ENGINEERING BULLETIN NO 12

THE SEPTIC TANK ;
A METHOD OF SEWAGE DISPOSAL FOR PRIVATE OR PUBLIC BUILDINGS

ENVIRONMENTAL HEALTH SERVICES

F O R E W O R D

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There are many advantages in using community sewerage facilities instead of individual systems. One of these is cost. Another is the degree of effectiveness to be expected, especially as individual systems become inoperative when neglected or if not properly located and installed in the first place, resulting in the overflow of waste water on the surface of the ground.

A septic tank system is recommended as a means of sewage disposal for a residence, place of business, camp, school, or institution where public sewers are inaccessible, impracticable or uneconomical, provided soil conditions are such that satisfactory treatment and disposal of the sewage can be accomplished. When properly located, installed and maintained, a septic tank system has certain advantages over other methods of individual sewage disposal in cost, safety, convenience and permanence.

The purpose of this Bulletin is to provide standards for septic tank construction throughout the State and for the information and benefit of private individuals, plumbers, architects, engineers, and others interested in providing adequate and satisfactory individual sewage disposal facilities when connection to a public sewer is not practicable.

The fundamental characteristics of a septic tank system are discussed in order to acquaint interested persons not only with the features of this type of treatment but also with its rigid limitations. The construction and operation of a septic tank system involve certain definite scientific principles which if violated, either through ignorance or neglect, will prevent proper operation of the system. However, when followed with a reasonable degree of understanding, a workable method for the disposal of sewage should result.

The standards set forth in this Bulletin were adopted on August 17, 1962 and met the minimum requirements of both the Federal Housing Administration and U.S. Veterans Administration, and were based on recommendations contained in the U.S. Public Health Service Publication No. 526, "Manual of Septic Tank Practice", 1957.

The County Health Department should be consulted before construction is started as the County Sanitarian is in a position to give advice on this subject, especially with regard to the purposes and interpretation of the percolation tests. In addition, approval of the design and installation by the County Health Department is a requirement.

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PART I - GENERAL CONSIDERATIONS

A. APPROVAL REQUIRED

1. Design and Installation - Each septic tank disposal system shall be designed and installed so as to meet the approval of the local county health department.

2. Septic Tanks Excluded - Septic tanks will not be approved nor shall septic tanks be installed under the following conditions:

   a. Where connection to a public sewerage system is practicable.

   b. Where soil conditions or topography is such that a septic tank system cannot be expected to work satisfactorily.

   c. Where installation of such a system would constitute a potential hazard to a ground water supply.

   d. In a planned community or large subdivision where a considerable number of buildings will be served. In such cases, when connection to an existing system is not practicable, a community sewerage system will be required, along with sewage treatment facilities, satisfactory to the Arizona State Department of Health.

B. SUITABILITY OF SOIL

1. General - Before designing any septic tank system it must first be determined that soil conditions are suitable for absorption of the septic tank effluent. The soil shall have an acceptable percolation rate without interference from ground water or impervious strata below the level of the absorption system.

2. Site Conditions - Unless the conditions noted below are met, the site selected is considered unsuitable for subsurface disposal systems and the construction of residences or other structures requiring waste disposal facilities will be prohibited unless an alternate method of sewage disposal satisfactory to the department of health is provided.

   a. The percolation time shall be within the limits specified in Table I below.

   b. Rock formations or other impervious strata and the maximum elevation of the ground water table shall be at a depth greater than 4 feet below the bottom of each tile trench or seepage pit.

3. Borings - To determine subsurface formations in a given area it may be necessary that subsurface explorations be made, although useful information can sometimes be obtained from road cuts, stream beds and building excavations. The depth to which borings shall be taken is dependent upon the type

of leaching system proposed. For subsurface tile fields, the borings shall be made to a depth of 10 ft. and for seepage pits to a depth of at least 30 ft. Since subsoil strata may vary widely within short distances, additional borings at the site of the proposed system may be necessary at the discretion of the local health department.

4. Percolation Tests - When subsurface conditions are satisfactory and the soil appears suitable, percolation tests are required at points and elevations typical of the area in accordance with recommendations of the county health department. All tests shall be conducted at the owner's expense, by or under the supervision of an engineer, sanitarian, or other qualified person, and results shall be submitted to the local health department for review and decision as to the suitability of the area for septic tank disposal systems. It is extremely important that only qualified personnel conduct percolation tests as the results obtained will determine not only the acceptability of the site but also the design of the subsurface disposal system.

TABLE I

ABSORPTION AREA REQUIREMENTS AND
ALLOWABLE RATE OF APPLICATION BASED ON PERCOLATION TESTS

Percolation Rate (Time in minutes required for water to fall 1 inch)	Required Absorption Area in sq.ft. per bedroom (see 1, 2, 3 below)	Maximum Rate of Application gallons per sq.ft. per day (see 2, 3, 6, 7 below)
1 or less	70	5.0
2	85	3.5
3	100	2.9
4	115	2.5
5	125	2.2
10	165	1.6
15	190	1.3
30 (4 below)	250	0.9
45	300	0.8
60 (5 below)	350	0.6

1. Sufficient area shall be provided for at least 2 bedrooms.
2. Absorption area for trenches is figured as trench-bottom area.
3. Absorption area for seepage pits is effective side-wall area below the inlet.
4. Over 30 minutes unsuitable for seepage pits.
5. Over 60 minutes unsuitable for leaching systems.
6. Quantity of sewage to be determined from Table III.
7. No provisions made for automatic washing machines or garbage grinders, for buildings where these appliances are installed, the calculated leaching area should be increased 20% for automatic washing machines, 40% for garbage grinders, and 60 % for both.

TABLE II

QUANTITIES OF SEWAGE FLOW

Type of Establishment	Gallons Per Person Per Day
Multiple-Family Dwellings (Apartments)	60
Rooming Houses	40
Boarding Houses	50
Additional Kitchen Wastes for Non-Resident Boarders	10
Hotels Without Private Baths	50
Hotels with Private Baths (2 persons per room)	60
Restaurants (Toilets and Kitchen Wastes per Patron)	8
Restaurants (Kitchen Wastes per Meal Served)	3
Additional for Bars and Cocktail Lounges	2
Tourist Courts or Trailer Parks with Central Bathouse	35
Tourist Courts or Mobile Home Parks (Individual Bath Units)	50
Resort Camps (night and day) with Limited Plumbing	50
Luxury Camps	100
Work or Construction Camps (semi-permanent)	50
Day Camps (No Meals Served)	15
Day Schools without Cafeterias, Gymnasiums or Showers	15
Day Schools with Cafeterias (No Gymnasiums or Showers)	20
Day Schools with Cafeterias, Gymnasiums and Showers	25
Boarding Schools	100
Day Workers at Schools and Offices (per shift)	15
Hospitals	200
Institutions Other Than Hospitals	100
Factories (Per Person Per Shift - No Industrial Wastes)	25
Picnic Parks (Toilet Wastes Only), (Per Picnicker)	5
Picnic Parks with Bathhouses, Showers and Flush Toilets	10
Swimming Pools and Bathhouses	10
Luxury Residences and Estates	100
Country Clubs (Per Resident Member)	100
Country Clubs (Per Non-Resident Member Present)	25
Motels (Per Bed Space)	40
Motels with Bath, Toilet and Kitchen Wastes	50
Drive-In Theaters (Per Car Space)	5
Movie Theaters (Per Auditorium Seat)	5
Airports (Per Passenger)	4
Self Service Laundries (Per Wash, i.e., Per Customer)	50
Stores (Per Toilet Room)	400
Service Stations (Per Vehicle Served)	10

PART II - PRINCIPLES OF OPERATION

Where subsurface disposal of sewage is provided, the sewage must be properly conditioned prior to discharge, to protect the absorptive capacity of the soil, as untreated sewage will quickly clog all but the most porous gravel formations. A septic tank is installed to accomplish this purpose in 3 ways, namely: (1) solids removal, (2) biological treatment, and (3) sludge and scum storage.

