garage, footing, surface water, drainage and cooling water shall be excluded from the sewage tank. All sewage tank effluent shall be discharged to a soil absorption system that is designed to retain the effluent upon the property from which it originated. All tanks must be constructed of concrete, fiberglass, molded plastic or other corrosion resistant material approved by the Resource Management Department.

Fiberglass and molded plastic tanks shall be properly anchored to prevent flotation, and shall be bedded and backfilled in accordance with the manufacturer's specifications.

All tanks regardless of material or method of construction shall:

1. Be watertight and designed and constructed to withstand all lateral earth pressures under saturated soil conditions with the tank empty.

2. Be designed and constructed to withstand a minimum of two feet (2') of saturated earth cover above the tank top; and

3. Not be subject to corrosion or decay.

4. Be placed on firm level subgrade.

(B) Septic Tanks

Septic tanks, regardless of material or method of construction, shall conform to the following criteria:

1. The liquid depth of any septic tank or its compartment shall be not less than thirty inches (30"). A liquid depth greater than six and one-half (6 ½) feet shall not be considered in determining tank capacity.

2. No tank or compartment shall have an inside horizontal dimension less than twenty-four inches (24").

3. Inlet and outlet connections of the tank shall be submerged by baffles.

4. The space in the tank between the liquid surface and the top of the inlet and outlet baffles shall be not less than twenty percent (20%) of the total required capacity, except that in horizontal cylindrical tanks this space shall be not less than fifteen percent (15%) of the total required liquid capacity.

(4)(B) cont.

5. Inlet and outlet baffles shall be constructed of acid-resistant concrete, acid-resistant fiberglass or plastic.

6. Sanitary tees shall be affixed to the inlet or outlet pipes with a permanent waterproof adhesive. Baffles shall be integrally cast with the tank, affixed with a permanent water proof adhesive or affixed with stainless steel connectors top and bottom.

7. The inlet baffle shall extend at least six inches (6") but no more than twenty percent (20%) of the total liquid depth below the liquid surface and at least one inch (1") above the crown of the inlet sewer.

8. The outlet baffle and the baffles between compartments shall extend below the liquid surface a distance equal to forty percent (40%) of the liquid depth except that the penetration of the indicated baffles or sanitary tees for horizontal cylindrical tanks shall be thirty-five percent (35%) of the total liquid depth. They also shall extend above the liquid surface as required in paragraph (4)(B)4. of these standards. In no case shall they extend less than six inches (6") above the liquid surface.

9. There shall be at least one inch (1") between the underside of the top of the tank and the highest point of the inlet and outlet devices.

10. The inlet invert shall be not less than three inches (3") above the outlet invert.

11. The inlet and outlet shall be located opposite each other along the axis of maximum dimension. The horizontal distance between the nearest points of the inlet and outlet devices shall be at least four feet (4').

12. Sanitary tees shall be at least four inches (4") in diameter. Inlet baffles shall be no less than six inches (6") or no more than twelve inches (12") measured from the end of the inlet pipe to the nearest point of the baffle. Outlet baffles shall be six inches (6") measured from beginning of the outlet pipe to the nearest point on the baffle.

13. Access to the septic tank shall be as follows:

    A. There shall be one (1) or more manholes, at least twenty inches (20") least dimension and located within six feet (6') of all walls of the tank. The manhole shall extend through the cover to a point within twelve inches (12") but no closer than six inches (6") below finished grade. Manhole risers are not required when the top of the tank is within twelve inches (12") of final grade. All manhole openings must be provided with a substantial, fitted water-tight cover of concrete, cast iron or other approved material. All manhole covers should be covered with at least six inches (6") of earth. Manhole covers which terminate above grade shall have an effective approved locking device; and

    B. There shall be an inspection pipe of at least six inches (6") diameter or a manhole over both the inlet and outlet devices. The inspection pipe shall extend through the cover and be

(4)(B) cont.

capped flush or above grade. A downward projection of the center line of the inspection pipe shall be directly in line with the center line of the inlet or outlet device.

14. Compartmentation of single tanks shall be in accordance with the following:

    A. Septic tanks larger than fifteen hundred (1500) gallons and fabricated as a single unit shall be divided into two (2) or more compartments.

    B. When a septic tank is divided into two (2) compartments, not less than one-half (½) nor more than two-thirds (2/3) of the total volume shall be in the first compartment;

    C. When a septic tank is divided into three (3) or more compartments, one-half (½) of the total volume shall be in the first compartment and the other half equally divided in the other compartments;

    D. Connections between compartments shall be baffled so as to obtain effective retention of scum and sludge. The submergence of the inlet and outlet baffles of each compartment shall be as specified in paragraphs (4)(B)7. and 8. of these standards;

    E. Adequate venting shall be provided between compartments by baffles or by opening of at least fifty (50) square inches near the top of the compartment wall; and,

    F. Adequate access to each compartment shall be provided by one (1) or more manholes at least twenty inches (20") least dimension and located within six feet (6') of all walls of the tank. The manhole shall extend through the cover to a point within twelve inches (12") but no closer than six inches (6") below finished grade, unless the Resource Management Department requires otherwise.

15. The use of multiple tanks is not allowed without special approval of the Resource Management Department.

16. The liquid capacity of a septic tank serving a dwelling shall be based upon the number of bedrooms contemplated in the dwelling served and shall be at least as large as the capacities given below:

Table III

Number of Bedrooms	Minimum Liquid Capacity (Gallons)
1 to 3	1000
4	1250
5	1500

These figures provide for use of garbage grinders, automatic clothes washers and other household appliances. The use of garbage grinders is not recommended due to the increase of additional solids into the septic tank

(4)(B) cont.

A. For six (6) or more bedrooms the septic tank shall be sized on the basis similar to an establishment. See paragraph (4)(B)17. of this section.

17. For individual residences with more than five (5) bedrooms, multiple-family residences or any place of business or public assembly, the liquid capacity of the septic tank shall be designed in accordance with the following:

    V =1.5Q+500 where,

    V is the liquid capacity of the septic tank; and
    Q is the design daily sewage flow.

18. Where a building serves an accessory use, such as a garage, barn, or workshop, and has no living quarters, the minimum size tank shall be five hundred (500) gallons.

19. Pump chambers shall be sized and constructed as outlined in Chapter 3 (6) (C) of these regulations.

(C) Location

1. The sewage tank shall be placed so that it is accessible for the removal of liquids and accumulated solids;

2. The sewage tank shall be placed on firm and settled soil or rock subgrade capable of bearing the weight of the tank and its contents; and

3. Tops and sides of sewage tanks shall be covered with earth backfill or other approved material.

   The top of the tank shall be covered with a minimum of twelve inches (12") of earth.

   Where it is impractical to completely bury the tank, the sides shall be covered with a minimum of three feet (3') of earth graded to a slope not steeper that 2-1/2 horizontal to 1 vertical, or enclosed in a retaining wall, and insulated as required to provide the same r-value as three (3) feet of earth cover.

(D) Solids Removal

It is recommended that the owner of any septic tank or his/her agent {} regularly inspect and arrange for the removal and sanitary disposal of septage from the tank whenever the top of the sludge layer is less than twelve inches (12") below the bottom of the outlet baffle or whenever the bottom of the scum layer is less than three inches (3") above the bottom of the outlet baffle. Yearly inspections of septic tanks are recommended.

When a repair is made to any part of an on-site wastewater system the tank shall be pumped within 72 hours prior to the start of construction and baffles inspected. Receipt from the septic tank pumping service must be submitted prior to approval of work.

(4) cont.
(E) Removing Existing Tanks

Where existing tanks are to be removed from service, the contents of the tank shall be pumped out. The tank may then be crushed in place and backfilled with earth.

The tank must be inspected by the Resource Management Department after pumping and prior to backfilling.

(F) Aeration Units

An aeration unit wastewater treatment plant utilizes the principle of oxidation in the decomposition of sewage by the introduction of air into the sewage. An aeration unit may be used as the primary treatment unit instead of a septic tank except where special local conditions may limit their use. All aeration unit type treatment systems shall comply with the general requirements for sewage tanks set forth in subsection (4)(A) of these standards and with the following:

1. Limitations. Special conditions where aeration units should not be used may include, but not be limited to, the following:

    A. Where intermittent (interruptions of more than five (5) days without flow) use will adversely affect the functioning of the plant;

    B. Where dependable maintenance service is not available;

    C. Where electrical service is unreliable; and

2. General. The aeration unit shall be located where it is readily accessible for inspection and maintenance. Set-back distances for aeration units shall be in accordance with subsection (1)(D) of these standards.

3. Design. All aeration units shall comply with National Sanitation Foundation Standard No. 40 or as required by the Resource Management Department. In addition, all aeration unit treatment plants shall comply with the requirements stipulated in this section.

    A. The aeration unit shall have a minimum treatment capacity of one hundred twenty (120) gallons per bedroom per day or five hundred (500) gallons whichever is greater.

4. Effluent disposal. Effluent from an aeration unit shall be discharged into a soil absorption system or other final treatment system in accordance with section (6) of these standards. No reductions in the area of soil absorption systems or other final treatment systems shall be permitted because of the use of an aeration unit instead of a septic tank.

    Direct surface discharge from an aeration unit treatment plant shall not be permitted.

5. Operation and maintenance. Where aeration units are used, institutional or administrative arrangements to control their use, operation and maintenance are recommended. Aeration units should be pumped at least once a year to remove excess solids from the plant.

(5) ABSORPTION SYSTEMS

The common design of absorption systems is one using absorption trenches, each separate from the other and each containing a distribution pipe. This type of system should be used whenever practical. Other types of absorption systems may be used as alternatives where the site conditions meet the specific design requirements of the alternative systems.

(A) Standard Absorption Trenches

The absorption trench gives additional treatment to the sewage from the treatment tank. Regardless of its appearance of clarity or transparency, the outflow or effluent from a sewage tank is a dangerous source of contamination. The satisfactory operation of the sewage disposal system is largely dependent upon the proper site selection, design and construction of the absorption trench.

1. Standard absorption trenches shall not be constructed in soils having a soil loading rate less than 0.2 gallons per day per square foot or soils where rapid permeability could result in effluent entering the groundwater without proper treatment. Where these conditions occur, standard trenches must be modified as set forth in subsection (B) below or an alternative system shall be constructed.

2. The absorption trench shall be located on the property to maximize the vertical separation distance from the bottom of the absorption trench to the seasonal high ground water level, as determined by the presence of mottling, bedrock or other limiting layer. The vertical separation between the bottom of the absorption trench and limiting layer or seasonal high ground water table should be three feet (3') and in no case shall the separation distance be less than two feet (2') for standard systems. Greater vertical separation may be required where water-bearing formations are in danger of contamination.

3. Absorption trenches shall not be constructed in unstabilized fill or ground which has become severely compacted due to construction equipment.

4. Absorption fields shall not be constructed in soils which are wet.

5. The minimum area in any absorption trench system shall be in accordance with Table IV. The minimum size system shall be six hundred (600) square feet, except where a building serves an accessory use, such as a garage, barn, or shop, etc., and has no living quarters, the minimum size field shall be four hundred fifty (450) square feet, with a minimum tank size of five hundred (500) gallons. Area shall be set aside for a replacement field equal in area to the area required for the proposed absorption field.

(5)(A)5 cont.

Table IV

Percolation Rate	Absorption Area sq. ft. /bedroom*	Loading rate gal./ sq. ft*	Probable soil texture
<10	not suitable for	standard absorption	trenches
10-30	200	0.8	sand, loamy sand
30-45	265	0.45	sandy loam, loam
45-65	300	0.4	silt loam, clay loam, silty clay loam**
60-120	600	0.2	silty clay, sandy clay, clay***

Footnotes to Table IV

* Gallons of sewage tank effluent per day per square foot of trench bottom.

** Fine loams with low to moderate shrink/swell potential and less than thirty-five percent (35%) clay.

*** Clays with low to moderate shrink/swell potential above any perched water table or zone of seasonal saturation. These soils are easily damaged during construction due to compaction from equipment. Absorption trenches should be installed only when the soil moisture content is less than the plastic limit. Extreme care should be taken to determine if a perched water table or zone of seasonal saturation as evidenced by mottling is within two feet (2') of the trench bottom of these soils.

(1) Standard absorption trenches in highly permeable soils shall have a minimum vertical separation of four feet (4') between the absorption trench bottom and seasonal high groundwater table or bedrock.

(2) Cherty clay soils shall have less than fifty percent (50%) rock fragments and a vertical separation distance of four feet (4') between the absorption trench bottom and bedrock.

(3) Unlined absorption trenches shall not be installed in cherty clays when the field evaluation indicates the presence of zones of large voids.

(4) Absorption trenches installed in areas of potential groundwater contamination with cherty clays shall be designed for a maximum loading rate of forty-five hundredths (.45) gallons per square foot or a minimum of two hundred sixty-five (265) square feet per bedroom.

(5) Standard absorption trenches will not be permitted in soils having a loading rate less than 0.4 gallons per day per square foot.

(6) Soil absorption fields of any type will not be permitted in soils having a loading rate less than 0.2 gallons per day per square foot, unless no alternative sites are available on the property, and the property has been zoned and subdivided in accordance with Greene County regulations. In these cases a system may be approved by the Resource Management Department provided that all reasonable measures have been taken to ensure disposal of effluent without surfacing.

(5)(A)

6. Each absorption trench system shall have a minimum of two (2) trenches with no one (1) trench longer than one hundred feet (100') or shorter than fifty feet (50'). The absorption trenches shall be located not less than three (3) times the trench width on centers with a minimum spacing of six feet (6') on centers.

7. Absorption trenches shall be at least eighteen inches (18") wide and no more than thirty-six inches (36") wide. The bottom of standard absorption trenches shall be at least eighteen inches (18") and not more than thirty inches (30") below the finished grade unless approved by the administrative authority. Absorption fields shall not be located within other utility excavations.

8. The pipe used between the sewage tank and the absorption system shall be a minimum of five feet (5') in length have a four-inch (4") inside diameter and be equivalent to the pipe used for the building sewer as set forth in section (3) of these standards. The pipe shall have a minimum fall of not less than one-eighth inch (1/8") per foot. All joints shall be of watertight construction.

9. Gravity-fed absorption field distribution lines shall be at least four inches (4") in diameter. Perforated distribution lines shall be used. The perforations shall be at least one-half inch (½") and no more than three-fourths inch (3/4") in diameter.

   A. All perforated pipe used in the absorption system shall be a minimum of ASTM standard D-2729, 2500 crush proof. Perforated pipe with three (3) rows of holes shall not be used.

   B. When four (4)- or six (6)-inch diameter corrugated plastic tubing is used for distribution lines, it shall be certified as complying with ASTM standards F405. The corrugated tubing shall have three (3) rows of holes, each hole between one-half inch (½") and three-fourths inch (3/4") in diameter and spaced longitudinally approximately four inches (4") on centers. The rows of holes may be equally spaced one hundred twenty degrees (120) on centers around the periphery or three (3) rows may be located in the lower portion of the tubing, the outside rows being approximately on one hundred twenty degree (120) centers. COILED TUBING SHALL NOT BE USED.

10. The absorption trenches shall be constructed as level as possible but in no case shall the fall in a single trench bottom exceed one-fourth inch (1/4") in ten feet (10') as determined by an engineer's level. The ends of distribution lines should be capped or plugged, or when they are at equal elevations, they may be connected. All caps shall be exposed for inspection. Step downs within the absorption trenches are not allowed.

11. Rock used in soil absorption systems shall be clean, washed gravel or crushed stone and graded or sized between one and one-half and two and one-half inches (1 ½"-2 ½") with no more than ten percent (10%) of the material small enough to pass through a ½" screen.

(5)(A)11. cont.

The rock shall be placed a minimum of one foot (1') deep with at least six inches (6") below the pipe and two inches (2") over the pipe and distributed uniformly across the trench bottom and over the pipe. Before placing soil backfill over the trenches, the gravel shall be covered with -

A. Unbacked, rolled, three and one-half inch (3 ½") thick fiberglass insulation;

B. Untreated building paper;

C. Synthetic drainage fabric;

D. A minimum of eight inches (8") of straw for a compacted thickness of two inches (2"); or

E. Other material approved by the Greene County Resource Management Department laid as to separate the gravel from the backfill.

12. Complex slope patterns and slopes dissected by gullies shall not be considered for installation of absorption trenches.

Uniform slopes under fifteen percent (15%) shall be considered suitable for installation of absorption trenches.

When slopes are less than two percent (2%), provisions shall be made to insure adequate surface drainage.

When slopes are greater than four percent (4%), the absorption trenches shall follow the contour of the ground.

Uniform slopes between fifteen percent (15%) and thirty percent (30%) should not be used for installation of absorption trenches unless the soil depth is three feet (3') or more below the trench bottom. Slopes within this range may require installation of interceptor drains upslope from the soil absorption system to remove all excess water that might be moving laterally through the soil during wet periods. Usable areas larger than minimum are ordinarily required in this slope range.

Slopes greater than thirty percent (30%) shall not be utilized for installation of absorption trenches.

13. Effluent distribution devices, including distribution boxes, flow dividers flow diversion devices and drop boxes, shall be of sound construction, watertight, not subject to excessive corrosion and of adequate design as approved by the Resource Management Department. Effluent distribution devices shall be separated from the sewage tank and absorption trenches by a minimum of two feet (2') of undisturbed or compacted soil and shall be placed level on a solid foundation of soil or concrete to prevent differential settlement of the device.

(5)(A)13. cont.

A. Each distribution line shall connect individually to the distribution box. A minimum of five-feet (5') of schedule 40 pipe shall exit the distribution box.

B. The pipe connecting the distribution box to the distribution line shall be of a tight joint construction laid on undisturbed earth or properly bedded throughout its length.

C. No more than five (5) distribution lines shall be connected to a distribution box.

D. Distribution boxes shall be installed only in systems where the pipe are at equal elevations.

E. The use of multiple distribution boxes is not allowed unless engineering data is submitted to demonstrate that the system will function as intended.

14. Stepdowns or drop boxes may be used where topography prohibits the placement of absorption trenches on level grade. Serial distribution systems should be limited to where there is at least three feet (3') separation between the bottom of the absorption trenches and the limiting condition such as slow permeability or zone of seasonal saturation as evidenced by mottling.

Whenever the design sewage flow rate requires more than seven hundred fifty feet (750') of distribution line in a stepdown or drop box type system, the absorption field shall be divided into two (2) or more equal portions.

Stepdown trenches shall be separated by a minimum of two feet (2') of undisturbed soil excavated to a height level with the top of the upper distribution line. The trench relief line should be placed either in the center or as far as practical from the outlet (overflow) from the same trench. The overflow line connecting trenches shall be four inch (4") schedule 40 PVC.

Stepdowns shall be constructed such that the upper distribution line will fill to a depth of two inches (2") before effluent begins to drain into the next trench.

Drop boxes shall be constructed so that the invert of the inlet supply pipe is one inch (1") above the invert of the outlet supply pipe which is connected to the next lower drop box. The piping connecting drop boxes shall be schedule 40 or better.

The top of the trench outlet laterals, which allow effluent to move to the distribution lines, shall be two inches (2") above the invert of the outlet supply line. The pipe connecting drop boxes to absorption line shall be solid schedule 40 PVC and a minimum of five-feet (5') in length.

It is recommended that drop boxes be designed to close off the trench outlets to provide for periods of resting when the absorption trench becomes saturated.

(5)(A) cont.

15. Dosing is required for all systems when the design sewage flow requires five hundred (500') lineal feet or more of trench. Distribution from the dosing system shall not include serial distribution.

    When the design sewage flow requires more than one thousand (1000) lineal feet of distribution line, the absorption field shall be divided into two (2) equal portions and each half dosed alternatively, not more than four (4) times per day.

    Dosing may be accomplished by the use of a pump. Each side of the system shall be dosed not more than four (4) times per day. The volume of each dose shall be the greater of the daily sewage volume divided by the daily dosing frequency, or an amount equal to approximately three-fourths (3/4) of the internal volume of the distribution lines being dosed (approximately one-half (.5) gallon per lineal foot of four-inch (4") pipe).

    Whenever dosed distribution box systems are utilized, the separation distance between the absorption trench bottom and limiting condition should be at least two feet (2').

16. <u>Gravelless subsurface absorption systems</u> may be used as an alternative to conventional four-inch (4") pipe placed in gravel filled trenches, however they cannot be used in areas where conventional systems would not be allowed due to poor permeability, high groundwater or insufficient depth to bedrock. Design approval for these systems will be required from the Greene County Resource Management Department prior to installation and all manufacturing specifications and installation procedures shall be closely adhered to.

    A. For purpose of calculation, the eight inch (8") pipe shall be considered equal to eighteen inches (18") in width of a standard absorption trench. The ten inch (10") pipe may be considered equal to twenty-five inches (25") in width of a standard absorption trench. One twelve inch (12") polystyrene aggregate bundle with a four inch (4") diameter polyethylene drain pipe may be considered equal to twenty-five inches (25") in width of a standard absorption trench.

    B. Two (2) rows of perforations shall be provided located one hundred twenty degrees (120) apart along the bottom half of the tubing, each sixty degrees (60) from the bottom centerline. Perforations shall be cleanly cut and uniformly spaced along the length of the tubing and should be staggered so that there is only one (1) hole in each corrugation. The tubing shall be visibly marked to indicate the top of the pipe. All gravelless drainfield pipe shall be encased at the point of manufacture with a spun bonded nylon filter wrap.

    C. The trench for the gravelless system shall be dug with a level bottom. On sloping ground, the trench should follow the contour of the ground to maintain a level trench bottom and to ensure a minimum backfill of six inches (6"). It is recommended that the minimum trench width for the gravelless system be eighteen inches (18") in friable soils to ensure proper backfill around the bottom half of the pipe.

(5)(A)16 cont.

In cohesive soils, the minimum width of excavation should be twenty-four inches (24"). In clay soils it is recommended that the trench be backfilled with sandy material or good topsoil. The gravelless system may be installed at a trench bottom depth of eighteen inches (18") minimum to thirty inches (30") maximum, but a more shallow trench bottom depth of eighteen to twenty-four inches (18-24") is recommended. To promote equal effluent and suspended solids distribution, the slope of the drain pipe should be from zero (0) to one-half inch (0.5") per one hundred feet (100').

D. Unless specifically approved by the soil scientist and designing engineer, all gravelless pipe must be installed in a 24" wide trench.

E. Gravelless pipe may not be substituted for a conventional absorption trench unless the designing professional has authorized its use and it has been approved by the pre-site evaluation.

F. Backfill material for gravelless pipe shall be free of large or hard objects such as dirt clods or rocks. Backfill material must be approved by the Resource Management Department Inspector before placement.

17. Bed systems may be used on sites where the minimum soil loading rate is 0.4 gallon per day per square foot and essentially meeting the other requirements of this section, and only on lots which are limited by topography, space or other site planning considerations. The number of square feet of bottom area needed shall be increased by fifty percent (50%) over what would be required for a trench system.

Distribution lines shall be at least eighteen inches (18") from the side of the bed and shall have lines on three-foot (3') centers. When the design volume of sewage exceeds six hundred (600) gallons per day, adequate space shall be provided to accommodate a trench system for the absorption system.

Bed systems will generally be limited to sites with five percent (5%) or less slopes.

In any area where a bed system is proposed, the existing ground elevation at all four (4)corners of the proposed bed must be shown on the plans. The bottom of gravel at the lowest edge of the bed shall be a minimum of eighteen inches (18") below the existing ground surface. This depth may be reduced to twelve inches (12") where shallow placement is recommended.

The maximum distance from the ground surface to the bottom of gravel shall be thirty inches (30") along the highest edge of the bed.

The maximum allowable bed width for a site of a given slope shall be computed as follows:

(5)(A)17 cont.

$$W = \frac{V}{100 \times S}\text{ ,where}$$

W = maximum allowable bed width in feet
S = ground slope across the bed area in feet per foot
V = maximum allowable variation in bed

18. Leaching chambers will be permitted on sites having a percolation rate slower than of sixty (60) minutes per inch, or an allowable soil loading rate of less than 0.4 gallons per day per square foot.

    Leaching chambers may be constructed of concrete, high density polyethylene, or other material approved by the Department.

    Minimum soil cover over the leaching chamber structure shall be twelve inches (12").

    The total soil contact area for the effluent shall be equal to the required area computed for standard absorption trenches. For purposes of calculation, the fifteen inch (15") chamber shall be considered equal to twenty-four inches (24") in width of a standard absorption trench. The twenty-two inch (22") chamber shall be considered equal to twenty-eight inch (28") width of a standard absorption trench. The thirty-four inch (34") chamber may be considered equal to thirty-six inches (36") in width of a standard absorption trench.

19. Absorption fields shall not cross water lines unless no other repair possibilities exist (including moving the water line). The following items must be adhered to:

    1. The water line shall be cased in schedule 40 PVC sealed with caulk or grout.

    2. Each lateral line that crosses the water line shall contain a section of solid schedule 40 PVC pipe for ten feet (10') on each side of the water line.

