PLANNING GUIDE

for

PRIVATE WATER SUPPLY AND SEWAGE DISPOSAL

for

SMALL PUBLIC, COMMERCIAL AND PLACE OF EMPLOYMENT BUILDINGS

—Minimum Requirements—

BULLETIN S.E. 13

1964

INDIANA STATE BOARD OF HEALTH
1330 WEST MICHIGAN ST.
INDIANAPOLIS, INDIANA 46207

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Section 100. GENERAL CONDITIONS AND SCOPE

The purpose of this bulletin is to guide architects and engineers in *some minimum requirements* for layout and design of private water supply and sanitary sewage disposal systems for small public, commercial and place of employment buildings, at locations where such private facilities may be approvable.

However, a connection to an approved public water supply and public sewer system is a primary building requirement.

Wherever private water or sewage treatment may be contemplated for use, adequate engineering preliminary investigations shall be made to determine if private water or sewage treatment facilities may be approvable for the use intended and at the location contemplated.

Some locations and uses may not be approved due to such reasons as: (1) inadequate area for facilities, (2) inadequate or nonpotable ground water supplies, (3) tight or wet soils, (4) areas subject to flooding, (5) inadequate dilution water for final effluent, (6) proximity of heavily inhabited or built-up areas, (7) watershed sanitation considerations, (8) availability of municipal or public facilities, (9) or other health and sanitation considerations.

It is not intended to provide fully detailed construction drawings in this bulletin and the information herein should be considered only as a *minimum planning guide.* Each proposed facility will be considered separately.

The sewage treatment devices outlined in Sections 503 through 508 are minimal and generally should only be considered for some small waste flows involving human excrement, human bathing and handwashing waste and limited food service waste. See Sections 400 through 406.

It should be particularly noted that proposed new private water supply and sewage treatment facilities should be located so that future expansion or addition to a building can be done without jeopardizing the use of the existing systems or making it necessary to relocate them.

Also, an existing private water or sewage treatment facility shall be suitably expanded or revised to provide for any proposed building addition. Separate, scattered systems for each expansion of a building will not be permitted.

No condition shall be created or maintained which may result in or cause a potential health or safety hazard.

Section 101. PREPARATION, SUBMITTAL AND APPROVAL OF PLANS AND SPECIFICATIONS

Complete, detailed working plans and specifications for water supply and sewage disposal facilities, or changes to existing facili-

ties, shall be submitted where required to the State Board of Health for review and possible approval, including facilities for building projects such as commercial buildings, institutions, hospitals, nursing homes, motels, organization camps, restaurants, food and drink processing plants, industrial plants, places of public assembly, schools, publicly owned or financed buildings, etc.

Plans and specifications submitted to the State Board of Health for review shall have approval obtained in writing prior to releasing the plans and specifications to bidders or beginning construction.

Plans and specifications submitted to the State Board of Health shall be prepared and/or certified by an architect or engineer currently licensed to practice in Indiana. One copy of any plans and specifications, and revisions thereto, approved by the State Board of Health will be retained and filed by the Board.

Permits for zoning, building construction, and installation of private water supply and sewage disposal facilities are required locally by several cities, towns and counties and such permits must be obtained at least prior to bidding or construction.

Section 102. SOME ITEMS TO BE INCLUDED ON PLANS

The following items are representative of some of the location and construction information to be supplied on plans and specifications:

1. Topography, property lines, streets, drives, roads, buildings and any adjoining lakes, streams or ditches.
2. Location of any water supply sources or structures, water lines, sewers, sewage treatment facilities, etc., for at least 200 feet outside the project property boundary lines.
3. Location and identification of any housing, buildings or other occupied structures, or land uses, such as parks, camps, playgrounds, etc., within at least 1,000 feet outside the project property boundary lines.
4. Details and results of water well test drilling, chemical analysis and potability as necessary.
5. Location and details of *existing and proposed* water supply sources and *underground lines* in regard to all possible sources of contamination.
6. Details of well construction, including method of sealing the casing top and height above grade and flood level at which casing will be terminated.
7. Details of sealing and grouting the well casing.
8. Details of housing the pumping equipment.
9. Details of the pumping equipment including controls, pump capacity and type.
10. Details of the water storage tank or the combination water storage-pressure tank.

11. Provisions for well logs and yield testing.
12. Details of water piping materials, sizes, location and installation.
13. Details of water main construction.
14. Location and details of any type of proposed water treatment.
15. Provisions for disinfection of the water supply system and bacteriological analysis of the water prior to occupant use of the supply.
16. Location and details of existing sewers and proposed sewers, including materials, jointing, infiltration limits, bedding, slopes and elevations.
17. Location and details of manholes, lift stations, etc.
18. Location and details of existing and proposed sewage treatment structures and processes.
19. Location and description of discharge point of outfall sewer from sewage treatment including:
    a. Description and use (existing and probable) of land areas adjacent to outfall discharge points.
    b. Description and location of discharge point of final effluent.
    c. Description, name, location and low water flow estimates of the all-weather receiving water course.
20. If an underground absorption field is proposed, submit percolation test results and maximum ground water elevations, in addition to construction details of the field. (Note: The possibilities of use of underground absorption fields are limited.)
21. Details of plumbing systems in compliance with Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.
22. Details of general construction, heating, ventilating, air conditioning and electrical work in compliance with the regulations of the Administrative Building Council, insofar as applicable.
23. Zoning permit information.

NOTE: Some building uses such as hospitals, nursing homes, motels and mobile home parks must comply with licensing requirements of the State Board of Health.

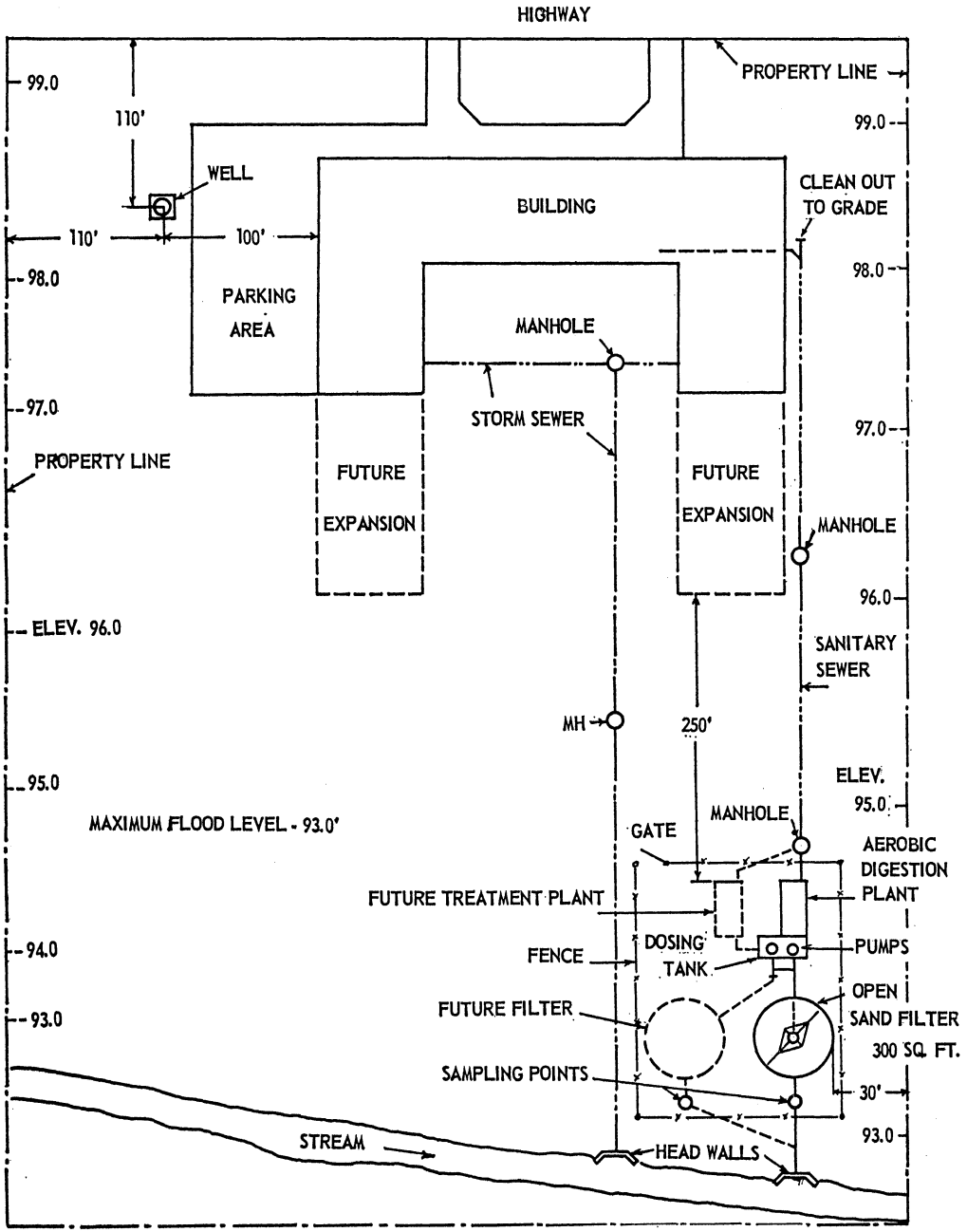


FIGURE 1—LAYOUT OF A WATER WELL AND SMALL SEWAGE TREATMENT FACILITY

Schematic—No Scale

WATER SUPPLY

Section 200. GENERAL REQUIREMENT

Connection to and use of an approved public water supply are basic and primary requirements. However, private wells may be proposed for a water supply source where such private facilities may be approvable.

Section 201. LOCATION OF WELLS

Water wells shall be located a safe distance from all existing and potential sources of contamination. See Table I for minimum allowable separation distances between wells and sources of contamination.

In fissured or creviced water bearing rock formations, greater separation distances than in Table I and other precautions may be necessary to minimize possibilities of water contamination.

Wells shall be located *outside* the foundation walls of buildings. Wells should be located so that the natural topography will provide surface drainage away from the wells. Wells should be located at elevations high enough to prevent any drainage toward them from sewers or sewage treatment facilities or other sources of contamination. Also, wells should be located where flooding does not occur.

It should be particularly noted that private water supply and sewage treatment facilities should be located so that future expansion or addition to a building can be done without jeopardizing the use of the existing systems or making it necessary to relocate them.

Also an existing private water or sewage treatment facility shall be suitably expanded or revised to provide for any proposed building addition. *Separate, scattered systems for each expansion of a building will not be permitted.*

Section 202. CAPACITY OF WELLS

The capacity of the well as indicated by test pumping or yield testing shall be adequate to supply the daily and peak load requirements. Where this is not possible, the water supply system design shall be adequate for daily and peak load requirements. This may involve storage as well as other considerations.

See Table III, page 17, for estimating daily water requirements for drinking and sanitary purposes.

