Onsite Sewage Disposal System Management

Beaufort County, South Carolina

Clement Solomon

Graham Knowles

The National Environmental Services Center
West Virginia Research Corporation

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EXECUTIVE SUMMARY

This report was commissioned by the Ocean and Coastal Resource Management Division (OCRM) of the South Carolina Department of Health and Environmental Control (DHEC) and prepared by National Environmental Services Center (NESC). The report's purpose is to investigate, research, and recommend appropriate onsite/decentralized wastewater management strategies to Beaufort County, South Carolina.

This Onsite Disposal System (OSDS) Management Report addresses core issues and generates essential insights necessary to enable Beaufort County, South Carolina to make appropriate decisions as it considers the development of a county onsite/decentralized wastewater management system (OMS).

Inspection and maintenance ordinances and/or regulations are identified for Beaufort County and the state of South Carolina. Operational inspection and maintenance requirements established in coastal zone states nationwide are also examined. Programmatic recommendations for Beaufort County are set forth in draft ordinance language establishing protocols for a model onsite/decentralized wastewater management inspection and maintenance program within the county's overall onsite management system (OMS).

Standards for conventional, innovative, and small flow community OSDS germane to South Carolina are reviewed. A comparative analysis of protocols, policies, procedures, and practices of existing standards countywide, statewide, and a cross coastal-zone states is presented.

A comprehensive quantitative and qualitative analysis of primary, secondary and tertiary onsite/decentralized systems along with significant operation and maintenance considerations and associated costs for conventional, innovative, and small flow community OSDS applicable statewide is provided.

Existing standards for household appliances countywide, statewide and throughout the coastal zone states is afforded. New standards for relevant household appliances are set forth within recommendations for draft ordinance language.

General recommendations for the establishment of a countywide OSDS management system are articulated throughout the body of the document and further reinforced through the draft ordinance developed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Chapter 1
Project Overview

1.1 Introduction

According to the Bureau of the Census 1998, the population in the coastal counties exceeds 141 million even though these areas account for only 17 percent of the total land mass. More than 180 million people visit the coast every year, and beaches are one of the largest vacation destinations in America. The coastal areas face a variety of major environmental problems, such as degraded water resources, shellfish bed closings, toxic contamination, etc.

Beaufort County, South Carolina, a rural county of islands and waterways, began a period of accelerating growth when it developed the former Hilton Head Island plantations as a golf and beach retirement and resort community in the early 1960s. The area has proved so popular that development has spread to the mainland and other islands. Development has been mainly on the basis of collection of sewage by conventional gravity and force main sewers, followed by activated sludge treatment, tertiary treatment and reuse of the final disinfected effluent for nighttime irrigation of the many golf courses. In general, onsite sewage disposal systems (OSDS) served areas developed earlier.

Formerly pristine estuarine waters had become polluted to the extent that 31,000 acres of shellfish waters were closed. In 1995, the closure of 500 more acres raised the concern of a group of Beaufort County citizens to form The Clean Water Task Force. The Task Force prepared a study and report that included "Ten Steps to Clean Water." This study is one of the steps intended to address the potential threat to water quality caused by OSDS (septic systems) and to recommend methods by which the perceived threat might be alleviated by creating a wastewater management program.

Beaufort County lies at the southern end of South Carolina's coast and includes 691 square miles. The entire area is interlaced with water – rivers, streams, fresh and saltwater wetlands, ocean, estuaries, and channels between islands, including 40 percent of the state's shellfish beds. It presents many challenges to acceptable onsite wastewater treatment and disposal, including areas with highly-permeable soils or poorly-drained soils, elevations barely above sea level, and areas with shallow seasonal water tables or confining layers.

1.2 Background Legislation

In 1987,Congress passed Section 319 of the Clean Water Act (CWA), establishing a national program to control non-point sources (NPS) of pollution. This program is the major source of funding for states to carry out their NPS management plans. Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 requires coastal states to develop a Coastal Non-point Pollution Control Program. South Carolina's plan won conditional approval in 1998 and is part of the overall statewide Non-point Source Management Program. Beaufort County's Special Area Management Plan (SAMP) is among the projects in the five-year action strategy as well as a "New Onsite Disposal Management Measure."

The two major pieces of legislation - the CWA (Water pollution Control Act, PL92-500), and Coastal Zone Management Act (PL 92-583) contain elements that directly address the causes and effects of OSDS. The Water Pollution Control Act, or CWA, is the primary federal law addressing pollution in lakes, rivers, and coastal waters. This act was passed to restore and maintain the chemical, physical and biological integrity of the nation's waters. The federal government, through the Environmental Protection Agency (EPA), sets basic water quality criteria. Standards are developed and implemented by individual states based on the set criteria. They are required to be at least as stringent as the criteria established by EPA.

The Coastal Zone Management Act of 1972 established a partnership between federal and state governments to manage the coast. Individual states developed coastal zone management programs with enforceable policies designed to meet national objectives. The federal government funds these programs and requires federal agencies to act consistently with federally approved state programs. The goal of the Coastal Zone

Management Act is to protect and conserve coastal zone resources of the by providing incentives and funding to coastal states (including those around the Great Lakes) to develop and implement management plans for their coastal areas.

In order to obtain federal approval of their coastal zone management programs, states must define a coastal boundary, designate critical areas of concerns based upon a coastal resources inventory, and adopt enforceable policies covering their most important objectives. Federally approved state coastal zone management programs manage more than 99.7 percent (153,083 km) of the U.S. shoreline.

Unlike the CWA, participation by states in coastal planning is not compulsory. This is due to the fact that although the preservation of the coastal zone was the goal of this legislation, the writers recognized that the role of zoning and managing land near shore coastal areas is traditionally one of state and local jurisdiction. Therefore, it provides for, and encourages, local decisions by offering federal funding as an incentive for states to participate based upon the specific nature of many of the planning issues.

1.3 Special Area Management Plan (SAMP)

Beaufort County, South Carolina, faced with the population predicted to double its population by 2015, and aware that water quality protection is vital to the area's future, initiated a SAMP in 1999. Funded through the National Oceanic and Atmospheric Administration (NOAA), the Clean Water Task Force (CWTF) initiated this effort in 1997. Alarmed by closure of shellfish beds due to fecal coliform bacteria contamination in 1995, this citizens' group spent more than a year investigating water quality in the area by interviewing federal and state agencies, local governments, and other organizations.

It was concluded that the cumulative impact of many pollution sources threatened to destroy the ecological balance of the fragile coastal estuaries, unless a coordinated effort among state agencies, local municipalities, and county government resulted in a plan to clean up existing pollution and prevent future pollution. The CWTF developed "A Blueprint for Clean Water: Strategies to Protect and Restore Beaufort County's

Waterways," which includes specific recommendations, and they proposed that Beaufort County, the Town of Hilton Head, other municipalities, Jasper County, and the Low Country Council of Governments initiate a SAMP because of the overlapping jurisdictions and multi-watershed components.

The Ocean and Coastal Resource Management Division (OCRM) of the South Carolina Department of Health and Environmental Control (DHEC) administer the SAMP with the assistance of committees and consultants. The OCRM has used the CWTF strategy and plan to develop five major areas of focus for the SAMP, which include: storm water management, water quality monitoring and enforcement, boating impact management, wastewater management, and a public education and involvement program.

1.4 Purpose and Objectives

Wastewater management is only one part of SAMP being developed to protect water quality in Beaufort County and the surrounding area. The purpose of this study is to identify, collect, review, and synthesize information about various aspects of OSDS in Beaufort county, South Carolina, and the coastal states in the US. Specific objectives of this project are listed below.

Objective 1:

Develop a draft ordinance establishing recommendations for a model onsite wastewater management inspection and maintenance program (systems applicable to South Carolina) for Beaufort County, South Carolina.

- Identify existing onsite wastewater inspection and maintenance requirements (ordinances/regulations) for Beaufort County, South Carolina.
- Identify existing onsite wastewater inspection and maintenance requirements (ordinances/regulations) for compliance to South Carolina state code.
- Identify existing onsite wastewater inspection and maintenance requirements (ordinances/regulations) established and operational in the coastal zone states nationwide.

- Execute a comparative analysis of protocols, policies, procedures, and practices of existing inspection and maintenance requirements currently established in Beaufort County, South Carolina, and all other coastal zone states in the U.S.
- Formulate onsite wastewater management inspection and maintenance programmatic recommendations.
- Schedule and facilitate a stakeholder meeting to present the recommendations for the proposed model inspection and maintenance program.
- Articulate onsite wastewater inspection and maintenance recommendations in the form of an outline for the draft ordinance.

Objective 2:

An evaluation of new standards for conventional, innovative, and small flow community OSDS systems (applicable to South Carolina) that includes a draft ordinance that has broad stakeholder support.

- Identify existing standards (design, siting, etc.) for onsite wastewater systems in Beaufort County, South Carolina.
- Identify existing standards (design, siting, etc.) for onsite wastewater systems in the state of South Carolina.
- Identify existing standards (design, siting, etc.) for onsite wastewater systems in the coastal states nationwide.
- Execute a comparative analysis of protocols, policies, procedures, and practices of existing standards for onsite systems currently established in Beaufort County, the state of South Carolina, and all other coastal zone states in the U.S.
- Schedule and facilitate a stakeholder meeting to present the recommendations for the proposed new standards draft ordinance.
- "Draft" an outline of an ordinance for broad stakeholder support and acceptance.

Objective 3:

An evaluation of relevant operation and maintenance considerations including capital, operating and administrative costs for conventional, innovative, and small flow community OSDS (applicable to South Carolina).

- Review of current conditions such as the number and types of systems currently in the ground (information to be provided by OCMR/DHEC) in Beaufort County, South Carolina.
- Identify primary, secondary, and tertiary systems currently permitted and installed in Beaufort County, South Carolina.
- Generate a comprehensive document of these systems.
- Analyze and report the cost associated with the existing systems Beaufort County, South Carolina.
- Identify the installation, maintenance, and capital costs of the existing systems.
- Prepare a comparative analysis of conventional and common Innovative/Alternative systems for coastal zone states and Beaufort County, South Carolina.

Objective 4:

An evaluation of new standards for relevant household appliances that includes a "Draft Ordinance" that has broad stakeholder support.

- Identify existing standards for household appliances in Beaufort County, South Carolina.
- Identify existing standards (regulations/ordinances) for household appliances in the state of South Carolina.
- Identify existing standards (regulations/ordinances) for household appliances in the coastal states nationwide.
- Prepare a comparative analysis with South Carolina current onsite wastewater regulations.
- Review any proposed changes with the current South Carolina onsite wastewater regulations.

- Schedule and facilitate a stakeholder meeting to present the recommendations of the proposed new standards for household appliances.
- Draft an outline for acceptance of an ordinance for stakeholder review and acceptance.

Objective 5:

Implementation assistance, provided as additional efforts and on a time and material basis, as directed by the SAMP manager.

- Activities under this objective will be carried out on mutually acceptable terms negotiated between DHEC and National Environmental Services Center (NESC).

This report will start with a look at the SAMP and background legislation with special attention to factors relevant to managing OSDS. Chapter 2 will present a scan of Beaufort county focusing on the current population density and expected population growth, socioeconomic and demographic data, geology, geography, and hydrology. Chapter 3 will compare wastewater inspection and maintenance procedures as practiced in the study area, other coastal counties and statewide. Chapter 4 and 5 will include a review of standards for selecting, placing, and operating a wide variety on OSDS locally, in the state and in coastal areas. Chapter 6 will describe various household appliances and their effect on wastewater flow and treatment. A summary of recommendations of the detailed information presented in the preceding chapters will be presented in Chapter 7 along with the conclusions. Appendices will include additional data and sources.

1.5 Methods

NESC resources and a number of different sources were used to research the content of state onsite wastewater codes and other wastewater-related needs and issues from all the coastal states. Keywords, terms, or phrases commonly used within the regulations to define and analyze the use of a particular wastewater technology, a specific regulatory responsibility, or administrative action of the regulatory agency etc., related to OSDS were used. It should be noted that the term ”alternative” is defined differently among the coastal states. A comparative analysis on a number of subjects was executed to develop the recommendations included in the following sections of this study.

CHAPTER 2
Beaufort County

2.1 Introduction

Beaufort County is part of the aptly named Low Country of South Carolina. The highest elevation is approximately 40 feet above sea level. The county is in the extreme south-east of the state and has an area of 581 square miles or 372,000 acres. With the adjoining county of Jasper, 11 percent of the area is cropland, two percent pasture, 57 percent woodland, and 11 percent non-farm and urban. Approximately 20 percent of the land area (some 35 percent of Beaufort County), is flooded daily or occasionally by salt water.

The climate is subtropical and averages 49 inches rainfall (40-58 in. per year). Tropical storms and hurricanes occasionally bring strong winds and heavy rainfall. The first settlements occurred in 1521, but most were unsuccessful until the period leading to the charter of Beaufort in 1710. Following trade in furs, skins, and lumber, rice became a major crop, indigo and “sea island” cotton arrived later. The civil war affected this economy adversely, and farming turned to corn, tobacco, truck crops and livestock with limited cotton. Today, farming is diverse with soy, truck crops, and small grains predominating. The fishing industry has always been important but urban development and numerous recreational facilities, particularly golf now predominate.

The geology of the area represents the effects of many inundations by the Atlantic Ocean due to changes in the level of both land and sea over the past 32 million years. Formations have been laid down and eroded, leaving at least seven former shorelines. The underlying bedrock is a carboniferous series of limestone, siltstone and shale. As an aquifer, it has little commercial importance due to low yield and poor quality. It is used for isolated residences and farms but commonly the water requires point of entry treatment due to excess hardness, iron, manganese, and hydrogen sulfide content.

Some homeowners resort to using purchased bottled water for cooking and drinking. The stratum of deposited sediments above the bedrock is primarily of stratified riverborne deposits of sand/silt/clay in various combinations in the northern part of the county. The further east and southeast deposits are of ocean-born littoral drifts and wind-borne dune formations of fine silty sands. It has been said that, in a geological time frame, Fripp Island emerged from the ocean only this morning. This afternoon, the sea is reclaiming parts of the adjacent Hunting Island.

2.2 Wastewater Infrastructure – Central Systems

All of the older urban areas have been developed on the basis of relatively high-density housing and commerce with main line water and sewer. Initially, presumably, with direct discharge to the tidal waterways. All urban areas have added treatment, and discharge disinfected effluent to the estuaries. Sewage collection, treatment, and disposal in the county (conventional central sewer) are mostly privately owned in most of the gated plantation communities.

With the creation of the Beaufort Jasper Water and Sewer Authority (BJWSA), all sewage collection systems, with the exception of the privately owned “gated” communities, have been consolidated under a single management entity. The BJWSA operate the remainder and use the effluent to irrigate golf courses in summer. The authority operates one natural wetland discharge of 0.5 million gallons per day (gpd) as necessary. Figure 2.1 shows a layout of the water and sewer lines of the BJWSA.

All wastewater treatment plants other than the Cherry Point Plant and the Great Swamp Effluent Management system were visited. Most of the effluent from wastewater treatment plants in the county is used for golf course irrigation. It is understood that the effluent is spray irrigated to the courses at night, even when irrigation is not required to maintain turf. This eliminates the need for direct discharge to the rivers and estuary. The irrigation effluent is treated to tertiary standards and disinfected, but it is possible that potential pathogens will be delivered and remain on the ground surface.

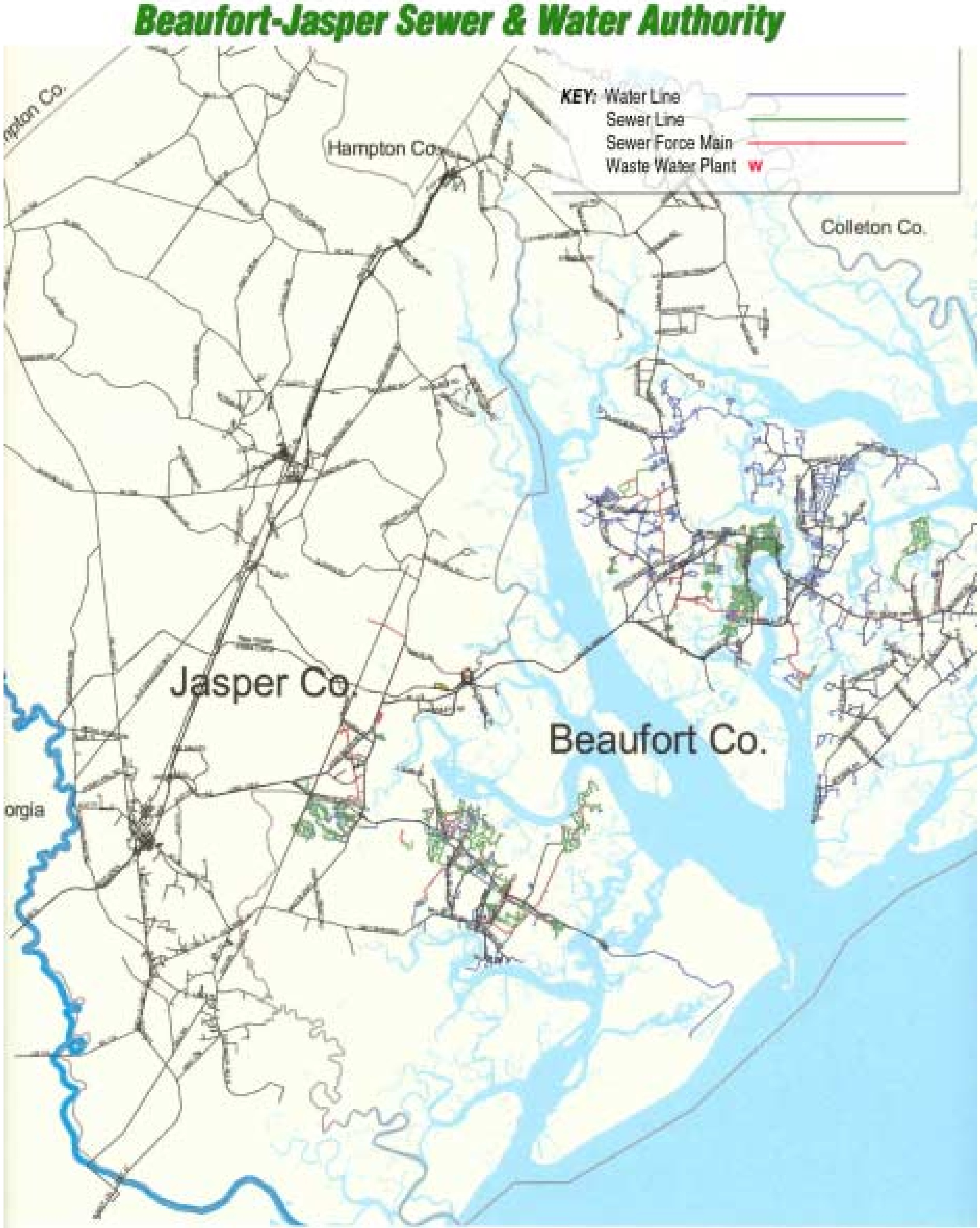


Figure 2.1 BJSWA Water and Sewer lines

During severe storm events it is possible that storm water run-off may carry nutrients and pathogens to the marine environment. Two wastewater treatment plants serving the town of Beaufort and the two military bases do discharge treated and disinfected effluent to the estuary. Nutrients and pathogens are discharged at low and moderate levels in the effluent. The presence of these contaminants is a contributing factor to the decision to close the shellfish beds in the Beaufort River. The BJWSA has plans to transfer the effluent from the Beaufort facility to the Cherry Point system.