(B) <u>Modifications to Standard Absorption Systems</u>

Modified systems which may be utilized to overcome selected soil and site limitations and must be approved by the Resource Management Department include the following:

1. <u>Shallow placement of absorption trenches</u> shall be utilized where insufficient depth to seasonally high or perched water table or where insufficient soil thickness prevents the placement of conventional distribution lines in accordance with this section.

    Shallow trenches shall be designed and constructed to provide a minimum of two feet (2') of natural soil separation between the trench bottom and the uppermost elevation of the seasonally high or perched water table and rock.

    In some areas with shallow restrictive horizons, a modified shallow placement system may be used when there is a minimum of twelve inches (12") of natural soil separation between the

(5)(B)1 cont.

bottom of the trench and the seasonally high or perched water table, providing an interceptor curtain or vertical drain is also used. These modified shallow placement systems will not be allowed unless an interceptor drain is included. No variance will be allowed for a modified shallow placement system for natural soil separation of less than twelve inches (12").

Shallow trenches may be constructed by placing the top of the gravel at original ground level and covering the absorption field with loamy soil or good topsoil to a depth of twelve to eighteen inches (12-18") at the center.

The cover over the absorption field shall extend at least three feet (3') beyond the edge of any trench and have a turf grass cover established immediately after construction.

If an area is to be filled and the trenches constructed in the fill with the bottom of the trenches in at least six inches (6") of natural soil, the following procedures must be followed:

A. The fill material shall be of a sandy texture with a maximum clay content of fifteen percent (15%). The fill material shall not be hauled or worked wet. The area to be filled must be protected from traffic and small brush and trees removed prior to placement.

B. The soil surface must be loosened with a cultivator or garden plow. This work must be done when the soil is dry.

C. The fill is moved onto the site without driving on the loosened soil. The fill material is then tilled into the natural soil to create a gradual boundary between the two. The remaining fill is then added in layers until the desired height is obtained with each layer being tilled into the preceding layer.

D. The site is then shaped to shed water and fill all low spots before the absorption system is installed. After installation of the absorption system the site must have a turf grass cover established as soon as possible.

2. <u>Alternating dual field absorption systems</u> may be utilized where soils are limited by high clogging potentials, percolation rates slower than sixty (60) minutes per inch or high shrink/swell potential soils and where the potential for malfunction and need for immediate repair is required. Alternating dual field absorption systems shall be designed with two (2) complete absorption fields, each sized a minimum of seventy-five percent (75%) of the total area required for a single field and separated by an effluent flow diversion valve. The diversion valve shall be constructed to resist five hundred pounds (500 lbs.) crushing strength, structurally sound and shall be resistant to corrosion. Valves placed below ground level shall be constructed and oriented to allow the valve to be operated from the ground surface.

3. <u>Sand-lined trenches</u> shall be used in areas where the soil has greater than fifty-percent (50%) rock fragments due to bedrock conditions. For a maximum loading rate of forty-five hundredths gallons (.45 gals.) per day per square foot or a minimum of two hundred sixty-five (265) square feet per bedroom the sand is not required to meet the specifications for intermittent sand filters.

(5)(B)3 cont.

The material must be natural or manufactured sand and have no more than fifteen percent (15%) clay content. Clean "creek sand" that is screened to 1/4" and smaller may be used. Manufactured sand shall be chat sand produced from flint chat in the Joplin area or fines manufactured from igneous rocks or chert gravel may be used.

The sand used for the liner shall contain less than twenty-five percent (25%) material retained on a No. 10 sieve. Finely crushed limestone is not acceptable. For higher loading rates, the sand must meet the requirements for an intermittent sand filter.

A. In standard four-inch (4") pipe and gravel trenches the depth of liner material must be twelve inches (12") below the gravel and at least six inches (6") on the sides of the gravel up to the top of the gravel. To place sand on the sides of the trenches, the trench walls may be excavated on a slope instead of vertically.

   When it is impossible to excavate the trenches on a slope the sand may be placed on the sides of trenches by digging the trench twelve inches (12") deeper than the recommended trench depth. The sand is placed eighteen (18") inches deep in the bottom of the trench and a V-shaped form is dragged through the sand to push the sand at least six (6") up on the sides of the gravel.

B. In gravelless pipe systems the minimum thickness of liner material is six inches (6") around the pipe.

C. The effluent to sand-lined systems in areas of potential groundwater contamination should be equally distributed as much as practically possible. Serial and drop box systems shall not be used. As a minimum, a distribution box shall be used to evenly distribute the effluent to the trenches. Dosing is recommended in order to more positively assure even distribution.

4. Interceptor Drains

Interceptor drains can be used to improve soil drainage in areas having seasonally high water tables or perched groundwater. Interceptor drains shall consist of a perforated drain pipe meeting the same specification as set forth in Section (5)(A)8. B. of this chapter for absorption lines. Coiled tubing may be used for interceptor drains.

The pipe shall be bedded in rock meeting the specifications set forth in Section (5)(A)11 of this chapter. There shall be a minimum of 4" of gravel below the pipe, and 2" of gravel above the pipe. The gravel shall be covered with insulation, building paper, drainage fabric, or straw, as set for the Section (5)(A)10.A.-E. of this chapter, and the remainder of the trench backfilled with earth.

Trenches for interceptor drains shall be excavated to a minimum width of twelve inches (12") and maximum width of twenty-four inches (24"). Trenches shall not be closer than ten feet (10')

5)(B)4 cont.

or further than fifteen feet (15') from the absorption field. Trenches must be excavated a minimum of six inches (6") into the restrictive layer.

The depth of the interceptor drains shall be set such that the top of the pipe is no higher than two inches (2") below the bottom of the absorption trench at any adjoining point in the absorption field.

Interceptor drains shall be laid at a minimum slope of 1/8" per foot (1-1/2" fall per 10 feet of pipe). Interceptor drains shall be extended to daylight. The outlet ends of the interceptor drain pipe shall be protected in a manner to prevent damage to or breakage of the pipe.

Interceptor drains shall discharge to a public right-of-way, drainage easement, or natural watercourse unless otherwise approved by the Resource Management Department.

Where the ground slope on the property is too flat to allow the interceptor drains to daylight on the property, a sump pump shall be provided to remove excess water from the trench. The sump pump shall be equipped with automatic on-off controls. Electrical wiring for the sump pump installation shall meet the requirements of the National Electric Code. The wet well for the sump pump shall be made of durable, non-corrosive material. The bottom of the wet well shall be made of concrete or other durable non-corrosive material.

5. Vertical Drains

The use of vertical drains is not allowed unless there are other means to improve soil drainage; no alternative sites are available on the property, and the property has been zoned and subdivided in accordance with Greene County regulations.

6. Diversion Berms

Diversion berms may be used to keep surface water from contributing to high soil moisture levels in the absorption field areas. Diversion berms shall be located transversely to the direction of the ground slope.

The area where the berm is constructed shall be stripped of vegetation prior to placing fill for the berm. Fill shall be a good quality topsoil reasonably free of stones, roots, and other debris.

Berms shall be a minimum of six inches (6") and a maximum of twelve inches (12") high, and shall be sloped no greater than 3 horizontal to 1 vertical.

7. Chlorinators.

In cases where the threat of groundwater contamination is high, and there is no reasonably available alternative site for the absorption field, the Resource Management Department may require a chlorinator to disinfect the effluent from the septic tank.

(5)B7 cont.

Chlorinators shall be commercially manufactured units equivalent to the Jet-Chlor Tablet Chlorinator manufactured by Jet, Inc. The chlorinator shall be installed on the solid PVC line between the septic tank and the absorption field. Chlorinators shall have a locking cap to prevent unauthorized access.

(6) ALTERNATIVE SYSTEMS

(A) General

The intent of this section is to provide minimum standards for the design, location, installation, use and maintenance of alternative sewage treatment systems in areas of limiting soil characteristics or where a standard system cannot be installed or is not the most suitable treatment. Where such systems are employed, they shall comply with all requirements of the Resource Management Department.

(B) Adoption and Use

Nothing in these standards or section shall require the Resource Management Department to allow the installation of any system in this section.

(C) Low Pressure Pipe (LPP) Systems

A low pressure, two- to four-foot (2-4') pressure head, pipe system may be utilized where soil and site conditions prohibit the installation of a conventional or modified septic tank system due to the presence of shallow soil conditions, seasonally high water table conditions and slow soil permeability.

LPP systems shall be designed by a professional engineer.

The Resource Management Department may also require the LPP trenches to be sand-lined if the soils have severely diminished treatment capability due to excessive rock content. The amount of rock fragments shall be less than seventy percent (70%) unless the trenches are lined with sand.

1. The LPP shall consist of the following basic components:

   A. A network of small diameter one- to two- inch (1-2") diameter perforated PVC one hundred sixty pounds (160 lbs.) per square inch pipe or equivalent placed in natural soil at shallow depths, generally six to twelve inches (6-12"), in narrow trenches not less than six inches (6") in width. The holes in the perforated pipe should be spaced from two feet (2') to no more than eight feet (8'). The minimum hole size is five thirty-seconds inch (5/32");

   B. A properly designed, two (2)-compartment septic tank or other approved pretreatment system and a pumping or dosing tank. The pumping or dosing tank should be a minimum of five hundred gallons (500 gals.) or have the capacity to store one day's flow above the pump on level, whichever is greater.

(6)(C)1B cont.

There shall be a minimum clearance of two feet (2') feet between the septic tank and the pumping tank. The pipe connecting the tanks shall have a minimum slope of one-fourth inch (1/4") per foot in the direction of the pumping tank.

C. An approved submersible effluent pump with appropriate on/off controls for controlled dosing and a high water alarm or other approved pressure dosing and distribution system. The pump shall be capable of passing solids up to one and one-quarter inches (1 1/4") inches in diameter.

D. Effluent from the septic tank must pass through a properly anchored effluent screen or filter capable of preventing particles larger than one-eighth inch (1/8") from passing, prior to uptake by the effluent pump.

E. A watertight supply manifold pipe for conveying effluent from the pump to the low pressure network.

2. The soil and site criteria for low pressure pipe systems shall meet the following minimum requirements:

A. LPP absorption fields should not be installed on slopes in excess of ten percent (10%). LPP absorption fields may be installed on slopes greater than ten percent (10%) but require special design procedures to assure proper distribution of effluent over the absorption field (see Appendix C);

B. There shall be at least twenty-four inches (24") of separation between the naturally occurring soil surface and rock, water-impeding formation, seasonally high water table or evidence of chroma 2 mottles. This twenty-four-inch (24") depth shall consist of permeable soils with soil loading rates of 0.4 gallons per day per square foot or greater or be classified as SUITABLE or PROVISIONALLY SUITABLE in accordance with section (2) of these standards. The bottom of the proposed trenches must be located a minimum of one foot (1') above rock, water-impeding formation, seasonally high water table or where there is evidence of chroma 2 mottles. In areas where there is a concern for groundwater contamination and the soils have a high chert content, the bottom of the proposed trenches may be required to be as much as four feet (4') above bedrock;

C. Components of the LPP shall not be located in depressions or areas subject to frequent flooding. Surface water, perched ground water and other subsurface lateral water movement shall be intercepted or diverted away from all components of the LPP. Final shape of the LPP distribution field shall be such that rainwater or runoff is shed;

D. Location of the septic tank, pumping or dosing chamber and LPP absorption field is subject to the same horizontal setbacks specified in subsection (1)(D). Horizontal distances from the LPP absorption field shall be measured from a margin of two and one-half feet (2 ½') beyond the lateral and manifold pipes;

(6)(C)2 cont.

E. An area that is at least equal in size to the LPP distribution field area plus a two and one-half foot (2 ½') margin beyond the lateral and manifold pipes and meeting all other site and soil criteria shall be set aside for a replacement field;

F. There shall be no soil disturbance to an approved site for an LPP system except the minimum required for installation;

G. Additional design considerations that should be followed are included in Appendix C of these standards;

H. An access riser shall be installed over each ball valve and lateral turnup.

I. A threaded disconnect and a ball valve shall be installed inside the pump chamber on the supply line running from the pump to the absorption field.

3. The following application rates shall be used in determining the maximum application rate for low pressure pipe systems.

Table V

Percolation Rate	**Absorption Area sq. ft./bedroom**	**Loading Rate* gal./sq. ft.**	**Probable soil texture**
1-10	***	0.6	Sand, loamy sand
11-30	300	0.4	Sandy loam, loam
31-45	400	0.3	Loam, silt loam, clay loam
46-60	600	0.2	Silt loam, clay loam, silty clay loam, cherty clays**

Footnotes to Table V:

* Gallons of sewage tank effluent per day per square foot of total area.

**<u>Where the soils consist of cherty clays, with greater than 50% rock fragments the loading rate of two-tenths gallons (.2 gals.) per day per square foot should be used even when soil factors evaluation would indicate a higher loading.</u>

*** Soil loading rates of greater than 0.6 gallons per day per square foot generally represent unsuitable soil conditions for low pressure pipe systems.

**** LPP systems will not be allowed in locations where the soil loading rate is less than 0.2 gallons per day per square foot, except upon existing lots which were subdivided in accordance with Greene County regulations in effect at the time of subdivision and for which there are no alternative locations for the soil absorption field.

4. In calculating the number of square feet for the absorption field (not square footage of trench bottom) the design sewage flow shall be divided by the application rate from Table V. The

(6)(C)4 cont.

lateral lines shall have a minimum spacing of five feet (5') on centers within the area calculated for the absorption field. The systems shall be designed so that the discharge from any one (1) lateral line does not vary more than ten percent (10%) from the other laterals. All laterals shall have an envelope of trench rock surrounding the pipe. The trench rock shall be placed to a minimum depth of four inches (4") below the pipe and two inches (2") above the pipe.

5. Lateral trench rock shall be 1" to 2 ½” clean crushed rock or washed creek gravel free of fines.

6. All electrical wiring for the operation of the low pressure pipe (LPP) system shall be either direct bury under ground feed (UF) placed a minimum of twenty four inches (24") into the ground or shall be conduit encased wire placed a minimum of eighteen inches (18") into the ground. Wire size shall meet the requirements of the 1996 National Electrical Code (NEC).

(D) <u>Wastewater Stabilization Ponds</u> (Lagoons)

Plans for wastewater stabilization ponds must be approved and inspected by the Greene County Health Department.

A waste stabilization pond can provide satisfactory sewage treatment in rural areas where soils are not suited for absorption systems. Single residence wastewater stabilization ponds are not generally suitable in subdivisions with lots less than three (3) acres in size.

1. The following minimum separation distances are required for wastewater stabilization ponds:

   A. The pond shall be located a minimum of seventy-five feet (75') from property lines as measured from the adjoining pond shoreline. However, this distance must be increased where necessary to be sure that all effluent is disposed upon the property from which it originated;

   B. The pond shall be located a minimum of two hundred feet (200') from the nearest existing residence and a minimum of one hundred feet (100') from the residence that it serves;

   C. The pond shall be located at least one hundred feet (100') from a potable water supply or pump suction line; and

   D. The pond shall be located at least fifty feet (50') from a stream, water course, lake or impoundment.

2. Ponds may be utilized when there are no significant limitations related to groundwater from their use and the soils have been demonstrated to be impermeable such as percolation rates slower than one hundred twenty minutes per inch (120 min./1 in.). There shall be a minimum separation between the pond bottom and creviced bedrock of three feet (3'). Percolation losses from the pond shall not exceed one-eighth inch (1/8") per day to prevent groundwater contamination or nuisance conditions. Site modifications may be accomplished to provide

(6)(D)2 cont.

these soils requirements. In areas of highly permeable bedrock, restrictive layers such as fragipans shall be a minimum of twelve inches (12") thick and shall not be breached during construction.

3. Steeply sloping areas should be avoided.

4. Selection of the pond site should consider a clear sweep of the surrounding area by prevailing winds. Heavy timber should be removed for a distance of fifty feet (50') from the water's edge to enhance wind action and prevent shading.

5. A properly sized and constructed septic tank or aeration unit shall precede the pond. If irrigation of the effluent is required to maintain the wastewater on the property from which it originated, a septic tank or aeration unit shall precede the pond. The use of a septic tank or aeration unit shall not be used as a basis for reduction of the set-back distances as set forth in subparagraphs (6)(D)1.A.-D.

6. The pond shall be designed on the basis of four hundred forty (440) square feet of water surface area per bedroom at the three-foot (3') operating level. Whenever the pond is preceded by a septic tank or aeration unit, the water surface area may be reduced up to a maximum of twenty percent (20%); however, the minimum water surface area at the three foot (3') level shall be nine hundred (900) square feet. This reduction in size shall not be allowed where irrigation of the pond effluent is required by the Greene County Health Department in order to keep the wastewater on the property from which it originated.

7. A single cell is generally acceptable for single residence pond systems. If multiple cells are used for further polishing or storage of the effluent, the secondary cell should be at least one-half (½) the size of the primary cell.

8. The minimum embankment top width shall be four feet (4'). The embankment slopes shall not be steeper than three to one (3:1) on the inner and outer slopes. Inner embankment slopes shall not be flatter than four to one (4:1). Outer embankment slopes shall be sufficient to prevent the entrance of surface water into the pond. Freeboard shall be at least eighteen inches (18"). Additional freeboard may be provided.

9. Embankments shall be seeded with a locally hardy grass from the outside toe to one foot (1') above the water line to minimize erosion and facilitate weed control. Alfalfa or similar long-rooted crops which might interfere with the water-holding capacity of the embankment shall not be used. Riprap may be necessary under unusual conditions to provide protection of embankments from erosion.

10. The influent line shall be schedule 40 PVC or better material of water-tight construction. The line shall have a minimum diameter of four inches (4") inches and be laid on a firm foundation at a minimum grade of one-fourth inch (1/4") per foot. The influent line shall discharge as far as practical from the possible outlet side of the pond. A cleanout or manhole should be provided in the influent line near the pond embankment. From this point, the line should be laid

(6)(D)10 cont.

to the inner toe of the embankment and then on the bottom of the pond to the terminus point. A concrete splash pad three feet (3') square should be placed under the terminus of the pipe. The elevation of the cleanout or manhole bottom should be a minimum of six inches (6") above the high water level in the pond.

11. The shape of the pond should be such that there are no narrow or elongated portions. Round, square or rectangular cells are considered most desirable. Rectangular cells shall have a length not exceeding three (3) times the width. No islands, peninsulas or coves shall be permitted. Embankments should be rounded at corners to minimize accumulation of floating materials.

12. The floor of the pond shall be stripped of vegetation and leveled to the proper elevation. Organic material removed from the pond area shall not be used in embankment construction. The wetted area of the pond must be sealed to prevent excessive exfiltration. Seals consisting of soils must be adequately compacted by the construction equipment or a sheeps-foot type roller may be used.

13. Embankments shall be constructed of impermeable materials and compacted sufficiently to form a stable structure with very little settlement.

14. Any effluent should be withdrawn from six inches (6") below the water surface. This can be accomplished by placing a tee on the inlet end of the pipe or by placing the outlet pipe eight to ten inches (8-10") lower on the inlet end than the outlet end of the pipe.

15. The pond area shall be enclosed with a five-foot (5') high woven or chain-link fence to preclude livestock and discourage trespassing. The fence shall be so located to permit mowing of the embankment top and slopes. A gate of sufficient width to accommodate mowing equipment shall be provided. Appropriate warning signs shall be provided to designate the nature of the facility.

16. Effluent from a pond must be disposed of on the property from which it originated. This may be accomplished by locating the outlet as far as practical from the property line and out of any natural drainage ditches or swales. The minimum distance from the outlet to a property line shall be one hundred feet (100'). Another method is to construct a terraced swale with a minimum length of one hundred fifty feet (150'). If these methods are unsuccessful, or whenever there is less than twelve inches (12") of permeable soil over a restrictive layer, controlled surface irrigation must be used. To utilize controlled surface irrigation, the pond must be capable of operating up to five feet (5') deep with one foot (1') of freeboard or have a second cell for storage. The Greene County Health Department shall approve the method of effluent disposal.

17. It may be necessary to introduce water into the pond to facilitate start-up of the biological processes, however, there shall be no permanent connection of any roof drain, footing drain or any source of rainwater to the wastewater stabilization pond.

(6)(D) cont.

18. Odor problems caused by spring turnover of water, temporary overloading, ice cover, atmospheric conditions or anaerobic conditions may be controlled by broadcasting sodium or ammonium nitrate over the surface of the pond. In general the amount of sodium or ammonium nitrate should not exceed two pounds (2 lbs.) per day until the odor dissipates.

(E) Elevated Sand Mounds

Elevated sand mounds may be considered whenever site conditions preclude the use of absorption trenches. The construction of a mound shall be initiated only after a site evaluation has been made and landscaping, dwelling placement, effect on surface drainage and general topography have been considered. Due to the nature of this alternative system, actual selection of mound location, size of mound and construction techniques must be carefully considered and the criteria established in this standard implicitly followed.

Mound systems must be designed by a professional engineer and be specifically approved before construction begins. A set-back distance of fifty (50') from the down slope property line is recommended. Mound systems shall be designed in accordance with the procedures set forth in the United States Environmental Protection Agency publication Design Manual - Onsite Wastewater Treatment and Disposal Systems, October 1980, EPA 625/1-80-012.

1. Elevated sand mounds shall not be utilized on soils where the high ground water level as evidenced by mottling, bedrock or other strata having a soil loading rate of less than 0.2 gallons per day per square foot occurs within twenty-four inches (24") of natural grade. Up to four feet (4') of soil depth over bedrock may be required in areas where there is a significant potential for groundwater contamination. Mounds shall be constructed only upon undisturbed naturally occurring soils.

2. Elevated sand mounds are subject to the setback distances required in subsection (1)(D) of these standards.

3. The fill material from the natural soil plowed surface to the top of the rock-filled bed shall have a sand texture as classified by the Soil Conservation Service, U.S. Department of Agriculture. Loading rates on the sand fill shall not exceed the values in Table VI:

Table VI

Texture	Loading Rate
Medium to coarse sand	1.2 gal/sq.ft./day
Fine sand	1.0 gal/sq.ft./day
Loamy sand	0.8 gal/sq.ft./day
Sandy loam	0.6 gal/sq.ft./day

Note: Rock fragments larger than one-sixteenth (1 1/16") shall not exceed fifteen percent (15%) by volume of the material used for sandy fill.

(6)(E) cont.

4. There shall be a minimum of one foot (1') of fill material and two feet (2') of naturally occurring soils between the bottom of the trench rock and the highest elevation of the limiting conditions as defined in paragraph (6)(E)1. of these standards.

5. Whenever possible, mounds should be located on flat areas or crests of slopes. Mounds should not be located on natural slopes of more than six percent (6%) if the percolation rate is slower than sixty minutes per inch (60 min./1 in.) to a depth of a least twenty-four inches (24") below the sand layer. Mounds may be located on slopes up to a maximum of twelve percent (12%) if the soil percolation rate is faster than sixty minutes per inch (60 min./1 in.) to a depth of twenty-four inches (24") below the sand layer.

6. In no case shall the width of the trench rock in a single bed exceed ten feet (10').

7. The required bottom area of the trenches or bed and the effective basal area of the mound shall be based on one hundred twenty gallons (120 gals.) per bedroom per day. The basal area of the mound shall have the minimum area as shown in Table VII.

Table VII

Soil loading rate	Loading rate of basal area
1.0 - 0.8	1.2
0.8 - 0.6	0.75
0.6 - 0.4	0.50
0.4 - 0.2	0.25

8. The area of sand fill shall extend beyond the basal area and the sides shaped to a three to one (3:1) or four to one (4:1) slope. The sand fill shall be covered with six inches (6") of fine textured soil and a final cap of six inches (6") of good topsoil applied. Also the mound shall be seeded with a hardy grass to establish a turf grass cover as soon as possible. No shrubs shall be planted on the top of the mound. Shrubs may be placed at the foot and side slopes of the mound.

9. The land area fifty feet (50') down slope of the elevated sand mound is the effluent dispersal area and the soil in this area may not be removed or disturbed.

10. Dosing shall be required for all elevated sand mounds. The mound shall be dosed not more than two (2) times per day. The size of the dosing pump shall be selected to maintain a minimum pressure of one pound (1 lb.) per square inch, two and three-tenths feet (2.3') of head, at the end of each distribution line.

    A. Perforation holes and hole spacing shall be determined to insure equal distribution of the effluent throughout the bed or trenches.

(6)(E)10 cont.

B. The perforated pipe laterals shall be connected to a two-inch (2") diameter manifold pipe with the ends capped. The laterals shall be spaced no farther than forty inches (40") on center and no farther than twenty inches (20") from the edge of the trench rock. The perforated pipe laterals shall be installed level with the perforations downward. There shall be a minimum of nine inches (9") of trench rock below the laterals and two inches (2") above the laterals. The material used to cover the trench rock shall be untreated building paper, six inches (6") of compacted straw, three and one-half inches (3 ½") unbacked fiberglass insulation or a geotextile.

C. The manifold pipe shall be connected to the supply pipe from the pump. Anti-backflow valves are prohibited in the pump discharge line. The pump discharge line shall be graded to permit gravity flow to the absorption area or back to the dosing tank.

