Minimum Construction Standards for

On-Site Sewage Disposal Systems

RAYMORE
development services

As adopted by City Council of the City of Raymore, MO
Municipal Code Article II Section 710.150

11/2018

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Section 1

REQUIREMENTS

1. GENERAL

A. Scope

These standards apply to all private sewage disposal systems located within the city limits of Raymore, Missouri, which utilize soil absorption, or evaporative systems for final treatment and disposal of wastewater.

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

The purpose of these regulations and standards is to protect the health and welfare of the citizens of Raymore, MO by preventing discharge of improperly treated wastewater on to the surface or into groundwater, to the greatest extent possible. In the event that conditions on any particular site warrant, the Building Official may require additional tests, or design exceeding the minimum requirements.

B. Authority

These standards have been adopted by City Council of the City of Raymore, MO. The Building Official shall be the authorized representative of said body and have the duty to monitor and upgrade all on-site private sewage disposal systems within the city limits of Raymore.

Violations of the requirements set forth herein shall constitute a violation of the On-Site Sewage Disposal Standards Ordinance, and shall be subject to enforcement procedures and penalties as set forth in the ordinance.

Any decision of the Building Official may be appealed in writing to the Board of Appeals as established in Chapter 540 of the City of Raymore Municipal Code.

2. REQUIRED PERMITS

For any property within the city limits of Raymore, a permit is required before construction, or major modification, or major repair of on-site private sewage disposal system. No permit shall be issued for any private on-site sewage disposal system employing subsurface absorption facilities where the area of the lot is less than three (3) acres. Any person engaged in the construction or renovation of a private on-site sewage disposal system shall obtain a construction permit from the office of Building Inspections. The following must be submitted in order to obtain the permit:

A. Construction of New Systems

(1) A soil morphology evaluation or a certified percolation test, site review and application completed by the installer shall be submitted along with appropriate fee at the time of the permit application.

B. Modifying or Replacing existing systems

(1) Replacing tank and absorption field or relocating absorption field: The installer shall submit a site sketch including a soils test and information required on application form.

(2) Replacing tank only: The installer shall submit a site sketch including information required on application form.

(3) Adding or replacing absorption field lines: The installer shall submit a site sketch including a soils test and information required on application form.

C. Rebuilding and replacing structures

In the case where a home or other structure is destroyed by fire or other cause and the owner wishes to rebuild, the existing private on-site sewage disposal system may be used to serve the replacement structure provided that public sewer is not within three hundred (300) feet, 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 private on-site sewage disposal system is not functioning properly, the Building Official shall require the system to be repaired or replaced as new construction.

3. FEES

A. Permit for construction of new residential or commercial system under three thousand (3000) gallons per day / flow or complete renovation, modifying, repair, partial replacement of existing system: ***$150.00***

B. Permit for new commercial system over three thousand an one (3001) gallons per day / flow: ***$250.00***

C. Installer annual registration and occupational license: ***$100.00***

Failure to submit plans and the required documents to obtain a permit by the Building Official before construction begins shall be assessed a penalty fee of three (3) times the cost of the permit.

4. REQUIRED PLANS AND DATA

All plans and data for new construction shall be prepared and sealed by a professional engineer that is licensed by the State of Missouri.

All plans and data for repairs, alterations, renovations or partial replacements shall be prepared by a certified and registered installer by the Missouri Department of Health and Senior Services.

Site evaluations are considered valid indefinitely, provided the soil properties at the site are not altered by excavating, filling, tilling, compacting 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 been altered by construction of pavements. Site evaluations shall be done by a State certified soil scientist, or a State certified percolation tester.

A. New Construction

The following items shall be submitted for new construction permits:

(1) Site evaluation form and soil morphology as performed by a certified soil scientist or percolation tester

(2) Details showing the typical cross section dimensions of the absorption trench including: depth; width; size, type, and depth of gravel; size, type, and depth of pipe or chamber; depth of fill; type of restrictive layer (landscaping fabric, fiberglass, paper, etc.)

(3) Site plan: A site plan must be prepared by a professional engineer or registered surveyor showing the following minimum information:

a) Lot lines, dimensions, and total lot area, or acres;
b) North Arrow
c) Location of proposed dwelling or building (show distances from all property lines);
d) Location of proposed septic tank and absorption field or other proposed system;
e) Location of soil morphology pits or percolation holes;
f) Slope of ground surface across absorption field area. Spot elevations or topographic contours may be used. Show grade to nearest ½ percent;
g) Arrows showing direction of surface drainage;
h) Flowing or intermittent streams or watercourses, ponds, lakes, and floodplain boundaries;
i) Location of proposed and/or existing wells (in use or abandoned) located within proximity to the required setback distances of the proposed system;
j) Location and distance of springs, sinkholes, caves located within proximity to the proposed system;
k) Existing utility lines and easements;
l) Existing or proposed swimming pools;
m) Existing or proposed drives, parking lots, or other paved or gravel surfaced areas;
n) Any other conditions which may effect the design or performance of the system;
o) Distance of neighboring residences for lagoon or evaporation pond installations.

B. Repair or replacement of existing system

(1) Replacing tank and replacing or relocating absorption field: submit a site sketch and information required by Building Inspections including a soil evaluation by a certified tester
(2) Replacing tank only: submit application showing tank size and location.
(3) Adding or replacing lateral lines: submit application showing existing and new lateral to be installed and a soil evaluation by a certified tester.

C. Commercial Property: Less than 3000 gallon per day / flow

Any business requesting a construction permit must provide the following information to the Building Official at the time of permit application:

(1) A statement as to the type of business to be conducted including number of employees, if public restrooms are provided, anticipated number of customers per day;
(2) Engineering plans for the proposed sewage disposal system to be installed including soil evaluation;
(3) Detailed plans of the water system to be used, including a detailed drawing of all water lines and distance to sewer lines.

D. Existing Subdivisions

The following items must be provided to the Building Official before a construction permit for private on-site sewage disposal system will be approved in an existing subdivision:

(1) A copy of Department of Natural Resources approval of the subdivision to use on-site septic systems and design criteria.
(2) A plat of the subdivision showing the following:
    a) all existing homes or structures
    b) all wells in the subdivision and location of water lines
    c) if streets are named, it shall be noted on the plat
(3) If the subdivision has previously been filed with Community Development, then only lot number is required for the permit application.

