WEST VIRGINIA STATE

BOARD OF HEALTH

Sewage Systems

Regulations

WEST VIRGINIA STATE BOARD OF HEALTH

CHAPTER 1, ARTICLE 10

SEWAGE SYSTEMS REGULATIONS

WEST VIRGINIA STATE BOARD OF HEALTH

CHAPTER 1, ARTICLE 5

SEWAGE SYSTEM REGULATIONS

SECTION 1.0 GENERAL

1.1 Scope

These regulations amend and readopt Chapter 1, Article 10, Small Sewage and Excreta Dispoal Systems Regulations, of the West Virginia State Board of Health.

1.2 Authority

Pursuant to the authority conferred upon the State Board of Health by Chapter 16, Article 1, Public Health Laws, Code of West Virginia, the State Board of Health hereby establishes these regulations as the minimum requirements for sewage systems.

1.3 Initial Filing Date - On November 2, 1979, as prescribed by Section 8, Article 3, Chapter 29A, of the Code, these regulations were filed with the Secretary of State, with an attached notice of time, date, and place for opportunity to submit data.

1.4 Notification of Opportunity to Submit Data - On December 10, 1979, at 7:00 p.m. in Rooms A and B, Building Number Seven, State Capitol Complex, Charleston, West Virginia 25305, interested parties were given an opportunity to submit data, objections, suggested amendments, views, evidence, and arguments, orally, or in writing, as prescribed by Section 8, Article 3, Chapter 29A of the Code.

1.5 Final Adoption - On March 19, 1980, the regulations were adopted by the State Board of Health as prescribed by Section 10, Article 3, Chapter 29A, of the Code.

1.6 Final Filing - On May 2, 1980, the final version of the regulations, as adopted by the State Board of Health, with proposed effective date were filed in the state register, pursuant to Section 10, Article 3, Chapter 29A of the Code.

1.7 Governor's Filing - On May 2, 1980, as prescribed by Section 7, Article 3, Chapter 29A, of the Code, the regulations were filed with the Governor.

1.8 Legislative Rule Making Review Committee - On May 2, 1980, as prescribed by Section 7, Article 3, Chapter 29A of the Code, these regulations were filed with the Legislative Rule Making Review Committee, to implement a federally assisted program.

1.9 Effective Date - On August 1, 1980, these regulations became effective, as approved by the Legislative Rule Making Committee.

SECTION 2.0 DEFINITIONS

2.1 Accessible - Sewers are considered accessible when a public sewer system is located adjacent to, or available by right-of-way, to a particular lot, and sewage can discharge thereto by gravity or other means approved by the Director.

2.2 Approved - A procedure of operation or construction which is in accordance with design standards, specifications and instructions established by the Director.

2.3 Chief, Division of Water Resources - The Chief, Division of Water Resources, Department of Natural Resources.

2.4 Complete Application - Application forms, plans, specifications, fee, if required, and other data as set forth in the design standards.

2.5 Design Standards - Application procedures, design requirements, specifications and construction standards issued by the Director.

2.6 Director - Director of the State Department of Health or his authorized representative, delegated appointee, assistant or employee.

2.7 Dwelling - A building, structure or place used or intended to be used for human occupancy as a single family or multi-family res-

idence. The term "dwelling" shall be construed to mean and include the terms "house and housing". This definition also includes, but is not limited to, mobile homes, vacation homes and cabins.

2.8 Effluent - Liquid discharge from a sewage treatment or disposal system.

2.9 Establishment - Any building, structure or place used or intended to be used for multiple dwelling units, or for manufacturing, commercial, religious, institutional, educational or recreational purposes.

2.10 Individual Sewer System - A system serving a single dwelling or establishment for the collection, treatment and disposal of sewage.

2.11 Individual Sewer System Installer - Any person engaging in the construction, installation, extension, alteration and location of an individual sewer system, an excreta disposal system or modification thereof, excepting an individual installing, extending, or altering a system for his own use.

2.12 Lot - A tract or parcel of land or part of a subdivision used as or intended to be used as a site for a dwelling or establishment, whether immediate or future.

2.13 Municipal Sewer System - A system or group of systems which, as a whole, receives sewage from more than one dwelling or establishment and is operated and maintained by an incorporated municipality, or Public Service District, or Sanitary Board.

2.14 Percolation Test - A test described in the design standards, by which the soils in a particular area are evaluated for subsurface effluent disposal.

2.15 Permit - A written document issued by the Director giving the holder permission to construct, install, extend, alter or operate an approved sewer system, or method of sewage disposal or to collect, remove, transport or dispose of sewage.

2.16 Person - Individual, partnership, association, syndicate, company, firm, trust, corporation, government corporation, institution, department, division, bureau, agency, or any entity recognized by law.

2.17 Public Sewer System - A sewage collection system or systems with or without treatment facilities and serving more than one dwelling or establishment. Ownership of the system is held by and maintenance performed by a single entity. This definition includes municipal sewer systems.

with an average frontage of less than 150 feet for the purpose of dwelling or establishment development and including the division of land by deed, metes and bounds description, lease, map, plat or other instrument, or by act of construction.

2.24 Wastewater - The spent water, exclusive of industrial wastes from one or more dwellings or establishments.

2.25 Well - An artificial excavation that derives water from the gaps or intervals of the rocks or soil which it penetrates.

SECTION 3.0 GENERAL REQUIREMENTS

3.1 Every dwelling or establishment whether publicly or privately owned, where persons reside, assemble, or are employed, shall be provided with toilet facilities, and a sewer system as set forth in design standards approved by the Director.

3.2 It shall be the duty of the owner of such dwelling or establishment to provide toilet facilities and a sewer system constructed and installed in compliance with the design standards.

3.3 When, upon investigation, the Director finds a person is constructing, installing, extending, altering, maintaining or operating a toilet facility or sewer system which does not comply with applicable provisions of these regulations, said person shall be notified of the fact in writing, and if said person shall fail to abate or correct the condition within a period of time not to exceed thirty (30) days after the receipt of the written notice, said person shall be guilty of a misdemeanor and, upon conviction thereof, shall be punished according to the penalty set forth.

3.4 All sewer systems shall be designed, constructed, installed, maintained and operated in such a manner that excreta or sewage contained therein or effluent discharged therefrom:

3.4.1 Shall not create a health hazard affecting the public.

3.4.2 Shall not endanger or contaminate any surface or subterranean body of water which is used as an individual or public water supply or for recreational purposes.

3.4.3 Shall not cause an odor or unsightly appearance.

3.4.4 Shall not violate any federal, state or local laws or regulations governing water pollution or sewage disposal.

3.5 Whenever a municipal sewer system is, or becomes accessible to and can adequately serve a property, all other sewer systems existing on or serving the property shall be abandoned and the sewage disposed of through the municipal sewer system.

3.6 The owner or operator of a sewer system to be abandoned shall abandon such system in a manner set forth in design standards approved by the Director.

3.7 The owner and any person or persons installing or modifying a sewer system shall be jointly responsible for compliance with all applicable provisions of these regulations.

3.8 Off lot disposal of sewage or effluent requiring the use of or crossing of adjacent property shall require a recorded easement or

authorization for said purposes. Such rights to be binding to the heirs and assigns of the properties involved.

SECTION 4.0 PERMITS

4.1 In accordance with Chapter 16, Article 1, Section 9, of the Code of West Virginia, no system or method of sewage or excreta disposal shall be installed or established without first obtaining a written permit from the Director.

4.2 Individual and public sewer systems shall be permitted and constructed only after a complete application for, and plans and specifications of, the proposed system, as prepared in accordance with the design standards, have been reviewed and approved by the Director, and where applicable, a discharge permit (Water Pollution Control Permit) has been issued by the Chief, Division of Water Resources in conformance with Chapter 20, Article 5A of the Code of West Virginia.

4.3 A complete application to construct, install or modify an individual sewer system shall be made in writing to the Director. A permit to construct, install or modify shall be obtained prior to such construction or installation.

4.4 A complete application for a permit to construct or install either a public sewer system or an individual sewer system discharging into the surface waters of the state shall be made in writing to the Director at least fifty (50) days prior to the intended construction or installation of such facility. A permit to construct or install shall be obtained prior to such construction or installation.

4.5 A person engaging in the business of sewage tank cleaning shall receive a permit only after application has been made on a form prescribed by the Director and the Director has inspected, or caused to be inspected, all sewage tank cleaning equipment, containers, or other devices used in the collection, removal, transportation or disposal of sewage tank contents to ascertain that said items are used, maintained and operated in compliance with all applicable provisions of these regulations.

4.6 The Director shall deny a permit if the information on the application form is incomplete, inaccurate, false, or misleading, or indicates the applicable provisions of these regulations or the design standards cannot be met.

4.7 A permit shall be suspended or revoked by the Director for failure to comply with the provisions of the permit, improper construction or operation of the sewer system, where false misleading information was utilized in obtaining the permit; or for failure to comply with a lawful order of the Director.

4.8 When a sewage tank cleaning permit has been suspended, or revoked, the person thereby affected shall immediately discontinue engaging in the business of collecting, "removing", transporting or disposing of the contents of sewage tanks.

4.9 Any person whose application for a permit has been denied or whose permit has been suspended or revoked may request a hearing

and a hearing date shall be established within ten (10) days after the Director has received a written request for such hearing. Said hearing shall be held within a period of forty-five (45) days after receipt of the written request for such hearing.

4.10 A permit to construct an individual sewer system shall be valid for a period of one (1) year from the date of issuance. A permit to construct a public sewer system shall be valid for a period of one (1) year from the date of issuance.

4.11 Permits to construct and other permits shall not be transferable or assignable and shall automatically become invalid upon a change in ownership, except when application for transfer or assignment is made to, and such transfer or assignment is approved by, the Director. Permits to construct shall be issued to the property owner.

4.12 The permit to construct or a copy of the permit shall be prominently displayed at the construction site.

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4.12 The permit to construct or a copy of the permit shall be prominently displayed at the construction site.

SECTION 5.0 CONSTRUCTION AND INSTALLATION REQUIREMENTS

5.1 General

5.1.1 The construction and installation or modification of all sewer systems shall be in accordance with the design standards, (Design Standards may be obtained from the central office, district offices or local health department offices. Addresses of the central office and district offices are listed in the appendices) and approved plans and specifications and the construction permit issued by the Director.

5.1.2 Upon the sale of sewage treatment plants and equipment, or package treatment systems, including, but not limited to, recycle systems, composting toilets, home aeration units, and extended aeration treatment plants, the manufacturer or party selling the plant or equipment shall notify the Director in writing of the name and address of the purchaser of these products and the location where the products are to be installed.

5.1.3 Prior to construction and/or installation of said sewage system, the contractor or manufacturer or installer installing same shall assure himself that permits have been obtained in accordance with Chapter 16, Article 1, Section 9; Chapter 20, Article 5A, Section 5, Code of West Virginia, and Section 4.0 of these regulations.

5.2 Diversion drains, ditches and curtain drains shall be installed when storm water, surface or ground water will affect the satisfactory operation of a sewer system. No foundation drains or downspouts shall be connected to the sanitary sewer system.

5.3 Percolation tests and other tests, as may be required for installation of an individual sewer system, shall be performed by persons whose qualifications are acceptable to the Director and such tests shall be conducted in accordance with the latest design standards. The person conducting the tests shall certify as to the accuracy of the results of such tests and such information shall be submitted in a form acceptable to the Director.

5.4 Subsurface absorption systems shall be constructed at the site where percolation and other tests have been performed. In the event the location of the subsurface absorption system must be changed, additional testing will be required at the proposed new location.

5.5 The holder of a construction permit shall notify the Director when construction or installation is to begin.

SECTION 6.0 INSPECTIONS

6.1 The Director shall make, or cause to be made, as many inspections as he deems necessary during the construction, installation, modification, or operation of sewer systems to determine compliance with the applicable provisions of these regulations.

6.2 The owner or occupant of a dwelling, establishment, or land shall provide the Director access to all parts of the property for the purpose of making such inspection.

6.3 No individual system shall be used or placed into operation until the system has been inspected and approved in writing by the Director.

6.4 No part of any individual sewer system utilizing soil absorption disposal of effluent shall be covered until said system has been inspected and approved in writing by the Director. Any part of such system that is covered prior to such approval shall be uncovered upon oral or written order of the Director.

6.5 In addition to making inspections or causing inspections to be made of a sewer system, the Director may collect or cause to be collected samples of sewage and effluent from the system, or conduct or cause to be conducted, such tests as he deems necessary and proper to insure that the system is in compliance with all applicable provisions of these regulations.

6.6 If the Director shall find that the construction, installation, or modification of a sewer system is not in compliance with the applicable requirements of these regulations, the Director may issue an order revoking the construction permit. The order shall be issued in writing to the owner of the sewer system and such order shall be effective immediately. An order revoking a construction permit may be appealed in accordance with the procedure set forth in Section 4.9 of these regulations.

SECTION 7.0 MAINTENANCE AND OPERATION

7.1 All sewer systems shall be maintained and operated so as to be in compliance with Chapter 16 of the Code of West Virginia and the provisions of these regulations.

7.2 Upon written request by the Director, the permit holder shall submit operational data such as influent, effluent, flow data, or any operational data necessary to ascertain compliance with Chapter 1, Article 11, Environmental Health Regulations.

SECTION 8.0 SUBDIVISIONS

8.1 All subdivisions or housing developments originating after July 1, 1970, the effective date of the original regulations, shall be served by a method of sewage disposal approved by the Director.

8.2 In the event it is proposed that a subdivision be served by a public sewer system, a permit to construct said system must be obtained from the Director in compliance with the provisions of Section 4.0 of these regulations.

8.3 In the event individual sewer systems are proposed as the desired method of sewage disposal for a subdivision, written approval shall be obtained from the Director in compliance with the provisions of these regulations and the procedures set forth in the design standards. In addition, a permit to construct each individual sewer system within the subdivision shall be obtained in compliance with Section 4.0 of these regulations.

8.4 The replatting of a prior recorded plat or of a subdivision which originated prior to July 1, 1970, the effective date of the previous regulations, shall not be exempt from the provisions of these regulations. The prior platting of a portion of a larger tract prior to July 1, 1970, shall not exempt the remainder of the tract from the provisions of these regulations.

8.5 The division of land through public or private auction sale or through the terms of a will shall constitute a subdivision under the provisions of these regulations. It shall be the responsibility of the owner of such land or executor of the will to meet all requirements of these regulations.

8.6 In those instances where a lot was purchased or acquired for dwelling construction, and either its deed was recorded prior to July 1, 1970, or the lot was laid out, described and designated on a map of a subdivision, which map was recorded prior to July 1, 1970, and:

8.6.1 Where an approved public water supply system is available, but an approved public sewer system is not available, no individual sewer system shall be permitted on any lot, site or area containing less than 10,000 square feet.

8.6.2 Where neither an approved public sewer system nor an approved public water supply system is available, no individual sewer system shall be permitted on any lot, site or area containing less than 20,000 square feet.

8.7 The Director may waive the square footage requirements stipulated in Section 8.6 provided he has been petitioned and has ascertained through a hearing, an on-site inspection, percolation tests and other requirements of these regulations that an individual sewer

system can be expected to function satisfactorily on a lot, site, or area containing less than the minimum prescribed number of square feet.

8.8 For subdivisions and lots originating after July 1, 1970, the minimum sizes as set forth in Section 8.6 do not apply. All lots originating after July 1, 1970, must comply with the design standards.

SECTION 9.0 CORRECTION OF HEALTH HAZARDS

9.1 To correct or abate public health hazards resulting from the malfunctioning of individual sewer systems, which hazards are not correctable by methods set forth in the design standards, the Director may permit the installation of an experimental or non-standard sewer system upon written petition for such system.

9.2 The petition shall request the Director to authorize installation of the system desired and shall contain information as to the location, reasons why a conventional system cannot be installed, information concerning the malfunctioning system, and information concerning the system desired.

9.3 If, after presentation of the petition at an informal hearing, the Director determines that a potential public health hazard exists, he may issue a declaratory ruling authorizing installation of the system desired. The declaratory ruling shall apply only to the petitioner and the facts presented at the informal hearing.

SECTION 10.0 SEWAGE TANK CLEANING

10.1 No person shall engage in the business of collecting, removing, transporting, or disposing of the contents of a sewage tank without first obtaining a state-wide permit for such activity from the Director, in accordance with Section 4.0 of these regulations.

10.2 Equipment, containers or other devices used in the collection, removal, transportation or disposal of the contents of sewage tanks shall be in compliance with the current design standards, information, and specifications issued by the Director.

SECTION 11.0 INDIVIDUAL SEWER SYSTEMS INSTALLERS CERTIFICATION

11.1 All individual sewer system installers shall be certified for such activity by the Director. Provided, that certification requirements shall not apply to an individual who constructs, installs, extends, alters, or modifies his own individual sewer system pursuant to a permit obtained from the Director and such system is constructed and inspected in accordance with the provisions of these regulations.

11.2 Certification is not required of a driver delivering a part or parts of a system, a manufacturer who does not install a part or parts of a system or an employee of a contractor holding a certificate, provided, that such employee is under the direct on-site surveillance of a certified installer.

11.3 Certificates shall be issued to qualified installers of individual sewer systems in two classifications.

11.3.1 A Class I certificate shall apply to the installation of conventional septic tank soil absorption systems and privies.

11.3.2 A Class II certificate shall apply to those individual sewer systems covered by the Class I certificate plus all alternative and innovative individual sewer systems approved for installation by the Director.

11.3.3 Within one year after the date these regulations become effective, all installers of alternative and innovative systems shall be certified for this activity.

11.4 An application for certification to install individual systems, or renewal of certification to install individual systems, shall be made in writing to the Director on a form prescribed by the Director.

11.5 The Director may deny certification if the information on the application form is incomplete, inaccurate, false or misleading.

11.6 In addition to filing an application for certification to install individual sewer systems, the applicant must pass a written examination for each classification and may be required to demonstrate that he possesses adequate knowledge and skill in making installations in accordance with applicable design standards.

11.7 Written examinations shall be administered by the Director at a site and on a date designated by the Director. A passing grade of 70% must be obtained. Any applicant who has failed an examination must wait thirty (30) days before re-examination.

11.8 Certification shall not be transferable or assignable and shall automatically become invalid upon suspension or revocation.

11.9 Certification shall expire five (5) years from date of issuance and the certificate holder shall apply to the Director for renewal of the certificate prior to the expiration date. Renewal will be based upon:

11.9.1 Evidence of construction of at least one approved system within the preceding year.

11.9.2 Recommendation of the local health department.

11.10 In the event any person certified is found to be violating any of the applicable requirements of these regulations, his certification may be immediately suspended for a period of ten (10) days by the Director. Two successive violations shall be sufficient grounds for revocation of certification. Upon suspension or revocation a hearing shall be held within ten (10) days of the date of such suspension or revocation.

11.11 Any person whose application or certification has been denied may request a hearing and a hearing date shall be established within ten (10) days after the Director has received a written request for such a hearing.

SECTION 12.0 REPEAL OF FORMER REGULATIONS

12.1 All regulations previously adopted by the West Virginia State Board of Health which are in conflict with the provisions of these regulations are hereby repealed.

SECTION 13.0 SEVERABILITY

13.1 If any provision of these regulations or the application thereof to any person or circumstance shall be held invalid, such invalidity shall not affect the provisions or applications of these regulations which can be given effect without the invalid provisions or application, and to this end the provisions of these regulations are declared to be severable.

SECTION 14.0 PENALTIES FOR VIOLATING PROVISIONS OF REGULATIONS

14.1 Any person who violates any provision of these regulations or any regulation adopted by the West Virginia State Board of Health pursuant to authority granted by these regulations shall be guilty of a misdemeanor and shall, upon conviction, be punished by a fine of not less than twenty-five dollars ($25) nor more than five hundred dollars ($500) as provided in Chapter 16, Article 1, Section 9 of the Public Health Laws of West Virginia, Code of West Virginia.

14.2 Each day's failure to comply with any applicable provision of these regulations shall constitute a separate offense.

SECTION 23 CERTIFICATION AND FILING OF THE REGULATION

I hereby certify that the foregoing regulations constitute the official regulations promulgated by the State Board of Health on , and filed pursuant to law in the Office of Secretary of State.

_____

George E. Pickett, M.D.

Secretary

State Board of Health

Acknowledgement, that the above regulations were filed with the Office of Secretary of State on .

_____

A. James Manchin

Secretary of State

DESIGN STANDARDS

FOR

SEWAGE TREATMENT

AND

COLLECTION SYSTEMS

DRAFT

Environmental Health Services
West Virginia State Department of Health
Charleston, West Virginia

NOTICE

The Division of Water Resources, Department of Natural Resources, has been designated by the Director to act as the authorized agent of the Department of Health in the review of all EPA-Construction Grants Program projects. This authorization was granted in a letter dated July 10, 1979, in accordance with an Executive Order of the Governor dated June 11, 1979. As the authorized representative of the Director, the Division of Water Resources is responsible for the review of all EPA-Construction Grants projects and application of these design standards to all EPA-Construction Grants Program projects as long as the aforementioned executive order remains in effect.

ALL APPLICATIONS, PLANS AND REQUESTS FOR INFORMATION CONCERNING EPA-CONSTRUCTION GRANTS PROGRAM PROJECTS SHOULD BE FORWARDED TO:

Warren Means
Construction Grants Branch
Division of Water Resources
Department of Natural Resources
617 Broad Street
Charleston, West Virginia 25301

INTRODUCTION

These design standards set forth general criteria and minimum design parameters for the design and construction of sewage systems. Variations from these standards may be allowed due to the peculiarities of a specific system. These design standards are not intended as a substitute for engineering experience or judgement based upon such experience. Deviations from these standards shall be justified in the design report or in documentation accompanying the application. These design standards may change in response to changes in technology.

NOTE

Projects designed under the Construction Grants Program may be required to meet general criteria and design parameters more stringent than those found herein due to USEPA guidelines and requirements.

Part I

SEWAGE PERMIT APPLICATIONS

Part I

SEWAGE PERMIT APPLICATIONS

INDEX

1.0 PROCEDURE A--shall be followed in preparing a complete application for a construction permit for proposed sewage collection and treatment works with a capacity of 100,000 gallons per day or less.

1.1 Complete Application--Six (6) copies of application forms, design data sheets, reports, plans and specifications shall be submitted to the Sewage Disposal Division. A check or money order in the amount of fifty dollars ($50), payable to the State of West Virginia shall be required when the submission is for sewage treatment facilities which have discharge. Cash will not be accepted. Note: A separate application, plans, and other data will be required for any potable water facilities.

1.2 Applications--Application forms and design data sheets may be obtained from the local health departments; State Health Department District Offices; or the Sewage Disposal Division, State Department of Health, 1800 Washington Street, East, Charleston, West Virginia 25305. Assistance in filling out application forms and in preparing the application may be obtained from the local health departments or District Offices when requested. (For location of District Offices see Appendix.)

1.3 Required Information to Accompany Application

1.3.1 Application Forms and Design Data Sheets

1.3.1.1 Completed application form ES-69 with $50 application fee if applicable.

1.3.1.2 Completed design data sheet EG-4.

1.3.1.3 Completed form EG-1 (MOBILE HOME PARK ONLY).

1.3.1.4 Completed form EG-2 (MOBILE HOME PARK ONLY)

1.3.2 Required Information to Accompany Application

1.3.2.1 U.S. Geological Survey Topographic Map showing property lines, point of discharge, downstream water intake impoundment, or water recreational facilities, if any.

1.3.2.2 Site plan of the proposed facility showing:

A. Layout with dimensions and property lines.

B. Proposed home sites, mobile home sites, camping trailer or camp sites, schools or other buildings.

C. Location of/and distances to water intakes or wells.

D. Location of existing or proposed water lines.

E. Proposed sewage treatment unit or public sewer line.

F. Layout and size of proposed sewer lines, manholes and/or cleanouts and location of lift stations.

G. Distance(s) of proposed sewage treatment plant, stabilization pond, and polishing pond from surrounding residences or other buildings.

H. Point of discharge of effluent in stream. List mile point, if known.

I. Effluent routing details.

J. A six (6) foot minimum high fence around sewage treatment facilities with locked entrance gate.

K. Twenty-five (25) year and 100 year flood elevation.

1.3.2.3 Profile of proposed sewer, effluent discharge lines and force mains showing:

A. Existing and finished ground level.

B. Invert elevations and manhole designation and locations. (gravity only)

C. Size, length and grade of proposed sewer lines.

D. Water main crossing.

1.3.2.4 Report and specifications setting forth:

A. General description of proposed project and location.

B. Number of units to be served and possible expansion of facility.

C. Type and specifications of pipe and joints to be used. (ASTM)

D. Specifications for proposed sewage treatment plant.

E. Specifications for lift stations.

F. Hydraulic calculations. (TDH, Friction Head, Static Head, Horsepower, Detention and Running times, etc., for lift stations)

G. Soil characteristics of site for a stabilization pond, aerated lagoon or polishing pond. Report from U.S. Department of Agriculature, soil conservation service required.

H. Manhole details.

I. If land disposal of effluent is used, information as required in Part 3 Section 16 of this publication is to be submitted.

J. Gravity filter details.

K. Sewer riser details. (Mobile Home Parks)

L. Test Equipment.

M. Waste allocation from Division of Water Resources, Department of Natural Resources.

N. Aerated Sludge Holding Tank.

O. Chlorinator.

P. Flow Equalization.

Q. Post Aeration.

R. Nutrient Removal.

1.3.2.5 Plans of sewage treatment plant, lift station, stabilization pond, aerated lagoon, filter, or polishing pond to be installed.

1.3.2.6 Documentation shall be furnished consisting of:

A. Legal document stating who shall bear responsibility for maintenance of sewage treatment facility. Certification of installation and operation of sewage treatment plant. (Form ES-78)

B. Letter granting permission to connect to public or privately owned sewage collection or treatment system when such is the proposal.

C. Legal document(s) granting permission for right-of-way through adjacent property for installation of sewers or effluent discharge lines.

D. Articles of incorporation of property owners association for developments of less than 25 service connections.

E. Articles of incorporation of a private utility under Public Service Commission to assure adequate operation and maintenance of sewage treatment facilities.

F. Written documentation from the Division of Water Resources, the Department of Natural Resources, granting permission to connect to existing public sewer system which discharges without benefit of acceptable treatment, when such is the proposal.

1.3.2.7 Report From District Engineer--(See Appendix for Location of District Offices)

ALL OF THE ABOVE INFORMATION SHALL BE SUBMITTED IN SIX (6) COPIES!

1.4 Size of Plans--Plans shall not be less than 18" x 24" in size, nor greater than 27" x 40". Plan submissions of 10 sheets or less per set shall be folded by sets with the project title showing. Plan submissions consisting of an excess of 10 sheets per set may be rolled. Plans must be of uniform size and stapled together by sets.

2.0 PROCEDURE B--shall be followed in preparing a complete application for a construction permit for sewage collection and treatment facilities having a capacity greater than 100,000 GPD will incorporate all requirements in Section 1.0 and in addition require the following:

2.1 Design Engineering Report--The following is a recommended format for the engineering report.

2.1.1 Title: Engineering report--Name of sewage works project.

2.1.2 Transmittal Letter--A letter typed on firm's letterhead and bound into a report briefly summarizing findings, conclusions, and recommended action.

2.1.3 Title Page

2.1.3.1 Project Title

2.1.3.2 Applicant

2.1.3.3 Consulting engineering firm

2.1.3.4 Professional engineer's seal and signature

2.1.4 Table of Contents

2.1.4.1 Chapter headings and subheadings

2.1.4.2 List of tables

2.1.4.3 List of figures

2.1.4.4 Appendixes

2.1.5 Information Concerning Scope of Project

2.1.6 Population--Current, design and saturation.

2.1.7 Wastewater Flow and Strength--Hydraulic and organic loading.

2.1.8 Collection System--Immediate needs to implement recommended project, deferred needs to complete recommended project, and pump stations, force mains, appurtenances, etc.

2.1.9 Treatment Process--Selected process.

2.1.10 Receiving Stream--Existing flow and water quality, classification and wasteload allocations, (See 1.3.2.4, M, page I-4) downstream water uses, and impact of project on receiving streams.

2.1.11 Institution Responsibilities--Administrative capabilities necessary to carry out the recommended project through construction and operation and maintenance of the system.

2.2 Specifications--Complete technical specifications for the construction of sewers, sewage pumping stations, treatment plants, and all appurtenances, shall accompany the plans.

The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown on the drawings which is necessary to inform the contractor in detail of the design requirements including the quality of materials and workmanship and fabrication of the project and the type, size, strength, operating characteristics and rating of equipment; allowable infiltration; the complete requirements for all mechanical and electrical equipment including machinery, valves, piping, and jointing of pipe; electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials, special filter materials such as stone, sand or gravel; miscellaneous appurtenances; chemicals when used; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

2.3 Operation and Maintenance Manual--should include the following considerations for preparation:

2.3.1 Introduction

2.3.2 Permits and Standards

2.3.3 Description, Operation and Control of Wastewater Treatment Facilities.

2.3.4 Description, Operation and Control of Sludge Handling Facilities.

2.3.5 Personnel (Staffing)

2.3.6 Laboratory Testing

2.3.7 Records

2.3.8 Maintenance

2.3.9 Emergency Operation and Response Program

2.3.10 Safety

2.3.11 Utilities

2.1.11 Institution Responsibilities--Administrative capabilities necessary to carry out the recommended project through construction and operation and maintenance of the system.

2.2 Specifications--Complete technical specifications for the construction of sewers, sewage pumping stations, treatment plants, and all appurtenances, shall accompany the plans.

The specifications accompanying construction drawings shall include, but not be limited to, all construction information not shown on the drawings which is necessary to inform the contractor in detail of the design requirements including the quality of materials and workmanship and fabrication of the project and the type, size, strength, operating characteristics and rating of equipment; allowable infiltration; the complete requirements for all mechanical and electrical equipment including machinery, valves, piping, and jointing of pipe; electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials, special filter materials such as stone, sand or gravel; miscellaneous appurtenances; chemicals when used; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

2.3 Operation and Maintenance Manual--should include the following considerations for preparation:

2.3.1 Introduction

2.3.2 Permits and Standards

2.3.3 Description, Operation and Control of Wastewater Treatment Facilities.

2.3.4 Description, Operation and Control of Sludge Handling Facilities.

2.3.5 Personnel (Staffing)

2.3.6 Laboratory Testing

2.3.7 Records

2.3.8 Maintenance

2.3.9 Emergency Operation and Response Program

2.3.10 Safety

2.3.11 Utilities

2.3.12 Electrical Systems

3.0 Revisions to Approved Plans and Specifications--Any deviations from approved plans or specifications affecting capacity, flow, or operation of units shall be approved in writing before such changes are made. Plans or specifications so revised should, therefore, be submitted well in advance of any construction work which will be affected by such changes, to permit sufficient time for review and approval. Structural revisions or other minor changes not affecting capacities, flows, or operation will be permitted during construction without approval. "As built" plans clearly showing such alteration should be submitted to the State Health Department and the municipality at the completion of the work.

4.0 Operation During Construction--Specifications shall contain a program for keeping existing treatment plant units in operation during construction of plant additions. Should it be necessary to take plant units out of operation, a shutdown schedule agreed to by the State agencies shall be followed.

NOTE: STATE LAW REQUIRES THAT PLANS FOR PROJECTS MUST BE PREPARED BY OR UNDER THE SUPERVISION OF/AND SIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF WEST VIRGINIA.

PLEASE READ THE ABOVE INSTRUCTIONS CAREFULLY AND SUBMIT THE REQUIRED INFORMATION. OMISSION OF ANY OF THE REQUIRED INFORMATION WILL RESULT IN THE APPLICATION BEING DENIED AND RESULT IN NEEDLESS DELAY.

PRIOR TO SUBMITTAL OF THE PROPOSED APPLICATION FOR A NON-EPA CONSTRUCTION GRANTS PROJECT, A CONFERENCE MAY BE REQUESTED BY CONTACTING THE SEWAGE DISPOSAL DIVISION AT 348-0578.

PRIOR TO SUBMITTAL OF THE PROPOSED APPLICATION FOR AN EPA CONSTRUCTION GRANTS PROJECT, A CONFERENCE MAY BE REQUESTED BY CONTACTING THE CONSTRUCTION GRANTS BRANCH, DIVISION OF WATER RESOURCES, DEPARTMENT OF NATURAL RESOURCES, AT 348-0641.

IN ACCORDANCE WITH CHAPTER 20, ARTICLE 5A, SECTION 6, OF THE STATE CODE, AN APPLICATION MUST BE A COMPLETE APPLICATION FOR ACCEPTANCE FOR REVIEW. OMISSION OF ANY OF THE REQUIRED APPLICATION FORMS, DESIGN DATA OR OTHER INFORMATION WILL RESULT IN THE APPLICATION BEING RETURNED.

Part II

SEWAGE COLLECTION SYSTEMS

Part II

SEWAGE COLLECTION SYSTEMS

INDEX

1.0 GENERAL

1.1 New systems or extensions to an existing system will be approved to carry sanitary sewage flows plus an allowance for non-excessive infiltration.

1.2 Modifications to existing systems will be approved to carry sanitary sewage flows plus an allowance for non-excessive infiltration and inflow.

1.3 Overflows from interceptor sewers shall not be permitted.

1.4 No new combined system shall be approved.

1.5 Design Factors--In determining the required capacities of sanitary sewers, the following factors should be considered.

1.5.1 Maximum hourly quantity of sewage.

1.5.2 Additional maximum wastewater flow from industrial plants.

1.5.3 Groundwater infiltration.

1.6 Design Basis per capita flow--New systems shall be designed on the basis of either of the following two methods to arrive at average dry weather flows from combined residential, commercial and institutional sources.

1.6.1 Estimates based on fully documented analysis of water use records adjusted for consumption and losses. Minimum one year records analysis is recommended.

1.6.2 State developed per capita wastewater flows for various sizes and types of municipalities.

1.6.2.1 Less than 10,000 population - 70 GPCD.

1.6.2.2 10,000 to 25,000 population - 80 GPCD.

1.6.2.3 Planning areas and towns with greater than 25,000 population - 90 GPCD.

2.0 GRAVITY

2.1 Design Period--The maximum allowable design period for sewers will be 50 years for the estimated tributary area. Phasing of collection system will be allowed.

2.2 Infiltration Allowance and Industrial Flows--An infiltration allowance of 200 gallons per inch diameter per mile per day and a reasonable allowance for future industries may be added to the per capita design flows to arrive at the average daily flow (ADF).

2.3 Peak Flows--The sewers should be designed to carry a peak flow, when flowing full, of:

2.3.1 Lateral Sewers - 4 x ADF

2.3.2 Trunk and Interceptor and Outfall Sewers - 2.5 x ADF

2.4 Alternate Method--When deviations from the above stated peak design flows are desired, a brief justification and description of the procedure used for sewer design shall be included in the design engineering report.

2.5 Calculations--Computations and other design data shall be presented in an appropriate form for proposed sewage collection and treatment facilities of greater than 100,000 GPD. These computations shall include average daily flow and peak daily flow at critical points such as change in size of sewers; velocity at minimum, average and peak flows in sewers, etc., as required.

2.6 Minimum Size--No gravity sewer shall be less than eight (8) inches in diameter except that six-inch-diameter sewer pipe may be used for lateral sewers where no possibility of future extension exists.

Examples are: Thirty (30) mobile homes or fifteen (15) residences. Four inch sewer pipe will not be allowed for the collection system.

2.7 Cover--Minimum allowable earth cover on sewers shall be 3 feet unless otherwise approved by the Director. Generally, sewers shall be sufficiently deep to drain basement fixtures and to prevent freezing.

2.8 Slope

2.8.1 All new sewers shall be so designed and constructed to give velocities, when flowing full, of not less than 2.0 feet per second based on Kutter's or

Manning's formula using an "n" value of 0.013. For existing sewers, value of "n" is recommended as 0.015 to determine existing capacities. Use of other practical "n" values may be permitted, if deemed justifiable on the basis of research or field data presented by the consulting engineer. The following are the minimum slopes to be provided. Slopes greater than these are desirable.

Sewer Size	Minimum Slope in feet per 100 feet
6"	0.62
8"	0.40
10"	0.28
12"	0.22
14"	0.17
15"	0.15
16"	0.14
18"	0.12
21"	0.10
24"	0.08
27" and larger	0.07

2.8.2 Under special conditions, if detailed justifiable data is given, slopes slightly less than those required for the 2.0 feet per second velocity when flowing full may be permitted.

Whenever such decreased slopes are selected, the engineer must furnish with his report his computations of the depth of flow in such pipes at minimum, average, and peak rates of flow. It is recognized that such decreased slopes may cause additional sewer maintenance.

2.8.3 Sewers shall be laid in a straight line with uniform slope between manholes. Sewers laid on 20 percent slope or greater shall be anchored securely with concrete anchors, or approved equal, spaced as follows:

2.8.3.1 Not over 36 feet center to center on slopes between 20% to 35%.

2.8.3.2 Not over 24 feet center to center on slopes between 35% to 50%.

2.8.3.3 Not over 16 feet center to center on slopes 50% and over.

2.9 Alignment--Sewers 24 inches in diameter or less shall be laid with straight alignment between manholes.

2.10 Increasing Size--When a sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth of both sewers at the same elevation.

2.11 High Velocity Protection--Where velocities greater than 15 feet per second are attained, special provisions shall be made to protect against displacement by erosion and shock.

2.12 Materials--The material selected for the pipe should be adapted to local conditions, such as character of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loadings, abrasion and similar problems.

2.13 All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made according to the width and depth of trench.

Gravity sewer lines shall be constructed of clay, plastic, asbestos cement, cast iron, ductile iron or concrete sewer pipe meeting the following minimum specifications:

2.13.1 House Connection to Collector Sewers:

Clay - ASTM C 700

Plastic - ASTM D 2729, D 2751, D 2836, D 2852

Asbetos Cement - Class 2400

Ductile Iron - AWWA C-110, C-151, Cement lined

Cast Iron - ASTM A 74

Concrete - ASTM C 14

2.13.2 Collector and Interceptor Sewers:

Clay - ASTM C 700--Joints shall meet the requirements of ASTM C 425.

NOTE: Slip seal joints or cement joints shall not be permitted.

Plastic - ASTM D 3033, D 3034

Composite - ASTM D 2680

Asbestos Cement - ASTM C 428, Class 2400

Ductile Iron - AWWA C-110, C-151, Cement lined

Cast Iron - AWWA C-108, Cement lined

Concrete - ASTM C-76

2.14 Bedding--Class "A", "B", "C" in accordance with ASCE Manual & Report on Engineering Practice No. 37 will be permitted. The class of bedding shall be determined by the engineer to provide the strength necessary for the soil and load conditions that will be encountered.

2.15 Inverted Siphons--Inverted siphons should have not less than 2 barrels, with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall have adequate clearances for rodding; and in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3 feet per second for average flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be taken out of service for cleaning. Cast iron pipe or equal shall be utilized.

2.16 Stream Crossing--Whenever sewers must cross under a stream or watercourse, a minimum separation of 3 feet between the stream bed and the top of the sewer pipe shall be provided. Additionally, the sewers shall be encased in concrete for at least 10 feet on either side of the stream. Cast iron pipe or equal shall be utilized.

2.17 Aerial Sewers--Aerial sewers will require prior approval of the director.

2.18 Protection of Drinking Water Supplies

2.18.1 Water Supply Interconnections--There shall be no physical connection between a public or private drinking water supply system and a sewer, or appurtenance thereto.

2.18.2 Relation to Water Works Structures--While no general statement can be made to cover all conditions, it is generally recognized that sewers shall be kept remote from a drinking water supply.

2.18.3 Relation to Wells--In general, no sewer line shall be located within 50 feet of any well utilized for a public or private drinking water system. However, if physical limitations prevent a 50 foot separation, the sewer shall be constructed and tested as prescribed

in Section 2.18.5. Under no conditions shall any sewer be constructed closer than 10 feet to a well.

2.18.4 Relation to Water Lines

2.18.4.1 Horizontal Separation--Routinely, sewers shall be laid a minimum of at least 10 feet horizontally away from any existing or proposed water lines. However, if the conditions prohibit a 10 foot separation, the sewer must be constructed and tested as prescribed in Section 2.18.5. Under no circumstances shall any sewer be constructed closer than 3 feet edge to edge to a water line.

2.18.4.2 Vertical Separation--Whenever a sewer must cross water lines it should be constructed at such an elevation so that the top of the sewer line is a minimum of 18 inches beneath the bottom of the water main. However, if elevation conditions can not be met, then the sewer shall be constructed and tested as prescribed in Section 2.18.5.

2.18.5 Special Construction Requirements

2.18.5.1 Horizontal--In cases where water and sewer lines must be laid closer than 10 feet apart, the sewer line shall be constructed a minimum of 18 inches lower than the water line and constructed of a pressure type pipe meeting requirements for water lines. The installation shall be hydraulically tested for a period of not less than 24 hours and shall be considered satisfactory if leakage is not more than 0.25 gallons per inch diameter of pipe per joint.

2.18.5.2 Vertical--If a vertical clearance of 18 inches as specified in Section 2.18.4.2 cannot be maintained the sewer shall be so located that it crosses between joints of the water line. The sewer line shall also be constructed so that it crosses under the water line at mid joint. The sewer shall be constructed and tested as required in 2.18.5.1. Under no circumstances shall a sewer line be constructed over the top of a water line.

3.0 VACUUM SEWAGE COLLECTION SYSTEMS

3.1 Main Lines

3.1.1 Materials

3.1.1.1 PVC or ABS of schedule 40 DWV, Class 200, or SDR 21.

3.1.1.2 Joints may be either solvent welded, "O"-Ring, or heat fusion joints, which have been specifically designed to seal against vacuum.

3.1.2 Piping

3.1.2.1 Minimum diameter pipe size shall be three inches in the collection system.

3.1.2.2 Cleanouts shall be provided at a maximum of every 200 feet on straight runs and at changes in direction.

3.1.2.3 Line shall be buried as deeply as dictated by frost depth and/or load condition.

3.1.2.4 Thrust blocks shall be located at each change in direction of the vacuum main.

3.1.2.5 Maximum length of any vacuum main shall be 3000 feet. The length of collection line must be justified based upon engineering calculations.

3.1.2.6 The lines shall be sized to provide a minimum of 2 fps velocity and shall accomodate the peak load from each residence or building served.

3.1.2.7 The manufacturer's recommendation for reform pockets and lifts shall be utilized.

3.1.2.8 Total available head loss from any input point should not exceed 18 feet of water. Five feet of water should be reserved for valve operation.

3.1.2.9 Installation of the collection system shall meet the following tightness test specification "the system shall be vacuumed to 24

inches of mercury vacuum pressure, allowed 15 minutes to stabilize, and thereafter shall not lose more than 1% vacuum pressure per hour over a minimum of a four-hour period." Testing should be done prior to the installation of valves.

3.2 House Connections

3.2.1 Valves shall be actuated by pneumatic or electric controllers. Those valve systems which are electrically controlled shall require a separate electrical power source at each valve site to control valve operation.

3.2.2 Emergency holding of 60 gallons shall be provided for each residence served by the valve. Buffer capacity required for commercial or industrial buildings, schools, etc. shall be based on expected water use and as recommended by the manufacturer.

3.2.3 The valve shall be located outside the dwelling. The pipe between the dwelling and valve shall be located to provide 10-15 gallons storage, or a 30 gallon tank shall be located between the dwelling and the valve. A permanent maintenance easement for the valve and its appurtenances shall be required.

3.2.4 Valve boxes shall have a solid bottom, and be counter weighted to prevent flotation. The cover and valve box material shall be of adequate strength to withstand the expected maximum dynamic and static loading conditions. Valve boxes shall be well vented to reduce condensation, and constructed of corrosion resistant material.

3.2.5 The vent system for the house must have a diameter of three inches or greater to prevent evacuation of traps during vacuum valve operation. The vent pipe shall be extended above the eaves of the house.

3.2.6 Those systems using a pneumatic controller shall have adequate protection of the sensor controllers, and any portion of the controller apparatus vented to atmosphere shall be protected from flooding, screened from insect entry, and provided with rain covers.

3.3 Sewage Collection Tanks

3.3.1 The sewage collection tanks shall be of either coated welded steel or fiber glass and shall be vacuum tight.

3.3.2 Each inlet to the tank shall have its own shut-off valve.

3.3.3 Liquid level sensors shall be installed to operate the discharge sewage pumps, the high level alarm and to interrupt the electrical power to the vacuum pumps.