11. Prior to preparing the area selected for the mound, above ground vegetation must be closely cut and removed from the ground surface. Prior to plowing, the dosing pump discharge line from the pump chamber to the point of connection with the distribution manifold shall be installed. The area shall then be plowed to a depth of seven to eight inches (7-8") parallel to the land contour with the plow throwing the soil upslope to provide a proper interface between the fill and natural soils. A rubber-tired tractor may be used for plowing but in no case shall a rubber-tired tractor be used after the surface preparation is completed. Tree stumps should be cut flush with the surface and the roots should not be pulled. The soil shall be plowed only when the moisture content of a fragment eight inches (8") below the surface is below the plastic limit.

12. Mound construction shall proceed immediately after surface preparation is completed.

A. A minimum of twelve inches (12") of sand fill shall be placed where the trench rock is to be located. A crawler tractor with a blade shall be used to move the sand into place. At least six inches (6") of sand shall be kept beneath equipment to minimize compaction of the plowed layer. The sand layer upon which the trench rock is to be placed shall be level.

B. After hand leveling of the trench rock, place the distribution system and cover the pipes with two inches (2") of rock. After installation of the distribution system, the entire mound is to be covered with topsoil native to the area. Crown the entire mound by providing twelve inches (12") of topsoil on the side slopes with a minimum of eighteen inches (18") over the center of the mound. The entire mound shall then have a turf grass cover established to assure stability of the installation.

C. The area surrounding the elevated sand mound shall be graded to provide diversion of surface runoff waters.

(F) <u>Holding Tanks</u>

The use of holding tanks is generally discouraged and their interim use shall be limited to situations where construction of satisfactory sewage treatment and disposal systems will occur within one (1)

(6)(F) cont.
year. Use of a holding tank must be specifically approved by the Greene County Resource Management Department.

1. A holding tank shall be constructed of the materials and by the same procedures as those specified for watertight septic tanks.

2. A cleanout pipe of at least six inches (6") diameter shall extend to the ground surface and be provided with a sealed and properly secured cover to prevent odor and exclude insects and vermin. A manhole of at least twenty inches (20") least dimension shall extend to finished graded. The manhole cover shall not be covered with earth.

3. The tank shall be protected against flotation under high water table conditions. This shall be achieved by weight of the tank, earth anchors or shallow bury depths.

4. For a residence, the size shall be one thousand gallons (1000 gals.) or four hundred gallons (400 gals.) times the number of bedrooms, whichever is greater.

   A. For permanent structures other than residences, the capacity shall be based on measured flow rates or estimated flow rates. The tank capacity shall be at least five (5) times the daily flow rate.

5. Holding tanks shall be located as follows:

   A. In an area readily accessible to the pump truck under all weather conditions;

   B. As specified for septic tanks in Table I set forth in subsection (1)(D) of these standards; and

   C. Where accidental spillage during pumpage will not create a nuisance.

6. A contract for disposal and treatment of the sewage wastes shall be maintained by the owner with a pumper, municipality, agency or firm established for that purpose. The owner shall keep records of who pumped the tank, when the tank was pumped, and where the contents of the tank were disposed. The contract must accompany the application for permit.

7. A high water alarm shall be required on all holding tanks. This warning system shall be both visual and audible and installed to allow twenty-five percent (25%) reserve capacity after actuation.

8. Holding tanks used in conjunction with permanent black water/gray water systems must conform to the requirements of this section except that the minimum size tank is one thousand gallons (1000 gals.). In these situations, the holding tank is to receive toilet wastes only.

(6) cont.
(G) Sand Filters

Septic tanks or aeration units and sand filters may be used along with soil absorption systems where criteria for other alternative systems cannot be met. Sand filters shall be designed by a professional engineer. These systems must be specifically approved by the Greene County Resource Management Department.

1. The septic tanks and aeration units must be sized and constructed in accordance with section (4) of these standards. Setback distances as shown in Table I and as specified in subsection (1)(D) of these standards shall apply except that the minimum distance to the down slope property line should be fifty feet (50').

2. Sand filters must be designed and constructed in accordance with 19 CSR 20-3.060 Minimum Construction Standards for On-Site Sewage Disposal Systems as established by the Missouri Department of Health, with the following exceptions:

   A. All sand filters must be pressure dosed.

   B. Effluent may not surface discharge.

3. Use of these facilities with mechanical equipment and sand filters should be limited to where continued maintenance can be performed by an entity such as a sewer district, municipality or private firm established for that purpose. A contract for continued maintenance should be maintained by the owner at all times.

4. The size of the soil absorption system following the sand filter may be reduced by one-third (1/3) of the area required for a required for a conventional soil absorptions field. For re-circulating sand filters the Department may permit further reductions in the soil absorptions area depending on the site and soil conditions with adequate supporting data submitted by the engineer.

(H) Constructed Wetlands

Constructed wetlands may be used for secondary treatment of wastewater. Primary treatment of the wastewater must be provided by a septic tank or aeration unit designed in accordance with Section (4) of this chapter, prior to discharge into the constructed wetland. Effluent from the wetland must be discharged into a soil absorption field sized according to the procedures set forth in Section (5) of this chapter.

Constructed wetlands shall be designed according to the procedures and specifications set forth in Design of Submerged Flow Wetlands for Individual Homes & Small Wastewater Flows by Dr. Dennis M. Sievers, University of Missouri-Columbia Agricultural Engineering Department.

(6) cont.
(I) <u>Other Systems</u>

Where unusual conditions exist special systems of treatment and disposal, other than those specifically mentioned in these standards, may be employed provided:

1. Reasonable assurance of performance of the system is presented to the Greene County Resource Management Department;

2. The engineering design of the system is first approved by the Greene County Resource Management Department;

3. There is no discharge to the ground surface or surface waters;

4. Adequate substantiating data to indicate that the effluent will not contaminate any drinking water supply, groundwater used for drinking water or any surface water;

5. Treatment and disposal of the wastes protects public health and general welfare; and

6. These systems comply with all applicable requirements of these standards, with all Greene County codes and ordinances and all applicable requirements of chapter 701 of the Missouri statutes.

End of Chapter 3

APPENDIX A

FORMS

GREENE COUNTY RESOURCE MANAGEMENT DEPARTMENT

SITE EVALUATION
FOR
ON-SITE WASTEWATER TREATMENT & DISPOSAL SYSTEM

TYPE OF EVALUATION:

SOIL FACTORS ________

DATE OBSERVATIONS MADE: ___________

LEGAL DESCRIPTION: _____ 1/4, _____ 1/4, SECTION ____ TOWNSHIP ____ RANGE ____

SUBDIVISION ______________________________ LOT # ____

LOCATION ______________________________

OWNER/CONTRACTOR NAME ______________________________

MAILING ADDRESS ______________________________

TYPE OF OCCUPANCY: RESIDENCE ____ NO. BEDROOMS: ____

COMMERCIAL ____ TYPE __________ NO. PERSONS SERVED ___

SOIL SURVEY MAP NUMBER: _____

NAME(S) OF SOIL MAPPING UNITS: ______________________________

____

ANTICIPATED GEOLOGIC FORMATION: ______________________________

SITE PLAN: (Attach copy)

ABSORPTION TRENCH AREA RECOMMENDATIONS:

LOADING RATE: _________ GALLONS/DAY/SQ. FT.

TOTAL ABSORPTION TRENCH AREA REQUIRED: __________ SQUARE FEET (for standard system; if Low Pressure Pipe or other alternative system, attach required forms or design calculations)

SEE BACK OF FORM for General Recommendations, and Recommendations for meeting Provisional Requirements. All required provisions must be met for absorption trench area recommendations to apply.

I, the undersigned, hereby certify that the site evaluation was made in accordance with the requirements of the Greene County Design Standards for On-site Wastewater Treatment Systems, and that the data recorded are correct to the best of my knowledge.

NAME: ______________________________ PHONE: ______________

ADDRESS: ______________________________

Form EV01 (1/2000) SIGNATURE ______________________________

NOTE: All factors with a US or PS rating have a potential requirement even if a specific recommendation is not listed here.

Recommendations for Meeting Provisional Requirements

List All Factors Rated US or PS

_____ Trenches should not be dug when soil is wet to prevent sealing of trench surfaces.

_____ Recommended trench depth: __________ inches.

_____ ____

_____ ____

_____ ____

_____ ____

_____ ____

_____ ____

#1 -- Lower clayey horizons will have significantly slower permeability and poorer aeration under absorption field conditions, therefore the trenches should be kept as shallow as possible due to the ________ horizon at _______ inches.

#2 -- An interceptor drain is needed upslope from the soil absorption system to remove excess water moving laterally through the soil during wet periods, Interceptor drain should be at a minimum depth of _______ inches for a (____ curtain drain), (____ vertical drain).

#3 -- Surface water flow (from drainageway____; from upslope _____) needs to be diverted away from absorption field.

#4 -- Shallow placement of trenches (12-inch depth) is needed.

#5 -- Due to the highly permeable horizons and/or the slope, it is preferable not to utilize serial or drop box systems.

GENERAL RECOMMENDATIONS

1 -- The absorption field should be placed over as wide an area of the landscape as possible.

2 -- Drainage water from house guttering and/or subsurface foundation drain should be diverted away from absorption field.

*NOTE: Requirements and recommendations provided herein represent the most reasonable and practical means available to overcome site limitations which have been identified. They do not give any guarantee that the absorption field system will function properly.

GREENE COUNTY RESOURCE MANAGEMENT DEPARTMENT

SOIL EVALUATION - SOIL FACTORS DATE:________

LOCATION:________ OWNER/CONTRACTOR NAME________

SOIL PIT NUMBER: ________ DEPTH OF PIT: ________ INCHES

SOIL TYPE: ________ DEVIATIONS: ________

FACTOR	SUITABILITY CLASSIFICATION	FACTOR	SUITABILITY CLASSIFICATION
I. TOPOGRAPHY AND LANDSCAPE POSITION		II. SOIL CHARACTERISTICS	
A. Slope:________ %		A. Soil Texture Group	
B. Slope type:		Above ____ inches ____	
Uniform ____		Below ____ inches ____	
Complex ____		Depth to clayey horizon (>35% clay):________	
C. Landscape position: ________		Depth and thickness of unsuitable horizon(s): ________ / ________	
III. SOIL DRAINAGE		Horizon with >50% rock fragments: Yes___ No___	
A. Seasonal High Water Table:		Depth and thickness: ________ / ________	
Yes ____ Perched ____ Apparent ____		B. Soil Structure: ________	
No ____		Depth and thickness of unsuitable horizon(s): ________ / ________	
* B. Depth to low chroma mottling________		IV. SOIL DEPTH:________	
V. RESTRICTIVE HORIZON(S)		VI. AVAILABLE SPACE: ________	
Yes____ No____		________	
Depth and thickness ________/________		OVERALL SITE SUITABILITY	

S - Suitable PS - Provisionally Suitable U - Unsuitable

Abnormally high potential for groundwater contamination: Yes___ No ___
Due to: Rapid permeability ____, Sinkhole ____
Depth to highly permeable bedrock ____

COMMENTS:

* Include only low chroma colors due to wetness, indicating a water table.

** If fine textured soils are expected to have a percolation rate slower than 120 min./in., they will be placed in the 4b texture group regardless of the perceived type of clay or amount of chert.

*** Some factors rated US may be reclassified PS if the required provisions are met.

PROFILE DESCRIPTION

Location: ______________________ Date: ______________

Pit No.: ______________ Excavation Depth: __________ Soil Type: __________ Description by: __________

Parent Material: ______________________ Clay Type: ______________________ Vegetative Cover: __________

____

Hori-zon	Depth In.	2 Texture (USDA)	% Chert	% Chert >7.6CM	3 Consistency	4 Structure	5 Roots	Misc. 5 (pores, notes)	Color 6 Munsell Notation	Color Munsell Descriptive	

1 - Descriptions made in accordance with soil survey manual guidelines. 0 - Sample screened

2 - l-loam, sil-silt loam, scl-sandy clay loam, cl-clay loam, sicl-silty clay loam, sc-sandy clay, sic-silty clay, c-clay.

3 - Use wet conditions. ss-slightly sticky, s-sitcky, vs-very sticky, sp-slightly plastic, p-plastic, vp-very plastic.

4 - Record grade and shape. 1-weak, 2-moderate, 3-strong; abk-angular blocky, sbk-subangular blocky, gr-granular.

5 - f-few, c-common, m-many; f-fine and/or very fine, m-medium, c-course.

6 - color descriptions made with moist, broken samples.

GREENE COUNTY RESOURCE MANAGEMENT DEPARTMENT

LOW PRESSURE PIPE SYSTEM DATE: ________
DESIGN SUMMARY SHEET BY: ________
FORM EV06 PAGE 1 of 5

Daily waste flow:	_____	gallons
Septic tank size:	_____	gallons
Pumping tank size:	_____	gallons
Effluent loading rate:	_____	gal/sq.ft./day
Absorption field area:	_____	sq. ft.
Total length of laterals:	_____	feet
Lateral diameter:	_____	inches
Number of laterals:	_____	
Length of each lateral:	_____	feet
Supply line length:	_____	feet
Supply line diameter:	_____	inches
Manifold placement:	_____	
Hole size: *	_____	inches
Hole spacing:	_____	feet
Number of holes:	_____	
Pressure head:	_____	feet
Flow per hole:	_____	gpm
Total flow rate:	_____	gpm
Elevation head:	_____	feet
Friction head:	_____	feet
Pressure head:	_____	feet
Total head:	_____	feet
Pump requirements:	_____	gpm @
	_____	feet
Storage volume in laterals:	_____	gallons
Storage volume in supply line:	_____	gallons
Total storage volume:	_____	gallons
Dosing volume:	_____	gallons
Dosing depth:	_____	inches
Check valve needed ?	_____	

---

*NOTE: Data on hole size, spacing, pressure head and flow must be listed for each line for systems (such as sloping lots) where these values may be different for each line.

GREENE COUNTY RESOURCE MANAGEMENT DEPARTMENT

LOW PRESSURE PIPE SYSTEM
DESIGN WORKSHEET

PREPARED BY: ____________

FORM EV06 1/94

DATE: ____________

ABSORPTION AREA

STEP 1: CALCULATE DAILY WASTEWATER FLOW

>>>> ______bedrooms @ 120 gal/day = _____ gallons per day (gpd)

STEP 2: DETERMINE LOADING RATE (from Site Evaluation Form EV01)

>>>> Loading rate = _____ gpd per sq. ft.

STEP 3: COMPUTE the total area needed for the absorption system using the equation: A = daily flow / loading rate

Absorption area =

______ gpd / ______gpd / sq. ft. = _________ square feet

STEP 4: DETERMINE the total length of distribution lines. Spacing between the lines must be 5 feet or more to prevent overloading. Divide the total area by 5 to obtain the total length of distribution lines required.

Total length =

_____ sq. ft. / _____ feet = ______feet

Show lateral line layout on site plan.
>>>> Length of lateral lines = ______feet

Number of lateral lines required = _________

SEPTIC TANK

Size is the same as conventional system. (= _________ gallons)

PUMPING TANK

The pumping tank shall provide one day of emergency storage, thus the volume shall be at least twice the volume of the daily wastewater flow.

Minimum volume of pumping tank =

_____ gpd X 2 = ______ gallons. Use _________ gal. tank.

DOSING RATE

\>>>>
The best starting values for calculations are a 5/32 inch hole diameter, 5 feet hole spacing and a 3 ft. pressure head.

STEP 1: Calculate the number of holes.
Hole diameter: 5/32 inch. Hole spacing (ft.): 5
Number of holes = length of line / hole spacing

= ______feet / 5 feet per hole

= ______holes per line

Total # holes = ______holes per line X ________ lines

= ______holes

STEP 2: Determine the flow rate per hole from TABLE 4-1.

STEP 3: Calculate the total dosing rate.

\>>>> Flow rate per hole = __________ gpm

Flow rate per line

= ______gpm X ______holes per line

= ______gpm

Total flow rate

= ______gpm X ______lines

= ______gpm

PUMP SELECTION

STEP 1: Compute friction head. Use TABLE 4-2 for pipe friction losse

Friction head = 1.2 X pipe friction loss
\>>>> Diameter of supply line & header = __________inches

\>>>> Pipe friction loss = Length of supply __________feet
line & header

Divided by 100 = __________

\>>>> Times value
from TABLE 4-2 = __________feet/100 ft.

= __________feet

Friction head = 1.2 X friction loss = __________feet

PUMP SELECTION - (continued)

STEP 2: Calculate total head.

>>>> Total head = ______elevation (gravity) head = difference in elevation between pump and highest lateral on the manifold

\+ 3.0 pressure head (ft.)

\+ ______friction head (ft.)

= ______feet

STEP 3: Select pump based on calculated flow rate and total head.

Pump required: ______gpm at ______feet of head

DOSING VOLUME

STEP 1: Calculate the minimum dosing volume.
Use TABLE 4-3 to find the volume of the lateral lines.

Dosing volume = Volume of supply line + 5 times volume of lateral lines

A. Supply line diameter = ______inches
length = ______feet

Volume of supply line = ______feet / 100

>>>> X ______value from TABLE 4-3

= ______gallons

>>>> B. Lateral line diameter = ______inches
length = ______feet

Volume of lateral lines = ______feet / 100

>>>> X ______value from TABLE 4-3

= ______gallons

C. Dosing volume = __________ gallons

Plus 5 times volume of laterals __________ gallons

= __________ gallons

STEP 2. Select the dosing volume.

* Dosing two to four times per day provides adequate resting time.

STEP 3. Compute the depth of effluent to be pumped per dose in order to set pump on and off float switch settings.

Dosing depth = dosing volume in gallons divided by 7.48 gallons per cubic foot divided by the area of the septic tank in square feet times 12 inches per foot

= ______gallons / 7.48 gallons per cubic ft.

>>>> divided by ______square feet

= ______X 12 = _________ inches

NOTE: TO BE DETERMINED AFTER TANK SELECTED

CHECK VALVE CALCULATION

* Use check valves ONLY when total storage volume of pipes is greater than 1/4 of the total daily wastewater volume.

STEP 1: Calculate storage volume.

Storage volume = volume of supply line + volume of laterals

= ______gallons + ______gallons

= ______gallons

STEP 4: Compare to 1/4 daily wastewater volume.

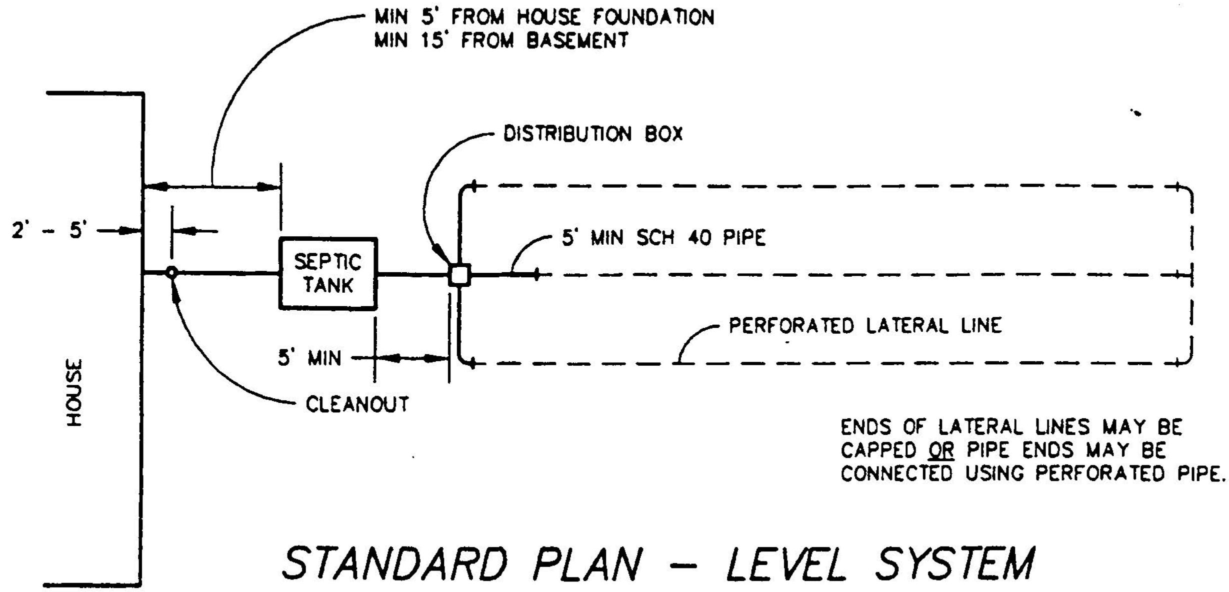
1/4 Daily wastewater volume = ______gallons

Compare to storage volume = ______gallons

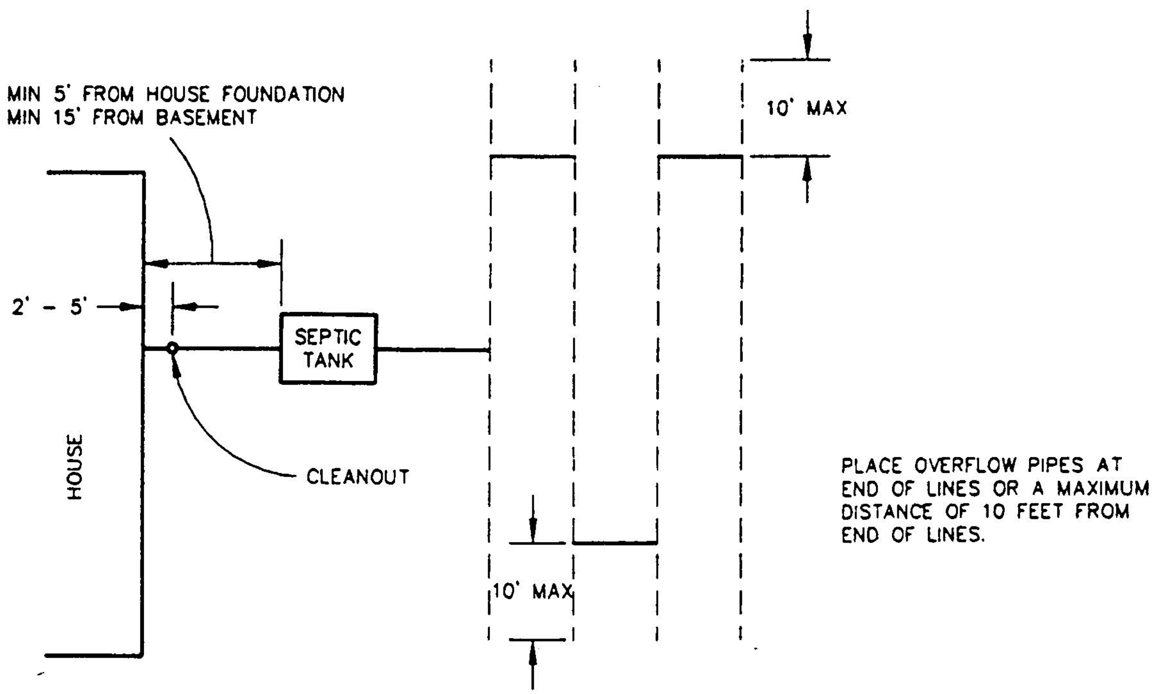
CHECK VALVE IS / IS NOT REQUIRED

APPENDIX B

STANDARD DRAWINGS



STANDARD PLAN – LEVEL SYSTEM

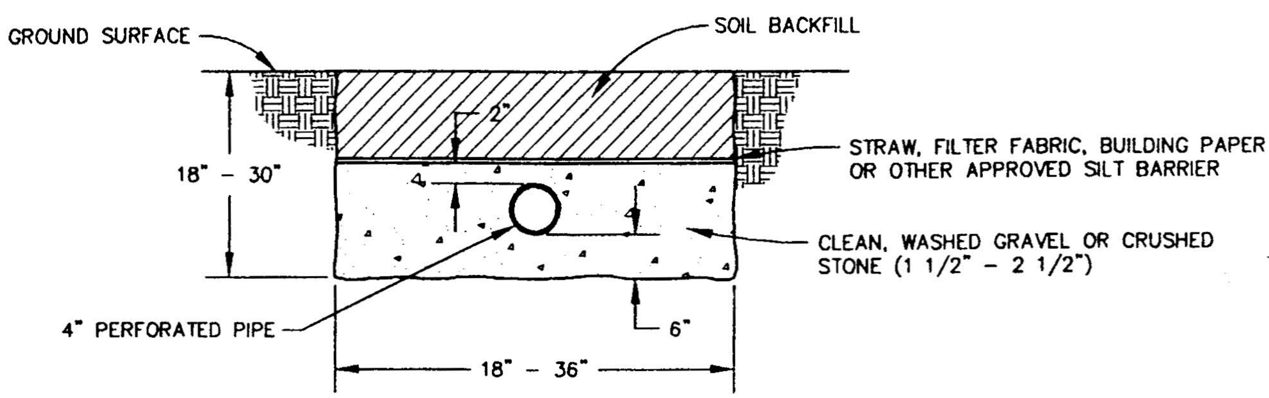


STANDARD PLAN – SERIAL DISTRIBUTION SYSTEM

——— SCHEDULE 40 PVC (ASTM D 1785)
– — – PERFORATED PIPE (ASTM D 2729)