5. INSTALLER QUALIFICATIONS

A. Any person engaging in the installation, construction, or maintenance of any private on-site sewage disposal system shall be registered by the *Missouri Department of Health and Senior Services.*

B. The term of registration is for three (3) years.

C. Any registered installer failing to comply with any and all regulations, rules, orders, and decisions of the Building Official to the type of systems installed, constructed, or maintained shall be subject to termination of occupational license per Chapter 605.040 (B) of the City of Raymore Municipal Code. The installer has the right to an appeal per Section 1 (B) in this code.

D. Installers found installing any system without the required permit shall be subject to Chapter 605.040 (B) of the Raymore Municipal Code.

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

F. Separate training and examination is required for certification to install alternative systems.

G. Any homeowner of his or her own property may install a private on-site sewage disposal system on the same property provided the property owner can demonstrate a thorough knowledge of the code for these systems. The use of registered installers is highly recommended.

6. REVIEW AND INSPECTION PROCEDURES

A. Plan Review

(1) New Systems:

Submit Permit Application with plans, Site Review, and the appropriate Fees to the Building Inspections Department. The Building Official within five (5) working days will review the information submitted for compliance, if approved, then issue a construction permit.

No excavation for construction of a private on-site sewage disposal may be started until a permit has been granted by the Building Official. Any construction before a permit is granted shall be subject to the penalties in Section 1 (5) C

and/ or section 500.140 of the City of Raymore Municipal Code.

(2) Repair of an existing system:

Submit a Permit Application with site sketch showing existing system and modifications and appropriate fee to the Building Official for review. A construction permit will be issued upon approval. If a variance is required submit the approval letter by the Zoning Board of Adjustments.

B. Construction Inspections

All private on-site sewage disposal systems shall be inspected by the Building Inspections Department before covering up the system. The request for an inspection shall be made with **at least 24 hour notice**.

The inspector will note any deficiencies for correction(s), and a re-inspection shall be required before covering up the system.

Section 2

REGULATIONS

1. DEFINITIONS

For the purposes of these standards, the following words and terms shall have the following meaning:

Absorption System: The final treatment and disposal of the septic tank effluent. The absorption system includes the distribution box, the perforated pipe and gravel or other gravelless distribution pipe, the filter materials and the trenches.
Aeration Unit: Any sewage tank which utilizes the principle of oxidation in the decomposition of sewage by the introduction of air into the sewage.
Alternative System: A means by which septic tank effluent is disposed of other than the conventional absorption system. Examples of alternative systems are wet lands, intermittent sand filters, and low pressure pipe.
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.
Bedrock: That layer of parent material which is consolidated and unweathered.
Bedroom: An enclosed space with a closet within a dwelling unit.
Black Water: Liquid waste from a dwelling unit or other establishment produced by toilet waste, or culinary operations and specifically excluding laundry facility discharge.
BOD: (Biochemical Oxygen Demand) The quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days twenty degrees centigrade (20°C). expressed in milligrams per liter.
Building Drain: That part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five (5) feet (1.5 meters) outside the inner face of the building wall.
Building Official: The officer or other designated authority charged with the administration and enforcement of these standards
Building Sewer: The extension from the building drain to its discharge of an individual sewage treatment system.
Business: Any building used for any purpose other than as a single family dwelling.

Capacity: The liquid volume of a sewage tank using inside dimensions below the outlet.
Certified Percolation Tester: An individual certified by the State of Missouri to conduct percolation tests.
Classified Stream, lake or impoundment: Any body of water that maintains permanent flow or permanent pools during drought periods and support aquatic life.
Commercial System: An on-site sewage disposal system used for the disposing of wastewater from a commercial establishment or subdivision.
Distribution Pipes: Perforated pipes or agricultural drain tiles that used to distribute sewage tank effluent in soil treatment systems.
Distribution Box: A water-tight box that receives the discharge or effluent from the septic tank and equalizes the flow of sewage to each individual line of the absorptions system. All gravity fed outlets are required to have flow equalization devices.
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.
Dosing device: A pump, siphon or other device that discharges sewage tank effluent from the dosing chamber to the soil treatment system.
Dwelling: Any building or place used or intended to be used by human occupants as a single family or two (2) family unit.
Geologist: A person that meets the requirements of chapter 256 of the Missouri Statutes.
Gravelless system: An absorption system comprised of large diameter, eight (8) inch and ten (10)-inch corrugated plastic pipe, perforated with holes on a one hundred twenty degree (120) arc centered on the bottom, wrapped in a sheath of spun bonded nylon filter wrap and installed level in a trench without gravel bedding.
Gray water*:* Liquid waste from a dwelling or other establishment produced by bathing, laundry, culinary operations, from floor drains and specifically excluding toilet waste.
Grease interceptor or grease trap: A device to catch or trap grease that is in suspension or solution in liquid waste and to retain the grease solids separated in the trap receptacle.
Holding tank: A watertight tank for storage of sewage until it can be transported to a point of approved treatment and disposal.
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.
Individual sewage treatment system: A sewage treatment system, or part of a system, serving dwellings(s) or other establishment(s), which utilizes subsurface soil treatment and disposal.

Intermittent sand filters: Intermittent and 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) shall be discharged to a soil absorption system.
Mottling: A zone of chemical oxidation and reduction activity appearing as splotchy patches of red, brown, orange and gray in the soil.
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.
Other establishment: Any public or private structure other than a dwelling which generates sewage.
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.
Professional engineer: An engineer holding a current license to practice from the Missouri Board for Architects, Professional Engineer and Land Surveyors, having a background in soils, wastewater, and geology.
Rock fragments: The percentage of rack 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.
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. Also known as Environmental Public Health Specialist or Public Health Specialist.
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.
Setback: A separation distance measured horizontally.
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.
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 by 19 CSR 20-3.060 Small Sewage Works Design Guide.