Sewage enters the septic tank through a sewer laid on a grade sufficient to maintain a self-cleansing velocity. An arrangement is provided on or at the inlet to reduce the velocity and change the direction of flow so that the sewage will spread out and move more or less uniformly across the width of the tank. The enormous increase in the cross sectional area of the tank, as compared to the sewer, causes a decrease in the velocity of sewage flow and induces a slow and quiescent movement toward the outlet or effluent end of the tank. During the course of travel across the tank many of the suspended solids settle to the bottom so that when the sewage passes out of the tank it contains a lower concentration of these solids. The effluent, however, still contains all of the solids in solution which were originally present, the remaining solids in suspension, which because of their small size or low density did not have time to settle, together with large numbers of bacteria.

The accumulation of solids which are retained in the tank is referred to as sludge. This sludge and the liquid in the tank are subject to decomposition by bacterial and natural processes. Bacteria present are of a variety called anaerobic which thrive in the absence of oxygen (air). This decomposition, or treatment under anaerobic conditions, is termed "septic", hence, the name of the tank, and is accompanied by the evolution of obnoxious gases which pass off through the house sewer vents and by the formation of water which mixes with the effluent sewage. The remaining product is digested sludge which is stored by the tank until its removal.

The heavier sewage solids that settle to the bottom of the tank form a blanket of sludge while the lighter solids, including fats and greases, rise to the surface and form a layer of scum. During the process of digestion or decomposition the gas that is liberated from the sludge will rise and may carry some of the settled solids to the surface where they accumulate with the scum. Ordinarily these solids undergo further digestion in the scum layer and a portion again settles to the bottom. This action is retarded if there is much grease in the scum layer.

The effluent from the tank, still high in putrescible organic matter and bacteria, passes on into the subsurface disposal system for final treatment and disposal. This final treatment process is based, first, upon the filtering or straining action of the soil which removes practically all the remaining suspended solids and, second, upon the action of aerobic bacteria which oxidize or disintegrate these solids into stable elements or compounds. The effluent from this final treatment process then percolates deeper into the soil although a portion may be disposed of by transpiration and evaporation. Periodic or intermittent dosing of the disposal area supplies the aerobic bacteria alternately with food to eat and air to breathe. If the field were to be kept saturated with sewage, the aerobes, which decompose organic matter without producing offensive odors, would be suffocated and the anaerobes would take over with their resulting putrefactive odors.

The erroneous opinion is still held by some that a properly operating septic tank will, by some mysterious process usually called "fermentation", magically destroy and eliminate all traces of whatever solid substances are put into it and, therefore, will never require cleaning. In order that proper respect for the limitations of a septic tank be emphasized, general facts regarding the work done by a well designed tank upon average domestic sewage should be thoroughly understood. For instance, about 0.1% of the sewage flow is solid material, approximately 60% of this being dissolved and the remainder being in suspension. Of the 40% in suspension, only about 50% is removed by settling, the remaining one-half consisting of colloidal or minute particles that cannot be removed by ordinary sedimentation facilities. Therefore, only one-fifth of the total solids are removed by the tank, the remaining four-fifths passing out in the effluent. Of the one-fifth retained in the tank, 60% is organic and 40% inert mineral solids. But of the 60% organic matter only two-thirds will be reduced or digested, the other third consisting generally of relatively inert woody fibers and similar substances which digest with great difficulty, if at all. It is evident from the above that 80% of the solids entering the tank pass on through it while 60% of the solids which settle out remain in the tank until removed. Therefore, given sufficient time and usage any septic tank will become full of digested sludge, indigestible organic and mineral matter and, if not cleaned, will cease to perform its main function of removing and digesting solids as well as conditioning the sewage that passes through it.

PART III - DESIGN AND CONSTRUCTION OF THE SEPTIC TANK

A. GENERAL CONSIDERATIONS - Significant features to be considered in the design of a septic tank are included in this section. The designs shown elsewhere in this pamphlet, as Plate I and Plate II, are in accordance with good engineering practice, and it is recommended that the basic principles outlined on design and construction be followed. The fact that the septic tank is a simple and relatively inefficient method of sewage treatment often causes its design to be slighted or based on guess-work and hearsay which could result in unsatisfactory operation; but, because of its permanence, low cost, and ability to prepare sewage for final disposal, it is important that the design of the tank be carefully considered before construction is started.

B. DESIGN

1. Location - Both the septic tank and disposal facilities should be located at least 10 feet distant from any building. Due to objectionable odors, which arise during the periodic cleaning process, greater distance is preferred if it can be obtained.

The tank should be placed so that its top will be as near the surface of the ground as possible, although for tanks close by and serving residences it is well to have from 2 to 6 inches of earth over the cover slab. More than 6 inches of earth cover results in an excessive dead load on the slab, while no earth cover at all results in the destruction of an otherwise smooth and uniform landscape.

2. Tank Capacity - The plans for each septic tank shall be in accordance with approved engineering standards in general and the following standards in particular: the length shall be at least 2 but no more than 3 times the width; the uniform liquid depth shall be not less than 4 feet nor greater than 6 feet; the theoretical detention period shall be not less than 24 hours based on the average flow, except that regardless of how small the estimated sewage flow may be no tank shall be installed having a liquid capacity less than 750 gallons. The capacities recommended in Plate I allow for use of automatic washing machines, garbage grinders, and other household appliances. However, no provisions have been made for use of these appliances, especially garbage grinders, in the tank sizes recommended in Plate II. In such cases, particularly where garbage grinders are to be installed, the calculated capacity of the tank should be increased up to 50% to provide additional sludge storage for the increase in solids expected in the raw sewage.

3. Inlet, Outlet, and Baffling Arrangement - At least a 12 inch freeboard or empty space is required between the water level and the underside of the tank cover to provide for that portion of the scum that floats above the liquid. For this reason the invert or flow line of the outlet or effluent pipe should be set a minimum of 12 inches below the bottom of the tank cover. To prevent sewage from backing up in the inlet or influent pipe, this line should enter the tank 2 inches higher than the outlet pipe or, with its invert, a minimum of 10 inches below the bottom of the tank cover. Some arrangement must be provided to change the direction of flow of the influent stream of sewage and spread it as uniformly as possible across the tank. It has been found that a submerged tee inlet, penetrating approximately 12 inches below the surface, and a tee outlet from the tank, penetrating between 18 and 24 inches below the surface, accomplishes these purposes satisfactorily and occasions fewer stoppages than a straight inlet or outlet arrangement with a baffle.

4. Compartmentation - For the larger tank sizes it is recommended that a sludge retaining wall be constructed near the effluent end of the tank and a scum board be placed directly above this wall spaced far enough apart to prevent any appreciable increase in velocity. These two features are indicated in order to lengthen the period of satisfactory service of the more elaborate and extensive systems for secondary treatment and final disposal of the sewage. The retaining wall at the bottom will prevent accumulated sludge from sliding over into this second compartment, while the scum board tends to hold back

the greater part of the scum blanket. Either a tee or ell is satisfactory as an outlet from this compartment but a tee must be used at one end of the tank to provide a means of escape for the gases of decomposition (digestion).