Table 2.1 (SCDHEC, 2002) provides the current status of wastewater treatment diversion, expansions or new construction according to the Clean Water State Revolving Fund (CWSRF) priority list, January 2002.

Table 2.1 South Carolina's priority list of CWSRF projects

No.	Project Name	Project Description	Amount ($)
1	BJWSA - Port Royal Island regional WWTP	New WWTP on Port Royal Island to replace the Shell Point and Southside WWTPs. The new facility is needed to comply with TMDL for the Beaufort river	35,000,000
2	BJWSA – Bluffton WWTP diversion to Cherry Point	BJWSA diversion from Bluffton to Cherry Point WWT	3,500,000
3	Fripp Island PSD - New tertiary WWTP for Fripp Island	Construction of new WWTP (tertiary treatment) to replace two existing plants and provide wastewater treatment for unsewered areas currently using septic tanks	4,850,000
4	Fripp Island PSD - Wastewater collection system expansion	Construction of a wastewater collection system to serve several unsewered areas of the island which would alleviate non-point source pollution of adjacent shell fish waters	3,500,000
5	BJWSA – Cherry Point WWTP expansion	Cherry Point WWTP expansion to 3.2 million gallons per day (mgd). Expansion needed due to Rose Hill and Bluffton diversion projects	3,500,000

It is evident from the list that a considerable amount of effort and economic resources will be directed to the five projects in Beaufort County. A decision has been made to provide mandatory collection of sewage into the authorities collection systems that now extend over the southern section of the county, south of the Whale Branch river. Currently BJWSA does not intend to extend the collection of sewage north of the Whale

Branch. Effluent from the treatment works is delivered as irrigation water to the constituent golf resorts. Surplus effluent from the Cherry Point wastewater treatment plant is discharged to an innovative distribution system within a natural wetland, the Great Swamp. The swamp discharges to the estuary/river system by subsurface diffusion. The Authority has been unable to detect any significant contamination of the estuarine waters.

2.3 Overview of Planning Areas, Census Tracks, and Block Groups

An understanding of current county-wide population growth trends, housing unit growth over time, households, current and projected household incomes, along with the means of wastewater disposal housing units use provides essential information for local onsite/decentralized wastewater management decision making and planning processes. This section uses the six principal planning areas (Figure 2.2) as its point of reference for purposes of organizing and reporting.

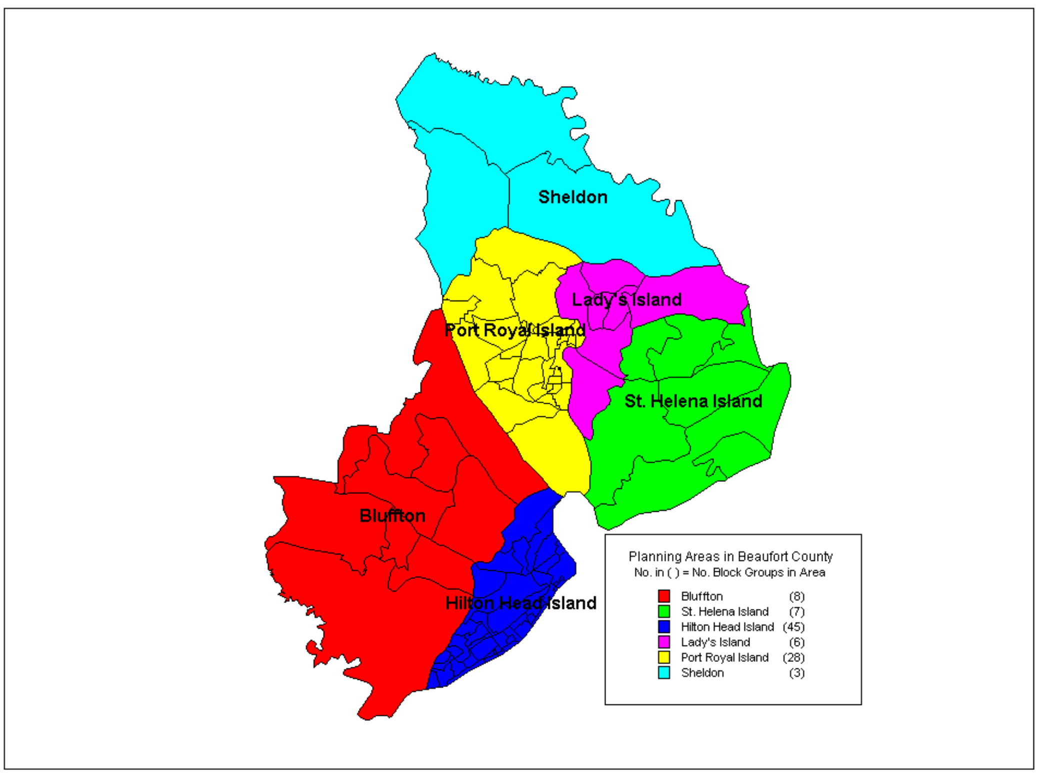


Figure 2.2 Beaufort County planning areas

Beaufort County has twenty-two Census Tracts (Figure 2.3) within the six designated county planning areas. Each Census Tract is further divided into a number of Census Block Groups. There are ninety-seven Census Block Groups (Figure 2.4) countywide. Block Groups by Census Tract and Census Tracts within the principal Planning Areas of Beaufort County are used in this chapter for purposes of data collection and analysis and are summarized in Table 2.2.

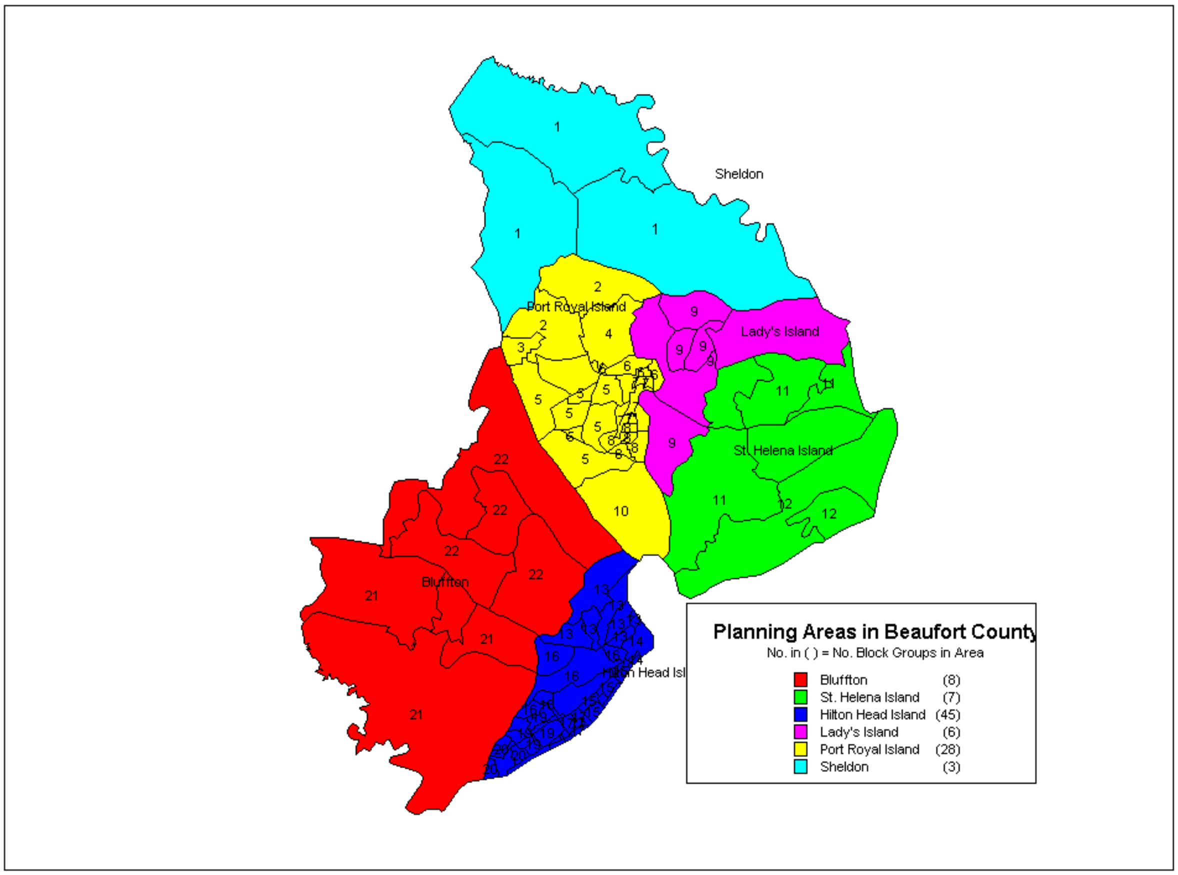


Figure 2.3 Census tracts within Beaufort County planning areas

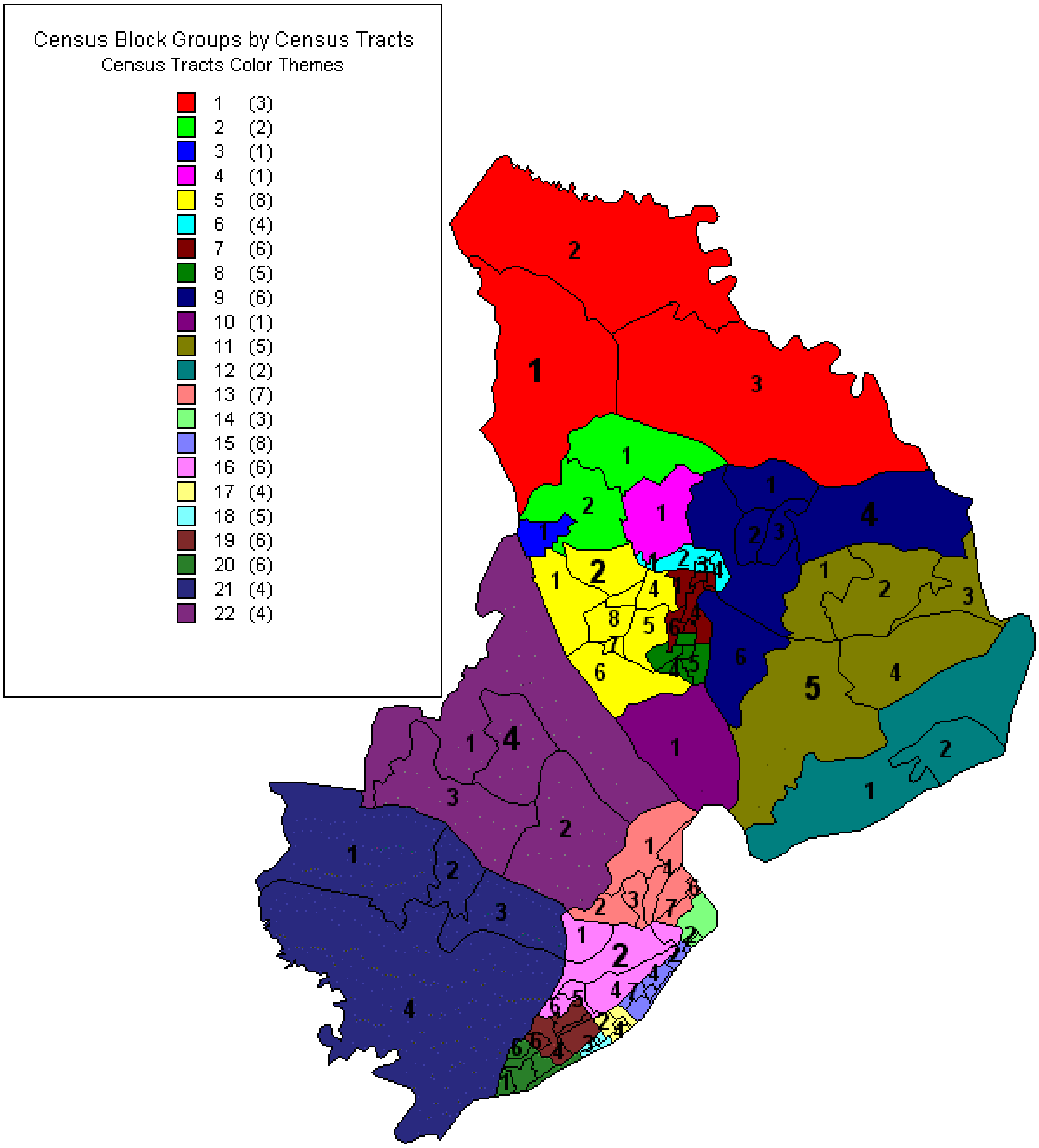


Figure 2.4: Census block groups by census tracts within Beaufort County[1]

[1] Number in parenthesis ( ) indicates number of Block Groups within each Census Tract

Table 2.2 Distribution of Beaufort County planning areas, census tracts and block groups

Planning Area	TRACT	BG	Planning Area	TRACT	BG	Planning Area	TRACT	BG
Bluffton	21	1	Hilton Head Island	16	1	Port Royal Island	2	1
Bluffton	21	2	Hilton Head Island	16	2	Port Royal Island	2	2
Bluffton	21	3	Hilton Head Island	16	3	Port Royal Island	3	1
Bluffton	21	4	Hilton Head Island	16	4	Port Royal Island	4	1
Bluffton	22	1	Hilton Head Island	16	5	Port Royal Island	5	1
Bluffton	22	2	Hilton Head Island	16	6	Port Royal Island	5	2
Bluffton	22	3	Hilton Head Island	17	1	Port Royal Island	5	3
Bluffton	22	4	Hilton Head Island	17	2	Port Royal Island	5	4
St. Helena Island	11	1	Hilton Head Island	17	3	Port Royal Island	5	5
St. Helena Island	11	2	Hilton Head Island	17	4	Port Royal Island	5	6
St. Helena Island	11	3	Hilton Head Island	18	1	Port Royal Island	5	7
St. Helena Island	11	4	Hilton Head Island	18	2	Port Royal Island	5	8
St. Helena Island	11	5	Hilton Head Island	18	3	Port Royal Island	6	1
St. Helena Island	12	1	Hilton Head Island	18	4	Port Royal Island	6	2
St. Helena Island	12	2	Hilton Head Island	18	5	Port Royal Island	6	3
Hilton Head Island	13	1	Hilton Head Island	19	1	Port Royal Island	6	4
Hilton Head Island	13	2	Hilton Head Island	19	2	Port Royal Island	7	1
Hilton Head Island	13	3	Hilton Head Island	19	3	Port Royal Island	7	2
Hilton Head Island	13	4	Hilton Head Island	19	4	Port Royal Island	7	3
Hilton Head Island	13	5	Hilton Head Island	19	5	Port Royal Island	7	4
Hilton Head Island	13	6	Hilton Head Island	19	6	Port Royal Island	7	5
Hilton Head Island	13	7	Hilton Head Island	20	1	Port Royal Island	7	6
Hilton Head Island	14	1	Hilton Head Island	20	2	Port Royal Island	8	1
Hilton Head Island	14	2	Hilton Head Island	20	3	Port Royal Island	8	2
Hilton Head Island	14	3	Hilton Head Island	20	4	Port Royal Island	8	3
Hilton Head Island	15	1	Hilton Head Island	20	5	Port Royal Island	8	4
Hilton Head Island	15	2	Hilton Head Island	20	6	Port Royal Island	8	5
Hilton Head Island	15	3	Lady's Island	9	1	Port Royal Island	10	1
Hilton Head Island	15	4	Lady's Island	9	2	Sheldon	1	1
Hilton Head Island	15	5	Lady's Island	9	3	Sheldon	1	2
Hilton Head Island	15	6	Lady's Island	9	4	Sheldon	1	3
Hilton Head Island	15	7	Lady's Island	9	5			
Hilton Head Island	15	8	Lady's Island	9	6			

2.4 Population Growth and Projections

In the 1980, Beaufort County population was 65,362. This number grew to 86,425 by 1990. Over the 21-year period from 1980 to 2001, the population grew by 55,575 persons. U.S. Census 2000 reported that the county population of 120,937, which reflected an increase of 34,512 people, is a 39.9 percent increase over the decade from

1990 to 2000. This increase in population was 6.6 percent of the overall growth (525,309) in the state's population over the same period. It is anticipated that the county will continue to grow to 137,493, an 11 percent increase in population during the five-year period from 2001 to 2006 (Figure 2.5 – 2.7).

Of the 3,141 counties nationwide, Beaufort County ranks within the top five percent and is the 150th fastest growing county. Currently, the county's population represents 16.29 percent of the coastal counties population and 3.01 percent of the state population. Beaufort County is currently the third most populous coastal county in South Carolina, behind Charleston (309,969) and Horry (196,629) counties (Figure 2.8).

Bluffton, Hilton Head Island, Lady's Island, and St. Helena Island planning areas each experienced significant growth over time from 1980 to 2001. Significant population growth rates are expected to continue for both Bluffton (23 percent) and Lady's Island (17 percent) planning areas until 2006 (Figure 2.9).