3.3.4 The collection tank shall be sized to hold a maximum of 10 minutes design flow. Collection tanks shall be sized at 1.5 x operating volume or a minimum of 400 gallons.

3.4 Vacuum Pumps

3.4.1 Vacuum reserve tanks shall be installed in series between the sewage collection tank and the vacuum pumps.

3.4.2 Either liquid ring or sliding vane vacuum pumps may be used, as long as they are compatible with pumping moist air containing some sewer gases.

3.4.3 A check valve shall be installed between the vacuum reservoir tank and the vacuum pumps.

3.4.4 Dual vacuum pumps, each capable of handling the load, and emergency back-up power shall be provided.

3.4.5 The vacuum pump exhaust shall be vented outside the building. If there is a possibility of objectional odors, due to proximity of inhabited dwellings, the evacuation line from the vacuum reserve shall have carbon absorption.

3.5 Sewage Pumps

3.5.1 Dual pumps, each capable of handling 2.5 times the average daily flow, shall be provided.

3.5.2 Emergency back-up power shall be provided to operate the entire system.

3.5.3 The sewage pumps shall be capable of meeting the NPSH requirements as dictated by the vacuum conditions in the sewage collection tanks.

3.5.4 Shut-off valves shall be provided so that each pump may be isolated for repairs.

3.5.5 The discharge piping shall incorporate a check valve, gate valve arrangement such as utilized in a conventional pump station.

3.5.6 High level alarms and loss of vacuum alarms shall be located in an area which is manned 24 hours/day.

3.6 Design Requirements

3.6.1 Hydraulic calculations for the vacuum mains and force mains must be submitted with the application.

3.6.2 Plans and profiles of all mains must be submitted. Profiles must indicate depth to mains. All valves must be indicated on the plans.

3.6.3 The manufacturers recommendations shall be followed in design, when these standards are not applicable.

3.7 Maintenance and Operation

3.7.1 Factory trained maintenance personnel employed by the entity shall be available 24 hours/day.

3.7.2 Spare valves, controllers, valve pits, etc. must be kept in inventory.

3.7.3 Mixing of equipment (different makes and models) for a specific project will not be allowed.

3.8 Miscellaneous

3.8.1 Collection stations shall be supplied with ventilators and heater dehumidifiers.

3.8.2 Branch lines shall have individual cut off valves to allow isolation of the line for repair.

3.8.3 In new systems where water saving devices (such as vacuum toilets) are used, some lessening in the size of the treatment units shall be considered based upon review and approval of the Director.

3.8.4 Spare controllers, valves, and sensors shall be retained on a basis of 1 per each 10 units installed.

3.8.5 House vent stacks must be at least three inches in diameter. If necessary, a three to four inch stack shall be installed on the gravity sewer lateral adjacent to the house wall.

4.0 PRESSURE SEWAGE COLLECTION SYSTEM

4.1 General

4.1.1 Simplex units shall serve no more than two residences. Duplex units shall serve no more than four residences. Other multiple source applications shall be approved by the Director.

4.1.2 Types of Pressure Systems

4.1.2.1 Grinder Pump Pressure System

4.1.2.2 Septic Tank Effluent Pumping Pressure System

4.1.3 Types of Pumps

4.1.3.1 Submersible, Centrifugal Grinder Pumps--Pumps shall be readily removable and replaceable without dewatering the wet well.

4.1.3.2 Semi-Positive Displacement Grinder Pumps

A. Pumps shall be readily removable and replaceable without dewatering the wet well.

B. Pressure relief valves are required.

4.1.3.3 Non-Clog Submersible Centrifugal Effluent Pumps.

4.2. Design Requirements

4.2.1 Hydraulic Calculations--Calculations must be submitted with the application.

4.2.1.1 Peak flows shall be determined from the manufacturers recommendations based upon the pumping equipment used.

4.2.1.2 Head losses due to valves and fittings must be included in the hydraulic calculations.

4.2.1.3 For purposes of calculation, a C=100 in the Hazen-Williams Formula must be used for all pipe, except a C=120 can be used for plastic pipe.

4.2.1.4 Design velocity shall be in the range of 2 to 5 ft/sec.

4.2.1.5 Design life of the pumps shall be computed on the basis of ten (10) years.

4.2.2 Plans--Plans and profiles of all force mains must be submitted. Profiles must indicate depth of force mains. All valves must be indicated on the plans.

4.2.3 Design--The design shall be in accordance with the standards herewith stated, except when not covered by this standard, then the manufacturer's recommendations shall be followed.

4.3 Force Mains

4.3.1 Type (Minimum Pressure Rating)

PVC SDR 21, Schedule 40, or PVC SDR 26 may be used.

4.3.2 Color--All force main pipe shall be colored solid grey.

4.3.3 Size--The minimum size service line from the grinder pump to the collection main shall be 1¼".

4.3.4 Valves and Cleanouts

4.3.4.1 Mains must be valved at junctions in order that segments of the system may be taken out of service for maintenance.

4.3.4.2 Cleanouts shall be provided at junctions so that lines may be cleaned.

4.3.4.3 Cleanouts with valves shall be placed every 400 to 600 feet on straight runs.

4.3.4.4 Cleanouts and valves shall be located at changes in direction of the lines.

4.3.4.5 Air release valves shall be provided at high points in the line.

4.3.4.6 Ball or gate valves with cleanouts shall be provided at the ends of lines.

4.3.4.7 A method of providing continuity of service shall be provided for main collector lines.

4.3.5 Thrust Blocks--Concrete thrust blocks shall be provided at changes in direction and at "T" junctions.

4.3.6 Flushing--one of the following methods shall be provided:

4.3.6.1 Flush tanks of one-thousand gallons capacity with pumps at the ends of lines.

4.3.6.2 Water hydrants (with backflow preventers) at the end of lines. The backflow preventer shall be of the reduced pressure type and shall be non-removable.

4.3.6.3 Water tank truck with pumps.

4.4 Grinder Pump Pressure System

4.4.1 Location

4.4.1.1 The pump station shall be located outside the residence or commercial building.

4.4.1.2 The control box for a single residence unit shall be located on the outside of the building, preferably with the pump station.

4.4.1.3 For duplex grinder pump stations the control box shall be located with the pump station.

4.4.2 Electrical

4.4.2.1 Control panels shall be of the NEMA type 3 Enclosure.

4.4.2.2 The pump and float electrical controls shall have provisions for disconnection without entering the main control box.

4.4.3 Alarms

4.4.3.1 Where a single unit grinder pump station is utilized, a high water alarm light shall be placed within the residence (preferably the kitchen).

4.4.3.2 Where a dual grinder pump station is utilized, an alarm light and an audio alarm shall be placed at the control box by the pump station.

4.4.4 Emergency Holding

4.4.4.1 If a septic tank exists, such a tank maybe used for an emergency holding tank.

4.4.4.2 In areas of frequent power outages of a duration of more than four hours each, emergency holding tanks of 200 gallons capacity shall be installed.

4.4.5 Sequence of Connections--The sequence of valves, pump, and other appurtenances from the residence to the collection force main shall be as follows: four inch (4") sewer line, gate valve, pump, check valve, gate valve, and connection line with 45 degree bend in the direction of flow.

4.4.6 Check and Gate Valves

4.4.6.1 Check or gate valves shall be either plastic or bronze.

4.4.6.2 Check valves may be either swing check or ball type. If swing type check valves are utilized, a 1 to 2 foot horizontal run of straight pipe shall be constructed on the downstream side of the check valve.

4.4.7 Level Controls--Level controls in the pump station shall be either mercury magnetic switches or mercury switches.

4.5 Septic Tank Effluent Pressure Systems

4.5.1 Location (Same as Grinder Pump Pressure Systems; See 4.4.1)

4.5.2 Controls

4.5.2.1 Control panels shall be NEMA type 3 enclosure.

4.5.2.2 The pump and float controls shall have provision for disconnection without entering the main control box.

4.5.3 Alarms (Same as Grinder Pump Pressure Systems; See 4.4.3)

4.5.4 Sequence of Connections--The sequence of valves, pump, and other appurtenances from the residence to the collection force main shall be as follows: four inch (4") sewer line, septic tank, pumping chamber with pump, gate valve, check valve. gate valve and connection to main collection line with 45 degree bend in direction of flow.

4.5.5 Check and Gate Valves (Same as Section 4.4.6)

4.5.6 Level Controls (Same as Section 4.4.7)

4.5.7 Provisions for the treatment of septage shall be provided at the plant. A septic tank pumping vehicle shall be provided.

4.6 Maintenance and Operation

4.6.1 In the interest of obtaining proper maintenance and operation on a pressure sewer system, such a system must be either:

4.6.1.1 Under the jurisdiction of a public entity.

4.6.1.2 Under the jurisduction of a private company regulated by the Public Service Commission.

4.6.2 Maintenance personnel employed by an entity operating a pressure system must attend a factory training course on maintenance and operation of the proposed units.

4.6.3 A truck provided with a hoist is recommended.

4.6.4 Permanent maintenance easements are required if the location of the pumping equipment and other appurtenances is on private property.

4.6.5 Spare parts, such as air relief valves, gate valves, relay switches, etc. must be kept in inventory.

4.6.6 Mixing of equipment (makes, models) for a specific project will not be allowed.

4.6.7 Spare pumps shall be provided in the initial design as follows:

Installed Units	Spare Units
1 to 10	1
11 to 20	2
21 to 30	3
31 to 40	4
41 to 50	5
51 to 75	6
76 to 100	7
101 to 150	8
151 to 200	9
201 to 300	10
301 to 400	11
401 to 500	12
501 - up	As approved by the Director.

Part II

Section V

R E S E R V E D

6.0 Manholes

6.1 Location--Manholes shall be provided at the end of each sewer line; at all changes in slope, size, or alignment; at all intersections; and at distances not greater than 400 feet for sewers 15 inches in diameter or less, and 500 feet for sewers 18 inches to 30 inches in diameter. Greater spacing may be permitted in larger sewers and in sewers carrying settled effluent.

Cleanouts may be constructed at the upper end of short 6" laterals, which are no further than 150 feet from the nearest manhole. Cleanouts may be substituted for manholes in some special situations, but approval by the Director is required prior to submission.

6.2 Materials--Manholes shall be pre-cast concrete, poured-in-place concrete or concrete manhole block.

6.3 Drop Type--An outside drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. (The entire drop connection shall be encased in concrete). If an inside drop is necessary, the pipe shall be fastened to the manhole and access provided for cleaning. Where the difference in elevation between the incoming sewer and manhole invert is less than 24 inches, the invert should be filled.

6.4 Diameter--The minimum base diameter of manholes shall be 48 inches; larger diameters are preferable for large diameter sewers. (Minimum opening 24")

6.5 Steps--Non-corrosive steps embedded in the walls, offset and spaced 12 to 18 inches apart vertically shall be provided.

6.6 Flow Channel--The inside base of the manhole shall be filled with concrete to form a bench sloping toward the flow channel. Both the flow channel and the bench shall be trowelled to a smooth surface.

6.7 Watertightness--Solid manhole covers are to be used wherever the manhole covers may be flooded by street runoff or high water. Manholes of segmented block shall be water proofed on the exterior with plaster coatings, supplemented by a bituminous waterproof coating concrete manholes shall be waterproofed on the exterior where groundwater conditions are unfavorable. Pipe connections to manholes and joints on manholes shall be watertight.

7.0 PUMPING STATION

7.1 General

7.1.1 Flooding--Pumping stations including electrical equipment shall be located at an elevation not subject to the 100 year flood or shall otherwise be adequately protected against the 100 year flood.

7.1.2 Location--A suitable structure, preferably located off the right-of-way of streets and alleys shall be provided. The station shall be readily accessible. If possible, the station should be 100 feet from the nearest dwelling. Fencing shall be required to prevent entry of unauthorized persons.

7.1.3 Overflows--No overflows or bypasses from lift stations shall be permitted.

7.1.4 Pumping Rates and Number of Pumping Units--Dual pumps shall be provided at all lift stations, each capable of providing the maximum design flow. Pumping units shall be sized to provide the minimum cleaning velocity of 2.5 feet per second at the rated capacity, assuming a C=120 for plastic pipe and C=100 for all other pipe materials in the Hazen-Williams Formula.

7.1.5 Type--Either the wet well or wet well/dry well type may be approved.

7.2 Design

7.2.1 Long Drive Shaft Pumps--A wet well installation in which the pump is mounted in the wet well and connected by a drive shaft to the motor above the wet well, will not be approved.

7.2.2 Separation--Wet well and dry well including their superstructure shall be completely separated.

7.2.3 Pump Removal--Provisions shall be made to facilitate removing pumps and motors.

7.2.4 Access--Suitable and safe means of access shall be provided to dry wells of pumping stations and shall be provided to wet wells containing either bar screens or mechanical equipment requiring inspection or maintenance. Stairways should be installed, with rest landings not to exceed 10 foot vertical intervals.

7.2.5 Size--The effective capacity of the wet well should provide a detention time not exceeding 30 minutes for the design average flow.

7.2.6 Floor Slope--The wet well floor shall have a minimum slope of one to one towards the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the inlet. Bottoms shall have a smooth finish.

7.2.7 Protection Against Clogging--Pumps handling raw sewage shall be preceded by readily accessible bar screens with clear openings not exceeding 2½ inches, unless pneumatic ejectors are used or special devices are installed to protect the pumps from clogging or damage. Where the size of the installation warrants, a mechanically cleaned bar screen with grinder, or comminution device is recommended. Where screens are located below ground, convenient facilities must be provided for handling screenings. For the larger or deeper sections, duplicate protection units of proper capacity are preferred.

7.2.8 Pump Openings--Pumps shall be capable of passing 2½ inch solids, or be of the grinder pump type when used in residential developments of 500 persons or less. Pumps for all other installations shall be capable of passing 3 inch solids or be of the grinder pump type. Pumps shall be non-clog type pumps or ejectors.

7.2.9 Priming--The pump shall be so placed that under normal operating conditions it will operate under a positive suction head, except as specified for suction lift pumps.

7.2.10 Electrical Equipment--Electrical systems and components (e.g. motors, lights, cables, conduits, switchboxes, control circuits, etc.) in enclosed or partially enclosed spaces where gas may be present (including raw wastewater wet wells) shall comply with the National Electrical Code requirements for Class I, Group D, Division I locations.

7.2.11 Intake--Each pump shall have an individual intake. Wet Well design should be such as to avoid turbulence near the intake.

7.2.12 Dry Well Dewatering--A separate pump shall be provided in the dry wells to remove leakage or drainage with the discharge above the overflow level of the wet well. A connection to pump suction is also recommended as an auxiliary feature. Water ejectors connected to a drinking water supply will not be approved. All floor and walkway surfaces should have an adequate slope to a point of drainage.

7.2.13 Controls--Control float cables shall be so located as not to be affected by the flows entering the wet well or by the suction of pumps. Float tubes in dry wells shall extend high enough to prevent overflow. Provision should be made to automatically alternate the pump in use. Pump stations with motors and/or controls below grade shall be equipped with a secure external disconnect switch.

7.2.14 Valves and Piping--Pumps shall be equipped with a full closing valve on the suction piping except on submersible and vacuum-primed pumps. A check valve followed by a gate valve shall be installed on the discharge piping. Valves shall not be located in a wet well.

7.2.15 Ventilation--Mechanical ventilation must be provided if routine maintenance will require personnel to enter the station.

7.2.15.1 Wet Wells--Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least 12 complete air changes per hour; if intermittent, at least 30 complete air changes per hour.

7.2.15.2 Dry Wells--Ventilation may be either continuous or intermittent. Ventilation, if continuous, shall provide at least six complete air changes per hour; if intermittent, at least 30 complete air changes per hour.

7.2.16 Flow Measurement--The capability for emplacing suitable devices for measuring sewage flow shall be provided at all pumping stations. Such devices will be required to be in place at critically located pumping stations.

7.2.17 Water Supply--There shall be no physical connection between any potable water supply and a sewage pumping station.

7.2.18 Alarm Systems--All pump station installations shall be provided with a high water alarm light at the lift station.

7.2.19 Reliability--Emergency power may be required under specific circumstances, such as, above water intakes, recreational waters, or other situations as determined by the Director.

7.2.20 Portable Equipment--In some instances portable equipment may furnish service to more than one pumping station; however, where such equipment is utilized, it shall have the capability to operate between the wet well and the discharge side of the station. The station shall be provided with permanent fixtures, which will facilitate rapid and easy connection of lines.

7.2.21 Emergency Power Generation--All emergency power generation equipment, if required, shall be provided with instructions indicating the essentiality of routinely and regularly starting and running such units at full load.

7.3 Suction Lift Pumps

7.3.1 Suction lift pumps shall be of the self-priming or vacuum priming type.

7.3.1.1 Self-priming Pumps-- shall be capable of rapid priming and repriming at the "lead pump on" elevation. Such self-priming and repriming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 25 feet in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 4 feet from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 22 feet.

7.3.1.2 Vacuum-priming Pump Stations-- shall be equipped with dual vacuum pumps capable of automatically and completely removing air from the suction lift pump. The vacuum pumps shall be adequately protected from damage due to sewage. The combined total of dynamic suction lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 22 feet.

7.3.2 The capacity of a suction lift pump station shall be limited by the net positive suction head and specific speed requirements as stated on the manufacturer's pump curve under the most severe operating conditions.

7.3.3 Suction lift pumps shall not be located within the wet well.

7.3.4 Access to the wet well shall not be through the dry well, and the dry well shall have a gas-tight seal when mounted directly above the wet well.

7.4 Submersible Pumps

7.4.1 Pump Removal--Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

7.4.2 Hoist Provision--A submersible pumping facility may be required to have a hoist for removing the pump from the wet well.

7.4.3 Electrical Control Location--Electrical controls must be located outside the wet well in a suitable housing for protection against weather and vandalism.

7.5 Pneumatic Ejectors

7.5.1 Venting--Ejector pots shall be vented to the atmosphere.

7.5.2 Duplicate Compressors--Duplicate compressors shall be provided and consideration shall be given to providing an air storage tank.

7.6 Force Mains

7.6.1 Size--Minimum size of force mains to serve facilities having a population equivalent of 500 people or less shall be three (3) inches for solids passing pumps. Minimum size of force mains serving population equivalent of over 500 population, shall be four (4) inches for solids passing pumps. Smaller size force mains may be utilized in conjunction with grinder pumps.

7.6.2 Air Relief Valve--Air relief valves shall be placed at high points in the force mains.

7.6.3 Termination--The force mains should enter the receiving manhole with its center-line horizontal and with an invert elevation which will insure a smooth laminar flow transition to the gravity flow section, but in no case shall the force main enter the gravity sewer system at a point more than one foot above the flow line of the receiving manhole. The design shall especially prevent turbulence at this point. (Immediately upstream, the force main design shall

include a positive trap to keep the force main full of liquid at all times.) For discharge into deep manholes, a raised section may be provided, and for shallow manholes, a depressed section may be provided.

Attention should be given to the use of inert material or protective coatings for receiving manholes and sewers to prevent deterioration as a result of hydrogen sulfide.

7.6.4 Materials of Construction--Force mains shall be constructed of plastic, cast iron, asbestos cement or cement lined steel pipe bearing the NSF seal and of the pressure class required by the total dynamic head.

7.6.5 Anchoring--Force mains shall be sufficiently anchored within the pump station and throughout the line length. The number of bends shall be as few as possible. Thrust blocks, restrained joints, and/or tie rods shall be provided where restraint is needed.

Part III

SEWAGE TREATMENT WORKS

Part III

SEWAGE TREATMENT WORKS

INDEX

1.0 GENERAL

1.1 Sewage treatment plants shall be designed to provide for an estimated population 20 years hence. All plants shall be designed so they can readily be increased in capacity except where circumstances preclude the probability of expansion.

1.2 Plant Location--A sewage treatment plant site shall be as far as practicable from any present built-up or any area which will probably be built up within a reasonable future period. A buffer zone as indicated in Table 1 shall be provided from any surrounding occupied residences to the plant site. The direction of prevailing winds should be considered when selecting the plant site. The plants operational units shall be located at an elevation which is not subject to the 100 year flood or shall otherwise be adequately protected against 100 year flood damage. The plant shall remain fully operational during a 25-year-flood. The plant shall be readily accessible in all seasons. The site shall be of sufficient size to accommodate expansion or addition of facilities to increase the degree of treatment.

1.3 Quality of Effluent

1.3.1 Surface Water Discharge--The required degree of wastewater treatment shall be based on the stream standards and water quality criteria established by the Water Resources Board and effluent limitations established by the Division of Water Resources. More strigent requirements may be established by the Director if a water supply intake, a recreational water use area or aquaculture is located downstream from the discharge point.

Table 1

BUFFER ZONE REQUIREMENTS FOR SEWAGE TREATMENT UNITS

Package Sewage Treatment Plants	Buffer Zone Requirements
40,000 gpd or less and polishing ponds, package sand filters and alternating surface sand filters, TKN removal equipment, aerated lagoons	100 feet
40,001 gpd -- 100,000 gpd	200 feet
greater than 100,000 gpd	300 feet
Lagoons, Trickling Filters, Land Treatment Systems.	
All units	300 feet

1.3.2 Land Discharge--See Section 16.

1.3.3 New Processes, Methods and Equipment--The policy of the Director is to encourage the development of new processes, methods and equipment for sewage treatment. The following may be required:

1.3.3.1 Monitoring observations, including test results and engineering evaluations, demonstrating the efficiency of such processes.

1.3.3.2 Detailed description of the test methods.

1.3.3.3 Testing, including appropriately-composited samples, under various ranges of strength and flow rates (including daily variations) and waste temperatures over a sufficient length of time to demonstrate performance under climatic and other conditions which may be encountered in the area of the proposed installations.

1.3.3.4 Other appropriate information.

The Director may require that appropriate testing be conducted and evaluations made under the supervision of a competent process engineer other than those employed by the manufacturer or developer.

1.3.3.5 A performance bond may be required.

1.4 Design

1.4.1 Industrial Wastes--When treating industrial and institutional wastes in a sewage treatment works, consideration shall be given to the character of the wastes in the design of the plant. In such cases, treatability studies on the composite wastewater may be required prior to the plant design.

1.4.2 Hydraulic Loading--The design of treatment plant units shall be based on the average rate of sewage flow per 24 hours except where significant deviations from the normal daily flow pattern are noted.

1.4.3 Existing Sewage Systems--Where there are existing sewers, the volume and strength of sewage flow shall be determined. These data shall be obtained from actual flow measurements, preferably for both wet and dry weather periods. Laboratory analysis shall be made on composite samples taken over 24-hour periods.

Plans and specifications for sewage works to serve existing sewage systems will be designed on the basis of characteristics and strength of sewage as shown by results of composite samples examined and gaugings of the present flow plus allowance for estimated increase in population. In addition, non-excessive infiltration /inflow will be included.

1.4.4 New Sewage Systems--Where new sewers are to be constructed, plans for sewage treatment works shall be designed on the basis of 70 gallons per capita per day.

1.4.5 Organic Loading--The design organic loading shall be computed in the same manner used in determining design flow. Generally, organic loading shall be computed at 0.17 pounds of five-day BOD per person per day.

1.4.6 Conduits--All piping and channels shall be designed to carry the maximum expected flows. The incoming sewer shall be designed for free discharge. Bottom corners of the channels must be filleted. Pockets and corners where solids can accumulate shall be eliminated. Suitable gates shall be placed in channels to seal off unused sections which might accumulate solids. The use of shear gates or stop planks is permitted where they can be used in place of gate valves or sluice gates.

1.4.7 Arrangement of Units--Component parts of the plant shall be arranged for greatest operating convenience, flexibility, economy, and so as to facilitate installation of future units. Multiple treatment units shall be provided for plants greater than 100,000 gallons in size. Appurtenances shall be provided in such a manner that any unit may be temporarily taken out of service. The remainder of the plant must be operational with the unit or units out of service. In the case of oxidation ditches, the above requirements are satisfied if multiple rotors are provided.

1.5 Miscellaneous

1.5.1 Provisions for Taking Units Out of Service--Properly located and arranged diversion piping and/or structures shall be provided so that either dual or multiple units of the plant can be removed from service independently for inspection, maintenance, and repairs.

1.5.2 Dewatering--Means shall be provided to dewater each unit. Due consideration shall be given to the possible need for hydrostatic pressure relief devices.

1.5.3 Construction Materials--Due consideration shall be given to the selection of materials which are to be used in sewage treatment works because of the possible presence of hydrogen sulfide and other corrosive gases, greases, oils, and similar constituents frequently present in sewage. This is particularly important in the selection of metals and paints. Dissimiliar metals should be avoided to minimize galvanic action.

1.5.4 Covering Units--Properly vented covers may be used.

1.5.5 Painting--The use of paints containing lead or mercury should be avoided. In order to facilitate indentification of piping it is suggested that the different lines be color-coded. The following color scheme is recommended for purposes of standardization.

Sludge line	Brown
Gas line	Orange
Potable water line	Blue
Chlorine line	Yellow
Sewage line	Gray
Compressed air line	Green
Water lines for heating digesters or buildings	Blue with 6 inch red bands spaced 30 inches apart

The contents shall be stenciled on the piping in a contrasting color. The above color scheme is only required for plants of over 100,000 gallons in size.

1.5.6 Operating Equipment--The specifications shall include a complete outfit of tools and accessories for the plant operator's use, such as squeegees, wrenches, valve keys, rakes, shovels, etc. A portable pump is desirable. Readily accessible storage space and work bench facilities shall be provided and consideration given to provision of a garage area which would also provide space for large equipment, maintenance and repair.

1.5.7 Grading and Landscaping--Concrete or gravel walkways should be provided for access to all units. Where possible, steep slopes shall be avoided to prevent erosion. Surface water shall not be permitted to drain into any unit. Particular care shall be taken to protect trickling filter beds, sludge beds, and intermittent sand filters from surface water. Provision should be made for landscaping, particularly when a plant must be located near residential areas.

1.6 Plant Outfalls

1.6.1 Outlet--The outfall sewer, where practicable, shall be extended to the low water level of the receiving body of water in such a manner to insure satisfactory dispersion of the effluent thereto, and insofar as practicable, it shall have its outlet submerged. Headwalls may be used where adequate dispersion is obtained without carrying the outfall into the stream.

1.6.2 Design and Construction--The outfall sewer shall be so constructed and protected against the effects of flood water, ice, or other hazards as to reasonably insure its structural stability and freedom from stoppage.

1.7 Essential Facilities

1.7.1 Emergency Power

1.7.1.1 General--All plants greater than 100,000 gallons in size shall be provided with an alternate source of electric power to allow continuity of operation during power failures, except as noted below.

A. Methods of providing alternate sources include:

1. The connection of at least 2 (two) independent public utility sources, such as substations. A power line from each substation is recommended, and will be required unless documentation is received and approved by the reviewing agency verifying that a duplicate line is not necessary to minimize water quality violations;

2. Portable or in-place internal combustion engine equipment which will generate electrical or mechanical energy; and

3. Portable pumping equipment when only emergency pumping is required.

B. Power for Aeration--Standby generating capacity normally is not required for aeration equipment used in the activated sludge process. Where power outages of

four (4) hours or more are common, auxiliary power for minimum aeration of the activated sludge will be required. Full power generating capacity may be required by the reviewing authority on certain critical stream segments.

C. Power for Disinfection--Continuous disinfection, where required, shall be provided during all power outages.

1.7.2 Electrical Equipment--All electrical equipment such as motors and local controls, and electrical conduits shall either be located at an elevation above the 100 year flood level or be of waterproof design. All outdoor equipment shall be adequately protected from the weather. Motors located indoors, and near liquid handling piping and equipment, shall be of splashproof design. All electrical wires in underground conduits or in conduits that can be flooded shall have water resistant insulation as identified in the National Electrical Code.

1.7.3 Water Supply

1.7.3.1 General--An adequate supply of drinking water shall be provided for use in the laboratory and general cleanliness around the plant. No piping or other connections shall exist in any part of the treatment works which, under any condition, might cause the contamination of a drinking water supply. The chemical quality should be checked for suitability for the intended use, in heat exchangers, chlorinators, etc.

1.7.3.2 Direct Connections--The drinking water supply line to each treatment plant shall be equipped, as a minimum, with an approved reduced-pressure type backflow preventer. These devices must be installed in a location to prevent flooding, corrosion and allow for adequate, quick service and periodic inspections. Installation in below grade meter type vaults will not be acceptable. All water supply take-off points must follow the devices and no extension of this line to serve the public shall be allowed.

Drinking water from a municipal or separate supply may be used directly at points above grade for the following hot and cold supplies:

A. Lavatory sinks

B. Water Closets

C. Laboratory sinks which are equipped with approved vacuum breakers.

D. Showers

E. Drinking fountains

F. Approved outside hydrants

G. Hose bibbs which are equipped with non-removable vacuum breakers.

H. Chlorinators provided with suitable vacuum breakers or other approved back-flow preventers appropriately installed.

Hot water for any of the above units shall not be taken directly from a boiler used for supplying hot water to a sludge heat exchanger or digester heating coils.

1.7.3.3 Indirect Connection--Where a potable water supply is to be used for any purpose in a plant other than those listed in Section 1.7.3.2, a break tank, pressure pump, and pressure tank shall be provided. Water shall be discharged to the break tank through an air-gap at least six (6) inches above the maximum flood line or the spill line of the tank, whichever is higher. A sign shall be permanently posted at every hose bibb, faucet, or stop cock located on the water system beyond the break tank to indicate that the water is not safe for drinking.

1.7.3.4 Separate Drinking Water Supply--Where it is not possible to provide drinking water from a public water supply, a separate well may be provided. Location and construction of the well shall comply with requirements of the State Department of Health. Requirements governing the use of the supply are those contained in Section 1.7.3.2 and Section 1.7.3.3.

1.7.3.5 Separate Non-Drinking Water Supply--Where a separate non-drinking water supply is to be provided, stop cocks, hos bibbs, and

other water outlets shall be posted with a permanent sign indicating the water is not safe for drinking.

1.7.4 Sanitary Facilities--All sewage treatment plants with laboratory facilities shall be provided with a shower, toilet, and lavatory. Locker facilities shall also be provided.

1.7.5 Sewage Flow Measurement--Facilities for measuring the volume of sewage flows shall be provided at all treatment works greater than 100,000 gallons in size. All plants having a capacity of greater than 100,000 gallons per day shall be equipped with indicating, recording, and totalizing equipment for effluent flow measurement.

1.7.6 Floor Slope--Floor surface shall be sloped adequately to a point of drainage.

1.7.7 Stairways--Stairways shall be installed with a slope of 30 to 35 degrees from the horizontal to facilitate carrying samples, tools, etc.

All risers in a stairway should be of equal height. All stairways must be provided with handrails.

1.8 Safety--Adequate provision shall be made to protect the operator and visitors from hazards. Following are the minimum requirements for all plants:

1.8.1 Enclosure of the plant site with a minimum six feet high fence with a locked entrance gate designed to discourage the entrance of unauthorized persons and animals.

1.8.2 Installation of handrails, grating, and guardrails where necessary, such as open basins, screen channels, mechanical equipment and other hazardous places. For all extended aeration plants of 40,000 gallons per day or less grating will be required.

1.8.3 Provision of first-aid equipment.

1.8.4 Posting of "No Smoking" signs in hazardous locations.

1.8.5 Provision of protective clothing and equipment such as gas masks, gloves, etc.

1.8.6 Provision of portable blower and sufficient hose.

1.8.7 Explosion proof electrical equipment, nonsmoking tools, etc. shall be provided in work areas where hazardous conditions may exist, such as digester

a vaults and other locations where potentially explosive atmospheres of flammable gas or vapor accumulate.

1.8.8 All electrical wiring shall be properly grounded and insulated. No part of the plant piping may be used for grounding.

1.8.9 Portable lighting equipment shall be provided.

1.8.10 All manhole steps shall have slip-proof rungs and the steps shall be of the railroad type which will help prevent foot slippage off the ends of the rungs.

1.8.11 Separate storage located remotely from the plant shall be provided for flammable and hazardous material.

1.8.12 Heating devices with open flames shall be located in separate rooms with outside entrances, and at grade or above.

1.8.13 Particular safety precautions for gas-collection piping shall be installed.

1.8.14 Adequate ventilation must be provided.

1.8.15 Chlorinator rooms and chlorine storage areas shall be equipped with heat, light, and a ventilation fan must be capable of being turned on from outside the room. The room shall be at grade or above. A viewing window from the plant interior shall be provided.

1.8.16 The treatment works should comply with the provisions of the Occupational Safety and Health Act (OSHA).

1.9 Laboratory Space--All treatment works shall have facilities, either contractual or on-site, for making the necessary analytical determinations and operating control tests. Whenever an on-site laboratory is utilized, isolation should be such as to render the laboratory reasonably free from the adverse effects of noise, heat, vibration, and dust. Minimum laboratory space for facilities not performing BOD and suspended solids testing on-site shall be 100 square feet floor space with 35 square feet bench area. Facilities providing on-site BOD, suspended solids, and/or fecal coliform analysis shall provide a minimum of 400 square feet floor space and 150 square feet of bench space. If more than two persons will be working in the laboratory at any given time, 100 square feet of additional space should be provided for each additional person. Advanced wastewater treatment plants shall provide a minimum of 100 additional square feet of floor space with proportionate increase in

bench space. Lists of laboratory equipment shall be compiled from the latest edition of Standard Methods for the Examination of Water & Wastewater, by APHA - AWWA - WPCF.

1.10 Laboratory Equipment--All treatment works shall be provided with laboratory equipment determined by the Director based upon type and complexity of the treatment process. However all extended aeration treatment plants of 100,000 gallons per day or less shall be provided with the following:

1.10.1 Test kit for pH and for chlorine residual. This test kit shall be of the comparator type as manufactured by Hach, Taylor, Hellige or Wyandotte.

1.10.2 Two (2) 1-liter graduated beakers.

1.10.3 Secchi disk.

1.10.4 Squeegee with proper length of handle, five (5) quart bucket and rubber gloves.

2.0 SCREENING DEVICES AND COMMINUTORS

2.1 Bar Racks and Screens

2.1.1 Protection for pumps and other equipment shall be provided by either coarse bar racks or bar screens. Protection for comminutors should be provided by coarse bar racks.

2.1.2 Location

2.1.2.1 Indoors--Screening devices, installed in a building where other equipment or offices are located, should be accessible only through a separate outside entrance.

2.1.2.2 Outdoors--Screening devices installed outside shall be protected from freezing.

2.1.2.3 Access--Screening areas shall be provided with stairway access, lighting and ventilation, and a convenient means for removing the screenings.

2.1.3 Design and Installation

2.1.3.1 Bar Spacing--Clear openings between bars should be no less than one inch for manually cleaned screens. Clear openings for mechanically cleaned screens may be as small as 5/8 of an inch. Maximum clear openings should be 1 3/4 inches.

2.1.3.2 Slope--Manually cleaned screens, except those for emergency use, should be placed on a slope of 30 to 45 degrees from the horizontal.

2.1.3.3 Velocities--At normal operating flow conditions, approach velocities should be no less than 1.25 feet per second, to prevent settling; and no greater than 3.0 fps, to prevent forcing material through the openings.

2.1.3.4 Channels--For plants of greater than 100,000 gallons per day, dual channels shall be provided and equipped with the necessary gates to isolate flow from any screening unit. Provisions shall also be made to facilitate dewatering each unit. The channel preceding and following the screen shall be shaped to eliminate stranding and settling of solids. Channels shall be 3 to 6 inches below the invert of the incoming sewer.

2.1.3.5 Mechanical Devices--A positive means of locking out each mechanical device shall be provided.

2.1.4 Control Systems

2.1.4.1 Timing Devices--All mechanical units without timing devices must run continuously. All mechanical units which are operated by timing devices shall be provided with auxiliary control which will set the cleaning mechanism in operation at predetermined high water elevations.

2.1.4.2 Electrical Fixtures and Controls--Electrical fixtures and controls in screening areas where hazardous gases may accumulate shall meet the requirements of the National Electrical Code for Class 1, Group D, Division 1 locations.

2.1.4.3 Manual Override--Automatic controls shall be supplemented by a manual override.

2.1.5 Auxiliary Screens--Where mechanically operated screening or comminuting devices are used, auxiliary manually cleaned screens shall be provided. Design shall include provisions for automatic diversion of the entire sewage flow through the auxiliary screens should the regular units fail.

2.1.6 Fine Screens--The use of fine screens in lieu of sedimentation is not permitted. In special cases where it can be demonstrated that the features peculiar to fine screens may be advantageous, such proposed installation may be approved by the Department of Health on a case-by-case basis.

2.1.7 Disposal of Screenings--Facilities must be provided for removal, handling, storage, and disposal of screenings in a sanitary manner. Manually cleaned screening facilities shall include an accessible platform from which the operator may rake screenings easily and safely. Suitable drainage facilities shall be provided both for the platform and for storage areas. Grinding of screenings and return to the sewage flow is prohibited. Open area disposal is prohibited. Screenings may be buried in a manner approved by the Director or placed in a landfill when permitted.

2.2 Comminutors

2.2.1 Location--Comminutors shall be provided at all sewage treatment plants 40,000 gallons or greater in size.

Comminutors should be located downstream of any grit removal equipment.

2.2.2 Size--Comminutors shall be designed to handle peak flow.

2.2.3 Installation--A bar screen bypass channel shall be provided. The use of the bypass channel should be automatic at depths of flow exceeding the design capacity of the comminutor.

2.2.4 Servicing--Provision shall be made to facilitate servicing units in place and removing units from their location for servicing.

2.2.5 Macerators and Grinder Pumps--Macerators and grinder pumps or similar devices may be used in lieu of comminutors where approved by the Director.

3.0 GRIT REMOVAL

3.1 General--Grit removal facilities shall be provided for all sewage treatment plants serving combined sewer systems. Provision shall be made for further installation of grit removal facilities for all plants of greater than 100,000 gallons in size serving new sanitary sewer systems. Grit removal facilities may be required for new plants serving existing sewer systems. All sewage treatment plants having anaerobic digesters will require grit removal.

3.2 Location--Grit removal facilities, except in unusual circumstances shall be located ahead of pumps and comminuting devices, and coarse bar racks should be placed ahead of mechanically cleaned grit removal facilities.

3.3 Type and Number of Units--Grit removal facilities for plants treating wastes from combined sewers shall have at least 2 manually cleaned units or one mechanically cleaned unit and one manually cleaned unit.

Facilities other than channel-types are desirable for plants 100,000 gallons or greater in size, if provided with flexible controls for agitation and/or air supply devices and with grit removal equipment.

3.4 Velocity-Controlled Grit Removal

3.4.1 Inlet--Inlet turbulance shall be minimized.

3.4.2 Velocity and Detention--Channel-type chambers shall be designed to provide a velocity of 1 foot per second. The detention time shall be based on the size of particles (0.21 mm) to be removed. The design should take into consideration undesirable turbulence and velocities at inlets and outlets.

3.4.3 Grit Washing--The need for grit washing should be determined by the method of final grit disposal.

3.4.4 Drains--Provisions shall be made for dewatering each unit.

3.4.5 Water--An adequate supply of water under pressure shall be provided for clean up.

3.4.6 Grit Removal--Grit removal facilities located in deep pits shall be provided with mechanical equipment for pumping or hoisting grit to ground level. Such pits shall have a stairway, elevator or manlift, ventilation, and lighting, and be provided with means of drainage.

3.5 Aerated Grit Removal

3.5.1 Air Diffusers--Air diffusers shall be located on one side of the tank, 2 to 3 feet above the tank bottom.

3.5.2 Air Supply Rate--A detention time of 3 minutes at the maximum rate of flow shall be provided.

3.5.3 Inlet and Outlet--Design of the aerated grit chamber must be such as to prevent short circuiting at the inlet and outlet. The inlet to the chamber shall introduce the wastewater directly into the circulation pattern caused by the air diffusion. The outlet shall be at a right angle to the inlet and a baffle shall be installed near the outlet.

3.5.4 Grit Removal--The aerated grit chambers shall be provided with mechanical grit removal equipment.

3.6 Grit Handling--Impervious surfaces with drains should be provided for grit handling areas. If grit is to be transported, the conveying equipment should be designed to avoid loss of material and to provide protection from freezing.

3.7 Grit Disposal--Grit may be buried in a manner approved by the Director or placed in a landfill when permitted.

4.0 PRE-AERATION

General--Pre-aeration of sewage to reduce septicity may be required in special cases.

5.0 FLOW EQUALIZATION

5.1 General--Flow equalization shall be provided where large daily variations in organic or hydraulic loadings are expected.

5.2 Location--Equalization basins shall be located downstream of pretreatment facilities such as bar screens, comminutors, and grit chambers.

5.3 Type--Flow equalization can be provided by using separate basins or on-line treatment units, such as aeration tanks. Equalization basins may be designed as either in-line or side-line units.

5.4 Design

5.4.1 Mixing--Mixing requirements for normal raw domestic wastewaters shall range from 0.02 to 0.04 hp/1000 gallons of maximum storage volume.

5.4.2 Aeration--A minimum of 1.0 mg/l of dissolved oxygen shall be maintained in the mixing basin at all times. Air supply rates should be a minimum of 1.25 cfm/1000 gallons of storage capacity.

5.4.3 Storage--Sufficient storage shall be provided to allow the sections of the plant which follow the storage to operate at or at less than their rated design capacity.

5.4.4 Detention/Equalization--Basins designed for a combination of storage of wet weather flows and equalization shall be compartmentalized to allow utilization of a portion of the basins for dry weather flow equalization.

5.4.5 Flow Discharge Control--Multiple pumping units capable of delivering the desired flow rate from the equalization basin with the largest pumping unit out of service shall be provided.

5.4.6 Aeration Support--When floating surface aerators are provided, provisions shall be made to protect the units when the tank is dewatered.

5.4.7 Basin Cleaning--Facilities shall be provided to flush solids and grease accumulations from the basin walls.

5.4.8 Scum Control--For plants greater than 100,000 gallons in size a high-water-level takeoff shall be provided for withdrawing floating material where subsurface diffusers are used.

5.4.9 Controls--The follwoing controls shall be provided for plants greater than 100,000 gallons per day. Inlets and outlets for all basin compartments shall be suitably equipped with accessible external valves, stop plates, weirs, or other devices to permit flow control, level control, and the removal of an individual unit from service. Facilities shall also be provided to measure and indicate liquid levels and flow rates.

6.0 SETTLING

6.1 Inlets--Inlets should be designed to dissipate the inlet velocity, to distribute the flow equally, and to prevent short-circuiting. Channels should be designed to maintain a velocity of at least 1 foot per second at one-half design flow. Corner pockets and dead ends should be eliminated and corner fillets or channeling used where necessary. Provisions shall be made for elimation or removal of floating materials in inlet structures having submerged ports.

6.2 Dimensions--The minimum length of flow from inlet to outlet should be 10 feet unless special provisions are made to prevent short-circuiting. The liquid depth of mechanically cleaned settling tanks shall be as shallow as practicable but not less than seven feet. Sidewater depth for final clarifiers for activated sludge should not be less than 12 feet for plants greater than 100,000 gallons in size.

6.3 Scum Removal--Effective scum collection and removal facilities, including baffling, shall be provided ahead of the outlet weirs on all settling tanks. Provisions may be made for discharge of scum with the sludge; other provisions may be necessary to dispose of floating materials which may adversely affect sludge handling and disposal.

6.4 Weirs--Overflow weirs shall be adjustable. Weir loadings should not exceed 10,000 gallons per day per linear foot for plants designed for average flows of 1.0 mgd or less. Special consideration will be given to weir loadings for plants designed for flows in excess of 1.0 mgd, but such loadings should not exceed 15,000 gallons per day per linear foot. If pumping is required, pump capacity should be related to tank design to avoid excessive weir loading.

6.5 Submerged Surfaces--The tops of beams and similar construction features which are submerged shall have a minimum slope of 1.4 vertical to 1 horizontal. The underside of such features should have a slope of one to one to prevent the accumulation of scum or solids.

6.6 Multiple Units--Multiple units capable of independent operation shall be provided at all plants having a capacity greater than 100,000 gallons per day.

6.7 Protective and Servicing Facilities--In plants greater than 100,000 gallons in size all settling tanks shall have provision for easy access for maintenance, and protection of operators. Such features include stairways, walkways, handrails, etc. If side walls are extended some distance above the liquid level to provide flood protection for other purposes, convenient walkways shall be provided to facilitate housekeeping and maintenance of weirs.