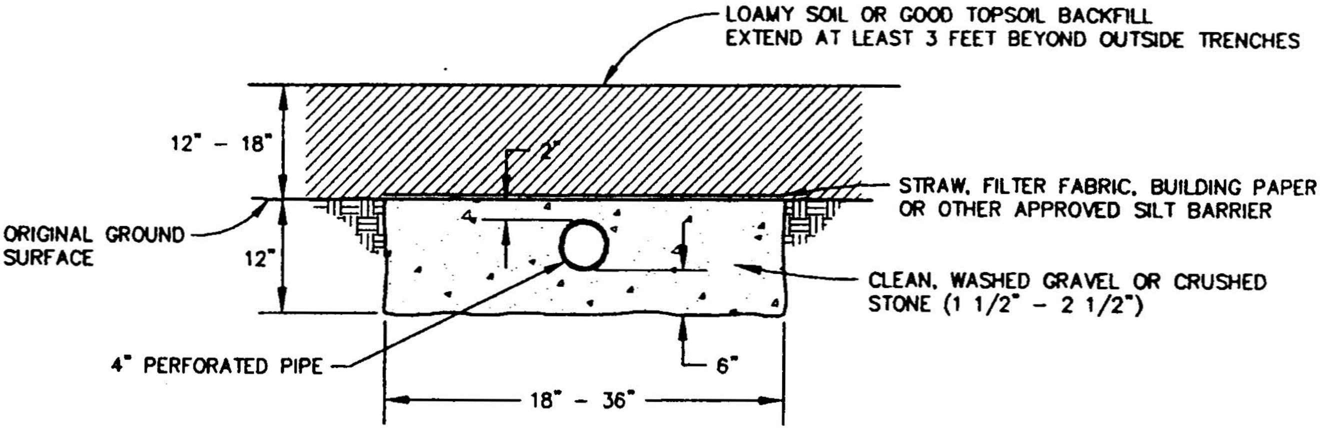
GREENE COUNTY, MISSOURI – STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD ABSORPTION SYSTEM TYPICAL SYSTEM LAYOUT	FILE: OWS01.dwg DATE: 1/1/2000



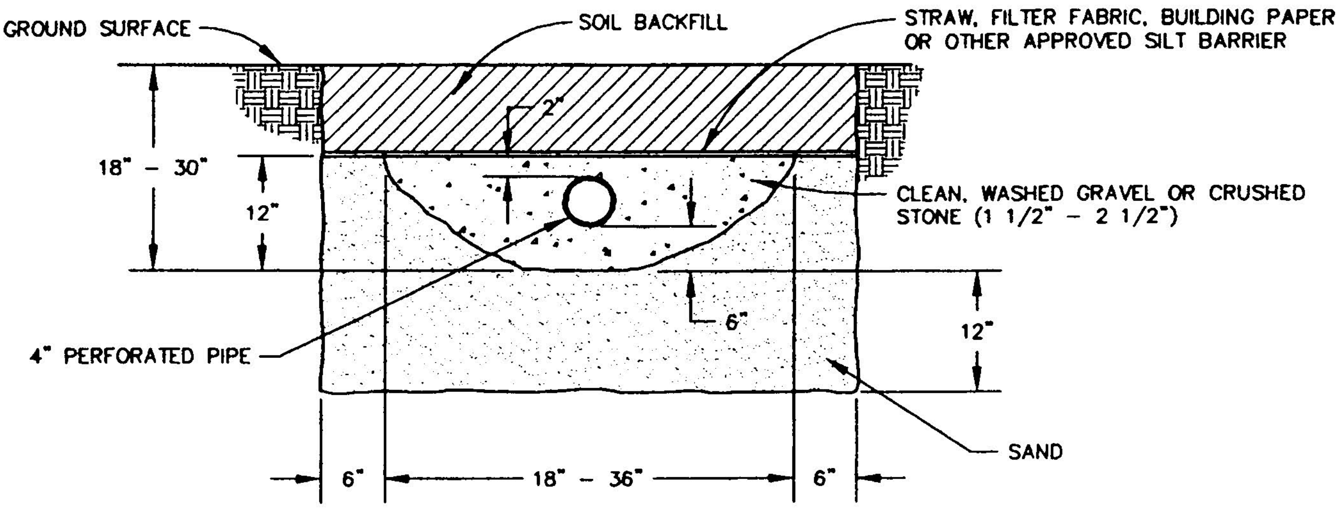
GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD ABSORPTION SYSTEM TYPICAL TRENCH CROSS-SECTION	FILE: OWS02.dwg DATE: 1/1/97



GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD ABSORPTION SYSTEM TYP. SHALLOW PLACEMENT TRENCH X-SECTION	FILE: OWS03.dwg DATE: 1/1/97

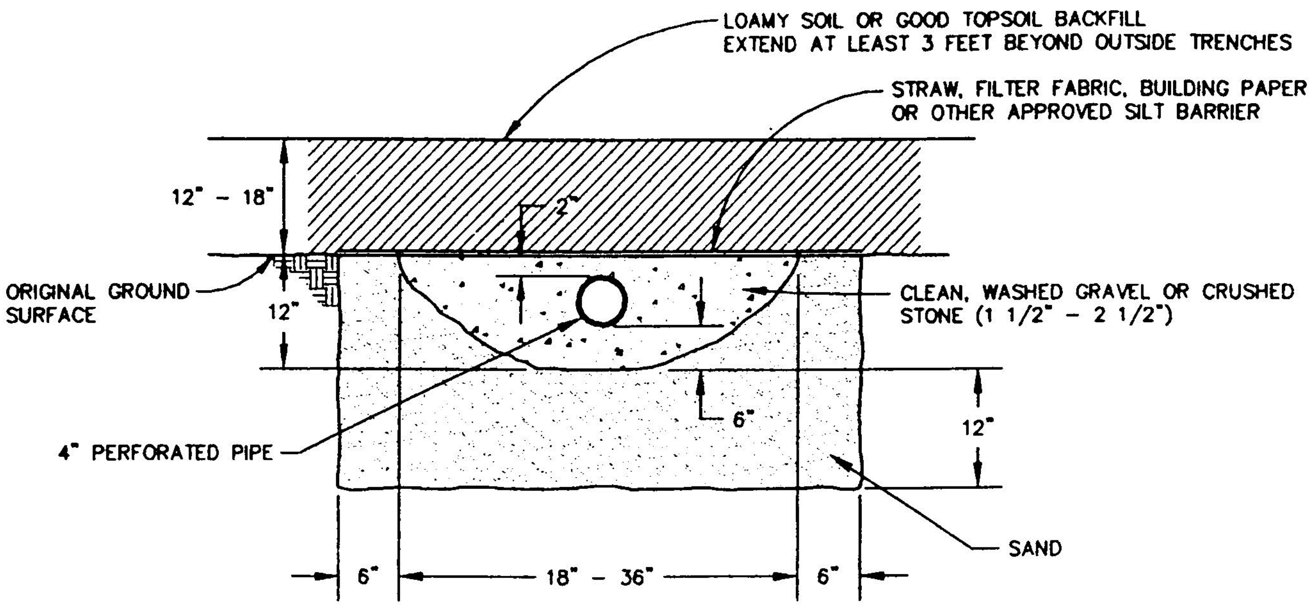


GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD ABSORPTION SYSTEM
TYP. SAND LINED TRENCH CROSS-SECTION

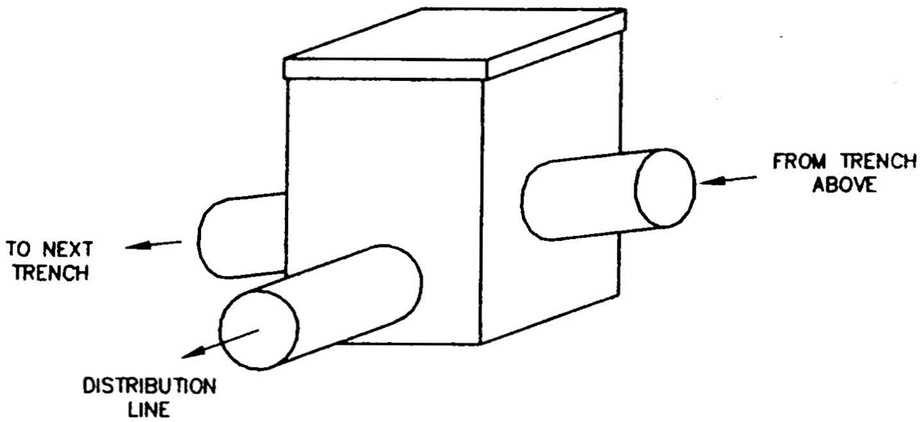
FILE: OWS04.dwg

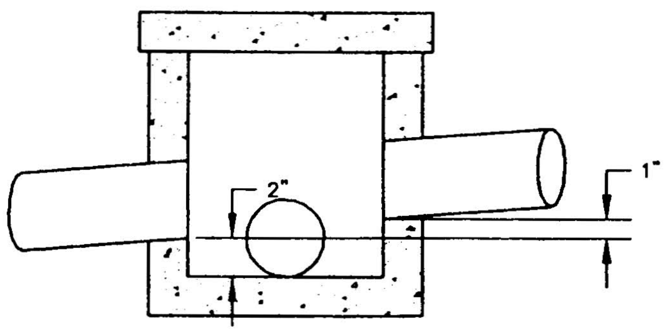
DATE: 1/1/97



GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

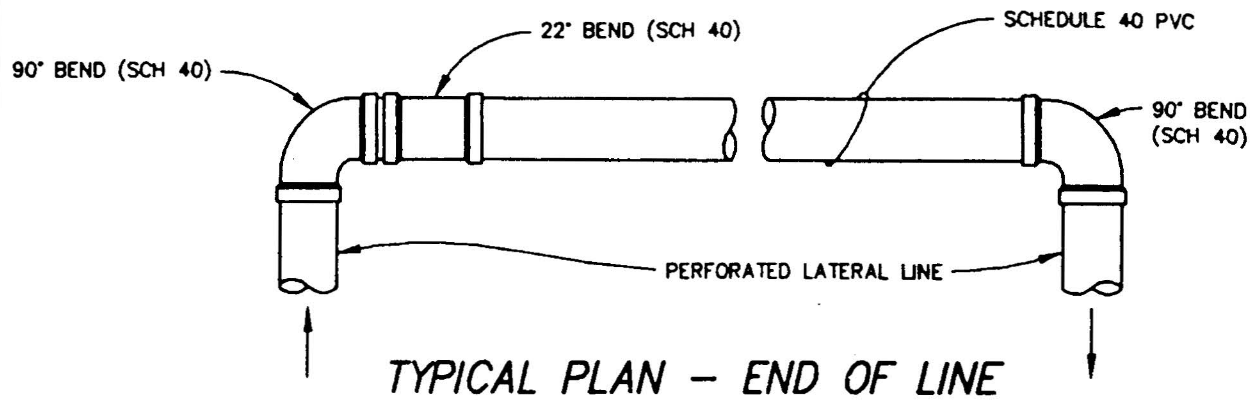
STANDARD ABSORPTION SYSTEM TYP. SAND LINED SHALLOW PLACEMENT TRENCH CROSS-SECTION	FILE: OWS05.dwg DATE: 1/1/97



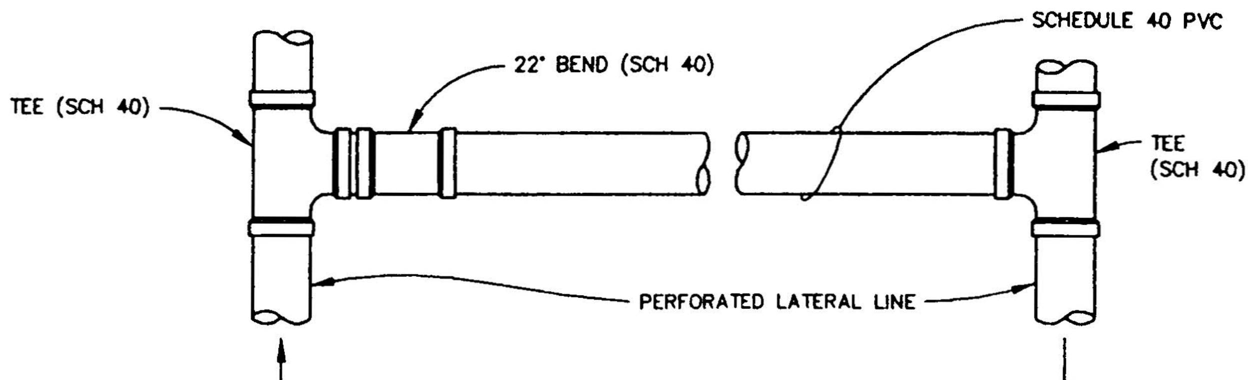


GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

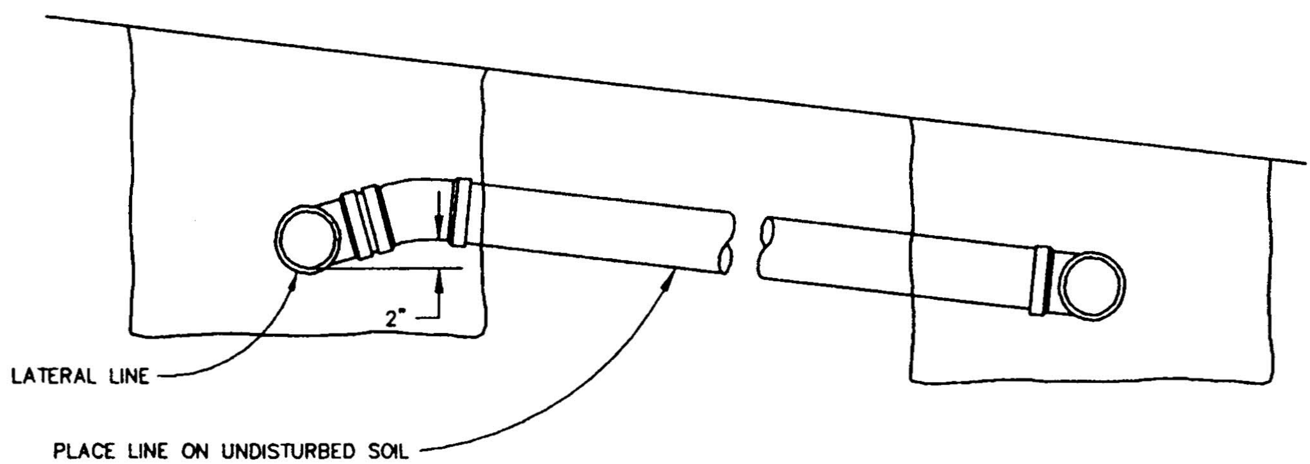
STANDARD ABSORPTION SYSTEM TYPICAL DROP BOX	FILE: OWS06.dwg DATE: 1/1/97



TYPICAL PLAN - END OF LINE



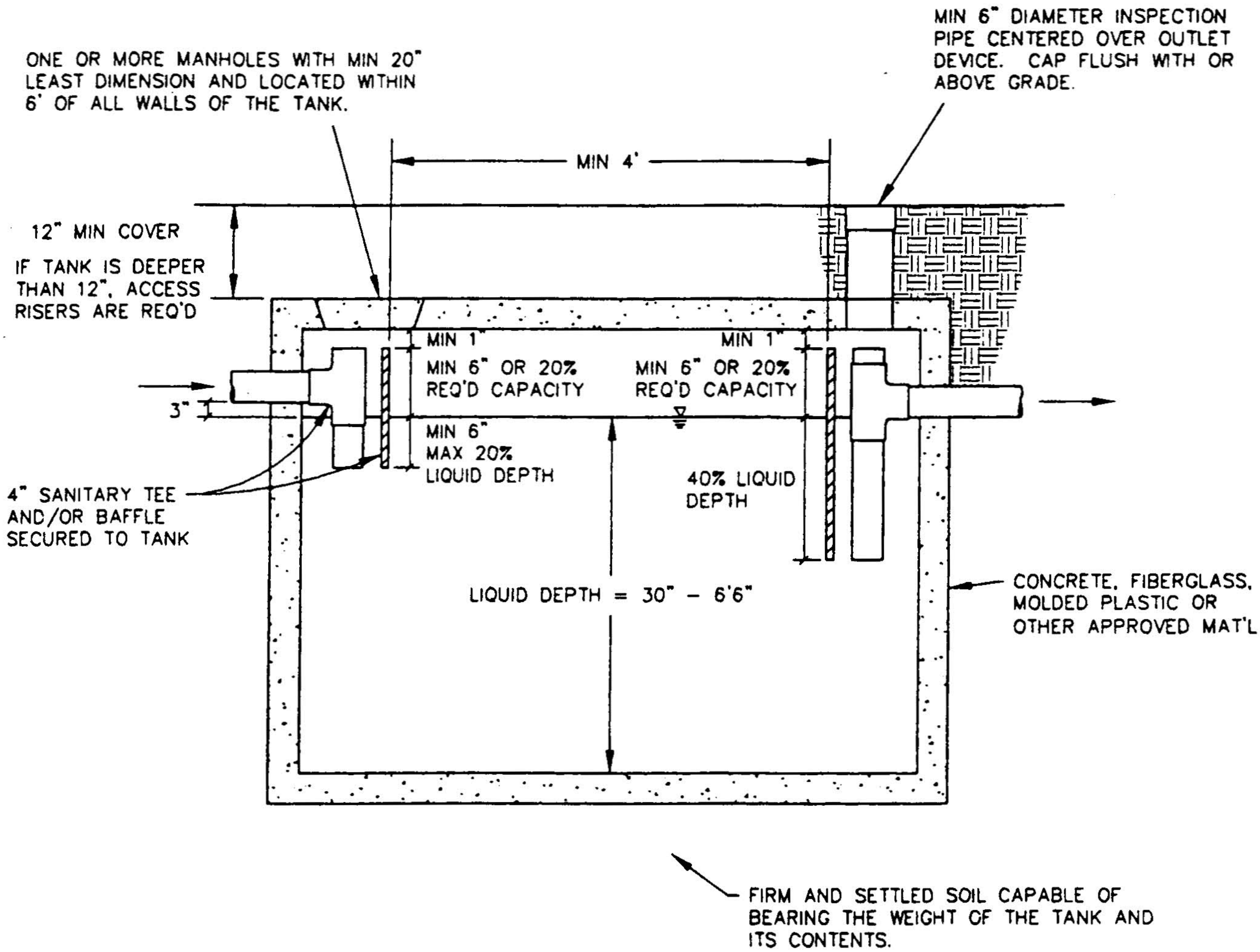
TYPICAL PLAN - MID-LINE



TYPICAL PROFILE

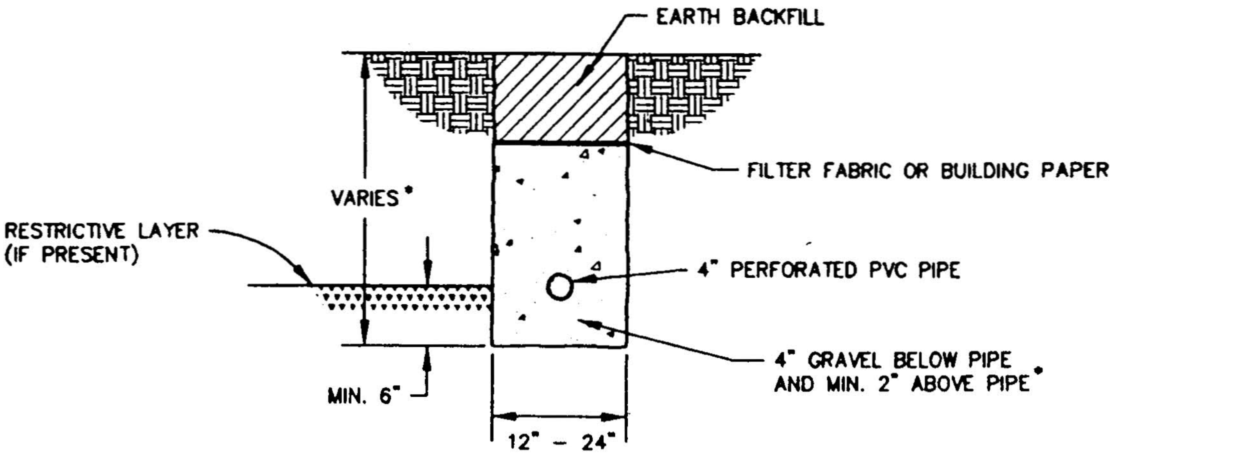
GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD ABSORPTION SYSTEM TYP. OVERFLOW - SERIAL DISTRIBUTION SYSTEMS	FILE: OWS07.dwg DATE: 1/1/97

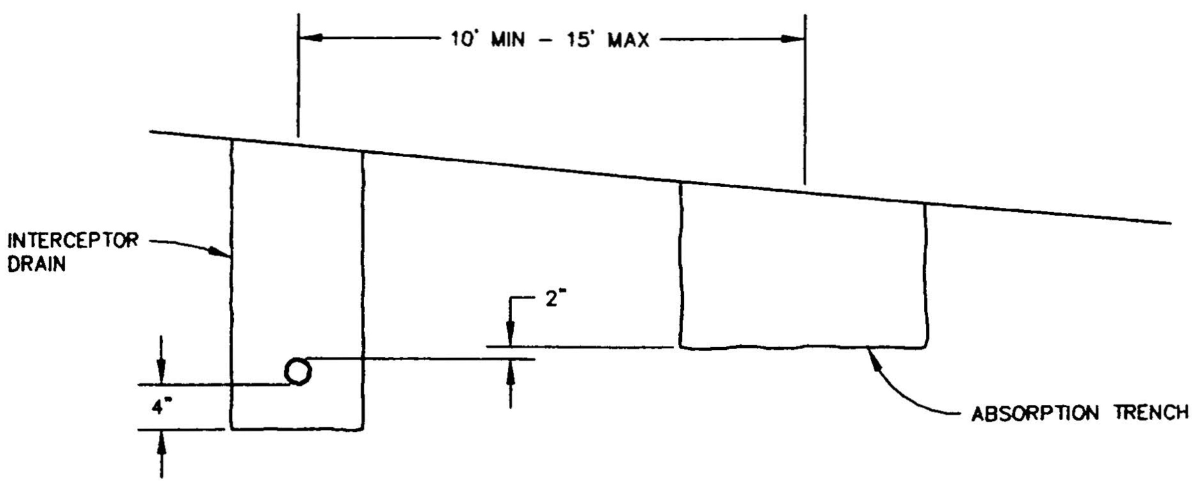


GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

STANDARD SEPTIC TANK	FILE: OWS08.dwg DATE: 1/1/2000

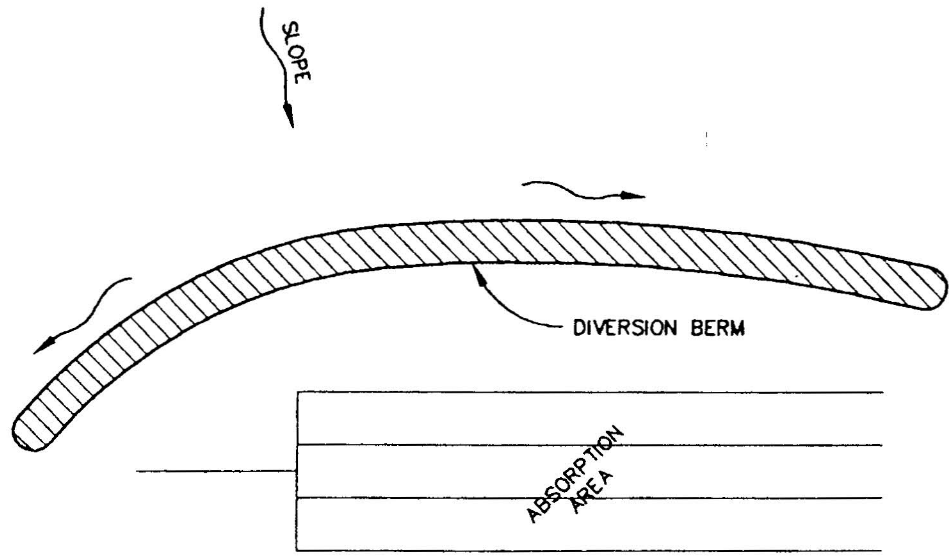


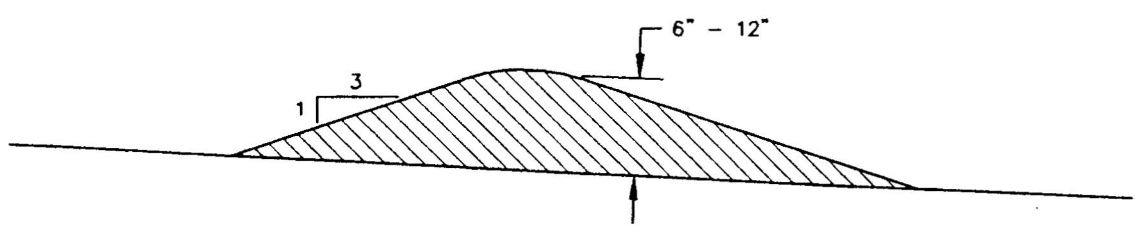
* THE DEPTH OF THE INTERCEPTOR DRAINS SHALL BE SET SUCH THAT THE TOP OF THE GRAVEL IS NO HIGHER THAN THE BOTTOM OF THE ABSORPTION TRENCH AT ANY POINT IN THE ABSORPTION FIELD.