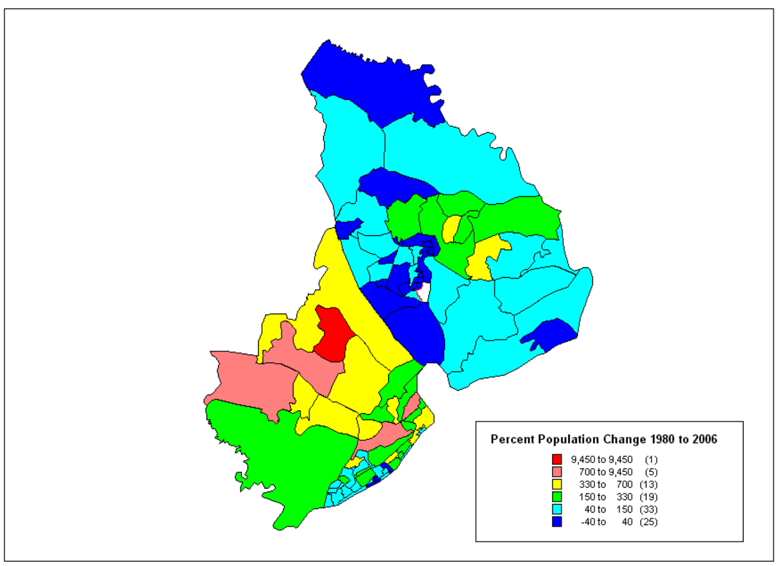


Figure 2.5 Beaufort County percent population change by census tract 1980-2006[2]

[2] Number in parenthesis ( ) indicates number of Block Groups within each range

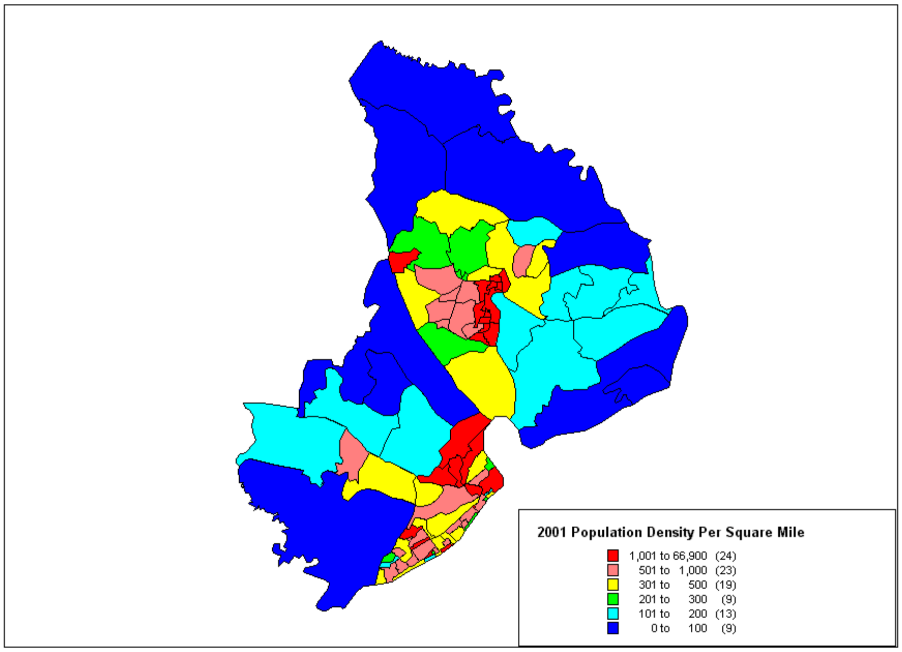


Figure 2.6 Beaufort County population density per square Mile 2001[3]

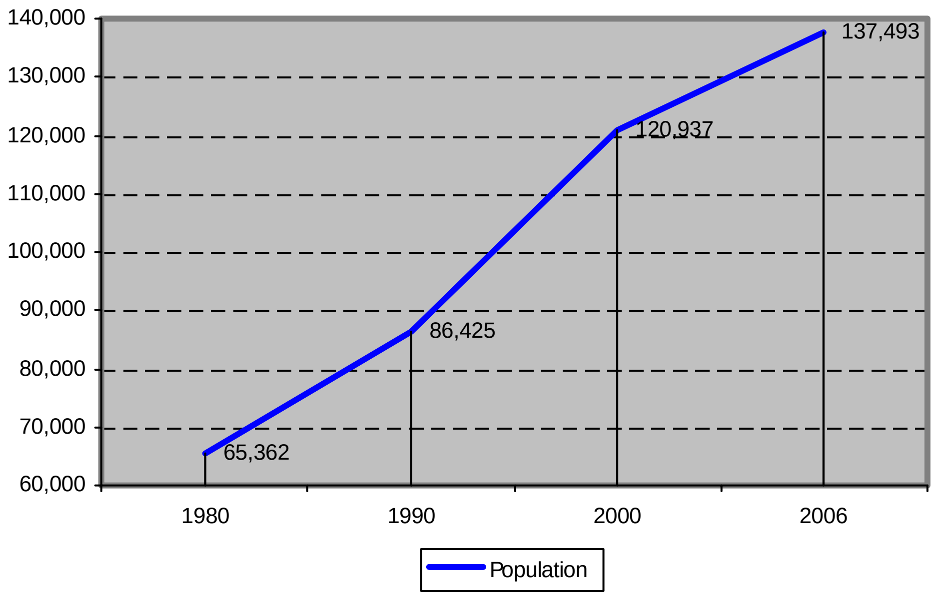


Figure 2.7 Beaufort County population growth and projections 1980-2006

[3] Number in parenthesis ( ) indicates number of Block Groups within each range

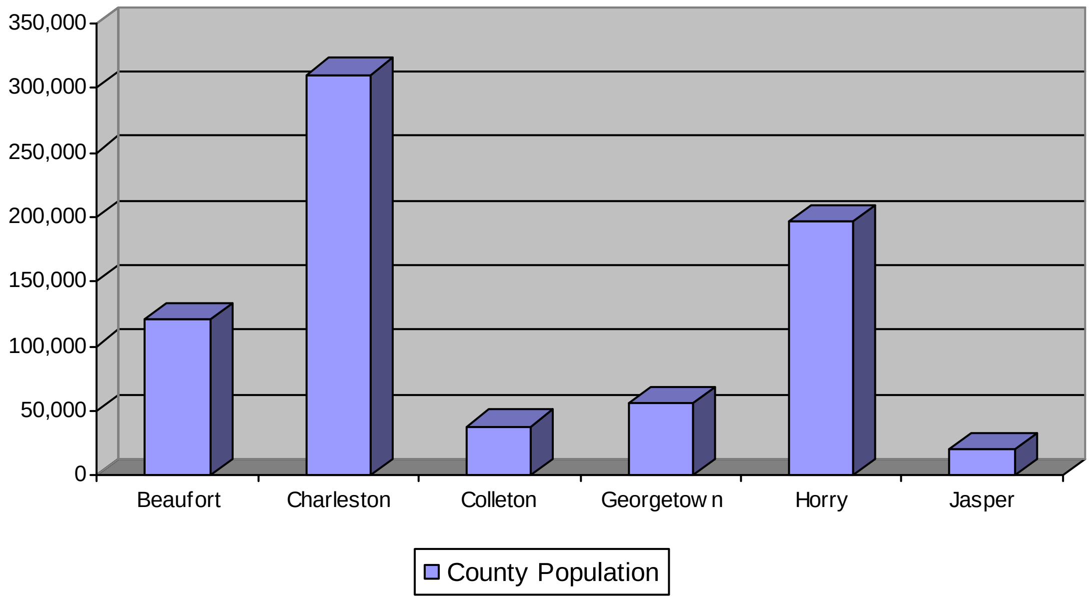


Figure 2.8 South Carolina coastal counties current populations

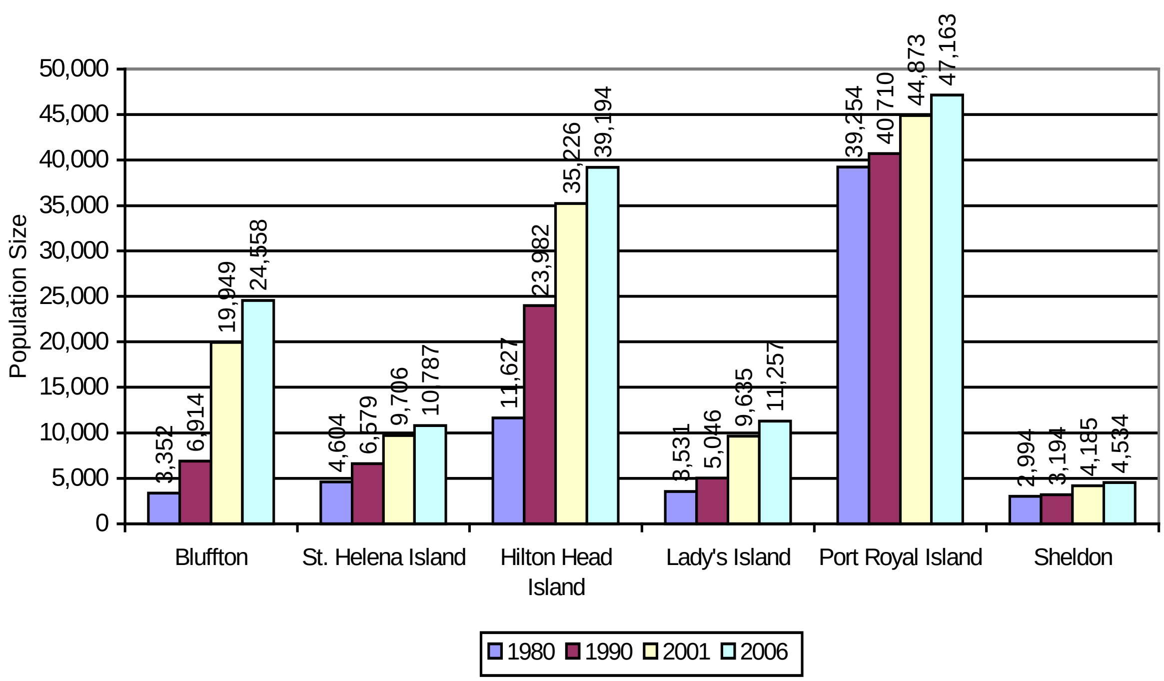


Figure 2.9 Beaufort County planning area, population growth, and projected growth 1980 to 2006

2.5 Planning Areas and Population Growth

Bluffton

In 1980, the population of Bluffton was 3,352, which more than doubled to 6,914 by 1990. As of 2001, the population once again more than doubled its 1990 population figures to 19,949 persons. Over the 21-year period from 1980 to 2001 the planning area grew in population by 16,597 persons the most significant growth by percentage countywide over the reporting period. It is projected that Bluffton's population will continue to grow by 23 percent over the five-year period from 2001 to 2006. This rate of growth is significantly greater than the anticipated 11 percent countywide population growth rate. Bluffton planning area has experienced, continues to experience, and anticipates experiencing the most rapid growth rate in population of all Beaufort County planning areas in the coming years.

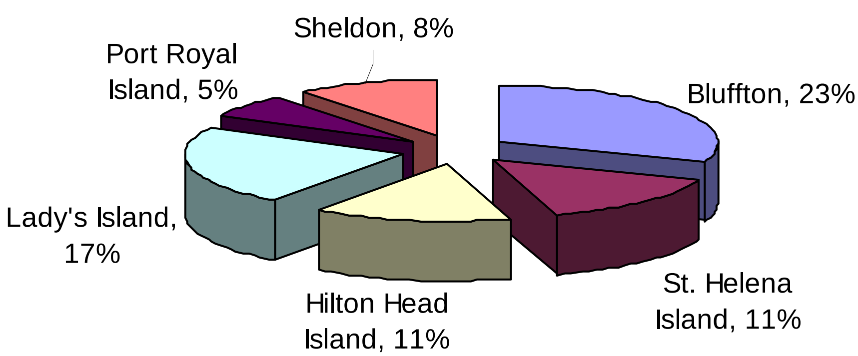


Figure 2.10 Beaufort County planning area anticipated population growth patterns 2001 to 2006

St. Helena Island

The population of St. Helena Island in 1980 was 4,604, which grew to 6,579 by 1990. By 2001, the population had grown to 9,706 persons. Overall population growth for the 21-year period between 1980 and 2001 was 5,102 persons, the fourth fastest growing planning area countywide. It is projected that St. Helena Island's population will grow by 11 percent over the five year period between 2001 and 2006. This is the same as the anticipated 11 percent countywide population growth rate for the same period.

Hilton Head Island

The population of Hilton Head Island in 1980 was 11,627, which more than doubled to 23,982 by 1990. In 2001, the population had grown to 35,226 persons. During the 21-year period from 1980 to 2001, Hilton Head Island planning area population grew by 23,599 persons, the second most rapidly growing planning area in the county. It is projected that Hilton Head Island's population will continue to grow by some 11 percent over the five year period from 2001 to 2006.

Lady's Island

The Lady's Island population in 1980 was 3,531, which grew to 5,046 by 1990, and 2001 population figures indicate an increase in population to 9,635 persons. This was the third fastest growing planning area countywide. It is projected that Lady's Island will experience a population increase of 17 percent over the five year period from 2001 to 2006. This growth is greater than the anticipated 11 percent countywide percentage population growth rate.

Port Royal Island

In 1980, Port Royal Island had a population of 39,254, the largest planning area population in the county. As of 1990, it had increased in population to 40,710 persons, and by 2001 had increased by just over 4,000 more inhabitants. Port Royal Island experienced the lowest percentage population growth by planning area for the county over the 21-year period from 1980 to 2001, a trend projected to continue as the area is expected to increase by only 5 percent over the five years during 2001 to 2006.

Sheldon

In 1980, Sheldon's population was 2,994, the lowest population of all planning areas. This increased to 3,194 by 1990. As of 2001, the population had grown to 4,185, reflecting a 51 percent growth rate over the 21-year period between 1980 and 2001, the lowest population growth rate by planning area. Sheldon is projected to continue to grow at 8 percent over the five-year period between 2001 and 2006. Sheldon has consistently had the lowest population and population growth rate changes over time of all planning areas in the county for all reporting periods.

2.6 Planning Area and Housing Units

2.6.1 Beaufort County

As of 1980, there were 27,311 housing units countywide. This number grew to 45,981 by 1990, and it has continued to grow. U.S. Census 2000 reported 60,509 housing units, while 2001 figures indicate that 70,962, or four percent of all housing units statewide, are located in the county (Figure 2.11).

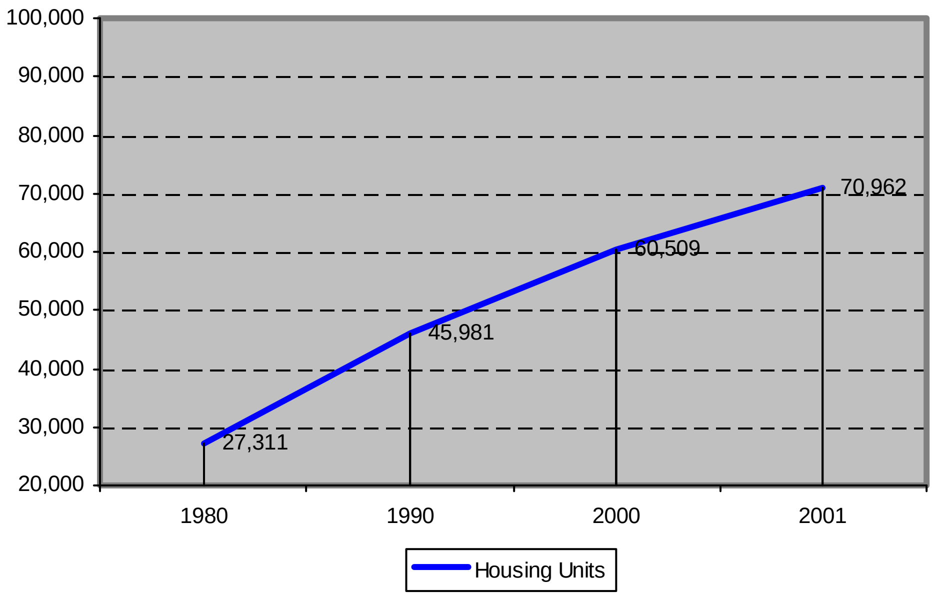


Figure 2.11 Beaufort County housing units

During the 21-year period from 1980 to 2001, the county experienced a significant housing-unit growth rate. It is anticipated that the county will have a growth rate of 13 percent in housing units over the five-year reporting period from 2001 to 2006. Projections indicate that two planning areas specifically, Bluffton and Lady's Island, will grow at rates faster than the county average.

2.6.2 County Planning Areas

Bluffton

In 1980, there were 2,551 housing units in the planning area. In 2001, there were more than 10,000. Continued growth in this area at a projected rate of 25 percent (the highest in the county), is expected over the five-year period from 2001 to 2006 (Figure 2.12 and 2.13).

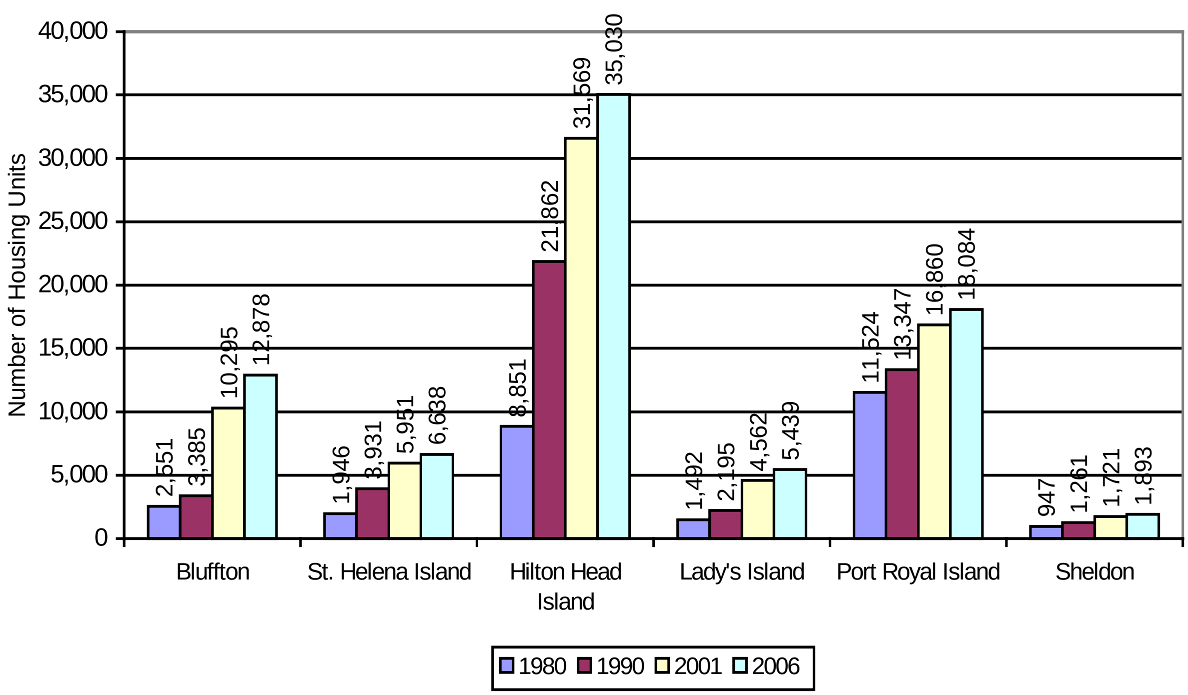


Figure 2.12 Growth in number of housing units 1980 to 2006

St. Helena Island

St. Helena Island increased housing units from 1,946 in 1980 to 5,951 in 2001. Projections indicate a continued growth rate of 11 percent for the five-year reporting period from 2001 to 2006.