6.8 Surface Settling Rates

6.8.1 Primary Settling Tanks--Surface settling rates for primary tanks shall not exceed 1000 GPD per square foot at design flow or 1500 GPD per square foot for peak hourly flows, whichever is larger, for plants having a design flow of 1.0 mgd or less. Higher surface settling rates may be permitted for larger plants.

6.8.2 Intermediate Settling Tanks--Surface settling rates for intermediate settling tanks, where used following fixed film reactors, should not exceed 1,500 GPD per square foot based on their design flow.

6.8.3 Final Settling Tanks--Surface settling rates for final settling tanks, based on maximum flow rates, shall be as follows:

6.8.3.1 Fixed Film Biological Reactors--Surface settling rates for settling tanks following trickling filters or rotating biological contactors shall not exceed 1200 GPD per square foot based on peak hourly flow.

6.8.3.2 Activated Sludge--The hydraulic design of intermediate and final settling tanks following the activated sludge process shall be based upon the anticipated peak hourly rate for the area downstream of the inlet baffle. The hydraulic loadings shall not exceed: 1200 GPD per square foot for conventional, step aeration, contact stabilization and the carbonaceous stage of separate-stage nitrification; 1000 GPD per square foot for extended aeration; and 800 GPD per square foot for the separate nitrification stage. The solids loading for all activated sludge processes shall not exceed 50 lbs. solids per day per square foot at the peak rate.

6.9 Freeboard--Walls of settling tanks shall extend at least 6 inches above the surrounding ground surface and shall provide not less than 12 inches freeboard. Additional freeboard or the use of wind screens is recommended where larger settling tanks are subject to high velocity wind currents that would cause tank surface waves and inhibit effective scum removal.

6.10 Scum Removal--Effective scum collection and removal facilities, including baffling, shall be provided for all settling tanks. The unusual characteristics of scum which may adversely affect pumping, piping, sludge handling and dis-

posal, should be recognized in design. Provisions may be made for the discharge of scum with the sludge; however, other special provisions for disposal may be necessary.

6.11 Sludge Removal--Provisions shall be made to permit continuous sludge removal from settling tanks. Final clarifiers in activated sludge plants greater than 0.25 mgd shall be provided with positive scraping devices. Each sludge withdrawal line shall be at least four inches in diameter, if pumped, and, if gravity flow, at least six inches in diameter and shall be individually valved. This does not apply to air lift methods of sludge removal rate. Head available for withdrawal of sludge shall be at least 30 inches. Adequate provisions shall be made for rodding or backflushing individual pipe runs. Piping shall also be provided to return waste sludge to primary clarifiers.

6.12 Sludge Hopper--The minimum slope of the side walls shall be 1.7 vertical to 1 horizontal. Hopper wall surfaces should be made smooth with rounded corners to aid in sludge removal. Hopper bottoms shall have a maximum dimension of two feet.

7.0 ACTIVATED SLUDGE

7.1 General--The activated sludge process, and its various modifications, may be used where sewage is amenable to biological treatment.

7.2 Settling Tanks--The following requirement is in addition to those set forth in Section 6.0, Part III.

Bypass--When a primary settling tank is used, provision shall also be made for discharging raw sewage directly to the aeration tanks to facilitate plant start-up and operation during the initial stages of the plant design life.

7.3 Aeration

7.3.1 Aeration Tanks

7.3.1.1 General--Multiple tanks capable of independent operation shall be provided for all plants rated at greater than 100,000 GPD. The size of the aeration tank for any particular adaptation of the process shall be based on such factors as the size of the plant, degree of treatment desired, sludge age, mixed liquor suspended solids concentration, BOD loading and food to microorganism ratio. Calculations shall be submitted to justify the basis of the aeration tank capacity and process efficiency.

When process design calculations are not submitted, the aeration tank capacities and permissible loadings for the several adaptations of the processes shown in the following table shall be used. These values apply to plants receiving peak to average daily load ratios ranging from about 2:1 to 4:1. Thus, the utilization of flow equalization facilities to reduce the daily peak organic load may be considered by the Director as justification to approve organic loading rates that exceed those specified in Table.2.

(See Next Page)

Table 2
PERMISSIBLE AERATION TANK CAPACITIES AND LOADINGS

Process	Aeration Tank Organic Loading--lb. BOD_5/day per 1000 cu. ft.	F/M Ratio lb.BOD5/day per lb.MLVSS	MLSS* mg/liter
Conventional Step Aeration Complete Mix	40	0.2-0.5	1000-3000
Contact Stabilization	50**	0.2-0.6	1000-3000
Extended Aeration Oxidation Ditch	15	0.05-0.1	3000-5000

* MLSS values are dependent upon the surface area provided for sedimentation and the rate of sludge return as well as the aeration process.

** Total aeration capacity, includes both contact and reaeration capacities. Normally the contact zone equals 30 to 35% of the total aeration capacity.

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7.3.1.2 Arrangement of Aeration Tanks--The dimensions of each independent mixed liquor aeration tank shall be such as to maintain effective mixing and utilization of air. Liquid depths should not be less than 10 feet for plants greater than 100,000 GPD. For very small tanks or tanks with special configuration, the shape of the tank and/or the installation of aeration equipment should provide for elimination of short-circuiting through the tank.

7.3.2 Inlets and Outlets--Inlets and outlets for each aeration tank unit shall be suitably equipped with valves, gates, stop plates, weirs or other devices to permit control of the flow and to maintain reasonably constant liquid level. The hydraulic properties of the system shall permit the maximum instantaneous hydraulic load to be carried with any single aeration tank unit out of service.

7.3.3 Conduits--Channels and pipes carrying liquids with solids in suspension shall be designed to maintain self-cleaning velocities or shall be agitated to keep such solids in suspension at all rates of flow within the design limits.

7.3.4 Measuring Devices--For plants designed for greater than 100,000 GPD devices shall be installed for indicating flow rates of influent sewage, return sludge and air to each aeration tank. For plants designed for greater than 1,000,000 GPD, devices shall be installed for totalizing, indicating and recording influent sewage and returned sludge to each aeration tank. Where the design provides for all returned sludge to be mixed with the raw sewage (or primary effluent) at one location, then the mixed liquor flow rate to each aeration unit shall be measured.

7.3.5 Freeboard and Foam Control

7.3.5.1 Aeration tanks shall have a freeboard of at least 18 inches.

7.3.5.2 Foam control devices shall be provided for aeration tanks on all plants greater than 10,000 gallons in size. Suitable spray systems or other appropriate means will be acceptable. The spray lines shall have provisions for draining to prevent damage by freezing.

7.4 Aeration Equipment

7.4.1 General--Aeration equipment shall be designed to supply sufficient oxygen to maintain a minimum dissolved oxygen concentration of 2 mg/l throughout the mixed liquor at all times. Aeration equipment shall be capable of transferring 1.1 lbs. of oxygen per pound of peak BOD applied to the aeration tank with the exception of the extended aeration process for which the value shall be 1.8. Calculations shall be submitted to justify the oxygen requirements and the aeration equipment capacity for plants greater than 100,000 gallons in size.

7.4.2 Nitrification--In the case of nitrification, the oxygen requirement for oxidizing ammonia must be added to the above requirement for carbonaceous BOD removal. The nitrogen oxygen demand (NOD) shall be taken as 4.6 times the daily peak TKN content of the influent. In addition, the oxygen demands due to recycle flows--heat treatment supernatant, vacuum filtrate, elutriates, etc.--must be considered due to high concentrations of BOD and TKN associated with such flows.

7.4.3 Controls--Variable air controls to aeration basins shall be provided. Time clocks, variable speed devices or variable depth weirs for the blowers or aerators may be used. A 24-hour time clock graduated in 15 minutes intervals shall be provided for all extended aeration plants.

7.4.4 Diffused Air Systems

7.4.4.1 The aeration equipment shall be designed to provide oxygen requirements set forth below.

Minimum Air Requirements:

Process	Cubic Feet of Air Available Per lb. of BOD_5 Load in Aeration Tank
Conventional	1500
Step Aeration	1500
Contact Stabilization	1500
Modified or "High-Rate"	400 to 1500 (depending on BOD_5 removal expected)
Extended Aeration	2600

7.4.4.2 Air volume requirements shall be added to the requirements above for channels, pumps or other air-use demands.

7.4.4.3 The specified capacity of blowers or air compressors, particularly centrifugal blowers, shall take into account that the air intake temperature may reach 40^{o} C (104^{o} F) or higher and the pressure will be less than atmospheric.

7.4.4.4 The blowers shall be provided in multiple units, for plants of a capacity greater

than 20,000 GDP in size, so arranged and in such capacities as to meet the maximum air demand with the single largest unit out of service. The design shall also provide for varying the volume of air delivered in proportion to the load demand of the plant.

7.4.4.5 The spacing of diffusers shall be in accordance with the oxygenation requirements through the length of the channel or tank and should be designed to facilitate adjustments of their spacing without major revision to air header piping. The arrangement of diffusers should also permit their removal for inspection maintenance and replacement without dewatering the tank and without shutting off the air supply to other diffusers in the tank.

7.4.4.6 Individual assembly units of diffusers shall be equipped with control valves, preferably with indicator markings for throttling or for complete shut-off. Diffusers in any single assembly shall have substantially uniform pressure loss.

7.4.4.7 Air filters shall be provided to prevent clogging of the diffuser system used and tp protect the blower(s).

7.4.5 Mechanical Aeration System

7.4.5.1 The mechanism and drive unit shall be designed for the expected conditions in the aeration tank in terms of the power performance. Certified testing shall verify mechanical aerator performance.

7.4.5.2 A mechanical aeration system shall also accomplish the following:

A. Maintain all biological solids in suspension.

B. Meet maximum oxygen demand and maintain process performance with the largest unit out of service. Where system capacity is greater than 20,000 GPD and where single unit installations are proposed, a spare aeration mechanism shall be provided.

C. Provide for varying the amount of oxygen transferred in proportion to the load demand on the plant.

7.5 Return Sludge Equipment

7.5.1 Return Sludge Rate--The rate of sludge return expressed as a percentage of the average design flow of sewage should generally be variable between the limits shown:

	Minimum	Maximum
Standard Rate	15	75
Carbonaceous Stage of Separate Stage Nitrification	15	75
Step Aeration	15	75
Contact Stabilization	50	150
Extended Aeration	50	150
Nitrification Stage of Separate Stage Nitrification	50	200

The rate of sludge return shall be varied by means of variable speed motors, drivers, air lifts, or timers, to pump sludge at the above rates.

7.5.2 Return Sludge Pumps--If motor driven return sludge pumps are used, the maximum return sludge capacity shall be obtained with the largest pump out of service. A positive head should be provided on pump suctions. Pumps should have at least 3 inch suction and discharge openings.

If air lifts are used for returning sludge from each settling tank hopper, no standby unit will be required provided the design of the air lifts are such to facilitate their rapid and easy cleaning and removal and other standby measures are provided. Air lifts should be at least 3 inches in diameter.

7.5.3 Return Sludge Piping--Discharge piping should be at least 3 inches in diameter and should be designed to maintain a velocity of not less than 2 feet per second when return sludge facilities are operating at normal return sludge rates.

7.5.4 Waste Sludge Facilities--Waste sludge control facilities should have a maximum capacity of not less than 25% of the average rate of sewage flow and function satisfactorily at rates of 0.5 percent of average sewage flow or a minimum of 10 gallons per minute, whichever is larger, for plants greater than

100,000 GPD in size. Aerated sludge holding tanks shall be provided for extended aeration plants from 10,000 to 100,000 GPD in size. Sludge holding tanks shall be designed with a minimum capacity of 10% of the average daily design flow.

8.0 TRICKLING FILTERS

8.1 Design--Filters shall be designed so as to provide the reduction in carbenaceous and nitrogenous oxygen demand required, and to properly condition the sewage for subsequent treatment processes. The hydraulic loading on standard rate trickling filters shall be between two and four million gallons per acre per day with an organic loading equal to or less than 400 lbs. of BOD_5 per acre foot per day.

8.2 Dosing Equipment

8.2.1 Distribution--The sewage may be distributed over the filter by rotary distributors or other suitable devices which will permit reasonably uniform distribution to the surface area. At design average flow, the deviation from a calculated uniformly distributed volume per square foot of the filter surface shall not exceed plus or minus 10 percent at any point.

8.2.2 Dosing--Sewage may be applied to the filters by siphons, pumps, or by gravity discharge preceding treatment units when suitable flow characteristics have been developed. Application of sewage shall be practically continuous. Consideration shall be given to a piping system which will permit recirculation.

8.2.3 Hydraulics--All hydraulic factors involving proper distribution of sewage on the filters shall be carefully calculated. For reaction type distributors, a minimum head of 25 inches between low water level in siphon chamber and center of arms shall be required. Surge relief, to prevent damage to distributor seals, shall be provided where sewage is pumped directly to the distributors.

8.2.4 Clearance--A minimum clearance of six inches between media and distributor arms shall be provided. Greater clearance will be required where icing occurs.

8.3 Media

8.3.1 Quality--The media may be crushed rock, slag, or plastic, or specially manufactured material. The media shall be durable, resistant to spalling or flaking and relatively insoluble in sewage. The top 18 inches shall have a loss by the 20-cycle, sodium sulfate soundness test of not more than 10%, as prescribed by ASCE Manual of Engineering Practice No. 13, "Filtering Materials for Sewage Treatment Plants".

The balance to pass a 10-cycle test using the same criteria. Slag media shall be free from iron. Manufactured media shall be structurally stable and chemically and biologically inert.

8.3.2 Rock and/or slag filter media shall have a minimum depth of 5 feet above the underdrains. Manufactured filter media should have a minimum depth of 10 feet to provide adequate contact time with the wastewater. Rock and/or slag filter media depths shall not exceed 10 feet and manufactured filter media depths shall not exceed 30 feet.

8.3.3 Size and Grading

8.3.3.1 Rock, Slag, and Similar Media--shall not contain more than five percent by weight of pieces whose longest dimension is three times the least dimension.

They shall be free from thin elongated flat pieces, dust, clay, sand or fine material and shall conform to the following size and grading when mechanically graded over vibrating screens with square openings:

Passing 4½-inch screen	100% by weight
Retained on 3-inch screen	95-100% by weight
Passing 2-inch screen	0-2% by weight
Passing 1-inch screen	0-1% by weight

8.3.3.2 Hand Picked Field Stone

Maximum dimensions of stone-five inches
Minimum dimensions of stone-three inches

8.3.3.3 Manufactured Media--Applications of manufactured media will be evaluated on a case-by-case basis.

8.3.3.4 Handling and Placing of Media--Material delivered to the filter site shall be stored on wood planks or other approved clean, hard surfaced areas. All material shall be rehandled at the filter site and no material shall be dumped into the filter. Crushed rock, slag, and similar media shall be rescreened or forked at the filter site to remove all fines. Such material shall be placed by hand to a depth of 12 inches above the tile so as not to damage the underdrains. The remainder of the

material may be placed by the engineer. Manufactered media shall be handled and placed as approved by the engineer. Trucks, tractors, or other heavy equipment shall not be driven over the filter during or after construction.

8.4 Underdrainage System

8.4.1 Arrangement--Underdrains with semi-circular inverts shall be provided and the underdrainage system shall cover the entire floor of the filter. Inlet openings into the underdrains shall have an unsubmerged gross combined area equal to at least 15% of surface area of the filter.

8.4.2 Slope--The underdrains shall have a minimum slope of 1%. Effluent channels shall be designed to produce a minimum velocity of two feet per second at average daily rate of application to the filter.

8.4.3 Flushing--Provision shall be made for flushing the underdrains. The use of a peripheral head channel with vertical vents is acceptable for flushing purposes. Inspection facilities shall be provided.

8.4.4 Ventilation--The underdrainage system, effluent channels and effluent pipe shall be designed to permit free passage of air. The size of drains, channels, and pipe shall be such that not more than 50% of their cross-sectional area will be submerged under the design hydraulic loading. Provision shall be made in the design of the effluent channels to allow the possibility of increased hydraulic loading.

8.5 Special Features

8.5.1 Flooding--Provisions shall be made in the design of filter structures so that they may be flooded.

8.5.2 Maintenance--All distribution devices, underdrains, channels and pipes shall be installed so that they may be properly maintained, flushed, or drained.

8.5.3 Freeboard--A freeboard of four feet or more should be provided for tall, manufactured media filters to minimize windblown spray.

8.5.4 Flow Measurement--Devices shall be provided to permit measurement of flow to filter, including recirculated flows.

8.5.5 Recirculation--Consideration should be given to the merits of recirculation for various purposes; for example, to prevent drying of a standard rate filter between dosings.

8.6 Two-Stage Filters--Consideration should be given to the use of two-stage filters where single stage filters may not accomplish the required removals.

8.7 Efficiencies--Expected efficiencies shall be calculated and documented. Consideration shall be given to the effect of climatic conditions on the overall filter performance.

8.8 Rotary Distributor Seals--Mercury seals will not be permitted. Ease of seal replacement shall be considered in design.

9.0 ROTATING BIOLOGICAL CONTACTORS (RBC's)

9.1 Winter Protection--Year round operation requires that rotating contactors be covered to protect the biological growth from cold temperatures and the excessive loss of heat from the wastewater with the resulting loss of performance.

Enclosures shall be constructed of a suitable corrosion resistant material. Windows or simple louvered mechanisms which can be opened in the summer and closed in the winter shall be installed to provide ventilation. To minimize condensation, the enclosure should be insulated and/or heated.

9.2 Required Pretreatment--RBC's must be preceded by primary settling tanks equipped with scum and grease collecting devices. Bar screening or comminution are not suitable as the sole means of pretreatment.

9.3 Unit Sizing--Unit sizing shall be based on experience at similar full-scale installations or thoroughly documented pilot testing with the particular wastewater. In determining design loading rates, expressed in units of volume per day per unit area of media covered by biological growth, the following parameters must be considered:

9.3.1 Design flow rate and influent waste strength;

9.3.2 Percentage of BOD to be removed;

9.3.3 Media arrangement, including number of stages and unit area in each stage;

9.3.4 Rotational velocity of the media;

9.3.5 Retention time within the tank containing the media;

9.3.6 Wastewater temperature; and

9.3.7 Percentage of influent BOD which is soluble.

In addition to the above parameters, loading rates for nitrification will depend upon influent total Kjeldahl nitrogen (TKN), influent ammonia nitrogen concentration, pH, and the allowable effluent ammonia nitrogen concentration.

9.4 Design Safety Factor--Effluent concentrations of ammonia nitrogen from the RBC process designed for nitrification are affected by daily load variations. Therefore, it may be necessary to increase the design surface area proportional to the ammonia nitrogen daily peaking rates to

meet effluent limitations. An alternative is to provide flow equalization sufficient to insure process performance within the required effluent limitations.

10.0 OTHER BIOLOGICAL SYSTEMS

New Biological Treatment Schemes--with promising applicability in wastewater treatment may be considered if the required engineering data for new process evaluation is provided in accordance with Part III, Section 1.3.3.

11.0 SEWAGE STABILIZATION PONDS, ANAEROBIC LAGOONS, AND AERATED LAGOONS

11.1 General--Stabilization ponds, anaerobic lagoons, and aerated lagoons may be used for treatment of raw sewage, primary sewage effluent or secondary sewage effluent.

11.2 Stabilization Ponds

11.2.1 Location--Stabilization ponds of 4 acres and larger shall be located a minimum of 1500 feet from the nearest occupied structure. Stabilization ponds of less than 4 acres in size may be located as close as 300 feet to the nearest occupied structure. These distance requirements may be waived upon releases being obtained from the neighboring property owners.

11.2.1.1 Wind Sweep--Stabilization ponds shall be located to permit an unobstructed wind sweep across the ponds.

11.2.1.2 Water Supply--Stabilization ponds shall be located a minimum of 100 feet from a water supply.

11.2.2 Geology and Soils--Borings to determine surface and sub-surface characteristics of the pond site shall be obtained for all ponds greater than 2.5 acres in size or where required by the Director. A soil report from the Soil Conservation Service, U.S. Department of Agriculture, is required for all pond sites.

11.2.3 Pond Shape--The shape of all ponds should be such as to produce a uniform perimeter with no coves, islands or peninsulas permitted. Corners of ponds shall be rounded. The most desirable shape is round, square or rectangular with the length not exceeding three times the width.

11.2.4 Design

11.2.4.1 Loading--Stabilization ponds shall be designed on the basis of 34 pounds per day of five-day BOD per acre.

11.2.4.2 Ponds in Series--If one or more ponds are added in series with the primary pond, the primary pond shall have a surface area equal to that required in Section 11.2.4.1.

11.2.4.3 Pretreatment--Where stabilization ponds follow some type of conventional treatment facility, reduction of the pond loading as

set forth in Section 11.2.4.1 may be considered on a case-by-case basis.

11.2.4.4 Depth--Liquid depth of ponds shall be no less than 3½ feet or greater than 5 feet. A 3 foot minimum freeboard shall be provided.

11.2.5 Influent Lines

11.2.5.1 Location of Discharge--Influent lines shall discharge at the one-third point of the primary stabilization pond. Ponds following the primary pond or secondary treatment facilities in multiple unit systems shall be edge discharging.

11.2.5.2 Gravity--Influent lines from gravity collection systems shall discharge at a point 12 to 18 inches above the pond surface.

11.2.5.3 Pressure--Pressure influent lines may discharge either above the pond surface or at a point one foot above the pond bottom. When discharging below the pond surface, the end of the pressure line shall rest upon a concrete apron of two square feet minimum size.

11.2.5.4 Pipe Support--Influent lines shall be supported on piers or other open structures. Dikes for pipe support will not be permitted.

11.2.6 Pond Details

11.2.6.1 Embankments--Embankments shall be constructed of compacted impervious materials with a minimum top width of 8 feet. All vegatation shall be removed from the area upon which the embankment is to be placed.

11.2.6.2 Slope--Embankment slopes shall not be steeper than 2 horizontal to 1 vertical. Minimum slopes shall not be flatter than four horizontal to one vertical.

11.2.6.3 Pond Bottom--Pond bottoms shall be level and cleared of all vegetation and debris.

11.2.6.4 Watertightness--If soil characteristics are such that seepage will take place, ponds shall be made watertight through use of a pond liner of man-made materials or clay or

through use of a soil additive. Lining, if required, shall be of the thickness recommended by the manufacturer, or a six-inch minimum of natural materials.

11.2.7 Effluent Lines

11.2.7.1 Discharge--The effluent line shall be designed to discharge from a point 18 inches below the surface of the pond. The effluent line may be vented to prevent siphoning. The effluent line shall discharge on a concrete slab or rip-rap apron. Effluent lines shall be placed at the furthest point from the influent line discharge.

11.2.7.2 Discharge Structure--For ponds greater than 2.5 acres in size, discharge structures capable of variable depth control shall be provided. Depth shall be adjustable between 3.5 and 5 feet in increments of 0.5 foot or less. Withdrawal points shall be spaced from 18 inches below the surface to 12 inches above the pond bottom discharge structures. These structures shall be placed at a point furthest from the influent line discharge and be readily accessible from the embankment.

11.2.8 Recirculation--Recirculation should be considered for multiple pond facilities. Whenever recirculation is proposed, and pond size is thereby reduced, calculations justifying the proposed reduction shall be submitted to the Director for approval.

11.2.9 Drain Lines--Drain lines shall not be permitted.

11.2.10 Miscellaneous

11.2.10.1 Surface Runoff--Provision shall be made to divert storm and surface water around stabilization ponds.

11.2.10.2 Fencing--Ponds shall be enclosed with a stock-tight fence a minimum of six feet in height with a locked entrance gate.

11.2.10.3 Signs--Several signs stating the nature of the facility shall be installed on the fence.

11.2.10.4 Prefilling--Stabilization ponds shall be prefilled to a minimum depth of two feet prior to use.

11.2.10.5 Access Road--An all-weather access road shall be provided to the pond site.

11.3 Anaerobic Lagoons

11.3.1 General--Anaerobic lagoons are normally used for animal waste treatment.

11.3.2 Location--Anaerobic lagoons shall be located a minimum of 1500 feet from the nearest occupied structure.

Water Supply--An anaerobic lagoon shall be located a minimum of 100 feet from a water supply.

11.3.3 Geology and Soils--Shall comply with Section 11.2.2.

11.3.4 Lagoon Shape--Shall comply with Section 11.2.3.

11.3.5 Design--Design shall comply with West Virginia Standard for Disposal Lagoon (359) published October, 1972, by the Soil Conservation Service USDA.

11.4 Aerated Lagoons

11.4.1 General--Aerated lagoon sewage treatment facility shall consist of the following:

11.4.1.1 Pretreatment.

11.4.1.2 Aeration basin.

11.4.1.3 Settling basin, if required.

11.4.1.4 Supplementary treatment, if required.

11.4.2 Location--Aerated lagoons shall be located a minimum of 300 feet from the nearest occupied structure.

11.4.3 Water Supply--Distance from a water supply shall comply with Section 11.3.2.

11.4.4 Geology and Soils--Shall comply with Section 11.2.2.

11.4.5 Shape--Shall comply with Section 11.2.3.

11.4.6 Design

11.4.6.1 Method--The design of aeration basins is normally based upon the aerated lagoon theory using a K_e of 0.5 (at 20^oC). Formulas to be used are:

$$t = \frac{\%\ \text{removal}}{(100-\%\ \text{removed})\ K_T} = \text{days detention}$$

where: $K_T = 0.5\ (1.075)^{T-20}$

T = average year-round air temperature at the site in ^{o}C.

The dissolved oxygen level should be a minimum of 2 ppm and ratio of oxygen transfer (α) should be assumed at (0.9). The oxygen requirement should be based upon 1.5 pounds/pound of BOD_5 to be removed.

11.4.6.2 Depth--The aeration basin shall be of a depth ranging from six to 15 feet. Air shall be supplied to the aeration basin by means of surface aerators or subsurface air diffusers. Basins shall be designed to distribute oxygen throughout, but not to keep solids in suspension.

11.4.6.3 Settling--A settling pond shall follow the aeration basin. The settling pond shall be sized based upon BOD_5 remaining after aeration at the loading rate of 34 pounds of BOD_5 per surface acre/day.

11.4.6.4 Lagoon Details--Lagoon shape, dikes, embankments, construction and effluent lines shall comply with Sections 11.2.6 thru 11.2.10.

12.0 DISINFECTION

12.1 General--All sewage treatment plant effluents shall be adequately disinfected prior to discharge.

12.2 Chlorination

12.2.1 Chlorine Terminology--Unless otherwise indicated the word "chlorine" wherever used in this section refers to dry chlorine.

12.2.2 Equipment

12.2.2.1 Feed Equipment Type--Solution-feed vacuum-type chlorinators are generally preferred for plants greater than 100,000 GPD in size. The use of hypochlorite solution feeders of the positive displacement type may be considered. For plants of 100,000 GPD or less in size, tablet type chlorinators may be used.

12.2.2.2 Feed Equipment Capacity--Chlorinator capacities required will vary, depending on the use and point of application of the chlorine. For disinfection, the capacity shall be such to produce a residual of 0.5 ppm maximum in the final effluent at peak flow rates.

12.2.2.3 Chlorination Equipment and Spare Parts--An inventory of parts subject to wear and breakage shall be maintained at all times. Dual chlorinators are required for plants over 100,000 GPD in size. Each chlorinator must be able to provide the required chlorination at peak flow rates.

12.2.2.4 Water Supply--A supply of water shall be available for operating the chlorinators. Where a booster pump is required, duplicate pumping equipment shall be provided. When connection is made from domestic water supplies, equipment for backflow prevention shall be provided. Pressure gauges shall be provided on chlorinator water supply lines.

12.2.2.5 Measurement Equipment-Equipment for measuring the amount of chlorine use shall be provided.

12.2.2.6 Evaporators--Where manifolding of several cylinders will be required to feed sufficient chlorine, consideration shall be given to the installation of evaporators.

12.2.2.7 Leak Detection and Controls--A bottle of ammonium hydroxide solution shall be available for detecting chlorine leaks. Consideration shall also be given to the provision of caustic soda solution reaction tanks for absorbing the contents of leaking 1-ton cylinders where such cylinders are in use.

12.2.3 Piping and Connections

12.2.3.1 General--Piping systems shall be well supported, adequately sloped to allow drainage and protected from mechanical damage. Suitable allowance shall be provided for pipe expansion due to changes in temperature.

12.2.3.2 Condensation--Where adequate superheat is not provided by a vaporizer, condensation should be prevented by reducing the pressure with a pressure reducing valve.

12.2.3.3 Chlorine solution piping shall be arranged such that pre- and post-chlorination may be accomplished by any or all chlorinators.

12.2.4 Housing

12.2.4.1 Building--Any building to house chlorine equipment or containers shall be designed and constructed to protect all elements of the chlorine system from fire hazards. If flammable materials are stored or processed in the same building with chlorination equipment other than that utilizing hypochlorite solutions, a fire wall shall be erected to separate the two areas.

If gas chlorination equipment and chlorine cylinders are to be in a building used for other purposes, a gas-tight partition shall separate this room from any other portion of the building. Doors to this room shall be equipped with panic hardware. Such rooms shall be at ground level and shall permit easy access to all equipment. Storage area should be separated from the feed area. No basement shall be permitted.

Means of exit to the outside of the building should be provided from each separate room or building in which chlorine, other than hypochlorite, is stored, handled or used.

A clear glass, gas-tight window shall be installed in an exterior door or interior wall of the chlorinator room to permit the chlorinator to be viewed without entering the room.

12.2.4.2 Heat--Chlorinator rooms shall be provided with a means of heating so that a temperature of at least 60°F can be maintained. The room shall also be protected from excess heat.

12.2.4.3 Ventilation--Forced, mechanical ventilation which will provide one complete air change per minute shall be installed in all chlorine feed rooms and rooms where chlorine cylinders are stored. The entrance to the air exhaust duct from the room shall be near the floor and the point of discharge shall be so located as not to contaminate the air inlets to any building or inhabited areas. Air inlets shall be so located as to provide cross ventilation with air and at such a temperature that will not adversely affect the chlorination equipment. The vent hose shall run without traps from the chlorinator and shall discharge to the outside atmosphere above grade.

12.2.4.4 Electrical Controls--The controls for the fans and lights shall be such that they will automatically operate when the door is opened and can also be manually operated from the outside without opening the door.

12.2.5 Respiratory Protection--Respiratory air-pac protection equipment, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH), shall be available where chlorine gas is handled, and shall be stored at a convenient location, but not inside any room where chlorine is used or stored. Instructions for using the equipment shall be posted. The units shall use compressed air, have a least 30-minute capacity, and be compatible with the units used by the fire department responsible for the plant.

12.2.6 Application of Chlorine

12.2.6.1 Mixing With Flow--Provisions shall be made to ensure uniform mixing of the chlorine solution with the wastewater flow near the point of application.

12.2.6.2 Contact Period--A minimum contact period of 40 minutes at average daily flow or 15 minutes at maximum daily flow shall be provided.

12.2.6.3 Contact Tank--Chlorine contact tanks shall be designed to minimize "short-circuiting" of flow. Over and under, or end-around baffling shall be provided. Air lift sludge returns from the contact tank are required for all extended aeration sewage treatment plants 10,000 GPD or greater in size unless preceded by a filter or polishing pond. Multiple units shall be required for plants over 100,000 gallons in size.

12.2.7 Dechlorination--The removal of all or part of the chlorine residual may be required prior to final discharge, to meet the adopted stream standards or other requirements for particular streams.

12.3 Other Methods--The use of other methods for disinfection will be evaluated on a case-by-case basis. As a minimum, the following shall be investigated when other methods are to be utilized for disinfection:

12.3.1 Minimum effluent conditions, such as clarity, soluble organics and pH required for adequate disinfection.

12.3.2 Methods for dispersion and mixing with the waste stream.

12.3.3 Other factors, including but not limited to, equipment reliability, safety and application rates required for varying waste flows.

12.3.4 Refer to Part III, Section 1.3.3.

12.4 Evaluation of Effectiveness

12.4.1 Sampling--Facilities shall be included for securing a sample prior to discharge to determine the effectiveness of the disinfection method.

12.4.2 Residual Chlorine Testing and Control--When chlorine is used for disinfection, equipment shall be provided for measuring chlorine residual. Where the

discharge occurs in critical areas, the installation of facilities for continuous automatic chlorine residual analysis, recording and proportioning systems may be required.

13.0 SUPPLEMENTARY TREATMENT

13.1 General--Supplementary treatment shall be required when health considerations and/or waste load allocations and effluent limitations require treatment more stringent than secondary.

13.2 Alternating Surface Sand Filters

13.2.1 General--Alternating surface sand filters normally shall be used for plants of 100,000 GPD or less in size.

Alternating surface sand filters may be permitted for plants of over 100,000 GPD in size on a case-by-case basis.

13.2.2 Filter Rate--An alternating sand filter shall be designed for a filter rate of not more than 20 gallons per square foot per day.

13.2.3 Application--Effluent shall be applied with either a pump or siphon chamber designed to dose all sections of the filter equally with three to four inches of liquid or, where elevation differences permit, gravity application of effluent to the filter may be permitted, if uniform distribution of effluent is provided.

13.2.4 Location--Alternating surface sand filters shall not be located within 100 feet of the nearest occupied residence or habitation. This distance requirement may be waived in the event a release is obtained from the neighboring property owner(s).

13.2.5 Media--The sand used in alternating surface sand filters shall be coarse, clean sand of uniform size. Other media may be approved on a case-by-case basis.

13.2.6 Construction--The side walls and bottom of the sand filters shall be impermeable.

13.2.7 Disinfection--Disinfection will be required after the filters and before discharge to a stream.

13.3 High Rate Effluent Filtration

13.3.1 General--High rate filters may be either gravity or pressure.

13.3.1.1 Gravity--The use of gravity high rate filters shall be limited to plants of 40,001 GPD or more in size.

13.3.1.2 Pressure--The use of pressure high rate filters shall be limited to plants of greater than 100,000 gallons per day in size.

13.3.2 Filtration Rates--Allowable rates for gravity filters shall not be greater than gallons per minute per square foot per day. Filtration rates for pressure filters shall not be greater than five gallons per minute per square foot per day. Rates are based upon the maximum flow rate applied.

13.3.3 Number of Units--Total filter area shall be provided in two or more units, and the filtration rate shall be calculated on the total available filter area with one unit out of service.

13.3.4 Backwash--Backwash shall include either air scouring or positive surface wash. Filtered effluent shall be used for backwash and waste filter backwash water shall be returned to the head of the plant.

13.3.4.1 Backwash Water Storage--Total backwash water storage capacity required shall equal or exceed one complete backwash cycle.

13.3.4.2 Backwash Rate--The backwash rate shall not exceed 20 gallons per minute per square foot with a minimum backwash period of 10 minutes.

13.3.4.3 Pumps--Pumps for backwashing filter units shall be sized and interconnected to provide the required rate to any filter with the largest pump out of service.

13.3.5 Proprietary Equipment--Where proprietary filtration equipment not conforming to the preceding requirements is proposed, data which supports the capability of the equipment to meet effluent requirements under design conditions shall be provided. Such equipment will be considered on a case-by-case basis by the Director.

13.4 TKN Removal

13.4.1 General--TKN removal shall be considered when the total Kjeldahl nitrogen limit as stated in the discharge load allocation is less than 18 mg/l.

13.4.2 Methods--Methods which may be used to achieve TKN removal may include, but not be limited to: additional aeration in extended aeration plants;

separate stage nitrification; break-point chlorination; nitrification column; and alternating surface sand filters.

13.4.3 Limitations--TKN removal is temperature dependent. Therefore, consideration should be given to the use of winter-summer discharge load allocations.

13.5 Microscreening

13.5.1 General--Microscreening units may be used following a biological treatment process for the removal of residual suspended solids.

13.5.2 Materials--Microscreen shall be either a specially woven polyester or stainless steel with apeture size of 20-30 microns.

13.5.3 Design--The hydraulic loading shall not be greater than ten gallons per minute per square foot of submerged drum surface. Maximum head loss shall be 12-18 inches. An overflow weir shall be provided to by-pass part of the flow when head exceeds six to eight inches. It is recommended that drums be not less than 10 feet in diameter.

13.5.4 Backwash--Continuous pressureized (60 psig) backwash shall be applied at a minimum rate of eight gallons per minute per square foot of screen. Dual backwash pumps shall be provided, each pump being capable of supplying 100% of the required flow. Backwash water shall be returned to the head of the plant at a rate not to exceed 15% of the average daily design flow.

13.5.5 Reliability--Dual microscreen units shall be provided, each unit being capable of providing 100% of the design microscreen capacity. Automatic drum speed controls with provision for manual override shall be provided for each screen. All units shall be enclosed in a heated and ventilated structure.

13.6 Polishing Ponds

13.6.1 General--Polishing ponds shall be designed in accordance with Part III, Section 11.2. Polishing ponds shall have a capacity of at least 65,000 gallons or capacity for a detention time of 10 days plant design flow, whichever is greater.

13.6.2 Distance Requirements--Polishing ponds shall be located at least 100 feet from the nearest occupied structure.

13.7 Post Aeration--A discharge load allocation of 6.0 milligrams per liter dissolved oxygen shall be met by means of one of the following:

13.7.1 Post aeration tank with air added by diffusion or mechanical means.

13.7.2 Cascade aeration.

13.7.3 Polishing ponds are considered to provide the dissolved oxygen requirements.

14.0 SLUDGE HANDLING AND DISPOSAL

14.1 Anaerobic Sludge Digestion

14.1.1 Multiple Units--Multiple tanks are recommended. Where a single digestion tank is used, an alternate method of sludge processing or emergency storage to maintain continuity of service shall be provided.

14.1.2 Depth--For those units proposed to serve as supernatant separation tanks, the depth shall be sufficient to allow for the formation of a reasonable depth of supernatant liquor. A minimum sidewater depth of 10 feet is recommended.

14.1.3 Maintenance Provisions--To facilitate draining, cleaning, and maintenance, the following features are desirable.

14.1.3.1 Slope--The tank bottom should slope to drain toward the withdrawal pipe. For tanks equipped with a suction mechanism for withdrawal of sludge, a bottom slope not less than 1:12 is recommended. Where the sludge is to be removed by gravity alone, 1:4 slope is recommended.

14.1.3.2 Access Manholes--At least two 36-inch diameter access manholes should be provided in the top of the tank in addition to the gas dome. There should be stairways to reach the access manholes. A separate sidewall manhole shall be provided. The opening should be large enough to permit the use of mechanical equipment to remove grit and sand.

14.1.3.3 Safety--Nonsparking tools, safety lights, rubber-soled shoes, safety harness, gas detectors for inflammable and toxic gases, and at least two self-contained breathing units shall be provided for emergency use.

14.1.4 Sludge Inlets and Outlets

14.1.4.1 Recirculation--Multiple recirculation withdrawal and return points, should be provided, unless mixing facilities are incorporated within the digester. The return shall discharge above the liquid level and be located near the center of the tank.

14.1.4.2 Raw Sludge Discharge--Raw sludge discharge to the digester should be through the sludge heater and recirculation return piping, or directly to the tank if internal mixing facilities are provided.

14.1.4.3 Withdrawal--Sludge withdrawal to disposal shall be from the bottom of the tank. This pipe shall be interconnected with the recirculation piping.

14.1.5 Tank Capacity--The total digestion tank capacity should be determined by rational calculations based upon such factors as volume of sludge added, its percent solids and character, the temperature to be maintained in the digesters, the degree or extent of mixing to be obtained, and the degree of volatile solids reduction required. Calculations shall be submitted to justify the basis of design.

When such calculations are not based on the above factors, the minimum combined digestion tank capacity shall be designed based upon: the assumption that a raw sludge is derived from ordinary domestic wastewater, that a digestion temperature is to be maintained in the range of 90° to 100°F (32°C and 38°C), that 40 and 50 percent volatile matter will be maintained in the digested sludge, and that the digested sludge will be removed frequently from the system.

14.1.5.1 Completely-Mixed Systems--Completely-mixed systems shall provide for effective mixing. The system may be loaded at a rate up to 80 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion units. When grit removal facilities are not provided, the reduction of digester volume due to grit accumulation shall be considered.

14.1.5.2 Moderately-Mixed Systems--For digestion systems where mixing is accomplished only by circulating sludge through an external heat exchanger, the system may be loaded at a rate up to 40 pounds of volatile solids per 1,000 cubic feet of volume per day in the active digestion units. This loading may be modified upward or downward depending upon the degree of mixing provided.

14.1.6 Gas Collection, Piping, and Appurtenances

14.1.6.1 General--All portions of the gas system, including the space above the tank liquor, the storage facilities and the piping, shall be so designed that under all normal operating conditions, including sludge withdrawal, the gas will be maintained under positive pressure. All enclosed areas where any gas leakage might occur shall be adequately ventilated.

14.1.6.2 Safety--All necessary safety facilities shall be included where gas is produced. Pressure and vacuum relief valves and flame traps, together with automatic safety shutoff valves, shall be provided. Water seal equipment shall not be permitted. Gas safety equipment and gas compressors shall be housed in a separate room with an exterior entrance.

14.1.6.3 Gas Piping and Condensate--Gas piping shall be of adequate diameter and shall slope to condensate traps at low points. The use of float-controlled condensate traps is not permitted.

14.1.6.4 Gas Utilization Equipment--Gas-fired boilers for heating digesters shall be located in a separate room not connected to the digester gallery.

14.1.6.5 Electrical Fixtures--Electrical fixtures and controls, in places enclosing anaerobic digestion appurtenances, where hazardous gases are normally contained in the tanks and piping, shall comply with the National Electrical Code for Class 1, Group D, Division 2 locations. Digester galleries should be isolated from normal operating areas, to avoid an extension of the hazardous location.

14.1.6.6 Waste Gas--Waste gas burners shall be readily accessible and should be located at least 25 feet away from any plant structure if placed at ground level, or may be located on the roof of the control building if sufficiently removed from the tank.

All waste gas burners shall be equipped with automatic ignition, such as a pilot light or a device using a photoelectrical

cell sensor. Consideration should be given to the use of natural or propane gas to insure reliability of the pilot light.

In remote locations it may be permissible to discharge the gas to the atmosphere through a return-bend screened vent terminating at least 10 feet above the ground surface, provided that the assembly incorporates a flame trap.

14.1.6.7 Ventilation--Any underground enclosures connecting with digestion tanks or containing sludge or gas piping or equipment shall be provided with forced ventilation. The piping gallery for digesters shall not be connected to other passages. Where used, tightly fitting, self-closing doors shall be provided at connecting passageways and tunnels to minimize the spread of gas.

14.1.6.8 Meter--A gas meter with bypass shall be provided to meter total gas production.

14.1.7 Digester Heating

14.1.7.1 Insulation--Wherever possible, tanks should be constructed above ground water level and shall be suitably insulated to minimize heat loss.

14.1.7.2 Heating Facilities--Sludge may be heated by circulating the sludge through external heaters or by heating units located inside the digestion tank.

A. Piping for external heating shall be designed to provide for the preheating of feed sludge before introduction to the digesters. Provisions shall be made in the layout of the piping and valving to facilitate cleaning of these lines. Heat exchanger sludge piping should be sized for heat transfer requirements.

B. Other Heating Methods: Other types of heating facilities will also be considered on their own merits.

14.1.7.3 Heating Capacity--Heating capacity sufficient to consistently maintain the design sludge temperature shall be provided.

Where digester tank gas is used for sludge heating, an auxiliary fuel supply is required.

14.1.7.4 Hot Water Internal Heating Controls

A. An automatic mixing valve shall be provided to temper the boiler water with return water so that the inlet water to the heat jacket can be held below a temperature at which caking will be accentuated. Manual control shall also be provided by bypass valves.

B. The boiler should be provided with automatic controls to maintain the boiler temperature at approximately 180°F to shut off the main gas supply in the event of pilot burner or electrical failure, low boiler water level, or excessive temperature.

C. Thermometers shall be provided to show temperatures of the sludge, hot water feed, hot water return, and boiler water.

14.1.8 Supernatant Withdrawal

14.1.8.1 Piping Size--Supernatant piping shall not be less than six inches in diameter.

14.1.8.2 Withdrawal

A. Piping should be arranged so that withdrawal can be made from three or more levels in the digester. A positive unvalved vented overflow shall be provided.

B. If a supernatant selector is provided, provisions shall be made for at least one other drawoff level located in the supernatant zone of the tank in addition to the unvalved emergency supernatant drawoff pipe. High pressure backwash facilities shall be provided.

14.1.8.3 Sampling--Provisions shall be made for sampling at each supernatant drawoff level. Sampling pipes shall be at least 1-½ inches in diameter, and shall terminate at a suitably-sized sampling sink or basin.