5. Tank Cover - The cover for a septic tank should be sufficiently strong to support whatever load may be imposed upon it, and tight enough to prevent entrance of dirt or other foreign matter and the escape of the odorous gases of digestion. Removable sections should be provided at strategic points for inspection and for cleaning purposes. For the smaller tanks it is advantageous to simplify construction by designing slabs to extend across the width of the tanks, the slabs to contain handles at either end and be narrow and light enough to facilitate easy removal. The larger tanks should have continuous cover slabs with either standard manhole castings or reinforced removable concrete sections.

6. Dosing Chamber - A dosing chamber equipped with an automatic siphon is recommended for tanks designed to accommodate a daily sewage flow of 1500 gallons or more when a subsurface tile field, filter trench or filter bed is to be used for secondary treatment. It is also desirable when seepage pits are to be provided or when the amount of tile required for any tank exceeds 500 feet. The purpose of this chamber is to more effectively utilize the disposal area provided and to give the absorption field rest periods between dosings. The dosing chamber should be deep enough to permit the operation of the siphon at a head lower than the level of water in the septic tank. In addition, the volume contained by the chamber, calculated on the draft of the particular siphon, should be such that the tile in the distribution field will be filled one-half to three-fourths full in one dosing. The floor of the chamber should slope toward the siphon and a vent should connect the discharge line with the chamber at a point above the flow line. Where the total length of tile exceeds 1000 feet, the dosing tank should be provided with 2 siphons dosing alternately and each serving one-half of the tile field. All siphons should be carefully installed in accordance with manufacturer's recommendations.

C. CONSTRUCTION

1. Excavation - The excavation for the tank should be made to such depth that the top will preferably be not more than 6 inches below the ground surface. If the topography of the location is such that the influent will enter at a greater depth, the freeboard of the tank should be increased to maintain a maximum earth cover of 6 inches, or the tank adequately reinforced to support the additional load imposed, with manholes extending to within 6 inches of the surface.

2. Materials - All septic tanks should be water-tight and constructed of materials not subject to corrosion or decay, such as concrete, vitrified clay block, heavyweight concrete block, or hard-burned brick. Properly cured pre-cast and cast-in-place reinforced concrete

are acceptable anywhere. Pre-cast tanks should have a minimum wall thickness of $2\frac{1}{2}$ inches and should be adequately reinforced to facilitate handling. For cast-in-place tanks, reinforcing may be omitted in the smaller units but, for tanks of over 1500 gallon capacity, it is recommended that steel bars 3/8 to 1/2 inch in diameter be placed each way at intervals not exceeding 18 inches as shown in Plate II. All steel should be placed 1 inch from the inside surfaces of the walls and floors. Where heavyweight concrete block, hard-burned brick or vitrified clay block are used, they shall be laid on a solid foundation, all mortar joints well filled and the interior of the tank surfaced with two $\frac{1}{4}$-inch coats of cement-sand plaster or other provision made to insure that the tank will be as watertight as possible.

3. Covers - The tank cover must be adequately reinforced regardless of tank capacity. For tanks less than 1500 gallons capacity, it is recommended that several slabs 4 inches thick, not over 18 inches wide, and as long as the overall width of the tank, be constructed and placed so as to make a snug cover. Loops of steel set in each end of each slab facilitate easy handling both at the time of installation and in the future when it becomes necessary to inspect or clean the tank. Three steel reinforcing bars 3/8 inch in diameter should be placed 1 inch from the bottom and extend the long way of each slab. This multiple slab type of cover simplifies form construction and removal and provides adequate access facilities without construction difficulties. For tanks of 1500 gallons and more capacity it is considered better practice to build the cover as an integral part of the tank. In this case, it should be borne in mind that all inside forms must be dismantled after the cover has gained sufficient strength, usually about 1 to 2 weeks, and removed through the manholes. These manholes may be either standard castings or reinforced concrete slabs. Manholes should be provided to each compartment and both inlet and outlet devices should be accessible.

4. Dosing Chamber - The floor of the dosing chamber should slope toward the siphon, 2 inches is considered satisfactory. The minimum depth of the chamber is dependent upon the drawing depth of the siphon but ordinarily the chamber should not exceed the minimum depth required; otherwise the loss-of-head will be unnecessarily increased, resulting in excessive depth, except on steep slopes, for the tile field. The trap of the siphon should be set absolutely vertical in concrete at an elevation such that the bottom of the bell will be suspended 2 inches above the floor of the chamber and, at the same time, 3 inches plus the drawing depth below the flow line of the septic tank. The invert of the vent should lead back into the dosing chamber at or above the flow line of the septic tank. These precautions allow a safety factor of 3 inches in preventing the contents of the chamber from backing up in the septic tank or overflowing through the vent before the drawing depth is reached. The trap of the siphon should be filled with water before the bell is set in place and the tank placed in operation.

5. Inlet and Outlet - Cast iron inlets and outlets are recommended for each installation, although vitrified clay fittings or other satisfactory inlet and outlet materials may be used on smaller units.

6. Compartmentation - In tanks of over 1500 gallons capacity, a sludge retaining wall should be constructed of brick or concrete block at a point 3 feet from the effluent end of the tank and extending up 2½ feet above the floor. The scum board, 2 inches thick, should be of redwood or other water-resistant material. If the inside wall forms are removed before the cover slab is cast, the scum board may be dropped into the wall slots before the forms for supporting the cover are built. If the cover is cast integrally with the tank, as recommended, the scum board can be sawed in two pieces, set in place, extended into the slots, and the two butting pieces securely joined. Where more than one board is used, the joints on the several boards should be staggered.

PART IV - LEACHING SYSTEMS

A. GENERAL CONSIDERATIONS - After it has been determined that percolation rates are satisfactory for subsurface disposal, the required absorption area should be calculated from Table I and the leaching system selected that will be suitable for the area under consideration. A safe distance should be maintained between the site and any source of water supply. Since the distance that pollution will travel underground depends on numerous factors, it is not practical to specify minimum distances that would be reasonable in all localities, although the greater the distance the greater the safety provided. In general, all subsurface disposal systems should be located at least 100 feet but in no case less than 50 feet from any well or other water structure, 50 feet from any stream or water course, and 10 feet from dwellings and property lines.

B. TYPES OF LEACHING SYSTEMS - The types of leaching systems usually considered are (1) subsurface absorption fields consisting of standard trenches or seepage beds, and (2) seepage pits. Seepage pits are the least desirable of the two systems and will not be approved where there is a possibility of contaminating underground waters or where soil conditions are satisfactory for subsurface absorption fields.

1. Subsurface Absorption Fields

   a. Standard Trenches - Consist of a subsurface tile system, having 12 inch lengths of 4 inch agricultural drain tile, vitrified-clay sewer pipe, or perforated non-metallic pipe, laid in a trench 18" to 36" wide and in such a manner that flow from the septic tank will be dispersed uniformly into the natural soil. The tile lines should slope 2 to 4 inches per 100 feet but not greater than 6 inches, and should not exceed 4 inches in 100 feet where a siphon is required. The spacing between trenches varies from 6 to 8 feet depending on the width of the trench.

The general arrangement or layout of the tile lines will depend on the topography of the ground, the amount of tile required, and the size and shape of the disposal area. Several suggested arrangements are shown in Plate III; these may be varied, combined one with another, or taken as shown, according to the slope of the ground and the amount of tile required.

Until recently, a distribution box was considered essential for all absorption field systems, to provide uniform distribution of the septic tank effluent over the total absorption area. It has now been determined that serial distribution has certain advantages over any method of equal distribution for systems serving private residences, or when dosing tanks are not required, thereby eliminating the need for, and resultant cost of distribution boxes. Serial distribution is achieved by arranging individual trenches in the absorption system as shown by Plates V and VI so that each trench is forced to pond to the full depth of the gravel fill before liquid flows into the succeeding trench. In this manner the total area of the system is utilized before ultimate failure can occur.