Table I

SOME MINIMUM SEPARATION DISTANCES FOR PRIVATE WATER SUPPLY AND SEWAGE FACILITIES

	Separation in Feet			
	Water Well	Outside of Buildings	Property Lines	Lake or Stream
Buried Sewers and Drains (1) (2)	100 Ft.	10 Ft.	10 Ft.	
Septic Tank	100 Ft.	10 Ft.	10 Ft.	25 Ft.
Aerobic Digestion Plant (2) (3) (4)	100 Ft.	250 Ft. Desirable	25 Ft.	25 Ft.
Open Sand Filter: (2) (3) (4)				
(a) Preceded by Primary Treatment	100 Ft.	250 Ft. Desirable	25 Ft.	25 Ft.
(b) Preceded by Secondary Treatment	100 Ft.	250 Ft. Desirable	25 Ft.	25 Ft.
Buried Sand Filter (2) (3) (4)	100 Ft.	50 Ft.	25 Ft.	25 Ft.
Absorption Field (2) (3) (4)	100 Ft.	50 Ft. Desirable	25 Ft.	25 Ft.
Water Well (4)		Outside Foundation Walls	100 Ft. Desirable	25-100 Ft.

(1) If it is necessary to locate buried sewers or drains closer than 100 feet to a well or pump suction line, extra heavy cast iron soil pipe with caulked and leaded joints shall be used. Extra heavy cast iron sewers and drains shall not be constructed closer than 30 feet to water sources.

(2) No sewage treatment facility or buried sewer or drain shall be closer than 200 feet to a public or municipal water supply well.
In fissured or creviced water bearing rock formations, greater separation distances and other precautions may be necessary to minimize possibilities of water contamination.

(3) Open sewage filters and other open sewage treatment devices should be located down-wind from buildings with respect to prevailing wind direction. *Additional precautions and increased property line and building separation distances may be required in built-up areas and areas that are potential for build-up.*
Sewage treatment devices shall not be located under parking areas, drives, walks, or similar, nor in playground, picnic, assembly or other similar areas.

(4) Sewage treatment devices and water wells should not be located where flooding may occur.
Wells should be located at elevations high enough to prevent any drainage toward them from sewers or sewage treatment facilities or other sources of contamination.

Section 203. PEAK WATER DEMANDS

Peak and instantaneous water demands are often difficult to estimate accurately. For general design purposes, for the establishments listed in Table III, peak water demands for drinking and sanitary purposes may be reasonably estimated at approximately $\frac{1}{3}$ the total daily water requirement over a one-hour period. Table III does not include fire protection water requirements. Also the water supply system shall be designed so that a minimum pressure of not less than 20 pounds per square inch is maintained under all conditions of use.

Section 204. CONSTRUCTION OF WELLS

Drilled and cased wells should be used. The drilling and the casing of the well shall be done in such a way to exclude all surface water and seepage along the outside of the casing into the water-bearing stratum. The well water supply should be obtained from a depth of not less than 20 feet, and from a water-bearing stratum not likely to be contaminated.

The well casing shall be new wrought iron or steel pipe with welded or threaded joints. The casing shall extend to a height of at least 1 foot above finished grade and at least 2 feet above maximum flood level. Where a rock formation contains or overlays the water-bearing stratum, the casing shall be terminated and adequately sealed into the rock with cement grout in accordance with "The American Water Works Association Standards for Deep Wells."

In a sand or gravel or other unconsolidated water-bearing strata, a well screen shall be attached to the bottom of the casing.

Some details of typical well construction are shown in Figures 2 and 3.

Also, where water pressures may exceed 100 pounds per square inch, a pressure reducing valve should be properly installed.

Section 205. SEALING THE TOP OF THE WELL CASING

The top of the well casing shall be adequately sealed to prevent the entrance of contaminants. This may usually be done with a sanitary well casing seal or by use of an approved pitless type well adapter. (See Section 208 for Submersible Pumps.)

However, if a deep well turbine pump is used, the casing should extend up as far as possible into a one-piece pump casting.

Section 206. HOUSING THE PUMP

The pump shall be housed at the well and above grade in an enclosure which provides protection from freezing and has necessary ventilation. (See Section 208 for Submersible Pumps.)

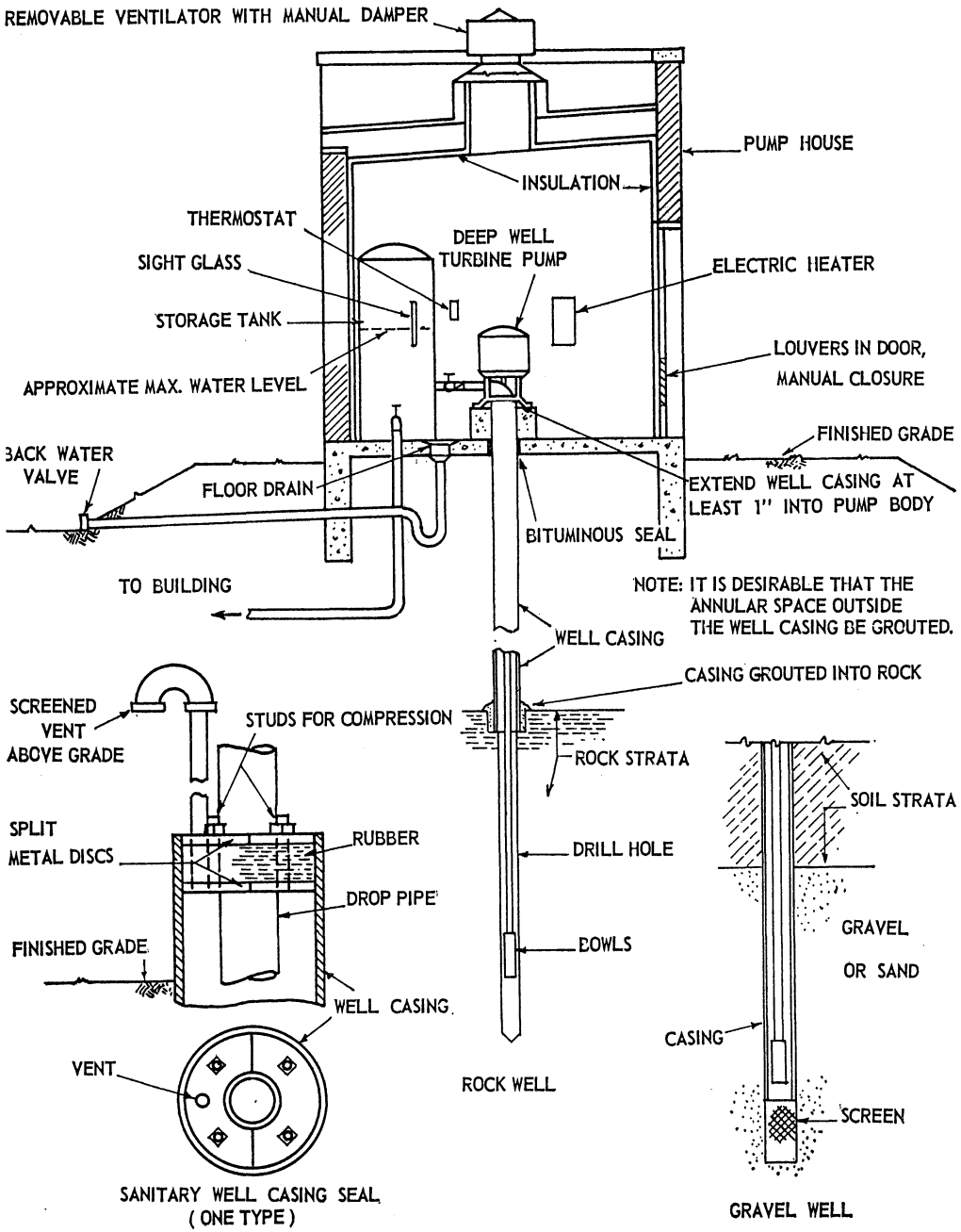


FIGURE 2—PUMP HOUSE AND WELLS
Schematic—No Scale

The floor of the structure shall be concrete and shall be drained by gravity to the ground surface. The well casing shall be sealed at the pump house floor with bituminous material or similar. A detail of one type of pump house is shown in Figure 2.

Section 207. SELECTION OF THE PUMP

Selection of the pump must be correlated with the design conditions for the water supply and distribution system.

For example, where a well has sufficient capacity and other conditions are favorable, so that only a pressure tank need be used, the pump should then have sufficient capacity to deliver the daily water requirements as well as peak demands.

Where water storage is provided, such as elevated storage or by a combination of pressure and storage tanks, then the pump should be selected and sized accordingly.

In any event, the water supply and distribution system should be designed to provide maximum daily water requirements and peak demands at adequate pressures at each point of water use. The water supply system shall also be designed so that not less than 20 pounds per square inch pressure can be maintained under all conditions of use.

Section 208. LOCATION OF PUMP, SNIFTER AND CHECK VALVES

Pumps shall be located at wells.

Where a submersible type pump is used, an approved pitless type well adapter shall be used. The pitless adapter shall extend at least 1 foot above finished grade and 2 feet above maximum flood level and be adequately protected.

The snifter valve and all check valves for submersible type pump installations shall be located inside the well casing.

EXCEPTION: Under special circumstances and conditions, such as where very low water demands occur and occupancy or use is minimal, etc., it may be permitted to offset some types of pumps from a well. However, if this type of installation is permitted, all suction lines shall be permanently and completely encased watertight and airtight and the offset should not exceed 10 feet. The return line of a shallow or deep well jet pump is a suction line.

(See Figure 3, Page 10.)

Section 209. STORAGE AND PRESSURE TANKS AND CONTROLS

Pumps shall discharge into an adequate pressure tank or combinations of pressure and storage tanks. Such tanks shall be located near the pump and pressure tanks shall not be buried unless specifically designed for such operation and constructed of materials and adequately coated to prevent deterioration.