14.1.8.4 Alternate Supernatant Disposal--Consideration should bezgiven to supernatant conditioning, where appropriate,zin relation to its effect on plant performance and effluent quality.

14.2 Aerobic Sludge Digestion

14.2.1 General--Aerobic digestion can be used to stabilize secondary sludge. Digestion is accomplished in single or multiple tanks, designed to provide effective air mixing, reduction of the organic matter, supernatant separation, and sludge concentration under controlled conditions.

14.2.2 Digestion Tanks--Multiple tanks are recommended. A single sludge digestion tank may be used in the case of small treatment plants or where provision is made for sludge handling and where a single unit will not adversely affect normal plant operations.

14.2.3 Mixing and Air Requirements--Aerobic sludge digestion tanks shall be designed for effective mixing by aeration equipment. Sufficient air shall be provided to keep the solids in suspension and maintain dissolved oxygen between one and two milligrams per liter. A minimum mixing and oxygen requirement of 30 cfm per 1,000 cubic feet of tank volume shall be provided with the largest blower out of service. If diffusers are used, the nonclog type is required, and they shall be designed to permit continuity of service. If mechanical aerators are utilized, a minimum of 1.0 horsepower per 1,000 cubic feet shall be provided. Use of mechanical equipment is discouraged where freezing temperatures are normally expected.

14.2.4 Tank Capacity--The determination of tank capacities shall be based on rational calculations, including such factors as quantity of sludge produced, sludge characteristics, time of aeration, and sludge temperature.

14.2.4.1 Volatile Solids Loading--The volatile suspended solids loading shall not exceed 100 pounds per 1,000 cubic feet of volume per day in the digestion units. Lower loading rates may be necessary depending on temperature, type of sludge, and other factors.

14.2.4.2 Solids Retention Time--Required minimum solids retention time for stabilization of biological sludges varies depending on type of sludge. Normally a minimum of 15 days

retention should be provided for waste activated sludge and 20 days for combination of primary and waste activated sludge, or primary sludge alone. Where sludge temperature is lower than 50°F, additional detention time should be considered.

14.2.5 Supernatant Separation--Facilities shall be provided for separation and withdrawal of supernatant and for collection and removal of scum and grease.

14.2.6 Sludge Thickening--Prior to placement on sludge drying beds, all sludge produced by the activated sludge process shall be conditioned to a minimum solids content of 5% by weight.

14.3 Sludge Pumps and Piping

14.3.1 Sludge Pumps

14.3.1.1 Duplicate Units--Duplicate units shall be provided.

14.3.1.2 Type--Plunger pumps, screw feed pumps, recessed impeller type centrifugal pumps, progressive cavity pumps, or other types of pumps capable of solids handling shall be provided for handling raw sludge.

14.3.1.3 Minimum Head--A minimum positive head of 24 inches shall be provided at the suction side of centrifugal-type pumps and is desirable for all types of sludge pumps. Maximum suction lifts shall not exceed 10 feet for plunger pumps.

14.3.1.4 Sampling Facilities--Unless sludge sampling facilities are otherwise provided, quick-closing sampling valves shall be installed at the sludge pumps. The size of valve and piping shall be at least 1-½ inches.

14.3.2 Sludge Piping

14.3.2.1 Size and Head--Sludge withdrawal piping shall have a minimum diameter of 8 inches for gravity withdrawal and 6 inches for pump suction and discharge lines. Where withdrawal is by gravity, the available head on the discharge pipe should be adequate to provide at least 3.0 feet per second velocity.

14.3.2.2 Slope--Gravity piping shall be laid on uniform grade and alignment. The slope of gravity discharge piping should not be less than 3%. Provisions shall be made for cleaning, draining, and flushing discharge lines.

14.3.2.3 Supports--Special consideration shall be given to the corrosion resistance and continuing stability of supporting systems located inside the digestion tank.

14.4 Sludge Dewatering

14.4.1 Sludge Drying Beds--The sizing of the drying bed shall be estimated on the basis of 2.0 ft^2/capita when the drying bed is the primary method of dewatering, and 1.0 ft^2/capita if it is to be used as a back-up dewatering unit. An increase of bed area by 25% is recommended for paved beds.

14.4.2 Design

14.4.2.1 Gravel--The lower course of gravel around the underdrains should be graded and shall be 12 inches in depth, extending at least 6 inches above the top of the underdrains. It is desirable to place this in two or more layers. The top layer of at least three inches should consist of gravel 1/8 inch to ¼ inch in size.

14.4.2.2 Sand--The top course shall consist of 6 to 9 inches of clean washed coarse sand. The finished sand surface shall be level.

14.4.2.3 Underdrains--Underdrains shall be at least four inches in diameter. Underdrains shall be spaced not more than 20 feet apart.

14.4.2.4 Partially Paved Type--The partially paved drying bed shall be designed with consideration for space requirement to operate mechanical equipment for removing the dried sludge.

14.4.2.5 Walls--Walls shall be watertight and extended 15 to 18 inches above and at least 6 inches below the surface. Outer walls shall be curbed to prevent soil from washing onto the beds.

14.4.2.6 Sludge Removal--Not less than two beds shall be provided and they shall be arranged to

facilitate suldge removal. Concrete truck tracks should be provdied for all percolation-type sludge beds.

14.4.2.7 Sludge Influent--The sludge pipe to the drying beds shall terminate at least 12 inches above the surface and be so arranged that it will drain. Concrete splash plates for percolation-type beds shall be provided at sludge discharge points.

14.4.2.8 Protective Enclosure--A protective enclosure shall be provided if winter operation is required.

14.4.3 Mechanical Dewatering Facilities--Provision shall be made to maintain continuity of service so that sludge may be dewatered without accumulation beyond storage capacity. The number of vacuum filters, centrifuges, filter presses, belt filters, or other mechanical dewatering facilities shall be sufficient to dewater the sludge produced with the largest unit out of service. Unless other standby facilities are available, adequate storage facilities shall be provided. The storage capacity shall be sufficient to handle at least a three-month sludge production.

14.4.3.1 Auxiliary Facilities for Vacuum Filters--Back-up vacuum pumps and filtrate pumps shall be provided. It is permissible to have an uninstalled back-up vacuum pump or filtrate pump for every three or less vacuum filters, provided that the installed unit can easily be removed and replaced.

14.4.3.2 Ventilation--Facilities shall be provided for ventilation of dewatering area. The exhaust air shall be properly conditioned to avoid odor nuisance.

14.4.3.3 Chemical Handling Enclosures--Lime-mixing facilities shall be completely enclosed to prevent the escape of lime dust.

14.4.4 Drainage and Filtrate Disposal--Drainage from beds or filtrate from dewatering units shall be returned to the sewage treatment process at appropriate points.

14.4.5 Other Dewatering Facilities--If it is proposed to dewater or dispose of sludge by other methods, a detailed description of the process and design data shall accompany the plans.

15.0 SEWAGE SLUDGE DISPOSAL ON LAND

Land spreading of sewage must be evaluated as an integral system which includes stabilization, storage, transportation, application, soil, crop, and groundwater. Sewage sludge contains heavy metals and other substances which could affect soil productivity and the quality of food.

15.1 General--Only stabilized sludge shall be surface applied to farmland or pasture. Stabilized sludge is processed sludge in which the organic and bacterial contents of raw sludge are reduced to prevent nuisance odors and public health hazards.

15.2 Site Plan and Report--The following items shall be considered and shall be included in a site plan and report.

15.2.1 Location Maps--USGS topographic map of the area (7½ minute series where published) showing the location of the total property and proposed sludge disposal site. West Virginia State Highway Department County Maps showing location of the total property.

15.2.2 Plan--A topographic map of the entire property at a workable scale showing all buildings, sludge disposal area, area of possible expansion, roads, direction of groundwater flow, wells (active and abandoned), ground water monitoring wells, streams, wooded areas, fences or other barriers, visible geologic formations (sinkholes and rock outcrops), ponds, sludge storage area and all structures, wells and ponds on adjacent property within 1500 feet of the proposed sludge disposal area.

15.2.3 Soil Map--A soil map shall be furnished showing soil types within the sludge disposal site. This information may be incorporated on the plan.

15.2.4 Report--shall include the following:

15.2.4.1 Geology of Site--including formations, rock types, degree of weathering of bedrock, local bedrock structure, character and thickness of surficial deposits, solution openings and sinkholes (limestone areas).

15.2.4.2 Hydrology of Site--depth to seasonal high water table; test well data including chemical and bacterial analysis for ground water quality and depth of well.

15.2.4.3 Soils at Site--Cation exchange capacity of the soil, soil types and characteristics,

detailed chemical analysis of the soils and thickness of the soils.

15.2.4.4 Climatological Data--including daily rainfall and daily temperature.

15.2.4.5 Agricultural Practices at Site--including the present and intended soil-crop management practices, kinds of crops to be grown, harvesting frequency and ultimate use of crop(s).

15.2.4.6 Sludge Characteristics--detailed physical and chemical analysis of sludge to be disposed.

15.2.4.7 Rate and Frequency of Spreading--including all calculations relating to nitrogen, cadmium and heavy metals and calculations for winter storage.

15.2.4.8 Management Practices--including types of equipment for transport and application; supervision of site; contracts, land easements, land leases, land purchases, monitoring procedures, and emergency procedures in the event of plant or equipment breakdown.

15.3 Design--shall include the following considerations:

15.3.1 Food--Sludge shall not be applied to land which is used for growing food crops to be eaten raw, such as leafed vegetables and root crops.

15.3.2 Minimum pH--No sludge shall be applied on land if the soil pH is less than 6.5 when sludge is applied.

15.3.3 Persistent Organic Chemicals--If a known source of organic chemicals (such as pesticides in the sewer service area) is present, the sludge shall be analyzed for such chemicals.

15.3.4 Rate--The rate of sludge application shall be based on the nitrogen loading and cadmium and other heavy metal uptake by crops. The Director shall be contacted for specific limits.

15.3.5 Management of Spreading Operation

15.3.5.1 Hauling Equipment--The sludge equipment shall be designed to prevent spillage, odor, and other public nuisance.

15.3.5.2 Valve Control--The spreading tank truck should be provided with a control so that

the discharge valve can be opened and closed by the driver while the vehicle is in motion. The spreading valve shall be of the "fail-safe" type (i.e., self-closing) or an additional manual stand-by valve shall be employed to prevent uncontrolled spreading or spillage.

15.3.5.3 Sludge Storage--Sludge storage capacity shall be provided for a 90-day period of inclement weather and equipment failure. The storage facilities shall be designed, located, and operated so as to avoid nuisance conditions.

15.3.5.4 Spreading Methods--Spreading method depends on the sludge characteristics, health and environmental factors. When control of odor nuisance and runoff is required, immediate incorporation of sludge after spreading or subsurface injection is necessary. When such method is utilized, an adjustment in the reduced rate of ammonia loss into the atmosphere should be considered in the computation for nitrogen balance.

15.3.6 Boundary Demarcation--The boundaries of the site shall be marked (e.g., with stakes at corners) so as to avoid confusion regarding the location of the site during sludge application. The markers should be maintained.

15.3.7 Public Access--Public access to the disposal site must be controlled by either positive barriers or remoteness of the site.

15.3.8 Monitoring and Reporting--The requirements for monitoring and reporting of the sludge spreading operation will be determined on a case-by-case basis. As a minimum, the characteristics of the sludge and soil, groundwater, and volume of sludge to be spread on a particular site will be required. Frequency of sampling and reports will be determined on a case-by-case basis by the Director based upon site characteristics and sludge characteristics. If crops are to be used for animal or human consumption, analysis of the crop will be required at harvest.

16.0 OTHER SEWAGE SLUDGE DISPOSAL METHODS

When other sewage sludge disposal methods, such as incineration and landfill, are considered, pertinent requirements of the solid waste regulations shall be followed.

17.0 LAND APPLICATION OF SEWAGE EFFLUENT

17.1 General--Land application is not to be considered as a treatment process, but only a means of disposing of sewage effluent which has received secondary treatment. For public health reasons, land disposal of effluent that has received primary treatment only shall not be permitted.

17.2 Preliminary Considerations--Land application installations are normally used where the waste contains pollutants which can successfully be removed through distribution to the soil mantle. These pollutants can be removed through organic decomposition in the vegetation-soil complex and by absorptive, physical, and chemical reactions with earth materials. Preliminary considerations of a site for land application should be the compatibility of the waste with the organic and earth materials and the percolation rates and exchange capacity of the soils. The land application of wastewater will eventually recharge the local groundwater; therefore, the quality, direction and rate of movement and local use of the groundwater, present and potential, are prime considerations in evaluating a proposed site.

It is essential to maintain an aerated zone of at least five feet and preferably more, to provide good vegetation growth conditions and removal of nutrients. It must be realized a groundwater mound will develop below a disposal site after it is in use. The major factors in design of ground disposal fields are topography, soils, geology, hydrology, weather, agriculture practice, adjacent land use and equipment selection and installation.

17.3 Site Plan and Report--The following items shall be considered and shall be included in a site plan and report.

17.3.1 Location Maps--USGS topographic map of the area (7½ minute series where published) showing the location of the total property and proposed land application site. West Virginia State Highway Department County Maps showing location of the total property.

17.3.2 Plan--A topographic map of the entire property at a workable scale showing all buildings, land application area, area of possible expansion, roads, direction of groundwater flow, wells (active and abandoned), groundwater monitoring wells, streams, wooded areas, fences or other barriers, visible geologic formations (sinkholes and rock outdrops), ponds, sludge storage area, and all structures, wells and ponds on adjacent property within 1500 feet of the proposed sludge disposal area.

17.3.3 Soil Map--A soil map shall be furnished showing soil types within the land application site. This information may be incorporated on the plan.

17.3.4 Report

17.3.4.1 Geology of Site--Including formations, rock types, degree of weathering of bedrock, local bedrock structure, character and thickness of surficial deposits, solution openings and sinkholes (limestone areas).

17.3.4.2 Hydrology of Site--Depth to seasonal high water table; test well data including chemical and bacterial analysis for groundwater quality and depth of well.

17.3.4.3 Soils at Site--Cation exchange capacity of the soils, soil types and characteristics, detailed chemical analysis of the soils and thickness of the soils.

17.3.4.4 Climatological Data at Site--Including daily rainfall and daily temperature.

17.3.4.5 Agricultural Practices at Site--Including the present and intended soil-crop management practices, kinds of crops to be grown, harvesting frequency and ultimate use of crop.

17.3.4.6 Effluent Characteristics--Detailed chemical analysis of effluent to be disposed.

17.3.4.7 Rate and Frequency of Application--Including all calculations relating to nitrogen, cadmium and heavy metals and calculations for winter storage.

17.3.4.8 Management Practices--Including types of equipment for transport and application; supervision of site; contracts, land easements, land leases, land purchases, monitoring procedures, and emergency procedures in the event of plant or equipment breakdown.

17.4 Design

17.4.1 Effluent Requirements--Secondary treatment will be required (not less than 85% removal of BOD_5 and suspended solids). Disinfection will be required

with disinfection occurring between the holding pond and disposal site. Chlorination will require a minimum 40 minutes detention time.

17.4.2 Holding Pond--A minimum 90-day storage shall be provided to store all flow during periods when disposal cannot occur. All storage shall be provided above a fixed water level to prevent complete draining of the pond. A two foot residual water depth is required to prevent growth of vegetation.

17.4.3 Application Rates--The maximum application rates in terms of depth of effluent are: ¼ inch per hour; ½ inch per day; two inches per week. It shall be understood that the above are maximum rates and lower application rates may be necessary in some areas due to soil characteristics.

17.4.4 Slopes--Slopes on cultivated fields shall be limited to 4% or less. Slope on sodded fields shall be limited to 8% or less. Forested slopes are limited to 8% for year-round operation but for seasonal operation 14% slopes may be acceptable.

17.4.5 Runoff--The system shall be designed to prevent surface runoff from entering or leaving the project site.

17.4.6 Fencing--The irrigated area will be enclosed with a fence (locked entrance gate) to keep out children and domestic animals. The fence shall be at least six feet high.

17.4.7 Warning Signs--Appropriate signs shall be provided along the fence around the project boundaries to designate the nature of the facility and advise against trespassing.

17.5 Spray Irrigation

17.5.1 Piping to Sprinklers--The piping shall be arranged to allow the irrigation pattern to be varied easily. For a permanent system, facilities must be provided to allow the pipes to be completely drained to prevent pollution and freezing. The system shall be designed to provide an even distribution over the entire field.

17.5.2 Pump Station--Duplicate pumps will be provided for delivery to the spray field, with the capacity of each pump sized to handle maximum rate of flow, plus an allowance to deplete stored volumes.

A metering device will be provided at the pump station, which will show the total flow and rates to the irrigation field.

The top of the chlorine contact tank and the wet well of the pumping station will be at least as high as the maximum holding pond surface elevation, to prevent flooding these units when the spray irrigation equipment is not in operation.

A control valve between the holding pond and the spray irrigation pump station will be required.

17.5.3 Buffer Zone--Sprinklers must be so located as to give a non-irrigated buffer zone around the irrigated area and design of the buffer zone must consider wind transport of the wastewaters. A fence shall be placed at least 50 feet beyond the normal projected spray area. A minimum of 350 feet from the fence of the enclosed irrigated area to the property lines of adjacent areas or highways is required, unless:

17.5.3.1 Low sprays are provided to reduce wind transport of the effluent.

17.5.3.2 Physical buffers are provided (trees, etc.), alone or in conjunction with low sprays.

17.6 Ridge and Furrow

17.6.1 Slopes--Furrows may be constructed down slope on sites up to 1%. Furrows shall be constructed at right angles to the slope on sites up to 8%.

17.6.2 Construction--Furrows shall be no more than 1,000 feet in length and shall be spaced from 20 to 40 inches apart.

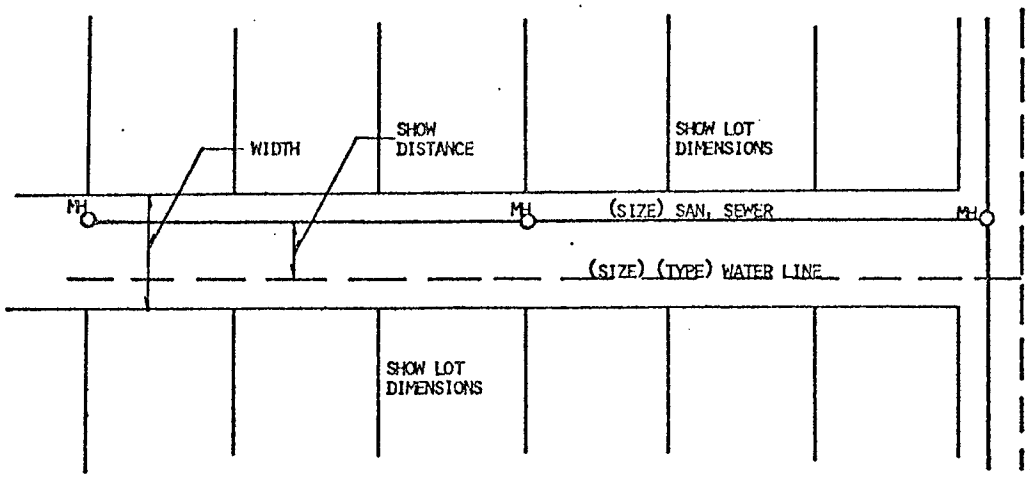
17.7 Overland Flow

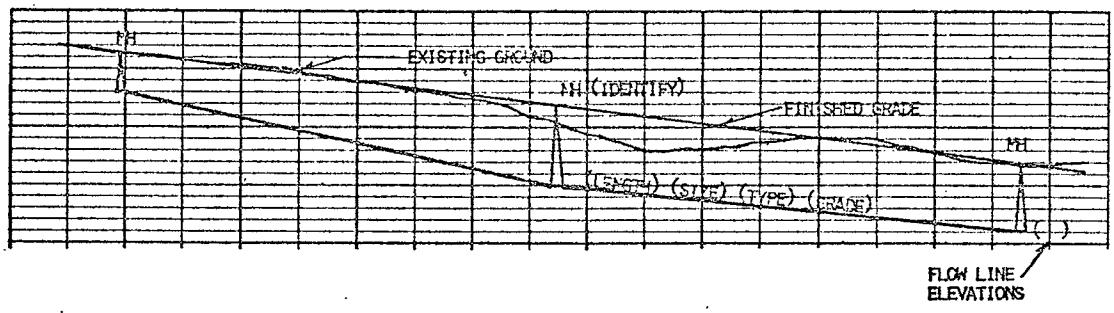
17.7.1 Slopes--Slopes shall range from 2 to 8%. Lengths of slopes shall range from 150 to 300 feet.

17.7.2 Construction--Slopes may be flooded or application made by gated pipe or spray.

17.8 Monitoring and Reporting--A minimum of one groundwater monitoring well must be drilled in each dominant direction of groundwater movement, and between the project site and public well(s) and/or high capacity private wells, with provision for sampling at the surface of the water table and at five feet below the water table at each monitoring site.

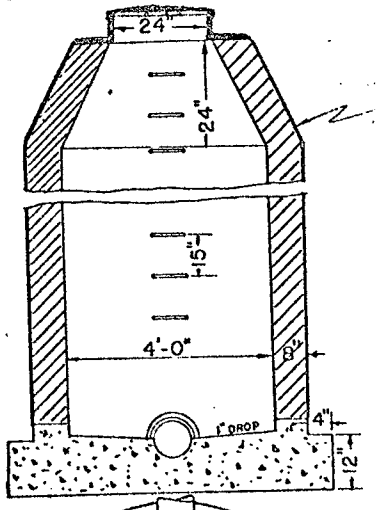
The location and construction of the monitoring well(s) must be approved. These may include one orzmore of the test wells where appropriate. If crops are to be used for animal or human consumption, analysis of the crop will be required at harvest. Frequency of reporting will be determined on a case-by-case basis, by the Director, based upon site characteristics.

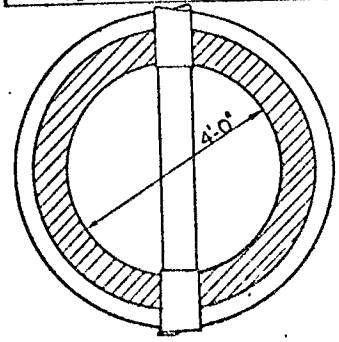




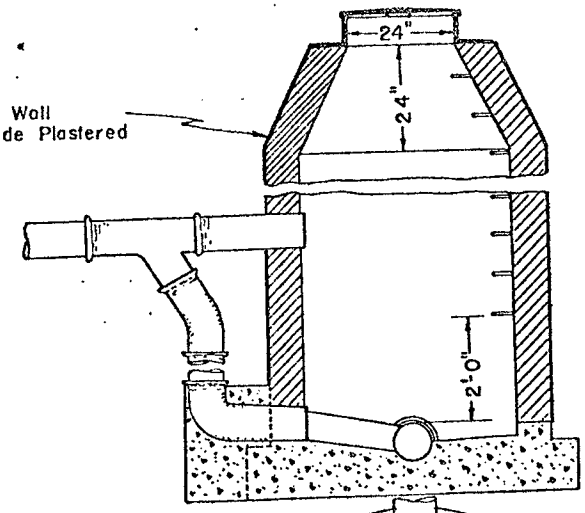
TYPICAL PLAN - PROFILE

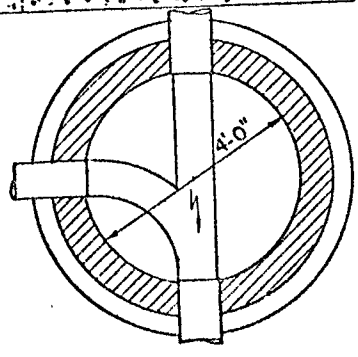
STRAIGHT THROUGH MANHOLE





DROP MANHOLE

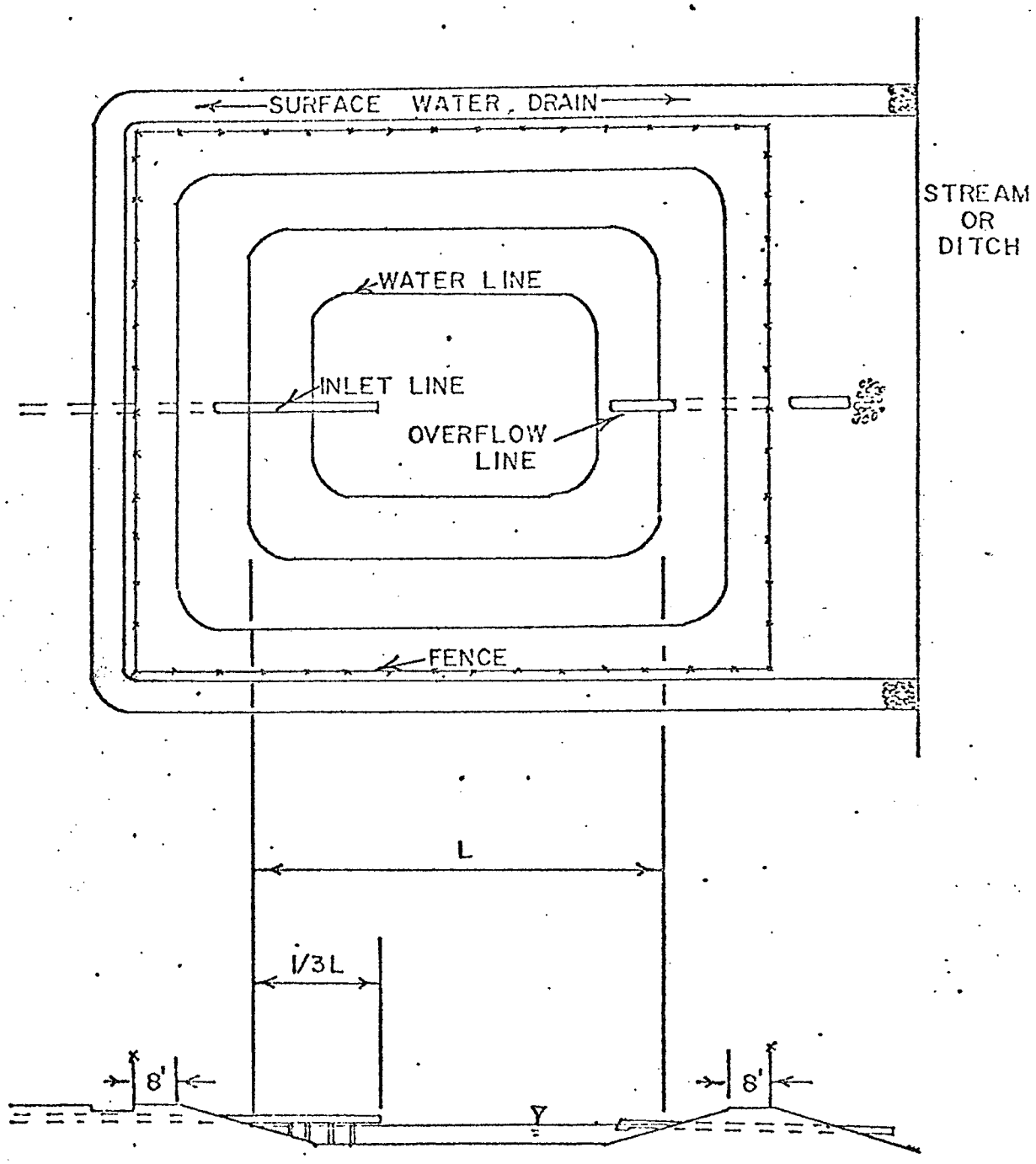




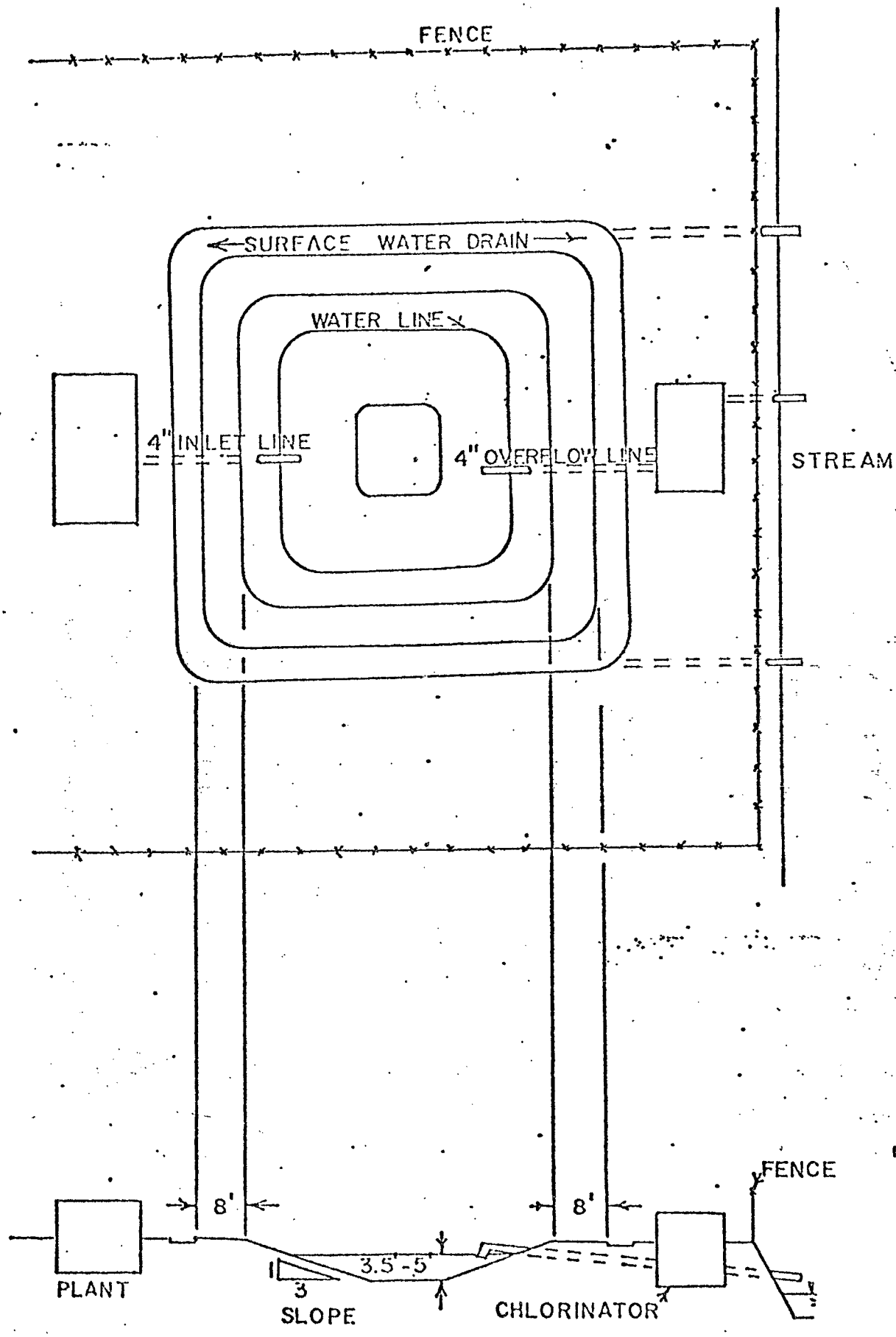
Brick Wall Outside Plastered

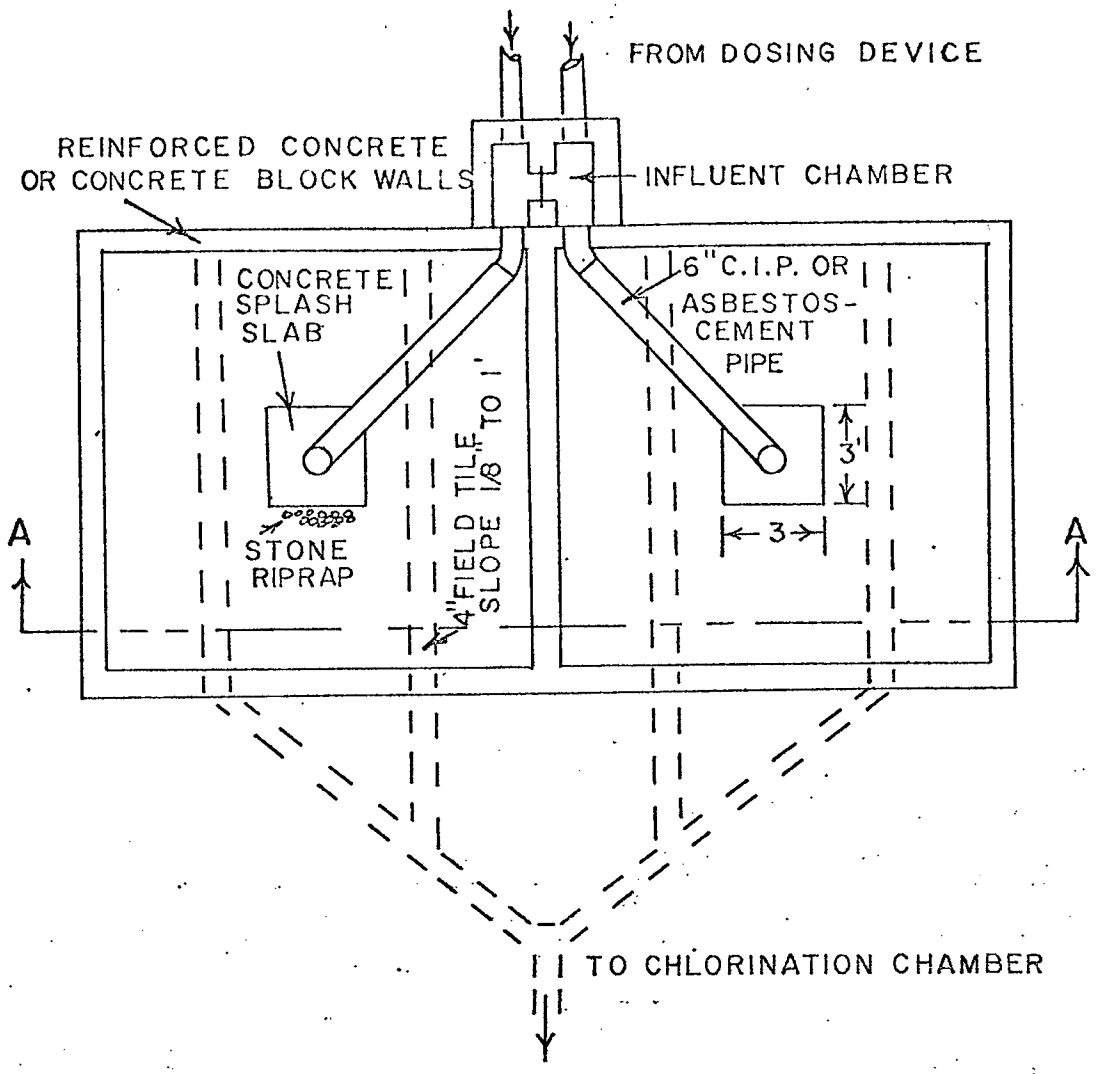
PROVIDE FLOW CHANNELS BY SHAPING THE CONCRETE MANHOLE BOTTOM OR BY USING HALF-SECTIONS OF PIPE. SLOPE MANHOLE BOTTOMS TO FLOW CHANNELS.

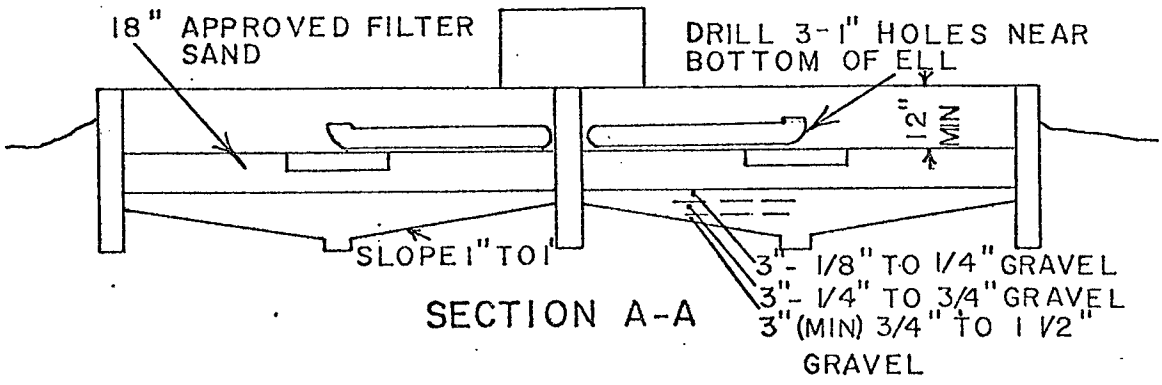
TYPICAL DETAIL SEWAGE STABILIZATION POND



TYPICAL DETAIL POLISHING POND







ALTERNATING
SURFACE SAND FILTER
DOSED BY FLOODING

MINIMUM DESIGN LOADINGS FOR SEWAGE TREATMENT FACILITIES

Facility Description	Unit Sewage Design Flow (gpd)	Unit Five-Day BOD (lbs/day)
Airports		
Each employee	15	.05
Each passenger	5	.02
Assembly Halls		
Per seat	2	.02
Bowling Alleys (No Food Service)		
Per Alley	75	.13
Per Alley with Bar	225	
Churches		
Per Member with Kitchen	5	.02
Per Member without Kitchen	2	.01
Clinics		
Per Staff	15	.03
Per Patient	5	.02
Country Clubs		
Per Member (non-resident)	25	.05
Per Member (resident)	100	.17
Domestic Sewage		
Residences (per resident -a-)		
a. New	70	.15
b. Existing/Old	90	.17
Summer Cottages, etc., per resident	50	.17
Apartment Houses--one bedroom	140	.34
--two "	210	.51
--three "	280	.60

(NOTE: These factors do not apply to the design of municipal sewage systems. Refer to Section 1.4 for design loadings for municipal sewage systems.)

Factories (per worker)		
Heavy with cafe and shower	35	.04
Light with cafe	25	.02
Light with shower	20	.02
Hospitals		
Each patient (bedside)	250	.30
Each resident staff	100	.17
Hotels, Boarding Houses (Exclusive of resturants, bars) per guest	80	.15
Industrial Park		
Per developable acre	500	.84
Institutions		
Per resident	70	.15
Laundry (coin operated)		
Per machine	400	1.34
Mine Bath Houses		
Per worker	15	.03
Mobile Homes (b)		
Per mobile home	210	.45
Motels (Exclusive or resturant or bar)		
Per unit	80	.15
Nursing and Rest Homes		
Per resident	150	.26
Per resident staff	70	.17
Offices and Warehouses		
Per workers, no food service	20	.03
Add for food service, per worker	5	.01
Recreation		
Parks, picnic areas, and breach areas	10	.02
Campground, per person	25	.05
Amphitheater, per person	5	.01
Historical site, per person	5	.01
Lodges, per person	80	.15
Park Residences, per person	80	.15
Park Washhouse, per person	30	.05
Resturants		
24 hour service, per seat	50	.17
Ordinary, not 24 hour service per seat	30	.10

Resturants (con't)			
Along freeway, per seat	100		.34
Curb service (drive-in) per car space	50		.17
Fast food (single service) per seat	25		.06
Schools			
Elementary, each staff or student	8		.02
High school, each staff or student	10		.03
Boarding school	70		.15
Service stations			
Per bay	400		
Per vehicle	10		
Shopping centers, per 100 sq.ft.	15		.03
Stores (dry goods)	400	per 25 ft. frontage	
Small stores (dry goods)	100		
Swimming Pools			
Per swimmer	5		.01
Add for shower facilities, per swimmer	2		.01
Taverns, Little or no food service			
Per seat	30		.05
Tennis Courts - per court	250		
Theatres			
Drive-in, per car space	4		.008
Movie, per seat	2		.004
Travel Trailer Park (-c-)			
No water to site, per person	35		.075
Water to site, per person	50		.10
Disco/Dance Halls, per seat	8-10		
Beauty Parlors/Barber Shops			
Per chair	150		.50
Per operator	35		
Dentist			
Per chair	200		
Per staff	35		
Doctor			
Per patient	10		
Per staff	35		

Fire Stations, per person (no food), part time	5
Gyms	
Per participant	10
Per spectator	3
Town Hall	
Per seat	5

(a) Assume four persons per residence

(b) Assume 3.5 persons per mobile home

(c) Assume three persons per travel trailer site

Part IV

CUSTOM SLAUGHTERHOUSES

Part IV

CUSTOM SLAUGHTERHOUSES

INDEX

CUSTOM SLAUGHTERHOUSES

1.0 GENERAL--These design requirements apply only to custom slaughterhouses (generally less than ten animals slaughtered per week). Prior to applying to the Sewage Disposal Division, an application must be made to the Meat Inspection Division of the West Virginia Department of Agriculture.

2.0 DESIGN--The treatment facility shall be designed on 8.0 lb. BOD_5 per 1,000 lb. live animal weight per day, and/or 150 gallons per 1,000 lb. live animal weight per day. This figure can only be used if all blood, offal, hair, feathers, paunch manure and fecal matter is removed from the sewage collection and treatment facilities.

2.1 Blood--Blood should be hauled off by a rendering company. If this is not possible, then land disposal may be considered.

2.2 Offal--Offal must be hauled off by a rendering company. Land disposal is not permitted.

2.3 Paunch Manure--Paunch manure and fecal matter can be land disposed.

3.0 TREATMENT--The following types of treatment are recommended:

3.1 Septic Tank--Soil Absorption System (recommended for a maximum of seven animals slaughtered per day operations). As a minimum, multiple septic tanks in series shall be required.

3.2 Aerated Lagoons--(See Part III, Section 11).

3.3 Stabilization Ponds--(See Part III, Section 11).

3.4 Extended Aeration Sewage Treatment Plants--(See Part III).

3.4.1 Will require flow equalization.

3.4.2 Will require aerated sludge holding tank.

4.0 ADDITIONAL TREATMENT--Additional treatment may be required depending upon health considerations or Discharge Load Allocation requirements (See Part III).

Part V

INDIVIDUAL SEWAGE SYSTEMS

Part V

INDIVIDUAL SEWAGE SYSTEMS

INDEX

1.0 GENERAL--These design standards apply to the site requirements, design, construction, and maintenance of individual sewage treatment systems including septic tanks, home aeration units, soil absorption fields, serial distribution fields, absorption beds, mounds, small lagoons, land application systems, composting toilets, grey water systems, holding tanks, privies, recycle systems or any other systems which provide waste treatment and disposal for individual dwellings and commercial establishments.

Application forms and design data sheets may be obtained from the local health department.

1.1 For systems utilizing subsurface or on-site effluent disposal, one (1) copy of the completed application design data sheet and plan shall be submitted to the Director.

1.2 For systems utilizing other methods of effluent disposal, six (6) copies of the completed application, design data sheet and plans shall be submitted to the Director.

2.0 GENERAL SITE REQUIREMENTS

2.1 An individual sewage system shall not be located in a swampy or filled area, or in any area where ponding or flooding is likely to occur, without the prior written approval of the Director. Exceptions may be made if the fill area has been constructed in accordance with directions of the Director or evidence has been provided to the Director that the fill area is suitable and of acceptable composition.

2.2 No part of an individual sewage system shall be located within 10 feet of a building or foundation or property line.

2.3 No part of an individual sewage system shall be located within 10 feet of a water supply line.

2.4 A septic tank, home aeration unit, privy, or other sewage tank shall be located at least 50 feet from a well or groundwater supply.

2.5 Septic tanks, home aeration units, privies, sewage tanks, trench fields, serial distribution systems, beds, mound systems, and other soil absorption systems shall not be located uphill from a water supply well or ground water source unless the system is 200 feet from the source.

2.6 Trench fields, serial distribution systems, beds, mound systems, and other soil absorption systems shall be located to comply with the following distances:

MINIMUM SEPARATION DISTANCES BETWEEN SOIL ABSORPTION SYSTEMS AND NATURAL AND MANMADE FEATURES

Distance	Feature
20 feet	Foundation drain upslope from disposal area.
25 feet	Stream banks and open drainage features, whether manmade or natural.
25 feet	Manmade cuts in soil and curtain drains.
50 feet	Foundation drains downslope from disposal area.
50 feet	Manmade cuts which intersect rock or shale.
100 feet	Water supply springs and water supply wells.
200 feet	Water supply springs, and water supply wells downslope from the disposal area.

2.7 Roof drains, foundation drains, sump pumps, surface drains, or similar drains shall not be connected to an individual sewage system.