Where a dosing tank is required, it is preferred that it be followed by a distribution box to assure equal distribution to the several distribution lines generally provided in a conventional type of tile field design. This will serve to prevent or reduce overloading and possible failure of one line while the remaining lines are still underloaded. At least 2 lateral lines should lead from the box and enough additional laterals should be added, where necessary, to provide the required percolation area. The individual laterals should not exceed 100 feet in length although under unusual circumstances lengths up to 150 feet may be necessary. Use of more and shorter laterals are usually recommended in order to assure continuous and satisfactory operation of the system even though something might happen to disrupt one or more of the lines. The design of the system can be varied to meet most topographical conditions encountered while giving proper grade and alignment for all laterals.

Generally, the depth of a trench should not be greater than 3 feet or less than 2 feet. The trench width should not be less than 18 inches nor greater than 24 inches.

The tile, laid in a trench of sufficient width and depth, is surrounded by clean, graded gravel, broken brick, washed rock, or other similar aggregate. The material selected should vary in size from ½ to 2½ inches. Cinders, broken shell, and other similar materials are not recommended as they are usually too fine, resulting in clogging of the field, or may break down under the action of the sewage. The material used should extend from 2 inches above the top of the tile to at least 6 inches, and preferably 12 to 18 inches, below the bottom of the tile. The upper half of the joint openings in the tile should be covered with roofing paper or other suitable material.

Drain tile connectors, collars, clips, or other spacers with covers for the upper half of the joints are valuable in obtaining uniform spacing and proper protection of the joint but use of such aids is optional. The top of the stone should be covered with untreated building paper or a 2 inch layer of hay, straw, pine needles, etc., before placing the backfill, to prevent the stone from becoming clogged. An impervious cover should not be used as this interferes with evapo-transpiration at the surface. Although not considered in calculating the design of a system, transpiration and evaporation do play an important part in the operation of horizontal leaching systems.

b. Seepage Beds - In the design of standard trenches, as mentioned previously, the width of the trench may vary from 18 inches to 36 inches; however, absorption systems having trenches wider than 3 feet are referred to as seepage "beds". In the past, the use of seepage beds has been limited by a lack of experience with their performance and the absence of design criteria comparable to that for trenches. Now, however, recent studies have demonstrated that the seepage bed is a satisfactory method for disposing of effluent in soils that are suitable for subsurface absorption fields. These studies also found that the empirical relationship between the percolation tests and bottom area required for trenches is applicable for seepage beds.

There are three main elements of a seepage bed: (1) Absorption surface; (2) Rock fill or packing material; (3) The distribution system. The design of the seepage bed should be such that the total intended absorption area is preserved, sufficient packing material is provided to allow for further treatment and storage of excess liquid, and the means for distributing the effluent is protected against siltation of earth backfill or mechanical damage. Construction details are outlined below in such a way that these principal design elements are incorporated; however, these recommended construction details are not intended to preclude other designs which may provide the essential features in a more economical or otherwise desirable manner. In particular, there may be equally acceptable or even superior methods developed for distributing the liquid over the seepage bed.

Where seepage beds are proposed the following design and construction procedures are recommended:

1. Percolation and boring tests are required to determine the suitability of the soil for subsurface disposal.

2. The amount of bottom absorption area required will be the same as shown on Table 1, page 2 for standard trenches.

3. The bed should have a minimum depth of 24 inches below natural ground level to provide a minimum earth backfill cover of 12 inches.

4. The bed should have a minimum depth of 12 inches of rock fill or packing material extending at least 2 inches above and 6 inches below the distribution pipe.

5. The bottom of the bed and the distribution pipe should have a relatively level grade.

6. Lines for distributing effluent shall be spaced not more than 6 feet apart and not more than 3 feet from the bed sidewall.

The advantages attributed to seepage beds are as follows:

1. A wide bed makes more efficient use of land available for absorption systems than a series of narrow trenches with wasted land between trenches.

2. Efficient use may be made of a variety of earth-moving equipment employed at construction sites, resulting in considerable savings on the cost of the system.

2. <u>Seepage Pits</u> - A seepage pit is a covered pit generally circular in plan, with open-jointed lining through which septic tank effluent may seep or leach into the surrounding porous soil. As mentioned previously, seepage pits are considered a less desirable method of disposal than subsurface absorption fields and are only permitted when absorption fields are impracticable and subsurface conditions are otherwise suitable for pit installations. Where seepage pits are to be provided, the bottom of the pit shall terminate at least 4 feet above any ground water table. However, in areas where domestic water supplies are obtained from shallow wells, the use of seepage pits is prohibited.

   When computing the capacity of area requirements for seepage pits, it is important that the <u>average</u> of the results of percolation tests, made in each vertical stratum penetrated, be used to obtain a design figure. The absorption area required can be determined from Table I for the percolation rate obtained. The effective area of a seepage pit is determined from the vertical wall area of the porous layer below the inlet with no allowance for impervious strata (rates in excess of 30 minutes per inch of fall) or the bottom area. Vertical wall areas can be obtained from Table III for circular pits. Note that the diameter of seepage pits will vary between 3 and 12 feet. Generally, the size selected is determined by area requirements, depth, number of pits, and other factors.

   It is recommended that the vertical walls of seepage pits be lined with masonry, placed without mortar, below the inlet pipe and the section above the inlet pipe laid with mortared joints or otherwise strengthened as indicated by Plate IV. Hard-burned brick, heavy-weight concrete block, structural clay tile, and fieldstone are acceptable if properly laid to provide necessary structural strength. If cored units are used, the cores should be laid in the vertical plane. Whatever the material, the walls should be laid close and no attempt made to provide all of the space necessary for the sewage to seep into the soil. Large openings only invite trouble, make the walls less stable structurally, permit easier infiltration of the surrounding soil, and are more likely to cave-in or collapse than pits with closely built walls.

Seepage pits having a depth greater than 20 feet should be located at least 20 feet apart and the same distance from any dwelling. The distance between shallow pits (less than 20 feet deep) should be at least 3 times the diameter of the pit. All seepage pits should be located as remote as possible from any water supply, well, or water structure, preferably 100 feet or more, although for wells that are properly cased and adequately protected the distance may be reduced to 50 feet.

TABLE III

VERTICAL-WALL AREAS OF ROUND SEEPAGE PITS
(In square feet)

DIAMETER OF LEACHING PIT (feet)	EFFECTIVE STRATA DEPTH BELOW FLOW LINE (BELOW INLET)									
	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.
3	9.4	19	28	38	47	57	66	75	85	94
4	12.6	25	38	50	63	75	88	101	113	126
5	15.7	31	47	63	79	94	110	126	141	157
6	18.8	38	57	75	94	113	132	151	170	188
7	22.0	44	66	88	110	132	154	176	198	220
8	25.1	50	75	101	126	151	176	201	226	251
9	28.3	57	85	113	141	170	198	226	254	283
10	31.4	63	94	126	157	188	220	251	283	314
11	34.6	69	104	138	173	207	242	276	311	346
12	37.7	75	113	151	188	226	264	302	339	377

EXAMPLE: A pit of 5 foot diameter and 6 foot depth below the inlet has an effective area of 94 square feet. A pit of 5 foot diameter and 16 foot depth has an area of 94 + 157, or 251 square feet.