Hilton Head Island

With the second greatest number of housing units (8,851) in 1980, Hilton Head Island now has by far the largest number (31,569) of housing units by planning area. It is further expected that growth will continue at the rate of 11 percent for the five-year period from 2001 to 2006.

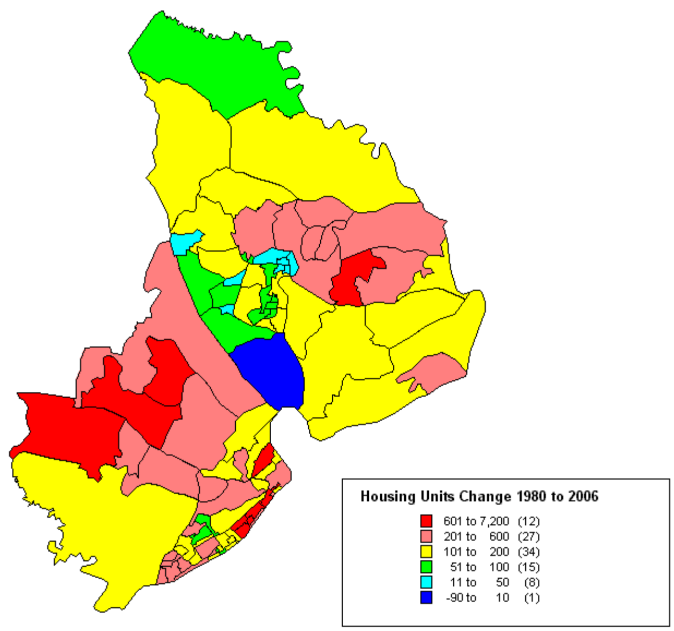


Figure 2.13 Beaufort County housing unit change by planning area 1980-2006[4]

Lady's Island

With 1,492 housing units in 1980, Lady's Island grew by 4,562 over the 21-year period from 1980 to 2001. With 4,562 housing units reported in 2001, it is anticipated that a 19

[4] Number in parenthesis ( ) indicates number of Block Groups within each range

percent growth rate, which is the second highest percentage growth rate in the county, will increase the number of housing units to 5,439 by 2006.

Port Royal Island

With 11,524 housing units in its planning area in 1980, Port Royal Island had the largest number of housing units of all planning areas. Over time it has continued to grow, however, at a lesser rate (57 percent) than other planning areas in the county. With a reported 18,084 housing units as of 2001, it is expected that Port Royal Island will grow by 7 percent over the five-year reporting period from 2001 to 2006.

Sheldon

Sheldon has consistently had the lowest number of housing units from 1980 to 2001 of all planning areas. Over the 1980 to 2001 reporting period it grew by 100 percent. Based on current housing unit figures of 1,721 for the planning area, it is projected that the area will have a below-countywide-average percentage increase (10 percent) in housing units, bringing it to 1,893 housing units by 2006.

2.7 Households

2.7.1 Beaufort County

Beaufort County had 20,115 households at 1980. The number of households grew by 48,271 over the 21-year reporting period between 1980 and 2001. Bluffton, Lady's Island, and St. Helena Island planning areas experienced the most significant increase in the number of households during this period. It is projected that there will be a 13 percent increase countywide in households over the five-year period from 2001 to 2006, with Bluffton and Lady's Island each expected to experience the highest increase in households.

2.7.2 County Planning Areas

Bluffton

Bluffton planning area had 1,315 households in 1980. As of 2001, the number of households had risen to 8,129. Projected household growth figures over the five-year period from 2001 to 2006 reflect an anticipated 25 percent growth in households, almost twice the growth rate in households projected for the county (Figure 2.14). It is anticipated that by 2006, Bluffton will rank third by planning area for households.

St. Helena Island

St. Helena Island planning area had 1,529 households in 1980. This grew to 2,405 units by 1990. As of 2001 the number of households had risen to 3,787. Projected household growth figures over the five-year period from 2001 to 2006 reflect an anticipated 13 percent growth in households, the average growth rate in households projected for the county.

Hilton Head Island

Hilton Head Island planning area had 4,564 households in 1980, making it the second largest planning area by households at that time. As of 2001, the number of households had risen to 15,661, making it the largest planning area by households. This trend is projected to continue as figures over the five-year period from 2001 to 2006 anticipate a 12 percent growth rate in households to 17,618 persons.

Lady's Island

Lady's Island planning area had 1,173 households in 1980, growing by less than 1,000 by 1990 and 4,018 households according to the 2001 data. Projected household growth figures over the five-year period from 2001 to 2006 reflect an anticipated 19 percent growth in households, the second highest household growth rate by percentage for a county planning area.

Port Royal Island

Historically, the largest planning area by household in 1980 with 10,680 households, Port Royal Island only experienced 51 percent growth for the period between 1980 to 2001. An anticipated growth in households of only 7 percent, the lowest by planning area in the county, will see Hilton Head Island continuing its trend of exceeding Port Royal Island's number of households.

Sheldon

Sheldon planning area with only 854 households in 1980 was the smallest planning area by households countywide. The 2001 data indicated that the number of households in the area rose by 86 percent to 1,442 households. Projected household growth figures over the five-year period from 2001 to 2006 reflect an anticipated 10 percent growth in households, less than the county average (13 percent). It is anticipated that Sheldon will continue to be the smallest planning area by households in 2006.

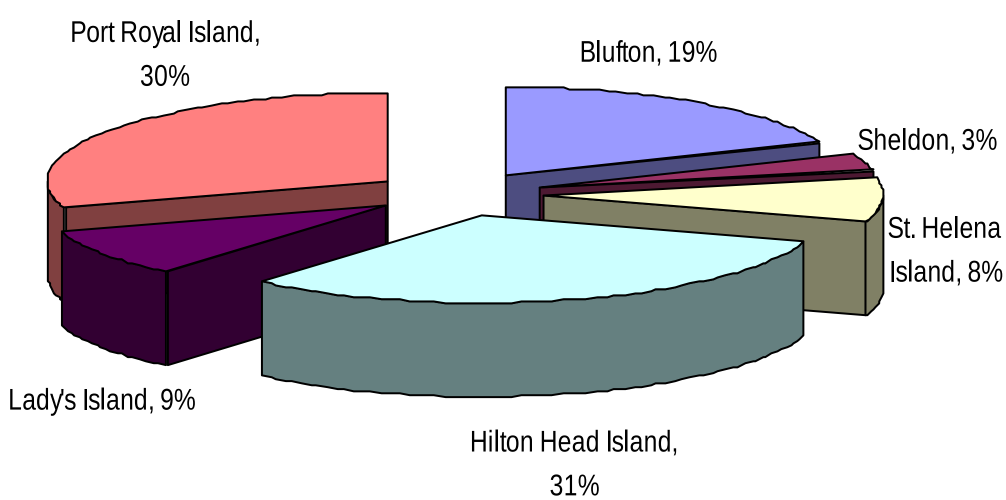


Figure 2.14 Projected households by planning area (2006)

2.8 Household Income in Beaufort County

Beaufort County 2001 income estimates indicate that less than four percent of all income groups within the county earn less than $5,000 annually (Figure 2.15 and 2.16). Another four percent earn between $5,000-10,000 per year.

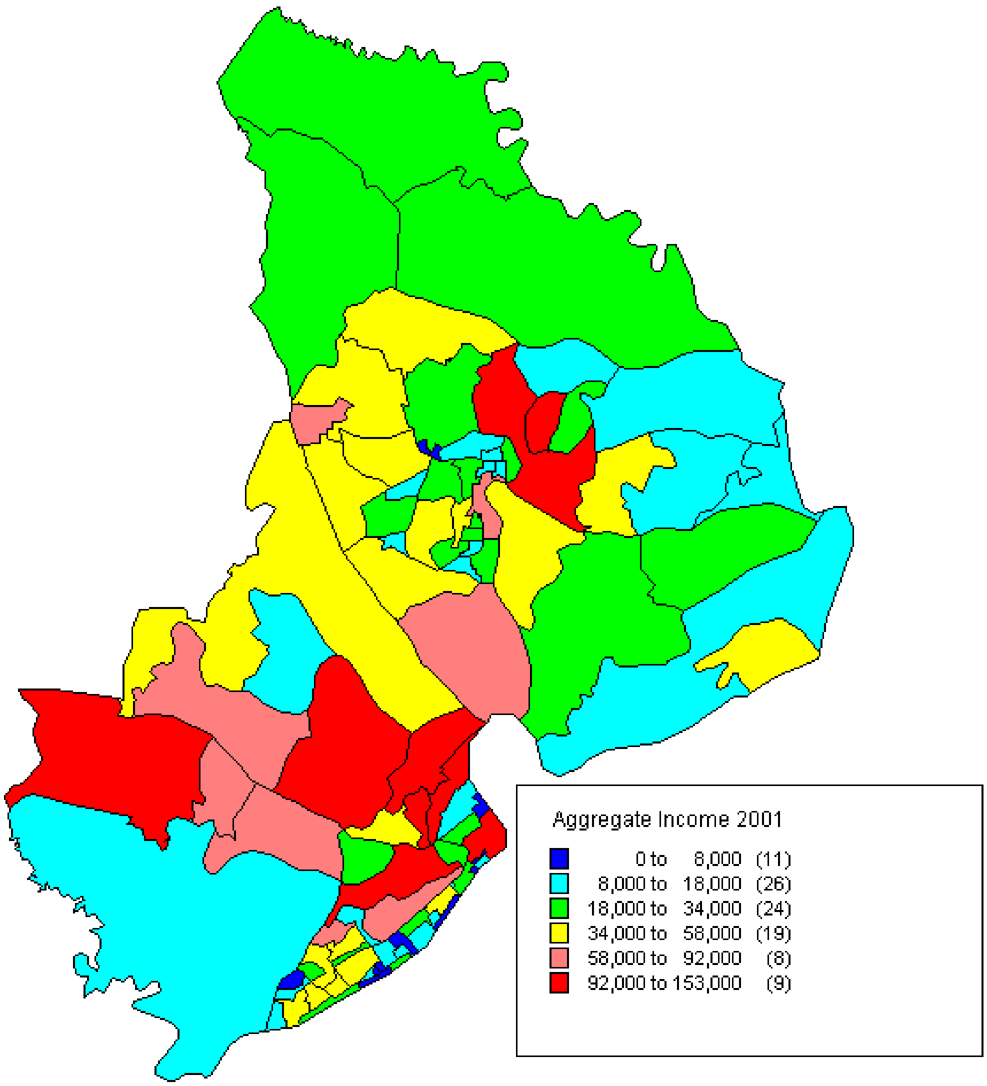


Figure 2.15 Beaufort County aggregate income by planning area census tract 2001[5]

Approximately 25 percent countywide have less than $25,000-household income, while almost 50 percent of all income groups generate more than $50,000 annually. More

[5] Number in parenthesis ( ) indicates number of Block Groups within each range

than 17 percent receive at least $100,000 annually. Hilton Head Island has the greatest number of households (15.5 percent) with an income of more than $150,000. Sheldon has the highest percentage (20.2 percent) of households with an income less than $10,000 per annum.

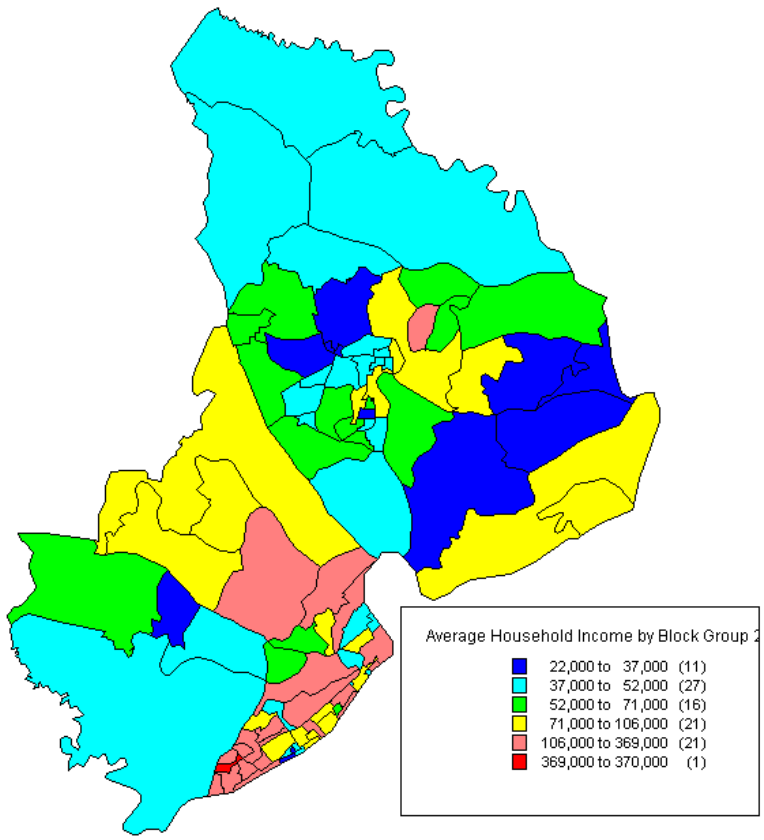


Figure 2.16 Beaufort County average household income by census block group 2001[6]

Household income projections countywide for 2006 indicate that almost 25 percent of households are expected to generate an income greater than $100,000 annually. However, 8.5 percent of St. Helena Island and Sheldon planning area households will generate less than $5,000 per year. Almost 20 percent of the county's households will have incomes less than $25,000,with over 50 percent earning above $50,000.

[6] Number in parenthesis ( ) indicates number of Block Groups within each range

Lady's Island (23.2 percent) and Hilton Head Island (21.5 percent) will have the highest percentages of households with incomes greater than $150,000 per year, with Port Royal Island having the lowest percentage (4.4 percent) of households with an income greater than $150,000.

2.9 Wastewater Disposal in Beaufort County

In 1990, the means of wastewater disposal for the 45,981 housing units in Beaufort County was predominantly public sewer, 28,393 (62 percent), which is greater than the state average of 58 percent. Thirty-seven percent or 17,327 housing units used an onsite wastewater treatment and disposal system that is three percent less than the state average (Figure 2.17).

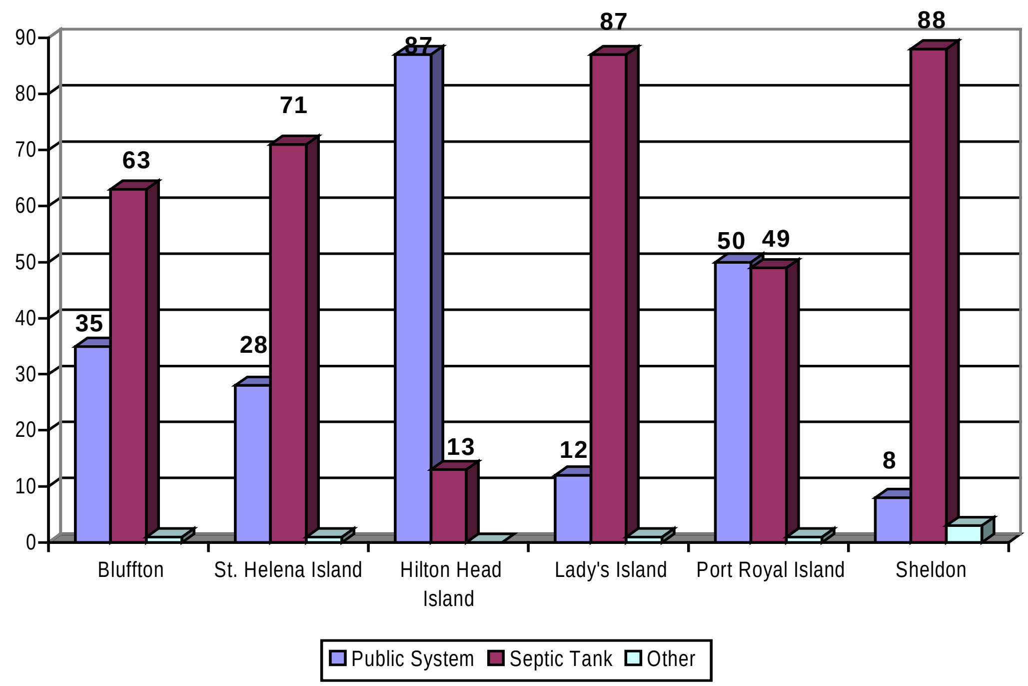


Figure 2.17 Percent of housing units utilizing OSDS by 1997 census block groups

The 33-year state trend was a 40 to 42.8 percent housing units' reliance on onsite wastewater disposal systems from 1970 to 1990. This trend has consistently been approximately 18 percent more than the national average.

Based upon this 33-year onsite wastewater disposal system trend in relation to the increasing population and growth in housing units, it is estimated that currently there are more than 22,000 onsite systems situated in the county (Figure 2.18 and 2.19). Port Royal Island planning area had the greatest number of onsite systems, 6,501. Of the six planning areas, Sheldon and Lady's Island had the highest percent of onsite systems, 88 and 87 percent respectively. The Hilton Head Island planning area has the lowest percent of housing units served by onsite systems.