2.8 The Director may require installation of a grease interceptor or grease trap on an individual sewage system serving a dwelling or establishment discharging a large amount of grease.

2.9 No portion of a treatment unit or disposal system shall be located under area to be paved, parking lots, driving surfaces, or any type of structure.

2.10 There shall be a minimum of 3 feet between any portion of a subsurface disposal system and seasonal groundwater or rock, shale or any other impermeable layer.

2.11 A subsurface disposal system shall not be installed in soils where percolation test results show an average percolation time less than 5 minutes per inch except where all surrounding dwellings or establishments are served by a public water supply.

2.12 The evaluation of a site for the installation of an absorption system (trench fields, serial systems, absorption beds, etc.) shall be based upon percolation test results and evaluation of a 6-foot excavation. Percolation tests shall be performed in the following manner:

2.12.1 Location: At least four test holes shall be placed at equal distances over the proposed absorption field site. If the results of the tests are reasonably close, an average test result can be assumed. If the tests show extreme variations, it may be necessary to relocate the field in a more suitable area.

2.12.2 Dig or bore holes from six to eight inches in diameter at the site where the soil-absorption field is to be installed. The holes shall be dug or bored to the depth of the proposed soil absorption field (24 inch minimum).

2.12.3 Scratch the bottom and sides of the hole with a sharp pointed instrument or wire brush to remove any smeared soil surfaces which interfere with the absorption of water into the soil.

2.12.4 Remove the loose dirt from the bottom of the test holes and place two inches of coarse sand or fine gravel into the holes to prevent sealing.

2.12.5 Place an eight or ten penny nail in the wall of each hole exactly six inches above the level of sand or gravel.

2.12.6 Completely fill the test hole with water to ground level. Keep water in the hole to a depth of at least twelve inches for a minimum period of four hours before beginning the percolation rate measurement.

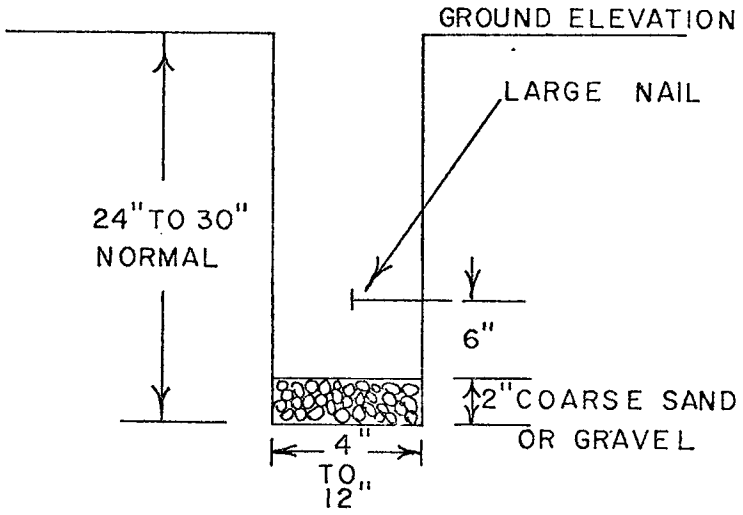
2.12.7 Percolation Rate Measurement

2.12.7.1 Upon completion of the above, adjust the water depth in the holes to the level of the nail. Accurately determine how many minutes it takes for this six inches of water (all the water) to be absorbed into the soil. This time in minutes divided by 6 gives the rate of fall (or absorption) per inch and is used to calculate the amount of absorption field required.

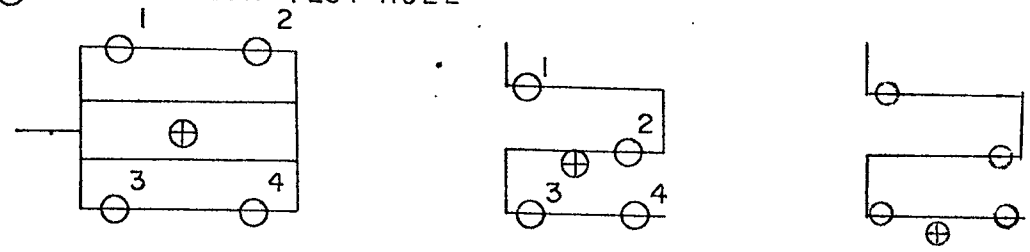
2.12.7.2 Average the rate of fall for all test holes. (Add the rate of fall for each test hole together and divide by the number of test holes.) This figure is the average rate of fall per inch for the absorption field and is the rate used in calculating the size of the soil absorption field required. (See Section 5.1, Part V)

2.12.8 If desired, an alternate method of measurement may be utilized such as a marked measuring stick and batter board if approved by the local health department.

SOIL PERCOLATION TEST



⊕ 6 FOOT DEEP BORE HOLE
⊖ PERCOLATION TEST HOLE



TYPICAL SPACING OF PERCOLATION TEST HOLES ON PROPOSED ABSORPTION FIELDS.

2.12.9 Six-Foot Hole--A six-foot hole shall be excavated in the center of the proposed soil absorption system area to evaluate soil depth to rock table and seasonal water table. If slopes at the proposed site exceed 15%, the six-foot hole shall be excavated at the location of the lowest proposed trench of the serial system.

3.0 SEPTIC TANKS

3.1 Septic tank capacities shall be in accordance with the following table:

No. of Bedrooms	Minimum Tank Capacity (gallons)
2 or less	750
3 and 4	1000
Each additional bedroom	250 gallons each

The liquid capacity for tanks serving other than individual residences shall be determined by the following:

Up to 1500 gallons per day - Capacity = 1.5 times Daily flow.

1500 gallons per day to 4000 gallons per day - Capacity = 1000 + 75% of Daily flow

4000 gallons per day to 5000 gallons per day - Capacity = Daily flow.

Commercial establishments utilizing garbage grinders shall have tank volume increased 20%.

The volume given is liquid capacity. Liquid capacity will be measured from the bottom of the tank to the elevation of the invert of the discharge pipe.

3.2 It is recommended that dual compartment tanks or dual tanks be used. If a dual compartment tank or dual tanks are used, the volume ratio of the first compartment or tank to the second compartment or tank shall approximate 2 to 1. In a dual compartment tank, the connection between compartments shall be an elbow with a minimum diameter of 4 inches, placed so that the invert at the partition is approximately 16 inches below the liquid level.

3.3 Septic tanks may be constructed of reinforced concrete, steel, fiber glass, or other watertight and durable material approved by the Director. Septic tank construction shall comply with the following:

3.3.1 Concrete Tanks-- Top shall be reinforced concrete, 4 inches thick with 3/8-inch reinforcing bars, 6 inches on centers.

Bottom shall be of reinforced concrete, 4 inches thick, reinforcement as above, or plain poured concrete 6 inches thick.

Walls shall be a minimum of 3½ inches thick with 3/8 inch rods running both horizontally and vertically on 6 inch centers or of equivalent strength.

3.3.2 Brick and Block Tanks--Walls may be of 8-inch brick masonry with 1-inch cement plaster inside finish; or 8-inch concrete blocks with 1-inch cement plaster inside finish and cells filled with mortar.

Top shall meet the requirements for concrete tanks. Bottom shall meet the requirements for concrete tanks.

3.3.3 Metal Tanks--Tanks shall bear the Underwriters Laboratories, Inc., label or the Kentucky Code Approved designation, or be approved by the Director.

3.4 General requirements for tanks shall be as follows:

3.4.1 The invert of the inlet knockout holes shall be a minimum of 3 inches above the invert of the outlet knockout hole.

3.4.2 Knockouts must be a minimum of 4 inches in diameter.

3.4.3 The inlet, shall be provided with a cast-in-place or inserted baffle, located eight inches to twelve inches from the inlet, or with a sanitary tee. The inlet baffle or sanitary tee shall extend to a minimum depth of 12 inches but no more than the depth of the effluent baffle or sanitary tee.

3.4.4 Septic tank design and construction details shall meet the following requirements:

3.4.4.1 Minimum liquid depth shall be 30 inches.

3.4.4.2 Minimum surface area shall be 25 square feet.

3.4.4.3 There shall be a minimum of 12 inches clearance above the liquid level.

3.4.4.4 Liquid depth should not exceed 5 feet for tanks less than 3000 gallons and should not exceed 6 feet for larger tanks.

3.4.5 The outlet shall be provided with a cast-in-place or inserted baffle or sanitary tee. The effluent baffle shall be located approximately 8 inches to 12 inches from the outlet and extend up to 40% of liquid depth for all tanks with the exception of horizontal, cylindrical tanks for which the baffle shall be extended to only 35% of liquid depth.

RECOMMENDED SEPTIC TANK DIMENSIONS

Size in Gallons G	Inside Length L	Inside Width W	Inside Depth D	Sewage Depth S
750	6'-8"	3'-4"	5'-4"	4'-6"
1000	8'-0"	3'-4"	6'-0"	5'-2"
1250	8'-8"	4'-0"	6'-0"	5'-0"
1500	10'-0"	4'-0"	6'-6"	5'-0"
2000	12'-0"	4'-6"	6'-6"	5'-0"
2500	13'-6"	5'-0"	6'-6"	5'-0"

3.4.6 Access--Adequate access must be provided to each compartment of the tank for inspection and cleaning. Both the inlet and outlet devices shall be accessible; therefore, each tank shall have a minimum of one manhole and one cleanout to cover the inlet and outlet respectively.

4.0 INDIVIDUAL HOME AERATION UNITS

4.1 Individual home aeration units shall only be used where additional treatment is provided, such as subsurface absorption or other means of effluent disposal approved by the Director. (The Director may require ownership, operation, and maintenance of a home aeration unit to be under the control of a public or private utility regulated by the Public Service Commission.)

4.2 Individual home aeration units must bear the NSF seal demonstrating conformance with NSF Standard 40. In order to obtain approval, design specifications and operational data must be submitted for evaluation.

5.0 THE STANDARD SOIL ABSORPTION FIELD

5.1 The design of standard soil absorption systems shall be based upon percolation tests and sized in accordance with the chart below.

(SOIL ABSORPTION SYSTEM SIZING CHART ON NEXT PAGE)

SOIL ABSORPTION SYSTEM SIZING FOR SINGLE RESIDENCES

Percolation Test Results (Average Time in Minutes Required for Water to Fall One Inch)	Minimum Area of Soil Absorption System (Square Feet per Bedroom)
Less than 5 minutes	Consult with local health department
5 - 10 minutes	200
11 - 30 minutes	250
31 - 45 minutes	300
46 - 60 minutes	400
over 60 minutes	Consult with local health department

SINGLE ABSORPTION SYSTEM SIZING FOR ESTABLISHMENTS OTHER THAN SINGLE RESIDENCES

Percolation Test Results	Square Feet Per 1000 Gallons Sewage Per Day
Less than 5 minutes	Consult with local health department
5 - 10 minutes	1650
11 - 30 minutes	2500
31 - 45	2950
46 - 60	3300
Over 60 minutes	Consult with local health department

5.2 Construction Materials

5.2.1 Pipe for gravity distribution systems shall have a minimum diameter of 4 inches. Smaller size pipe may be utilized for pressure distribution systems.

5.2.2 Pipe utilized in the construction of soil absorption fields shall conform to the following standards;

5.2.2.1 Plastic pipe ASTM - 405 rigid, D 2729, D 2852, D 3350, D 2751, D 2836.

5.2.2.2 Asbestos cement - Class 1500 or 2400.

5.2.3 Perforated pipe utilized in the construction of soil absorption fields shall have a minimum of 2 rows of downward facing holes approximately 90° apart.

5.2.4 Aggregate utilized in the construction of a soil absorption field shall be washed gravel, crushed stone, or slag, ½ to 2 inches in size with a hardness of 3 on the Moh scale of hardness. Crushed limestone shall be dolomitic. (Field test for hardness--aggregate shall scratch a copper penny without leaving a residue.)

5.2.5 Straw, hay, untreated building paper or newspaper may be utilized to cover the trenches following construction of the absorption fields.

5.3 The construction of the standard soil absorption field with either level or sloping topography shall be in accordance with the following specifications:

5.3.1 The trenches shall be 1 to 3 feet wide with a maximum depth of 36 inches and a minimum depth of 18 inches.

5.3.2 The maximum length of trench shall not exceed 100 feet. If distribution lines of greater than 100 feet are necessary, the solid sewer pipe from the septic tank shall be connected to the center of the distribution line so that the lengths on either side of the connection will be equal and not exceed 100 feet each. Absorption fields dosed by a pump may utilize trenches of greater length, but such designs must receive approval from the Director.

5.3.3 A minimum of 6 inches of aggregate shall be placed in the bottom of the trench beneath the pipe, and a minimum of 2 inches shall be placed above the pipe.

5.3.4 Trenches shall be constructed level, consistent with the topography and in such a manner so as to minimize the compaction and/or smearing of the sides and bottoms. Construction of the trenches is not to be done if the soil forms a "wire" instead of breaking apart when rolled between the hands.

5.3.5 The surface of the aggregate shall be covered with either 2 inches of straw or hay, one layer of untreated building paper or a thickness of at least 4 sheets of newspaper prior to backfilling.

5.3.6 There shall be a minimum of 6 feet of undisturbed earth between the sidewalls of each trench. Additional separation may be required in areas of severe topography and poor soil characteristics to avoid interaction between the trenches.

5.3.7 Soil absorption fields constructed in flat areas

shall be designed to provide a closed continuous system or closed circuit design.

5.3.8 The backfilling of the absorption field shall be performed in such a manner to minimize the movement of heavy equipment upon the absorption field. Backfill shall be mounded over the system to allow for settling and to promote run-off from the system. The area where the absorption field has been constructed shall not be graded after backfilling.

5.3.9 The sewer line from the structure to the septic tank shall be laid on a grade of not less than 1/8 of an inch per foot (1%).

5.3.10 Soil absorption fields with greater than 1500 square feet of area shall include a distribution box. In some cases a siphon chamber or pump chamber may be required to insure even distribution of effluent.

5.4 The construction of the standard soil absorption field in areas of sloping topography shall be in accordance with the following specifications in addition to the requirements of Section 5.3; Part V.

5.4.1 Soil absorption fields constructed on sloping ground shall use a serial distribution system.

5.4.2 Soil absorption systems shall not be constructed on ground with a slope in excess of 25%.

5.4.3 The bottom of each trench and its distribution line shall be level.

5.4.4 There should be a minimum of 6 inches of ground cover over the gravel fill in each trench.

5.4.5 The absorption trenches shall follow the approximate ground surface contours so that variation in trench depth will be minimized.

5.4.6 Adjacent trenches shall be connected with a relief line, cross over, or drop box arrangement--in such a manner that each trench is completely filled with septic tank effluent to the full depth of the gravel before effluent flows to succeeding trenches. The construction of the relief line, cross-over, or drop box arrangement shall incorporate the following requirements:

5.4.6.1 The relief line or crossover shall be solid 4-inch sewer line with tight joints

and with direct connection to the distribution lines or a drop box installation.

5.4.6.2 Relief lines, cross-overs, or drop boxes shall not be constructed in any location or manner where they will be subject to damage during and/or following construction. The location of these relief lines, cross-overs, or drop boxes must be marked prior to backfilling to avoid damage from heavy equipment.

5.4.6.3 The trench for the relief pipe or cross-over shall be no deeper than the top of the gravel of the trenches being connected. The line should rest on undisturbed earth and backfill shall be carefully tamped. Care must be exercised in construction of the relief or cross-over line to insure that an undisturbed block of earth remains between the trenches.

5.4.6.4 The invert of the overflow pipe in the first relief or cross-over line must be at least 4 inches lower than the invert of the septic tank outlet.

5.4.6.5 All other construction features of the disposal field shall comply with the specifications for the construction of a standard absorption field.

6.0 ABSORPTION BEDS

6.1 Absorption beds shall only be constructed when topography or space limitations prevent installation of a standard absorption field.

6.2 Absorption beds shall be sized to provide an area 30% greater than that calculated for a standard absorption field to make up for sidewall loss.

6.3 The piping distribution network within the bed shall be installed in such a manner that the pipes are located 18 inches from the sides of the bed with a minimum of 3 feet between pipes and in a continuous or closed circuit design. Construction of the bed shall be in accordance with the general design and construction requirements of the standard absorption field.

6.4 Maximum depth of a bed shall be 36 inches, minimum depth shall be 18 inches.

7.0 SHALLOW AND ELEVATED SOIL ABSORPTION SYSTEMS--Due to the shallowness of many West Virginia soils, a soil absorption system will often have to be shallow or elevated in fill to maintain the minimum distance above the seasonal high water table, rock table, or impermeable soil layer. The construction of a shallow or elevated system is permissible where there is a suitable layer of soil, sufficient room, and the natural slope is not excessive. Shallow and elevated soil absorption systems presently approved for use are: shallow fields, elevated beds, soil absorption mounds, and specifically designed systems for individual cases. Due to their complex construction and limited operational history, elevated systems should only be considered when intended to serve existing residences, to correct health hazards, or in other special cases. Shallow fields are similar to the standard absorption field, more easily constructed than elevated systems, and may be considered for new residences.

7.1 Shallow fields and elevated beds may be utilized under conditions where pervious rock table, an impermeable layer of any type, or seasonal water table is within 3½ feet of the ground surface. An elevated bed may be constructed on either level topography or sites of up to approximately 15% slope. Construction of the bed is such that the bottom of the trenches are 3 feet above the rock, any impermeable layer, or seasonal high water table.

Design of shallow fields and elevated beds shall correspond to the following examples dependent upon site conditions:

7.1.1 Shallow Field for Level Topography

7.1.1.1 Shallow fields shall in general be constructed in accordance with the procedures and requirements for standard absorption fields; however, the depth of the trenches in natural ground may vary from 6 to 18 inches. The space between trenches will vary from 6 to 12 feet depending on the trench depth. (See 5-E Diagram)

7.1.1.2 The site shall be filled prior to the construction of the trench system. The site shall be filled in accordance with requirements of Appendix B.

7.1.1.3 Topography of the site must be level, less than 3 percent slope.

7.1.1.4 The percolation rate for design considerations shall be the slower of the rates recorded for the natural soil at installation depth or for the fill material.

7.1.2 Elevated Bed for Sloping Topography

7.1.2.1 Elevated beds of this design may be utilized in areas of sloping topography where the pervious rock table, seasonal high water table, or other impermeable layer is at a minimum depth of 2 feet.

7.1.2.2 Slope of the site may vary from 3 to a maximum of 15 percent.

7.1.2.3 The foundation of the building to be served must be constructed high enough for gravity feed if a pump is not utilized.

7.1.2.4 The site shall be filled prior to the construction of the trench system. The site shall be filled in accordance with the requirements of Appendix B with the following exceptions:

A. A clay barrier or dam shall be constructed around the fill as shown in Diagram 5-F.

B. The finished grade of the fill over the bed must extend for a full ten feet beyond the bed before tapering off to a 3 to 1 slope as shown.

C. The extension of the fill shall be placed before the trench system is installed.

7.1.2.5 The absorption system shall in other respects be constructed in accordance with the requirements and procedures for absorption beds.

7.2 Soil Absorption Mounds

7.2.1 Soil and Site Requirments

7.2.1.1 Soil and site factors that restrict mound system are listed in the following tables:

(See Next Page for Table)

Restricting Factors	Soil Group	
	Slowly Permeable	Permeable Soils with High Water Tables
Percolation rate	60-120 min/in	3-60 min/in
Depth to pervious Rock	24 inches	24 inches
Depth to high water Tables	24 inches	24 inches

7.2.1.2 Minimum separation distances, as listed in Section 2.6, shall be measured from the toe of the fill to the respective feature.

7.2.2 Fill Material

7.2.2.1 Below Absorption Area--Fill material below the absorption area shall be of a medium sand texture. The sand does not have to be washed. (A medium texture sand is defined as 25% or more very coarse, coarse and medium sand and less than 50% fine and very fine sand. The design infiltration rate for medium sand texture is 1.2 gallons per square foot per day.)

7.2.2.2 Above the Absorption Area--The area above the bed or trenches (cap) should be a finer textured soil than the medium texture sand below, to allow plant growth. The soil should have a higher water holding capacity and promote increased runoff due to a more dense nature. A good quality top soil should be placed to a depth of 6 inches over the entire mound.

7.2.3 Mound Design

7.2.3.1 Daily waste water load for design purposes will be 150 gallons per day per bedroom.

7.2.3.2 Absorption Area

A. Sizing--The methods for sizing absorption area vary with the restricting factors. Examples of these methods are provided in Appendix C.

B. Configuration

1. For sites with slowly permeable soils with a seasonally high water table the absorption area shall be in the form of trenches.

2. For sites with permeable soils with a seasonally high water table the absorption area shall be in the form of a bed.

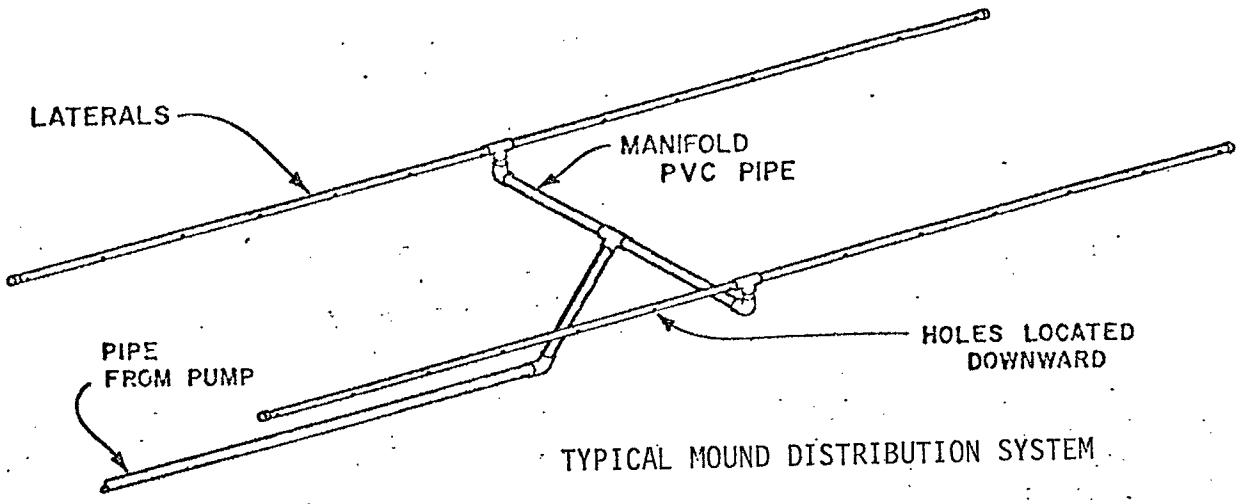
3. For sites with permeable soils over shallow pervious rock the absorption area may be either in the form of a bed or trenches.

4. The mound length runs perpendicular to the slope.

7.2.3.3 Mound Dimensions--Tables listing mound dimensions are provided in Appendix C.

7.2.4 Distribution System--Example of a typical distribution system is shown below. Pipe diameters will vary depending on the length of bed or trenches, as shown in the following table:

Perforation Spacing (inches)	Perforation Diameter (inches)	Pipe Diameter		
		(1 inch)	(1-¼ inches)	(1-½ inches)
		Allowable Pipe Lengths (feet)		
30	3/16	34	52	70
	7/32	30	45	57
	¼	25	38	50
36	3/16	36	60	75
	7/32	33	51	63
	¼	27	42	54



TYPICAL MOUND DISTRIBUTION SYSTEM

7.2.5 Pumping System

7.2.5.1 Recommended dosign frequency is four times daily. The following table gives recommended dosing quantities for various sized systems. The dosing volume shall be the dosing quantity recommended in the table or at least ten times the lateral pipe volume, whichever is greater.

Recommended Dosing Quantity for Various Sized Homes

Home Size No. Bedrooms	Dosing Quantity Gallons Per Dose
1	50
2	75
3	115
4	150
5	200

Void Volume for Various Diameter Pipes

Diameter inches	Volume gallons per foot
1	.041
1¼	.064
1½	.092
2	.164
3	.368
4	.655
6	1.47

7.2.5.2 Specifications for design of the pump chamber are provided in Appendix A.

8.0 DUAL SOIL ABSORPTION FIELDS

8.1 Dual absorption fields may be utilized if percolation rates are between 60 minutes an inch and 90 minutes per inch.

8.2 Area reserved for absorption shall be increased to provide sufficient area for the installation of dual soil absorption fields.

8.3 Construction of the dual absorption fields shall be in accordance with the dosing requirements of the standard soil absorption system, with a junction box or valving arrangement to provide for alternation of the fields. Each of the fields shall be sized in accordance with the percolation test results. Both fields shall be of the maximum sizing required at a 60 minutes per inch rate.

9.0 INDIVIDUAL SEWAGE SYSTEMS WITH SURFACE DISCHARGE--Individual systems with surface discharge require a lengthy approval process and, if approved, regular operational supervision and maintenance. For these reasons they should only be considered for existing residences or establishments when all other means of treatment and disposal have proven ineffective and a real or potential public health hazard exists.

9.1 Individual Sewage System Effluent Disposal Ponds

9.1.1 Effluent from an individual sewage treatment system may be discharged into a stabilization pond system.

9.1.2 Individual sewage system effluent disposal ponds shall be designed on the basis of no more than 34

pounds of 5 day BOD per surface acre. For the purposes of pond sizing, it shall be assumed that there is a 25% reduction in 5 day BOD from a septic tank system and that there is a 70% reduction in 5 day BOD from a home aeration unit. However, an individual sewage system effluent pond shall be a minimum of 1800 square feet in surface area.

9.1.3 Effluent from an individual sewage system effluent disposal pond may be discharged to either an approved land treatment system, or may be discharged to a stream following disinfection, upon approval by the Director.

9.1.4 An individual sewage system effluent pond shall be constructed in accordance with Part III, Section 11, of the Design Standards.

9.2 Intermittent Surface Sand Filters

9.2.1 Effluent from an individual sewage treatment system may be discharged to intermittent surface sand filters.

9.2.2 Effluent from a surface sand filter may be discharged to a stream after chlorination in accordance with the regulations and requirements pertaining to surface discharge of waste water.

9.2.3 Intermittent surface sand filters preceded by a septic tank shall be designed on a filtration rate of 5 gallons per day, per square foot. There shall be two filters of design size to provide for alternation of operation.

9.2.4 Intermittent surface sand filters preceded by an individual aerobic treatment system shall be designed on a filtration rate of 5 gallons per day per square foot. There shall be one filter.

9.2.5 Intermittent surface sand filters serving individual sewage systems shall be provided with an insulated cover to maintain operation during inclement weather.

9.2.6 The intermittent surface sand filter must be dosed by either a pump or sewage siphon.

9.2.7 The design and construction of an intermittent surface sand filter shall be in accordance with the design and specifications provided in figure 5-G.

10.0 COMPOSTING TOILETS

10.1 Composting toilets may be utilized only in conjunction with an approved grey water treatment and disposal system.

10.2 The design and construction of a composting toilet must meet the requirements of NSF Standard 41.

11.0 INCINERATING AND CHEMICAL TOILETS

11.1 Incinerating and Chemical toilets may be utilized only in conjunction with an approved grey water disposal system.

11.2 The design, construction, and application of incinerating or chemical toilets shall be approved by the Director. The use of chemical or incinerating toilets may be approved by the Director in emergency situations, temporary usage situations, or for recreational residences, and/or isolated residences.

12.0 GREY WATER DISPOSAL SYSTEMS

12.1 Those houses served by a grey water disposal system must have a house sewer of not more than 2 inches in diameter.

12.2 Houses served by grey water disposal systems shall not have garbage disposal units.

12.3 Manufactured grey water disposal systems must be approved by the Director.

12.4 Non-commercial grey water disposal systems shall consist of the following:

12.4.1 A soil absorption field designed on the basis of a 30% reduction in water usage, and constructed in accordance with the design requirements for the standard soil absorption fields.

12.4.2 A septic tank sized according to the following:

Number of Bedrooms	Minimum Capacity
2 or less	500
3 - 4	750
5 or more	Add 210 gallons for each additional bedroom

13.0 PRIVIES

13.1 Every privy shall be provided with:

13.1.1 An earthen bottom pit with water-tight walls, or a water tight vault or other water tight receptacle with walls extending at least 6 inches above ground level.

13.1.2 A crowned curb constructed of compacted earth or other suitable material, at least 6 inches thick, extending from the walls of the pit, vault, or receptacle, in all directions for a distance of 18 inches.

13.1.3 A riser that is flytight when not in use.

13.1.4 A vent pipe extending from the pit, vault, or receptacle to a point at least 24 inches above the roof of the superstructure or through the wall of the superstructure. The vent shall be screened to prevent the entrance of flies and other insects.

13.2 Privy pits may have an earthen bottom if:

13.2.1 The privy is located in an impervious soil.

13.2.2 The privy is located below and 100 feet or more from a groundwater supply or individual well, and is so located that any leaching therefrom is disposed of in a manner that does not create a nuisance or insanitary condition.

13.2.3 The pit is 4 feet or less in depth, and it has been determined by the excavation of a 7 foot hole that rock or water table does not exist within 3 feet of the bottom of the pit.

13.3 No privy shall be located within 20 feet of any dwelling or establishment or within 10 feet of any property line.

13.4 The construction and design of the privy superstructure, vault, pit or other type receptacle shall be such as to prevent access to the vault or receptacle and the contents thereof, by flies, rats, and wild or domestic animals.

13.5 Privy vaults, pits or receptacles shall have the contents removed as often as necessary to prevent creating a nuisance or unsanitary condition.

13.6 An approved grey water disposal system shall be installed to serve those residences with indoor plumbing or running water for sinks and showers. For those residences without

indoor plumbing, a shallow leach trench or pit may be installed for disposal of grey water.

14.0 RECIRCULATING TOILETS

14.1 Recirculating toilets and the piping for such toilets shall be separated from and not connected to the potable water system of any residence or other structure under any circumstances. Color coded pipe shall be used to facilitate inspection and maintenance of such installations.

14.2 Recirculating toilets shall:

14.2.1 Be installed and operated in accordance with the manufacturer's instructions.

14.2.2 Be approved by the Director before installation.

15.0 SELF CONTAINED EXCRETA DISPOSAL SYSTEMS

15.1 Self-contained excreta disposal systems shall be designed so as to prevent flies, rats, and wild or domestic animals from having access to the contents thereof.

15.2 All fixtures, tanks, or receptacles shall be constructed of impervious, easily cleanable material.

15.3 Tanks and receptacles shall:

15.3.1 Be watertight and vented to the outside air.

15.3.2 Be constantly supplied with sufficient amounts of an approved chemical agent to process and deodorize the contents thereof.

15.3.3 Have the contents removed and the tank or receptacle thoroughly cleaned as often as necessary to prevent creating a nuisance, or an unsanitary condition.

16.0 HOLDING TANKS

16.1 Holding tanks are considered a temporary means of sewage disposal to be used for periods of time not in excess of six months. Long term use of a holding tank, in excess of six months, must receive prior approval from the Director.

16.2 A holding tank must be watertight and constructed of the same materials and by the same procedures as a watertight septic tank. No openings or pipes through which the contents of the tank may be discharged will be permitted.

16.3 The liquid capacity of the holding tank shall be sufficient to contain one week design flow from the facility to be served.

16.4 Holding tanks shall be located in an area readily accessible for pumping under all weather conditions and where accidental spillage during pumping provides the least hazard to public health.

16.5 Holding tanks shall be located in accordance with the distance requirements established for septic tanks in Part V, Section 3 of the Design Standards.

16.6 Construction and installation of the holding tank shall provide adequate access to the tank for pumping, cleaning, and maintenance through manhole and cleanouts.

16.7 A holding tank installation shall be provided with an audio visual high level alarm to indicate when the tank is full and requires pumping.

16.8 A contract with a licensed sewage tank cleaner for pumping and maintenance of the tank on a regular schedule shall be required.

APPENDIX A:

Effluent Pumping for Individual Sewage Systems:

A. Pumps

1. Types of Pumps--Non-clog submersible centrifugal effluent pumps or progressing cavity positive displacement pumps.

2. Pumps shall be readily removable and replaceable without dewatering the wet well.

3. Pump should be sized to dose a soil absorption system one to four times a day. The recomended dosing cycle is twice a day, however, the dose shall be no more than 75% of the distribution pipe volume for all soil absorption systems utilizing four inch pipe.

4. The pump shall be located six to eight inches off the tank bottom to provide additional volume for sludge settlement.

B. Pump Controls

1. Relays, and electrical plug-ins or sockets shall not be located inside the wet well or access manhole. These devices must be located above-ground in a weatherproof box or in the residence.

2. A high water alarm shall be placed within the residence.

C. Distribution System

1. Pipe used for the distribution system (force main) shall be PVC SDR 21, PVC SDR 26 or Schedule 40 of 1¼" to 2" diameter.

2. All parts of the distribution system (manifold and laterals) shall be sloped slightly toward the inlet to avoid freezing and ponding of water in the system between dosing.

3. Piping shall be installed below the frost line.

D. Wet Well

1. The wet well shall be watertight and constructed of materials that will not corrode.

2. An access manhole of 24 inches or greater shall be provided to the wet well. The manhole shall be installed level with or above the ground surface and the cover secured.

3. A wet well shall be sized to provide adequate volume not only for one day reserve capacity, but also for single dose capacity plus additional capacity to maintain minimum depth for operation.

4. The wet well tank should be set lower than the septic tank to provide usage of maximum capacity of the wet well.

APPENDIX B:

Procedures for the construction of soil absorption systems in fill areas.

A. Scarify the area, removing all vegetation prior to preparing for filling. Be careful to minimize the amount of soil removed in this step.

B. Plow the area to be filled using a mold board plow, plowing perpendicular to the direction of surface slope with plow throwing soil up slope. Plow to the maximum possible depth (7 to 8 inches). Use as large a plow as possible to reduce the number of driven in furrows which result in compaction of the subsoil. (Plow soil only when the moisture content is low to avoid compaction and puddling. If a fragment of soil occurring approximately 9 inches below the surface can be easily rolled into a wire, the soil should not be plowed since the moisture content is too high. If the soil is friable or dry and falls apart when rolling it into a wire, the soil can be plowed.) Once plowing is completed, keep all vehicular traffic off the plowed area. Minimize time lag between plowing and filling. If it rains after plowing is completed, wait until the soil dries out before the start of construction. Immediate filling after plowing is highly preferable.

C. Suitable fill material shall consist of soil with a natural permeability of less than thirty minutes per inch, and should contain no large coarse fragments or debris.

D. Place the fill around the edge of the plowed area by dumping it on the plowed area, keeping the wheels of the dump truck off the plowed area. Wheel tracks in the plowed area will lead to compaction and ruts. This will allow the effluent to flow in the ruts, eventually resulting in seepage.

E. The plowed area shall be filled in 8 to 12 inch lifts, each lift being compacted to not less than 95% of the maximum density (AASHO). Initially, try to keep at least 6 inches of fill under the tracks to minimize sealing of the plowed layer.

F. Place all the fill needed in the plowed area until this area is at the desired elevation.

G. Using a bucket on the crawler tractor, dig the trenches in the filled area. Trenches should be 12 to 36 inches wide and 12 inches deep.

H. Using a bucket on the crawler, dump the gravel in the trench, leveling the gravel off to the desired elevation (6 inches above trench bottom).

I. Lay the distribution pipe in the center of the trenches, taking care to lay it level with holes downward. Using the bucket, dump gravel in the trench, taking care to disturb the pipe as little as possible. Level the gravel at the desired elevation (two inches above the top of the pipe).

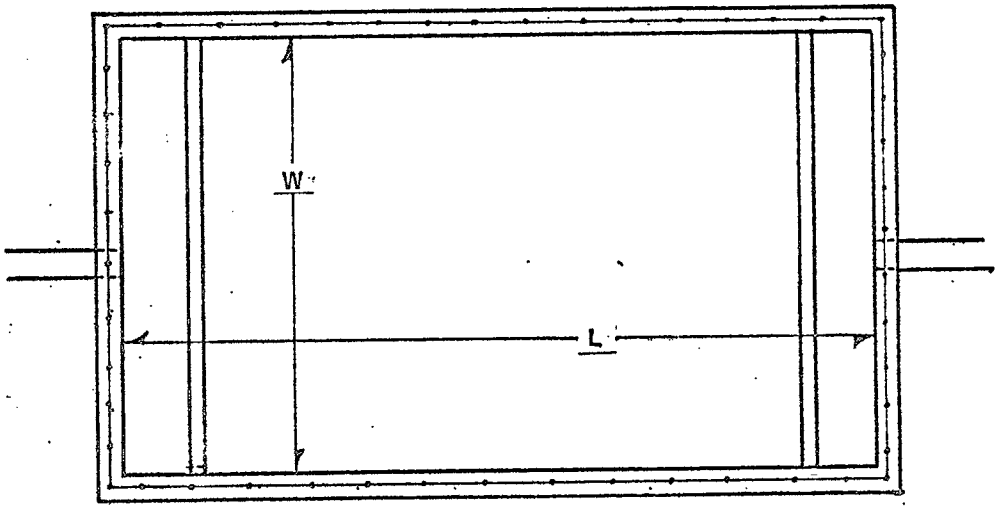
J. Place straw or hay 3 to 4 inches deep (uncompacted) over the top of the trenches.

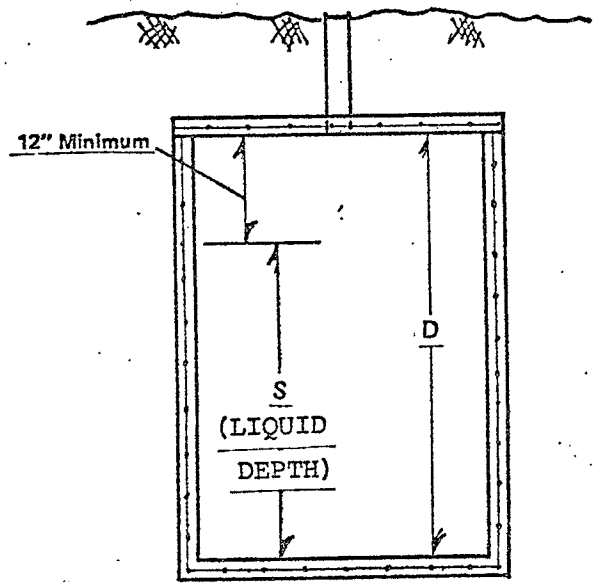
K. Place soil on top of the filled area to a depth of 1.5 feet above the top of the trenches in the center of the filled area and to a depth of 1 foot at the outside edge of the filled area. (Do not drive on the tops of the trenches as you will damage the distribution system.) The upper 6 inches of the soil should be a good top soil, equivalent to, or of a better grade than the soil used as fill material.

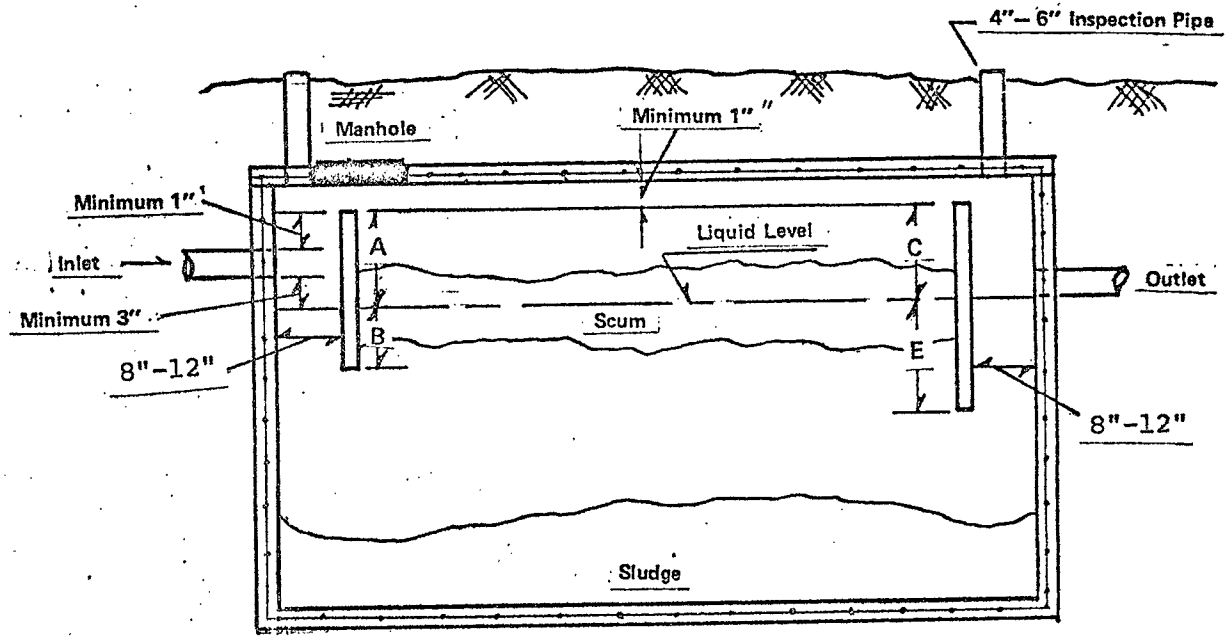
L. Landscape the filled area by planting grasses on the surface.