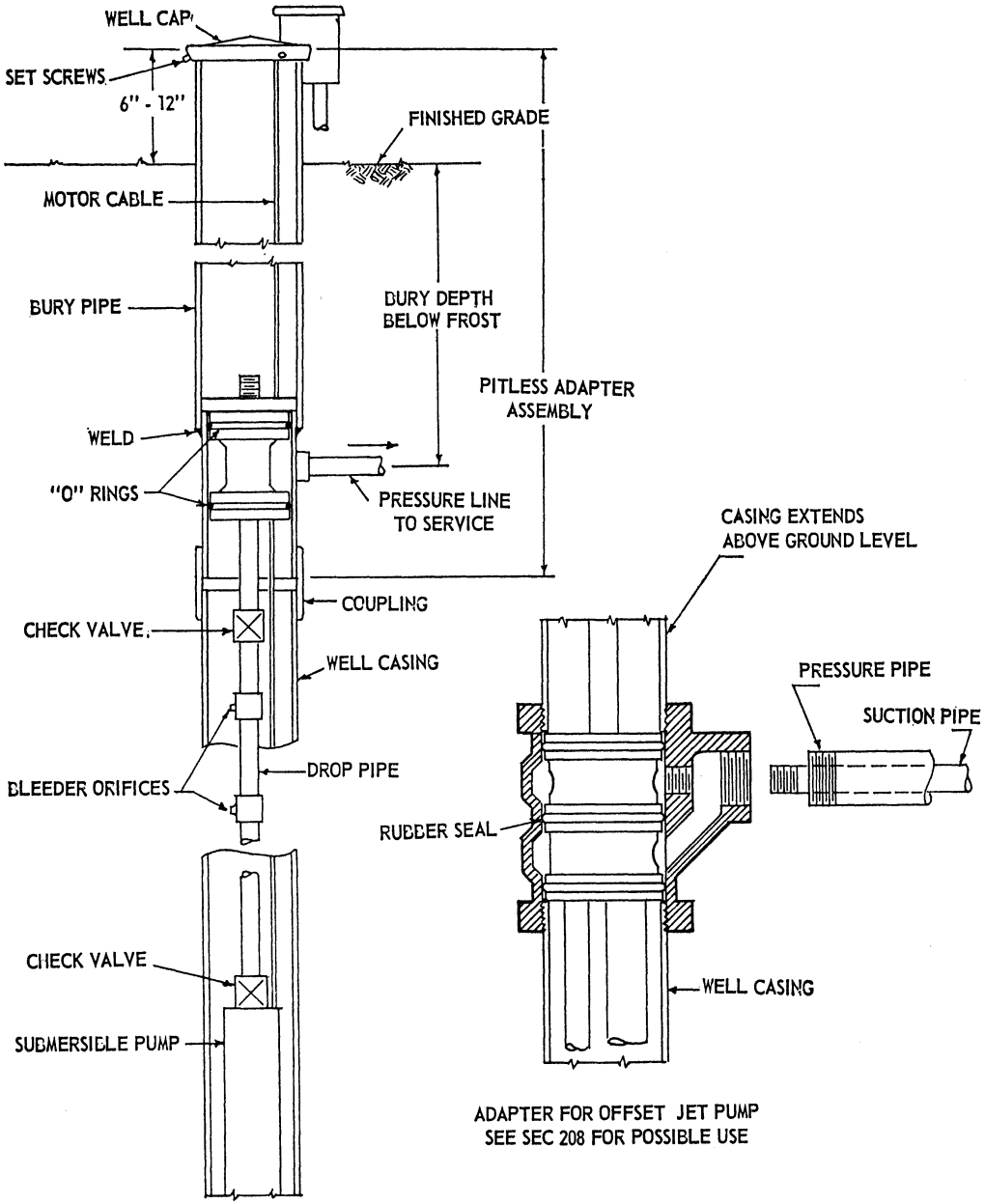


FIGURE 3—PITLESS WELL ADAPTER
Schematic—No Scale

If elevated storage is used, some types of pumps may be selected which can pump directly to the elevated storage, provided they are properly controlled, without use of a pressure tank.

In sizing a pressure tank or a combination pressure-storage tank, the tank air cushion should be calculated at 50 to 60 percent of the tank volume at the pump shut-off pressure. Then, the only water available for storage should generally be considered as the volume of water between the pump shut-off pressure and the pump starting pressure.

With a pressure tank or a combination pressure-storage tank installation, the tank water storage volume and the controls shall be adequate to prevent excessive on-off cycling of the pump and excessive pump running time.

The pumping system shall be automatically controlled to maintain adequate working pressures and water and air volume in pressurized tanks.

The system shall be designed to provide maximum daily water requirements and peak demands with adequate pressure and volume at each point of water use. System pressures under all conditions of use shall not be less than 20 pounds per square inch.

Pressure or compression tanks in a water supply system that may be subjected to excessive pressure shall have an approved type pressure relief valve installed and set to safely relieve the vessel below the safe working pressure of the system.

Where water supply system pressure may exceed 100 pounds per square inch a pressure reducing valve should be installed.

Section 210. DISINFECTION OF THE WATER SUPPLY SYSTEM AND BACTERIOLOGICAL TESTS

Before the water supply system is approved for use, it shall be adequately disinfected and satisfactory bacteriological tests obtained of the water. Disinfection should be carried out under the supervision of the architect or engineer. Sterile bottles for water samples and bacteriological tests may be obtained from private laboratories or the Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, Indiana. A charge will be made for each test made by the State Board of Health Laboratories.

Section 211. CHLORINATION AND OTHER WATER TREATMENT

In some instances, mechanical chlorination, iron removal or other treatment of the water supply may be necessary. In such instances, adequate details shall be furnished as a part of the water supply system plans and specifications. This requirement does not normally include boiler feed water treatment.

Section 212. WATER PIPING

The water supply and distribution system piping, materials and jointing shall conform to the requirements of Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

In buildings where an unsafe, non-potable water distribution system is installed or used, all such unsafe, non-potable water piping shall be completely separate from any other water piping and all such unsafe, non-potable water piping shall be durably color coded with a distinctive yellow paint and plainly labeled at not more than 10 feet pipe intervals with permanent type labels, "NON-POTABLE WATER."

All potable water supply systems shall be designed, installed and maintained to prevent contamination and introduction of toxic materials. There shall be *no* cross connections, either existing or potential.

Section 213. TRENCHING

Water piping shall be adequately protected from freezing and buried water lines shall be laid below prevailing frost penetration. Water lines and sewers shall not be laid in the same trench. A horizontal separation of 10 feet shall be maintained unless special construction is provided as in Article X of Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

It is necessary that crossing of buried sewer lines and buried water lines be avoided.

BUILDING SEWERS

Section 300. GENERAL REQUIREMENT

Connection to and use of an approved public sewer system are basic and primary requirements. However, private sewage treatment may be proposed for sewage disposal where such private facilities may be approvable.

Section 301. LOCATION OF SEWERS

The location of all sewer lines shall at least conform to the minimum separation distances in Table I. A buried sewer located closer than 100 feet to a water supply well or pump suction line shall be constructed of extra heavy cast iron soil pipe with leaded and caulked joints. No buried sewer or drain shall be closer than 30 feet to a well or pump suction line. (See Section 213.)

Section 302. CONSTRUCTION OF SEWERS

Sewers and water lines shall not be laid in the same trench. A horizontal separation of not less than 10 feet shall be maintained unless special construction is provided as in Article X of Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

Sewers and water lines shall be adequately protected from freezing and buried water lines shall be laid below frost penetration depths.

Except as otherwise required in Sections 301 and 302 herein, buried sewers beginning 3 feet outside the foundation walls of buildings may be constructed of vitrified clay, concrete, or asbestos-cement sewer pipe with approved tight joints, or other sewer materials as may be permitted under Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

Sewers shall be laid to a uniform grade to provide velocities of not less than 2 feet per second. Adequate sewer bedding and protection shall be provided. All buried sewers shall be laid deep enough to prevent freezing.

Sewers proposed under driveways, parking slabs, or other heavily loaded areas, shall be adequately constructed to prevent damage or breaking.

Manholes shall be constructed in sewer lines as may be necessary or required.

Section 303. SIZE OF SEWERS

No outside building sewer shall be less than 4 inches in diameter. Minimum sewer diameters will vary upward from 4 inches, according to use. Sewers shall be adequately sized to carry total daily flows as well as necessary allowance for intermittent peak flows. Soil, waste, vent and drain piping inside the building shall comply with Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

TABLE II

MINIMUM SLOPES OF SEWERS

Sewer Size	*Minimum Slope in Feet per 100 Feet*
6-inch diameter	0.80
8-inch diameter	0.40
10-inch diameter	0.28
12-inch diameter	0.22
15-inch diameter	0.15
16-inch diameter	0.14
18-inch diameter	0.12
21-inch diameter	0.10
24-inch diameter	0.08

Section 304. SEPARATE STORM WATER AND SANITARY SEWERS REQUIRED

Storm water run-off, footing drains, roof drains, downspouts, cooling water, etc., shall not be discharged to a private sewage or waste treatment system. Separate storm water drains and sewers shall be provided in accordance with Volume III, the Plumbing Rules and Regulations of the Administrative Building Council.

SEWAGE TREATMENT SELECTION AND LOCATION

Section 400. GENERAL REQUIREMENT

Connection to and use of an approved public sewer system are basic and primary requirements. However, private sewage treatment may be proposed for sewage disposal where such private facilities may be approvable.

Section 401. SELECTION OF PRIVATE SEWAGE TREATMENT

The type and degree of sewage treatment required will vary. For example, the type and the design of a sewage treatment facility for a restaurant operating 18 to 24 hours a day, or a commercial laundry, or a commercial dairy plant in most cases needs to be considerably different than a facility for treating only human excrement from a small building that may be occupied 8 hours a day for 5 days weekly.

It is not practical to give specific standards to be used in selecting the most suitable treatment units, or combination of units, for a particular installation. This can only be done by careful consideration of each proposed project. For example, if a sewage treatment facility is contemplated for discharge of final effluent to a stream, certainly it should first at least be determined if there is an accessible stream having adequate dilution water for the type and degree of treatment contemplated.

Listed below are some generalized selection and design factors as follows:

1. Quantity and rates of sewage flow.
2. Area available for location of treatment systems.
3. Watershed restrictions.
4. Dilution water available in stream.
5. Outfall conditions.
6. Topography in relation to access and gravity flow.
7. Ground water levels and flood or high water levels.
8. Plant operation and maintenance.
9. Surrounding land development and use.
10. Sewage composition and strength.
11. Projected future expansion needs.

Section 402. MAINTENANCE AND OPERATION

It is an indisputable fact that practically any building, structure, device, process, equipment or machine must have adequate maintenance and proper operation if it is to provide the function or service intended.

Certainly private water supply and sewage treatment facilities are no exceptions.

Varying degrees of maintenance and operation will be needed

for private sewage treatment facilities, depending generally upon their type, complexity and loading.

Septic tanks need periodic scum and sludge removal. Open sand filters need periodic raking, weed and grass removal, and top layer sand removal and replacement. Grease and oil separators must be periodically cleaned and the greases and oils incinerated or otherwise disposed of by sanitary methods. Rotary distributors will require periodic cleaning and flushing of the ports. Sewage pumps, screens, etc., must have attention.

Water supply systems, including pumps, pressure and storage tanks and controls, etc., must also receive periodic inspection and maintenance.

Listed below are a few suggestions that the designing engineer, the vendor and the contractor should consider in this regard:

1. At the completion of the job, explain to the owner and the maintenance supervisor the limitations of the system and outline check points and needs for routine maintenance and inspection.
2. Provide the owner and the maintenance supervisor with adequate written operating and maintenance instructions and a schematic diagram of the system showing all controls, valves, pumps, units, devices, etc.
3. In design, give consideration to providing adequate warning or alarm systems, etc., from vital points of possible failure or inoperation in the system. Such alarm or warning systems should be carefully designed and installed tamper-proof so that they cannot be disconnected or by-passed. For example, a grease or oil separator, if allowed to by-pass or overflow through a lack of cleaning, may cause a part of a sewage treatment system to become inoperative.
4. Also in design, adequate space for access, operation and maintenance should be provided. For example, if valves are located so that access is not easy, this defeats operation. On the other hand, if equipment that needs periodic servicing, maintenance or inspection is placed in enclosed spaces too small to permit access, this again hinders operation and maintenance.

Section 403. GREASES, OILS, ACIDS, ALKALIS AND OTHER DELETERIOUS SUBSTANCES

No substance of a quantity or type deleterious to the sewage treatment process shall be discharged directly into the sewage treatment facility. Such substances shall be adequately pretreated, or separately treated and disposed of, or necessary additional treatment provided.