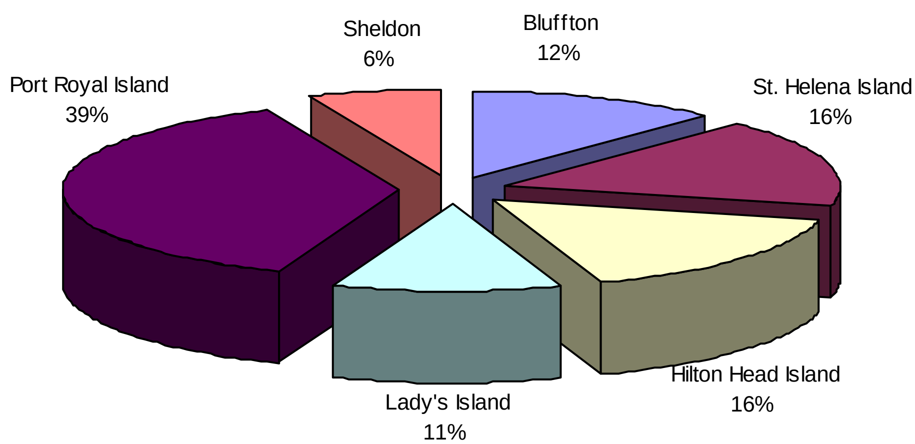


Figure 2.18 Number of onsite wastewater disposal systems by planning area (1990)

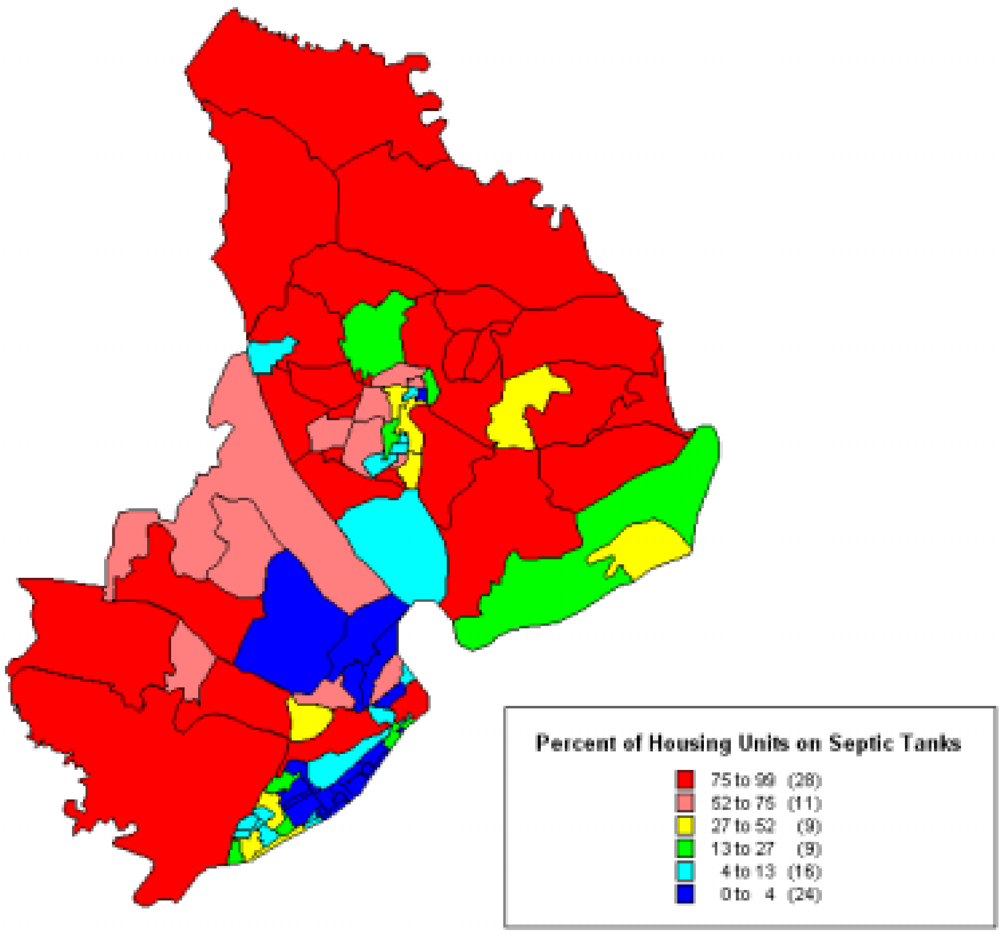


Figure 2.19 Percent of housing units on onsite systems[7]

Based upon 1990 U.S. Census data, 17,237 of the 45,981 (37.5 percent) housing units reported using an onsite wastewater disposal system as a means of sewage disposal. During this reporting period, the total countywide population was recorded as 86,425.

U.S. Census 2000 reports a 34,512 population increase as well as a 14,528 increase in housing units. Based upon the 33-year county onsite wastewater disposal trend, certain assumptions may be made.

1. The use of onsite/decentralized wastewater systems continues in the county.

[7] Number in parenthesis ( ) indicates number of Block Groups within each range

2. Approximately the same percentage of housing units served by an onsite/decentralized wastewater system over the past 30 years is a reasonable reflection of current trends.

Therefore, a universe of 60,509 housing units countywide, with 35 percent of all housing units served by an onsite/decentralized wastewater system, means that there are approximately 21,200 currently operating onsite/decentralized systems.

2.10 South Carolina Coastal Counties - A Comparative Analysis

Beaufort County is one of six coastal counties along a coastal shoreline of 2,876 miles in South Carolina. Of the 5,164 square-mile area of these counties, Beaufort County (587 square miles) represents 11.38 percent and is the smallest county by square-mile area. Horry (1,134), Colleton (1,057), Charleston (917), Georgetown (815), and Jasper (654) counties respectively are larger by area than Beaufort County (Figure 2.20).

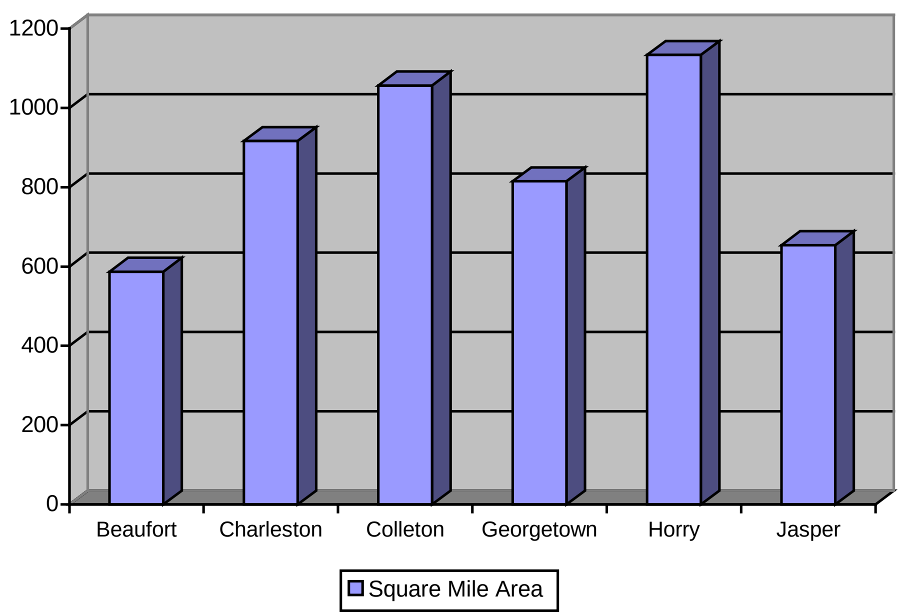


Figure 2.20 South Carolina coastal counties by square mile area

Beaufort County compares by square mile area with Atlantic regional counties, such as:

Fairfield, New Haven, and New London counties, Connecticut

Kent County, Delaware

Indian River, Martin, and St Lucie counties, Florida

Liberty County, Georgia

Baltimore and Dorchester counties, Maryland

Atlantic County, New Jersey

Albany County, New York

Carteret County, North Carolina

Of the total square-mile area of the coastal counties region, the six coastal counties have 4,813 square miles of rural area. This represents more than 93 percent of the total square mile area (Figure 2.21).

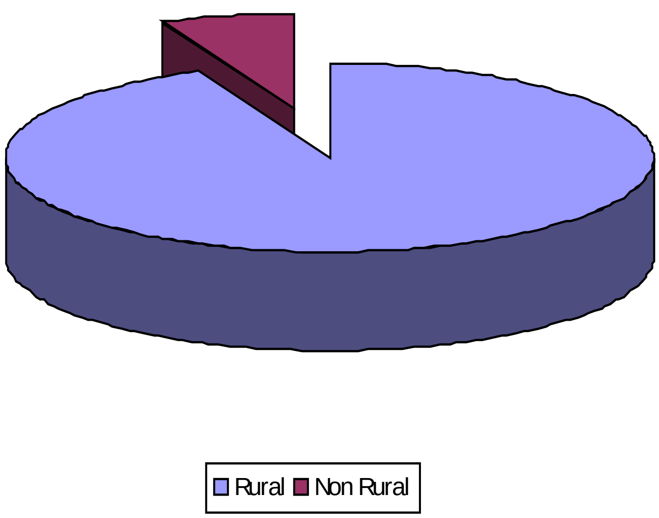


Figure 2.21 South Carolina coastal counties by rural and non-rural square mile area

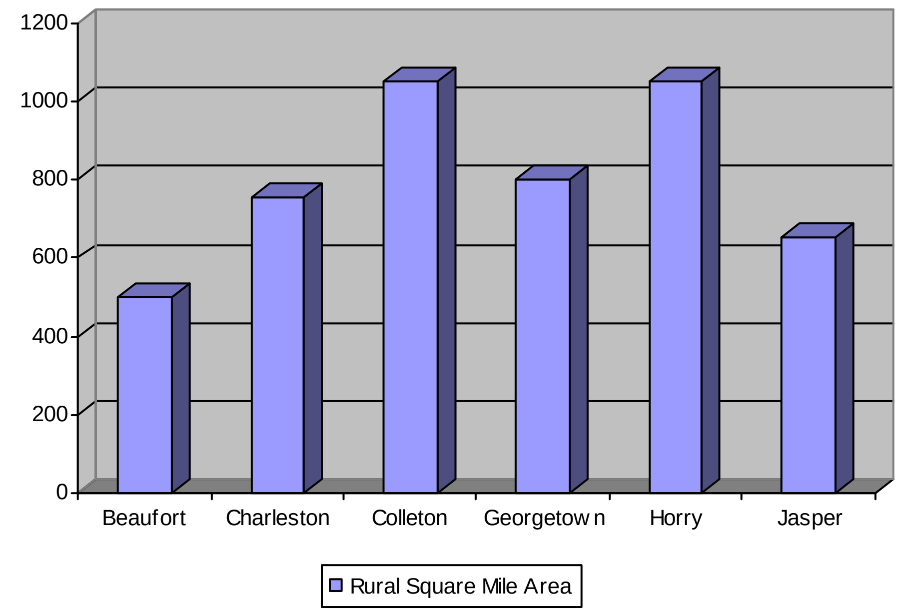


Figure 2.22 South Carolina coastal counties by rural square mile area

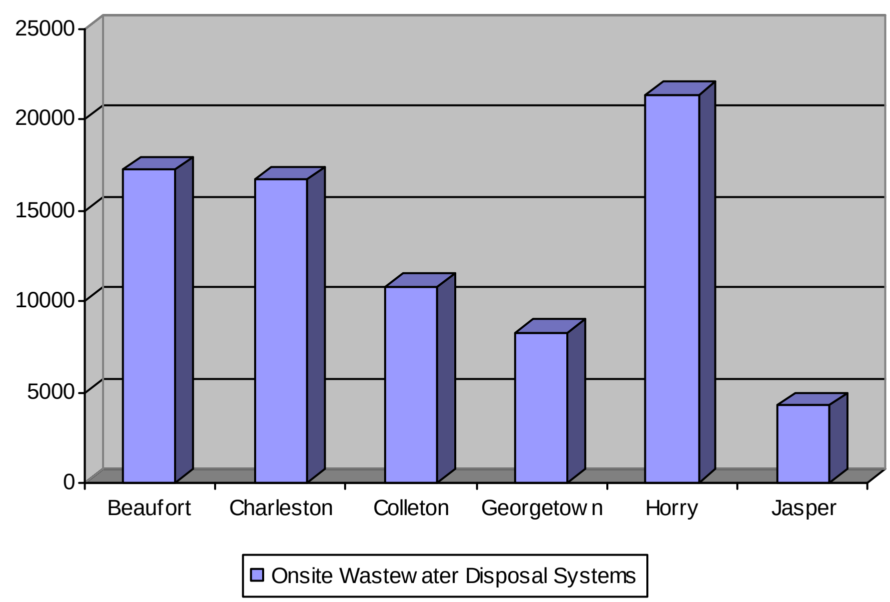


Figure 2.23 South Carolina Coastal Counties by Onsite Systems

Horry County has the largest rural square-mile area (1052.80) of all coastal counties, followed by Colleton (1051.80) and Georgetown (800.90) counties. Beaufort County has the fewest number of rural square miles (499.90) of all South Carolina coastal counties

(Figure 2.22). According to the U.S. Census (1990), there were 78,657 onsite wastewater disposal systems located in the coastal counties of South Carolina (Figure 2.23). The majority of onsite systems were located in Beaufort, Horry, and Charleston counties. Almost 22 percent were located in Beaufort County.

The density of OSDS (Figure 2.24) varies significantly among the six coastal counties. Beaufort County with 29.36 onsite systems per square mile has the highest density of onsite systems by coastal counties followed by Horry (18.86) and Charleston (18.19) counties. Jasper County has only 6.51 onsite systems per square mile area.

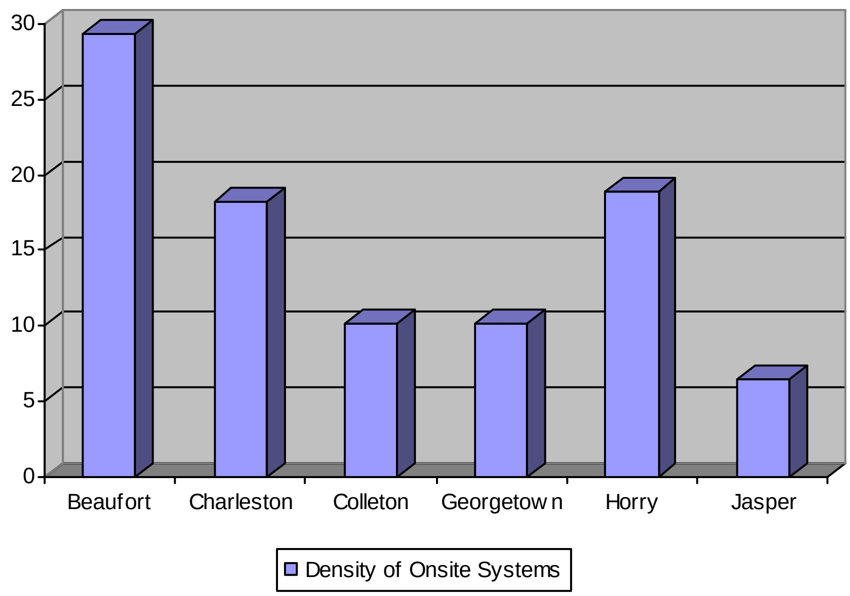


Figure 2.24 Density of onsite systems in Beaufort County

A comparative analysis of the density of Beaufort County onsite/decentralized wastewater systems by Atlantic region counties (1990) indicates that the density of systems in Beaufort County is:

- less than all Connecticut counties,
- less than most Delaware counties,
- less than the majority of Florida counties,
- greater than all Georgia coastal counties,

- less than most Maine and Maryland counties, as well as New Hampshire and New Jersey counties, and
- less than the majority of New York and Rhode Island counties, while being reasonably equal to both Virginia and North Carolina counties.

Of the 118 Atlantic region coastal counties, Beaufort County ranks 38th numerically in terms of the number of onsite/decentralized wastewater systems situated within its boundaries. South Carolina is one of 22 states with coastal counties.

California has a coastal population of almost 22 million followed by New York State with just over 15 million. Florida's coastal population is more than 12 million, which is almost double that of New Jersey. These four states represent 68 percent of the total coastal population of all coastal zone states. South Carolina's coastal population of 742,274 is comparable in range (600,000-800,000) to the states of Delaware, North Carolina, Maine, and Rhode Island.

Chapter 3
Inspection and Maintenance

3.1 Introduction

There are several important reasons for communities to consider implementing a community onsite management system to manage OSDS within their jurisdiction. These include:

- Protect public health and environment,
- Minimize "failure" (malfunction). Failure is any situation in which the public or environment is put at risk.
- Ensure compliance with county and state regulations.
- All OSDS need maintenance, from the simplest to the most sophisticated,
- Many homeowners do not maintain systems: "*out of sight, out of mind"* or simply unbudgeted,
- A cluster system is a joint venture by a group of homeowners and cannot function without some form of management.

3.2 Management of OSDS

In 1997, USEPA issued a report titled "*Response to Congress on Use of Decentralized Wastewater Treatment Systems."* This report was a milestone in that it represented the first time EPA acknowledged that sewering the entire country was not feasible and that onsite/decentralized wastewater systems are a viable alternative to centralized facilities. The report also described the inherent benefits of properly managing onsite/decentralized wastewater systems:

- More cost-effective than central sewer alternatives, except in densely populated urban centers;
- Longer service lives for managed onsite systems vs. unmanaged systems;
- Faster response to problems and smaller problem impacts;
- Increased opportunity for better watershed management;
- Better groundwater protection and management capabilities; and
- Increased property values.

The process of considering and developing a community **Onsite Management System (OMS)** is beneficial in itself because it fosters community visioning and long-term planning, enhances stakeholder information exchanges, and serves as the basis for other water issue planning needs. An OMS also promotes professionalism among service providers, offers the opportunity for performance-based continual improvement rather than prescriptive regulation, provides a vehicle for funding needed services, and makes enforcement approaches more flexible. Despite the inherent advantages of properly managed OSDS, five major barriers continue to inhibit full utilization of community onsite/decentralized wastewater management systems:

- Lack of knowledge about the benefits and potential uses of onsite/decentralized systems on the part of regulatory officials, technical practitioners, local governments, and citizens,
- Legislative and regulatory constraints that discourage optimum use of onsite/decentralized systems,
- Lack of community OMSs that can optimize performance of OSDS technologies,
- Liability and engineering fees that discourage considering these alternatives, and
- Financial barriers that discourage the application of onsite/decentralized systems.

Overcoming these barriers requires significant effort on the part of federal, state, tribal, and local regulatory authorities and the management entities developed to support them. The EPA identified several actions, listed below, as essential in addressing the barriers, listed above.

- Improved education of technical practitioners, including engineers, service providers (those responsible for site evaluation, installation, and operation/maintenance), regulators, local citizens, and political leaders who need to understand how systems work, how they should be managed, and how they affect public health and water quality. Efforts by the U.S. Department of Agriculture (USDA), EPA, NESC, and other national organizations are underway to improve education of engineers, service providers, regulators, and others who assist small communities.

- Improved regulatory programs based upon system performance, rather than using restrictive codes that rely on assumptions that certain site characteristics will protect public health and water resources. The EPA, the National Onsite Wastewater Recycling Association (NOWRA), and some states are seeking to develop management approaches to expand the range of technical options to solve existing onsite wastewater problems.
- Developing effective OMSs to ensure that performance requirements are met. The management guidelines and this handbook are part of a major effort by EPA, NESC, National Onsite Demonstration Program (NODP), and National Capacity Development Project (NCDP) to gather and share information about successful management approaches that enable small communities to protect public health and environmental quality in an affordable, cost-effective manner.
- Establishing supportive financing programs that assist local communities in creating and implementing effective management programs. The EPA, USDA, and others have programs designed to assist small communities. Federal, state, tribal, and local governments, as well as private sector funding sources and public/private partnerships, need more creative financing approaches.

3.3 What is a Community Onsite Management System?

A community OMS is that part of the overall community management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and the resources for developing, implementing, achieving, reviewing, and maintaining the community's onsite/decentralized wastewater management policy.

A community's onsite/decentralized wastewater management policy is the community's statement of its intentions and principles in relation to its overall onsite/decentralized wastewater management performance that provides a framework for action and for setting its onsite/decentralized wastewater management objectives and targets. Such a policy is appropriately formulated to meet a community's needs, and includes a commitment to comply with existing regulations and prevent pollution as well as to commit to continual improvement. Planning, implementation, operation, checking and corrective action along with management reviews, are integral elements of an effective community OMS.