DIMENSIONS

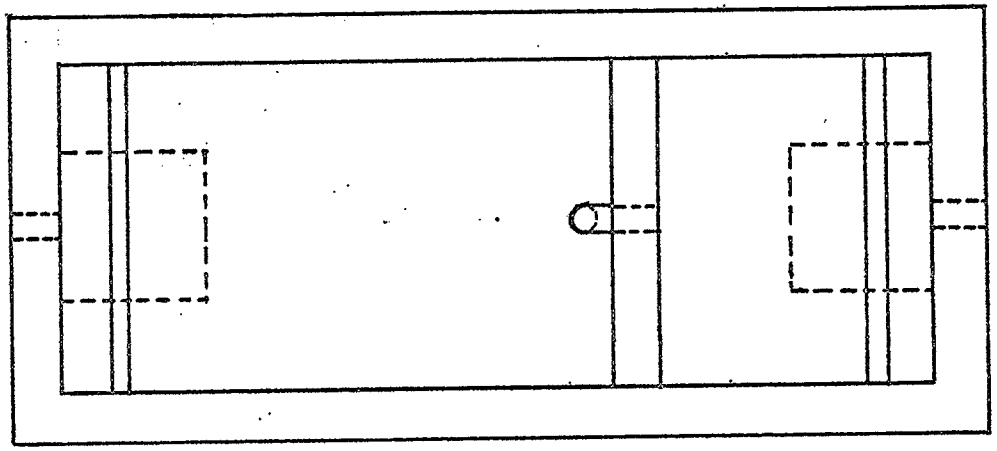
A	0.2S
B	6" Min., 0.25 Max.
C	0.2S
E	0.4 S
D	See Text Of
S	Design Standards
L	For
W	Recommendations

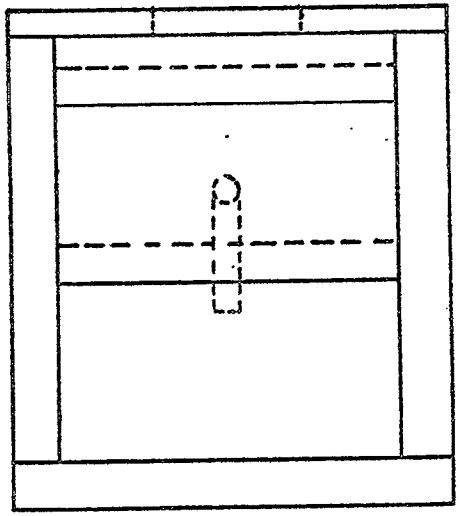


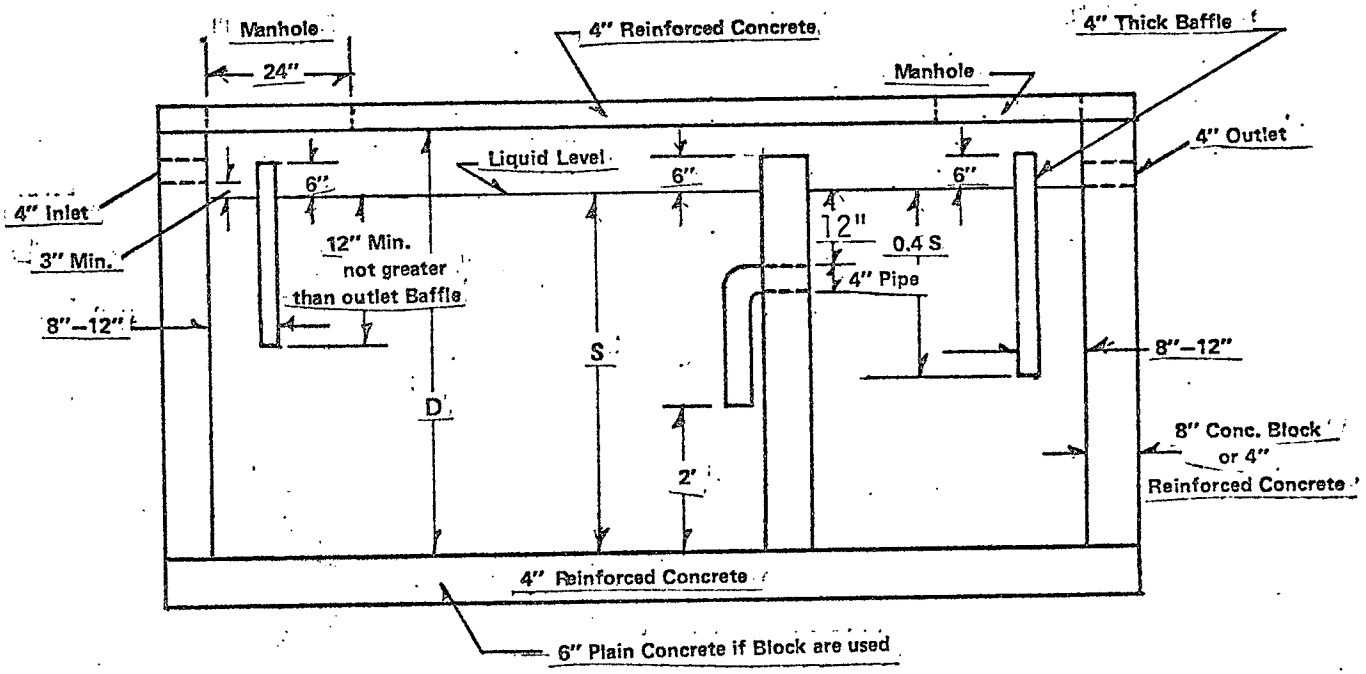




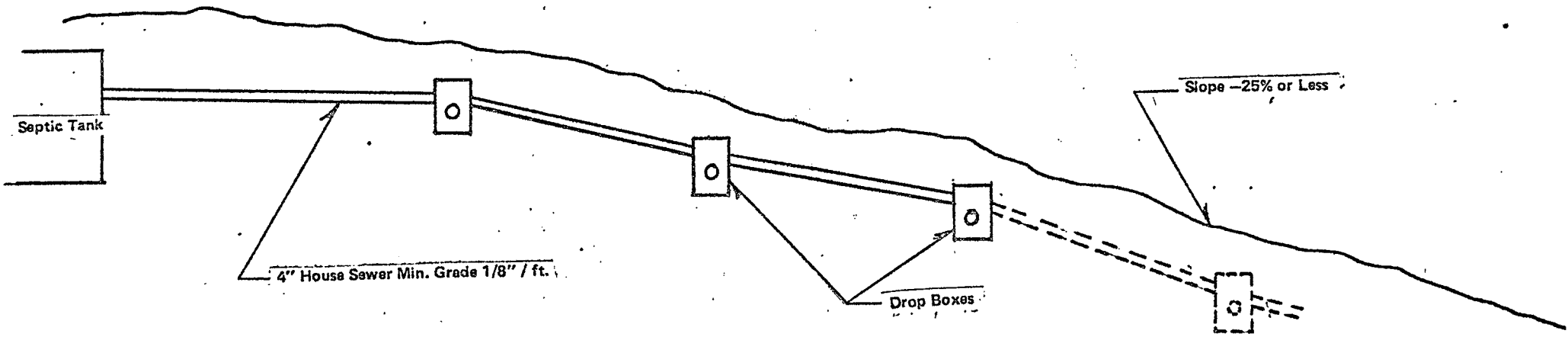
TYPICAL SINGLE COMPARTMENT SEPTIC TANK

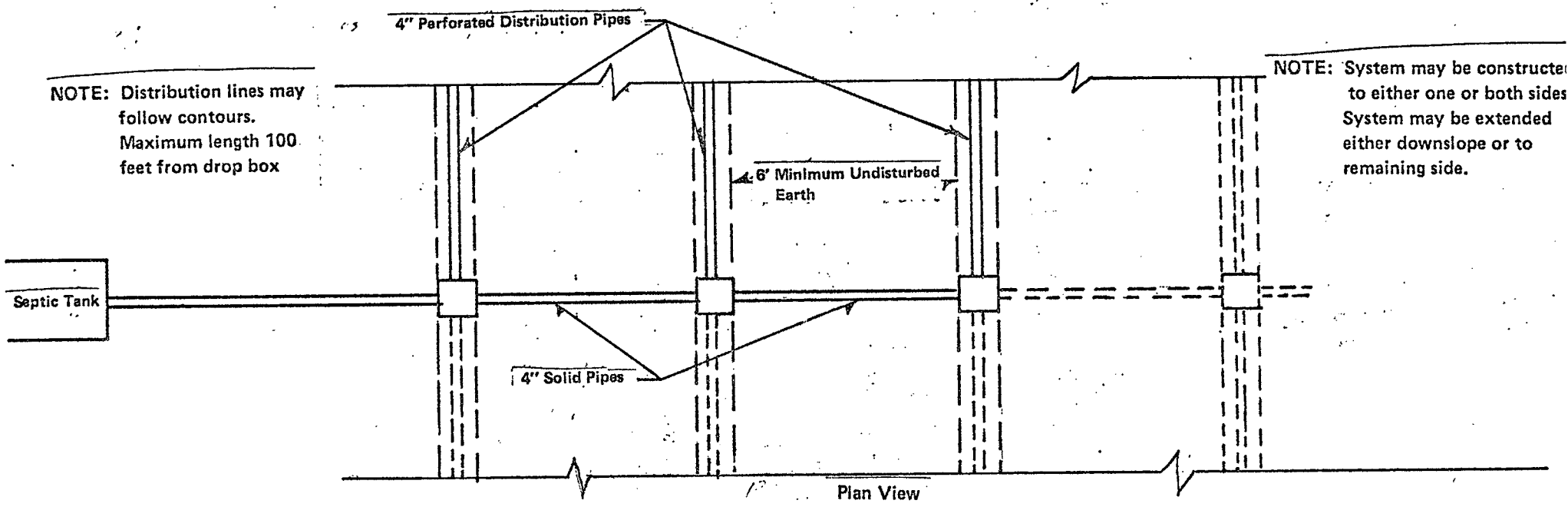






TYPICAL DUAL COMPARTMENT SEPTIC TANK





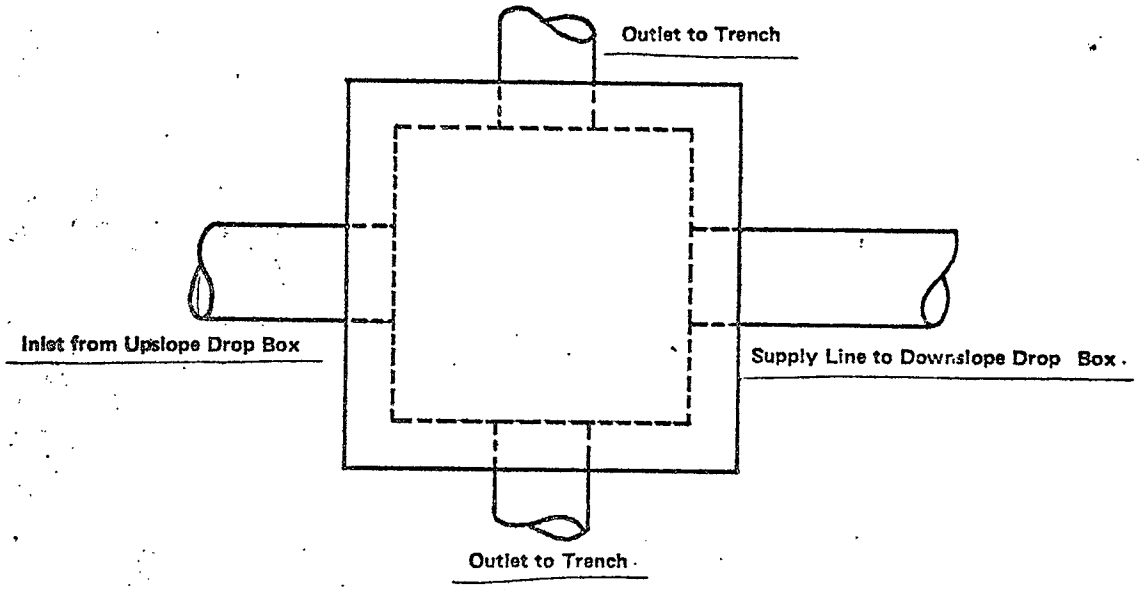
TYPICAL DROP BOX INSTALLATION

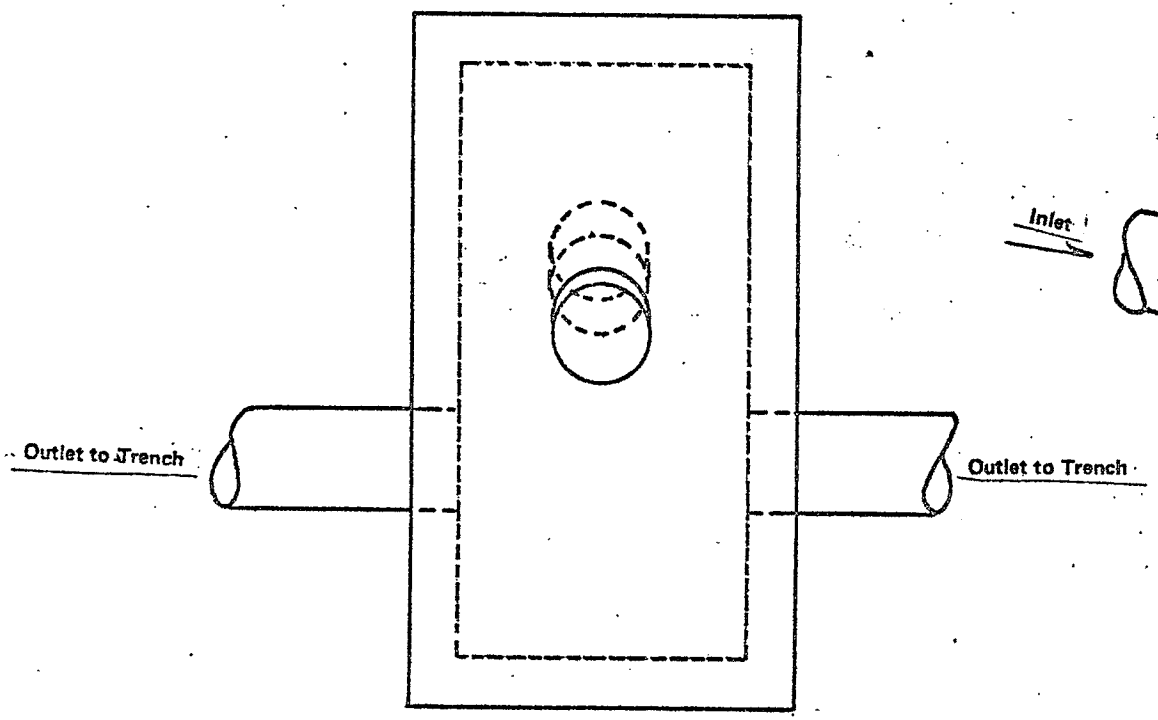
FOR

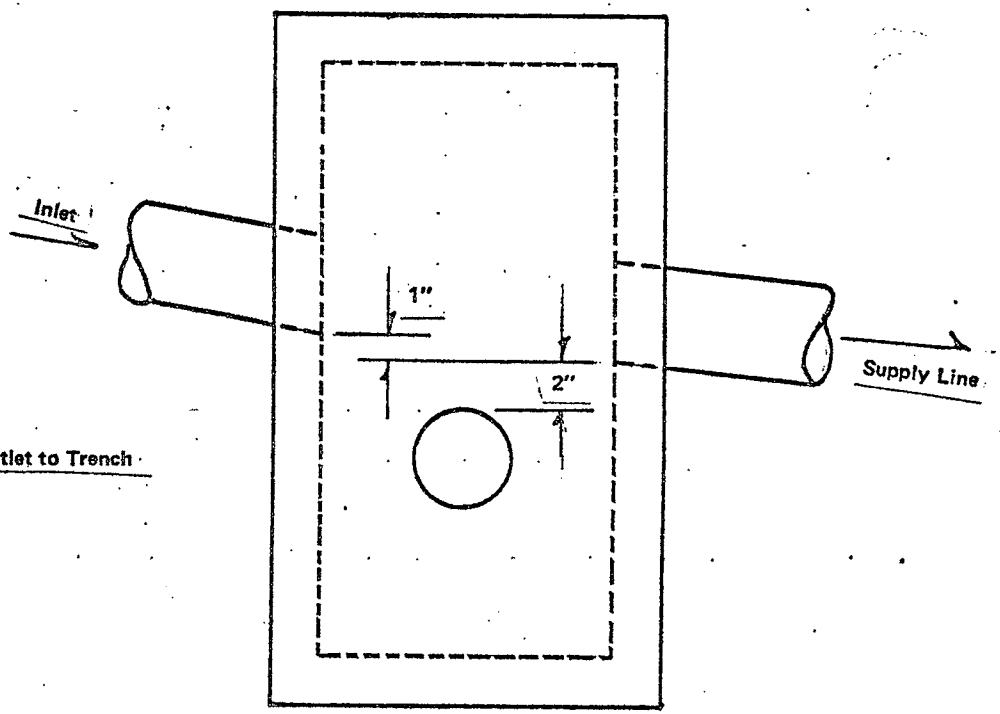
SERIAL DISTRIBUTION SYSTEMS

NOTES:

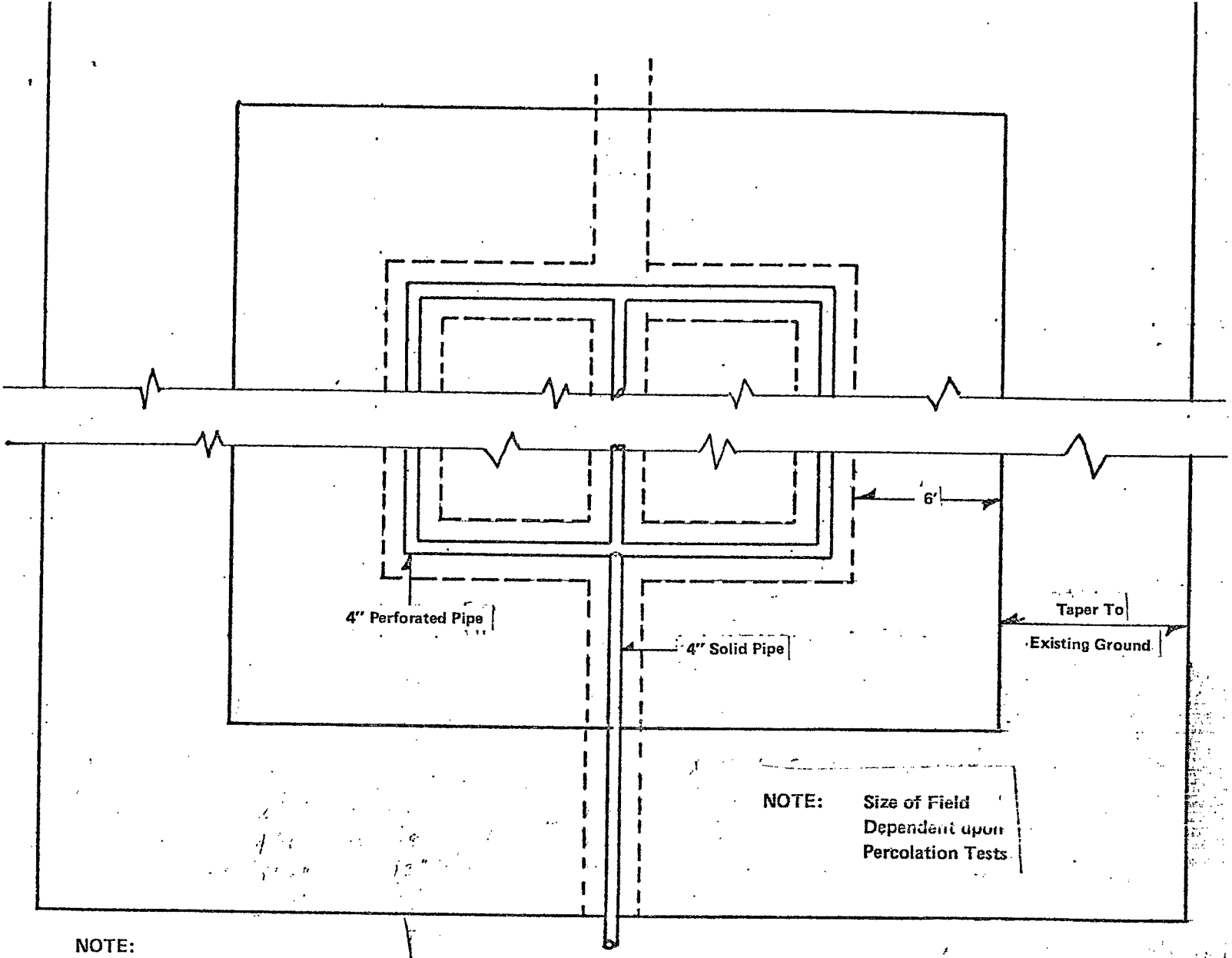
1. All pipe 4" in diameter
2. Invert of inlet 1" higher than invent of supply line to downslope Drop Box
3. Trenches may outlet to one side or both sides of Drop Box
4. Drop Boxes may be square, rectangular or cylindrical in shape and of plastic or concrete construction
5. Drop Boxes may be completely buried or placed so that the top of the box is flush with the surface of the ground







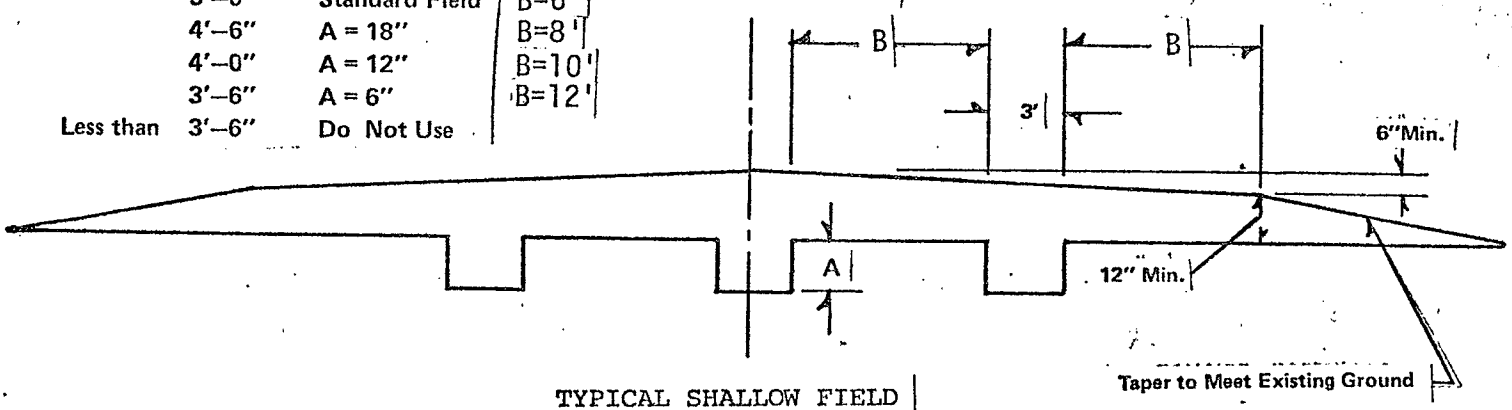
TYPICAL DROP BOX DETAIL



NOTE:

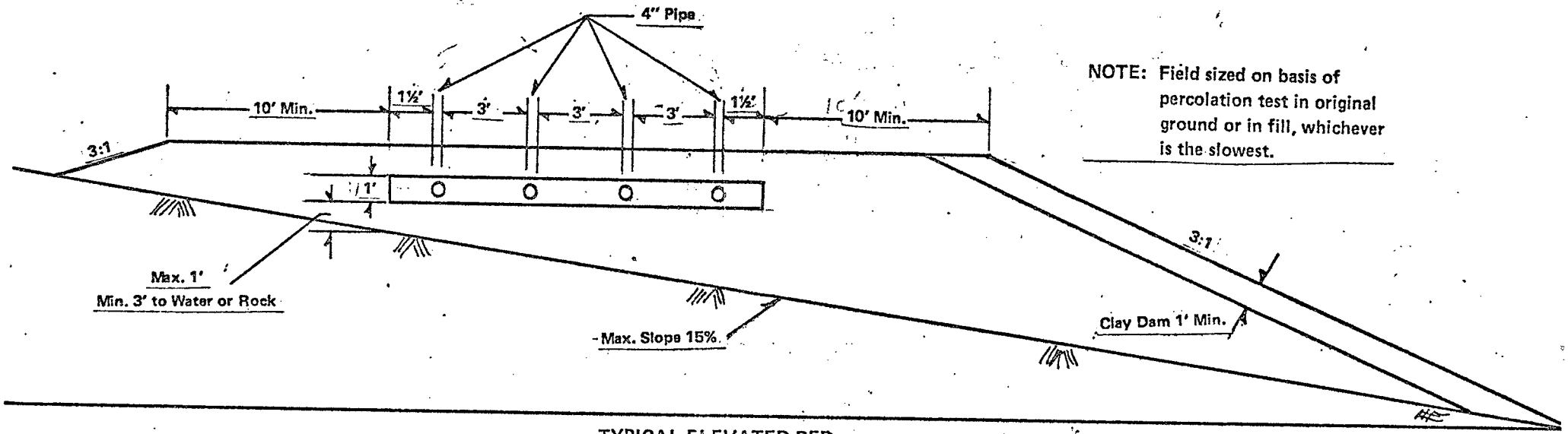
Depth to Ground Water or Rock

5'–0"	Standard Field	B=6'
4'–6"	A = 18"	B=8'
4'–0"	A = 12"	B=10'
3'–6"	A = 6"	B=12'
Less than 3'–6"	Do Not Use	



TYPICAL SHALLOW FIELD

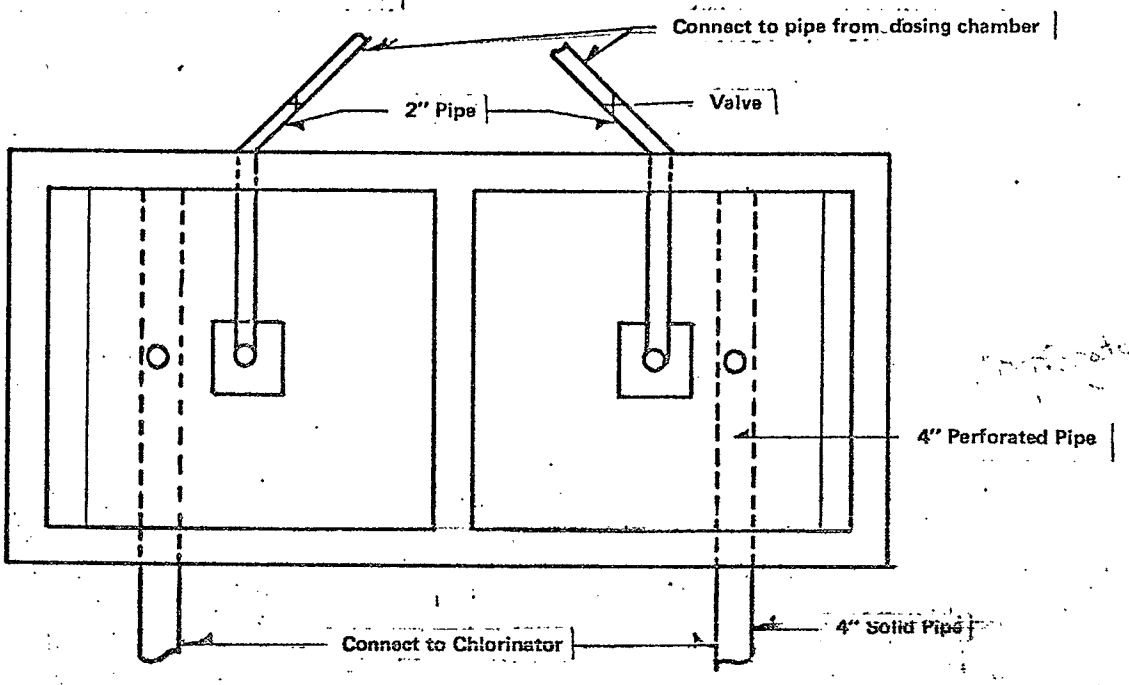
Ground Water or Rock 3½ to 5 Feet

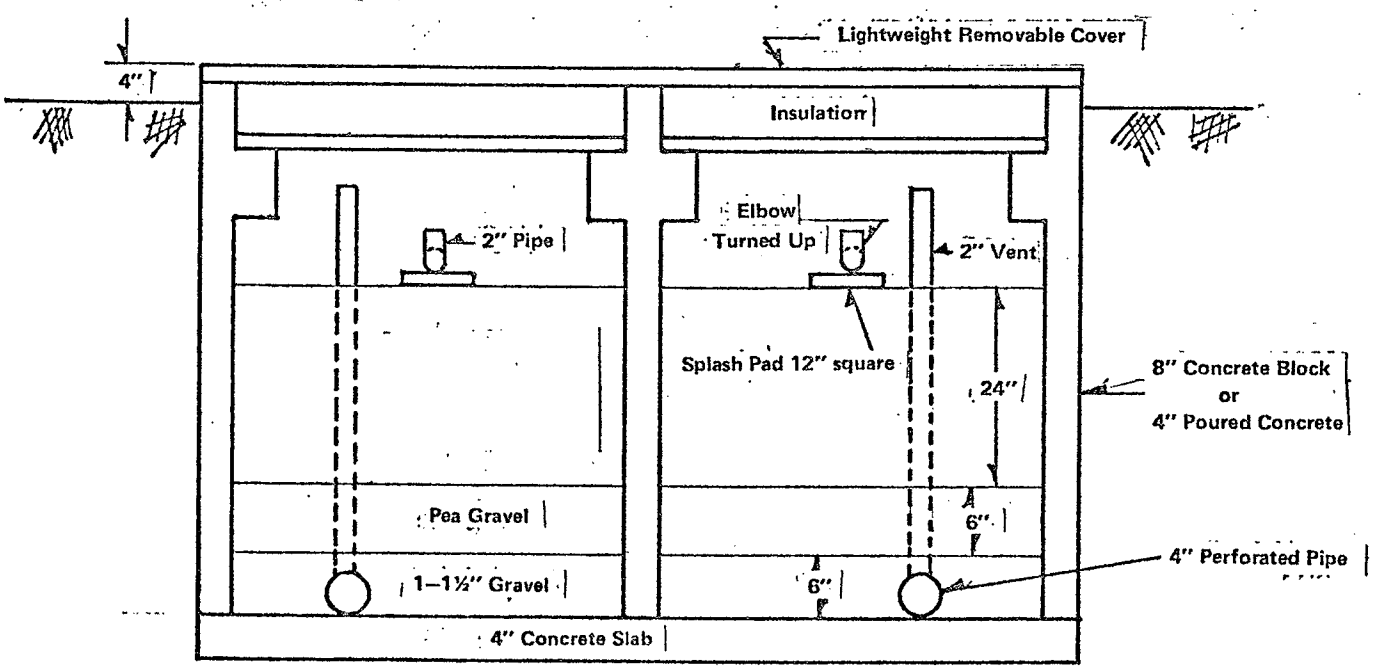


NOTE: Field sized on basis of percolation test in original ground or in fill, whichever is the slowest.

TYPICAL ELEVATED BED
SLOPING GROUND

NOTES:
1. Septic tank effluent systems require dual filters
2. Individual home aeration unit effluent systems require single filters
3. Size of filters based upon 5 gal./ft^2/day

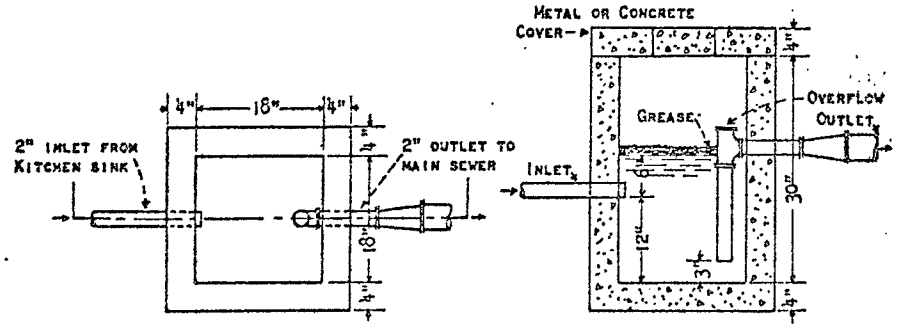




TYPICAL SURFACE SAND FILTERS

NO SCALE

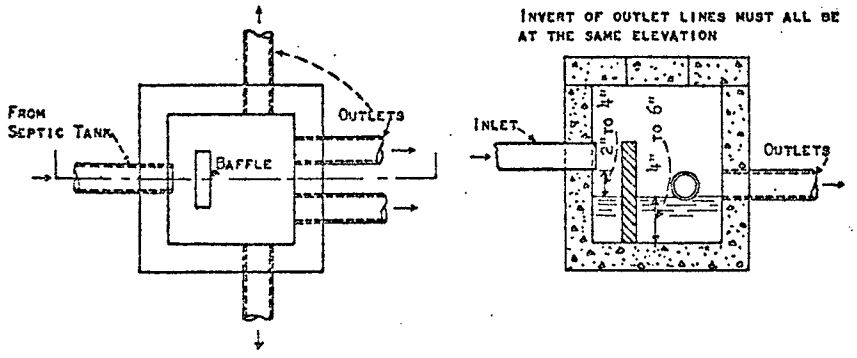
LOCATE GREASE TRAP SO THAT COVER IS EASILY ACCESSIBLE FOR REMOVING AND CLEANING OUT OF GREASE



PLAN - COVER REMOVED SECTION

GREASE TRAP

BAFFLE REQUIRED WITH SIPHON OR WHEN AN OUTLET IS DIRECTLY OPPOSITE THE INLET

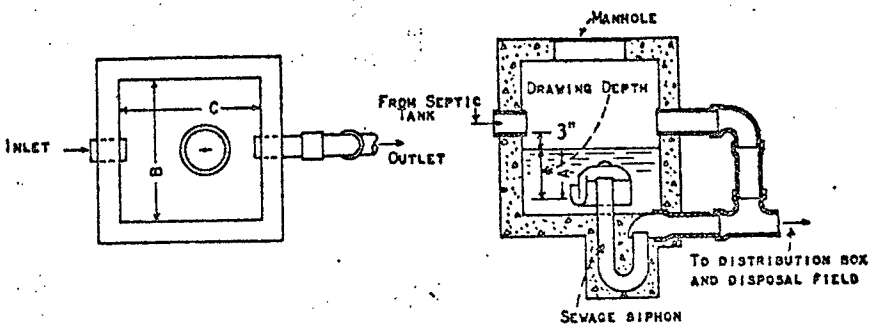


PLAN - COVER REMOVED SECTION

DISTRIBUTION BOX

TYPICAL GREASE TRAP

TYPICAL DISTRIBUTION BOX



PLAN SECTION

A DOSING CHAMBER AND SIPHON SHOULD BE INCLUDED ON ALL SEPTIC TANKS GREATER THAN 2500 GALLONS CAPACITY SO THAT LARGE QUANTITIES OF THE LIQUID, AFTER PASSING THROUGH THE TANK, MAY BE QUICKLY AND UNIFORMLY FLUSHED INTO THE ABSORPTION SYSTEM, ALLOWING ALTERNATE REST PERIODS FOR THE TILE DRAINAGE SYSTEM. THE WORKING CAPACITY OF THE DOSING CHAMBER SHOULD BE EQUAL TO ONE-HALF THE VOLUME OF THE TILE DRAINAGE SYSTEM.

DIMENSIONS OF SIPHON CHAMBER FOR SEVERAL DISPOSAL FIELD LAYOUTS

Siphon		Dosing Chamber Area Width x Length "B" x "C" (sq. Ft.)	Length of Tile (feet) in Tile Absorption Trench, Stone Filter Trench, Sand Filter Trench, or Subsurface Stone Filter
Size (Inches)	Drawing Depth* "A" (Inches)		
3	13	8.0	200
3	13	12.0	300
3	13	16.25	400
3	13	20.0	500
4	17	18.5	600
4	17	21.75	700
4	17	24.75	800
4	17	27.75	900
4	17	31.0	1000
5	23	27.5	1200
5	23	32.0	1400
5	23	36.5	1600
5	23	41.0	1800
5	23	45.5	2000
5	23	56.75	2500

* USE DRAWING DEPTH AS GIVEN BY MANUFACTURER FOR YOUR PARTICULAR SIPHON.

TYPICAL
DOSING CHAMBER AND SIPHON
SEPTIC TANK

Appendix C

Design Examples and Plans for Mound Systems

Reprinted from "Design and Construction Manual for Wisconsin Mounds"
Prepared by James C. Converse, Agricultural Engineering Department,
University of Wisconsin-Madison

C-1

DESIGN EXAMPLE AND PLANS

for

MOUND

on

SLOWLY PERMEABLE SOIL

DESIGN EXAMPLE
for
MOUND
on
SLOWLY PERMEABLE SOIL

An example is used to illustrate the design procedure. The method outlined in the text is followed step by step for a situation commonly found in practice. Example plans have also been prepared for most site conditions encountered and are included following the design example. These prepared plans may be used where similar site conditions exist. In cases where these plans cannot be adapted to the site, a mound may be designed as illustrated below.

Design a mound system for a 3 bedroom home with the following site conditions. Several small trees are on the site. Rock fragments, impermeable layer, and bedrock are not a factor. (Letter Notation on Fig. A.3 and A.4 are used as references in this example).

Slope	6%
Percolation Rate	120 min/in. at 24 inches*
Ground Water	24 in.

Step 1. Select the Site

The mound site should be selected prior to house location and road building. Consider all criteria listed in Table 1 and the discussion under the "Soil and Site Requirement" section for all possible locations on the lot. Consider the difficulties in construction of the mound at the various locations. Evaluate all criteria, weigh one site against the other, then pick the best site.

Step 2. Waste Water Load

Design loading is 150 gal/day/bedroom, so with 3 bedrooms the design loading is 450 gal/day.

Step 3. Select the Fill Material

Select a medium sand texture. Use Table 2 as a guide. Sometimes it is necessary to make a judgement on the quality of sand versus the transportation costs, but there are sands which are too coarse or too fine that are not acceptable. A medium sand texture will have a design infiltration rate of 1.2 gal/ft^2/day.

Step 4. Size the Absorption Area

Since the medium textured sand is being used, the infiltration rate is 1.2 gal/ft^2/day.

---

*Unless there is a more restrictive horizon above.

Absorption area required = 450 gal/day ÷ 1.2 gal/ft^2/day = 375 ft^2

Since this is a slowly permeable soil with high ground water, a trench system must be used. This will spread the liquid out along the slope and minimize the encroachment of the ground water into the mound. Trench width of 2-4 ft is permissible.

Use a trench width of 3 ft. (A) then:

trench length = 375 ft^2 ÷ 3 ft. = 125 ft.

This is too long for a trench system. Use 2 or 3 parallel trenches of equal length, preferably 2 trenches. More than 3 trenches may concentrate the liquid into a small area and also result in higher mounds on sloping sites.

For a 2 trench system:

Trench length = 125 ft. ÷ 2 ft. = 62.5 ft. (B)

Trench spacing is determined by the design loading rate of the natural soil. For a soil with percolation rate of 120 min/in., the design infiltration rate is 0.24 ft^2/day. All of the effluent from the upslope trench must be absorbed by the natural soil before it reaches the downslope trench through lateral movement. Assume one-half of effluent in each trench.

Trench spacing = 225 gal/day ÷ 0.24 gal/ft^2 ÷62.5 ft.
= 15 ft. (C) from center to center

Step 5. Mound Height

Fill depth (D) = 1 ft. (min. fill depth beneath absorption area)

Fill depth (E) = D + slope (C+A)
= 1 ft. + .06 (15+3) ft.
= 1 ft. + 1.1
= 2.1 ft. (this is approximate as trenches must be at same elevation)

Trench depth (F) = 0.75 ft. minimum depth with a min. of 0.5 ft. of aggregate below distribution system.

Cap and top soil depth (H) = 1.5 ft. which include 1 ft. of subsoil and 0.5 ft. of top soil.

Cap and top soil depth (G) = 1.0 ft. which include 0.5 ft. of subsoil and 0.5 ft. of top soil.

Step 6. Mound Length and Width

End Slopes (K) = mound depth at center x 3:1 slope.
= ((D+E)÷2+F+H) x 3
= 3.8 ft. x 3
= 11.4 ft.

Upslope Width (J) = mound depth at upslope edge x 3:1 slope x slope correction (Table 3)
= (D+F+G) x 3 x 0.85
= 2.8 ft. x 3 x 0.85
= 7 ft.

Downslope Width (I) = mound depth at downslope edge x 3:1 slope x slope correction (Table 3)
(E+F+G) x 3 x 1.22
= 3.9 ft. x 3 x 1.22
= 14 ft.

Mound Length (L) = B + 2 K
= 62.5 ft. + 2 x 11.4 ft.
= 85 ft.

Mound Width (W) = $J + A/2 + C + A/2 + I$
= 7 ft. + 1.5 ft. + 15 ft. + 1.5 ft. + 14.1 ft.
(C is center to center of trenches)
= 39 ft.

Step 7. Basal Area

On sloping sites the basal area is that area under and downslope of the trenches (B x (C+A+I). On level sites it is the total area under the mound (BxW) except for end areas. The design loading rate of the soil with percolation rate of 120 min/in. is 0.24 gal/ft^2/day.

Basal Area Required = daily flow ÷ infiltrative capacity of soil
= 450 gal/day ÷ 0.24 gal/ft^2/day
= 1875 ft^2

Basal Area Available = B x (C+A+I)
= 62.5 ft. x (15 ft. + 3 ft. + 14.ft.)
= 2006 ft^2

Sufficient area is available. If it were not, then the downslope width (I) would be increased until sufficient area is available.

Step 8. Distribution System

Fig. 11 and A. 7 shows typical examples of a distribution system. Design requires selection of hole spacing and diameter, lateral diameter and spacing, manifold length and diameter. Lateral length is defined as the distance from manifold (supply end) to far (distal) end. Tee to Tee construction is preferred. For systems larger than 5 bedroom residential, procedure outlined by Otis et al. (1978) must be used.

Hole spacing = 30 in.
Hole diameter = 1/4 in.

Lateral length -

Lateral lengths normally are about 0.5 feet shorter than one-half the length of trench. In this example, lateral length would be 30.5 ft. (62.5 ft. ÷ 2 -.5 ft.).

Hole Spacing -

Holes are spaced 30 in. apart.

The following are hole spacing distances in inches from the manifold to distal end of lateral. There are 13 holes per lateral.

15, 45, 75, 105, 135, 165, 195, 225, 255, 285, 315, 345, 366*

*If the last hole, based on 30 in. spacing, is equal to or greater than 15 in. from the end of the lateral, put another hole in the end cap of the pipe or close to it.

Lateral Diameter

Lateral diameters are dependent upon lateral length, hole size and spacing. Table 4 gives the maximum allowable length for various hole diameters and hole spacing. For the 30 in. spacing and 1/4 in. hole, allowable lateral lengths for 1 in. diameter is 25 ft. and for 1 1/4 in. diameter is 38 feet. Since lateral lengths required is 30.5 ft., the lateral diameter must be 1 1/4 in.

Lateral Spacing

For trench systems, lateral spacing is from center to center of trenches. For this example, it is 15 ft.

Manifold Length

Manifold length is distance between the outside laterals or summation of all lateral spacings. For this example, it would be 15 ft.

Manifold Diameter

For these mound systems, the manifold diameter is normally 2 or 3-in., depending on the size of the pipe from the pumping chamber to the mound and the inlet location. The inlet can be in the side of the manifold between the laterals (Fig. 11 or A.7), or it can be in the end of the manifold, preferably on the upslope edge. In either case, the manifold must slope toward the inlet so it will drain. For either inlet location, the manifold can be 2-in. diameter if the pipe is 2-in. diameter. If the pipe from the pump is 3-in. diameter, and the inlet is in the end, then the manifold must be 3-in. If the inlet is in the side, then the manifold can be 2-in. diameter. For larger systems, (greater than 5 bedroom size), friction losses in manifold must be considered.

Step 9. Pumping Chamber Size

Table 7 gives the recommended pumping chamber size which is 500-750 gal. capacity. The features shown in Fig. 12 should be incorporated into it.

Step 10. Pump Size

Assume the pumping chamber is located 75 ft. from the mound center and the elevation difference is 9 ft. from the pump to the lateral invert.

Pump Capacity

Using the recommended pressure of 2 ft. at the distal end of the lateral, Table 8 gives the pump capacity of 54 gpm for 1/4-in. diameter holes for a 3 bedroom sized mound. Fig. 13 can be used to determine flow rate for other pressures.

Pump Head

The total head consists of (1) elevation difference, (2) friction loss, and (3) desired pressure at end of laterals.

(1) elevation head = 9 ft.

(2) friction loss -

Friction loss is dependent upon flow rate and pipe diameter.

Table 9 gives the friction loss/100 ft. of pipe for various diameter pipes and flow rates. For flow rate of 54 gpm, the friction loss for:

(a) 2-in. diameter is 3.98 $ft/_{100\ ft.}$ x 75 ft. = 3.0 ft.

(b) 3-in. diameter is .67 $ft/_{100\ ft.}$ x 75 ft. = .5 ft.

Either pipe can be used. Ignore friction losses for fittings. Manifold friction loss can be estimated by adding its length to the pipe length when figuring friction loss.

(3) Pressure at distal end of lateral

Fig. 13 can be used to determine pressure at supply end of lateral. For a 2 ft. pressure at distal end for 1/4-in. diameter holes, the pressure at supply end is 2.5 ft.

Total Head = 9 ft. + 3 ft. + 2.5 ft. = 14.5 ft. for 2-in. diameter pipe.
= 9 ft. + .5 ft. + 2.5 ft. = 12 ft. for 3-in. diameter pipe.

Pump size

Select a pump which would pump at least 54 gpm at 14.5 ft. of head. This given head loss is based on using a 2 in. pipe. The pump opening will be smaller.

or

Select a pump which would pump at least 54 gpm at 12 ft. of head. This given head loss is based on using a 3 in. pipe. The pump opening will be smaller.

Step 11. Dosing Quantity

From Table 5, the net recommended dosing quantity is 115 gal/dose. The void volume of the laterals needs to be checked to see if the dosing quantity is 10 times the void volume. From Table 6, the void volume of 1-1/4 in. diameter pipe is .064 gal/ft. For 122 feet of lateral, the void volume is 7.7 gal which, when multiplied by 10, is less quantity given in Table 5. Therefore, the volume is 115 gal/dose. Adjustments need to be made for flow back so 115 gal is actually dosed. For a 5-ft. diameter pumping chamber, the net liquid level differential per dose cycle is 9.4 in.

Step 12. Select the controls which will give the flexibility necessary for the proper quantity per dose (Fig. 14).