Sewage tank: A watertight tank used in the treatment of sewage which includes, but is not limited to, septic tanks and aeration units.
Sewage tank effluent: That liquid which flows from a septic or aeration unit under normal operation.
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 period of detention and allow the clarified liquids to discharge to a soil treatment system.
Single dwelling wastewater stabilization pond: A sealed earthen basin which uses the natural unaided biological processes to stabilize wastewater and used on large lots.
Sinkhole: 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 depression may be gradual or abrupt; they may or may not have a well defined eye. While most sinkholes can be defined as the area with 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 the groundwater.
Site: The area bounded by the dimensions required for the proper location of the soil treatment system.
Slope: The ratio of vertical rise or fall to horizontal distance.
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 (120) minutes per inch. Also the amount of rock fragments in areas of significant potential for groundwater contamination.
Soil Morphology: The method of testing absorption qualities of the soil by physical examination of the soils' color, mottling, texture, structure, topography and hill slope position.
Soil scientist: A person who is qualified by the Missouri Department of Health as a soil scientist.
Soil textural classification: Soil particle sizes or textures specified in this rule refer to the soil textural classification in the Soil Survey Manual Handbook No. 18, U.S. Department of Agriculture, 1951.
Soil treatment area: That area of trench or bed bottom which is in direct contact with the trench rock of the soil treatment system.
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, drain field, disposal field and includes mound and low pressure pipe systems.

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, drain field or leach field.

Trench rock: Clean rock, washed creek gravel or similar insoluble, durable and decay-resistant material free from dust, sand, silt or clay. The size shall range from one and one half inches to three inch rock (1 ½" to 3").

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

Value 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.

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

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

2. MINIMUM SET BACK REQUIREMENTS

No private on-site sewage disposal system, or part thereof, shall be located in any lot other than the lot that is the site of the building or structure served by such private on-site sewage disposal system, nor shall any private on-site sewage or part there of be located at any point having less than the minimum distances indicated in Table 1.

TABLE I

Minimum Distance in Feet From	Sewage Tanks (1)	Disposal Area (2)	Lagoons
Private water supply well	50	100	100
Classified stream, lake or impoundment	50	50	50
Stream or open ditch	50	50	50
Property lines	10	10	100
Building foundation	5	15	50
Basement	15	25	100
Water line under pressure	10	10	10
Suction water line	50	100	100
Upslope interceptor drains	-	10	10
Downslope interceptor drains	-	25	25
Top of slope of embankments or cuts of 2 feet or more vertical height	-	20	20
Other soil absorption system except repair area	-	20	20
Swimming pools	15	15	15
Springs and caves	50	100	100
Sinkhole rim (3)	50	100	500
Trees	10	10	50

Footnotes:

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

(2) Includes subsurface absorption systems. Does not include waste water stabilization ponds.

(3) Set back 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 conforms to City of Raymore zoning regulations the following 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 exceeding the annual probability of 1% (100-year storm and a duration of 24 hours). 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 morphology 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. An alternative system may be required depending upon soil conditions.

e. The Building Official may require that absorption trenches be sand lined.

3. SEWAGE FLOW RATES

A. Single family dwellings (including manufactured homes)

In determining the volume of sewage from single family dwellings, the minimum flow rate shall be one hundred fifty (150) gallons per day per bedroom. The minimum volume of sewage from each single family dwelling shall be three hundred (300) gallons per day and each additional bedroom above two (2) bedrooms shall increase the volume of sewage by one hundred fifty (150) 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 seventy-five (75) gallons per person per day.

The maximum wastewater flow for on-site wastewater systems serving single family dwellings is 1500 gallons per day.

B. Other residential dwellings.

(1) Duplexes: 150 gallons per day per bedroom, minimum 300 gallons per day per unit, maximum 3000 gallons per day for two units.

(2) Apartments and condominiums: 150 gallons per day per bedroom, minimum 300 gallons per day per unit, maximum 3000 gallons per day per building.

C. Other establishments.

For establishments or housing developments other than a single-family residence 19 CSR 20-3.060-subsection 2 (E) shall be used to estimate the sewage flow rate. Values for estimated sewage flow derived from 19 CSR 20-3.060 for establishments having food service operations shall be increased by a factor of one and one-half (1.5) to compensate for the high organic strength. A portion of 19 CSR 20-3.060 2 (E) is shown in Table II for convenience.

TABLE II

Type of Establishment	Pounds BOD per person (unless otherwise noted)	Gallons* per day per person
Employee Sanitary Waste *(Generally means eight (8)-hour shift employees at institutions, commercial establishments, factories and similar establishments. Total employee waste figure, if applicable, must be added to the appropriate patron or residential total from the following table)*	**.05**	**15**
Residential (See previous page)		
Food or Drink Establishments (Wastes per patron) (1)		
Tavern or bar (not serving food)	**.01**	**2**
Fast-food (paper service)	**.02**	**3**
Cafe or restaurant	**.03**	**5**
Restaurant serving alcoholic beverages	**.04**	**5**
Restaurant grinding garbage	**.07**	**6**
Schools (Waste per student)		
Day school, no cafeteria, gym or showers	**.02**	**10**
with cafeteria – ADD	**.02**	**5**
With garbage grinding - ADD	**.02**	**2**
With gym and showers - ADD	**.01**	**10**
Boarding schools	**.17**	**75**
Institutions		
Hospitals (per bed)	**.22**	**300**
Institutions other than hospitals	**.17**	**120**
Nursing homes	**.17**	**120**
Residential Care Facilities	**.17**	**60**
Commercial and Recreational		
Public parks (toilets only) (2)	**.02**	**5**
Public parks with bath house, showers, toilets (2)	**.06**	**25**
Swimming Pools and Beaches	**.06**	**10**
Country clubs (per resident member)	**.17**	**75**
Country clubs (per member present)	**.06**	**25**
Service stations (waste per customer) (1)	**.01**	**5**
Laundromats (per machine)	**1.25**	**580**
Hotels	**.15**	**50**
Motels (without restaurants)	**.10**	**40**
Luxury resorts	**.17**	**75**
Camper trailer	**.08**	**30**
Work or construction camps	**.15**	**60**
Churches (per seat)	**.01**	**5**
Stores, malls or shopping centers (per one thousand (1000) square feet of floor area)	**.34**	**200**

Office buildings (per employee) (3)	.05	15
Drive-in theaters (2)	.01	5
Stadiums, auditoriums, theaters or drive-ins (per seat)	.01	5

NOTES:

(1) Number of customers or patrons assumed in determining the daily wastewater flow will be subject to verification by the Building Official 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 foot of gross floor area.