PART V - MAINTENANCE AND OPERATION

STARTING - When a septic tank system is first placed in service it is not necessary that anything be added to start decomposition or digestion. Where normal domestic or household sewage flows into the tank a sufficient number of suitable bacteria will be present to start the digestion process. The process may be accelerated by the addition of lime or sludge from another tank but this is very seldom convenient or necessary.

CLEANING - Most of the accumulated sludge and scum should be cleaned out regularly, or as required, in order to maintain the effective volume of the tank large enough to accomplish satisfactory sedimentation. Failure to clean the tank at proper intervals will result in overloading the absorption system and will prevent its successful operation. Under these conditions the soil will become clogged, liquid may break through to the ground surface, and sewage may back up into the plumbing fixtures. There are wide differences in the rate that sludge and scum will accumulate from one tank to the next and for this reason no definite time interval for cleaning can be specified. In general, it is recommended that tanks be inspected at least once each year and cleaned as necessary. Actual inspection and measurement of the sludge and scum accumulations is the only known way to determine when a tank needs to be cleaned, even though it may be difficult for most homeowners. The depth of sludge and scum should be measured in the vicinity of the outlet baffle and the tank should be cleaned if either: (a) the bottom of the scum mat is within 3 inches of the bottom of the outlet device, or, (b) if the depth of sludge is 2 feet or more.

Several methods and devices can be used to measure the depth of scum. A simple device recommended consists of a stick, to which a weighted flap has been hinged, to feel out the bottom of the scum mat. The stick is forced through the mat, the hinged flap falls into a horizontal position and the stick is raised until resistance from the bottom of the scum is felt. With the same device, the distance to the bottom of the outlet device can also be determined.

A long stick, wrapped with rough white toweling and lowered to the bottom of the tank, can be used to determine the depth of sludge and the liquid depth of the tank. The stick should be lowered behind the outlet device to avoid scum particles. After several minutes if the stick is carefully removed the sludge line can be distinguished by sludge particles clinging to the toweling.

SLUDGE DISPOSAL - In most communities there are firms which conduct a business of cleaning septic tanks. Your county health department should be contacted for suggestions where these services can be obtained. Cleaning is usually accomplished by pumping the contents of the septic tank into a tank truck. It is not necessary to completely empty the tanks, as a small amount of sludge should be retained for seeding purposes. The material removed should be properly buried preferably in uninhabited areas or, with permission of the proper authority, emptied into a sanitary sewer system. It should never be discharged into a storm drain, ditch, stream, or watercourse. In all cases, the method of disposal should be approved by the county health department.

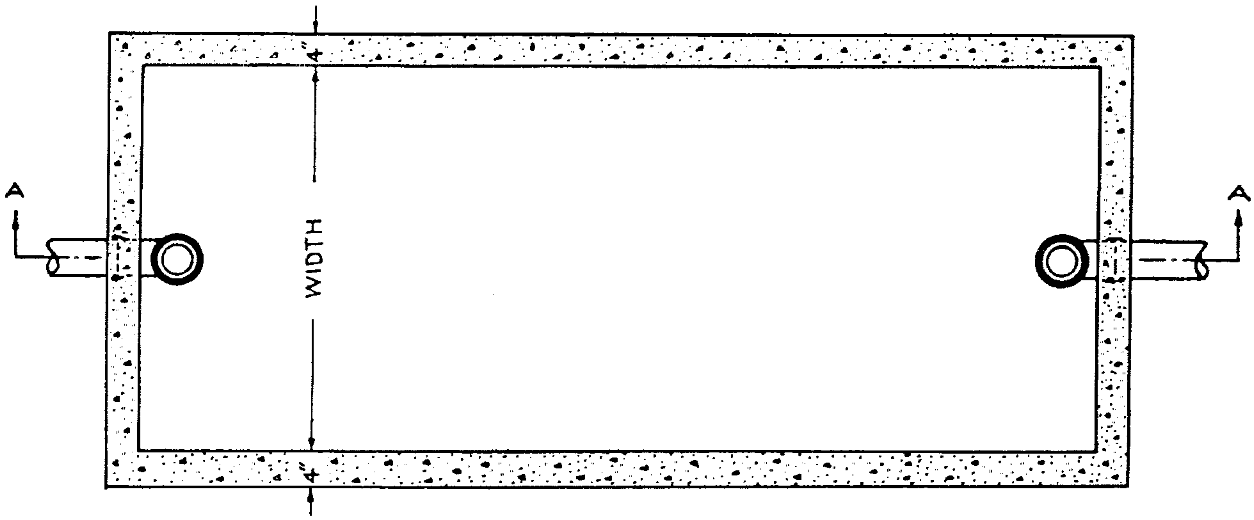
CHEMICALS - The functional operation of septic tanks is not improved by the addition of disinfectants or other chemicals and, therefore, use of these materials is not recommended. Some proprietary products which claim to "clean" septic tanks contain sodium or potassium hydroxide as the active ingredient. Such compounds can result in sludge bulking, causing a large increase in alkalinity, and may interfere with digestion. The resulting effluent could severely damage soil structure and accelerate clogging even though some temporary relief may be experienced immediately after application of the product.

Frequently the harmful effects of ordinary household chemicals are over-emphasized. Waste brines from household water softening units, soaps, detergents, bleaches, drain cleaners, and other similar materials, as normally used in the home, will have no appreciable adverse effect on the system. If the septic tank is adequately sized as herein recommended, the dilution available will be sufficient to overcome any harmful effects that might otherwise occur. Advice of your county health department and other responsible officials should be sought before chemicals arising from a hobby or home industry are discharged into a septic tank system.

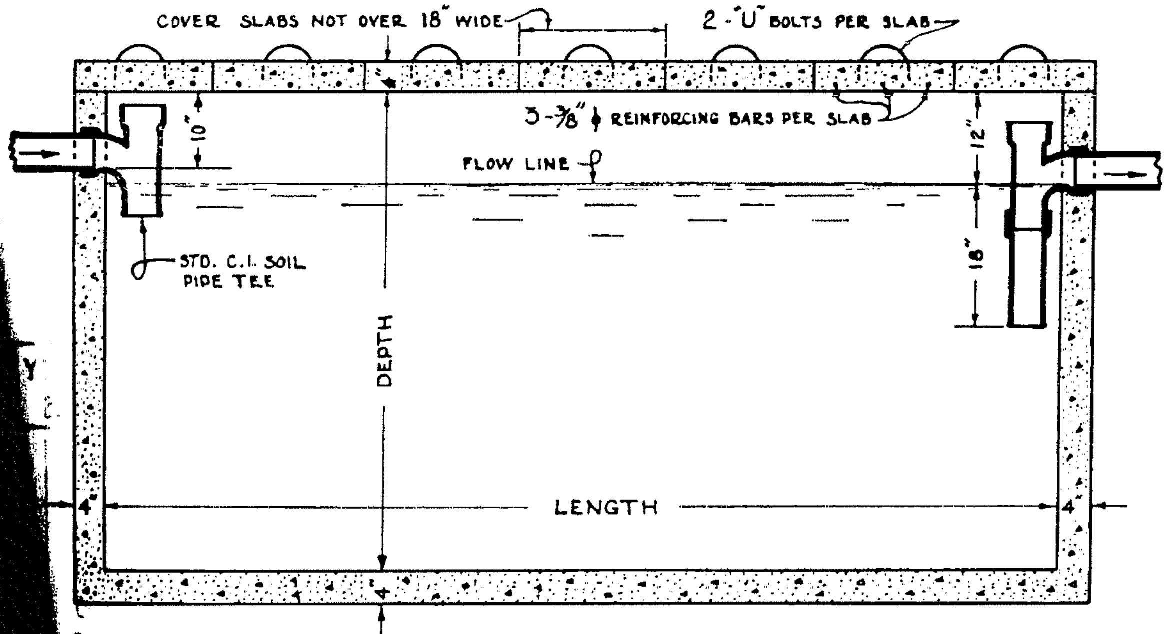
MISCELLANEOUS - It is generally advisable to have all sanitary wastes, including laundry, bath, and kitchen wastes from a household, discharged to a single septic tank disposal system. For most installations, it is more economical to provide a single system than two or more with the same total capacity. Roof drains, foundation drains, and drainage from other sources producing large intermittent or constant volumes of clear water, should not be discharged to any septic tank system. Such large volumes of clear water will stir up the contents of the tank, reduce the detention time and cause considerable carry-over of solids into the outlet line. Likewise, the disposal system following the tank will become flooded and clogged and eventually will fail. Drainage from garage floors or other sources of oily wastes should be excluded from the tank. Paper towels, newspaper, wrapping paper, coffee grounds, rags, sticks, and similar materials should also be excluded from the tank since they do not readily decompose and can lead to clogging of both the plumbing and disposal systems.