It should not be assumed that the sewage treatment devices outlined in Sections 503 through 508 are adequate for all types of sewage and waste treatment.

For example, at an animal laboratory where the waste may contain quantities of hair, flesh and other organics, it is not generally possible to adequately treat such waste by methods outlined in Sections 503 through 508. At a large restaurant operating 7 days a week, it is not likely that these methods will successfully handle the greases, oils and garbage. Further, at a commercial laundry, the treatment processes as outlined in Sections 503 through 508 may not be expected to handle this type of waste. The lint, soaps, scale, detergents, etc., involved present quite a different treatment problem.

Section 404. GARBAGE DISPOSAL

Limited amounts of ground or shredded garbage may be discharged to the building sewer for treatment and disposal through a private sewage treatment facility. However, where a major portion of the organic loading on the facility would be ground garbage, such as from a produce department of a super market, restaurant or similar, other methods of garbage disposal are necessary.

Where limited amounts of ground garbage are disposed of through a private sewage treatment facility, or when this is anticipated, necessary provisions for this load should be made in the design of the treatment facilities. Some general provisions where limited amounts of ground garbage are to be disposed of will include: (1) Increased detention and sludge storage capacity; (2) Increased treatment capacity.

Section 405. INDUSTRIAL AND PROCESSING WASTE TREATMENT

It is necessary that the Industrial Waste Section of the Division of Sanitary Engineering of the State Board of Health be consulted for recommendations prior to design or installation of any industrial or processing waste treatment facilities.

Industrial and processing wastes require more specialized design considerations and treatment than outlined in this bulletin. However, in some small intermittent food, meat or milk processing operations, some of the sewage treatment methods outlined in Sections 503 through 508 may be feasible. Generally this should be confined to establishments having estimated maximum daily waste flows of not more than 10,000 gallons per day.

Flow estimates for poultry killing and processing may range from 5 to 10 gallons per bird; for swine, 100 to 150 gallons per hog; for cattle, 300 to 400 gallons per beef; and milk processing plants from 150 to 250 gallons of waste per 1,000 pounds of milk handled.

Section 406. LOCATION REQUIREMENTS

It is essential that safe distances be maintained between water supplies and sewage treatment facilities. (See Table I.)

In addition to Table I, most of the generalizations in Section 401 may be used advantageously in terms of "Location Requirements."

It should be particularly noted that private water supply and sewage treatment facilities should be located so that future expansion or addition to a building can be done without jeopardizing the use of the existing facilities or making it necessary to relocate them.

Also, an existing private water or sewage treatment facility shall be suitably expanded or revised to provide for any building addition. Separate, scattered facilities for each expansion of a building will not be permitted.

TABLE III

*SOME SEWAGE FLOWS

*Type of Establishment**	*Gallons of Sewage per Day*
1. Nursing Home (per person)	80–120
2. Hospitals (per bed)	300–500
3. Motels and Hotels (per room)	60–100
4. Schools (without gymnasium and showers—per academic classroom)	500–600
5. Schools (with gymnasium and showers—per academic classroom)	800–900
6. Camps	
a. With shower and handwashing facilities only (per person)	20–30
b. With toilets, showers, handwashing and food service (per person)	40–60
7. Places of Employment (does not include industrial waste—per employee per shift)	15–35
8. Picnic Parks and Areas (per person)	5–10
9. Drive-in Theatres (per ramp parking space)	7–7
10. Mobile Home Parks (per mobile home parking space)	150
11. Small Eating Establishments (toilet and food service wastes per meal served)	7–10
12. Swimming Pool Bathhouse Facilities (per person)	10–15
13. Service Stations (without wash racks)	400
(with wash racks)	1000
14. Bars and Cocktail Lounges (per seat)	35–50
15. Bowling Alleys (per alley)	100

* The flows listed indicate a reasonable approach for the type of establishment referred to. Additional considerations will be necessary in some cases.

For building uses not mentioned in Table III, flow estimates should be submitted for preliminary design review and possible approval prior to proceeding with final plans.

SOME SEWAGE TREATMENT DEVICES

Section 500. EXPLANATION OF PRIMARY, SECONDARY AND SOME OTHER SEWAGE TREATMENT

Generally speaking, private sewage treatment within the scope of this bulletin may roughly be divided into four groups:

1. Primary treatment which is sedimentation or settling out of a limited portion of suspended sewage solids.
2. Secondary treatment which involves the removal of a high percentage of suspended, colloidal and dissolved organic matter.
3. Sand filters following either primary or secondary treatment.
4. Underground absorption fields following septic tanks for small sewage flows where soil and ground water conditions are favorable.

Within the intended scope of this bulletin, it may be reasonably expected that the minimal private sewage treatment required will be primary treatment followed by an absorption field or sand filter and, in many instances, secondary treatment followed by sand filtration.

Section 501. SOME SEWAGE TREATMENT DEVICES

It should be restated that the basic sewage treatment devices outlined in Sections 503 through 508 do not provide adequate treatment for many sewage and waste problems.

There are several types, devices and methods of sewage treatment which may be proposed as a part of private sewage treatment. Some of these include mechanical package type treatment, trickling filters, waste stabilization ponds, screens, sludge drying and storage, secondary settling tanks, aeration and aerobic digestion, coagulation and precipitation, separators, comminutors, etc.

Most of these types, devices and methods of treatment, and others, require a specialized engineering design approach.

It should be pointed out, however, that waste stabilization ponds are generally only feasible for some municipal or similar uses.

Section 502. AEROBIC DIGESTION SEWAGE TREATMENT

Aerobic digestion plants providing 24-hour aeration for sewage of average strength have been successfully utilized for treatment of sewage and organic wastes from schools, subdivisions, mobile home parks and similar occupancies.

The considerations for location of these plants should be similar to that of other exposed sewage treatment facilities. The plant must be securely fenced for safety considerations and to avoid vandalism.

The effluent from these plants may receive the same consideration as that from other treatment facilities. Therefore, the

requirement of sand filters and/or chlorination will generally depend upon the dilution water available and downstream water uses.

The design of such treatment facilities must be adapted to the specific installation; however, the following general approach should be considered:

1. Comminuting equipment should be provided. Garbage grinders in food service establishments will increase the organic loading which must be given special consideration.
2. The aeration tank is normally designed for a 24-hour detention for average strength sewage (0.17 pounds of B.O.D. per capita per day). Duplicate units are desirable to permit flexible operation.

   Duplicate blower of compressor units should be provided. If mechanical aeration facilities are utilized, a separate aeration mechanism should be provided. The air supply should provide at least 2,000 cubic feet of air per pound of B.O.D. applied, at least 3 cubic feet of air per minute per foot of tank length, and be adequate to maintain aerobic conditions throughout the plant.

   All aeration tanks utilizing diffused air should be equipped with easily removable diffuser headers to permit inspection and service without dewatering the tank. Shut-off valves must be provided on each air header.
3. The final settling tank should provide at least 4 hours detention based upon the average daily flow exclusive of the sludge hopper. Surface settling rates should not exceed 600 gallons per square foot per day and weir overflow rates should not exceed 5,000 gallons per day per lineal foot of weir. Positive sludge return to the aeration tank must be provided.
4. Sludge holding tanks may be required.
5. The plant must receive discharge only from properly designed and constructed sanitary sewers. Roof and foundation drains, cooling water and storm runoff must be excluded.

Section 503. SEPTIC TANKS

A septic tank provides only partial sewage treatment. A large part of the outflow from a septic tank is raw or inadequately treated sewage.

Where used, septic tanks shall at least be provided with sand filtration or underground absorption fields as may be required or feasible. See Section 508 for some limitations of use of absorption fields.

1. Location of Septic Tanks

The location of septic tanks shall at least conform to the minimum separation distances in Table I. Openings in tops of tanks

shall be above maximum ground water elevation. Surface water drainage over tanks shall be away from the water wells. (See Figure 1.)

2. Use and Capacity of Septic Tanks

The minimum liquid capacity of any septic tank shall be not less than 750 gallons. The quantity of sewage flow for preliminary estimates of tank liquid capacity may be taken from Table III.

Tank liquid capacities should be sufficient to allow for at least 24 hours detention. However, in some instances where a tank is large and used intermittently, the detention time may be reduced.

It is preferable that one tank be used. If multiple tanks must be used, then not more than three tanks connected in series should be used. The minimum capacity of any tank in series shall be not less than 750 gallons.

The extent of use of septic tanks is limited due to the low degree of primary treatment provided.
(See Figure 4, Page 21.)

3. Construction of Septic Tanks

a. Septic tanks should be constructed water-tight and of durable materials not subject to excessive corrosion or decay. Metal tanks shall meet Commercial Standard CS 177-51 or better.

b. Minimum tank liquid capacity of 750 gallons.

c. Tanks shall be adequately reinforced to prevent structural failure.

d. Cast-in-place concrete tanks shall have the walls and floor at least six inches thick poured from a 1:2:3 mix in one operation.

e. Concrete block tanks shall have at least eight-inch walls with cores filled with concrete and be reinforced at the corners. The blocks shall be laid with tight mortar joints. The walls shall be set on a concrete slab at least six inches thick and the wall-to-floor connection shall be satisfactorily sealed.

f. The liquid depth of a tank or compartment shall be not less than 30 inches. Liquid depths greater than 6½ feet are not advisable.

g. The tank inlet baffle or sanitary tee shall extend 6 inches below the liquid level and above the liquid level at least to the top of the inlet sewer.

h. The tank outlet baffle or sanitary tee, and baffles or submerged pipes between compartments, shall extend below the liquid level a distance 4/10 times the tank liquid depth.