(4) Maximum wastewater flow is limited to 1500 gallons per day unless otherwise approved by the Building Official.

(5) Gallons per person per day includes normal infiltration for residential systems.

(6) Population to be served. Unless satisfactory justification can be given for using lower per-unit occupancies, the following numbers shall be used in determining the population for which to design the sewage works:

Type of Unit	**Persons/Unit**
Residences	3.7
Apartments or Condominiums	
(1 bedroom)	2.0
(2 bedroom)	3.0
(3 bedroom)	3.7
Mobile Homes (based on bedrooms)	3.0-3.7
Camper trailer without sewer hookup	2.5
Camper trailer with sewer hookup	3.0
Hotel / Motels	3.0

D. Reduction in sewage flow.

Reductions in design sewage flow rates may be allowed by the Building Official, provided it can be shown for just cause for the reduction on a case-by-case basis and depending upon water conservation plans.

E. 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. Septic tank size for black water will be as required as in part 7. Minimum size for gray water tank shall be 1000 gallons.

4. SITE EVALUATION

A. The Site Evaluation is to be performed by a registered soil scientist in accordance with 19 CSR 20-3.060 subsection 2(A)-(D) or a certified percolation tester to determine the best location for the on-site system and the type and amount of lateral field to be used.

B. Procedures for Percolation Tests and Profile Holes. Two (2) types of site evaluations are acceptable. Each type depends upon the technical expertise of the individual conducting the evaluations. This would apply to all systems except for lagoons or other systems that do not use the soil for treatment. When percolation tests are slower that one hundred and twenty minutes per inch (120min. /in.), on-site sewage disposal systems shall not be permitted, except for lagoons or other systems designed accordance with sections 8 of this rule. The Building Official will determine which method(s) is to be used. The types of site evaluations are described as follows:

1. Percolation tests only. This type of site evaluation is where site suitability and sizing of the soil absorption system is made by percolation tests and there is no other evaluation of soil characteristics. This type of site evaluation can be used only for the proposed site and to size standard systems in areas which are not classified as having significant groundwater contamination potential. When using this type of evaluation, only percolation rates between ten minutes and sixty minutes per inch (10-60 min/in.) will be acceptable. Percolation tests shall be conducted by an engineer, sanitarian, registered geologist, soil scientist or a person who has been trained and certified by the Department of Health & Senior Services in accordance with section 701.040(2), RSMo. These tests shall be performed in accordance with the following procedure:

   A. A minimum of four (4) percolation test holes are required with three (3) of the holes around the periphery within the proposed soil absorption site;

B. Each test hole shall be six to eight inches (6-8”) in diameter, have vertical side walls and be bored or dug to a depth of the bottom of the proposed soil absorption system;

C. 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”) washed gravel shall be added to protect the bottom from scouring;

D. 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 twenty-four (24) hours. In sandy soils, the saturation and swelling procedure shall not be required and the test may proceed if on (1) filling of the hole has seeped away in less than ten (10) minutes;

E. In sandy soils, the water depth shall be adjusted to eight inches (8”) over the soil bottom of the test hole. From a fixed reference point, the drop in water level shall be measured in inches to the nearest one-eighth inch (1/8”) at approximately ten (10) minute intervals. A measurement can also be made by determining the time it takes for the water level to drop one inch (1”) from an eight-inch (8) reference point. If eight inches (8”) of water seeps away in less than ten (10) minutes, a shorter interval between measurements shall be used but in no case shall the water depth exceed eight inches (8”). The test shall continue until three (3) consecutive percolation rate measurements vary by a range of no more than ten percent (10%);

F. In other soils, the water depth shall be adjusted to eight inches (8”) over the soil at the bottom of the test hole. From a fixed reference point, the drop in water level shall be measured in inches to the nearest one-eighth inch (1/8”) at approximately thirty (30) minute intervals, refilling between measurements to maintain an eight- inch (8”) starting head. The test shall continue until three (3) consecutive percolation rate measurements vary by a range of no more than ten percent (10%). The percolation rate can also be made by observing the time it takes the water level to drop one inch (1”) from an eight-inch (8”) reference point if a constant water depth of at least eight inches (8”) has been maintained for at least four (4) hours prior to the measurement;

G. Percolation rate shall be calculated as follows:

(I) The time interval shall be divided by the drop in water level to obtain the percolation rate in minutes per inch;

(II) The slowest percolation rate of the four- (4) tests shall be used to determine the final soil treatment system design. Where the slowest percolation rate varies by more than twenty minutes per inch (20 min/in) from the other tests, a detailed soils morphology evaluation must be conducted to justify a design based upon the average percolation rate; and

(III) For reporting the percolation rate, worksheets showing all calculations and measurements shall be submitted; and

H. Depth to bedrock or other restrictive layer shall be determined in areas where it is known that bedrock may exist at depths less than ten feet (10').

C. Procedures for Soil Morphology

1. General. The intent of this section is to provide minimum standards for site evaluations based upon evaluation of the soil characteristics, namely texture, color, structure, drainage and depth. Criteria are also given for sizing standard systems and some alternative systems.
2. Nothing in this rule or section shall require any administrative authority to allow an installation based upon the criteria contained in this section. The Building Official may require percolation tests in addition to evaluation of soil characteristics. Whenever percolation tests and these criteria are used, the size of the proposed system or suitability of a site should be based upon which criteria produce the most conservative system. This type evaluation should be conducted by a professional soil scientist, engineer, sanitarian or registered geologist with special training in determining soil morphological characteristics in the field.
3. Site Evaluation. An investigation of a proposed soil absorption site shall consider the following factors:
    a) Topography and landscape position.
    b) Soil characteristics (morphology) which include texture, structure, porosity, consistence, color and other physical, mineral and biological properties of various horizons, and the thickness and arrangement of the horizons in the soil profile;

c) Soil drainage, which includes both external (surface) and internal (soil);
d) Soil depth;
e) Restrictive horizons; and
f) Available space.