GREENE COUNTY, MISSOURI – STANDARDS FOR ONSITE WASTEWATER SYSTEMS

TYPICAL INTERCEPTOR DRAIN CROSS-SECTION	*FILE: OWS09.dwg* *DATE: 1/1/97*

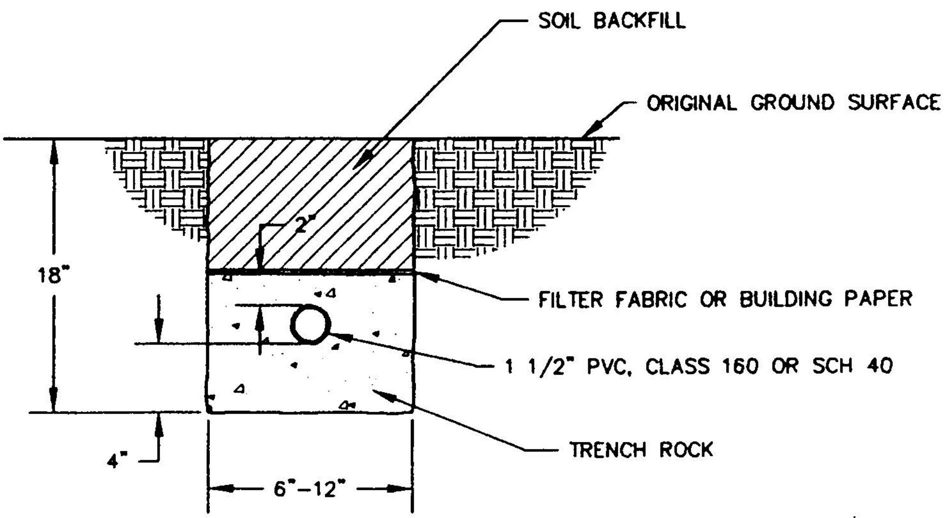




THE AREA WHERE THE BERM IS CONSTRUCTED SHALL BE STRIPPED OF VEGETATION PRIOR TO PLACING FILL FOR THE BERM. FILL SHALL BE A GOOD QUALITY TOPSOIL REASONABLY FREE OF STONES, ROOTS AND OTHER DEBRIS.

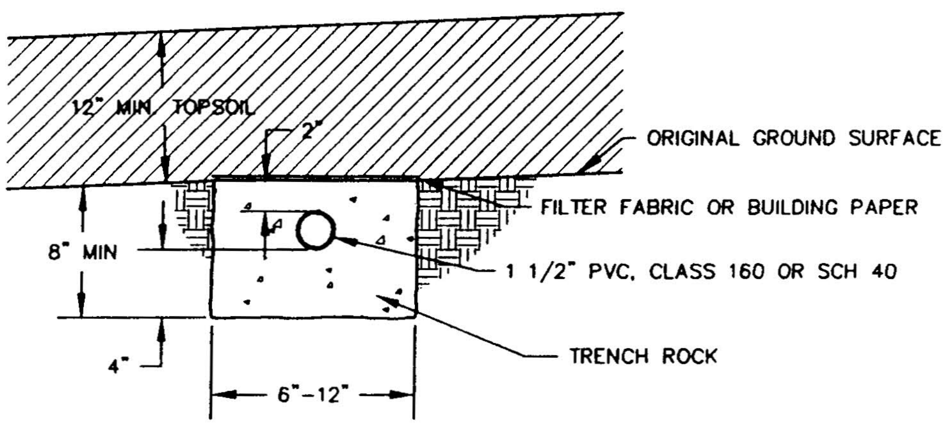
GREENE COUNTY, MISSOURI – STANDARDS FOR ONSITE WASTEWATER SYSTEMS

TYPICAL DIVERSION BERM	FILE: OWS10.dwg DATE: 1/1/97



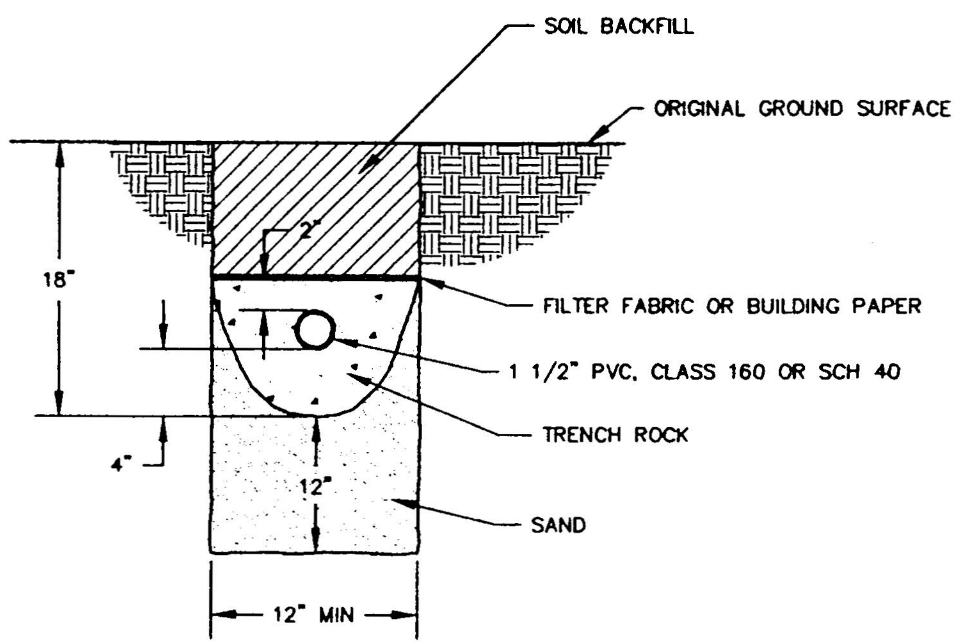
GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM TYPICAL TRENCH CROSS-SECTION	FILE: OWS11.dwg DATE: 1/1/97



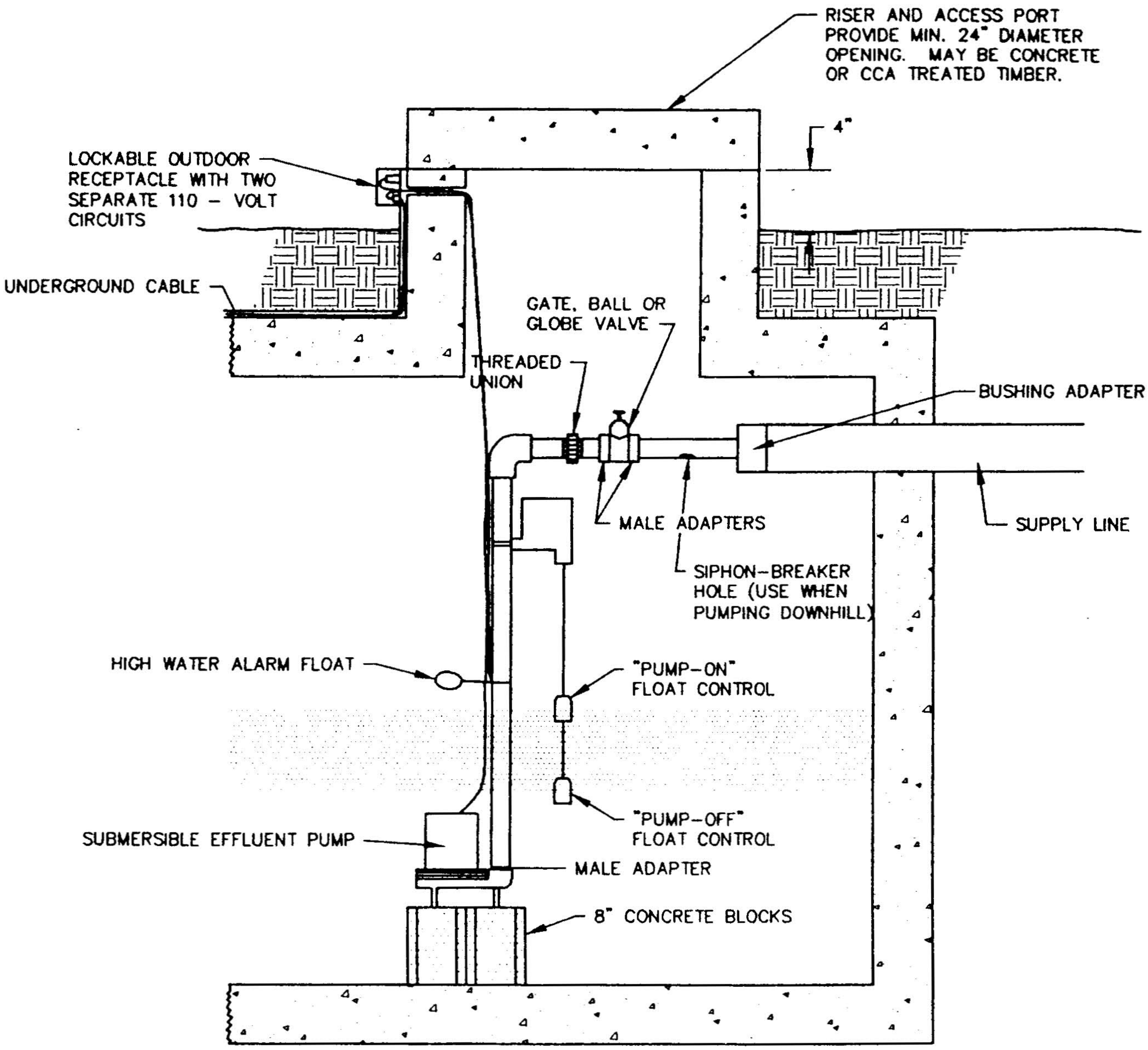
GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM TYPICAL SHALLOW PLACEMENT TRENCH CROSS-SECTION	FILE: OWS12.dwg DATE: 1/1/97



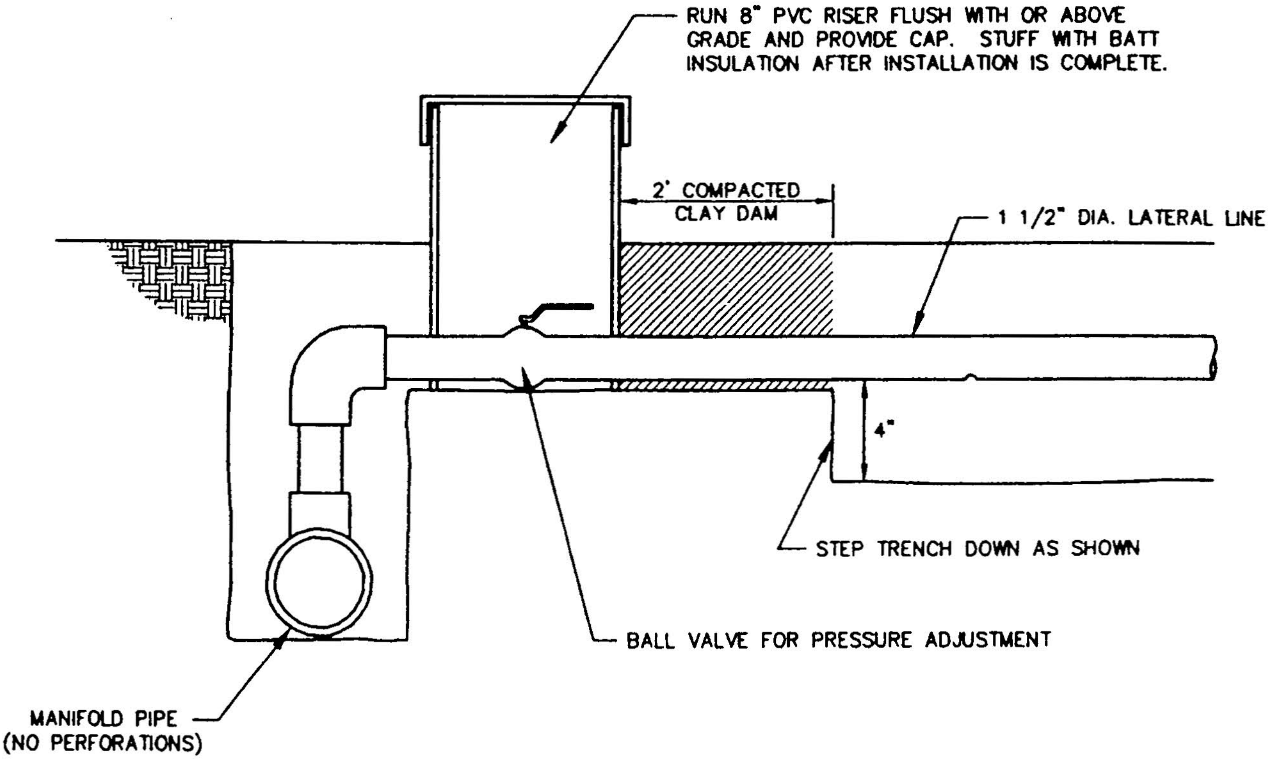
GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM TYPICAL SAND LINED TRENCH CROSS-SECTION	FILE: OWS13.dwg DATE: 1/1/97



GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM TYPICAL PUMP TANK CROSS-SECTION	FILE: OWS14.dwg DATE: 1/1/97

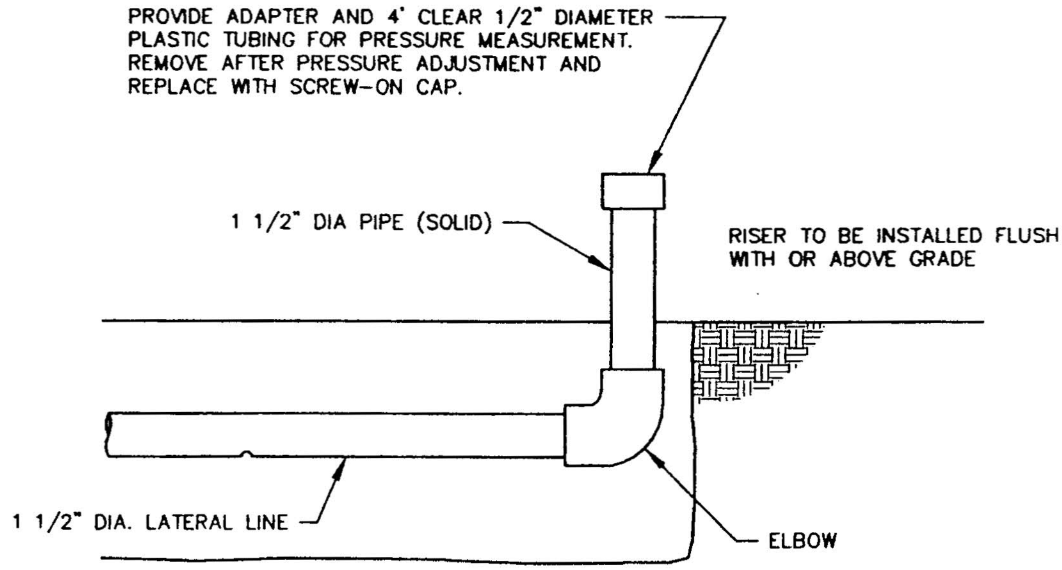


GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM
TYPICAL HEADER / BALL VALVE

FILE: OWS15.dwg

DATE: 1/1/97



GREENE COUNTY, MISSOURI - STANDARDS FOR ONSITE WASTEWATER SYSTEMS

LOW PRESSURE PIPE SYSTEM TYPICAL TURN-UP	FILE: OWS16.dwg DATE: 1/1/97

APPENDIX C

<u>DESIGN AND INSTALLATION</u>
<u>OF</u>
<u>LOW PRESSURE PIPE SYSTEMS</u>

INTRODUCTION

Many proposed building sites in **Greene County** are unsuitable for on-site sewage disposal by conventional subsurface sewage disposal due to the presence of such limiting site conditions as a high water table, shallow depth to rock or other restrictive layers or because of the heavy clay content of the soil. Some of these unsuitable conditions can be overcome and sanitary disposal of wastewater can be accomplished by utilizing alternative systems. Alternative subsurface sewage disposal systems are those systems and techniques, approved by the **Greene County Resource Management Department** that vary from the construction and installation procedures of conventional systems. However, alternative systems should not be misrepresented as a panacea for all unsuitable soil conditions, but only as a means to increase the range of suitable site conditions.

This manual specifies the procedures and material to be used for successful siting, design, installation and maintenance of one alternative system, the low-pressure pipe (LPP) system. Use of proper materials and techniques is critical to the success of LPP systems as well as to all other alternatives.

SECTION 1

What Is Low-Pressure Pipe Distribution?

A subsurface soil-absorption system must serve two purposes: 1) keep untreated effluent below the surface, and 2) purify the effluent before it reaches ground or surface water. The system works best when the distribution area is not saturated with water or effluent, allowing efficient aerobic bacteria to treat the wastes.

There are several conditions which frequently hinder the operations of soil-absorption systems. Clogging of the soil can occur from localized overloading during use or from the mechanical sealing of the soil-trench interface during construction. This clogging can cause effluent to break through to the surface, especially in fine-textured soils. Anaerobic conditions caused by continuous saturation due to overloading or a high-water table retard treatment, increasing the potential for a failure. Shallow soils may not be deep enough to purify the effluent.

The LPP system has three design improvements over conventional systems that help overcome these problems. They are:

- uniform distribution of effluent
- dosing and resting cycles
- shallow placement of trenches

Problems from local overloading are decreased when effluent is distributed over the entire absorption area. Dosing and resting cycles help maintain aerobic conditions in the soil improving treatment. Shallow placement increases the vertical separation from the system to any restrictive horizon or seasonal high-water table.

An LPP system is a shallow, pressure-dosed soil-absorption system (Figure 1). It consists of:

- septic tank
- single compartment dosing tank
- submersible effluent pump and level controls
- high water alarm
- supply line and manifold
- distribution system
- suitable area and depth of soil

When septic tank effluent rises to the level of the upper pump control, the pump turns on and effluent moves through the supply line and distribution laterals. These laterals are Schedule 40 PVC

PVC pipe containing small holes (5/32 inch to 1/4 inch) spaced 2.5 to 7.5 feet apart. The pipes are placed in narrow trenches 18 to 22 inches deep and spaced 5 or more feet apart. Under low pressure (0.7 to 2 pounds per square inch) supplied by the pump, septic tank effluent flows through the holes and into the trenches. It diffuses from the trenches into the soil where it is treated.

The pump turns off when the effluent level falls to the lower control. The level controls are set so that the effluent is pumped two to four times daily with resting periods in between to allow aerobic treatment of effluent. If the pump or level controls should fail, the effluent would rise to the level of the alarm control. The alarm would turn on, signaling the homeowner of failure.

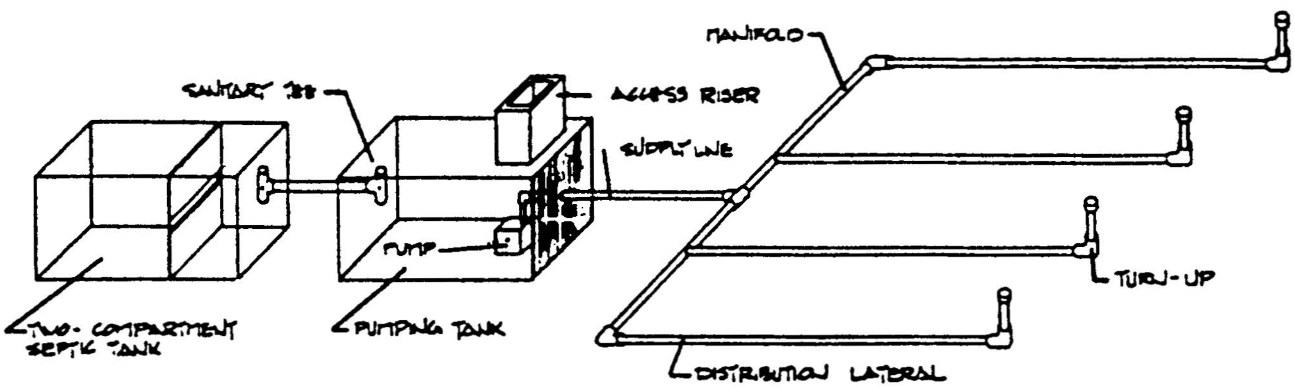


Figure 1. Basic components of a low pressure pipe system.

SECTION 2

Site and Soil Requirements for LPP Systems

The suitability of a LPP system for a given site is determined by the soil, slope and available space, as well as by the anticipated wastewater flow.

Space Requirements

The distribution network of most residential LPP systems occupies from 1000 square feet to 5000 square feet of area depending on soil permeability and design waste load. In addition, an area of suitable soil must be set aside for duplication or replacement of the system should a failure occur. This duplication area must be of sufficient size to install a complete system in accordance with regulations. Space between the existing lateral lines is not a suitable repair area. The septic tank, pumping chamber, distribution field and repair area are all subject to horizontal setbacks from wells, property lines, building foundations, etc., as specified in the regulations.

Soil Requirements

An LPP system should be situated on the best soil and site on the lot. A minimum of 12 inches of usable soil is required between the bottom of the absorption field trench and any underlying restrictive horizons such as consolidated bedrock or hardpan, or to the seasonal high water table. LPP trenches are installed 18 inches deep, giving a minimum soil depth requirement of 30 inches. However, up to 6 inches of a compatible fill material may be added to a site prior to the installation of a modified LPP system. On a site where 6 inches of compatible fill material is proposed, the restrictive layer may be as shallow as 24 inches.

Slope

An LPP system designed for a level site will have the same pressure head for each lateral. This allows the distance between holes in each of the laterals to remain constant. However, LPP systems located on slopes require special design and installation procedures. The elevation difference between any two laterals controlled by a common valve, will have a similar difference in their respective pressure head with the highest pressure head being found on the lowest lateral. When the disposal field is located lower than the pump, the system must be designed to ensure that effluent is not siphoned out of the pump chamber when the pump is turned off.

Drainage

Depressions, gullies, drains and erosional areas must be avoided to prevent hydraulic overloading by surface runoff. Neither the septic tank, pumping chamber nor distribution field should be located in such areas. Surface water and perched groundwater must be intercepted or diverted away from all components of an LPP system. Where suitability of the soil is dependent upon adequate drainage, a curtain drain or draw-down drain must be installed to maintain the upper level of ground water one foot below the bottom of the lateral trench bottom. Where subsurface drainage is required, there must either be an outlet on-site or, if off-site, appropriate easements are necessary.

SECTION 3

Layout of an LPP System

The next two Sections are a step-by-step procedure for designing LPP Systems on level ground. **Use Form EV06 for LPP calculations.** There is no one LPP that fits all sites (each must be designed individually). Additional procedures used when designing LPP systems on sloping sites are covered in Section 5.

Topographic Information

The plan for the LPP system must show the slope and shape of the ground surface at the site. Topographic contours of the site at 1 foot intervals are preferred. Spot elevations may be shown as an alternative as long as any non-uniform areas of slope are indicated. The percent grade shall be shown to the nearest ½ per cent and arrows placed on the plan indicating the direction of the ground slope.

Size of the Absorption Area

The total amount of absorption area depends on two factors - the daily wastewater flow of the system and the absorptive capacity of the soil.

Step 1. Calculate daily waste flow. For residential systems, the estimated flow is 120 gallons per day (gpd) for each bedroom (BR) in the house.

Example:	For a 3-BR house: Flow = 120 gpd/BR x 3 BR = 360 gpd

Step 2. Determine the loading rate. Consult the soil evaluation form to find the soil loading rate.

Step 3. Compute the total area needed for the initial absorption system using the equation:

Area = flow/loading rate.

Example: Using flow and loading rates calculated above:
Area = 360 gpd/ 0.2 gpd sq. ft. = 1800 sq. ft

Note: This area does not include duplication area

Step 4. Determine total length of distribution lines. Spacing between lines must be five feet or more to prevent overloading. Divide total area by five to obtain the total length of the distribution lines.

Example: Length = 1800 sq. ft./ 5 ft. = 360 linear ft.

Size of Septic and Pumping Tanks

The septic tank is sized in the same manner as for standard systems (see Chapter 3). The pumping tank **must** provide ample room for emergency storage; thus it **must** be at least twice the volume (v) of the daily waste flow.

Example: For a 360 gpd waste flow:
v pumping tank = 360 gal x 2 = 720 gal

Location of System

The LPP should be located in the best available soil on the lot. All set back requirements from wells, property lines and drainageways must be observed. The exact location of the system, including the tanks, the disposal field and drainage requirements, must be noted. An adequately sized **replacement field** area of suitable soil must be available.

Shape of Absorption Field

When selecting the best shape of an LPP system, to fit in the desired location, remember that laterals must be placed on the contour (see Figure 2 for example LPP field configurations). The maximum length of each lateral line should be 70 feet (from the manifold to the turn up) due to excessive friction loss.