3.3.1 Community Onsite Management Systems in South Carolina

Based on an analysis of Beaufort County communities, current ordinances and regulations do not include provisions for ongoing inspection, maintenance, and overall management of onsite/decentralized wastewater systems within its jurisdiction. The same situation applies across the state of South Carolina. However, the communities of Folly Beach and McClellanville are currently in the process of independently crafting enabling mechanisms to formalize community onsite/decentralized wastewater management efforts.

3.3.2 Coastal Zone Community Onsite Management Systems

Few coastal zone state regulations include provisions for the inspection, maintenance and overall management of an OSDS. The following is a review of coastal zone states that have established notable regulatory inspection, maintenance, and management requirements.

Maine

The property owner, or the owner's agent, is responsible for the safe and sanitary maintenance of an OSDS from "cradle to grave." Tank contents are to be removed whenever sludge and scum occupy one-third of the tank's liquid capacity. Ownership of all parts of a multi-user system beyond the building sewer is vested in a single and independently, legally-established entity. The entity is required to have an access easement, to service, to replace or repair any part of the system recorded against any associated properties (Maine Dept. of Human services and Health, 2000).

New Hampshire

Citizens with onsite/decentralized wastewater treatment and disposal systems with an ongoing professional maintenance requirement are expected to enter into a service contract for such services prior to attaining operational approval. Innovative/alternative technology owners are required by a covenant, that should the system fail to operate in terms of the state definition of failure, the system must be replaced by a conventional OSDS. For condominiums, responsibility for maintenance, operation, and replacing OSDS is to be clearly established by the condominium agreement (NH Department of Environmental Services, 1997).

Massachusetts

Full responsibility for inspecting, maintaining, and managing of all OSDSs within the state rests with the owner (MA Department of Environmental Protection, 1996).

Rhode Island

As with Massachusetts, responsibility for the inspection and ongoing maintenance management of all OSDS within the state rests with the owner. However, the director of Rhode Island Department of Environmental Management may order the owner to clean or repair such systems if he finds them to be in need of the same. Educational materials about operation and maintenance are published annually for distribution to homeowners (RI Department of Environmental Management, 1998).

Connecticut

Upon determining that the subsurface sewage disposal system has been installed in compliance with requirements, the local health director issues a permit to discharge. Such permits require proper operation and maintenance of any pollution abatement facility required by such permit. However, specific requirements for such operation and maintenance are not specified (CT Department of Public Health, 2000).

New York

Reduced separation distances may be approved upon request when the site evaluation by a design professional or soil scientist establishes that there will be no adverse environmental impact, and reducing the distance will not interfere with the satisfactory ongoing system operation and maintenance. No operation and maintenance protocols are stated in the regulations (NY Department of Health, 1990).

New Jersey

All property owners served by an OSDS statewide are issued written notification about how to properly operate and maintain their systems. The notice is reissued every three years (NJ Department of Environmental Protection, 1999).

Delaware

The responsibility for operating and maintaining an OSDS rests with the property owner. Systems are required to be pumped by a licensed liquid waste hauler according to an established schedule set forth in the state guidelines. Property owners are required to keep a record of pumping, and may be required upon request to produce documentation to the Department of Natural Resources and Environmental Control. The Department of Natural Resources and Environmental Control may impose specific operation and maintenance requirements for individual or community systems as determined. A responsible management entity is required to inspect community systems annually (DE Department of Natural Resources and Environmental Control, 1985).

Maryland

The state requires maintenance contracts between the owner of a holding tank and an approved service provider (Maryland Department of Environment 1991, and 1992).

Virginia

The state has adopted flexible guidelines (Virginia Department of conservation and Recreation, 1995) whereby the Commissioner may require operation and maintenance procedures, and schedules "whenever deemed appropriate." However, inspection ports and effluent filters must be provided in septic tanks, and for the optional installation of reduced maintenance septic tanks (30 percent larger, with baffles).

North Carolina

Comprehensive and extensive requirements for operating and maintaining onsite sewage disposal systems have been adopted (North Carolina Department of Health, Environment, and Natural Resources, 1999). Responsibility for operation and maintenance rests with the property owner. Conventional septic systems require pumping when solids accumulation exceeds one third of the tank volume. All other systems are required to be inspected and maintained at six-month to five-year intervals, or depending upon system complexity. A contract between the property owner and a management entity is required for the continued validity of an operational permit.

Georgia

The property owner is responsible for properly operating and maintaining the onsite/decentralized wastewater system. A cluster system serving properties owned by separate people is required to have a contract signed by all owners to properly operate and maintain the common system (Georgia Department of Human Resources, 2000).

Florida

The Department issues annual operating permits and performs annual inspections for engineer designed onsite/decentralized systems (Florida Department of Health, 2000).

Mississippi

The developer, owner(s) or their agent is responsible for operation and maintenance of onsite/decentralized systems. No provision is made as to how this shall be managed (Mississippi Department of Health, 1996).

Texas

Aerobic treatment unit distributors are required to inspect and repair systems for a two-year period subsequent to installation with extension at the owner's option (Texas Natural Resources Conservation Commission, 1997).

Washington

Responsibility for operating and maintaining an onsite/decentralized wastewater system rests with the system owner who is required to check the level of solids accumulation every three years and to call in a septic tank pumper as necessary. Periodic checks by local health authority inspectors ensure that inspection and maintenance procedures are being carried out. Protocols for operating, monitoring, and maintaining onsite/decentralized systems are set forth in a guidance handbook (Washington State Department of Health, 1995).

3.3.3 New and Repair Onsite Systems Permitted by Coastal Zone States

During 1998, almost half-a-million new onsite systems were permitted in coastal states, while more than 100,000 repair permits were issued (National Environmental Services Center, 2001). South Carolina issued 15,833 (3.3 percent) of all new onsite system permits and less than 0.5 percent of all repair permits. For comparative purposes, the adjacent states of Georgia and North Carolina issued 31,730 and 42,522 new permits respectively, and 4,707 and 7,399 repair permits. Virginia issued the greatest number of new permits (52,402), while Florida issued the largest number of repair permits.

3.3.4 Types of Enforcement Systems by Coastal Zone States

South Carolina uses fines and civil penalties to enforce regulations, which is the national trend. However, the states of Rhode Island and Delaware extensively use criminal violations for purposes of agency enforcement. In general, the agency enforcement approach in South Carolina is similar to that of the states of Connecticut, Maryland, Georgia, Massachusetts, and Oregon.

3.3.5 Inspection and Maintenance by Coastal Zone States

Onsite inspections may be conducted for several reasons, including but not limited to: new construction installation, complaints, failing system, additions and/or replacements to dwelling, property transfer, home sale, change of use or sewer flow, and maintenance schedules.

South Carolina personnel almost always conduct an onsite inspection for new construction installations or in response to complaints (National Environmental Services Center, 2001). Frequently, inspections are conducted for failing systems, while occasionally an inspection is conducted at the time of additions and/or replacements to dwellings when there is a change of use, sewer flow or when requested. South Carolina does not conduct inspections at the time of transfer or sale of property, or on a specific maintenance schedule.

In general, coastal zone states almost always conduct inspections for new construction and installation, in response to complaints, or when a failing system is identified. Most of the time additions and replacements to dwellings are inspected. Often an inspection will be conducted in response to a request, while almost half of the states execute an inspection at time of property transfer, or house sale, or when a change of use or sewer flow is noted. Only 14 percent of states conduct inspections based upon specific required maintenance schedules.

3.3.6 Community Onsite Management System: National Survey

A recent study of community OMSs conducted by the NODP at the NESC, surveyed sixty communities managing over half a million onsite/decentralized systems with self-declared onsite management entities (OMSs) across 17 states. The survey addressed a myriad of issues ranging from the impetus for action, sources and types of authorities granted, institutional frameworks for action, operation and maintenance, system failure rates, data management tools, overall management services, funding streams and financing mechanisms. This survey shares valuable insights into onsite management initiatives currently enabled and operating (yet to be published).

3.4 National Onsite Wastewater Management Initiatives

Currently, the EPA is developing guidelines for the managing onsite/decentralized wastewater treatment systems. These voluntary guidelines are designed to assist state and local officials, service providers, and other interested parties to improve existing and new onsite/decentralized system performance in a sustainable manner (Appendix

A). Individual and small cluster systems presently serve approximately one in every four housing units in the U.S., treating and releasing almost five billion gpd. Managing these onsite systems to ensure long-term public health and water resource protection, however, is relatively new, since they were originally installed with the idea that they would receive little, if any, management. Sensitive environmental conditions, poor soils and site conditions, high system densities, and the increasing use of mechanical components (e.g., electric pumps and switches) require improved *regulation* and *management*. Regulations as prescribed by state and local codes is typically adapted by a regulatory authority, such as, a county health department or water quality agency.

Management activities—planning, establishing performance requirements, site evaluation, design, construction, operation/maintenance, residuals management, training and certification, public education and involvement, inspection and monitoring, compliance enforcement, record keeping and reporting, and financial assistance—can be undertaken by an enhanced regulatory authority, independent service provider, other public agency, or other public and/or private *management entity* charged with responsibility for ensuring that these functions are properly carried out.

The structure and operational processes of a community's OMS will depend upon the circumstances, capabilities, resources, and commitment of each community. Many communities will likely develop a management system that involves several local organizations, such as traditional regulatory authorities, planning departments, approved service providers, environmental agencies, and/or design professionals. Others might opt for a more comprehensive program vesting most management responsibilities in a sanitation board, service district, or other entity that might own, maintain, and operate a number of onsite/decentralized treatment systems. Configuration and coordination arrangements of a community OMS will vary greatly across the nation, but all must be sustainable and responsible for the long term. All OMSs should have as their primary goal the protection of human health and water resources from disease-causing bacteria, nitrates in groundwater, high nutrient levels, and other potentially harmful pollutants.

The EPA approach is based upon a few essential concepts that are the earmarks of an effective community onsite management system (US EPA 2002):

- Regulatory authorities or management entities should create and maintain descriptive inventories of all existing systems.
- Those systems must be operated and maintained in a manner that ensures proper performance to protect public health and environmental resources.
- Increased management attention is needed for mechanized systems, larger and higher-density developments, and sensitive (high-risk) environmental settings.

Examples of elements the EPA perceive to be core characteristics of an effective community onsite/decentralized management system are listed below. The activities associated with each *element* will be based upon local resources and capabilities but should address the public health and environmental goals of each community. Local communities are encouraged to find the appropriate mix of elements and activities within the *management continuum* to meet their health and environmental goals. The enabling of an OMS should be a community decision that the onsite management system (OMS) is appropriate, affordable and sustainable over time.

- ***Planning*** based on cumulative impacts upon human health and water resources,
- ***Performance requirements*** to ensure appropriate system design and technology selection,
- ***Site evaluations*** and wastewater characterizations to guide system sizing and design,
- ***System designs*** that consider site conditions and performance requirements,
- ***Construction oversight*** to ensure compliance with design, siting, and performance criteria,
- ***Operation and maintenance*** functions focusing on performance and minimize risk,
- ***Residuals management*** programs that protect health and water resources,
- ***Training, Certification and licensing*** of regulators and all service providers,
- ***Public education and involvement*** programs for the serviced population,

- ***Inspections and monitoring*** to assess and document performance and initiate remediation,
- ***Checking & Corrective actions*** to ensure compliance when systems require repair, expansion, or replacement,
- ***Record keeping and reporting*** to support planning and management activities, and
- ***Financial assistance*** to support management programs and system installation/repair.

3.5 USEPA Onsite/Decentralized Management Approaches

The EPA suggests five OMS approaches (Table 3.2) by describing points along a management continuum that range from better record keeping, to system inventories, to improved public awareness of maintenance needs. Management entity responsibilities increase progressively from OMS approach 1 through 5, reflecting not only increased levels of management activities needed to achieve more stringent water quality and public health goals, but also increased capability needed to effectively manage more complex technologies (US EPA 2002).

The EPA is actively encouraging states and local communities to consider onsite/decentralized wastewater management approaches as a basis for their community OMSs because of the continuing public health and water resource threats that poorly performing, unmanaged onsite/decentralized systems pose. A small investment in improved management of onsite and cluster systems might prevent the need for subsequent—and much larger—investments in centralized wastewater facilities or in continued repair/replacement of decentralized systems that fail because they lack management attention. Existing and newly developing communities can benefit from using OMSs for residential and commercial facilities.

The OMS development group members should recognize that for each element there is a range of possible approaches, and that the appropriate activities for each element should be based upon the best judgment and capabilities of the community. For example, rural jurisdictions with little new residential or commercial construction will likely have a less developed planning function than a jurisdiction outside a major city facing large-scale development. Some jurisdictions might establish a rigorous program for certifying and licensing third-party design professionals, while others might allow only health department staff to design systems. There are a wide array of possible permutations of an OMS within the overall management continuum considering the list of elements and the range of activities under each.

Table 3.1 lists OMS elements and some activities related to each (US EPA 2002). The key point in developing an OMS is to address real, perceived, and developing problems with actual, on-the-ground resources or programmatic capabilities. Prioritizing, targeting, and addressing human health and water resource threats will likely drive development of program element activities that might fit anywhere across the management spectrum.

Table 3.1 Summary of management program elements and possible approaches

OMS element	Purpose	Basic activities	Advanced activities
Planning	Consider regional and site conditions and impacts; long-term watershed and public health protection	Establish surface/ground water setbacks and/or identify critical areas requiring more protection	Monitor and model regional pollutant loads of different development scenarios; tailor system performance requirements to receiver site environmental conditions
Performance requirements	Link treatment standards and relative risk to health and water resources	Prescribe acceptable site characteristics and/or system types allowed	Require system performance to meet standards that consider water resource values, vulnerabilities, and risks
Site evaluation	Assess soil-based and other treatment possibilities that meet performance requirements	Characterize landscape position, soils, ground & surface water location, site size, and other conditions	Assess cumulative watershed impacts, groundwater mounding potential, long-term treatment prospects, and cluster system potential
Design	Ensure system is appropriate for site and wastewater flow/strength	Prescribe a limited number of acceptable designs for various site conditions	Implement a process for developing alternative designs that meet performance requirements for each type of site and wastewater flow/strength conditions
Construction/ Installation	Certify installation as designed; record as-built drawings	Inspect installation prior to covering with soil	Supplemental training, certification & licensing programs; provide inspection of installations; verify & enter as-builts

OMS element	Purpose	Basic activities	Advanced activities
Operation and maintenance	Ensure systems meet performance requirements and minimize risk	Homeowner education/ reminder programs that promote regular inspections & pumping	Renewable, revocable operating permits with reporting requirements; electronic web-based monitoring; and responsibility for O/M activities
Residuals management	Minimize health or environmental risks from residuals handling/disposal	Require compliance with federal, state, local residuals disposal codes	Conduct beneficial reuse program; web-based reporting of pumpings & ultimate disposal activities; residuals education/outreach program
Training, certification and licensing	Promote excellence in design, installation, and other service areas	Recommend use of state licensed/certified service providers;	Provide supplemental training and certification/licensing programs in addition to state programs; offer continuing education opportunities
Public education and involvement	Maximize understanding and involvement of served population in management program	Homeowner brochures, circulation of training materials; program review representation	Sponsorship of wide variety of public outreach programs; involvement of served population in regular program reviews and advisory boards.
Inspections and monitoring	Document proper functioning of systems; advanced warning of possible problems	Construction inspection prior to covering; inspections prior to property title transfer; complaint response	Regional surface and ground water monitoring; web-based system and operational monitoring; periodic operational inspections
Enforcement/Compliance	Ensure compliance with applicable codes and performance requirements	Complaint reporting and prompt response procedures; nuisance laws and penalties	Denial and/or revocation of operating permit until compliance measures satisfied; set violation response protocol & legal response actions
Record keeping and reporting	Inventory development and maintenance for administrative, O/M, planning & reporting to oversight agencies	Inventory information on all systems; performance reports to health agency	GIS-enabled, comprehensive inventories; web-based monitoring capabilities for use in administration, O/M, compliance & reporting activities
Institutional support	Financial & legal support for management program; implementation of regular reviews & modifications.	Basic powers, revenue-generation & legal backup to implement a sustainable program	Monthly service fees; cost-share or other repair/replacement program; full financial & legal support for management program; equitable revenue base

The EPA model OMS approaches characterize what a community OMS might look like at various intervals along the management continuum. The approaches are presented as a series of progressive steps in the management continuum. Approaches are crafted so that the management requirements for wastewater systems become more rigorous as system technologies become more complex and/or the sensitivity of the environment increases. This concept is a key to OMS development.

The OMS models share the common goal of protecting human health and the environment. Effective implementation of any management program requires ongoing coordination among appropriate regulatory authorities and management entities. Coordination is necessary to help ensure that state and local management programs are managed on a watershed basis to protect public health and the environment and to meet state, or local water quality standards, such as applicable pathogen and nutrient criteria. The EPA believes that these goals are best achieved by using performance requirements for managed individual and cluster systems that have been developed to protect public health and the water quality of the receiving watershed and/or aquifer.

Each model program includes a set of management objectives and related program elements and activities for achieving the objectives. The model programs are benchmarks for a state or local unit of government to (1) identify management needs, (2) evaluate whether the current management program is adequate, and (3) develop an appropriate management program or necessary program enhancements to achieve public health and environmental goals. The EPA recognizes that state and local governments need a flexible framework and guidance to best tailor their programs to the specific needs of their communities and to the institutional and economic capacities of the regulatory authority. These model programs are not intended to supersede existing federal, state, or local laws and regulations but rather to facilitate compliance with them.

The model programs summarized in Table 3.2, and described in the following sections of this chapter, span the management continuum from simple inventory and maintenance awareness programs to programs with comprehensive management entities that own, operate, and maintain a number of treatment systems (US EPA 2002).