4. Soil Characteristics (Morphology). Soil borings or pits shall be taken at the site to be used for soil absorption systems. These borings shall be taken to a depth of forty-eight inches (48") or as required to determine the soil characteristics. Soil borings or pits and core samples shall be evaluated and a determination made on the suitability of the soil to treat and absorb septic tank effluent. The important soil characteristics, which shall be reviewed by the Building Official, are as follows:

A. 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, two to five hundredths millimeters (2 - .05 mm) in size; silt, which includes intermediate-sized particles that cannot be seen with the naked eye but feel like four when pressed between the fingers, five hundredths to two thousands millimeter (0.005 –0.002 mm) in size; or clay, which is extremely small in size and is the mineral particle that gives cohesion to a soil, less than two thousandths millimeters (0.002 mm) in size or a combination of these. 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 Table V of this standard.

1. 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 low filtering capacity leading to malfunction due to contamination of ground water. The sandy group includes the sand 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 from a ribbon or ball when wet or moist.

(II) Loamy san. Loamy sand has a gritty feel, stains the fingers (silt and clay), forms a weak ball and cannot be handled without breaking.

2. Soil Group II. Course loamy texture soils contain more than thirty percent (30%) sand-sized particles and fewer 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 are 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.

3. Soil Group III. These fine loamy texture soils contain fewer 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 characteristic and 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 texture.

(I) Silt loam. Silty 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 hundredths 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 non-distinct fingerprint.

4. Soil Group IV. These clay 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 most, are friable to firm; and when dry, they are slightly hard to hard. The non-expandable clays (Group IV a) shall generally be considered provisionally suitable in texture. The expandable clays, when wet are very sticky and very plastic and when moist, these clays are very firm to extremely firm and when dry, are very hard to extremely hard. The expandable clays (Group IV b) 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 inches (2”) in length.

   (II) Silty clay. Silty clay is both plastic and sticky when moist and lacks any gritty feeling. Silty clay forms and 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.

5. Soil Group V. This soil 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 will be considered provisionally suitable is geological limitations are not severe.

Recommendations may be made as follows:

Type A - is a parcel of land which is determined by the site evaluation to be unsuitable for conventional type systems, or the required distances from wells cannot be met, greater than 45% slope or as determined by the Building Official. **Type A Systems** - include intermittent and recirculation sand filters, aeration and chlorination, drip irrigation, wetland.

Type B - is a parcel of land which is provisionally suitable or can be made provisionally suitable for on-site systems as determined by the site evaluation.
Type B Systems - include sand lined trenches, shallow placement and LPP or dosing systems.
Type C - is a parcel of land which is suitable for conventional on-site systems as determined by a site evaluation.
Type C Systems - include conventional systems using 4" perforated pipe and gravel, gravelless pipe, or chamber system.

E. A site evaluation may be required on a repair as determined by the Building Official.

5. BUILDING SEWERS

A. 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. Suitable materials meeting ASTM standards are: schedule 40 PVC or ABS, 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 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, or equivalent and shall extend a minimum of two feet (2') beyond the hole of excavation for the sewage tank.
(5) Building sewers shall not be located in a common trench with or located closer than ten (10) feet horizontally or two (2) feet vertically
to waterlines with the water line located above the sewer line.
(6) Building sewers shall have a minimum of 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 4" of cleaned crushed rock bedding (nominal size not less than ½" or greater than 1") on all sides of the pipe.

6. SEWAGE TANKS

A. General.

(1) All liquid waste and washwater shall discharge into the sewage tank. Roof, garage, footing, surface water, drainage and cooling 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, or materials otherwise approved by the Building Official and meet criteria as set forth in 19 CSR 20-3.060.
(2) Blasting for the tank will be allowed if not in violation of any subdivision regulation and will not cause damage to existing property including homes, roads, or water lines.
(3) No metal tanks will be considered.
(4) Inspection ports shall be raised to grade.

B. Location.

Location of the sewage tank shall consider the following:

(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 three(3) inches of gravel in firm and settled soil or rock sub-grade capable of bearing the weight of the tank and its contents;
(3) The sewage tanks shall be set back as specified in Table I.
(4) 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 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 than 2-1/2 horizontal to 1 vertical, or enclosed in a retaining wall, and insulated as required to provide the same r-value as 3 feet of earth cover.

C. Lift Station

(1) Sizing requirements for lift stations shall be based upon two full day storage of residence plus dosing requirements

(2) Site plan shall specify pump type, horsepower required, total system head (dynamic and static) and flow rate.
(3) All pump inlets shall be set eight to twelve inches above bottom of lift station
(4) Electrical Wiring Requirements
a. Electrical box shall be on outside of pump tank with an electrical disconnect
(5) Plugs with electrical tape will not be approved
(6) Wiring shall be a minimum of 12-2 UF or manufactures recommendations, which ever is greater on all lift stations
(7) Wiring longer than two hundred fifty feet (250) shall be a minimum of 10-2 UF or manufactures recommendation whichever is greater
(8) Wiring on all alarms shall be a minimum of 14-2 UF or manufactures recommendation whichever is greater
(9) All discharge lines shall have a 1/8" weep hole drilled to prevent siphoning and air lock in discharge line.
(10) The Building Official shall require pump test for final approval.

D. Solids Removal.

It is recommended that the owner of any septic tank or his/her agent shall regularly inspect and arrange for the removal and sanitary disposal of sludge 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.

E. Liquid capacity.

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	**1200**
4	**1500**
5	**2000**

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 = 0.75Q + 1125; where,
V is the liquid capacity of the septic tank; and
Q is the design daily sewage flow.

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 type treatment systems shall comply with the general requirements for sewage tanks set forth in subsection (4) (E) of 19 CSR 20-3.060 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 use will adversely effect performance;
b) Where dependable maintenance service is not available;
c) Where electrical service is unreliable.

(2) General. The aeration unit shall be located where it is readily accessible for inspection and maintenance. Setback distances for aeration units shall be in accordance with Table I.