When using longer lateral lines, the manifold must be placed in the center of the Distribution network rather than along one side. For a layout example, see Figure 2

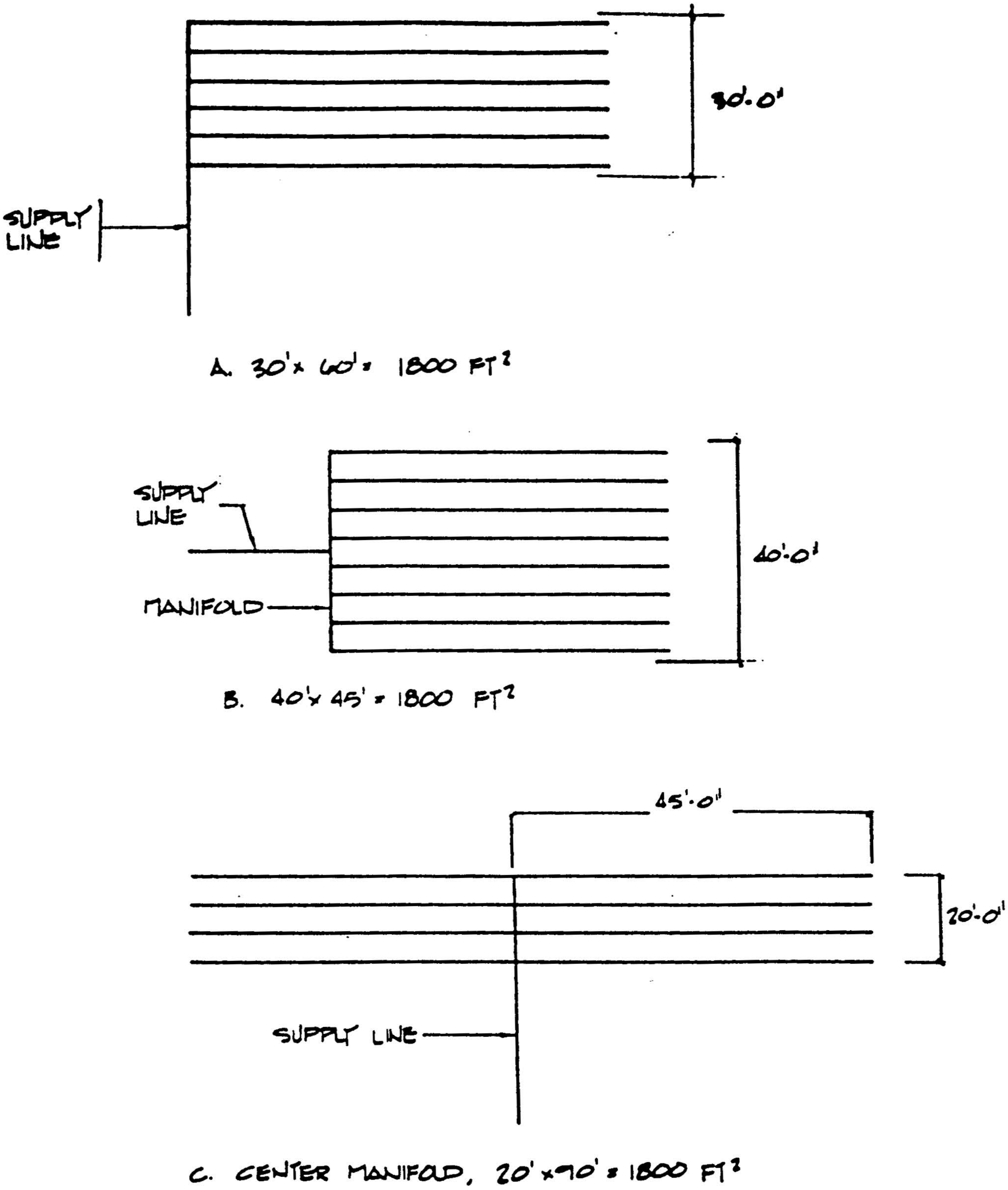


Figure 2. Three possible configurations of LPP distribution field.

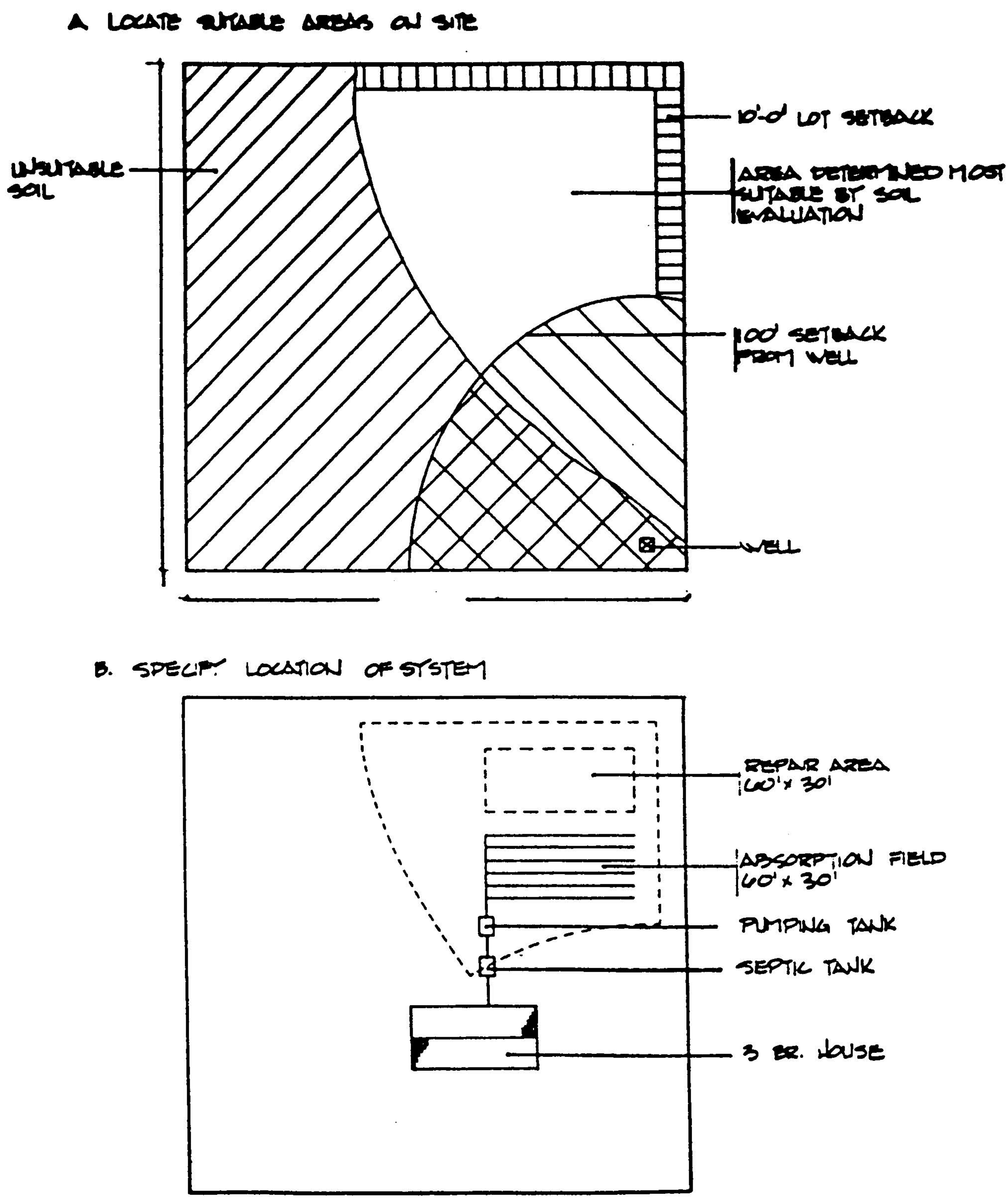


Figure 3. Layout of a sample system.

Landscaping and Drainage

Any cutting or filling of a site may render it unsuitable for an LPP system. Surface water must be diverted away from the disposal area. On sloping sites where a curtain drain is required, the drain shall be installed 4 to 6 inches into the restrictive layer. A positive outlet must be available either on-site or off-site easements **will** be **required.**

Depth of Lines

Lines are placed no deeper than 18 inches deep. Where a restrictive layer is 24 to 30 inches deep, up to 6 inches of fill material may be allowed in order to meet the one-foot vertical separation requirement between the bottom of the gravel trench and the restrictive layer.

SECTION 4

Dosing and Distribution System Design

The purpose of low pressure dosing is to provide uniform distribution of septic tank effluent over the entire soil absorption system. This is best achieved at a pressure head of 2 to 4 feet. Lower pressures do not provide uniform delivery of effluent. Higher pressures cause local scouring of the gravel and soil in the trench bottom. Proper dosing involves balancing the size of the distribution system with the dosing volume, pumping capacity, desired pressure and flow rate.

Dosing Rate

The dosing rate depends on the pressure head and the size and number of holes in the distribution lines. Pressure head can range from 2 to 4 feet for adequate performance; holes must be 5/32 inch or greater in diameter, and hole spacing can range from 2 ½ to 7 ½ feet. On sloping sites valves may be located on each lateral or variable hole spacing may be used as described in Section 5.

The dosing rate can be best estimated by calculating the flow utilizing a 5/32 inch hole diameter, five feet hole spacing and three feet of pressure head.

Step 1. Calculate the number of holes.

Number of holes = length of line/hole spacing.

Example: For a system with 5ft. hole spacing and 60 feet lines:
Number of holes/line = 60 ft/5ft/hole = 12 holes/line
Total holes = 12 holes/line x 5 lines = 60 holes

Step 2. Determine the flow rate per hole. This is calculated from the hole size and pressure head using Table 4-1.

Example: For 3-ft. pressure head and 5/32-inch holes:
Flow rate = 0.5 gallons per minute (gpm)

Step 3. Calculate total dosing rate.

Example: Flow rate/hole = 0.5 gpm
Flow rate/line = 0.5 x 12 holes = 6.0 gpm
Total flow rate = 0.5 x 60 holes = 30 gpm

For systems where the absorption field is at a lower elevation than the pump, a 1/4 inch siphon-breaker hole must be drilled in the supply line in the pumping tank. This hole will prevent inadvertent siphoning of the contents of the pump tank into the disposal field. An extra two gallons per minute must be added to the pumping rate to compensate for flow through the siphon-breaker hole.

Example: For a system with 30 gpm flow rate and a siphon-breaker hole.
Total flow rate = 30 gpm + 2 gpm = 32 gpm

Pump Selection

The pump must have enough power to pump effluent at the calculated flow rate against the total head (resistance) encountered in the distribution system. The total head is the amount of work the pump must do to overcome elevation (gravity) and friction in the system at the specified pressure and flow rate.

Total head = elevation head + pressure head + friction head

.

TABLE 4-1

Flow Rate as a Function of Pressure Head and Hole Diameter in Drilled PVC Pipe

Pressure Head (ft.)	(psi)	Hole diameter (in.) 5/32	3/16	7/32	1/4
		- Flow rate (gpm) -			
1	0.43	0.29	0.42	0.56	.74
1.5		0.35			
2	0.88	0.41	0.59	0.80	1.04
2.5		0.45			
3	1.30	0.50	0.72	0.98	1.28
3.5		0.54			
4	1.73	0.58	0.83	1.13	1.48
4.5		0.61			
5	2.16	0.64	0.94	1.26	1.65
5.5		0.66			
6	2.58	0.69	1.04	1.37	1.81

Elevation head is the difference in elevation from the pump to the highest lateral on the manifold. Remember that the pump will be four or five feet below ground level in the pumping chamber.

Pressure head is the pressure required for even distribution and is usually specified between two and four feet.

Friction head is the loss of pressure due to friction as the effluent moves through the pipes. Pipe friction is estimated using Table **4-2**. When estimating pipe friction, use the length of the supply manifold, but not the lateral lines. Add 20 percent to the pipe friction estimate to account for friction loss in joints and fittings. Note that friction loss varies with pumping rate as well as with pipe length and diameter.

The total head must be calculated to select the proper size pump.

Step 1. Compute friction loss.

Friction loss = 1.2 x pipe friction

Example:	For a 2 inch diameter supply line 70 feet long and 32 gpm pumping rate: Pipe friction = (70ft/100 ft) x 1.74 ft. = 1.2 ft. Fiction head = 1.2 x 1.2 ft. = 1.5 ft.

Step 2. Calculate total head.

Example:	For a system with 5 ft. of elevation head from the pump to the highest lateral, 3 ft. of pressure head and 2 ft. of friction loss: Total head = 5 ft. + 3 ft. + 2 ft. = 10 ft.

The system will require a pump with a capacity of 32 gpm against 10 feet of head. It is always necessary to specify the total head when selecting a pump. The head and flow requirements are checked against the performance curve provided by the manufacturer. It is important to use the performance curve for the specific brand and size of pump to be used.

Step 3. Select a pump by consulting the appropriate performance curve. The system requirements of flow and total head (32 gpm at 10 ft. of head) intersect at a point which must fall below the performance curve. If the point falls above the curve, then the pump is too small.

When the chosen pump turns out to be too small, there are several options to consider:

- Select a larger pump.

- Reduce the friction-head loss by using a larger diameter supply manifold (two inches is a practical maximum for residential systems).

- Reduce the flow rate by dist using a smaller hole size or by increasing hole spacing (maximum distance being 7.5 ft.).

- Raise the pump in the pump tank.

A combination of choices can be made. The goal is to design a system that works properly for the lowest possible price. A larger pump is an easy solution, but will be more expensive that one of the other options. For most residential systems a 0.3 to 0.5 horsepower pump will be adequate.

TABLE 4-2

Friction loss per 100 feet of PVC pipe

Flow (gpm)	Pipe diameter (in.) 1	1 1/4	1 ½	2	3	4
	Friction loss (ft)					
1	0.07	--	--	--	--	--
2	0.28	0.07	--	--	--	--
3	0.06	0.16	0.07	--	--	--
4	1.01	0.25	0.12	--	--	--
5	1.52	0.39	0.18	--	--	--
6	2.14	0.55	0.25	0.07	--	--
7	2.89	0.76	0.36	0.10	--	--
8	3.63	0.97	0.46	0.14	--	--
9	4.57	1.21	0.58	0.17	--	--
10	5.50	1.46	0.70	0.21	--	--
11	1.77	0.84	0.25	--	--	
12	--	2.09	1.01	0.30	--	
13	--	2.42	1.17	0.35	--	
14	--	2.74	1.33	0.39	--	
15		3.06	1.45	0.44	0.07	--
16		3.49	1.65	0.50	0.08	--
17		3.93	1.86	0.56	0.09	--
18		4.37	2.07	0.62	0.10	--
19		4.81	2.28	0.68	0.11	--
20		5.23	2.46	0.74	0.12	--
25			3.75	1.10	0.16	--
30			5.22	1.54	0.23	--
35				2.05	0.30	0.07
40				2.62	0.39	0.09
45				3.27	0.48	0.12
50				3.98	0.58	0.16
60					0.81	0.21
70					1.08	0.28
80					1.38	0.37
90					1.73	0.46
100					2.09	0.55

Dosing Volume

Dosing volume is the amount of effluent pumped to the absorption field each time the pump runs. The dosing volume must be large enough to provide adequate distribution in the field and adequate resting time between doses, yet small enough to avoid over-loading. The minimum dose to provide adequate distribution depends on the size of the supply and lateral network.

Step 1. Calculate minimum dosing volume.

V dose = V supply + 5 (V laterals)

The minimum volume is the sum of the supply-line volume and five times the volume of the lateral lines. The volume of the lines is calculated using Table **4-3**.

TABLE 4-3

Storage Capacity per 100 ft. of PVC Pipe

Pipe Diameter (inches)	Storage Capacity 160 psi (gal/100 feet)	Storage Capacity Schedule 40 (gal/100 feet)
1	5.8	4.1
1 1/4	9.0	6.4
1 ½	12.5	9.2
2	19.4	16.2
3	42.0	36.7

Example:

1. Supply line = 70 ft. of 2-in. pipe
   V supply = (70/100) x 19.4 gal. = 13.6 gal.

2. Lateral lines = 360 ft. of 1 1/4-in. pipe
   V lateral = (360/100) x 9.0 gal. = 32.4 gal.

3. V dose = 13.6 gal. + 5 (32.4 gal.) = 176 gal.

Dosing two to four times per day provides adequate resting time. For a 450 gallon-per-day design, this would be a range of 112 to 225 gallons per dose (gal/dose).

Step 2. Select dosing volume.

Example: Selecting 180 gal/dose would give between two and three doses per day. This volume is larger than the minimum in Step 1. If water use is less than gpd, dosing will occur less frequently, providing longer resting periods between doses.

Step 3. Compute the depth of effluent pumped per dose. In order to set the pump controls to deliver the proper dose, the depth of effluent to be pumped from the tank for each dose must be calculated. The computation is done using the following equation:

Dosing depth = (V dose/Tank cross-sectional area)

Example: For a 800-gal. pumping tank, with an inside dimension of 5 feet by 5 feet: Dosing depth = (180 gal/7.48 gal./cu. ft.) / (5 ft. X 5 ft.) = 0.96 ft. X 12 inches per foot = 11.55 inches. Round to 12 inches.

The "pump on" float should be set at minimum of 3" above the top of the pump.

<u>Check-valve calculation</u>

Any effluent which remains in the supply and lateral lines of a properly sited system will drain back to the pumping chamber when the pump shuts off. If this volume is too large, it can cause overuse of the pump and excessive consumption of electricity. A check valve may be needed to prevent this return flow to the pumping chamber, especially on a large system with a long pumping distance. Check valves should be avoided if possible because they may malfunction when used for septic tank effluent. In general, a check valve should only be used if the total storage volume of the pipes is greater than one fourth of the total daily waste flow.

Step 1. Calculate storage volume.

V storage = V supply + V laterals

Example: V storage = 13.6 gal + 32.4 gal = 46.0 gal

Step 2. Compare to 1/4 daily waste flow.
450 gpd x 1/4 = 112 gal
46.0 gal < 112 gal
No check valve needed.

.

SECTION 5

LPP Design and Installation on Sloping Ground

A sloping site presents a special set of problems for an LPP design. The system must be carefully planned to obtain even distribution of effluent throughout the absorption area. When a common valve is used to adjust the flow to different laterals on a sloping site, the pressure head on each lateral is different due to a different elevation. Each foot of elevation difference changes the pressure head by one foot. Also, perched water moving downslope onto the system and effluent moving from the upper trenches to the lower trenches can cause overloading. Pumping uphill or downhill to the absorption field can create additional problems. This Section highlights changes in the design procedure which are necessary when designing LPP systems on slopes.

Layout

The procedure for designing an LPP system on a sloping site using variable hole spacing is similar to that in Section 3, with careful emphasis placed on the following points:

* Lateral trenches must be placed on contour (Figure 4).

* The effects of slope can be lessened by making systems as long and narrow as possible across the contour. This design uses fewer and longer lines, decreasing the elevation difference between the highest and lowest lines.

* LPP systems with more than four feet of elevation difference between the highest and lowest laterals cannot be designed with a single manifold unless valves are used on every lateral. When separate manifolds for the upper and lower lines are used, each manifold must have its own pressure-control valve (gate or globe) for pressure adjustment (Figure 4B).

* Interceptor or curtain drains are often necessary to divert water moving down slope.

* When it is necessary to pump downhill, distribution lines should be in deeper trenches than the supply manifold. The opposite is true for level or uphill systems (Figure 5).

* **It is critical on sloping systems that earthen dams be maintained between the lateral trenches and the manifold trench.**

* Installation on slopes greater than 30 percent is **not allowed**.

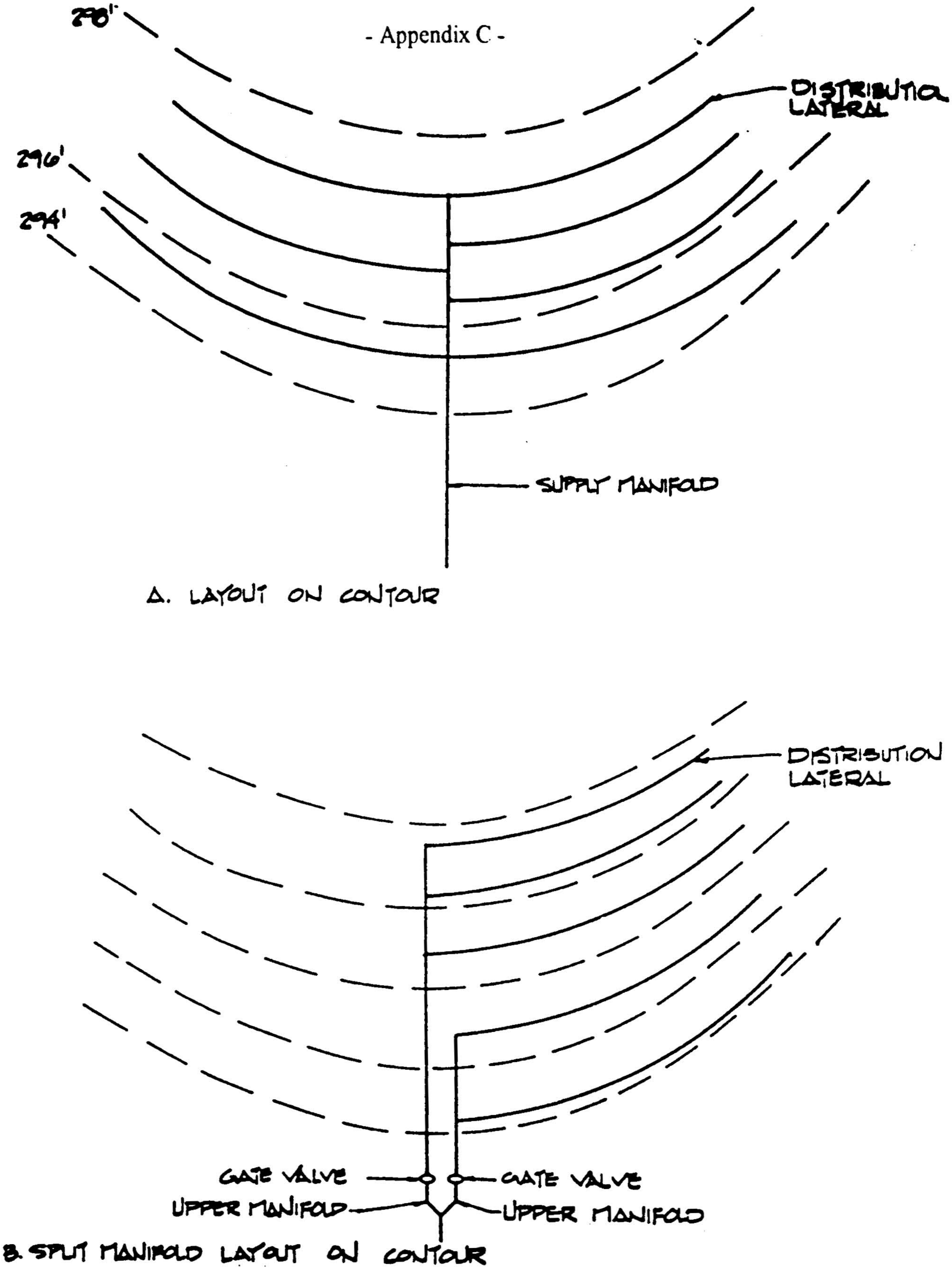
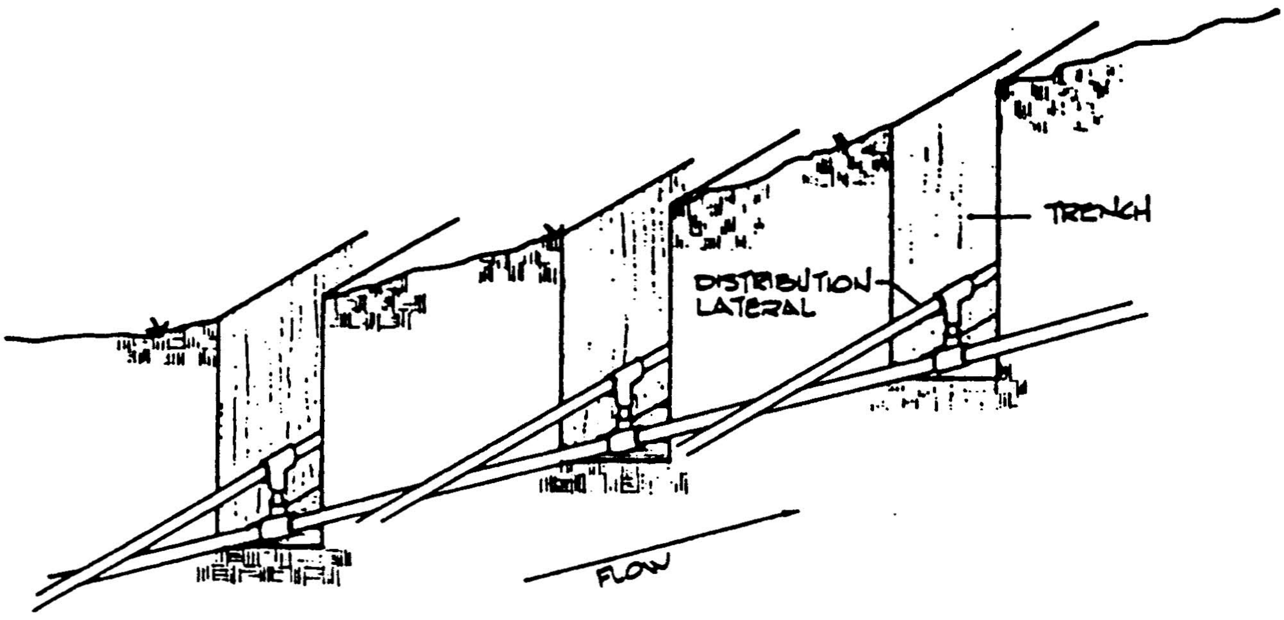
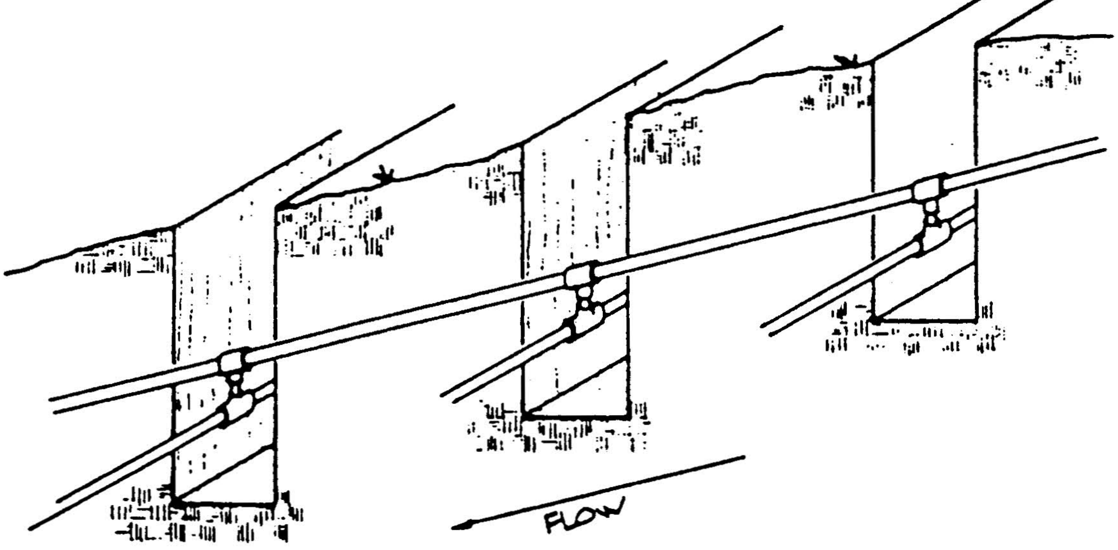


Figure 4. Layout of LPP systems on slopes.