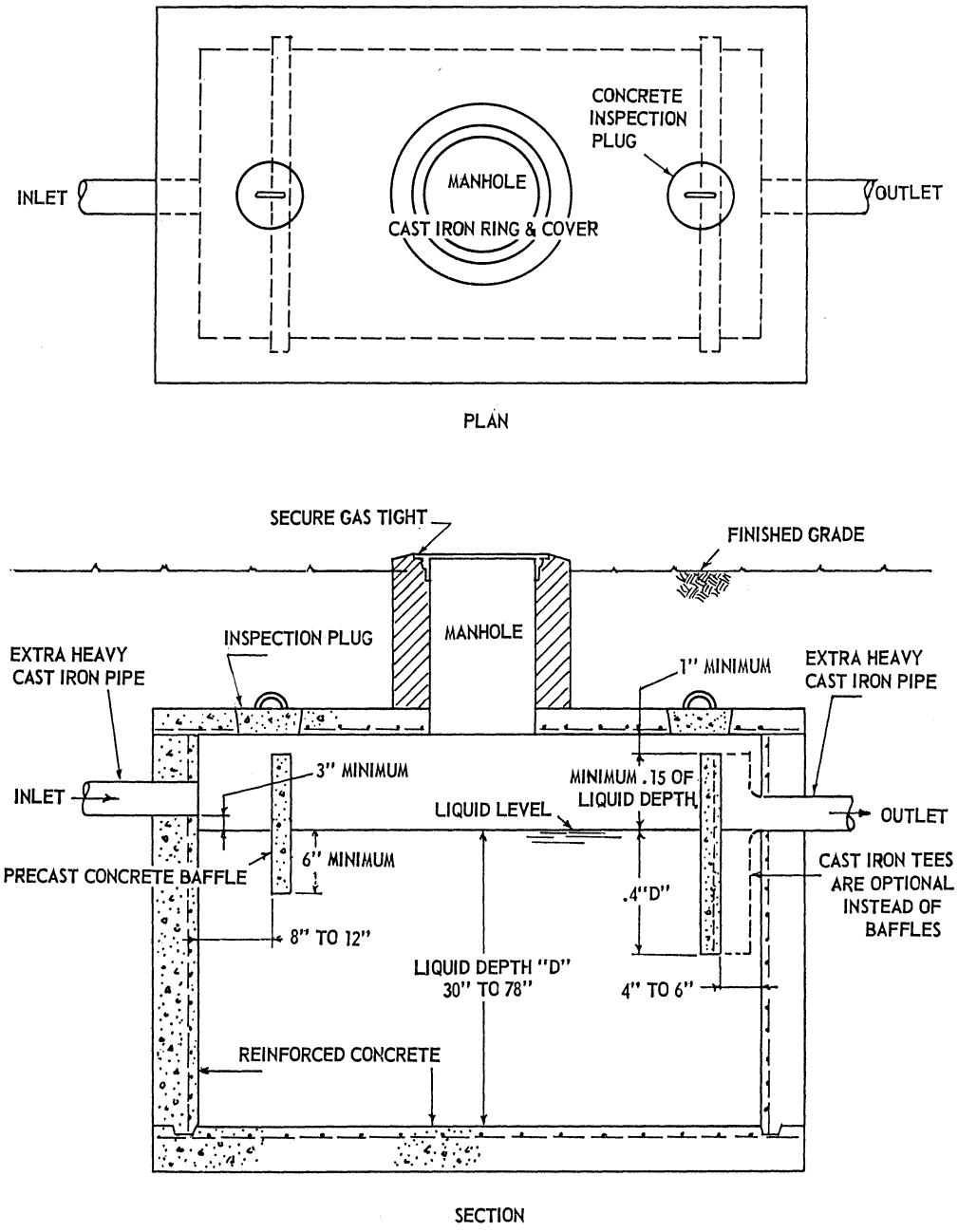


FIGURE 4—SEPTIC TANK
Schematic—No Scale

i. There shall be at least 1 inch clear space between the underside of the tank cover and the top of the inlet and outlet baffles or tees.

j. Scum storage capacity (space between the liquid level and the top of the inlet and outlet baffles) shall be not less than 15% of the total liquid capacity of the tank.

k. Where baffles are used, the tank inlet baffle shall not be more than 12 inches or less than 8 inches from the inside of the inlet end of the tank. The outlet baffle shall not be more than 6 inches or less than 4 inches from the inside outlet end of the tank. Baffles shall be constructed of durable materials not subject to excessive corrosion or decay.

l. The bottom of the inlet to the tank or the first compartment receiving the flow shall not be less than 3 inches above the flow line of the outlet from that compartment.

m. Access manholes, extending to the ground surface and fitted with safely secured, gas-tight covers, shall be provided for each tank or compartment.

n. Access for inspection shall be provided in the top of the tank above the inlet and outlet device of each tank and compartment.

o. See Figure 4 for representative tank details.

Section 504. SAND FILTER MEDIA

One of the most important factors in sewage sand filter design and construction is the obtainment of the correct sand size for efficient filtering and minimal clogging. It should be particularly noted that highway sand specifications, concrete or mortar sand specifications, or bank run sand, *will not* achieve the desired results. The specifications for such sands *are not* intended as a filtration media for organic and other wastes.

In the obtainment of a satisfactory sewage sand filter media, the following basic features must be considered:

1. The sand must be washed clean.
2. The sand must have a uniform particle size.
3. It may be necessary to set up the proper screens and screen the sand on the job in order to obtain the necessary sand characteristics.
4. Sufficient samples must be taken to establish uniformity of particle size and effective size, prior to placing the sand in the filter.
5. The filter sand must be placed evenly at least 2 feet thick in the filter.
6. Erosion of earth or any mixing or spilling of earth on or into the filter sand must be avoided.

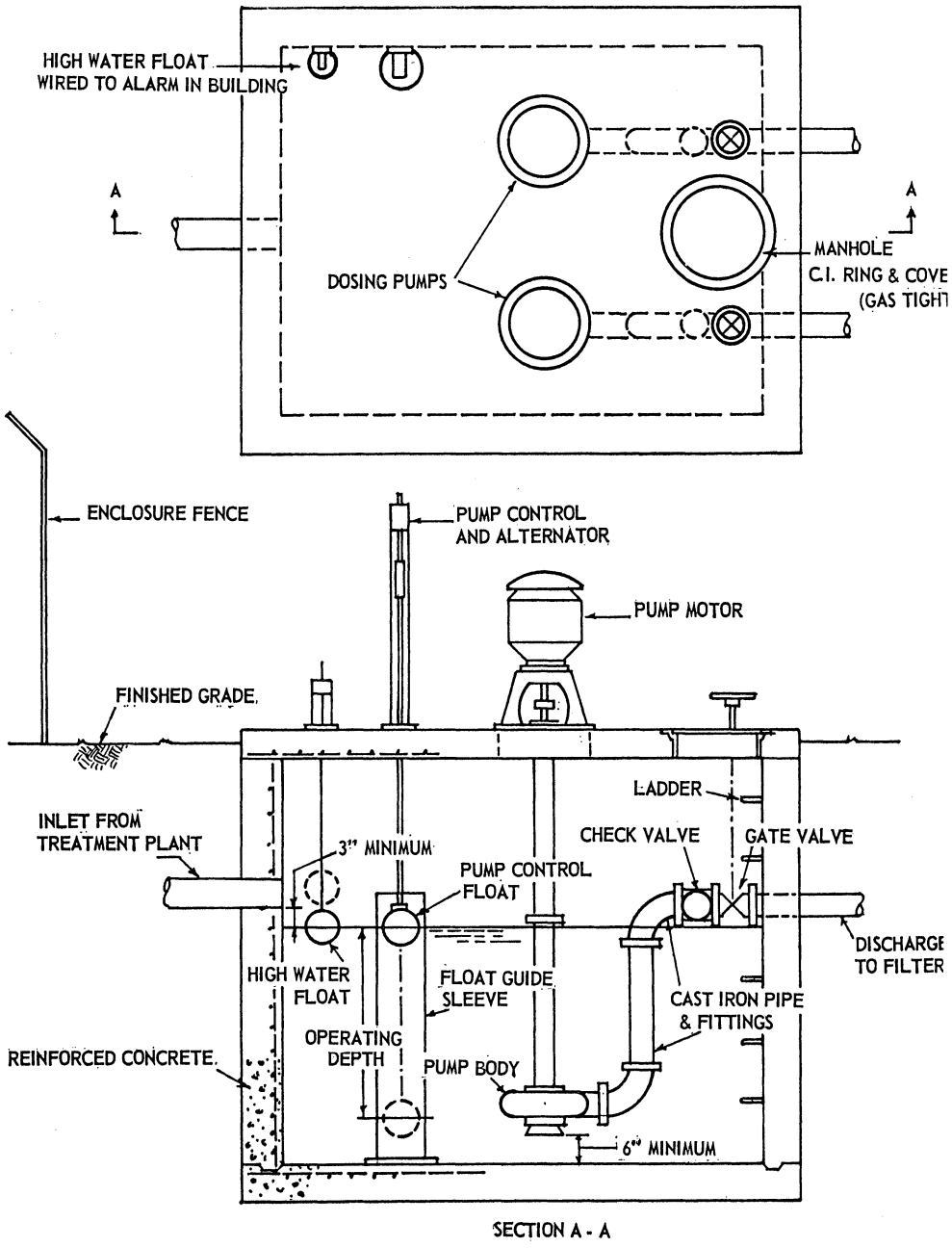


FIGURE 5—DOSING TANK AND ALTERNATING PUMPS
Schematic—No Scale

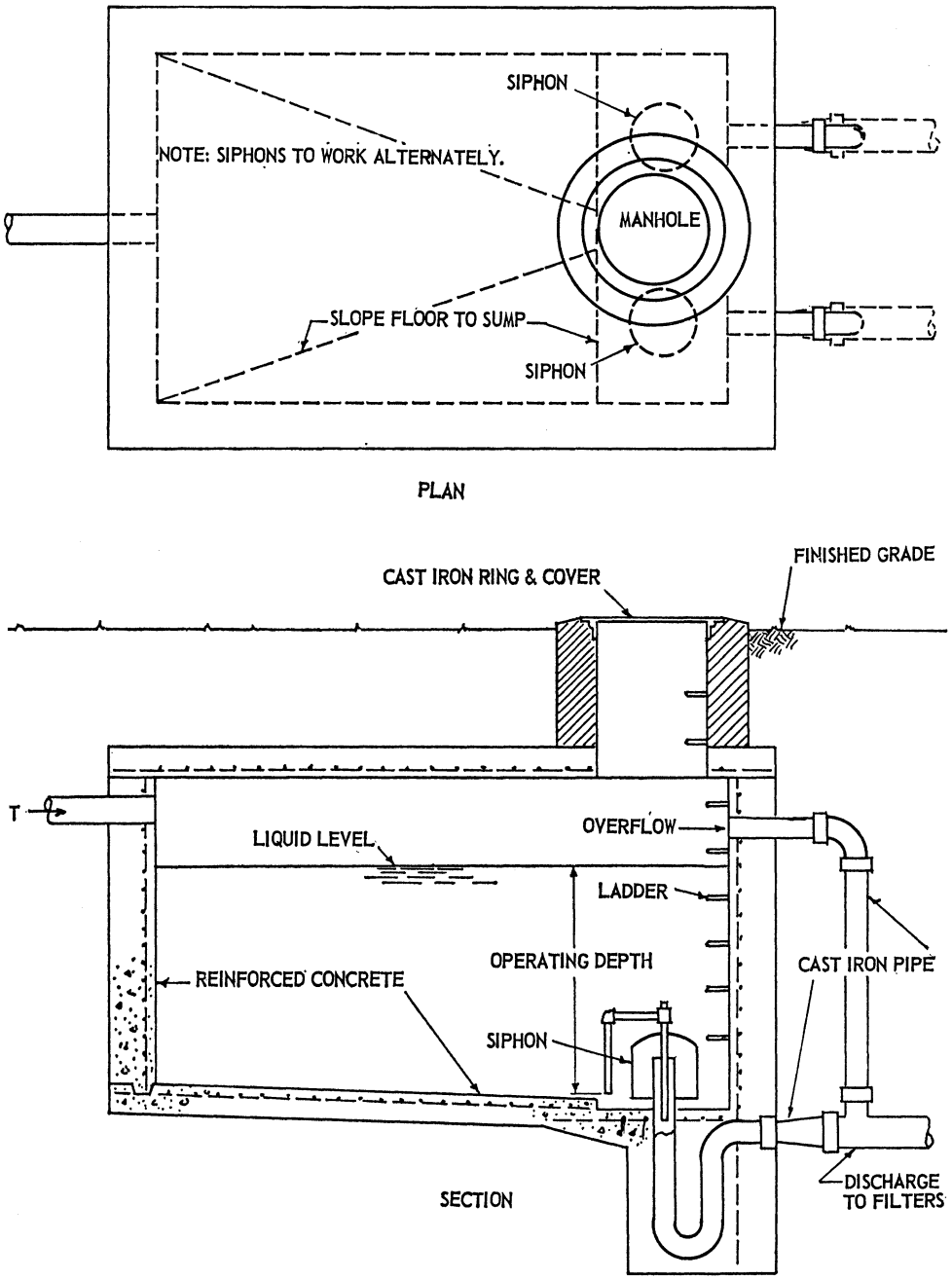


FIGURE 6—DOSING TANK AND SIPHONS
Schematic—No Scale

7. Placement of the filter sand and any other construction work must be carefully done to prevent underdrain breakage or other damage.