(3) Design. All aeration units shall comply with National Sanitation Foundation Standard No. 40 or as required by the Department. In addition, all aeration unit treatment plants shall comply with the requirements of 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 9 Alternative Systems of these standards. *NO reduction 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.

a) All aerobic treatment units, pump tanks, or any other serviceable equipment identified by the regulatory authority shall have a service contract maintained in accordance with the manufacturers specifications.

b) Any individual or company providing service in accordance with paragraph (1) shall be certified with the manufacturer of the equipment, or one of it's certified agents, when such certification is offered.

c) All individual or company providing service in accordance with paragraph (1) shall be registered with the regulatory authority.

d) All aerobic treatment units shall have a total suspended solids test performed annually. This test must be performed in the mixed liquor compartment (in accordance to manufacture specification) with sample taken immediately after the method of agitation has stopped. The sample must be allowed to settle undisturbed for thirty (30) minutes. If the solids (sludge) exceed seventy-five (75%) percent, the results must be reported to the regulatory authority and a licensed wastewater pump service must pump the tank.

7. 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 trenches shall be constructed in accordance with section (5) of 19 CSR 20-3.060.

(2) Absorption trenches shall not be constructed in non-compacted fill or ground which has become severely compacted due to construction equipment.

(3) Absorption trenches shall not be constructed in soils which are wet.

(4) The minimum area in any absorption trench system shall be based on daily wastewater flow and loading rate. The minimum size system shall be four hundred (400) square feet.

Table IV

Absorption Area as a Function of Loading Rate and Percolation Rate

3 BEDROOM						4 BEDROOM		5 BEDROOM	
Loading Rate	Absorption Area, ft^2	Percolation Rate	Loading Rate	Absorption Area, ft^2	Percolation rate	Loading Rate	Absorption Area, ft^2	Percolation rate
0.3	*1500	46-60	0.3	*2000	46-60	0.3	*2500	46-60
0.4	*1125	31-45	0.4	*1500	31-45	0.4	*1875	31-45
0.5	*900	21-30	0.5	*1200	21-30	0.5	*1500	21-30
0.6	*750	11-20	0.6	*1000	11-20	0.6	*1250	11-20
0.8	*563	≤10**	0.8	*750	≤10**	0.8	*938	≤10**

* Divide Sq. Ft. by trench width for linear feet. Maximum trench width 3 ft., minimum 1.5 ft.

** Soils with percolation rates of one to ten minutes per inch (1-10 min./in.) or less shall either be evaluated for severe geological limitations by a registered geologist or a soil morphology examination shall be required.

(5) Blasting of the rock in the area of the lateral lines is not allowed. Each absorption trench system shall have a minimum of two (2) trenches with no one- (1) trench longer than one hundred feet (100'). The absorption trenches shall be separated with a minimum spacing of ten feet of undisturbed earth between trenches.

(6) Absorption trenches shall be at least eighteen inches (18") wide and no more than thirty-six inches (36") wide. Thirty-six inch (36") wide trenches should not be utilized in soils with percolation rates slower than forty-five (45) minutes per inch. The bottom of standard absorption trenches shall be at least eighteen inches (18") and not more than thirty inches (30") below the finished grade except as approved by the Building Official.

(7) The pipe used between the sewage tank and the absorption system shall be a minimum of four-inch (4") inside diameter equivalent to the pipe used for the building sewer as set forth in section (6) 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.

(8) Gravity-fed absorption field distribution lines should be at least four inches (4”) in diameter. If perforated distribution lines are used, the perforation shall be at least one-half inch (1/2”) and no more than three-fourths inch (3/4”) in diameter.

a) All pipe used for distribution lines shall meet ASTM standard D2729 or those of an equivalent testing laboratory. ASTM 2729 is a minimum of 2500 lb. crushproof. Fittings used in the absorption field shall be compatible with the materials used in the distribution lines.
b) When four (4) or six (6)-inch diameter corrugated plastic tubing is used for distribution lines, it shall be certified as complying with applicable ASTM standards. The corrugated tubing shall have three (3) rows of holes, each hole between one-half inch (1/2”) 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) degree centers. **Coiled tubing shall not be used.**

(9) 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 shall be connected.

(10) Rock used in soil absorption systems shall be clean, washed gravel or crushed stone and graded or sized between one and one half to three inches (1 ½”-3”). 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) Unfaced, rolled, three and one-half inch (3 ½”) thick fiberglass insulation;
b) Untreated building paper;
c) Synthetic drainage fabric;
d) A minimum of eight (8”) of straw for a compacted thickness of two inches (2”);
e) Other material approved by the Building Official may belaid as to separate the gravel from the backfill.

(11) 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 soils are 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. Larger usable areas than the minimum are ordinarily required in this slope range. Slopes greater than thirty percent (30%) shall not be utilized for installation of absorption trenches unless the following requirements can be met and approval is obtained from the Building Official:

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

b) The soil is permeable and no restrictive layers or water tables occur at a depth within two (2') of the trench bottom;

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

d) If necessary, groundwater flow from heavy rainfall is intercepted and diverted to prevent that water from running into or saturating the soil absorption system; and

e) There is sufficient ground area available to install the absorption trench system with these modifications.

(12) Effluent distribution devices, including distribution boxes, flow dividers and flow diversion devices, shall be of sound construction, watertight, not subject to excessive corrosion and of adequate design as approved by the Building Official. 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.

a) Each distribution line shall connect individually to 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 four (4) distribution lines should be connected to a distribution box receiving gravity flow unless the ground surface elevation of the lowest trench is below the flow line elevation of the distribution box.

d) All distribution box devices shall be modified with a flow equalization device as approved by the health authority.

e) All distribution boxes should be marked or raised to grade.

(13) Step-downs 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 step-down or drop box type system, the absorption field shall be divided into two feet (2') of distribution line. The inlet to a trench should be placed either in the center or as far as practical from the outlet (overflow) from the same trench. Drop boxes shall be constructed so that the inlet supply pipe is one inch (1") above the invert of the outlet supply which is connected to the next lower drop box. The top of the trench outlet laterals, which allow effluent to move to the distribution lines, shall be two inches (2") below the invert of the outlet supply line. 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.

(14) Dosing is recommended for all systems except serial distribution systems and shall be provided when the design sewage flow requires more than five hundred (500) lineal feet of distribution line. 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 value 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').

(15) For all serial distribution systems where design sewage flow requires more than five hundred (500) lineal feet of distribution line, the absorption field shall be divided into two (2) equal portions and each half dosed alternatively by means of flow diverted devices.