A. PUMPING UPHILL



B. PUMPING DOWNHILL

Figure 5. Manifold placement on slopes.

[redacted]

Dosing and Distribution

The design must compensate for differences in elevation head in order to achieve uniform distribution. The load on each line must be individually calculated and then balanced by modifying the design of individual lines where needed.

Determining dosing rate:

Step 1. Measure and record the elevation of each line. Make sure that each line is laid out on the contour (see example below for summary of steps).

Step 2. Round-off each elevation to the nearest half-foot.

Step 3. Compute the difference in elevation of each line from the highest line.

Step 4. Determine the pressure head on each line. First select the pressure head for the highest line. Then add the elevation difference (Step 3) to determine the pressure head on the lower lines.

Example: Calculate the pressure head on each line for a system with five 60-ft. lines with elevations shown below. Pressure head for the highest line is 2 ft. See Table **5-1** below.

TABLE 5-1

Calculating Pressure Head

Line	Elevation (Step 1)	Round Off (Step 2)	Difference (Step 3)	Pressure Head (Step 4)
		FT		
1 Highest	359.2	359	0	2
2	358.6	358.5	0.5	2.5
3	358.2	358	1	3
4	357.9	358	1	3
5 Lowest	357.0	357	2	4

The pressure head should not exceed five feet on any of the lines. If it does, several modifications can be made. If suitable space is available, redesign the system, making it longer and narrower, thus covering less of a range in elevation. Remember that the lateral length is restricted to 70 feet or less, and the spacing to five feet or more.

As another option, lower the selected pressure head on the highest line and recalculate the heads on the remaining lines. The head on the highest line should be no less than one foot and is best kept at two feet.

Finally you can split the line into two or more manifolds. This is discussed in detail later in this Section.

Step 5. Check to see if the pressure head exceeds five feet on any lines.

Example: Highest pressure head is 4 ft.; therefore, no modifications need to be made.

Step 6. Determine the flow rate per hole for each line using Table **4-1** and the pressure heads calculated above. (See following example).

Step 7. Determine the flow rate for each line.

Example: Using the pressure heads above and assuming a 5-ft. hole spacing on 60-ft. lines (12 holes/line), prepare Table **5-2** below.

Table 5-2

Flow rate for each line

Line	Pressure Head (Step 4)	Flow Rate/Hole (Step 6)	Flow Rate/Line (Step 7)
	Ft.	GPM	GPM
1	2	.41	4.9
2	2.5	.46	5.5
3, 4	3	.50	6.0
5	4	58	7.0

The dose to the lower lines is larger due to the increased pressure head, while the dose to the upper lines is reduced, causing overloading of the lower lines. The flow rate should be balanced to within 10 percent among lines on the same manifold. It is wise to reduce the flow even lower in the lowest lines, because they receive an additional hydraulic load from downslope effluent movement from the upper lines.

Often the lengths of lateral lines vary. Some may be shorter than others to avoid obstacles such as larger trees, rocks or complex slopes. When this is the case, the flow rates of the lines cannot be directly compared. Rather the flow rates per foot of line must be calculated and these compared.

Step 8 Balance flow rate among lines. This can be done either by changing the number of holes or changing the size of the holes or by using ball valves on each line. The flow to lower lines can be reduced by increasing the hole spacing to greater than five feet or reducing the hole size to as small as 3/32 inch. But these sizes and spacings must not be used for an entire system.

Example: For the system in discussion, change the hole spacing to 4 ft. in line 1 (highest) and to 6 ft. in line 5 (lowest). See Table **5-3** below.

Table 5-3

Balancing the Flow Rate Among Lines

Line	Hole Spacing	No. of Holes	Flow/Hole	Flow/Line*
	Ft.		GPM	GPM
1	4	15	.41	6.2
2	4.5	13	.46	6.0
3,4	5	12	.50	6.0
5	6	10	.58	5.8

*For systems with lines of variable length, the flow rate/ft. is compared as described in Step 7.

When changing hole size or spacing to balance the flow it is very important to make the changes and instructions simple and clear. Hole placement and line installation should be inspected to ensure that they are done properly. **It is preferred that a constant hole spacing and diameter be used, and ball valves installed on each lateral line for pressure adjustment**.

Step 9. Calculate total dosing rate. The dosing rates for each line are added to obtain the total.

Example: For the system above:
Dosing rate = 5.8 + 6.0 + 6.0 + 6.0 + 6.2 gpm = 30.0 gpm
(Add 2 gpm if a siphon-breaker hole is needed.)

Pump Selection

The pump is chosen in the same manner as in Section 4. When pumping uphill the elevation head increases. If the hill is large enough it may become impractical to adjust the system for use with a 4/10-horsepower pump. It may be necessary to use a larger, more expensive pump.

If it is necessary to pump downhill, a 1/4-inch siphon-breaker hole must be drilled in the supply line in the pumping tank to avoid unintentional continuous siphoning of effluent from the tank to the absorption field.

In some downhill systems, intentional siphoning can be used instead of pumping to provide distribution. A gravity-dosing siphon replaces the electric pump. Siphons of different sizes are available, and the siphon and dosing volume must be matched. The remainder of the system design is the same as when a pump is used.

The remaining steps in the design of LPP systems for sloping ground are the same as that for level ground (Section 4).

Design of split manifold systems

A split manifold system is used when the elevation difference between the lowest and highest lines exceeds four feet. The supply line is split into two or more manifolds, each connected to a subsystem of distribution laterals. Each manifold is equipped with a gate or globe valve so the pressure heads on the subsystems can be adjusted separately. This allows each subsystem to act as an independent system although they may be operated from the same pump. The following is an example of a design where a split manifold is necessary.

Example: Lines are to be laid out on contours at 1319.8, 1318.4, 1317.0, 1315.2, 1313.7 and 1312.4 feet.

Steps 1-5: The procedure in the previous section is followed. The calculations are summarized in the following example.

Example: Pressure head of highest line is set at 2 ft. (See Table **5-4** below). The pressure head exceeds 5 ft. for 3 lines; therefore, a split manifold will be used.

TABLE 5-4

Calculating the Pressure Head

Line	Elevation (Step 1)	Round Off (Step 2)	Difference (Step 3)	Pressure Head (Step 4)
		Ft		
1	1319.8	1320	0	2
2	1318.4	1318.5	1.5	3.5
3	1317.0	1317	3	5
4	1315.2	1315	5	7
5	1313.7	1313.5	6.5	8.5
6	1312.4	1312.5	7.5	9.5

Step 6. Split the system into two subsystems.

Example: Subsystem 1 (higher) = lines 1-3
Subsystem 2 (lower) = lines 4-6

Step 7. Repeat steps 1 through 5 independently for each subsystem.

Example: Set the pressure head at 2 ft. for the highest line of each subsystem. (See Table **5-5** below). No pressure head exceeds 5 ft.; therefore, this system is satisfactory.

Follow the procedure of steps six through nine in the previous section to balance the flow rates and determine dosing rates.

Pump selection is done as in Section 4. When using a split manifold, the total friction loss decreases while the pipe volume increases. In many cases it may be best to decrease the diameter of the manifolds after they split. This will decrease the pipe volume, and may avoid the need for a check valve.

TABLE 5-5

Establishing a Subsystem

Subsystem	Line	Elevation and Round Off (Step 1,2)	Difference (Step 3)	Pressure Head (Step 4)
		ft.		
1	1	1320	0	2
	2	1318.5	1.5	3.5
	3	1317	3	5
2	4	1315	0	2
	5	1313.5	1.5	3.5
	6	1312.5	2.5	4.5

For most systems the gate or globe valves should be 1 1/4-inch diameter because they are easier to adjust than larger valves. Reducing adapters will be needed to fit these valves into larger diameter manifolds.

[Modified LPP design. This section not used. Installation of systems on fill is not permitted in Greene County.]

SECTION 6

Equipment Specification

All necessary equipment and tools should be clearly listed so they can be obtained prior to installation of the LPP system. A copy of the LPP worksheet (FORM EV06) along with a site plan including drainage and landscaping requirements, must be prepared for every system which is installed. Using this information, it is helpful to prepare a list of materials. Be sure that the materials meet the requirements discussed below. A sketch of the distribution lines (Figure 6) and the pump system (Figure 7) are useful for counting the fittings.

Septic Tank and Pumping Chamber

As noted earlier, an LPP system has two separate tanks - and approved septic tank and a single compartment pumping chamber. If a conventional septic system is being repaired by an LPP, the existing septic tank can be used (after being pumped out and inspected), and only one additional tank installed.

Effluent from the two compartment septic tank flows by gravity through a four inch solid PVC pipe to the pumping chamber. The pumping chamber should have a liquid capacity of at least two times the daily wastewater flow from the house, and should be a single compartment design.

The pumping chamber must be provided with an above ground concrete or masonry (or their equivalent) riser to provide easy access for pump service. It is advisable to provide similar access to the septic tank for periodic clean out. The riser should be placed over the pump access hole in the pumping chamber. Risers should be wide enough to accommodate the existing lids on the tanks, should extend at least six inches above the finished grade of the site and should also be covered with a concrete lid. Standard well tiles can be used for the risers, provided that the inside diameter is larger than the access hole in the tank. All joints must be sealed to prevent the infiltration of surface or ground water to the tanks.

Pipe and Fittings

All pipes and fittings in an LPP system should be made of Schedule 40 PVC plastic. PVC is lightweight, easy to use and resists corrosion. All joints must be cleaned and sealed with an appropriate PVC cleaner and solvent cement. The supply manifold from the pumping chamber to the LPP distribution field is usually 1 1/2 or 2 inch PVC, depending on specifications of the system (Section 4). A bushing or reducer may be needed to adapt the pump to the supply manifold. There should always be a threaded PVC union or similar device above the pump to allow easy removal or replacement. Lateral lines are usually made of 1 to 1 1/2 inch PVC. Appropriate holes in the laterals are drilled on site.

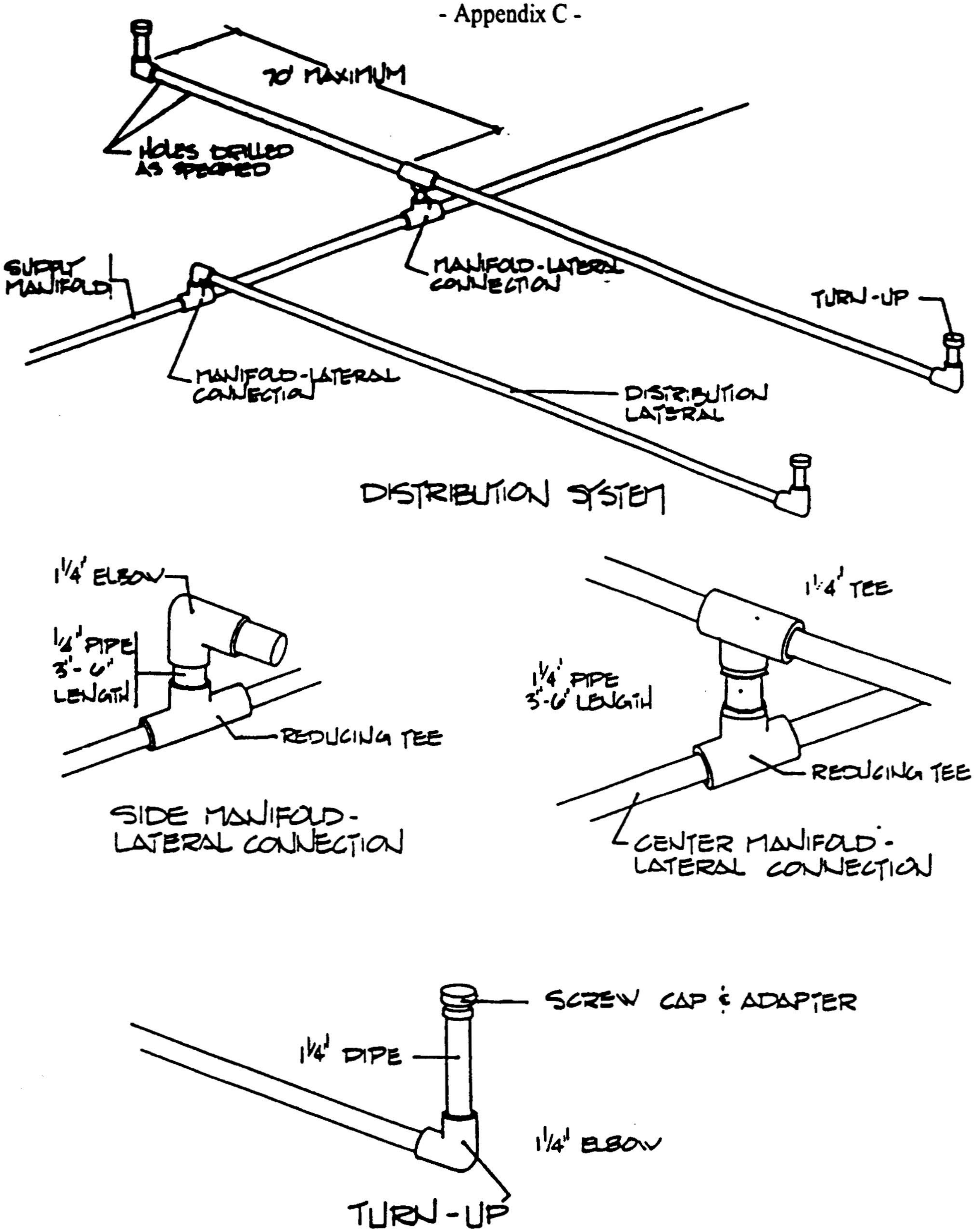


Figure 6. Typical LPP piping details.

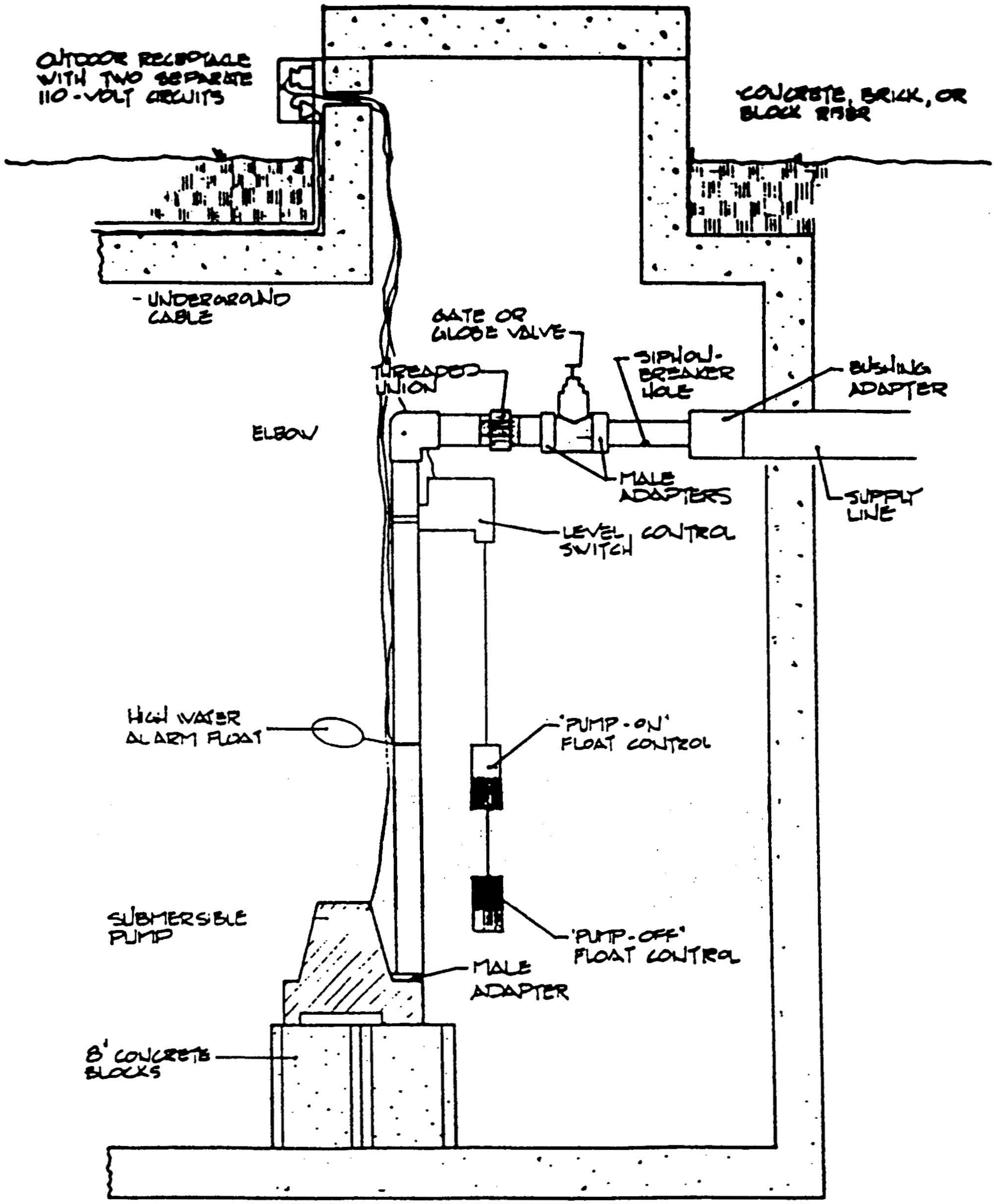


Figure 7. Typical details of pumping chamber.

PVC pipe must be of Schedule 40 specification with pressure fittings and of the straight length variety. A globe or gate valve for a final pressure adjustment is installed in the supply **line** inside the pumping chamber or on each individual lateral. The valve should be made of PVC or bronze. All other tees, elbows, caps and reducers in the distribution system should be made of PVC. The end of each lateral line is equipped with a capped "turn-up" that provides above ground access for clean-out or back-flushing. Using 45 degree elbows rather than 90 degree elbows for the turn-ups will make clean-out easier to do. Galvanized caps may be used if PVC is not available.

In the few instances where a check valve is necessary, it should also be installed with threaded fittings in the pump chamber to provide easy access for maintenanc

Pump, Float Control and Alarm System

A good quality, submersible effluent pump with oil lubricated bearings must be used in all LPP systems. An expensive grinder pump is not required because the septic tank effluent will be relatively free of solid material. A septic tank effluent pump or a submersible sump pump that will not be corroded by sewage should be used in the pumping chamber. Pumps with built in switches should be avoided, unless the switch can be adjusted for the quantity of water to be pumped. The selection of pump size is discussed in Section 4. Pumps in the range of 1/4 horsepower to 4/10 horsepower generally provide sufficient capacity for resident LPP systems, but the pumping requirements for each system must be checked against the performance curve of the pump to be used. It is better to use a slightly larger pump than necessary, because the final pressure can be adjusted with the in-line gate or globe valve.

The controls for the pumping system include a switching control for turning the pump on and off and a high water alarm to signal pump malfunctions. The pump control system must be mercury switches and adjustable to meet the recommended loading rate for different sizes and shapes of pumping chamber. The controls must also be sealed against entry of corrosive and explosive gases from the effluent and shall have NEMA (National Electrical Manufacturing Association) approval. All electrical connections must be made outside of the pump chamber unless an "explosion proof box" is used.

Mercury switches are activated by a sealed float which contains a tube of mercury in contact with power leads. Best performance has been obtained using two switches - one to close the pump circuit and the other to open it. Automatic timers with backup mercury floats have been successful in a few systems where uniform timing of the doses was important. Diaphragm and mechanical float switches are not acceptable for LPP use. The range of adjustment is often inadequate and the switches do not provide good service in a sewage environment.

In addition to the on and off control floats, a separate mercury control switch is needed for the high-water alarm. This switch should be mounted several inches above the "pump on" float. The high-water alarm should consist of a light bulb and audible signal mounted over a sign marked "wastewater system alarm" in a visible place in the home, such as the kitchen or utility room. It must be on a separate electrical circuit from the pump power line, and be equipped with a test switch. The alarm is activated if the water level in the pumping tank rises above the "pump on" float control. The tank provides at least one day or more of excess storage capacity (depending on water use in the home) during which time the system must be repaired. Refer to Section 9 for repair and maintenance tips.

Complete control boxes for high water alarms are available commercially. Simpler and cheaper systems can be assembled by an electrician. There are two basic requirements for an alarm system:

-- It must operate on a separate electrical circuit from the pump.

-- It must activate a labeled and easily visible and audible signal in the home whenever the water exceeds the normal "pump on" level in the tank.

Gravel

LPP systems require a minimum of nine inches of gravel in the lateral distribution trenches. Gravel size should be from ½ inch to one inch. Pea gravel or crushed rock may be used, but it must be washed. If crushed limestone is to be used it must be washed to remove fines and it can be no smaller than one inch. The trench rock shall be placed to a minimum depth of four inches (4") below the pipe and two inches (2") above the pipe.

SECTION 7

Installation Procedures

The actual installation of an LPP is simple and straightforward, and can usually be accomplished by three or four people in one day.

Tools and Supplies

A backhoe is needed only for installation of the two tanks. All other excavation can be done with a small trenching machine that will excavate a cut six inches wide. A transit or similar instrument is necessary for staking out the lateral lines on sloping lots. Other tools needed for installation are:

. Shovels, wheelbarrows - for moving gravel
. Electric drill (with power pack or generator, if necessary) - for drilling holes in lateral lines
. Drill bits
. Hack saw, extra blades - for cutting PVC pipe to required lengths
. PVC glue and cleaner
. Mortar - to seal tank openings
. Measuring tape
. Electrical wiring tools

In addition to tools, a complete list of parts and materials should be compiled from a sketch of the system.

Site Preparation

One of the most important concerns for an LPP system is to protect the site from soil disturbance by heavy equipment. Removal or compaction of the topsoil, especially during wet weather, may destroy the site's suitability for an LPP system. As soon as the absorption area has been designated, it should be flagged, roped off, and "quarantined" from construction traffic. No site preparation or LPP construction work should occur if the soil is wet. As a rule of thumb, if the soil is too wet to plow, it is too wet to disturb for system construction.

After the location is staked out and the soil is dry enough to plow, the site should be cleared of brush and small trees. If larger trees are removed, they should be cut off rather than uprooted in order to avoid created depressions and damaging the soil-pore network.

Provisions must be made for intercepting or diverting surface water and shallow groundwater away from the absorption area, septic tank, and pumping chamber. This can be done with grassy swales, open ditches, or curtain drains.