Section 505. OPEN SAND FILTER USE AND CONSTRUCTION

Open sand filters are easily accessible for maintenance and inspection. They can be loaded at higher rates than sub-surface sand filters. With proper use, construction and maintenance, they will generally provide a higher degree of treatment than sub-surface sand filters.

The discharge point of final effluent from sewage sand filters and similar shall be selected and located so that a potential health hazard or insanitary condition will not result.

1. Use of Open Sand Filters Required

Wherever sand filters are required or proposed as a part of sewage treatment, such filters *shall be open sand filters.* (See Section 506 for possible exception.)

2. Location of Open Sand Filters

Filters shall be located on a leveled area and above flood levels.

Other location requirements are set forth in Table I. (Also see Section 401.)

3. Dual Sand Filter Unit Requirements

The surface area of each dual sand filter unit shall not be less than approximately one-half of the total filter area required.

The total additive surface area of multiple sand filter units shall be not less than the total filter area required.

a. Open sand filters preceded by primary treatment

Where the total required sand filter surface area exceeds approximately 400 square feet, dual sand filters with alternate dosing shall be provided.

b. Open sand filters preceded by secondary treatment

Where the total required sand filter surface area exceeds approximately 400 square feet, dual sand filters with alternate dosing shall be provided.

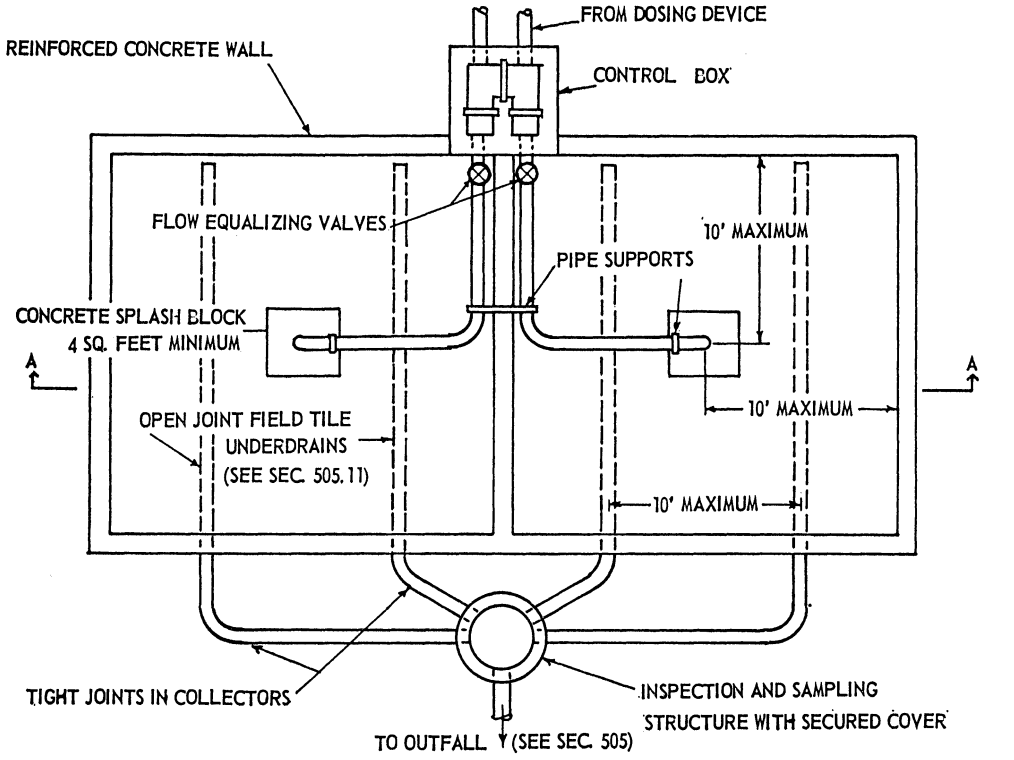
4. Use of Rotary Distributors Required

Where the total required sand filter surface area exceeds approximately 1,500 square feet, rotary distributors or the equivalent shall be used to distribute the sewage on the filters.

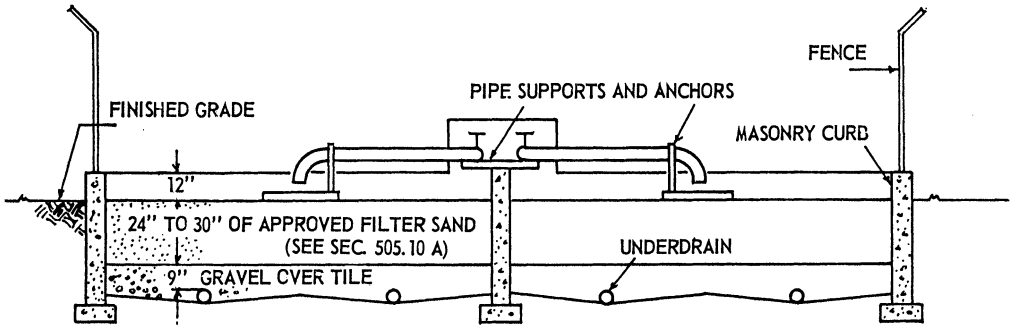
5. Sizing and Loading Open Sand Filters

a. Open sand filters preceded by primary treatment

Open sand filters preceded by primary sewage treatment shall be sized at a loading rate not to exceed 3 gallons per square foot per day.



PLAN



NOTE: GRAVEL IN 3 COURSES
UPPER 3" - 1/8" TO 1/4"
MIDDLE 3" - 1/4" TO 3/4"
LOWER COURSE - 3/4" TO 1-1/2"

SECTION A - A

FIGURE 7—OPEN SAND FILTER WITH SPLASH BLOCKS
Schematic—No Scale

b. Open sand filters preceded by secondary treatment
Open sand filters preceded by secondary sewage treatment shall be sized at a loading rate not to exceed 10 gallons per square foot per day.

6. Dosing Open Sand Filters and Dosing Tank Size

a. Open sand filters preceded by primary treatment
Open sand filters preceded by primary sewage treatment shall be dosed not to exceed 3 times per day.

b. Open sand filters preceded by secondary treatment
Open sand filters preceded by secondary sewage treatment shall be dosed not to exceed 6 times per day.

c. Dosing tanks and devices required
Dosing tanks and suitable dosing devices shall be provided for dosing open sand filters. Dosing devices shall be automatically controlled. Pumps are preferable for dosing devices.

Where dual or multiple filter units are used, alternate dosing shall be provided. The capacity and head of the dosing devices, and the pipe size and connections between the devices and the filter, shall be adequate to effectively dose the filter.

7. Distribution of Sewage on Open Sand Filters

a. Rotary distributors
Rotary distributors shall be of the impulse type.

b. Splash plates and flow equalizing valves
Splash plates and distributing pipe to splash plates shall be securely anchored.

Splash plates shall have sufficient area to minimize filter sand erosion around the plate. Splash plates shall have a minimum of 4 square feet area.

Adjustable equalizing valves or gates shall be placed in the pipes to splash plates so that the flow to each plate can be equalized.

The splash plates and the filter sand surface shall be constructed and maintained level.

The maximum filter area served by one splash plate shall not exceed approximately 400 square feet, with a maximum lateral travel of approximately 15 feet.

8. Curbs and Fencing for Open Sand Filters

All open sand filters shall have masonry curbs or the equivalent. Earth walls or earth curbs shall not be used.

a. Curbs
Curbs for filters using rotary distributors shall extend not less than 1 foot above the bottom of the distributor arm.

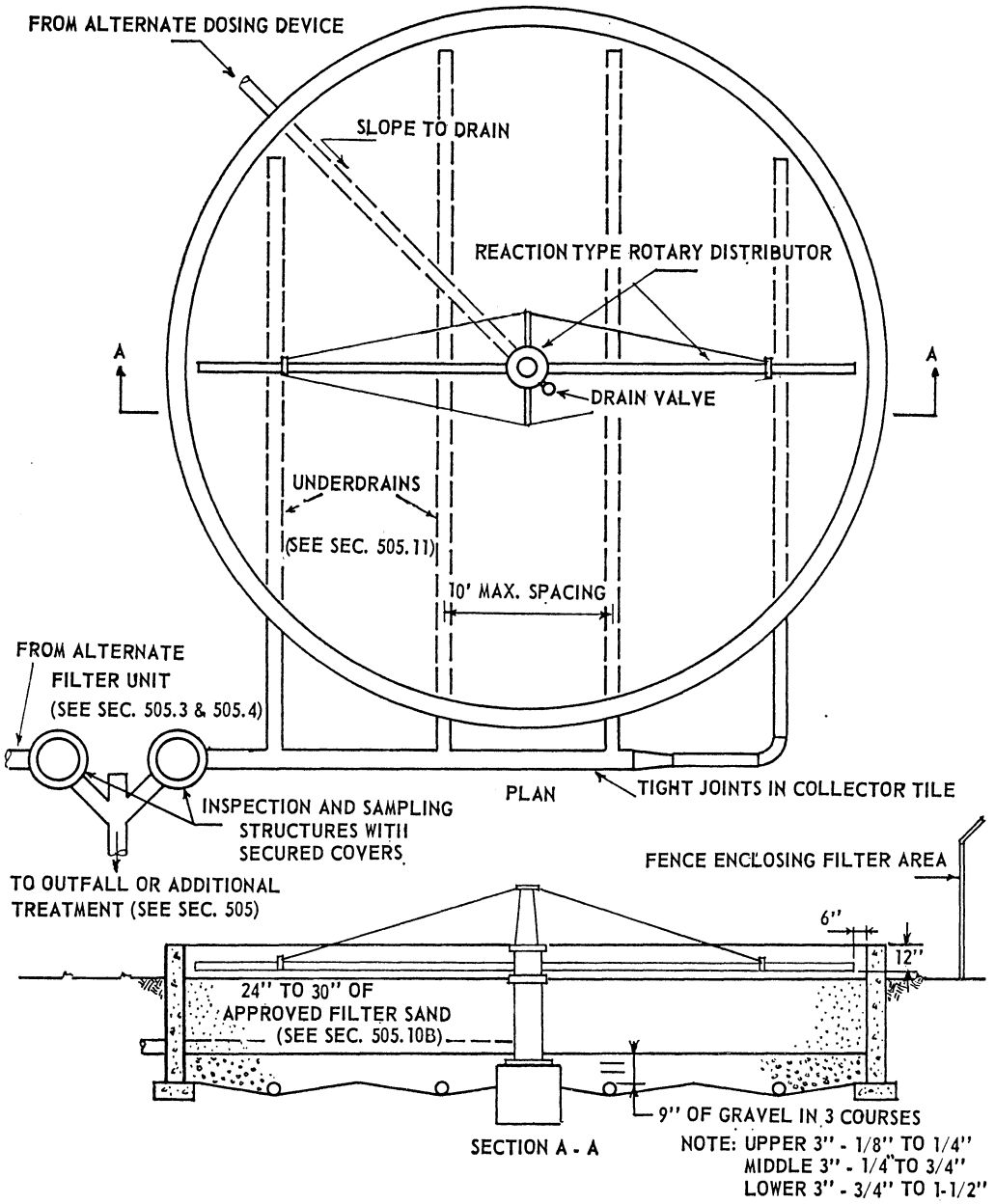


FIGURE 8—OPEN SAND FILTER WITH ROTARY DISTRIBUTOR
Schematic—No Scale

This will help minimize the build-up of ice in winter and prevent contamination of the surrounding area due to strong winds blowing the sewage as it discharges from the ports.