(16) Gravelless subsurface absorption systems 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 is required from the Department prior to installation and all manufacturing specifications and installation procedures shall be closely adhered to.

a) The eight (8), ten (10) (inner diameter) corrugated polyethylene tubing used in gravelless systems shall meet the requirements of ASTM F667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing. The eight-inch (8") pipe may be considered equal to an eighteen inches (18") wide standard absorption trench. The ten-inch (10") pipe may be considered equal to a twenty five-inch (25") wide absorption trench. Two 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. 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. 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 drainpipe should be from zero to one-half inch (0-0.5") per one hundred feet (100').

b) The Building Official may permit the use of chamber leach systems on sites where the minimum soil-loading rate is 0.3-gpd/sq. ft. The other requirements of these standards relative to depth to restrictive horizons, maximum depth of trenches, etc. shall also be met and installed according to manufacture specifications. There is an allowance for a reduction in square footage if indicated by the soil morphology results. Chambers must have a minimum of twelve inches (12") cover.

(17) Bed systems may be used on sites where the minimum soil-loading rate is 0.4 and essentially meets the other requirements of this section, and only on lots which are limited by topography, space or other site planning considerations. In these cases 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 field.

B. Modifications to Standard Absorption Systems

Modifications to standard absorption systems which may be utilized to overcome selected soil and site limitations and shall include the following:

(1) Shallow placement of absorption trenches 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 areas of thin soils and potential for groundwater contamination the vertical separation between the trench bottom and bedrock shall be four feet (4') or more. 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 five feet (5') 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 should be of sandy texture with a maximum clay content of fifteen (15%). The fill material should 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) Alternating dual field absorption systems 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 installed so that it may be operated from the ground surface.

(3)Sand-lined trenches may be used in areas where the soil has greater than fifty percent (50%) rock fragments and there is a potential for groundwater contamination due to bedrock conditions. For a maximum loading rate of forty-five hundredths gallons (0.45 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 requirements for intermittent sand filters. 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 ¼” 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. **Crushed limestone is not acceptable**. For high 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. The side slopes should be two to one (2:1) and in no case steeper than one to one (1:1). 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 inches (18") 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.

c) Sand-lined trenches may be used with the approval of the Department where the percentage of rock fragments is less than seventy percent (70%) for at least four feet (4') below the trench bottom. For sand-lined trenches to function properly, the permeability of the natural material should be similar to the permeability of the liner material. Sand-lined trenches must not be used over fragipans or other restrictive layers which have perched water tables and could cause saturation of the liner material.

(4) 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 8 (A) and 8 (B) of these standards. Coiled piping may be used for interceptor drains. The pipe shall be bedded in rock meeting the specifications set forth in Section 8 (A) 10 of these standards. There shall be a minimum of four inches (4") of gravel below the pipe, and two inches (2") of gravel above the pipe.

The gravel shall be covered with a barrier material as set forth in Section 8-(A) (10) of these standards 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 a maximum width of twenty-four inches (24”). 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.

(5) Vertical drains are not allowed unless there are no 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 City of Raymore regulations.

(6) 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 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 three (3) horizontal to one (1) vertical.

(7) Chlorinators to disinfect the effluent from the septic tank may be required by the Building Official in cases where threat of groundwater contamination is high and there is no reasonably available alternative site for the absorption field. 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.

8. 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 this code.

B. ***Drip Soil Absorption*****.** Drip soil absorption also known as trickle irrigation may be approved by the administrative authority in accordance with section (6) of this rule. Due to the various pretreatment methods and appurtenances and lack of extensive experience, drip soil

absorption systems must be viewed as experimental, and back-up design for another system shall be approved in case of failure of the drip soil absorption system.

1. Drip lines shall be placed two feet (2') apart in a parallel arrangement. Emitters shall be placed in the drip lines every two feet (2') so there will be a two-foot by two-foot (2'X2') grid pattern. Other configurations and spacings of the drip line and emitters may be used; however, each emitter will be considered to cover four square feet (4-sq. ft.) of absorption area.

2. The application rate shall not exceed the values as shown in Table 7.

3. Drip soil absorption systems may be allowed at sites where the soil is classified as being in group IV b. A minimum separation distance of twelve inches (12") shall be maintained between the driplines and emitters and a high ground water table or other limiting condition. The maximum application rate for IV b soils shall be from five hundredths to one-tenth gallons per day per square foot (0.05-. 10gpd/sq.ft.) of absorption field.

Table V **Loading Rates**

Percolation Rate	Loading Rates Absorption Area	Loading Rate*
(min. in.)	(sq. ft./bedroom)	(gal. /sq. ft.)
≤ 10 **	200	0.6
11-30	300	0.4
31-45	400	0.3
46-60	600	0.2

*Gallons of sewage tank effluent per day per square foot of total area.
** In areas where there are sever geological limitations and the soils consist of very gravelly soils of thirty-five or greater percent (>35%) gravels by volume, the loading rate of two-tenths gallons per day per square foot (0.2 gpd/sq. ft.) should be used even when the percolation rate would indicate a higher loading.

C. *Wastewater Stabilization Ponds.* A waste stabilization pond can provide satisfactory sewage treatment in large acreage 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. **Lagoon construction will not be allowed on lots less than five (5) acres in size** except under certain circumstances with an approved variance from the Zoning Board of Adjustments and plans sealed by a licensed engineer.

Waste stabilization ponds will be constructed according to Department of Health & Senior Services 19 CSR 20-3.060 Chapter 3 Section 6 (D).

1. The Building Official may require a properly sized and constructed Class 1 NSF Standard 40 listed aerobic treatment unit to precede any lagoon.

2. All lagoons shall be designed to operate at a minimum depth of four (4) feet.

3. Lagoons will not be allowed in front yards.

4. Lagoon design criteria shall be designed as shown in Table VI.

Table VI

Lagoon Sizing Requirements								
3 BEDROOM			4 BEDROOM			5 BEDROOM		
Surface Area Requirement ft^2	Square Pond Dimension, ft x ft	Round Pond Dimension, dia. (ft)	Surface Area Requirement ft^2	Square Pond Dimension, ft x ft	Round Pond Dimension, dia. (ft)	Surface Area Requirement ft^2	Square Pond Dimension, ft x ft	Round Pond Dimension, dia. (ft)
2500	50 x 50	56	3250	57 x 57	64	3970	63 x 63	71

5. The following minimum separation distances may be modified as necessary to accommodate site requirements:

   A. The pond shall be located a minimum of one hundred feet (100') 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, watercourse, lake or impoundment.