Table 3.2 Summary of OMS approaches for managing onsite/decentralized wastewater treatment systems

Approach	(1)Objectives	(2)Typical Application	Benefits	Limitations
1	**INVENTORY AND MAINTENANCE REMINDERS** Appropriate for areas of low environmental sensitivity where sites are suitable for conventional onsite systems, which are effective in protecting public health and water quality.	Ensures systems are sited and constructed properly in accordance with state/tribal/local codes and regulations that prescribe siting and design criteria that are deemed to satisfy performance requirements. Seeks to ensure that systems are regularly maintained and repaired as necessary by striving to make owners aware of maintenance needs through reminders sent to the owners by the regulatory authority. Establishes a database inventory of all systems (locations, designs, permits, and inspection reports) within the jurisdiction.	Ensures code compliant system is sited, designed and installed. Relatively easy and inexpensive to implement and maintain because it is based on existing, prescriptive system designs that rely on restrictive site criteria and system design requirements promulgated in existing codes. Provides an inventory of systems that is useful in system tracking and area-wide planning.	No mechanism provided to confirm operating compliance of systems. No mechanism provided to identify problems before failures occur. Limits building sites to those meeting the prescriptive siting requirements. Requires regulatory authority investment to implement a database of permitted systems and an owner education program.
2	(a)MAINTENANCE CONTRACTS Appropriate for areas of low to moderate environmental sensitivity where sites are marginally suitable for conventional onsite systems either due to small lots, shallow soils, or low permeability soils.	Ensures systems are sited and constructed properly in accordance with state/tribal/local codes and regulations that prescribe siting and design criteria that are deemed to satisfy performance requirements. Allows the use of more complex treatment options that may include mechanical components. Requires service contracts be maintained over the life of the system between the system owner and the equipment manufacturer, supplier, or independent service provider. Establishes a database inventory of all systems (locations, designs, permits, and inspection reports) within the jurisdiction. Establishes a service contract tracking system.	Reduces the risk of treatment system malfunctions through the requirement for sustained routine maintenance of mechanical components by skilled personnel.	State/tribal/local regulatory authority may have difficulty in tracking and enforcing compliance because it must rely on the owner or contractor to report a lapse in a valid contract for services. No mechanism is provided to assess the effectiveness of the maintenance program.

Approach	(3)Objectives	(4)Typical Application	Benefits	Limitations
3	(b)OPERATING PERMITS Appropriate for areas of greater environmental sensitivity such as wellhead or source water protection zones, shellfish growing waters, bathing or water-contact recreation or other areas where prescriptive designs alone are inadequate for meeting public health and water quality requirements.	Establishes system performance requirements for receiving environments including maintenance monitoring, possibly water quality monitoring, and compliance monitoring reporting. Allows engineered designs but also provides prescriptive designs for specific receiving environments. Allows regulatory oversight of system performance throughout its service life by issuing operating permits that must be renewed periodically but may be revoked for non-compliance. Establishes a database inventory of all systems (locations, designs, permits, and inspection reports) within the jurisdiction. Establishes a system inventory database and operating permit and compliance monitoring report tracking systems.	Allows use of onsite treatment systems in more environmentally sensitive areas or for wastes that may pose more of an environmental risk. Reduces the risk of a system operating out of compliance through a renewable/revocable operating permit issued to the owner that requires regular compliance monitoring reports. Routinely identifies non-compliant systems and initiates corrective actions.	Needs a higher level of technical/engineering expertise on part of regulatory authority to implement. Requires an effective permit tracking system. Education and enforcement activities of the regulatory authority will increase. Requires that the regulatory authority have the powers to issue citations and assess fines and penalties.
4	(c)RME* OPERATION AND MAINTENANCE Areas of moderate to high environmental sensitivity where sole source aquifers, wellhead or source water protection zones, critical aquatic habitats, outstanding value resource waters, or other critical resources exist where environmental and/or treatment complexity concerns require reliable and sustainable system operation and maintenance for resource protection or restoration.	Establishes system performance requirements for receiving environments including maintenance monitoring, possibly water quality monitoring, and compliance monitoring reporting Provides professional operation and maintenance services through RME (either public or private). Provides regulatory oversight by issuing operating or NPDES permits directly to the RME (system ownership remains with the property owner). May require the RME to monitor parts of the watershed. Establishes a database inventory of all systems (locations, designs, permits, and inspection reports) within the jurisdiction. Establishes a system inventory database and operating permit and compliance monitoring report tracking systems.	Responsibility for operation and maintenance is transferred from the system owner to a professional RME that is the holder of the operating permit. Routine monitoring and inspections identify problems needing preventive maintenance before failures occur. Allows use of onsite treatment systems in more environmentally sensitive areas or for wastes that may pose more of an environmental risk. Number of permits requiring tracking by the regulatory authority are reduced by issuing one permit for a group of systems in a watershed.	Enabling legislation may be necessary to allow a RME to hold the operating permit for an individual system owner. The RME must have owner approval to repair or replace system components, which may create conflicts between system owner and RME if performance problems identified and not corrected. Property owner may not agree to grant an easement for system access by the RME. Oversight by the regulatory authority is needed to ensure that the RME has the technical and financial capability to provide reliable and sustainable operation services to meet the permit requirements

Approach	(3)Objectives	(4)Typical Application	Benefits	Limitations
5	(d)RME OWNERSHIP Areas of greatest environmental sensitivity as described in Management Program 4. Preferred management program for cluster systems serving multiple properties under different ownership.	Establishes system performance requirements for receiving environments including maintenance monitoring, possibly water quality monitoring, and compliance monitoring reporting. Provides professional management of the planning, siting, design, installation, operation, maintenance, regulatory compliance, watershed monitoring, customer service, financing, and administration of decentralized systems through the public or private RMEs that own and manage individual systems. Provides regulatory oversight by issuing operating or NPDES permits that may require watershed monitoring directly to the RME. Establishes a database inventory of all systems (locations, designs, permits, and inspection reports) within the jurisdiction. Establishes a system inventory database and operating permit and compliance monitoring report tracking systems.	Achieves a high level of oversight for existing systems that may have performance problems. Simulates the municipal model of central sewerage by transferring all responsibilities from the system user to a RME, reducing the risk of non-compliance to the lowest level. Allows use of onsite treatment systems in more environmentally sensitive areas or for wastes that may pose more of an environmental risk. Allows effective area-wide wastewater planning and watershed management through the integration of decentralized systems with conventional sewerage under a single RME. Avoids the potential for conflicts between the user and RME that exists in Management Program 4.	Acquiring private property easements or land for treatment sites necessary for the RME to perform its functions may require formation of a public special purpose district. Greater financial investment may be necessary by the RME for installation and/or purchase of existing systems or components. Oversight by the regulatory authority is needed to ensure that the RME has the technical and financial capability to provide reliable and sustainable services to meet the permit requirements.

* - RME (Responsible Management Entity)

As noted previously, local programs will vary depending on the unique regulatory, ecological, and economic conditions of each community.

3.5.1 Inventory and Maintenance Reminders

The EPA recommends **Management Program 1: Inventory and Maintenance Reminders** as a minimum level of management (US EPA 2002). This is a suitable program in which conventional onsite wastewater treatment systems are owned and operated by individual property owners in areas of low environmental sensitivity, *i.e.*, no restricting site or soil conditions such as drinking water wells within locally determined horizontal setback distances.

Conventional systems are passive and durable treatment systems that can provide acceptable treatment under suitable site conditions, despite a lack of attention by the owner. Failures that occur and continue undetected will pose a relatively low level of risk to public health and the environment. Therefore, the objectives of this management program are to ensure that all systems are sited, designed, and constructed in compliance with the prevailing rules, that all systems are documented and inventoried by the regulatory authority, and that property owners are informed about maintenance needs of the systems.

The program is intended to provide an accurate record of the type and location of installed systems, to raise homeowners' awareness by reminding them of basic system maintenance requirements, and to ensure that the homeowners attend to those deficiencies that overtly threaten public health. This program is a starting point for enhancing management programs by providing communities with basic data for determining whether higher management levels are necessary.

3.5.2 Maintenance Contracts

The EPA recommends **Management Program 2: Maintenance Contracts** as the minimum necessary where more complex system designs are employed to enhance the capacity of conventional systems to accept and treat wastewater (US EPA 2002). For example, pretreating wastewater aerobically prior to dispersal into the soil may enhance system performance on marginally suitable sites (sites with limited area, slowly permeable soils, or shallow water-tables). Such systems can have mechanical components and sensitive treatment processes that require routine observation and maintenance to perform satisfactorily. The maintenance of these more complex systems is critical to sustaining acceptable performance in areas of greater environmental sensitivity. Therefore, these systems should be allowed only where trained operators are under contract to perform timely maintenance. The objectives of this program build on Management Program 1 by ensuring that maintenance contracts with trained operators are maintained by the property owner.

3.5.3 Operating Permits

The EPA recommends **Management Program 3: Operating Permits** where the onsite wastewater treatment system must provide treatment to achieve specific water quality criteria (US EPA 2002). Examples include estuaries or lakes where excessive nutrient concentrations may be a concern or situations where a source water assessment has identified decentralized systems as potential threats to drinking water supplies. A principal objective of this management program is to ensure that the onsite wastewater treatment systems continuously meet their performance requirements.

Toward this, end the property owner is issued a limited term operating permit that is renewable for another term if the owner demonstrates that the system complies with the terms and conditions of the permit. Where it is appropriate to use conventional onsite system designs, the operating permit may only require that routine maintenance be performed in a timely manner and that the condition of the system be inspected periodically.

With advanced treatment systems, treatment process monitoring may be required. An advantage of this management control is that treatment systems are designed to meet specific effluent limits so their application is less dependent upon site characteristics and conditions. Therefore, they can be used safely in more sensitive environments but only if they reliably and consistently meet the performance requirements. The permit provides the management program a mechanism for continuous oversight of system performance and negotiating corrective actions or levying penalties if compliance with the permit is not maintained. To comply with these performance standards, the property owner should be encouraged to hire a licensed maintenance provider.

Level 3 provides increased assurance of proper management over the first two models, and it permits the use of more sophisticated OWTS, while providing a more enforceable operation and maintenance approach. This model requires additional public outreach and education, as well as better record keeping, tracking, inspection, and permitting compliance. It features some form of notification to system owners that certain tasks are due to be performed for renewal of their operating permits.

The management entity might set certain area-specific protocols for site evaluation, design, installation, and operation/maintenance that may require supplemental training, licensing, and certification of service providers. The management program is likely to arrange periodic inspections and monitoring at the system owners' expense. This level of management also requires additional technical expertise on the part of the regulatory authority, and/or the management entity to oversee the program, especially when inspections, monitoring, or watershed/groundwater assessments are required.

3.5.4 Responsible management entity (RME) operation and maintenance

The EPA recommends **Management Program 4: RME Operation and Maintenance** where systems must meet specific water quality requirements because the environment is sensitive, such as, in wellhead protection areas or shellfish waters (US EPA 2002). Therefore, assurance that highly reliable operation and maintenance is provided is paramount. To achieve this assurance, issuing the operating permit to a RME instead of the property owner provides greater compliance control. This allows use of performance systems in more sensitive environments than outlined in Management Program 3.

For a service fee, a RME takes responsibility for operating and maintaining systems that remain under the ownership of the subscribers. This can reduce the number of permits as well as management program administration. System failures are also reduced as a result of routine and preventive maintenance. The operating permit system is identical to Management Program 3 except that the permitee is a public or private RME. States may need to establish a regulatory structure to oversee the rate structures that RMEs establish, and any other measures that a public services commission would normally undertake to manage entities in non-competitive situations. Under this approach, existing systems are analyzed and upgraded as necessary to accomplish the public health and water quality goals the regulatory authority and the community set.

System ownership remains with the property owner, and all required structural improvements or repairs are paid for by the system owners or through service fee receipts. Level 4 allows broad, flexible use of private service companies as the RME or as service providers under contract to the RME, which retains responsibility for complying with public health and water quality goals. The operating permit system is identical to the Model Program 3 except that the permittee is a public or private RME. Provisions for establishing special districts, sanitation boards, or management units that can serve as RMEs are in place in most states, though some enabling legislation adjustments might be needed to accommodate certain aspects of the management program or to ensure public oversight of rates, services, or other components.

Level 4 programs may be consolidated in management districts where onsite, cluster, and even central wastewater systems are employed. This level requires significant public education and involvement and more comprehensive record keeping, but it provides increased opportunities to cost-effectively employ cutting-edge monitoring and control systems and to positively affect regional planning efforts.

3.5.5 Responsible Management Entity (RME) Ownership

Management Program 5: RME Ownership is a variation of the RME operation/maintenance concept in Management Program 4, except the property owner no longer owns the facilities (US EPA 2002). The designated management entity both owns and operates the onsite wastewater treatment systems in a manner analogous to a conventional wastewater treatment and collection system. Under this approach, the RME maintains total control of all aspects of planning and management, not just operation and maintenance.

This management program is appropriate in environmental or public health conditions similar to those in Management Program 4, but provides a higher level of system performance control. It also reduces the likelihood of disputes between the system operator and the property owner that might arise when the property owner fails to maintain the system in working order. The RME can also more readily replace existing systems with higher performance units where necessary.

The EPA recommends implementing Management Program 5 in cases when new, high-density development is proposed in the vicinity of sensitive receiving waters. States may need to establish a regulatory structure to oversee the rate structures that RME's establish, as well as to oversee any other measures that a public services commission would normally undertake to manage entities in non-competitive situations.

Although Level 5 is a powerful and flexible management approach that removes all responsibility from the homeowners and businesses served, it is not recommended for all cases of decentralized system management. It is likely to be more expensive and requires a skilled staff to meet its obligations to the community and the regulatory oversight agencies.

Like Level 4, Level 5 also may require special enabling legislation and may be combined in management programs where onsite, cluster, and central wastewater systems are employed. This level requires a large, continuous public education and involvement effort and comprehensive record keeping and training, but it provides the greatest opportunities to cost-effectively employ cutting-edge monitoring and control systems and effectively impact regional planning efforts.

3.6 OMS – Review and Selection

The OMS selected for a particular community or service area should be based upon environmental sensitivity, public health risks, and the complexity of existing and planned wastewater treatment technologies. How a program will be implemented will depend on decisions by the local community or regulatory authorities based on locally appropriate statutes, ordinances, institutional structures, technical capabilities, public preferences, and other factors. Thus, the general framework for a program will need to be tailored to suit local circumstances and preferences.

For example, Level 1 has no ability to ensure proper management of more advanced onsite or cluster wastewater technology. Level 2 gives some control for more complex onsite systems to the regulatory authority or management entity, but is difficult to track if dependent only on unchecked reports from system owners and service providers on required maintenance activities. Level 3 gives the regulatory authority or management entity a strong legal basis for requiring compliance, but it requires more proactive oversight in the form of performance inspections in the field. Levels 4 and 5 provide the ability to vest management responsibility in a clearly identifiable RME, which provides much greater administrative and managerial ability to ensure that the program meets its responsibilities to the oversight agencies.

It must be stressed that each management entity—whether assembled from partner agencies and service providers, or created to handle the full range of program elements—will have unique requirements that will likely require some hybridization of one or more of the model programs discussed previously. For example, a management entity might elect to implement a Level 5 approach for the cluster systems that it manages because this approach is the most effective one for such systems.

However, it is perfectly reasonable to have a Level 5 program for the cluster system(s), and some lower-level approach for the remaining onsite systems, as long as they are part of the same management entity. Such a management mix might use a model 1 for conventional septic tank/soil dispersal systems or a higher-level model, depending upon the mix of technologies and the potential risk onsite systems represent. In all cases, the program should endeavor to take advantage of the existence of the cluster management entity's staffing resources.

Ciotoli and Wiswall (1982) found that voluntary levels of management, such as a homeowners' association, were inadequate as management entities because they could not legally enforce rules to maintain or restore compliance with discharge permits. Herring (2001) also concluded that homeowners were unlikely to conduct routine maintenance tasks unless gross failure occurred, and then it was too late. Providing high levels of management attention (inspections, monitoring, maintenance) to even simple treatment systems can extend the life of the systems and improve performance. Using RME staff for such purposes, therefore, makes sense if they are available and able to handle the extra work. The optimum approach will depend upon the relative number and nature of the onsite technologies in the management jurisdiction.

A different way of looking at the array of management program models is to first consider the local problems and needs. If improved public health protection is the primary concern because of a high rate of system failures, but the vulnerability of the watershed is minimal, a lower-level program might suffice since these programs are closely allied with better implementation of the existing prescriptive rules of most states. Since Levels 1 and 2 are primarily useful for improving public health protection, they should attain better hydraulic performance (fewer backups and less surfacing) than the existing unmanaged situation for new conventional and advanced onsite systems. In more ecologically-vulnerable areas where problems from unmanaged onsite systems exist, it is likely that a Level 3 or higher management entity might be in order to mitigate the present degradation and to satisfy the oversight agencies.

Another factor to consider is how the community decides to deal with equity issues. If a community establishes lower fees for more passive system types or in areas of lower sensitivity, more than one level of management could be employed in the program. The management entity in concert with the community will need to develop an equitable financial support arrangement that provides sufficient funding for projected future infrastructure replacement, and the oversight agency will need to approve it to assure compliance with existing statutes.

The implementation of higher or lower levels of management over time will often occur in progressive stages as more monitoring information becomes available, public awareness and support increases, and the ability of state, local, and tribal institutions to deal with management challenges improves over time. Implementation of Model Program 1, which is considered a minimal level of management, provides a basis for raising awareness about maintenance needs, identifying and characterizing existing or potential problem areas, and building support for higher levels of management if they are needed.

3.6.1 Environmental Sensitivity and Public Health Risk

The particular model program or management mix selected for an area should be based upon the potential for onsite system discharges to affect public health or the quality of surface and/or groundwater. The level of oversight incorporated into the management program should increase as the potential for negative impacts on public health or environmental degradation increases. Parameters to consider in assessing public health and environmental sensitivity include soil permeability, depth to groundwater, aquifer type, receiving ground and surface water use, proximity to surface waters, topography, geology, and density of development.

Another useful parameter to consider is the "susceptibility determinations" that states and local water utilities make as part of their source water assessments. These assessments determine which potential sources of pollution, including onsite wastewater systems, pose the greatest threats to potable water systems. Other issues that might directly impact public health and the local economy include the need to protect shellfish harvesting and direct-contact recreational waters.

An area far from any surface water with moderately permeable soils and a deep groundwater table might be designated as an area of low public health risk and environmental sensitivity. An area close to sensitive surface water with excessively permeable soils and a shallow, unconfined groundwater aquifer used directly (untreated) for drinking water might be designated as an area of high sensitivity.

For watersheds where it is determined that onsite wastewater systems are contributing to a violation of the ground and/or surface water quality standards, Model Programs 4 or 5 probably should be selected so that a sustainable entity is responsible for restoring or protecting the necessary quality of these waters and the watershed. More information about the pollutants of concern and their fate in soils and treatment systems is provided in the *Onsite Wastewater Treatment Systems Manual* (USEPA, 2001).

3.6.2 Types of Technologies

Onsite/decentralized wastewater system technology selection influences programmatic activities within a community OMS. One of the primary considerations when selecting the types of technologies to be permitted within the OMS is the level of sophistication of the technology options and the possible O&M elements that will need to be implemented to ensure the integrity of the systems installed for the long term. Conventional, or passive with less sophisticated technological components, requires less oversight, whereas greater oversight is needed as technology sophistication increases. A conventional septic system and gravity-fed soil absorption system depend upon simple natural processes for the treating and dispersing of wastewater back to the environment.