Curbs for filters using splash blocks shall extend not less than 1 foot above the top of the filter sand.

All curbs shall have adequate footings and footing depth, or other structural arrangement, to prevent heaving and to assure safety.

b. Fencing

All open sand filters shall have adequate protective fencing with access gates.

9. Inspection and Sampling Access Structures Required

An adequate inspection and sampling access structure shall be provided in the outfall sewer from each sand filter unit, immediately adjacent to each filter. This may be a manhole type structure or the equivalent not less than 2 feet in diameter.

The access structure shall at least extend upward to finished grade. A safe, securely fastened, vandal-proof cover shall be provided.

10. Filter Sand Requirements

The filter sand shall be clean, sharp, uniform sand.

The filter sand shall be placed not less than 2 feet deep in the filter.

a. Filter sand size when distribution is by splash blocks and similar

For this type of sewage distribution on open sand filters, the filter sand shall have an Effective Size of 0.3 to 0.6 millimeters with a Uniformity Coefficient not greater than 3.5.

b. Filter sand size when distribution is by rotary distributor

For rotary distribution of sewage on open sand filters, the filter sand shall have an Effective Size of 0.4 to 1.0 millimeters with a Uniformity Coefficient not greater than 3.5.

NOTE CAREFULLY that in order to obtain and maintain desirable filter operation and results, it may be IMPERATIVE THAT THE CONTRACTOR SET UP THE PROPER SCREENS AND SCREEN THE SAND ON THE JOB. Sufficient samples and analysis must be made of the screened sand to assure the filter sand size requirements are met.

11. Underdrains

The filter underdrain system shall consist of not less than 4-inch diameter drain tile laid with ¼-inch open joints, or not less than 4-inch diameter perforated pipe having at least

½-inch diameter holes spaced uniformly at intervals to at least provide a free, open area equivalent to comparable size drain tile laid with at least ¼-inch open joints.

Underdrains shall be spaced not more than 10 feet apart and slope not less than 2 inches in 20 feet.

The filter floor shall slope to each underdrain. Underdrains shall be covered to a depth of not less than 9 inches over the top of the drains with washed, graded gravel placed in three layers.

The bottom layer of gravel shall be ¾ to 1½-inch diameter, the second layer shall be ¼ to ¾-inch diameter, the top layer shall be ⅛ to ¼-inch diameter.

It is important that the gravel be washed clean and sized and placed as indicated to prevent clogging of the underdrains.

12. Grass and Weed Removal From Open Sand Filters

Periodically during the growing season, grass, weeds and other plant growth must be completely removed from the filter surface.

This may be done manually or by use of suitable herbicides. If herbicides are used, extreme caution must be observed to prevent any possible toxic conditions at the outfall which might result in pollution or hazards to humans or animals.

Section 506. SUB-SURFACE SAND FILTERS

1. Limitations of Use

The use of sub-surface sand filters is limited to situations or locations involving special or unusual circumstances or conditions, and then for only small, intermittent daily sewage flows.

Access and maintenance of sub-surface sand filters are not possible without completely tearing out the filter. Loading rates are much lower than for open sand filters.

Construction of sub-surface sand filters is difficult and such filters have a limited operational life.

The discharge point of final effluent from sewage sand filters and similar shall be selected and located so that a potential health hazard or insanitary condition will not result.

2. Location of Sub-Surface Sand Filters

Filters shall not be located where excessive ground water infiltration occurs, and they shall be located above flood level. They shall also be located on a leveled area.

The total depth of the filter, measured from the top of the finished grade to the bottom of the filter, shall not exceed approximately 6 feet.

No sub-surface filter unit shall be placed under walks, playgrounds, parking areas, drives, or similar.

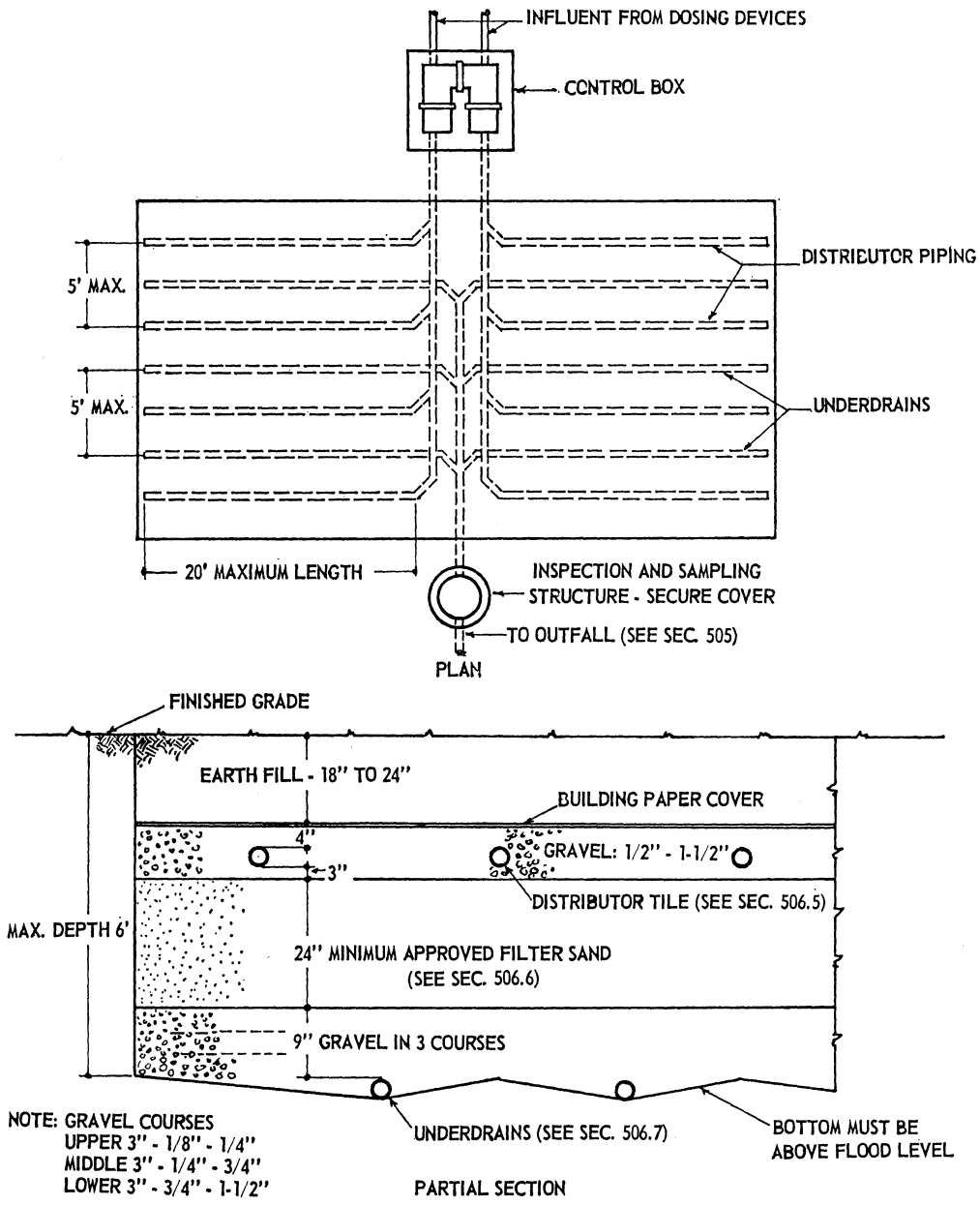


FIGURE 9—SUB-SURFACE SAND FILTER
Schematic—No Scale

Additional location requirements in Table I must be complied with.

3. Sizing and Loading Sub-Surface Sand Filters

The filter shall be sized at a loading rate of not more than 1½ gallons per square foot per day.

Where the total required sand filter area exceeds approximately 400 square feet, dual or multiple filter units with alternate dosing shall be provided.

4. Dosing Sub-Surface Sand Filters

The filters shall be dosed using a dosing tank and suitable dosing devices. The dosing tank and dosing device shall be sized so that each filter unit shall not be dosed more than 3 times per day.

Alternating dosing shall be provided for dual filters. Dosing devices shall be automatically controlled. The dosing device capacity and head shall be adequate to effectively dose the filters. Pumps are preferable for dosing.

5. Distribution of Sewage on Sub-Surface Sand Filters

The sewage shall be distributed over each filter through drain tile or properly perforated pipe.

The distributor tile or pipe shall be not less than 4 inches in diameter. The piping from the dosing device and the distributor piping shall be adequately sized to take the dose applied.

Tile distributors shall be laid with not less than ¼-inch open joints.

Perforated pipe distributors shall have at least ½-inch diameter holes spaced uniformly around the pipe at intervals to at least provide a free, open area equivalent to the comparable size drain tile laid with at least ¼-inch joints.

The filter distributors shall not exceed 20 feet in length and shall be laid approximately 5 feet apart.

The distributors shall be laid in clean coarse gravel ½ to 1½ inches in size, and this coarse gravel shall extend from 3 inches under the distributors to at least 4 inches above the distributors. This gravel shall be continuous across the filters.

A layer of untreated fibre paper or straw shall be placed continuously over the top of the coarse gravel which covers the distributors, and then 12 to 24 inches of earth backfill shall be placed on the paper or straw.

6. Filter Sand Requirements for Sub-Surface Sand Filters

The filter sand shall be clean, washed, and sharp and placed not less than 2 feet deep in the filter.

The filter sand shall have an Effective Size of 0.3 to 0.6 millimeters with a Uniformity Coefficient not more than 3.5.

7. Underdrains

The underdrain system shall be constructed as in Section 505.11 (Open Sand Filters) except that the spacing of the underdrains for a sub-surface filter shall not exceed 5 feet.

8. Inspection and Sampling Access Structures Required

Inspection and sampling structures shall be provided for each filter unit as in Section 505.9 (OPEN SAND FILTERS).