6. Ponds may be utilized when there are no significant limitations related to groundwater from their use and the soils have been demonstrated to be very slowly permeable such as percolation rates slower than one hundred twenty minutes per inch (120 min./in.). There shall be either a minimum separation distance between the pond bottom and creviced bedrock of three feet (3') or installation of a clay liner with a minimum thickness of one foot (1') or a synthetic liner, either of which must be acceptable to the administrative authority. 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 these soil requirements. In areas of severe geological limitations, restrictive layers such as fragipans shall be a minimum of twelve inches (12") thick and shall not be breached during construction.

7. Steeply sloping areas should be avoided.

8. 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.

9. The administrative authority may require that a properly sized and constructed septic tank or aeration unit 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 should precede the pond. The use as a basis for reduction of the setback distances as set forth in subparagraphs (6) (D) 1.A - D or this standard.

10. A single cell is generally acceptable for single residence pond systems. If multiple cells are used for further polishing or storing of the effluent, the secondary cell should be one-half (1/2) the size of the primary cell.

11. The minimum embankment top width shall be four feet (4'). The embankment sloped 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") and preferably twenty-four inches (24"). Additional freeboard may be provided.

12. To minimize erosion and facilitate weed control, embankments shall be seeded with a locally hardy grass from the outside tow to one-foot (1') above the water line.

Alfalfa or similar long –rooted crops, which might interfere with the structure of the embankment, shall not be used. Rip rap may be necessary under unusual conditions to provide protection of embankments from erosion.

13. The influent line shall be of a sound durable material or watertight construction of the line shall have a minimum diameter of four inches (4”) and be laid on a firm foundation at a minimum grade of one-eighth inch (1/8”) per foot from the point of entry into the pond. 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 shall either be laid to the inner toe of the embankment and then on the bottom of the pond to the terminus point or the line shall be supported and secured every five feet (5’). 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.

14. The pond shall be shaped so there are no narrow or elongated portions. Round, square or rectangular cells are considered most desirable. Rectangular cells shall have a length no 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.

15. 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 solid must be adequately compacted by the construction equipment.

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

17. 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.

18. The pond area shall be enclosed with a fence conforming to the following conditions:

    A. The fence shall be at least four feet (4’) in height.

B. The fence shall be welded, woven or chain link material with no smaller than fourteen gauge (14ga) wire. Cattle or hog panels can be substituted with a tee post being used for a line post.

C. Fence posts shall be pressure-treated wood, galvanized and/or painted steel. Fence posts shall be driven, tamped or set in concrete. Line posts should be at least eighteen inches (18”) deep and shall be spaced no more than ten feet (10’) apart. Corner posts should be properly braced;

D. The fence shall be of sound construction with no gaps or openings along the bottom;

E. The fence shall be no closer than the center of the berm to the water’s edge at the 4 foot operating level. Fence set-backs should not exceed thirty feet (30’) from the water’s edge;

F. A properly hinged four-foot (4’) high gate or comparable materials shall be installed and provided with an effective latching device. The gate should be thirty-six to forty-eight inches (36-48”) in width to accommodate maintenance and mowing equipment; and

G. The fence must be completed prior to occupancy of the dwelling.

19. 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 Building Official shall approve the method of effluent disposal.

20. 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, sump pump drainage, or any source of rainwater to the wastewater stabilization pond.

21. 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 (2lbs.) per day until the odor dissipates.

D. Low Pressure Pipe. The low pressure pipe system (LPP) is an alternative system that may be constructed in many areas where standard absorption trenches cannot. The LPP overcomes many problems with the site by utilizing uniform distribution of effluent, dosing and resting cycles and shallow placement of the trenches.

E. Holding Tanks. 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) year. Use of a holding tank must be specifically approved by the Building Official.

(1) Sizing: The minimum liquid capacity of a holding tank shall be provided for a single family residence per the following table:

Minimum Holding Tank Capacities

Table VII

No of Bedrooms	*Gallons*
1	2,000
2	2,000
3	2,000
4	2,500
5	3,000
6	3,500
7	4,000
8	4,500

(2) Warning Device: A high water alarm device shall be installed on holding tanks so that it activates one foot below the inlet pipe. This device shall either be an audible or illuminated alarm. If the latter, it shall be conspicuously mounted.

(3) Access: An access riser shall extend up to the finish grade with a properly secured or locked lid. The access riser shall be of sufficient size to permit access to the warning device controls and for pumping of the tank.

(4) Holding Tank Agreement: The property owner agrees to keep records of dates when the holding tank was pumped, who pumped the tank, and the name and address of an approved site where the sewage was disposed.

(5) All other construction standards in 19 CSR 20 – 3.060 apply to holding tanks.

F. ***Sand Filters.*** Septic tanks or aeration units and sand filters may be used along with soil absorption systems in soils with percolation rates between sixty (60) and one hundred twenty (120) minutes per inch. The Building

Official will require that these systems be designed by an engineer and specifically approve these systems.

(1) The septic tanks and aeration units must be in accordance with Section 6 of these standards. Setback distances as shown in Table I and as specified in Section 3 of these standards shall apply except that the minimum distance to the downslope property line should be fifty feet (50');

(2) Sand filters must be designed and constructed in accordance with 19 CSR 20-3.060 (6) (G).

(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 shall be based on the required treatment area for a soil having a loading rate of 0.4 as specified in Section 7 A (4) Table IV of these standards.

G. ***Constructed Wetlands.*** Wetland Disposal Systems shall be approved only by the Director of Public Works in special circumstances.

H. ***Other Systems.*** Where unusual conditions exist, special systems of treatment and disposal, other than those specifically mentioned in this standard, may be employed, provided:

(1) Reasonable assurance of performance of the system is presented to the Building Official;

(2) The engineering design of the system is first approved by the Building Official;

(3) There is no discharge to the ground surface of surface waters;

(4) Adequate substantiating data to indicate that the effluent will not contaminate any drinking water or any surface water;

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

(6) These systems shall comply with all applicable requirements of these standards and with all local codes and ordinances of the City of Raymore and all applicable requirements of Chapter 701 of the Missouri statutes.

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