TABLE A-1. DESIGN CRITERIA FOR A MOUND FOR A 1 BEDROOM HOME ON 0 TO 6% SLOPE WITH LOADING RATES UP TO 150 GAL/DAY FOR SLOWLY PERMEABLE SOIL Fig. A.1 and A.2.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	42	42	42	42
No. of Trenches	-	-	1	1	1	1
Mound Height	D	Ft	1	1	1	1
	F	Ft	0.75	0.75	0.75	0.75
	G	Ft	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5
Mound Width	J	Ft	11*	8	8	8
	I*	Ft	11	15	15	15
	W	Ft	25	26	26	26
Mound Length	K	Ft	10	10	10	10
	L	Ft	62	62	62	62
Lateral Length	P	Ft	20.	20.	20.	20.
Lateral Diameter	-	In	1	1	1	1
No. of Holes per Lateral**	-	-	9	9	9	9
Hole Spacing	-	In	30	30	30	30
Hole Diameter**	-	In	1/4	1/4	1/4	1/4

* Additional width to obtain required basal area

** Last hole is located at end of lateral which is 15" from other hole

TABLE A-2. DESIGN CRITERIA FOR A MOUND FOR A 2 BEDROOM HOME ON 0 TO 6% SLOPE WITH LOADING RATES TO 300 GAL/DAY FOR SLOWLY PERMEABLE SOIL
Fig. A.3 and A.4

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	42	42	42	42
No. of Trenches	-	-	2	2	2	2
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft	1	1	1	1
	E	Ft	1	1.4	1.7	2.1
	F	Ft	0.75	0.75	0.75	0.75
	G	Ft	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12	8	8	8
	I*	Ft	12	20	20	20
	W	Ft	42	46	46	46
Mound Length	K	Ft	10	10	10	10
	L	Ft	62	62	62	62
Lateral Length	P	Ft	20	20	20	20
Lateral Diameter	-	In	1	1	1	1
No. of Holes per Lateral**	-	-	9	9	9	9
Hole Spacing**	-	In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	15	15	15	15
Manifold Diameter***	-	In	2	2	2	2

* Additional Width to obtain required basal area

** Last hole is located at end of lateral which is 15" from other hole

*** Diameter dependent upon size of pipe from pump and inlet position

TABLE A-3. DESIGN CRITERIA FOR A MOUND FOR A 3 BEDROOM HOME ON A 0 TO 6% SLOPE WITH LOADING RATES OF 450 GAL/DAY FOR SLOWLY PERMEABLE SOILS. Fig. A.3 and A.4.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	63	63	63	63
No. of Trenches	-	-	2	2	2	2
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft	1	1	1	1
	E	Ft	1	1.4	1.7	2.1
	F	Ft	.75	.75	.75	.75
	G	Ft	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12*	8	8	8
	I*	Ft	12	20	20	20
	W	Ft	42	46	46	46
Mound Length	K	Ft	10	10	10	10
	L	Ft	83	83	83	83
Lateral Length	P	Ft	31	31	31	31
Lateral Diameter	-	In	1-1/4	1-1/4	1-1/4	1-1/4
No. of Hole per Lateral**	-	-	14	14	14	14
Hole Spacing**	-	In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	15	15	15	15
Manifold Diameter***	-	In	2	2	2	2

* Additonal width to obtain required basal area.

** Last hole is located 27" from previous one.

*** Diameter dependent upon size of pipe from pump and inlet position.

TABLE A-4. DESIGN CRITERIA FOR A MOUND FOR A 4 BEDROOM HOME ON A 0 TO 6% SLOPE WITH LOADING RATES OF 600 GAL/~~DAY~~ DAY FOR SLOWLY PERMEABLE SOILS. Fig. A.5 and A.6.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	56	56	56	56
No. of Trenches	-	-	3	3	3	3
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft	1	1	1	1
	E	Ft	1	1.7	2.3	3.0
	F	Ft	.75	.75	.75	.75
	G	Ft	1	1	1	1
	H	Ft	2	2	2	2
Mound Width	J	Ft	12*	8	8	8
	I*	Ft	12	20	20	20
	W	Ft	57	61	61	61
Mound Length	K	Ft	12	12	12	14
	L	Ft	80	80	80	84
Lateral Length	P	Ft	27.5	27.5	27.5	27.5
Lateral Diameter	-	In	1-1/4	1-1/4	1-1/4	1-1/4
No. of Holes per Lateral**	-	-	12	12	12	12
Hole Spacing**	-	In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	30	30	30	30
Manifold Diameter***	-	In	2	2	2	2

* Additional width to obtain required basal area

** Last hole is located at end of lateral which is 15" from previous hole.

*** Diameter dependent upon size of pipe from pump and inlet position.

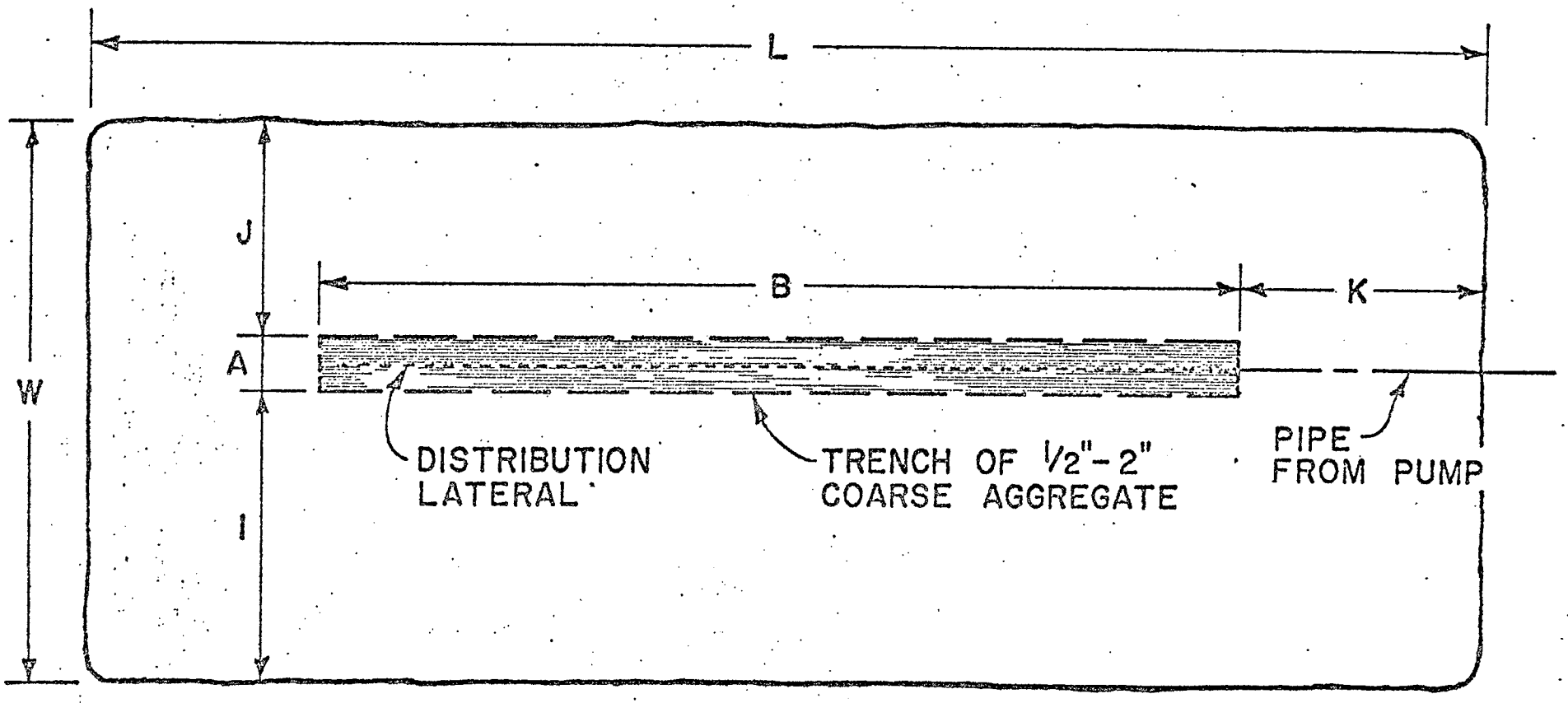


Fig. A.1 Plan view of a mound using 1 trench for absorption area.

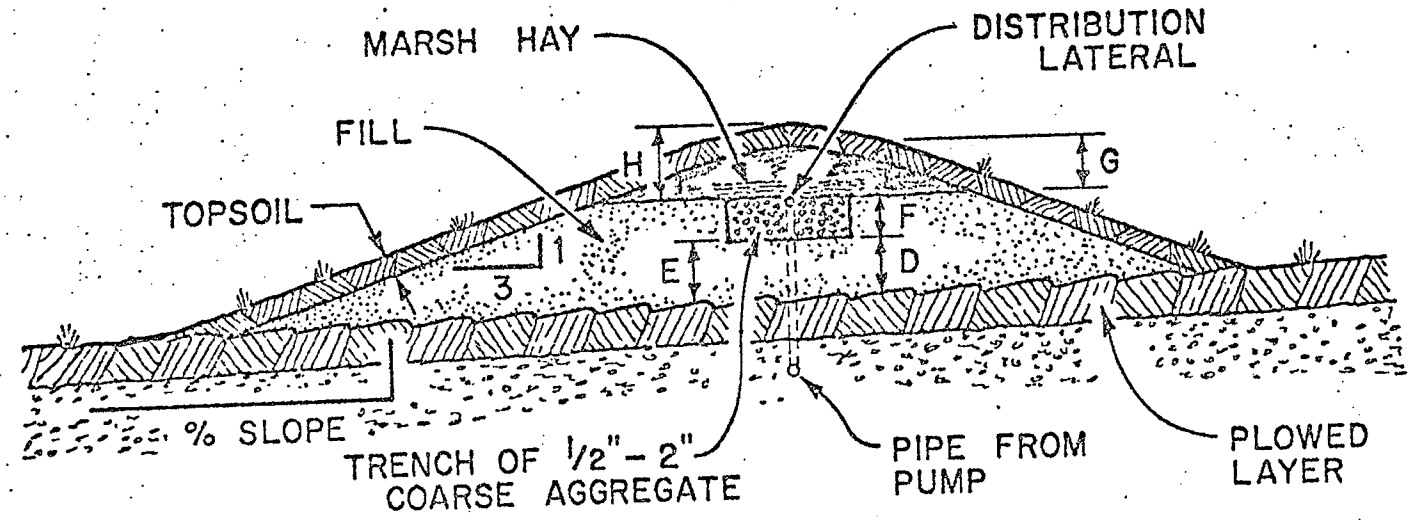


Fig. A.2 Cross section of a mound using 1 trench for absorption area.

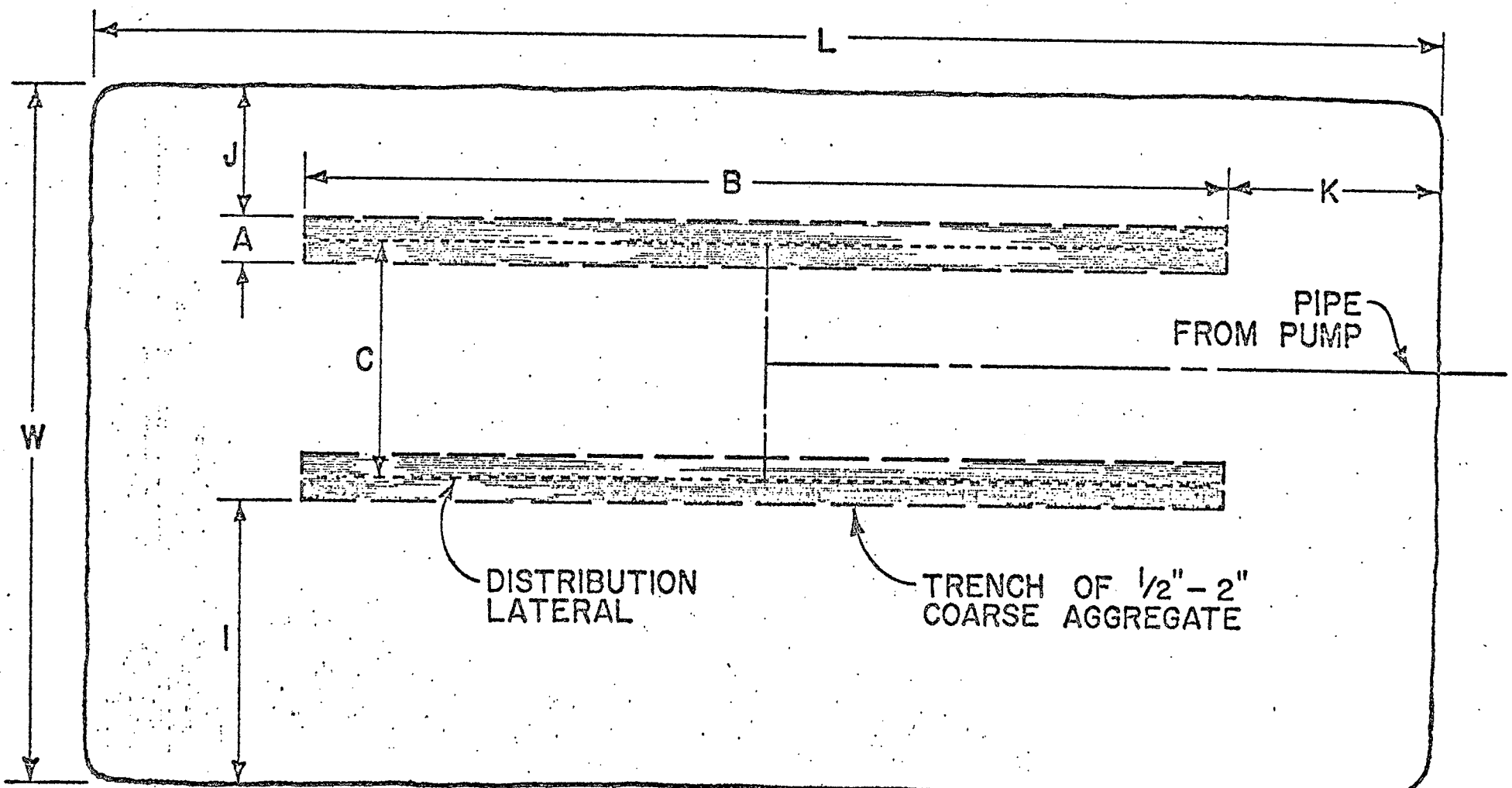


Fig. A. 3 Plan view of a mound system using 2 trenches for the absorption area.

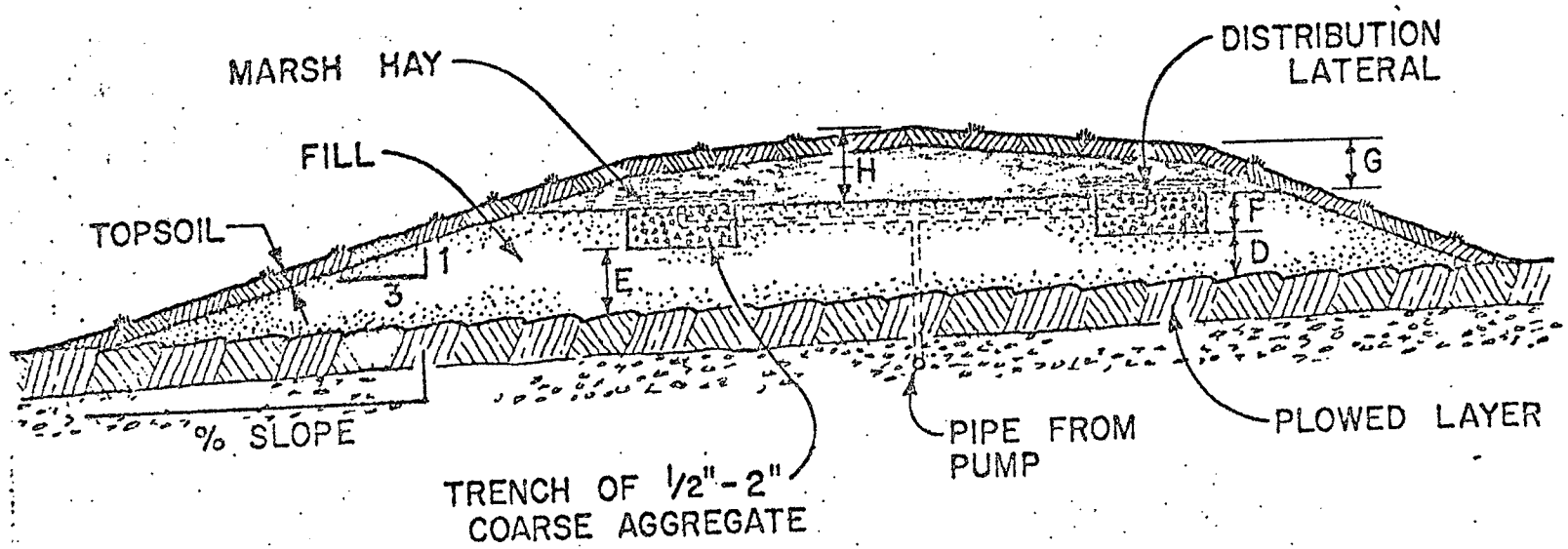


Fig. A. 4 Cross section of a mound system using 2 trenches for the absorption area.

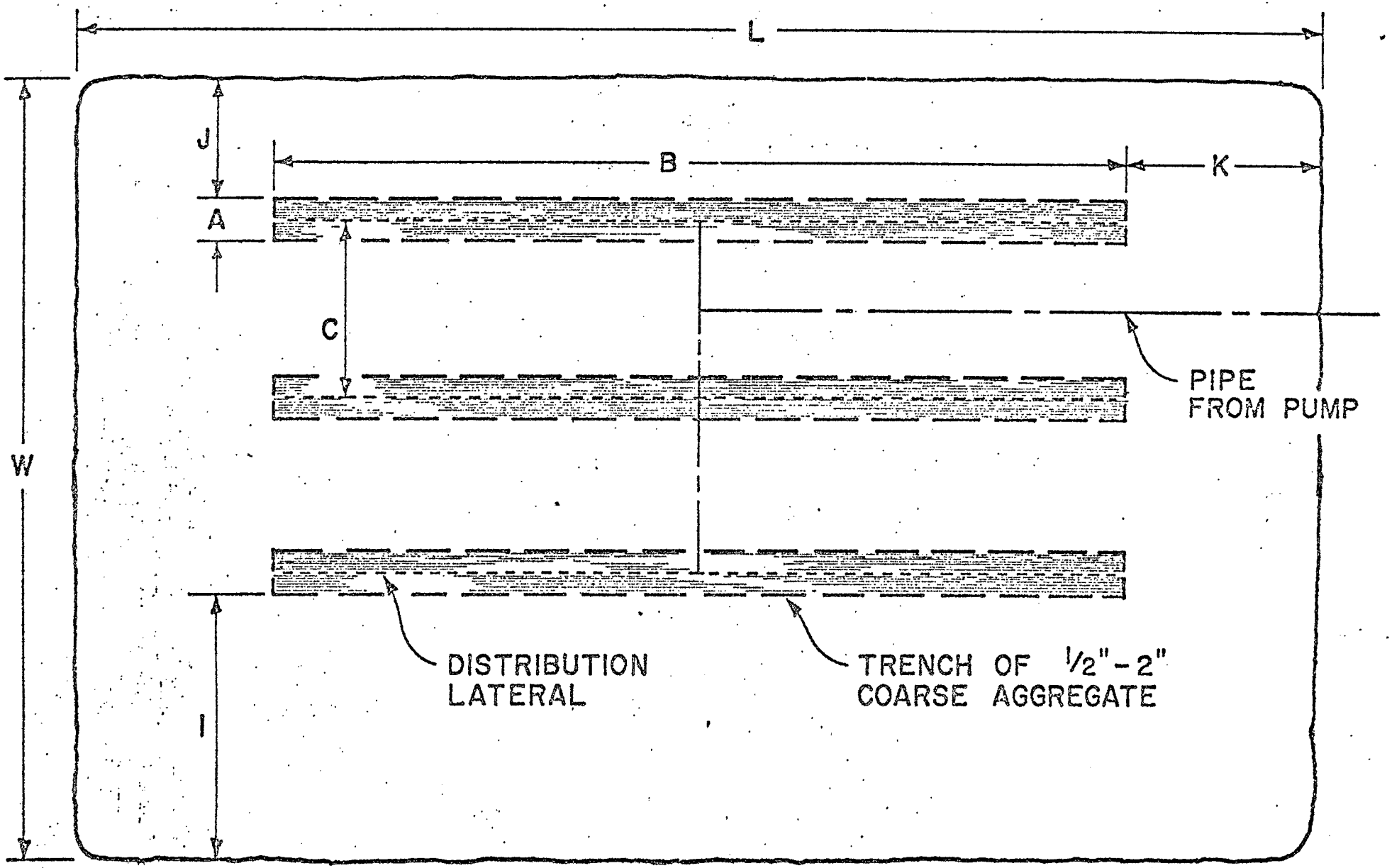


Fig. A. 5 Plan view of a mound system using 3 trenches for the absorption area.

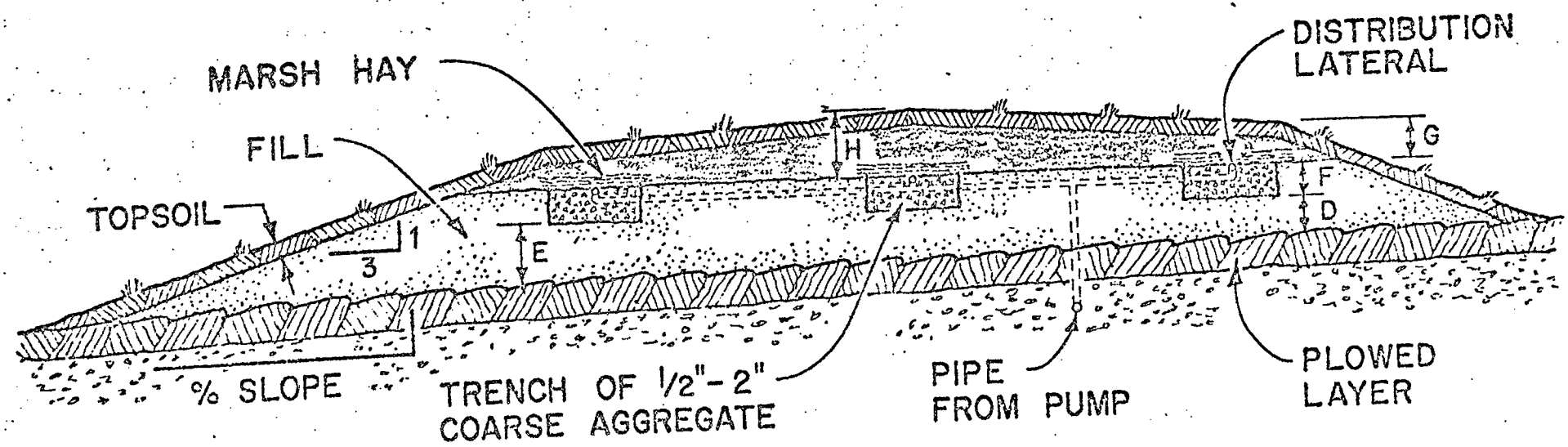


Fig. A. 6 Cross section view of a mound system using 3 trenches for the absorption area.

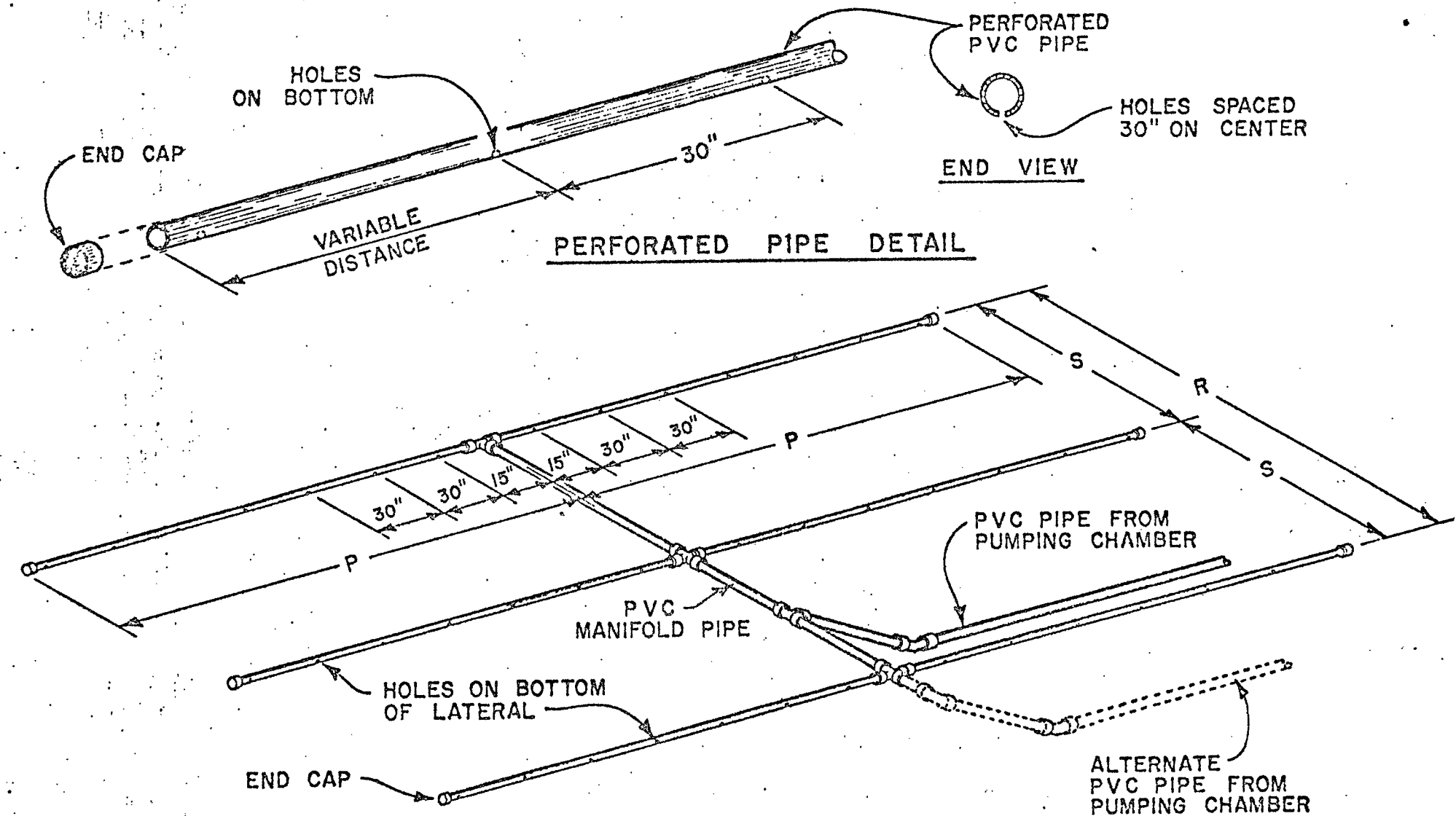


Fig. A. 7 The distribution system for a mound. One lateral is placed down the center of each trench as shown on plan views. Note alternate inlet positions. The variable distance between the last hole and the next to last hole will range between 15 and 30 in., depending upon the length of trench. Distribution system must be arranged so manifold and laterals drain after each dose.

C-2

DESIGN EXAMPLE AND PLANS

for

MOUND

on

SHALLOW PERMEABLE SOIL OVER CREVICED BEDROCK

DESIGN EXAMPLE
for
MOUND
on
PERMEABLE SHALLOW SOIL OVER CREVICED BEDROCK

An example is used to illustrate the design procedure. The method outlined in the text is followed step by step for a situation commonly found in practice. Example plans have also been prepared for most site conditions encountered and are included following the design example. These prepared plans may be used where similar site conditions exist. In cases where these plans cannot be adapted to the site, a mound may be designed as illustrated below.

Design a mound system for a 3 bedroom home with the following site conditions. Several small trees are on the site. Rock fragments, impermeable layer, and bedrock are not a factor. (Letter Notation on Fig. B.1, B.2 and B.3.

Slope	6%
Percolation Rate	50 min/in. at 12 in.
Creviced bedrock	24 in.

Step 1. Select the Site

The mound site should be selected prior to house location and road building. Consider all criteria listed in Table 1 and the discussion under the "Soil and Site Requirement" section for all possible locations on the lot. Consider the difficulties in construction of the mound at the various locations. Evaluate all criteria, weigh one site against the other, then pick the best site.

Step 2. Waste Water Load

Design loading is 150 gal/day/bedroom, so with 3 bedrooms the design loading is 450 gal/day.

Step 3. Select the Fill Material

Select a medium sand texture. Use Table 2 as a guide. Sometimes it is necessary to mak. a judgement on the quality of sand versus the transportation costs, but there are sands which are too coarse or too fine that are not acceptable. A medium sand texture will have a design infiltration rate of 1.2 gal/ft^2/day.

Step 4. Size the Absorption Area

Since the medium sand texture is being used, the infiltration rate is 1.2 gal/ft^{2}day.

Absorption area required = 450 gal/day 1.2 gal/ft^2/day = 375 ft^2

Since high ground water isn't a problem, the bed can be square or rectangular. On sloping sites with heavier soils where there is a possibility of some lateral movement before the effluent reaches the creviced bedrock, a rectangular shape mound may be desirable. This example will use a rectangular design.

Use a bed width of 12 ft. then:

bed length = 375 ft^2 ÷ 12 ft. = 32 ft.

Step 5. Mound Height

Fill depth (D) = 2 ft. (min. fill depth beneath absorption area.

Fill depth (E) = D + slope (A)
= 2 ft. + .06 (12) ft.
= 2 ft. + .7
= 2.7 ft. (this is approximate as bed must be at same elevation)

Bed depth (F) = 0.75 ft. minimum depth with a min. of 0.5 ft. of aggregate below distribution system.

Cap and top soil depth (H) = 1.5 ft. which include 1 ft. of subsoil and 0.5 ft. of top soil.

Cap and top soil depth (G) = 1.0 ft. which include 0.5 ft. of subsoil and 0.5 ft. of top soil.

Step 6. Mound Length and Width

End Slopes (K) = mound depth at center x 3:1 slope.
= (D+E÷2+F+H) x 3
= 4.6 ft. x 3
= 14 ft.

Upslope Width (J) = mound depth at upslope edge x 3:1 slope x slope correction (Table 3).
= (D+F+G) x 3 x 0.85
= 3.8 ft.
= 10 ft.

Downslope Width (I) = mound depth at downslope edge x 3:1 slope x slope correction (Table 3)
(E+F+G) x 3 x 1.22
= 4.45 ft. x 3 x 1.22
= 16 ft.

Mound Length (L) = B + 2 K
= 32 ft. +(2 x 14)ft.
= 60 ft.

Mound Width (W) = I + A + J
= 16 + 12 + 10
= 38 ft.

Step 7. Basal Area

On sloping sites the basal area is that area under and downslope of the trenches (B x (A+I). On level sites it is the total area under the mound (BxW) except for end areas. The design loading rate of the soil with percolation rate of 50 min/in. is 0.74 gal/ft^2/day.

Basal Area Required = daily flow ÷ infiltrative capacity of soil
= 450 gal/day ÷ 0.74 gal/ft^2/day
= 608 ft^2

Basal Area Available = B x (A+I)
= 32 ft. x(12 ft. + 16 ft.)
= 896 ft^2

Sufficient area is available. If it were not, then the downslope width (I) would be increased until sufficient area is available.

Step 8. Distribution System

Fig. 11 & B.3 shows typical examples of a distribution system. Design requires selection of hole spacing and diameter, lateral diameter and spacing, manifold length and diameter. Lateral length is defined as the distance from manifold (supply end) to far (distal) end. Tee to Tee construction is preferred. For systems larger than 5 bedroom residential, procedure outlined by Otis et al. (1978) must be used.

Hole spacing = 30 in.
Hole diameter = 1/4-in.

Lateral length -

Lateral lengths normally are about 0.5 feet shorter than one-half the length of trench. In this example lateral length would be 15.5 ft. (32 ft. ÷2 - .5 ft.)

Hole spacing -

Holes are spaced 30 in. apart.

The following are hole spacing distances in inches from the manifold to distal end of lateral. There are 7 holes per lateral.

15, 45, 75, 105, 135, 165, 186*

*If the last hole, based on 30 in. spacing, is equal to or greater than 15 in. from the end of the lateral, put another hole in the end cap of the pipe or close to it.

Lateral Diameter

Lateral diameters are dependent upon lateral length, hole size and spacing. Table 4 gives the maximum allowable length for various hold diameters and hold spacing. For the 30 in. spacing and 1/4 in. hole, allowable lateral lengths for 1 in. diameter is 25 ft. and for 1 1/4 in. is 38 ft. Since lateral lengths required is 15.5 ft. the lateral diameter can be 1 in.

Lateral Spacing

Bed is 12 ft. wide, using a maximum spacing of 3 ft. between laterals. Beds will require 4 parallel laterals on each side of manifold.

Manifold Length

Manifold length is distance between the outside laterals or summation of all lateral spacings. For this example, it would be 9 ft.

Manifold Diameter

For these mound systems, the manifold diameter is normally 2 or 3 in. depending on the size of the pipe from the pumping chamber to the mound and the inlet location. The inlet can be in the side of the manifold between the laterals, (Fig. 11 or B. 3) or it can be in the end of the manifold, preferably on the upslope edge. In either case, the manifold must slope toward the inlet so it will drain. For either inlet location, the manifold can be 2 in. diameter if the pipe is 2 in. diameter. If the pipe from the pump is 3 in. diameter, and the inlet is in the end, then the manifold must be 3 in. If the inlet is in the side, then the manifold can be 2 in. diameter. For larger systems (greater than 5 bedroom size), friction losses in manifold must be considered.

Step 9. Pumping Chamber Size

Table 7 gives the recommended pumping chamber size which is 500-750 gal. capacity. The features shown in Fig. 12 should be incorporated into it.

Step 10. Pump Size

Assume the pumping chamber is located 75 ft. from the mound center and the elevation difference is 9 ft. from the pump to the lateral invert.

Pump Capacity

Using the recommended pressure of 2 ft. at the distal end of the lateral, Table 8 gives the pump capacity of 54 gpm for 1/4 in. diameter holes for a 3 bedroom sized mound. Fig. 13 can be used to determine flow rate for other pressures.

Pump Head

The total head consists of (1) elevation difference, (2) friction loss, and (3) desired pressure at end of laterals.

(1) elevation head = 9 ft.

(2) friction loss -

Friction loss is dependent upon flow rate and pipe diameter.

Table 9 gives the friction loss/100 ft. of pipe for various diameter pipes and flow rates. For flow rate of 54 gpm the friction loss is:

(a) 2 in. dia. is 3.98 ft/$_{100\ ft.}$ x 75 ft. = 3.0 ft.

(b) 3 in. dia. is .67 ft/ $_{100\ ft.}$ x 75 ft. = .5 ft.

Either pipe can be used. Ignore friction losses for fittings. Manifold friction loss can be estimated by adding its length to the pipe length when figuring friction loss.

(3) Pressure at distal end of lateral

Fig. 13 can be used to determine pressure at supply end of lateral. For a 2 ft. pressure at distal end for 1/4 in. diameter holes, the pressure at supply end is 2.5 ft.

Total Head = 9 ft. + 3 ft. + 2.5 ft. = 14.5 ft. for 2 in. dia. pipe.
= 9 ft. + .5 ft. + 2.5 ft. = 12 ft. for 3 in. dia. pipe.

Pump Size

Select a pump which would pump at least 54 gpm at 14.5 ft. of head. This given head loss is based on using a 2 in. pipe. The pump opening will be smaller.

or

Select a pump which would pump at least 54 gpm at 12 ft. of head. This given head loss is based on using a 3 in. pipe. The pump opening will be smaller.

Step 11. Dosing Quantity

From Table 5 the net recommended dosing quantity is 115 gal/dose. The void volume of the laterals needs to be checked to see if the dosing quantity is 10 times the void volume. From Table 6 the void volume of 1 1/4" diameter pipe is .041 gal/ft. For 124 feet of lateral, the void volume is 5.1 gal which,when multiplied by 10, is less quantity given in Table 5. Therefore, the volume is 115 gal/dose.
Adjustments need to be made for flow back so 115 gal is actually dosed. For a 5-ft. dia. pumping chamber, the net liquid level differential per dose cycle is 9.4 in.

Step 12. Select the controls which will give the flexibility necessary for the proper quantity per dose (Fig. 14).

TABLE B-7. DESIGN CRITERIA FOR A 1 BEDROOM HOME FOR A MOUND ON 0 TO 12% SLOPE WITH LOADING RATES UP TO 150 GAL/DAY FOR SHALLOW PERMEABLE SOIL OVER CREVICED BEDROCK. B.1, 2, 3 and 4.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	-	%	0	2	4	6	8	10[3]	12[3]
Bed Width	A[5]	Ft	10	10	10	10	10	10	10
Bed Length	B	Ft	13	13	13	13	13	13	13
Mound Height	D	Ft	2	2	2	2	2	2	2
	E	Ft	2	2.2	2.4	2.6	2.8	3.0	3.2
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12	11	10	10	9	9	9
	I	Ft	12	13	14	17	18	21	26
	W	Ft	34	34	34	37	37	41	45
Mound Length	K	Ft	12	12	12	13	13	13	15
	L	Ft	37	37	37	39	39	39	43
Lateral Length	P[4]	Ft	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Holes per Lateral	-	-	6	6	6	6	6	6	6
Lateral Spacing	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral[1]	-	Ft	6	6	6	6	6	6	6
Hole Spacing[1]	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	6	6	6	6	6	6	6
Manifold Diameter[2]	-	In	2	2	2	2	2	2	2

1 Last hole is located at end of lateral which is 15" from previous hole

2 Diameter dependent upon size of pipe from pump and inlet position.

3 On steep sloping sites of 10-12% it may be desirable to reduce depth D to 1.5 ft so E isn't so great or reduce the width of bed.

4 Use a manifold with laterals only on one side.

5 Beds can be any desired width.

TABLE B-2. DESIGN CRITERIA FOR A 2 BEDROOM HOME FOR A MOUND ON 0 TO 12% SLOPE WITH LOADING RATES UP TO 300 GAL/DAY FOR SHALLOW PERMEABLE SOIL OVER CREVICED BEDROCK.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	-	%	0	2	4	6	8	10[3]	12[3]
Bed Width	A[5]	Ft	10	10	10	10	10	10	10
Bed Length	B	Ft	25	25	25	25	25	25	25
Mound Height	D	Ft	2	2	2	2	2	2	2
	E	Ft	2	2.2	2.4	2.6	2.8	3.0	3.2
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12	11	10	10	9	9	9
	I	Ft	12	13	14	17	18	21	26
	W	Ft	34	34	34	37	37	41	45
Mound Length	K	Ft	12	12	12	13	13	13	15
	L	Ft	49	49	49	51	51	51	55
Lateral Length	P[4]	Ft	12	12	12	12	12	12	12
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	6	6	6	6	6	6	6
Lateral Spacing	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral[1]	-	-	5	5	5	5	5	5	5
Hole Spacing[1]	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	6	6	6	6	6	6	6
Manifold Diameter[2]	-	In	2	2	2	2	2	2	2

1 End of lateral is 9" from last hole; since it isn't equal to or greater than 15 no hole is placed at end of lateral.

2 Diameter dependent upon size of pipe from pump and inlet position.

3 On steep sloping sites of 10-12% it may be desirable to reduce depth D to 1.5 ft so E isn't so great or reduce the width of bed.

4 This design is based on a manifold with laterals on both sides. It could be designed using 24 ft laterals with manifold at end.

5 Bed can be any desired width.

TABLE B-3. DESIGN CRITERIA FOR A 3 BEDROOM HOME FOR A MOUND ON 0 TO 12% SLOPE WITH LOADING RATES UP TO 450 GAL/DAY FOR SHALLOW PERMEABLE SOIL OVER CREVICED BEDROCK.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	-	%	0	2	4	6	8	10[3]	12[3]
Bed Width	A[5]	Ft	10	10	10	10	10	10	10
Bed Length	B	Ft	38	38	38	38	38	38	38
Mound Height	D	Ft	2	2	2	2	2	2	2
	E	Ft	2	2.2	2.4	2.6	2.8	3.0	3.2
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12	11	10	10	9	9	9
	I	Ft	12	13	14	17	18	21	26
	W	Ft	34	34	34	37	37	41	45
Mound Length	K	Ft	12	12	12	13	13	13	15
	L	Ft	62	62	62	64	64	64	68
Lateral Length	P	Ft	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	6	6	6	6	6	6	6
Lateral Spacing	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral[1]	-	-	8	8	8	8	8	8	8
Hole Spacing[1]	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	6	6	6	6	6	6	6
Manifold Diameter[2]	-	In	2	2	2	2	2	2	2

1 Last hole is located at end of lateral which is 27" from previous hole.

2 Diameter dependent upon size of pipe from pump and inlet position.

3 On steep sloping sites of 10-12% it may be desirable to reduce depth D to 1.5 ft so E isn't so great or reduce the width of bed.

4 Use a manifold with lateral only on one side.

5 Beds can be any desired width.

TABLE B-4. DESIGN CRITERIA FOR A 4 BEDROOM HOME FOR A MOUND ON 0 TO 12% SLOPE WITH LOADING RATES UP TO 600 GAL/DAY FOR SHALLOW PERMEABLE SOIL OVER CREVICED BEDROCK.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	–	%	0	2	4	6	8	10[3]	12[3]
Bed Width	A[5]	Ft	10	10	10	10	10	10	10
Bed Length	B	Ft	50	50	50	50	50	50	50
Mound Height	D	Ft	2	2	2	2	2	2	2
	E	Ft	2	2.2	2.4	2.6	2.8	3.0	3.2
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12	11	10	10	9	9	9
	I	Ft	12	13	14	17	18	21	26
	W	Ft	34	34	34	37	37	41	45
Mound Length	K	Ft	12	12	12	13	13	13	15
	L	Ft	74	74	74	76	76	76	78
Lateral Length	P[2]	Ft	24.5	24.5	24.5	24.5	24.5	24.5	24.5
Lateral Diameter	–	In	1	1	1	1	1	1	1
No. of Laterals	–	–	6	6	6	6	6	6	6
Lateral Spacing	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral[1]	–	–	10	10	10	10	10	10	10
Hole Spacing[1]	–	In	30	30	30	30	30	30	30
Hole Diameter	–	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	6	6	6	6	6	6	6
Manifold Diameter[2]	–	In	2	2	2	2	2	2	2

1 End of lateral is 9" from last hole; since it isn't equal to or greater than 15, no hole is placed at end of lateral.

2 Diameter dependent upon size of pipe from pump and inlet position.

3 On steep sloping sites of 10-12% it may be desirable to reduce depth D to 1.5 ft so E isn't so great or reduce the width of bed.

4 Use a manifold with lateral only on one side.

5 Beds can be any desired width

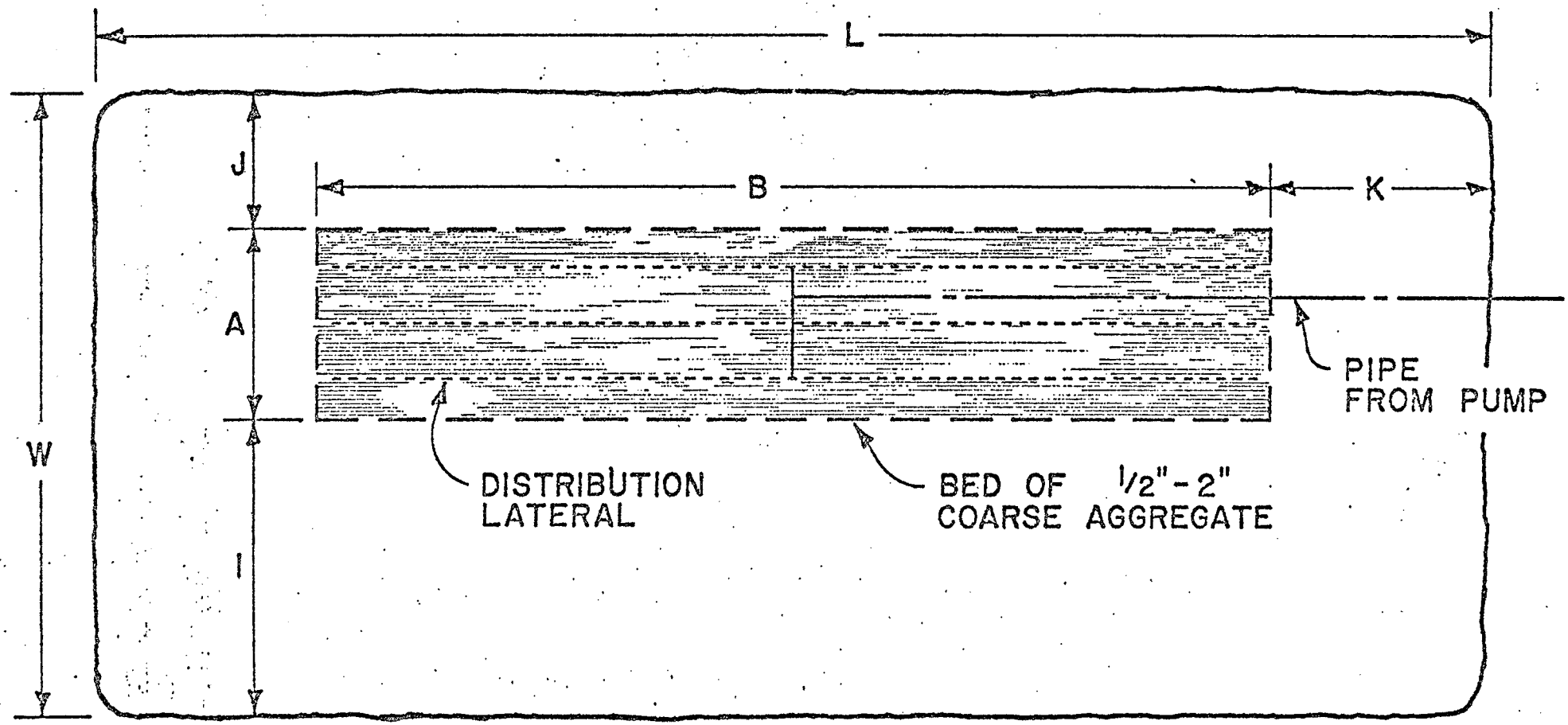


Fig. B. 1 Plan view of a mound using a bed for the absorption area. For the creviced bedrock site, the bed slope can be rectangular or square.