A chart showing the location of the septic tank and the disposal system should be placed at a suitable location in dwellings and/or other buildings served by such a system. Whether furnished by the builder, septic tank installer, health department, owner, or other person, the chart should contain brief instructions as to the inspections and maintenance required, thus forestalling failures and assuring satisfactory operation.

(Rev. May 1963)



PLAN
COVER SLABS REMOVED

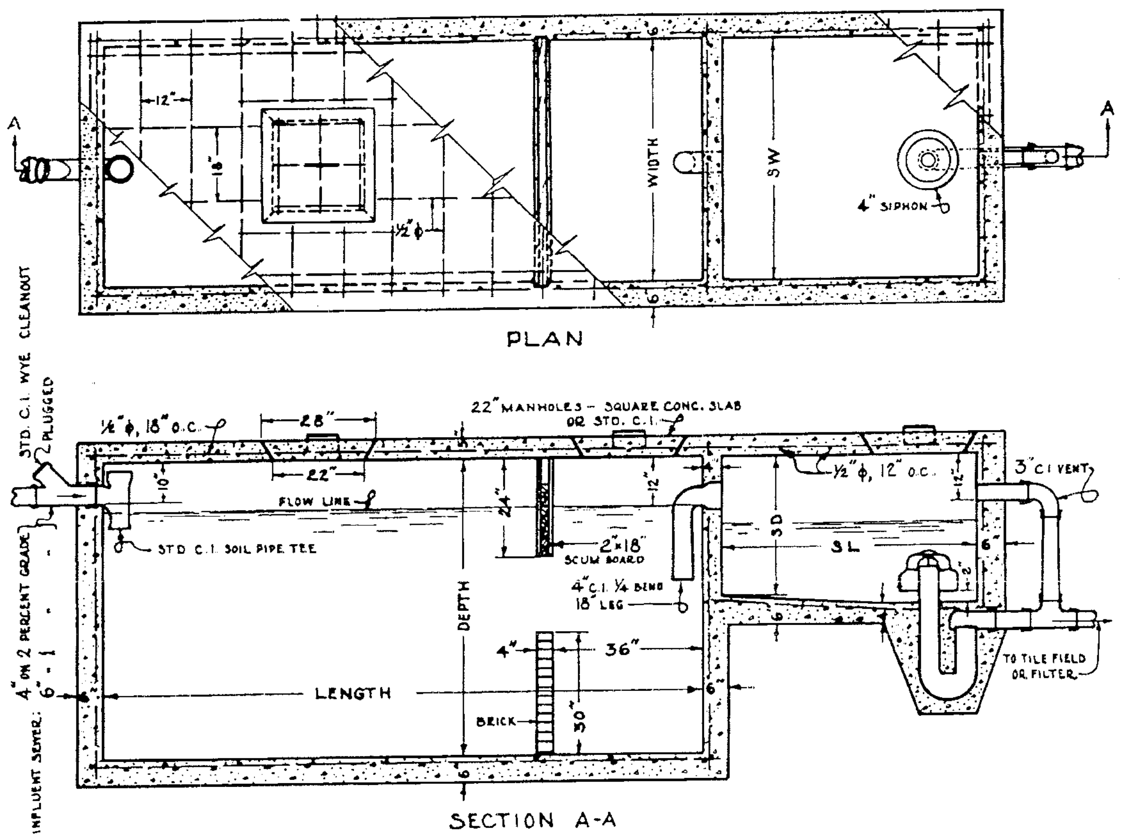


SEPTIC TANK DETAILS

CAPACITY: 780 TO 1500 GALLONS

[illegible]NK [illegible]ER	BEDROOMS SERVED	INSIDE TANK DIMENSIONS			CAPACITY GALLONS
		LENGTH	WIDTH	DEPTH	
[illegible]	2 OR LESS	8'-0"	3'-3"	5'-0"	780
[illegible]	3	8'-6"	3'-6"	5'-0"	900
[illegible]	4	8'-9"	3'-9"	5'-0"	1000
[illegible]	5	10'-6"	4'-0"	5'-0"	1250

PLATE I



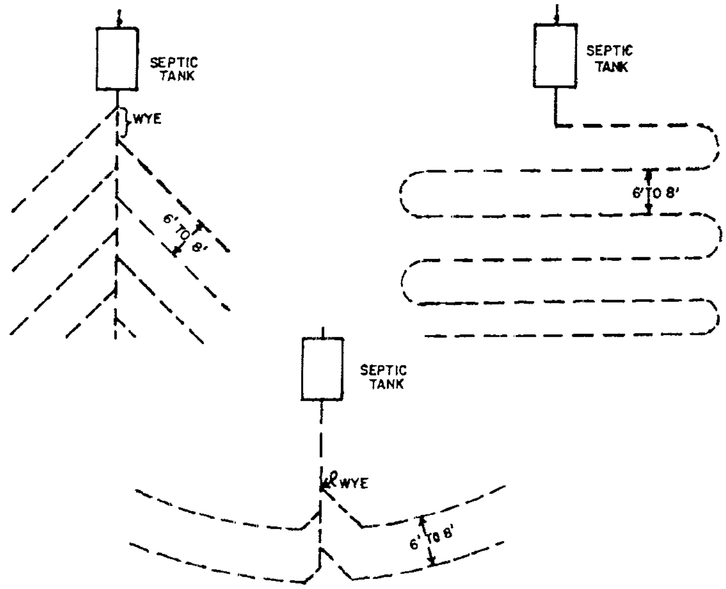
SEPTIC TANK DETAILS

CAPACITY: 1500 TO 10,300 GALLONS

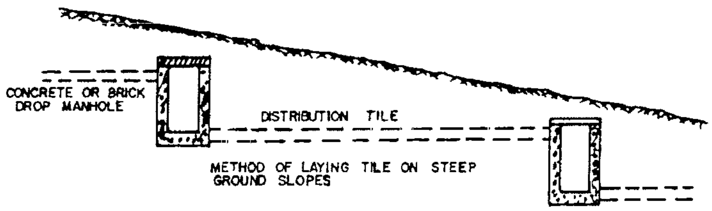
TANK NUMBER	PERSONS SERVED		INSIDE TANK DIMENSIONS			CAPACITY GALLONS
	RESIDENCE	SCHOOL	LENGTH	WIDTH	DEPTH	
5	10-13	75-100	11'-6"	4'-4"	5'-0"	1500
6	14-28	110-160	16'-0"	6'-0"	5'-0"	2900
7	29-42	161-250	17'-0"	6'-6"	6'-0"	4200
8	43-56	251-370	20'-0"	7'-8"	6'-0"	5600
9	57-70	371-460	22'-0"	8'-6"	6'-0"	7000
10	71-87	461-580	26'-0"	9'-0"	6'-0"	8700
11	88-99	581-680	27'-6"	10'-0"	6'-0"	10300