After the area has been cleared and shaped, the location of the lateral lines and supply manifold should be accurately staked out according to design specifications. Each lateral line must be laid out along a level contour using a transit. One lateral may be higher or lower than the next one, but each individual lateral must be level. In no case should a lateral line be allowed to slope away from the manifold.

Tank Installation

The septic tank is installed in the same way as a conventional system. The pumping chamber may be a single compartment septic tank with its direction reversed so that the outlet end becomes the inlet end adjacent to the septic tank. The lower invert of the outlet end ensures proper gravity flow from the septic-tank outlet into the pumping chamber. The tanks are connected with an appropriate length of solid, four-inch Schedule 40 PVC pipe. Inlet and outlet openings around the pipe must then be appropriately sealed.

The tank access lids must be equipped with a water-tight masonry or concrete riser to at least six inches above grade. Treated wood risers may be used but must be secured by a hasp and lock device. These risers provide easy access for repair and inspection, and help keep surface water out of the tanks.

If an LPP is being installed to replace an existing conventional septic system, only one additional tank (the pump chamber) must be installed. However, the existing septic tank must be pumped out before installing the LPP.

Supply Manifold

The supply manifold conveys effluent from the pump to the distribution laterals. Any effluent remaining in the lateral lines when the pump shuts off should drain back to the pumping chamber through the supply manifold (unless the system is large enough to require a check valve). The manifold joins each lateral through a short riser pipe connecting a reducing tee on the manifold to a smaller elbow or tee on the lateral. This assembly places each lateral pipe about six inches higher than the supply manifold and helps prevent the back-flow of effluent from a higher lateral to a lower lateral. The individual riser units may be assembled earlier and glued in place between the laterals after the manifold is cut into segments. Because the lateral line is now several inches higher than the manifold, the manifold requires a trench six inches deeper than the laterals. In the special case of pumping downhill, the laterals are placed lower than the manifold.

After the supply manifold has been placed in its trench and lateral lines connected, it should be backfilled with tightly tamped soil. The supply manifold trench must not be backfilled with gravel, or the trench may become a conduit for downslope flow of effluent from the laterals. The outlet hole in the pumping tank should not be sealed until after the pump is in place. There must be a two (2') foot earth dam between the sidewall of the manifold trench and the beginning of the lateral.

Lateral Lines

The lateral trenches are usually cut 18 to 22 inches deep. The depth of a given lateral trench should be uniform from the manifold to the end of the lateral. In no case should the trench bottom be allowed to slope away from the manifold. The lateral trench must not extend more than one or two feet beyond the end of the lateral pipe. Lateral trench bottoms are then lined with **four** inches of gravel (remember that gravel is not placed in the supply manifold trench).

The PVC pipes should be laid out and cut to proper lengths for the lateral lines. Holes are drilled (in a straight line) according to the design specifications after the laterals have been cut to their proper length. The first hole in each lateral **shall be drilled a minimum of 3 feet** from the manifold; the last hole **shall be drilled a minimum of 30 inches** from the end of the lateral. Holes are only drilled through one side of the pipe. If the drill bit should go through both sides, or if a hole is drilled in the wrong place, that section of pipe must be discarded.

Lateral pipes are placed holes-down in the trenches. A turn-up should be located at the end of each lateral to adjust the pressure head. Once the pressure head has been adjusted, the turn-ups are cut off flush with the final grade and capped. When installing each lateral, care must be taken to ensure that the holes are down and the turn-up pointed upward before the quick-drying PVC glue hardens. Positioning of the lateral should be checked to make sure it is level in the trench.

After the lateral lines are in place and leveled, they are covered with another two inches of gravel. The earthen dams in the lateral trenches and near the manifold must be tightly tamped from the trench bottom to the ground surface. Once the gravel is in place, the trenches are covered with paper or straw prior to backfilling with topsoil. Turn-ups should be cut to appropriate lengths and fitted with caps.

Pumps and Controls

Details of pump installation are shown in **Figure 7**. The pump must be placed on two concrete blocks set next to each other on the bottom of the tank. This prevents the pumping of any solid particles which can clog the LPP system. A piece of nylon rope or other non-corrodible material should be attached to the pump and to the outlet pipe for lifting the pump in and out of the chamber. The PVC outlet pipe is too fragile to support the pump.

Controls are fastened to the outlet pipe with clamps or brackets supplied by the manufacturer. The lower level control or "pump-off" must be positioned above the pump, so that the pump remains submerged at all times. The upper level control or "pump-on" is positioned to pump a specified volume of effluent (Section 4). The high water control float is then mounted about three inches above the upper pump-on control. (Note: Care must be taken to ensure that the floats do not become fouled by other components in the tank such as the electric power cord or the lifting rope).

The pump outlet pipe should be connected to the supply manifold with a threaded PVC union to allow quick removal. The gate or globe valve must also be installed in the supply line (within the pump chamber) to allow final adjustment of the pressure. If effluent will be pumped downhill, a **1/4 inch diameter** siphon-breaker hole must be drilled in the bottom of the supply line before it leaves the pump tank. This breaks any vacuum in the system and prevents the inadvertent siphoning of effluent out of the tank. This hole is very important.

Power and control cords should be guided out of the pump chamber through a recessed channel or opening that will protect the cords from damage by the concrete lid.

Electrical Connections

As noted earlier, the pump and high-water alarm must be placed on separate electrical circuits. (If the pump circuit fails, the alarm must still be able to operate). Follow the manufacturer's recommendations for proper fuses or circuit-breakers. All electrical connections must meet the National Electrical Codes.

All electrical connections must be made outside the pumping chamber. Power cords from the pump and controls should be plugged into a NEMA-approved outdoor receptacle mounted outside of the pumping chamber . The receptacle must not be located inside the pumping chamber due to the corrosive and explosive gases that may form from the sewage.

Electrical connections nay be made inside the pumping tank only if wired inside a sealed, "explosion proof" box. Some level-control switches have such a box built into the housing but are more expensive than the plug-in devices.

Wiring between the pumping chamber and the house should meet state and local code requirements. A lightning arrestor is recommended to protect the pump and controls from electrical surges.

Pump Operation Check

After all components have been installed and connected, the system should be checked for proper operation. With electrical power turned off, fill the pumping chamber with a garden hose (or allow effluent to accumulate) until the liquid rises to the level of the high-water alarm float.

Turn on the electrical power. The alarm light should go on in the house, and the pump should start operating. The alarm light should go off when the liquid level falls below the high-water float. The pump should turn off when the liquid reaches the lowest float control. Be sure the pump is still completely submerged.

Pressure Head Adjustment

The pressure head must be adjusted to match that specified in the design. The pressure head is measured as the height liquid will rise above the turn-up elbow when the pump is running. To adjust the head:

* Glue a three foot length of **clear pipe or tubing** to a threaded adapter that will screw onto the turn-up adapters.

* Replace the turn-up cap with the pipe adapter.

* Turn the power on to allow liquid to rise in the pipe.

* Adjust the gate or globe valve in the pumping tank and the ball valve on each lateral line until the effluent reaches the desired height in **each line**. Remember to include the distance below the ground surface to the lateral line when measuring the height.

Final Landscaping

After the LPP is installed, the following should be checked to ensure that the system will not be overloaded with excess rainwater and runoff.

* The distribution field is shaped to shed rainwater and is free of low areas.

* Curtain drains, grassy swales or ditches for diverting ground and surface water are properly installed.

* Gutter and downspout drains are directed away from the system.

Any problems should be corrected before approving the system.

Finally, the entire area should be planted with grass in order to prevent erosion. The soil should be properly tilled, limed (if necessary) and fertilized before planting. After applying an appropriate grass seed, the area should be heavily mulched with straw or other suitable material.

SECTION 8

Inspection and Maintenance

The successful performance of an LPP relies on proper design and installation. The details for a given system, from site preparation to final landscaping, should be carefully specified on the Construction Permit. This helps clarify the responsibilities of the property owner, contractor and permitting agency and helps avoid last-minute surprises when issuing a final inspection approval.

Operation Inspections

A properly designed and installed LPP system requires very little maintenance. The individual home owner should routinely check the pump, alarm system, and condition of the disposal field. Any indications of a failure should be reported to the **Resource Management Department** as soon as possible.

Routine Maintenance

All septic tanks, whether for conventional or alternative systems, require occasional pumping. Sludge and scum accumulation should be checked annually. Virtually all solids will be retained in the first compartment of the two-compartment septic tank. Little or no accumulation should occur in either the second compartment of the septic tank or in the pumping chamber. The rate of sludge accumulation will vary with individual living habitats. Most septic tanks require pumping about once every four years.

Some LPP systems may gradually accumulate solids at the ends of the lateral lines. These should be removed at least once a year by unscrewing the caps on each of the turn-ups, and back-flushing the laterals with a garden hose.

The pressure head in the upper and lower laterals should also be checked and adjusted one month after installation and annually thereafter. Proper pump and float-control operation should be checked during all routine inspections. If the alarm panel has a "push-to-treat" button, it should be checked regularly. Pump maintenance should follow the manufacturer's recommendations.

Repair Procedures

The alarm light should go on whenever effluent in the pump chamber rises above the pump-on level control. This can occur for several reasons:

* Power failure: If there has been a power failure, effluent will continue to accumulate in the tank until power is restored. At this time the alarm may come on for a brief period (less than 30 minutes), but will go off as soon as the pump draws down the effluent.

* Pump or switch failure: If the pump or level controls malfunction, they can be quickly replaced by unscrewing the PVC union and lifting the entire assembly out of the pumping chamber (use the nylon lift rope). Be sure to turn off the power supply, and disconnect all cords before removing or replacing the pump or control assembly.

* Clogged valve or discharge holes: If the distribution system becomes clogged, the tank will not be emptied. Back-flush the laterals and supply manifold if necessary.

Before replacing any components, make sure that the level controls have not simply become tangled. The problem can usually be isolated by checking the pump operation independently from the controls. Repair or replace the appropriate components.

End of Appendix C

APPENDIX D

SOIL CHARACTERISTICS

APPENDIX D

SOIL CHARACTERISTICS

The following criteria are for use in determining soil characteristics as a part of a site evaluation performed for design of on-site wastewater systems. These criteria have been reproduced from Section (7) of 10 CSR 20-8.021 Individual Sewage Treatment Systems Standards.

1. Texture. The relative amounts of the different sizes of mineral particles in a soil are referred to as soil texture. All mineral soils are composed of sand, (2-.05 mm in size); silt, which includes intermediate-size particles that cannot be seen with the naked eye but feel like flour when pressed between the fingers, (0.05-0.002 mm in size); and/or clay, which is extremely small in size and is the mineral particle that gives cohesion to a soil (less than 0.002 mm in size). The texture of the different horizons of soils may be classified into five (5) general groups and shall be used for determining the application rates shown in Tables VI and VII.

   A. Soil Group I. Sandy texture soils contain more than seventy percent (70%) sand-sized particles in the soil mass. These soils do not have enough clay to be cohesive. Sandy soils have favorable sewage application rates, but may have a lot of filtering capacity leading to malfunction due to contamination of groundwater. The sandy group includes the sane and loamy sand soil textural classes and shall generally be considered suitable in texture.

      (I) Sand. Sand has a gritty feel, does not stain the fingers and does not form a ribbon or ball when wet or moist.

      (II) Loamy sand. Loamy sand has a gritty fee, stains the fingers (silt and clay), forms a weak ball and cannot be handled without breaking.

   B. Soil Group II. Coarse loamy texture soils contain more than thirty percent (30%) sand-sized particles and less than twenty percent (20%) clay-sized particles in the soil mass. They exhibit slight or no stickiness. The coarse loamy group includes sandy loam and loam soil textural classes and shall generally be considered suitable in texture.

      (I) Sandy loam. Sandy loam feels gritty and forms a ball that can be picked up with the fingers and handled with care without breaking.

      (II) Loam. Loam may feel slightly gritty but does not show a fingerprint and forms only short ribbons ranging from twenty-five hundredths to fifty hundredths inch (.25-.50") in length. Loam will form a ball that can be handled without breaking.

C. Soil group III. These fine loamy texture soils contain less than forty percent (40%) clay-sized particles and not more than thirty percent (30%) sand-sized particles in a soil mass. Also this group is limited to less than thirty-five percent (35%) clay when the clay minerals exhibit high shrink/swell characteristics. They exhibit slight to moderate stickiness. The fine loamy group includes sandy clay loam, silt loam, clay loam and silty clay loam textural classes and shall generally be considered provisionally suitable in textures.

(I) Silt loam. Silt loam feels floury when moist and will show a fingerprint but will not ribbon and forms only a weak ball.

(II) Silt. Silt has a floury feel when moist and sticky when wet but will not ribbon and forms a ball that will tolerate some handling.

(III) Sandy clay loam. Sandy clay loam feels gritty but contains enough clay to form a firm ball and may ribbon to form seventy-five hundredth to one-inch (.75-1") pieces.

(IV) Silty clay loam. Silty clay loam is sticky when moist and will ribbon from one to two inches (1-2"). Rubbing silty clay loam with the thumbnail produces a moderate sheen. Silty clay loam produces a distinct fingerprint.

(V) Clay loam. Clay loam is sticky when moist. Clay loam forms a thin ribbon of one to two inches (1-2") in length and produces a slight sheen when rubbed with the thumbnail. Clay loam produces a nondistinct fingerprint.

D. Soil group IV. These clayey texture soils contain forty percent (40%) or more clay-sized particles and include sandy clay, silty clay, and clay. This group may also include clay loam and silty clay loam when the clay fraction is greater than thirty-five percent (35%) and of a high shrink/swell nature. There are two (2) major types of clays: non-expandable and expandable. The non-expandable clays, when wet, are slightly sticky to sticky; when moist, are friable to firm; and when dry, they are slightly hard to hard. The non-expandable clays (Group IVa) shall generally be considered provisionally suitable in texture. The expandable clays, when wet, are very sticky and very plastic. When moist these clays are very firm to extremely firm and when dry are very hard to extremely hard. The expandable clays (Group IVb) shall be considered unsuitable in texture.

(I) Sandy clay. Sandy clay is plastic, gritty and sticky when moist and forms a firm ball and produces a thin ribbon to over two (2) inches in length.

(II) Silty clay. Silty clay is both plastic and sticky when moist and lacks any gritty feeling. Silty clay forms a firm ball and readily ribbons to over two inches (2") in length.

(III) Clay. Clay is both sticky and plastic when moist, produces a thin ribbon over two inches (2") in length, produces a high sheen when rubbed with the thumbnail and forms a strong ball resistant to breaking.

E. Soil group V. This soils group may be of any texture, however, the most predominant are cherty and very cherty clays, silt loams and silty clay loams. The amount of rock fragments in these soils is of a concern in areas of residual soils overlying highly permeable bedrock where groundwater could become contaminated. In general, soils with less than fifty percent (50%) rock fragments will be considered suitable. In general, soils with greater than fifty percent (50%) rock fragments over highly permeable bedrock will be considered unsuitable. Soils with greater than fifty percent (50%) rock fragments over low permeability bedrock will be considered provisionally suitable.

F. The soil texture shall be estimated by field testing. Laboratory estimation of texture by particle size analysis may be substituted for field testing.

2. Soil consistence. Soil consistence comprises the attributes of soil material, typically clay, that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture.

A. Soil consistence when wet shall be considered as follows:

(I) Stickiness. Stickiness is the quality of adhesion to other objects. For field evaluation of stickiness, wet soil material is pressed between thumb and finger and its adherence noted. Degrees of stickiness are described as follows:

(a) Slightly sticky. After pressure, soil material adheres to both thumb and finger but comes off one or the other cleanly. It is not appreciably stretched when the digits are separated;

(b) Sticky. After pressure, soil material adheres to both thumb and finger and tends to stretch somewhat and pull apart rather than pulling free from either digit; and

(c) Very sticky. After pressure, soil material adheres to both thumb and finger and is decidedly stretched when they are separated.

(II) Plasticity. Plasticity is the ability to change shape continuously under the influence of an applied stress and to retain the impressed shape on removal of the stress. For field determination of plasticity, roll the soil material between the thumb and finger and observe whether or not a wire or thin rod of soil can be formed. Degree of resistance to deformation at or slightly above field capacity is described as follows:

(a) Slightly plastic. Wire formable but soil mass easily deformable;

(b) Plastic. Wire formable and moderate pressure required for deformation of the soil mass; and

(c) Very plastic. Wire formable and much pressure required for deformation of the soil mass.

B. Soil consistence when moist. Consistence when moist is determined at a moisture content approximately midway between air dry and field capacity. At this moisture content, most soil materials exhibit a form of consistence characterized by: tendency to break into smaller masses rather than into powder; some deformation prior to rupture; absence of brittleness; and ability of the material after disturbance to cohere again when pressed together. To evaluate this consistence, select and attempt to crush in the hand a mass that appears slightly moist.

(I) Friable. Soil material crushes easily under gentle to moderate pressure between thumb and finger, and coheres when pressed together.

(II) Firm. Soil material crushes under moderate pressure between thumb and finger but resistance is distinctly noticeable.

(III) Very firm. Soil material crushes under strong pressure; barely crushable between thumb and finger.

(IV) Extremely firm. Soil material crushes only under very strong pressure; cannot be crushed between thumb and finger and must be broken apart bit by bit.

C. Soil consistence when dry. The consistency of soil materials when dry is characterized by rigidity, brittleness, maximum resistance to pressure, more or less tendency to crush to a powder or to fragments with rather sharp edges, and inability of crushed material to cohere again when pressed together. To evaluate, select and air-dry mass and break in the hand.

(I) Slightly hard. Weakly resistant to pressure; easily broken between thumb and finger.

(II) Hard. Moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between thumb and finger.

(III) Very hard. Very resistant to pressure; can be broken in the hands only with difficulty; not breakable between thumb and finger.

(IV) Extremely hard. Extremely resistant to pressure; cannot be broken in the hands.

3. Organic soils. Organic soils shall be considered unsuitable; and

4. Soil structure. In many soils, the sand, silt and clay particles tend to cling or stick to one another to form a ped or a clump of soil. This is known as soil structure. Soil structure may have a significant effect on the movement of effluent through a soil. Structure is usually not important in soil groups I and II, and these types of soils shall generally be considered suitable as to structure. The three (3) kinds of soil structure that are most significant in movement of sewage effluent through groups III and IV soils are block-like, platy and the absence of soil structure or massive conditions. These kinds of soil structure are described as follows:

   A. Block-like soil structure. In group III and IV soils, if the soil exhibits many peds or angular and subangular peds, then the soils have block-like structure. The sewage effluent may move between the cracks of these types of peds. Block-like structure in group III and IV soils is frequently destroyed by mechanical excavating equipment manipulating the soil when it is too wet. Trenches for absorption lines being placed in group III and IV soils with block-like structure should only be dug when the soils are moist or dry. Block-like soil structure in Groups III and IV soils shall be considered provisionally suitable. Some rocks, even though weathered, such as creviced or fractured rocks, exhibit block-like structure, which is not changed by moving water, thereby allowing fluids to move downward without filtration. Rock shall be considered unsuitable as to structure;

   B. Platy soil structure. If group III and IV soils fall out into plate-like sheets, then the soils would have platy structure. Water or effluent movement through these soils would be extremely slow, and the structure shall be considered unsuitable; and

   C. Absence of soil structure. Some group II, III and IV soils are massive and exhibit no structural aggregates. In these kinds of soils, water or effluent movement would be negligible. This structure shall be considered unsuitable.

TABLE D - I

SOIL LOADING RATES FOR
<u>CONVENTIONAL SEPTIC TANK SYSTEMS</u>
DESIGNED ON THE BASIS OF
SOIL FACTOR EVALUATIONS

SOIL GROUP	SOIL TEXTURAL CLASSES		APPLICATION RATE (GPD/SQ.FT.)
1	Sands	Sand Loamy sand	1.2 - 0.8
2	Coarse loams	Sandy loam Loam	0.8 - 0.6
3	Fine loams well drained	Silt loam Clay loam Sandy clay loam Silty clay loam	0.6 - 0.4
4a	Clays and some fine loams; low to moderate shrink swell	Sandy clay Silty clay Clay Silty clay loam Clay loam	0.4 - 0.2
4b	Clays and some fine loams; high shrink swell > 35% clay content	Sandy clay Silty clay Clay Silty clay loam Clay loam	Unsuitable
5	Skeletal less than 50% rock fragments	Silt loam Silty clay loam Clay Silty clay	0.6 - 0.4

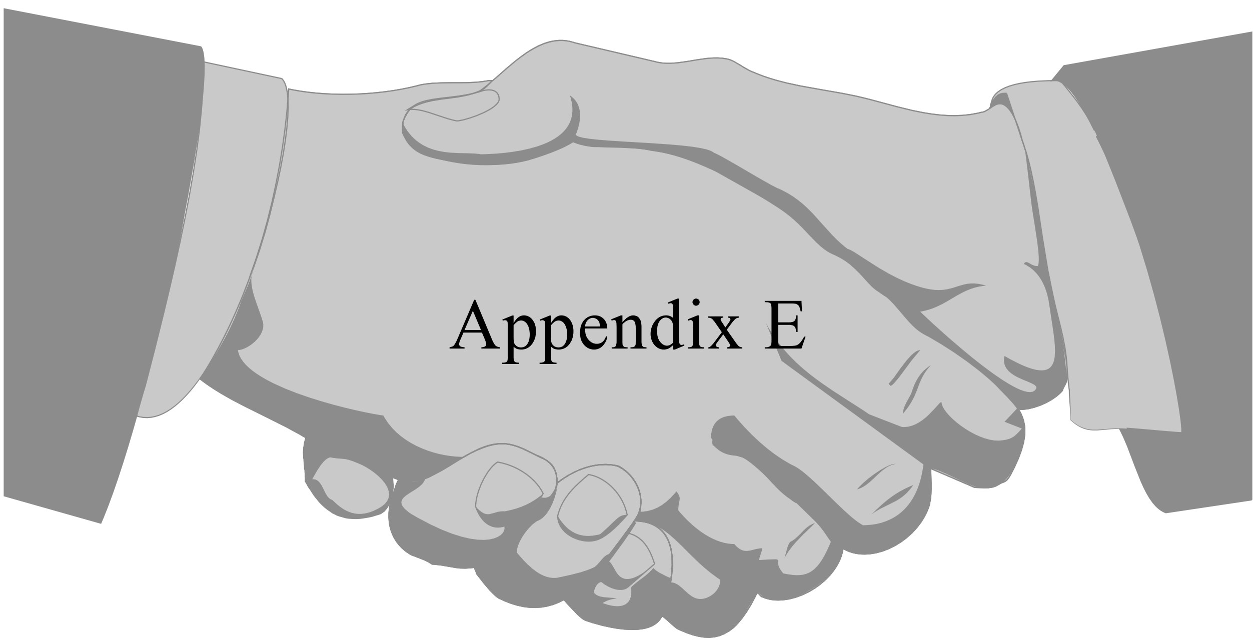
TABLE D - II

SOIL LOADING RATES FOR
LOW PRESSURE PIPE SYSTEMS
DESIGNED ON THE BASIS OF
SOIL FACTOR EVALUATIONS

SOIL GROUP	SOIL TEXTURAL CLASSES		APPLICATION RATE (GPD/SQ.FT.)
1	Sands	Sand Loamy sand	0.5 - 0.4
2	Coarse loams	Sandy loam Loam	0.4 - 0.3
3	Fine loams well drained	Silt loam Clay loam Sandy clay loam Silty clay loam	0.3 - 0.2
4a	Clays and some fine loams; low to moderate shrink swell	Sandy clay Silty clay Clay Silty clay loam Clay loam	0.2 - 0.1
4b	Clays and some fine loams; high shrink swell > 35% clay content	Sandy clay Silty clay Clay Silty clay loam Clay loam	Unsuitable
5	Skeletal less than 50% rock fragments	Silt loam Silty clay loam Clay Silty clay	0.3 - 0.2

End of Appendix D

Appendix E



MEMORANDUM OF UNDERSTANDING BETWEEN
THE GREENE COUNTY COMMISSION AND
THE MISSOURI DEPARTMENT OF NATURAL RESOURCES

The concepts of this Memorandum of Understanding are to be implemented by the Water Pollution Control Program for the Department of Natural Resources (DNR) and the Greene County Resource Management Department for the Greene County Commission (GCC). The general intent is to recognize that cooperation between state and local government will result in each level of government achieving its separate, lawful objectives and to cooperate fully in areas of mutual interest.

The DNR agrees not to act on an application for approval of a developer's plans for disposal of wastewater in a subdivision until the developer's plan has been approved by the Greene County Planning and Zoning Commission. The DNR also agrees to obtain concurrence from the Greene County Resource Management Department before placing conditions on an approval. If the DNR proposes conditions on an approval, the GCC will be contacted and given ten days to approve the conditions. If the conditions are not acceptable to the GCC, the subdivision will not be approved.

The GCC agrees to review and approve or comment on all subdivisions within two weeks of submission by the developer. Copies of all approvals issued by the GCC will be furnished to the DNR within ten working days.

G. Tracy Mehan, III
Director
Department of Natural Resources

H. C. "Mike" Compton
Presiding Commissioner

David L. Coonrod
Commissioner, 1st District

Jim Payne
Jim Payne
Commissioner, 2nd District