Section 507. DISINFECTION OF FINAL EFFLUENT

At some locations additional treatment may be required including chemical disinfection of final effluent by use of adequate chlorination facilities. Where additional treatment is required, design and construction details shall be provided as a part of the plans and specifications.

Section 508. SUB-SURFACE ABSORPTION FIELDS

1. Location and Limitations of Use

Under favorable conditions of soil permeability and low ground water levels, sewage effluent from septic tanks may be disposed of by absorption fields. These fields are limited to small daily sewage flows. They shall not be located under drives, parking areas, playgrounds, gardens or similar. Other location requirements shall conform to Table I.

2. Sizing Absorption Fields

Absorption fields shall be sized in accordance with Percolation Test results. See Figure 11 for Percolation Coefficients. The Percolation Coefficient is the square feet of trench bottom area required per gallon of sewage supplied daily to the absorption field.

Absorption fields having 1,000 lineal feet or more of trench shall be dosed using a dosing tank and a dosing device. Such fields shall be dosed not more than 4 times per day.

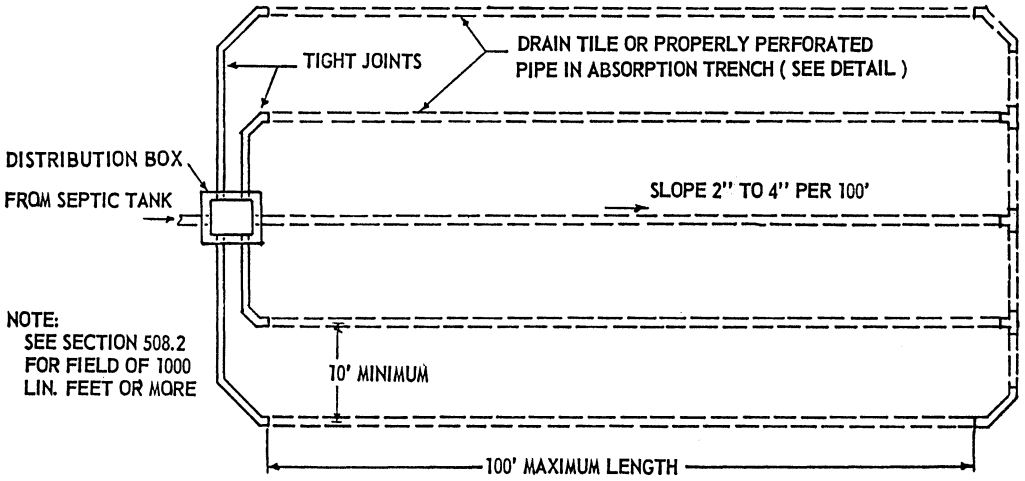
3. Percolation Test Procedures

After a site for the absorption field has been selected, several percolation tests shall be made. The percolation tests indicate the absorption rate of the soil. Knowing the absorption rate of the soil, the absorption area (trench bottom area) can be estimated from Figure 11 on page 36.

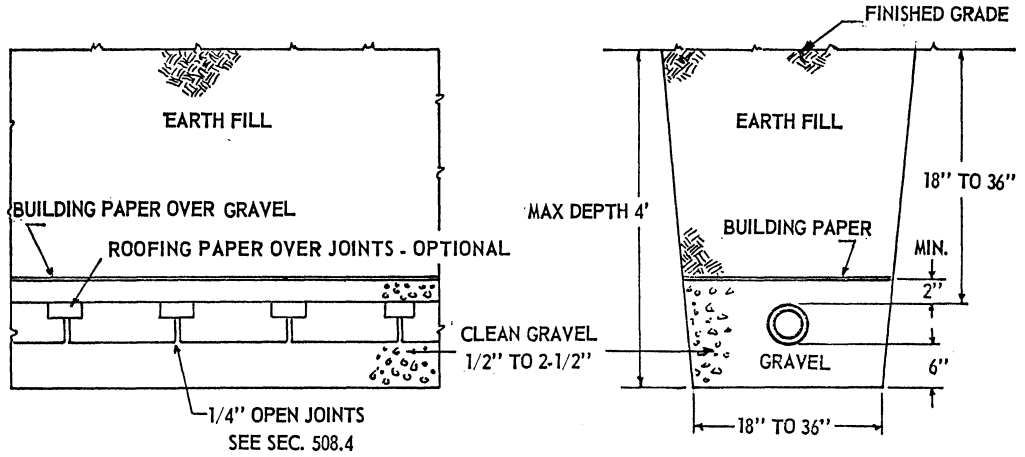
The procedures for conducting a percolation test are as follows:

a. Dig or bore holes with horizontal dimensions of from 4 to 12 inches and vertical sides, and to the estimated depth of the bottom of the proposed absorption trench. In order to save time, labor and volume of water required for test, the holes can be bored with a 4-inch auger.

b. Scratch the bottom and sides of the hole with a knife blade or sharp pointed instrument in order to remove any



PLAN OF ABSORPTION FIELD
SEE SECTION 508
FOR LIMITATIONS OF USAGE



DETAIL OF ABSORPTION TRENCH

FIGURE 10—ABSORPTION FIELD
Schematic—No Scale

smeared soil surfaces and to provide a natural soil interface into which water may percolate. Remove all loose soil from the hole. Place about 2 inches of clean coarse sand or fine gravel in the bottom of the hole.

c. Carefully fill the hole with clean water. By refilling if necessary, keep water in the hole for at least 12 hours. This saturation procedure will give most soils ample time to swell and approach the conditions that prevail during the wetter seasons of the year. Thus the test will give comparable results whether made during a wet or dry season.

d. After the 12-hour saturation period, allow the water in the hole to seep away completely. Remove that portion of the sand or gravel which has been coated with soil particles.

e. Pour about 12 inches of water into the hole and wait until about 6 inches of this water remains.

f. With about 6 inches of water remaining in the hole, establish a reference point by use of nail stuck in the side of the hole near the top of the hole. From this point obtain a measurement to the top of the water level. Record the measurement and the exact time.

g. Allow the water to seep away completely. Again record the exact time and compute the distance the water has dropped.

h. Convert the time interval to minutes and divide this figure by the number of inches of water which has seeped away to obtain the average time for 1 inch of water to seep away.

i. Determine from Figure 11 the square feet of trench bottom area needed.

4. Construction of Absorption Fields

Absorption trenches shall be not more than 4 feet deep and not less than 2 feet deep (measured from finished grade). The absorption lines shall be constructed of tile laid with ¼-inch open joints. Perforated pipe may be used if the perforations are at least ½-inch diameter and spaced uniformly to provide at least the equivalent total opening of comparable diameter tile laid with ¼-inch open joints.

The absorption lines shall be surrounded with clean coarse gravel having a minimum size of ½ inch up to 2½ inches, to a depth of at least 6 inches below the lines and extending around and then above the lines at least 2 inches. The coarse

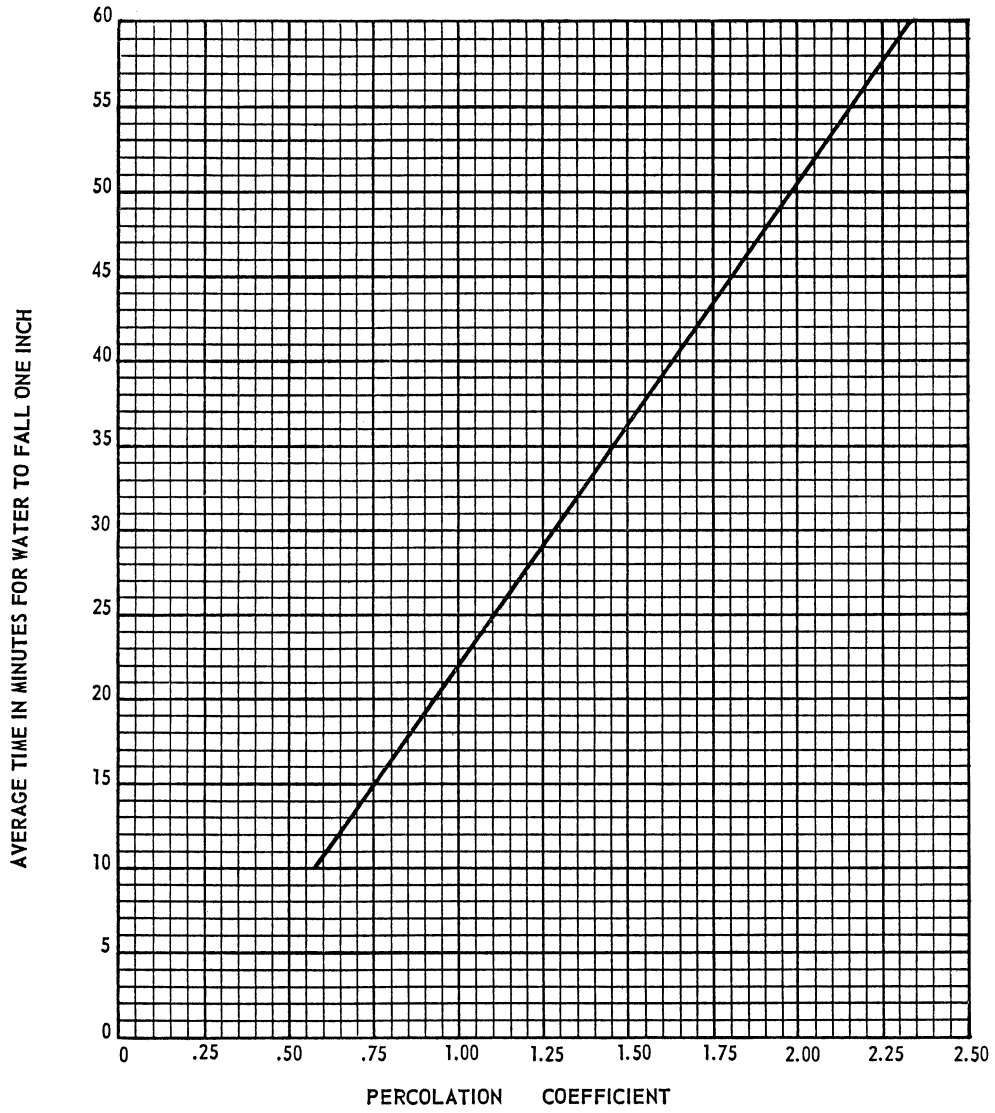


FIGURE 11—CHART FOR ESTIMATING PERCOLATION COEFFICIENT

gravel should then be covered with untreated building paper or similar and then backfilled with earth. Trenches for absorption lines shall be from 18 to 36 inches wide. The center-to-center separation of absorption trenches shall be not less than approximately 7 feet. (See note below.)

A distribution box should be provided for the absorption field. Absorption lines shall not exceed 100 feet in length and shall be laid at a slope not to exceed 2 to 4 inches per 100 feet. See Figure 10 on page 34.

Absorption fields having more than 1,000 lineal feet of trench shall be dosed, using a dosing tank and dosing device. Such fields shall be dosed not more than four times per day. The tile or properly perforated pipe size shall be adequate to handle the dose applied.

On sloping sites, absorption lines shall follow contours.

NOTE: A minimum trench spacing of at least 10 feet should be used if trucks and other equipment are to work between the trenches.

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