TANK NUMBER	INSIDE DIMENSIONS OF DOSING CHAMBER			SIPHON		GALLONS DOSED	NUMBER DOSES/DAY
	SL	SW	SD	SIZE	DRAFT		
5	5'-0"	4'-4"	3'-0"	4"	17"	300	5
6	6'-6"	6'-0"	3'-0"	4"	17"	415	7
7	7'-0"	6'-6"	3'-0"	4"	17"	486	9
8	7'-6"	7'-8"	3'-0"	4"	17"	600	9
9	7'-6"	8'-6"	3'-0"	4"	17"	680	10
10	8'-0"	9'-0"	3'-0"	4"	17"	760	11
11	9'-0"	10'-0"	3'-0"	6"	17"	950	11

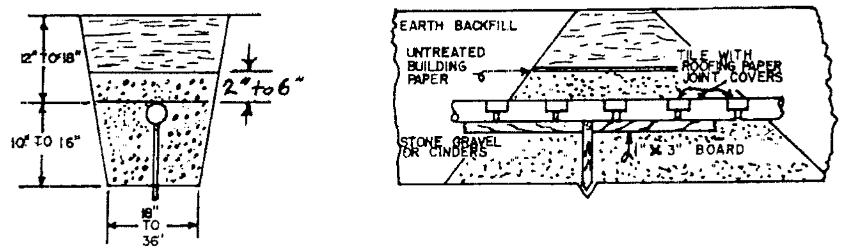
PLATE II



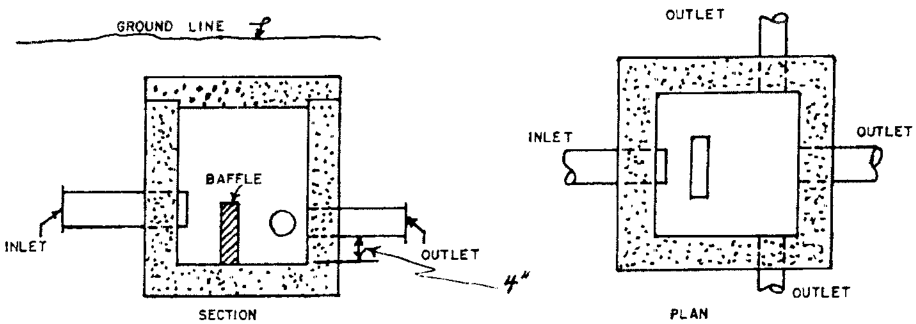
THREE METHODS OF LAYING OUT TILE DISTRIBUTION SYSTEM. USE METHOD OR COMBINATION OF METHODS SUITED TO LOCAL TOPOGRAPHY. SLOPE 2" TO 4" PER 100'