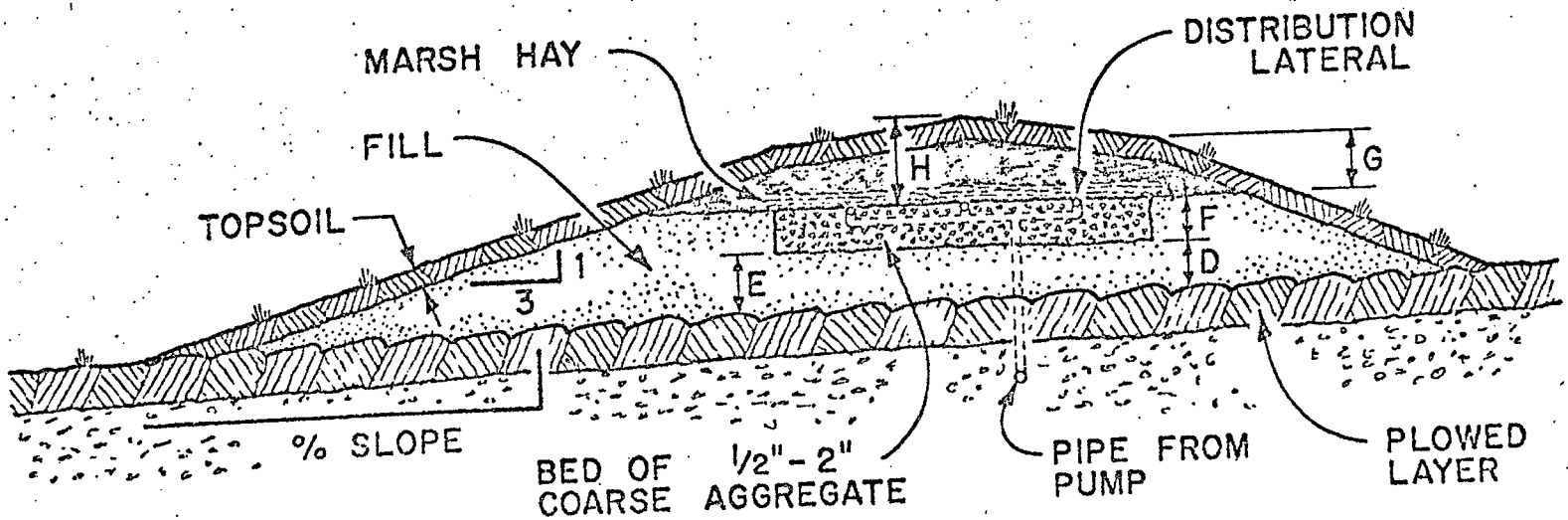


Fig. B. 2 Cross section of a mound using a bed as the absorption area.

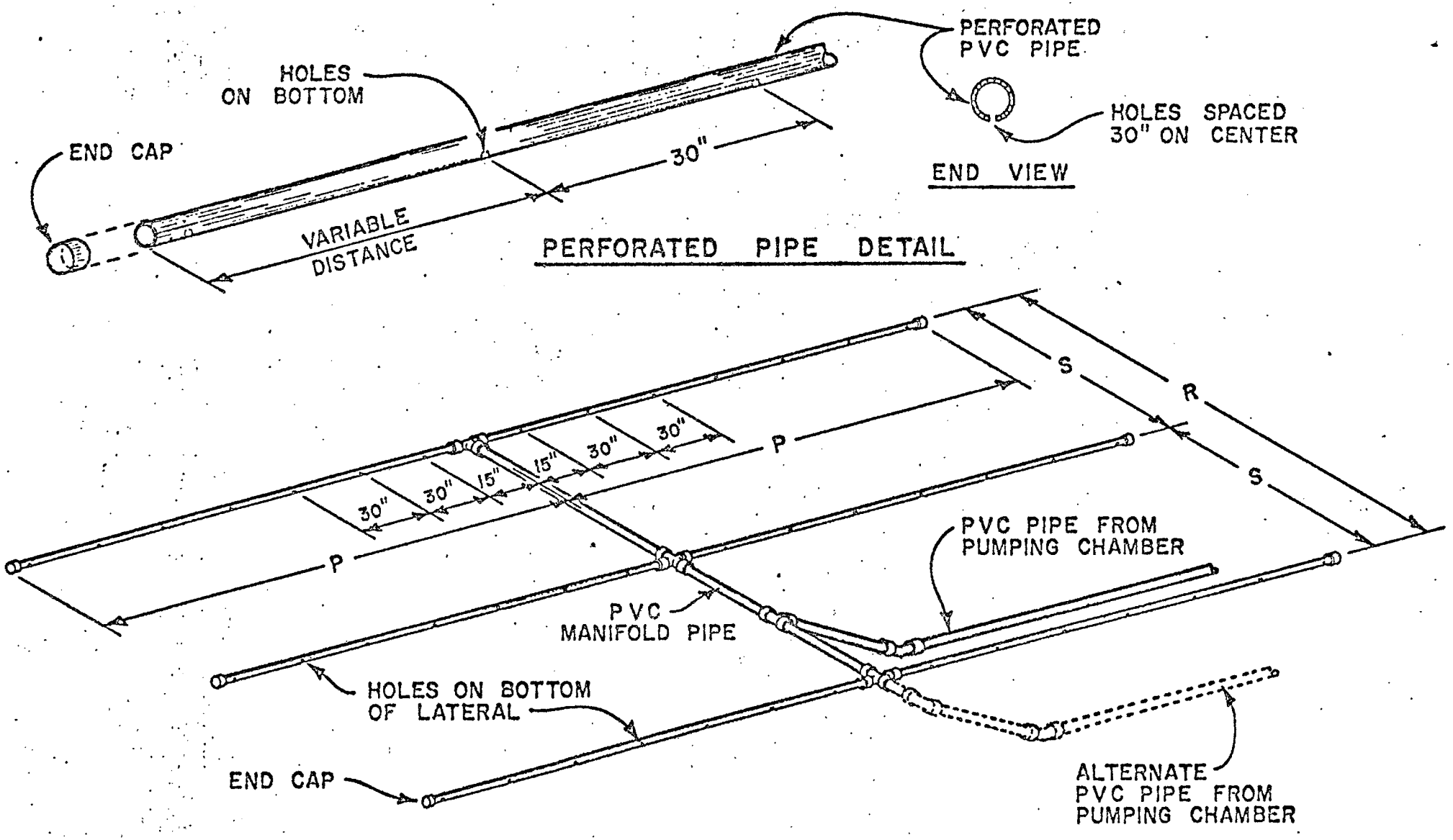


Fig. B. 3 The distribution system for a mound. One lateral is placed down the center of each trench as shown on plan views. Note alternate inlet positions. The variable distance between the last hole and the next to last hole will range between 15 and 30 in., depending upon the length of trench. Distribution system must be arranged so manifold and laterals drain after each dose.

C-3

DESIGN EXAMPLE AND PLANS

for

MOUND

on

PERMEABLE SOIL WITH HIGH WATER TABLE

DESIGN EXAMPLE
for
MOUND
on
PERMEABLE SOIL WITH HIGH WATER TABLE

An example is used to illustrate the design procedure. The method outlined in the text is followed step by step for a situation commonly found in practice. Example plans have also been prepared for most site conditions encountered and are included following the design example. These prepared plans may be used where similar site conditions exist. In cases where these plans cannot be adapted to the site, a mound may be designed as illustrated below.

Design a mound system for a 3 bedroom home with the following site conditions. Several small trees are on the site. Rock fragments, impermeable layer and bedrock are not a factor. (Letter Notation on Fig. C.1 and C.3 are used as references in this example).

Slope	6%
Percolation Rate	50 min/in. at 24 in.
Ground Water	24 in.

Step 1. Select the Site

The mound site should be selected prior to house location and road building. Consider all criteria listed in Table 1 and the discussion under the "Soil and Site Requirement" section for all possible locations on the lot. Consider the difficulties in construction of the mound at the various locations. Evaluate all criteria, weigh one site against the other, then pick the best site.

Step 2. Waste Water Load

Design loading is 150 gal/day/bedroom, so with 3 bedrooms the design loading is 450 gal/day.

Step 3. Select the Fill Material

Select a medium sand texture. Use Table 2 as a guide. Sometimes it is necessary to make a judgement on the quality of sand versus the transportation costs, but there are sands which are too coarse or too fine that are not acceptable. A medium sand texture will have a design infiltration rate of 1.2 gal/ft^2/day.

Step 4. Size the Absorption Area

Since the medium sand texture is being used, the infiltration rate is 1.2 gal/ft^2/day.

Absorption area required = 450 gal/day÷1.2 gal/ft^2/day = 375 ft^2.

Since this is a permeable soil with high ground water, a bed system can be used. Maximum bed widths are 10 ft. Since the soil percolation rate is 50 min/in. (indicating heavier soil) and situated on a slope, it is desirable to make the bed longer and narrower. This will spread the liquid along the slope. Some lateral movement of liquid will occur, since it is a heavier soil. By making it longer and narrower, it will reduce the possibility of seepage out the toe.

Use a bed width of 8 ft. (A) then:

bed length (B) = 375 ft^2 ÷ 8 ft. = 47 ft.

Step 5. Mound Height

Fill depth (D) = 1 ft. (min. fill depth beneath absorption area)

Fill depth (E) = D + slope (C+A)
= 1 ft. + .06 (8) ft.
= 1 ft. + .5
= 1.5 ft. (this is approximate as bed must be at same elevation)

Bed depth (F) = 0.75 ft. minimum depth with a minimum of 0.5 ft. of aggregate below distribution system.

Cap and top soil depth (H) = 1.5 ft. which include 1 ft. of subsoil and 0.5 ft. of top soil

Cap and top soil depth (G) = 1.0 ft. which include 0.5 ft. of subsoil and 0.5 ft. of top soil.

Step 6. Mound Length and Width

End Slopes (K) = mound depth at center x 3:1 slope.
= ((D+E)÷2+F+H)x3
= 3.5 ft. x 3
= 10 ft.

Upslope Width (J) = mound depth at upslope edge x 3:1 slope x slope correction (Table 3).
= (D+F+G) x 3 x 0.85
= 2.8 ft. x 3 x 0.85
= 8 ft.

Downslope Width (I) = mound depth at downslope edge x 3:1 slope x slope correction (Table 3).
(E+F+G) x 3 x 1.22
= 3.3 ft. x 3 x 1.22
= 13 ft.

Mound Length (L) = B + 2 K
= 47 ft. + 2 x 10 ft.
= 67 ft.

Mound Width (W) = I + A + K
= 13 + 8 + 8
= 29 ft.

Step 7. Basal Area

On sloping sites the basal area is that area under and downslope of the bed (B x (A+I). On level sites it is the total area under the mound (BxW) except for end areas. The design loading rate of the soil with percolation rate of 50 min/in. is 0.74 gal/ft^2/day.

Basal Area Required = daily flow ÷ infiltrative capacity of soil
= 450 gal/day ÷ 0.74 gal/ft^{2}day
= 608 ft^2

Basal Area Available = B x (A+I)
= 47 ft. x (8 + 13)ft.
= 987 ft^2

Sufficient area is available. If it were not, then the downslope width (I) would be increased until sufficient area is available.

Step 8. Distribution System

Fig. 11 and C. 3 shows typical examples of a distribution system. Design requires selection of hole spacing and diameter, lateral diameter and spacing, manifold length and diameter. Lateral length is defined as the distance from manifold (supply end) to far (distal) end. Tee to Tee construction is preferred. For systems larger than 5 bedroom residential, procedure outlined by Otis et al. (1978) must be used.

Hole spacing = 30 in.
Hole diameter = 1/4-in.

Lateral length -

Lateral lengths normally are about 0.5 feet shorter than one-half the length of bed. In this example, lateral length would be 23 ft. (47 ÷ 2 - .5)

Hole spacing -

Holes are spaced 30 in. apart.

The following are hole spacing distances in inches from the manifold to distal end of lateral. There are 10 holes per lateral.

15, 45, 75, 105, 135, 165, 195, 225, 255, 276*

*If the last hole, based on 30 in. spacing, is equal to or greater than 15 in. from the end of the lateral, put another hole in the end cap or close to it.

Lateral Diameter

Lateral diameters are dependent upon lateral length, hole size and spacing. Table 4 gives maximum allowable length for various hole diameters and hole spacings. For the 30 in. spacing and 1/4 in. hole, allowable lateral lengths for 1 in. diameter is 25 ft. and for 1 1/4 in. diameter is 38 ft. Since lateral length required is 23 ft., lateral diameter of 1 in. is satisfactory.

Lateral Spacing

Bed width is 8 ft. For 3 laterals on each side of manifold, the lateral spacing is 32 in. This gives 16 in. from lateral to edge of bed.

Manifold Length

Manifold length is distance between the outside laterals or summation of all lateral spacings. For this example, it would be 64 in.

Manifold Diameter

For these mound systems, the manifold diameter is normally 2 or 3-in., depending on the size of the pipe from the pumping chamber to the mound and the inlet location. The inlet can be in the side of the manifold between the laterals, (Fig. 11 or C.3), or it can be in the end of the manifold, preferably on the upslope edge. In either case, the manifold must slope toward the inlet so it will drain. For either inlet location the manifold can be 2-in. diameter if the pipe is 2-in. diameter. If the pipe from the pump is 3-in. diameter, and the inlet is in the end, then the manifold must be 3-in. If the inlet is in the side, then the manifold can be 2-in. diameter. For larger systems (greater than 5 bedroom), friction losses in manifold must be considered.

Step 9. Pumping Chamber Size

Table 7 gives the recommended pumping chamber size which is 750 gal. capacity. The features shown in Fig.12 should be incorporated into it.

Step 10. Pump Size

Assume the pumping chamber is located 75 ft. from the mound center and the elevation difference is 9 ft. from the pump to the lateral invert.

Pump Capacity

Using the recommended pressure of 2 ft. at the distal end of the lateral, Table 8 gives the pump capacity of 54 gpm for 1/4-in. diameter holes for a 3 bedroom sized mound. Fig.13 can be used to determine flow rate for other pressures.

Pump Head

The total head consists of (1) elevation difference, (2) friction loss, and (3) desired pressure at end of laterals.

(1) elevation head = 9 ft.

(2) friction loss -

Friction loss is dependent upon flow rate and pipe diameter.

Table 9 gives the friction loss/100 ft. of pipe for various diameter pipes and flow rates. For flow rate of 54 gpm, the friction loss for:

(a) 2-in. diameter is 3.98 ft/100 ft. x 75 ft. = 3.0 ft.

(b) 3-in. diameter is .67 ft/100 ft. x 75 ft. = .5 ft.

Either pipe can be used. Ignore friction losses for fittings. Manifold friction loss can be estimated by adding its length to the pipe length when figuring friction loss.

(3) Pressure at distal end of lateral

Fig. 13 can be used to determine pressure at supply end of lateral. For a 2 ft. pressure at distal end for 1/4-in. diameter holes, the pressure at supply end is 2.5 ft.

Total Head = 9 ft. + 3 ft. + 2.5 ft. = 14.5 ft. for 2 in. diameter pipe.
= 9 ft. + .5 ft. + 2.5 ft. = 12 ft. for 3-in. diameter pipe.

Pump size

Select a pump which would pump at least 54 gpm at 14.5 ft. of head. This given head loss is based on using 2 in. pipe. The pump opening will be smaller

or

Select a pump which would pump at least 54 gpm at 12 ft. of head. This given head loss is based on using a 3 in. pipe. The pump opening will be smaller.

Step 11. Dosing Quantity

From Table 5 the net recommended dosing quantity is 115 gal/dose. The void volume of the laterals needs to be checked to see if the dosing quantity is 10 times the void volume. From Table 6 the void volume of 1 in. diameter pipe is .041 gal/ft. For 138 feet of lateral, the void volume is 5.6 gal. which, when multiplied by 10, is less quantity given in Table 5. Therefore, the volume is 115 gal/dose. Adjustments need to be made for flow-back, so 115 gal. is actually dosed. For a 5-ft. diameter pumping chamber, the net liquid level differential per dose cycle is 9.4 in.

Step 12. Select the controls which will give the flexibility necessary for the proper quantity per dose (Fig. 14).

TABLE C-1. DESIGN CRITERIA FOR A MOUND FOR A 1 BEDROOM HOME ON 0-12% SLOPE FOR LOADING RATES OF 150 GAL/DAY FOR PERMEABLE SOIL WITH HIGH WATER TABLE. FIG. C.1 and C.2.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	-	%	0	2	4	6	8	10	12
Bed Width	A	Ft	4	4	4	4	4	4	4
Bed Length	B	Ft	32	32	32	32	32	32	32
Mound Height	D	Ft	1	1	1	1	1	1	1
	E	Ft	1	1.1	1.2	1.2	1.3	1.4	1.5
	F	Ft.	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	9	9	8	8	7	7	6
	I	Ft	9	10	11	12	13	14	15
	W	Ft	22	23	23	24	24	25	25
Mound Length	K	Ft	10	10	10	10	10	11	11
	L	Ft	52	52	52	52	52	53	53
Lateral Length	P	Ft	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	2	2	2	2	2	2	2
No. of Holes per Lateral*	-	-	7	7	7	7	7	7	7
Hole Spacing*	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4

* Last hole is located at end of lateral which is 21" from previous hole.

TABLE C-2. DESIGN CRITERIA FOR A MOUND FOR A 2 BEDROOM HOME ON 0-12% SLOPE FOR LOADING RATES OF 300 GAL/DAY FOR PERMEABLE SOIL WITH HIGH WATER TABLE. FIG. C.1 and C.2.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE MIN/IN						
			3-60				3-29		
Slope	-	%	0	2	4	6	8	10	12
Bed Width	A	Ft	6	6	6	6	6	6	6
Bed Length	B	Ft	42	42	42	42	42	42	42
Mound Height	D	Ft	1	1	1	1	1	1	1
	E	Ft	1	1.1	1.2	1.4	1.5	1.6	1.8
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	9	9	8	8	7	7	6
	I	Ft	9	10	11	12	13	15	17
	W	Ft	60	61	61	62	62	64	65
Mound Length	K	Ft	10	10	10	10	10	11	11
	L	Ft	62	62	62	62	62	64	64
Lateral Length	P	Ft	20	20	20	20	20	20	20
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	4	4	4	4	4	4	4
Lateral Spacings	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral*	-	-	8	8	8	8	8	8	8
Hole Spacing*	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	3	3	3	3	3	3	3
Manifold Diameter**	-	In	2	2	2	2	2	2	2

* Last hole is located at end of lateral which is 15" from previous hole.

** Diameter dependent upon size of pipe from pump and inlet position.

TABLE C-3. DESIGN CRITERIA FOR A MOUND FOR A 3 BEDROOM HOME ON 0-12% SLOPE FOR LOADING RATE OF 450 GAL/DAY FOR PERMEABLE SOIL WITH HIGH WATER TABLE. FIG. C. 1 and C.2.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE						
			0-60				3-29		
Slope			0	2	4	6	8	10	12
Bed Width	A	Ft	8	8	8	8	8	8	8
Bed Length	B	Ft	47	47	47	47	47	47	47
Mound Height	D	Ft	1	1	1	1	1	1	1
	E	Ft	1	1.2	1.3	1.5	1.6	1.8	2.0
	F	Ft	.75	.75	.75	.75	.75	.75	.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	9	9	8	8	7	7	6
	I	Ft	9	11	12	13	15	17	18
	W	Ft	26	28	28	29	30	32	32
Mound Length	K	Ft	10	10	10	10	11	11	12
	L	Ft	67	67	67	67	69	69	71
Lateral Length	P	Ft	23	23	23	23	23	23	23
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	6	6	6	6	6	6	6
Lateral Spacing	S	In	32	32	32	32	32	32	32
No. of Holes per Lateral*	-	-	10	10	10	10	10	10	10
Hole Spacing *	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	In	64	64	64	64	64	64	64
Manifold Diameter**	-	In	2	2	2	2	2	2	2

* Last hole is located at end of lateral which is 21" from previous hole.

** Diameter dependent upon size of pipe from pump to inlet position.

TABLE C-4. DESIGN CRITERIA FOR A MOUND FOR A 4 BEDROOM HOME ON 0-12% SLOPE FOR LOADING RATE OF 600 CAL/DAY FOR PERMEABLE SOIL WITH HIGH WATER TABLE. FIG. C. 1 and C.2.

PARAMETER	SYMBOL	UNITS	PERCOLATION RATE						
			0-60				3-29		
Slope	-	%	0	2	4	6	8	10	12
Bed Width	A	Ft	10	10	10	10	10	10	10
Bed Length	B	Ft	50	50	50	50	50	50	50
Mound Height	D	Ft	1	1	1	1	1	1	1
	E	Ft	1	1.2	1.4	1.6	1.8	2	2.2
	F	Ft	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	G	Ft	1	1	1	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Mound Width	J	Ft	9	8	8	8	7	7	6
	I	Ft	9	11	13	14	17	18	19
	W	Ft	28	29	31	32	34	35	35
Mound Length	K	Ft	10	10	10	10	11	11	12
	L	Ft	70	70	70	70	72	72	74
Lateral Length	P	Ft	24.5	24.5	24.5	24.5	24.5	24.5	24.5
Lateral Diameter	-	In	1	1	1	1	1	1	1
No. of Laterals	-	-	6	6	6	6	6	6	6
Lateral Spacing	S	Ft	3	3	3	3	3	3	3
No. of Holes per Lateral*	-	-	10	10	10	10	10	10	10
Hole Spacing	-	In	30	30	30	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	6	6	6	6	6	6	6
Manifold Diameter*	-	In	2	2	2	2	2	2	2

* End of lateral is 9 in. from last hole, since it isn't equal to or greater than 15, no hole is placed at end of lateral.

** Diameter dependent upon size of pipe from pump and inlet position

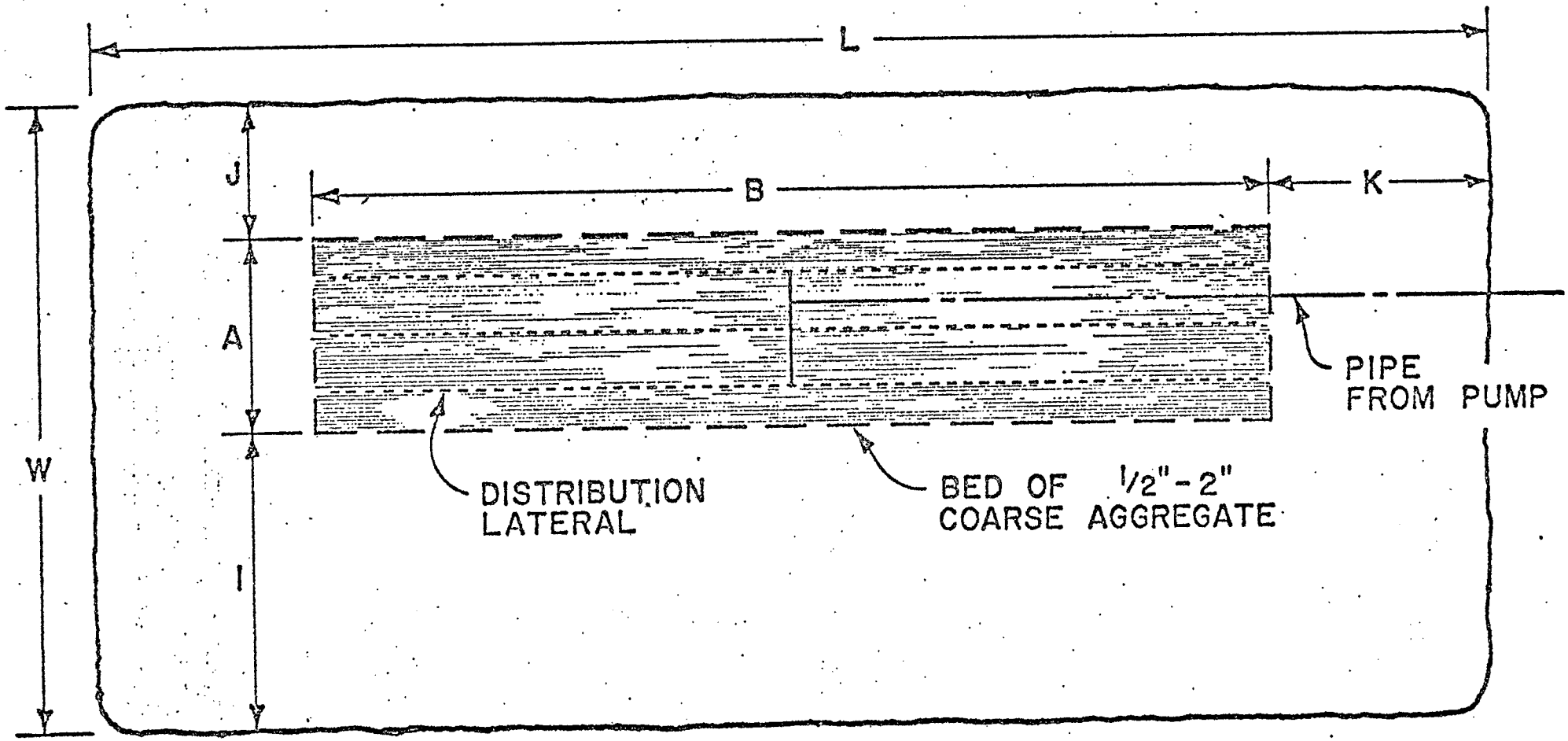


Fig. C.1 Plan view of mound using a bed for the absorption area. For the creviced bedrock site the bed slope can be rectangular or square.

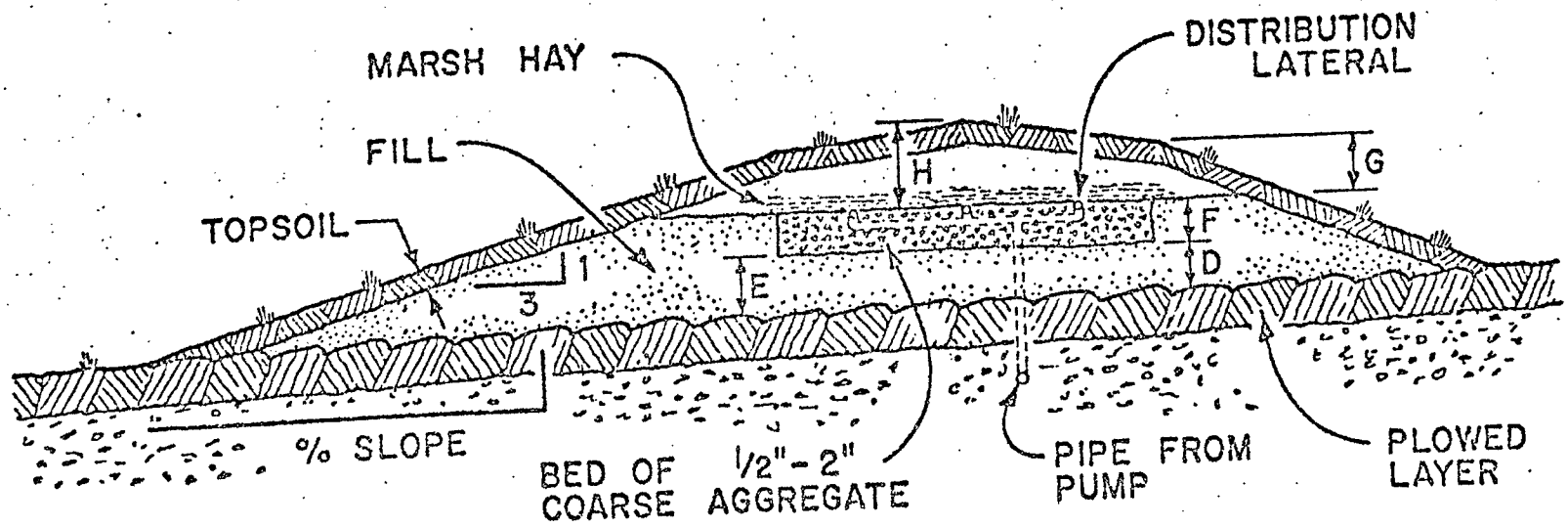


Fig. C. 2 Cross section of a mound using a bed as the absorption area.

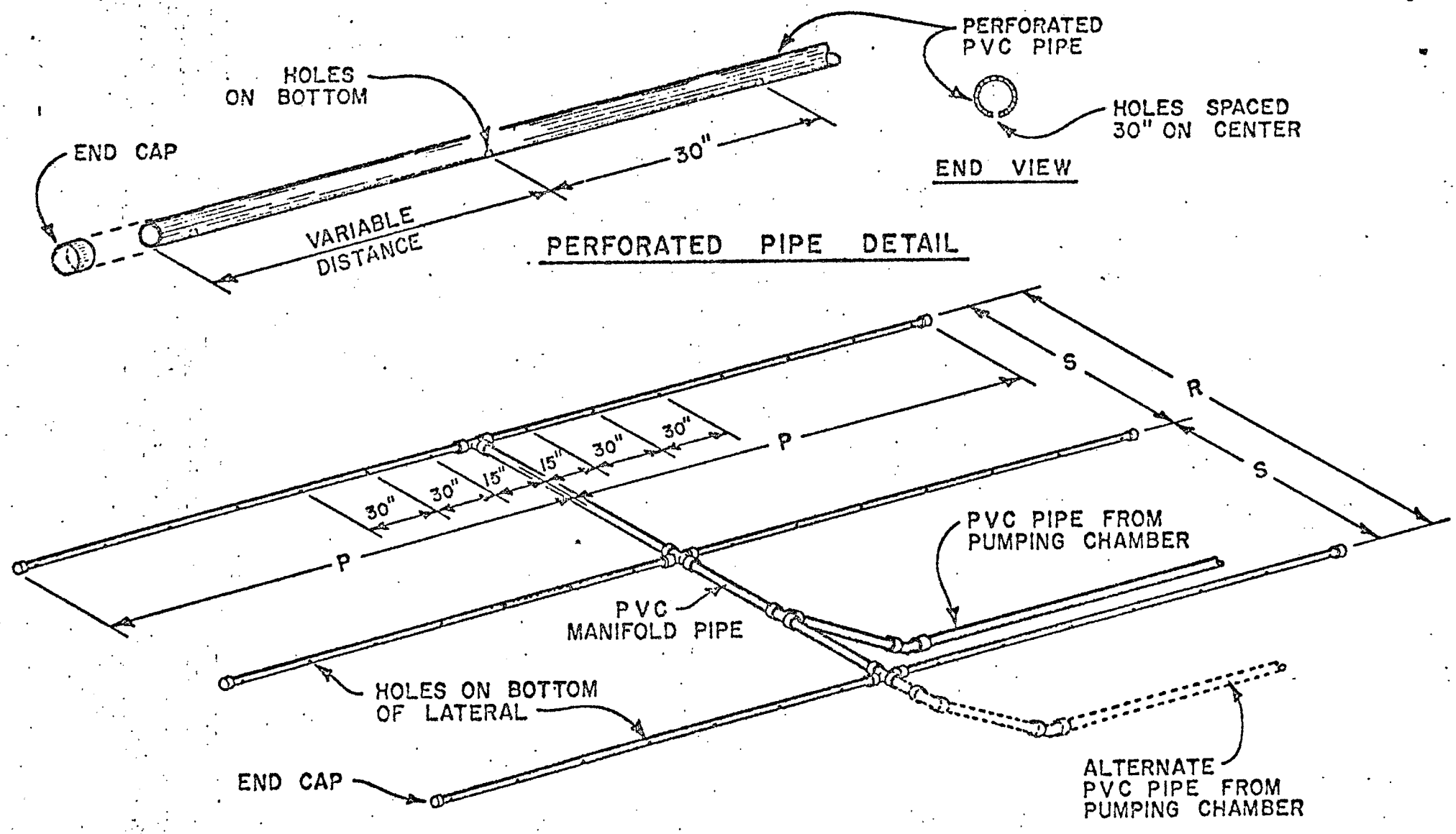


Fig. C. 3 The distribution system for a mound system. For a mound with trenches, one lateral is placed down the center of each trench as shown on plan view. Note alternate inlet positions. The variable distance between the last hole and the next to last hole will range between 15 and 30 inches. This will vary depending upon the lep-th of the trench. Distribution system must be arranged so ma .fold and laterals drain after each dose.

Part VI

SEWAGE TANK CLEANING

Part VI

Sewage Tank Cleaning

INDEX

1.0 GENERAL

1.1 The cleaning of sewage tanks by bailing or dipping and emptying the bailing or dipping container into a carrier tank is prohibited.

1.2 Precaution shall be taken by the sewage tank cleaner to prevent the leaking, spilling, or dripping of the sewage tank contents during collection, removal, transportation and disposal.

1.2.1 Any leakage, spillage, or drippings shall be cleaned up immediately.

1.2.2 Provisions shall be made by the sewage tank cleaner to carry chlorinated lime or similar satisfactory disinfectant for immediately treating the areas where leakage, spillage, or dripping has occurred.

1.3 Necessary hand tools such as picks and shovels, and other items such as sand and cement for repairing concrete sewage tanks shall be carried on the sewage tank cleaning vehicle.

1.4 The contents of sewage tanks shall not be transported in an open bed motor carrier vehicle, or any other type vehicle, unless said sewage contents are contained within approved portable receptacles.

1.5 All portable receptacles used for transporting the contents of sewage tanks shall be of approved construction, metal or equivalent, easily cleanable, good repair, equipped with tightfitting lids and shall be cleaned, deodorized and disinfected daily or more often if needed.

1.6 All facilities used for the cleaning of sewage tank cleaning equipment shall, prior to use, be inspected and approved by the Director.

2.0 MOTOR VEHICLE AND CHASSIS

2.1 The motor vehicle and its chassis shall be of sufficient capacity to haul all equipment necessary for transporting, pumping, tank filling, emptying and cleaning of sewage tanks.

2.2 Sewage tank cleaning motor vehicles may be of one unit or of the tractor-trailer type, but regardless of the type, said motor vehicles shall be in compliance with all applicable provisions of these standards.

2.3 All vehicles used in these operations shall carry in a conspicous place the name and address of the firm or operator under which business is conducted. All lettering shall be at least 2 inches in height.

3.0 CARRIER TANK

3.1 Carrier tanks shall be fully enclosed, leakproof, fly-proof, and operated in such manner as to prevent spillage during the collection, removal, transportation, and disposal of the sewage tank contents.

3.2 Carrier tank shall be of heavy gauge metal, preferably 10-12 gauge or equivalent, to withstand the treatment to which it will be subjected.

3.2.1 The carrier tank shall have a capacity of at least 500 gallons, preferably 750 gallons, to readily hold the accumulation of the average size sewage tank serving a one-family dwelling.

3.2.2 The capacity of the carrier tank, in gallons, shall be conspicuously painted on the side of said tank.

3.3 Carrier tanks shall be constructed so as to permit proper cleaning of the interior and exterior of the tank.

3.4 The exterior of the carrier tank shall be painted and said tank and appurtenances kept clean and in a state of good repair.

3.5 Carrier tanks shall be conspicuously and permanently labeled near the outlet valve in letters at least two inches high, "FOR SEWAGE ONLY," and said carrier tank shall not be used for any other purpose.

3.6 The Health Department permit number for the sewage tank cleaner shall be prominently displayed on the carrier tank.

3.7 Carrier tanks shall have a manhole in the top to provide for easy access to the tank interior for flushing and cleaning purposes. The manhole may be in combination with, or separate from, the filling connection.

3.8 The carrier tank shall have an outlet valve so located that the entire contents of the tank can be drained.

3.8.1 The outlet valve opening shall be at least three inches in diameter and shall have a non-leaking, non-clog type valve for draining the tank.

3.8.2 The outlet valve shall be adapted for a standard hose connection to the pump for recirculating the contents of the tank if required prior to emptying or for pumping to the disposal site if gravity draining is not feasible.

3.8.3 In pumping from the carrier tank, an air inlet is recommended to prevent collapsing the tank.

3.8.4 Outlet valves shall be capped when not in actual use to prevent leaking or spilling of the carrier tank contents. Caps shall be secured by chain to outlet valve or tank.

3.9 Facilities shall be available for the flushing, cleaning and deodorizing of sewage tanks, carrier tanks, and sewage tank cleaning implements or equipment.

3.9.1 A direct connection to a water distribution system for such flushing and/or cleaning action shall only be used when the water distribution system is protected by one or more approved and properly located back-siphonage prevention devices.

3.9.2 Wastes resulting from the flushing and/or cleaning operation shall be disposed of in accordance with applicable provisions of these Design Standards.

3.9.3 Odor controlling substances may be left in the sewage tank, carrier tank or other sewage tank cleaning implement or equipment, but in no case shall such substances be used in lieu of proper cleaning.

4.0 PUMPS AND HOSES

4.1 All pumps used for sewage tank cleaning purposes shall be of the non-clog, self-priming type and shall be capable of handling the contents of sewage tanks.

4.2 The use of potable water under pressure to prime pumps or to operate aspirators is prohibited.

4.3 Pumps and pump bases shall be of such construction that they can be easily handled and used for the purpose intended.

4.4 Hoses shall be of sufficient length for recirculating the contents of the sewage tank or carrier tank and to reach the point of discharge at the disposal site readily.

4.5 Hoses shall be flexible and so constructed that they can be readily cleaned.

4.5.1 Hoses shall be kept clean and in a good state of repair.

4.5.2 Hoses shall be used and stored in such manner as to prevent leaking, spilling, and dripping of any sewage tank contents.

4.5.3 When not in actual use hoses shall be tightly capped.

5.0 RECORDS

5.1 All sewage tank cleaners shall keep a written record of all jobs accomplished.

5.2 Such record shall contain, but not be limited to:

5.2.1 Name and address of the person for whom the sewage tank was cleaned.

5.2.2 Date and time the job was completed.

5.2.3 Size of sewage tank and the amount, in gallons, of the contents removed from said sewage tank.

5.2.4 Location and type disposal site utilized for the disposal of the sewage tank contents.

5.3 Said records shall be preserved for at least 12 months and upon request such records shall be readily available to the State Director of Health.

6.0 DISPOSAL

6.1 The contents of sewage tanks shall be disposed of in a manner that will prevent the spread of disease and avoid nuisance conditions, and said contents shall be disposed of by one or a combination of the following methods:

6.1.1 By incinerating in an approved high temperature incinerator.

6.1.2 By burial, provided prior written approval is received from the Director regarding the manner and the conditions under which said burial of sewage tank contents can take place. Sewage tank contents shall not be buried on public or private property without the written permission of the property owner or his authorized agent.

6.1.3 By discharging the contents into a public sewer manhole or at an acceptable point in a sewage treatment plant, provided, the written approval of a responsible official of the governmental entity or other entity owning or operating the public sewer system or sewage treatment plant is received prior to the use of such disposal facilities.

6.2 Special written permission from the Director must be obtained for any method of disposal not specifically mentioned in these Design Standards.

Part VII

SUBDIVISIONS

Part VII

SUBDIVISIONS

INDEX

1.0 GENERAL--A central sewage collection and treatment system to serve a subdivision shall be designed in accordance with Sections II and III of the "Design Standards for Sewage Collection and Treatment Systems". A permit shall be obtained prior to construction of the sewage system in accordance with Chapter 16, Article 1, Section 9 of the State Code and Section 4.0 of the Sewage Regulations. Application for the permit shall be made in accordance with the procedures outlined in Section I of the "Design Standards for Sewage Collection and Treatment Systems".

There are no limitations relative to lot size for subdivisions served by a central sewage collection and treatment system.

2.0 DESIGN--Design of a subdivision to utilize individual sewage disposal systems shall follow the procedures and requirements outlined in Section 3.0 and Section 4.0 of this part. Written approval of the proposed subdivision shall be obtained prior to initiation of construction in accordance with Section 8.0 of the Sewage Regulations.

3.0 APPLICATION

3.1 Complete Application

3.1.1 Four (4) copies of the application forms, design data, reports, plans, plats, and documentation shall be submitted to the Housing Division of the State Health Department.

3.2 Application Forms--Application forms may be obtained from the local Health Departments, State Health Department District Offices, or the Housing Division, State Health Department, 1800 Washington Street, East, Charleston, West Virginia 25305. Assistance in filling out application forms and in preparing the application will be given by the local Health Departments or District Offices when requested.

3.3 Required Application Forms and Design Information

3.3.1 Completed application form ES-69.

3.3.2 U.S. Geological Survey Topographic Map showing property lines.

3.3.3 Plat of the proposed subdivision, drawn to a scale of not more than 50 feet per inch, showing:

3.3.3.1 Number, size, and location of lots.

3.3.3.2 Lot dimensions and lot number or letter designation.

3.3.3.3 Location of roads, driveways, easements, rights-of-way, proposed rsidences and other physical features of the subdivisions.

3.3.3.4 Location of wells and/or public water lines.

3.3.3.5 Location of reserve area for the installation of two approved individual sewage disposal systems, as described in Section 4.0.

3.3.3.6 Location of percolation testholes and a six foot observation hole on each lot in the area reserved for the proposed individual on-site sewage system.

3.3.3.7 Topography of the subdivision showing five foot contour intervals for subdivisions of more than fifteen lots.

3.3.4 Soils report from the Soil Conservation Service detailing soil classifications and characteristics determined from on-site investigation of the area to be developed.

4.0 LOT SIZE

4.1 All lots shall contain a minimum on-site disposal area of 10,000 square feet, which shall be set aside for the installation of septic tank-soil absorption systems(s). Each such area shall have a minimum width of 80 feet, and no development or structures shall be permitted on this on-site disposal area other than those comprising the septic tank-soil absorption system(s).

4.2 Area consisting of land sloping in excess of 25%, land in an existing or proposed public road, or land within a 25 year flood plain shall not be utilized in establishing the minimum area for lots in accordance with the requirements of Section 4.1.

4.3 Area consisting of land containing rock strata or seasonal high water table within five feet of the ground surface shall not be utilized in establishing the minimum area for lots in accordance with the requirements of Section 4.1.

4.4 Area consisting of land not in compliance with the minimum separation distances listed in Section 2.6 of Part V, Individual Sewage Systems, shall not be utilized in establishing the minimum area for lots in accordance with the requirements of Section 4.1.

4.5 Area consisting of land which has been determined through testing to have a percolation rate slower than 60 minutes per inch shall not be utilized in establishing the minimum area for lots in accordance with the requirements of Section 4.1.

Part VIII

ABANDONING SEWAGE SYSTEMS

Part VIII

ABANDONING SEWAGE SYSTEMS

INDEX

1.0 GENERAL--The contents of the sewage tank shall be removed by a licensed septic tank cleaner, or by means approved by the Director, the tank filled with earth or a similar inert material, and the excavation, if any, filled to eliminate any physical hazard. If the tank is in useable condition it may be removed and the excavation filled to eliminate any physical hazard.

2.0 ELECTRICAL SERVICE--Any electrical service to the system shall be terminated, and electrical service boxes, switches, meters, and similar equipment, removed or rendered harmless.

3.0 WATER SERVICE--Any water service to the system shall be disconnected.

4.0 HAZARDOUS EQUIPMENT--Any other potentially hazardous equipment associated with the system shall be removed or rendered harmless.

WEST VIRGINIA STATE

BOARD OF HEALTH

Sewage Systems

Regulations