METHOD OF LAYING TILE ON STEEP GROUND SLOPES

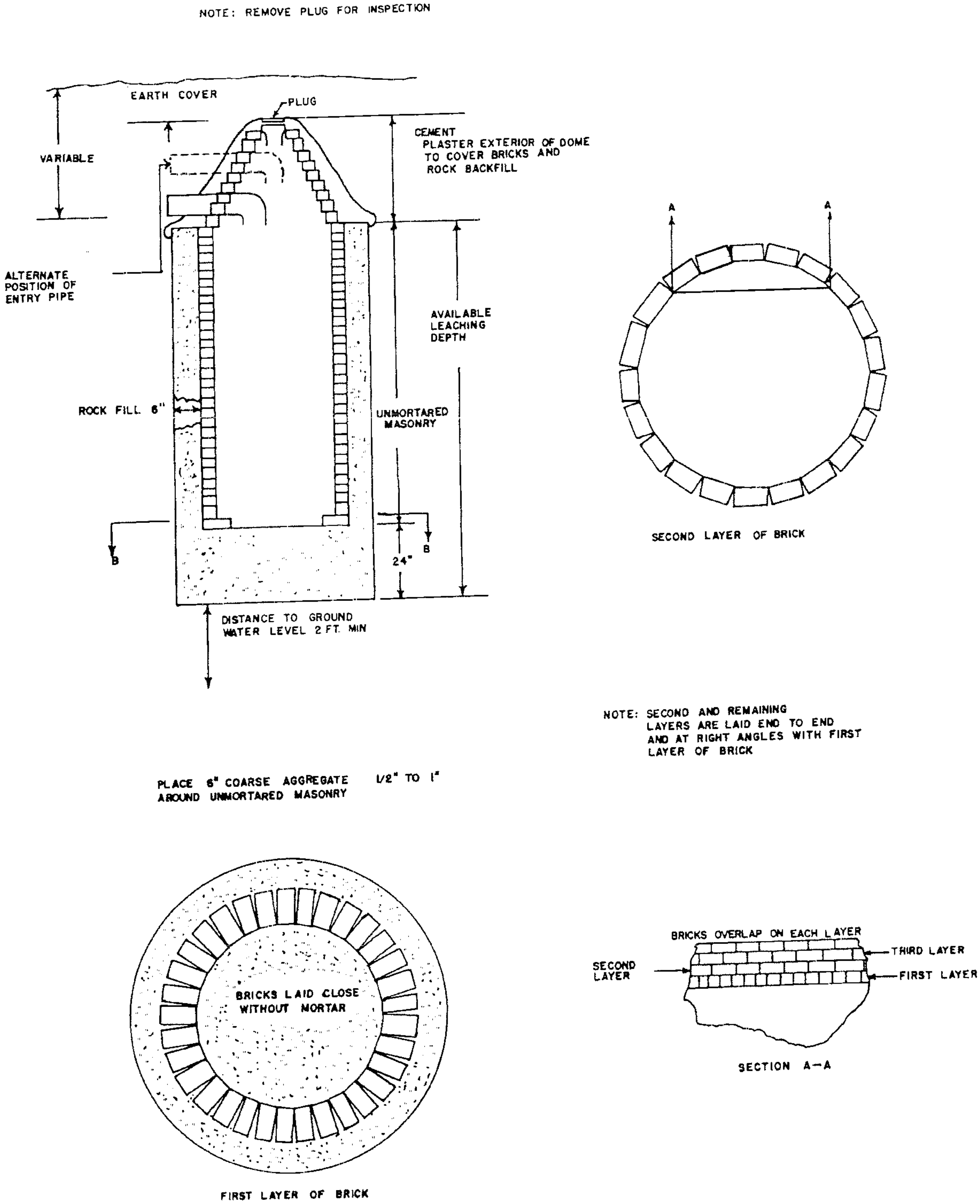


SUBSURFACE DISPOSAL SYSTEM



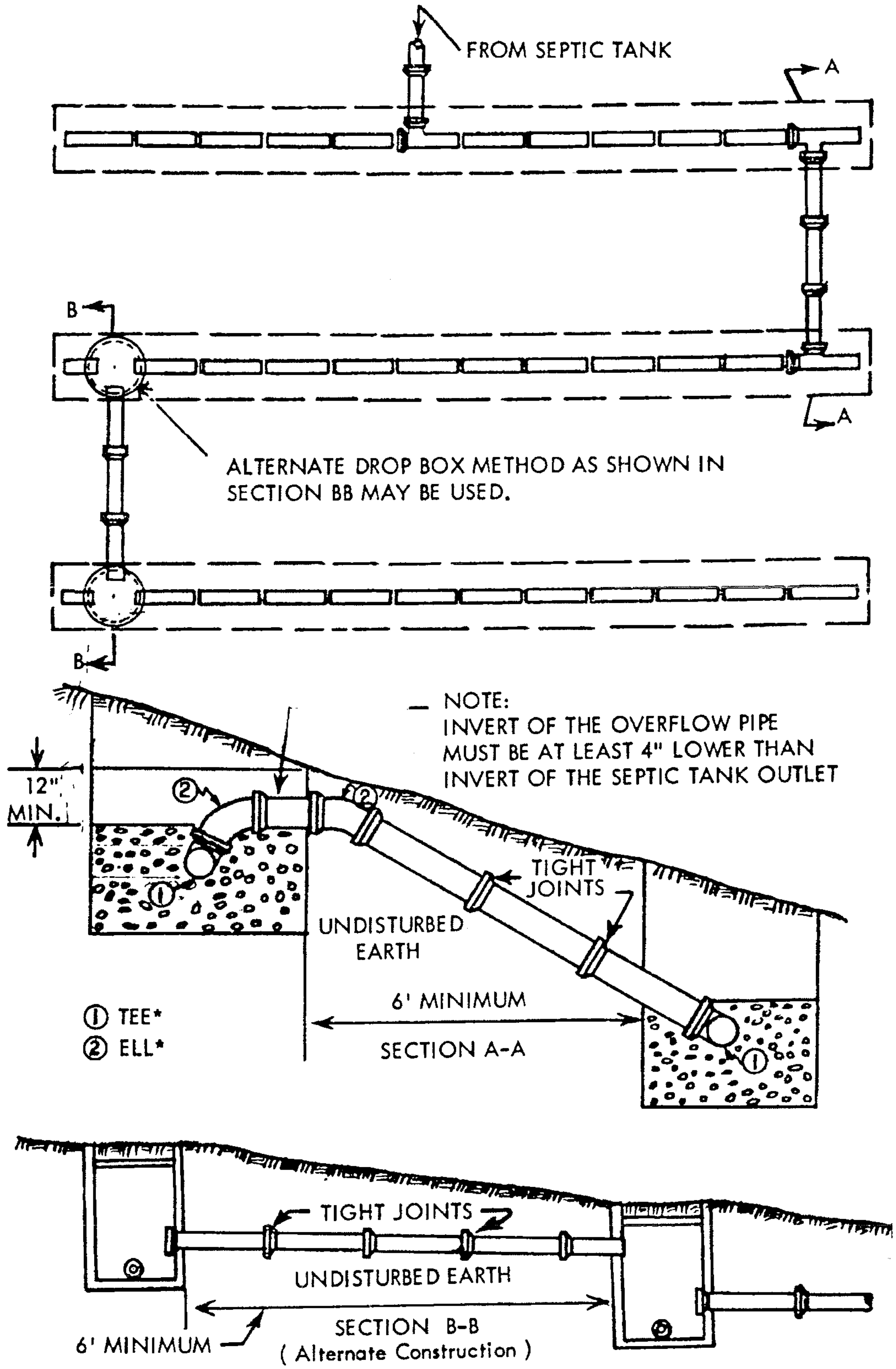
DISTRIBUTION BOX

PLATE III



SEEPAGE PIT

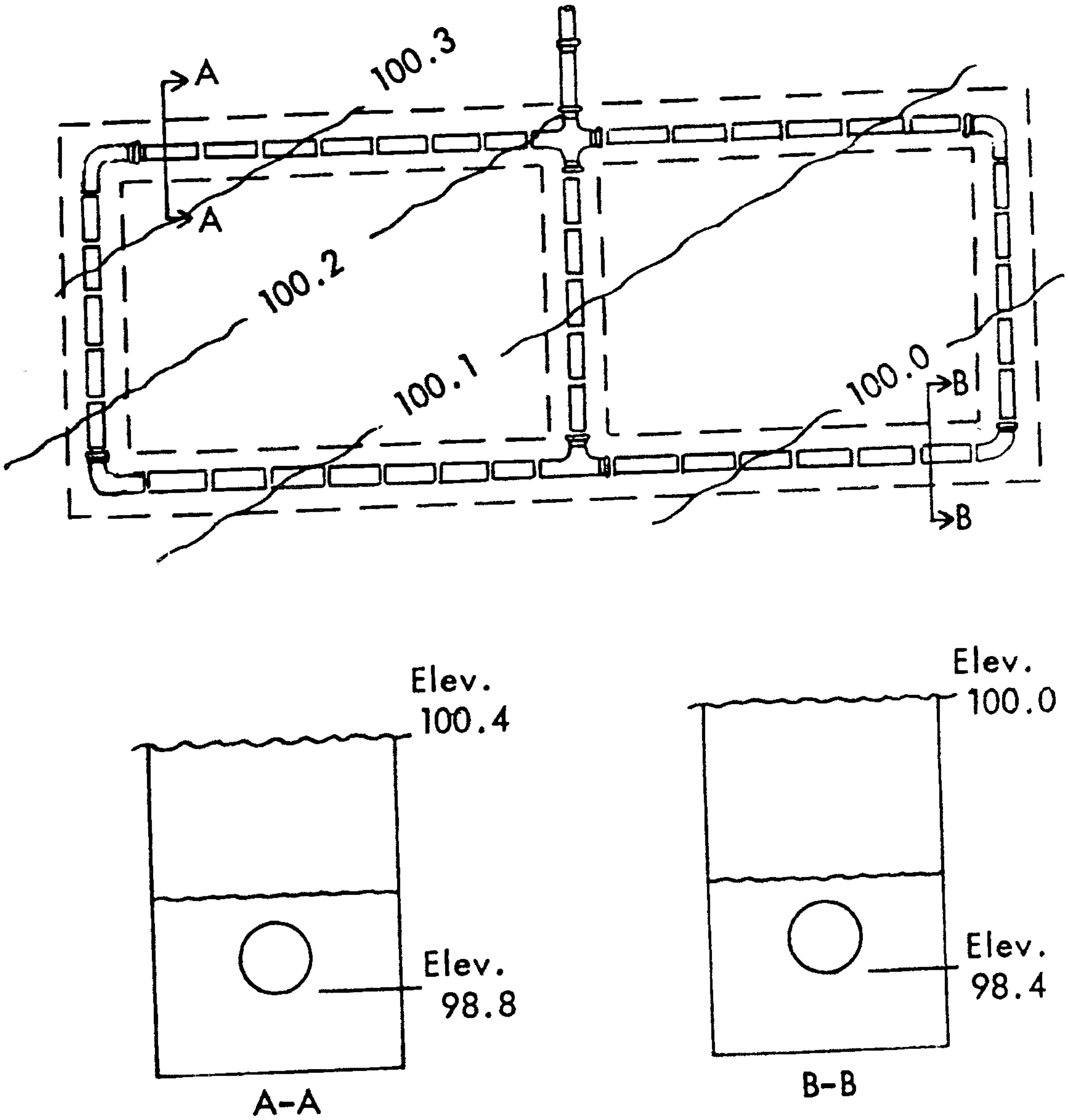
PLATE IV



* DIFFERING GROUND SLOPES OVER SUBSURFACE DISPOSAL FIELD MAY REQUIRE USE OF VARIOUS COMBINATIONS OF FITTINGS.

A RELIEF LINE ARRANGEMENT FOR SERIAL DISTRIBUTION

PLATE V



1. Max. difference in elevation of distribution tile cannot exceed 6 inches.
2. Min. earth cover over trenches 12 inches.

A DISTRIBUTION ARRANGEMENT FOR LEVEL GROUND

PLATE VI