Properly applying the normally prescriptive elements of the regulatory code under Model Program 1 should be sufficient to minimize the hydraulic backup problems resulting from unmanaged application of that code in areas where environmental concerns are minimal and improved public health protection is the goal of the program. A more complex treatment system, such as a surface discharging aerobic system with filtration and disinfection, will require frequent routine monitoring and attention from a professional technician to maintain its performance, and, therefore, requires a higher level of management. Similarly, using sophisticated onsite system monitoring may, in itself, require a higher level of management. The *Onsite Wastewater Treatment Systems Manual* (USEPA, 2001) also provides guidance about performance and management requirements for onsite technologies.

3.7 Inspection and Maintenance Procedures

It is commonly accepted among the environmental engineering professionals that, although many thousands of basic OSDS receive almost no maintenance unless obviously degraded, there are basic inspection, testing, and maintenance procedures that onsite systems should receive at regular intervals. The content of procedures varies in proportion to the complexity of the treatment processes installed. Procedures can be described in detail for simple septic tank and drainfields, for generic pumping and other pressure distribution systems, for generic secondary and tertiary treatment systems such as single and multiple pass filters, wetlands, and mounds. The designer or installer should provide a set of as-built drawings and instructions for ongoing maintenance.

In general, where a proprietary and/or patent soil absorption system (such as drip irrigation), secondary or tertiary treatment, disinfection or ancillary equipment has been installed, training by the manufacturer or his/her agent is a prerequisite for performing any inspection, testing or maintenance procedures. The manufacturer or his agent will provide a list of contractors and professionals authorized to inspect and maintain systems.

Authorized agents based on the concepts in the following sections may perform regulatory inspection of proprietary equipment. Many of these procedures may be performed by a sanitarian, a trained and licensed septic tank hauler or other contractor. Advanced equipment may require the services of a trained technician. Generic inspection, testing, and maintenance procedures are discussed in the following sections.

A. Pre-inspection

- Obtain records and/or permit of previous inspections performed on the system from homeowner, local health department, and other record-keeping sources.

B. Homeowner interview

- Check owners' understanding of layout and key components.
- Ask about any instances of temporary or prolonged sewer backup and any measures taken.

- Confirm any report of unusual wetness around sewer, septic tank, secondary treatment system, tilefield, seepage to ditch, embankments or neighbor's property.
- Investigate any evidence of odors from house vents, tank, secondary treatment or tilefield and when the tank was last pumped and/or inspected.

C. House sewer

- Check for any evidence of settling, exposure, fracture or leakage. Open trap or manhole, if available, and, inspect for evidence of block or backup.

D. Effluent sewer

- Check for evidence of settling, exposure, and leakage.

E. Septic tank

- Look for evidence or possibility of settling, integrity of roof slab, fracture of pipe entry, or exit joints due to settling.
- Open manholes and hatches.
- Check construction material (concrete, reinforced concrete, blockwork, brickwork, polyethylene, glass reinforced plastic).
- Check for structural soundness, tightness of roof slab, and manhole/hatch joints
- Remove effluent filter, observe for leakage or infiltration (liquid level above or below exit pipe). Check presence of scum layer and thickness.
- Measure average depth of accumulated solids.
- Pump solids as required, observing requirement to avoid flotation.
- Hose down effluent filter and re-install.
- Fasten hatches.

F. Tilefield

- Take note of vegetation colors for evidence of incipient ponding, and, if needed, note apparent size of field.

- Check for surfacing effluent in the past or present. If ponding is observed, auger holes upslope, downslope and center or side will help determine if ponding is due to bio-mat (water level in trench significantly higher than in adjacent auger holes), or due to low site hydraulic capacity (water level in trench, side, and downslope auger holes essentially the same). If the latter, relief trenches may be required along contour. If the former, effective area of trenches may need to be increased. A full hydraulic capacity examination may be required.

G. Sand Mound

- Survey (visual) around the mound noting any wetness or greener vegetation.
- Look for ponding along the crest (bio-mat problems), or seepage along the base, (loading rate too high for soil).
- Check with auger holes as for the tilefield above.
- Sand will achieve maximum density and minimum conductivity after 2 or 3 years of weathering. If sand is suspect, collect augered sample for laboratory analysis or use a portable permeameter.
- Check that the pressure distribution system is providing even distribution, (uncover and observe at least 3 holes during an initiated pressurized event).

H. Pump and pressure distribution systems

- Open pump or siphon chamber and check for recent operation, abnormal position, or settling of float switches and cables.
- Run kitchen or laundry tap to check for normal operation.
- Time and record pump cycle for future comparison. Note if there is check valve or unrestricted flow-back.
- At subsequent inspections, compare times to assess impeller deterioration. Advise homeowner to call technician in event of malfunction.
- At remote pump control circuit, check all alarm circuits and control circuits, noting timer settings.
- Check that an installed siphon is not in trickle flow mode (water level does not rise when faucet is opened).

I. Intermittent sand filters

- Note form of construction as generic or proprietary.
- Survey (visual) around the system for evidence of settlement, structural collapse, ponding, leakage, and odors.
- Remove covers or dig covering soil to expose one or more distribution nozzles.
- Look for evidence of excess bio-mat, even spread distribution pattern, time of operation, and cycling of pumps. If effluent does not permeate immediately, check grading of sand or perform permeability test. If accessible, check turbidity of the effluent.
- Flush all laterals of distribution system.
- Should the sand bed be plugged with bio-solids, arrange to replace the media with the correct grade of sand.

J. Recirculating sand and other media filters

- Note form of construction as generic or proprietary.
- Survey (visual) around the system for evidence of settlement, structural collapse, ponding, leakage, and odors.
- Remove covers to expose one or more distribution nozzles.
- Look for evidence of excess bio-mat, and even spread distribution pattern, time of operation, and cycling of pumps. If effluent does not permeate immediately, check grading of sand/media or perform permeability test. If accessible, check turbidity of effluent.
- Flush all laterals of distribution system.
- Should the sand bed be plugged with bio-solids, arrange to replace the media with the correct grade of sand.

K. Constructed Wetlands

- Survey (visual) around the system for evidence of settlement of dykes or leakage.
- Induce flow into the system and check for even distribution of effluent to the outlet collection manifold.

- Check for correct setting of outlet control weir to ensure effective water table is below the surface of the media, to prevent breeding of nuisance flies and mosquitos. Adjust level of weir as necessary.
- Probe below surface to ascertain degree wetland, is plugged by bio-solids. This will ultimately create a surface flow wetland, and the structure is usually abandoned with a replacement wetland built on adjacent land, if available. This may be more economical than attempting to remove the bio-solids.

L. Aerobic Treatment Units (ATU) or Home Aeration Units (HAU)

- Carry out superficial inspection for structural integrity and water tightness as for a septic tank.
- Check that the aeration system is functioning as designed, and determine whether it is on a timed, intermittent circuit
- Vertical shaft submerged aerators may have a service life of as little as three years and should be fitted with an alarm system to alert the homeowner
- Take a sample of the mixed liquid in a dark container and note the color. When operating satisfactorily, it will have a chocolate brown color when seen from above the surface. A gray translucent color indicates that the microbial population is under some form of stress. This may be due to the family's lifestyle, such as excessive use of water, detergents, or disinfectants. Compare water usage with the manufacturer's rated capacity. Advise the family, and return to re-inspect after an interval of several weeks. If the system is still malfunctioning, advise the homeowner to call his service provider.

3.8 Costs and Benefits of Management

It is clear that additional costs will be necessary for OWTS management programs because even the least-intrusive management entity must invest in record keeping, reporting, and other administrative and public education tasks. Because each model builds on the prior (lower-numbered) model, costs are presumed to increase with each higher-numbered Model Program. However, the realities of the relationship between cost, management level, and short/long-term benefits are not yet apparent because of insufficient data.

However, better management might preclude some unmanaged system costs associated with unnecessary repairs, pollutant discharge fines, loss of recreational opportunities, degradation of drinking water sources, closed shellfish beds, fines, and so forth, offsetting some or all of the actual expenses incurred in developing and implementing a management program.

The few studies of management programs available in the literature provide a widely varying picture of management program costs versus services provided. Mancl (2001) provides possibly the best single report, which attempted to compare five long-term management programs, failed to show any pattern of costs and services. However, combining this report with other case studies does offer insights.

For example, a responsible management entity (level 4 and 5), that often include cluster systems appears to cost somewhere between $180 and $450 per year per customer. This cost may not include certain special services or one-time costs to join. In contrast, minimal management programs (similar to level 1) appear to cost $100 per year or less. Intermediate management programs vary widely between these extremes, depending heavily on what is included in the fees charged, other sources of funding, and the technologies employed.

Current data concerning the long-term cost benefit of a community OMS as measured by monitoring of watersheds has yet to be examined exhaustively in detail. However, it could be deduced that if it failed to meet its goals, the regulatory oversight agency would have terminated its permits. There is empirical evidence of better performance of managed decentralized systems in terms of community satisfaction. There is clear evidence that management programs have failed due, almost exclusively, to lack of community involvement, and lack of agreement as to its makeup, and powers in the program's formative period. There is very limited evidence to indicate that it failed to meet its public health and watershed protection goals.

Additional support for this conclusion can be derived from Allee, et al, (2001) who after evaluating several programs, concluded that enhanced management of onsite systems is essentially a relationship-building process between the regulatory staff, the population served, community leaders, and the management entity within a facilitating political climate. If the process is properly performed, a variety of long-term positive environmental, public health, and political impacts will occur. If not, the program may be short-lived, and all goals may remain unfulfilled.

Based on the conclusions mentioned above, several public meetings were held during June 2001 to March 2002 at various locations within Beaufort County. Residents and other stakeholders from the different parts of the county were targeted and provided with a complete overview of the project as well as information about the different OSDSs and their management. Open forums provided the opportunity for those attendees to be involved in a discussion about various issues and needs of wastewater treatment and dispersal. A wide range of stakeholders was present including the Beaufort County Planning Department.

Since almost every management program has derived from recognizing a problem and/or potentially dire consequences of that problem, there is a need to obtain better documentation concerning the benefits of the management decision, even though it can be empirically determined that creating an OMS was the correct decision. Based on the high cost of central sewer solutions for communities, choosing a managed decentralized approach has increasingly become a long-term, viable option (USEPA 1997). Congress (CWA of 1975) has long recognized that the cost of traditional sewers in rural areas is prohibitive. The cost of continuing to rely on unmanaged onsite wastewater systems is to exacerbate the recognized problems. Therefore, choosing to provide lower-cost, alternative, decentralized wastewater management fills the void between these two extremes.

Chapter 4
Standards for Onsite Systems

4.1 Introduction

The South Carolina Department of Health and Environmental Control (DHEC) administers South Carolina's Onsite Wastewater Regulation 61-56, Individual Sewage Treatment and Disposal Systems (SC DHEC, 1986). Low Country Health District does follow the regulations as listed in the statewide code.

South Carolina follows unique administrative procedures regarding rule adoption. All proposed rules or rule modifications for a state agency are read and voted on during session in the state legislature. The process is highly politicized and time consuming. Consequently, DHEC's onsite sewage regulations have not been modified since 1986.

Innovation in the state's onsite practice occurs through the state's "Individual Sewage Treatment and Disposal System (ISTDS)–Reference Guide" published guidelines to county health departments. This manual has technical specifications for a variety of proprietary products, guidance on permitting issues, and other information.

Local regulators may not be aware of the limitations that exist in the South Carolina's state onsite wastewater code or how other states have addressed gaps in their codes. The purpose of this chapter is to provide information about various aspects of onsite wastewater regulations throughout the coastal states.

4.2 Conventional and Innovative OSDS

Onsite wastewater systems are broadly classified into conventional, innovative, or experimental. The term conventional is only a frame of reference and depends upon the state, county or town in which the systems are installed. When a conventional system is properly designed, installed, and maintained, the soil absorption field filters the suspended solids, biodegrades the organic matter, and kills pathogens. These systems provide only primary treatment before the wastewater is dispersed into the soil.

However, if there is high groundwater, impermeable soil, or other site conditions that may limit treatment by the soil, an innovative or experimental system is allowed. Innovative or experimental systems can often provide additional treatment using innovative mechanisms to treat domestic wastewater in order to protect public health and the environment. Innovative or experimental systems, in most cases, do not fit the prescriptive code. Performance factors will have to be clearly accounted for before an innovative or experimental system is installed.

A "prescriptive based" procedure is based upon a protocol that, although intended to achieve similar results, is based upon following a set of sometimes quite arbitrary, rules or "prescription." On the other hand, a "performance based" procedure is based upon a protocol designed to ensure that the end result will conform to a pre-set standard.

4.3 Regulation and Permitting

In general, the design standards in most coastal zone states are prescriptive by nature having been developed over the years on a trial and error basis with the benefit of some times extensive research on limited factors affecting the performance of both conventional, and innovative, or experimental systems. At the present time, South Carolina permits the use of innovative or experimental systems on only a limited basis.

Beaufort County has adopted the state onsite regulations without amendment. The Low Country Health District (LCHD), acting under the South Carolina DHEC, administers these regulations. Current regulations are largely prescriptive in that the local conditions found at a site evaluation (soil type, depth to seasonal saturation, proximity to surface water, etc.) determine whether a site is acceptable, and the design of the system to be installed is decided according to prescribed rules. The majority of regulatory authorities nationwide have adopted this practice, which is an accepted practice in most situations.

The number of standard designs available to the LCHD staff is limited but adequate for the range of topography and soil types within the county. Designs are predominantly selected based on the depth to seasonal high saturation. The systems range from a conventional buried trench system through shallow trench with limited cover, and shallow trench with cover of imported fill to mound systems constructed entirely with imported fill. These systems are designed to maintain a minimum depth of unsaturated soil between the infiltrative surface and seasonal high saturation.

The only questionable feature of this process is that the separation distance is determined before the system is operational. There is no protocol established to estimate or measure the rise in water table or zone of saturation–groundwater mounding. There is, thus, no information as to whether the desired zone of partial saturation beneath the infiltrative surface is being achieved, or indeed, whether the separation distance is actually necessary. Section 4.5 presents a more detailed discussion on soil hydraulics and effluent plume dynamics.

According to a summary of the status of onsite wastewater systems in the U.S., developed by the NESC conducted in 1998 (NESC, 2001), the Low Country Health District issued about 3,000 new permits and 50 repair permits. In 1998, about 60-70 percent of all new permits issued were for septic tank/drainfield/trench systems. Other systems also permitted include mounds, aerobic treatment units (ATU), gravelless systems, chamber systems, or at-grade systems.

The most significant comment that can be made about South Carolina and nationwide standards is that most do not base design and construction on performance-based site evaluation nor on performance of a complete system (both treatment and dispersal). Most standards place utmost significance upon one factor: vertical separation distance between the infiltrative surface and the water table. A few speak of the separation between infiltrative surface and saturated soil acknowledging the fact that the tension-saturated zone in the soil may be one to three feet above the water table.

Many, including South Carolina, establish a separation distance above the seasonal high saturation zone established by examining soil morphology, primarily mottling or chroma levels (SCDHEC 1999, 1994, and 1986). None consider the separation distance after the system is in operation, that is, no calculations or estimates take into account the rise in water table due to the addition of effluent to the groundwater regime.

4.4 Review of Coastal State Regulations

4.4.1 Site Evaluation

All states require some form of site evaluation. Discussed in this section are notable features and requirements of the coastal states regarding site evaluation. The majority requires the percolation test and/or a description of the soil morphology or texture. Approximately one third specify a minimum lot area ranging from one-third acre to four acres and a minimum hydraulic loading rate ranging from 0.1 to 0.6 gallons/square foot/day (gpd/sq.ft) depending on the soil classification. Maximum rates range are from 0.5 to 1.8 gpd/sq.ft. Without exception, the states specify design for single-family homes based upon prescriptive rules. That is, a description of topography, soil profile, percolation rate, and home size is translated to the design requirements in terms of pre-treatment requirement and length/area of soil absorption trench.

There are no forms of hydraulic calculations to determine the effect of the discharged effluent upon the rise in water table. Also, there is no assessment of the actual effect of the effluent upon the groundwater beneath, or the effects of the ultimate discharge to the surface water environment. This is not necessarily a poor practice, since the prescriptive rules have been developed by trial and error over time to give acceptable results within the local environment.

However, there is a scale effect to both soil hydraulics and the biological/chemical process of wastewater in the sub-soil environment. Designs for larger homes, groups of homes, and commercial establishments should be developed on a more scientific basis. Only a few states require this. The following comments are made upon the regulations of the various states with particular reference to where the regulations depart from the "national mean" and have a feature that is significant.

The minimum standards that DHEC require include: six inch separation between the base of the system to seasonal high water table, 12 inches to rock or restrictive horizon, five feet to building, property line, driveway or parking area, 50 feet to a private well, 50 feet to mean high tide, or ordinary high water line of fresh water. An experimental system requires minimum repair area of 50 percent. The maximum long-term acceptance rate is 1.25 gpd/sq.ft//day (SCDHEC 1986).

Table 4.1 presents a matrix with an overview of the most significant site evaluation parameters in coastal states relevant to South Carolina. Some of the specific parameters are discussed in detail in the following sections. A detailed performance based site evaluation is enclosed in Appendix B.

Table 4.1 Overview of site evaluation parameters in coastal states

State	AK	WA	OR	TX	LA	MS	AL	FL	GA	SC	NC	VA	MD	DE	NY	CT	RI	MA	NH	ME
Minimum Parameters																				
Site Evaluation																				
Area (acres) (Public)		0.5		0.5	0.5		0.34	0.25	0.5					0.5					0.69	0.46
Area (acres) (Private)		1		1.0			0.46	0.5	1.0				2 to 4	0.5					0.69	0.46
Width (ft)					125				100											
Slope (%) (maximum)	25			30		15	40				30	50	25	15	15	25			35	20
Soil depth	4							3.5		1	3	3			4		4	4	2	1.3
Depth to water table	4	1	4		2	4	1.5	2		0.5		1	4	4	4			4	4	2
Depth to saturation				3							2									
Depth bedrock or limiting layer	6						1.5			1		1.5			4		4		3	2
Standard percolation test	Y			Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil morphology and description	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
System to boundary		5		10	10		5		5	5	10	5		10	10	10	10	10	10	10
System to downslope boundary		5		10	10		5		5	5	10	5		10	10	10	10	10	10	10
System to watercourse or wetland	100	100	50	75		100	50	75	50	50	50	50	100	50	50	50	100	50	50	25
System to Well	100	100	100	150	100		100	75	100	50	50	50	100	100	100	75	75	100	75	100

Note: Data presented for a typical three bedroom home

In Oregon, a site evaluation may require two test pits, parcel dimensions, slope distance to surface water, wells, escarpment, cut/fill, unstable slopes, and depth to water table. Other requirements include connection to sewer if available, absorption area and replacement area, pre-cover inspection (Oregon Department of Environmental Quality, 2000). Site evaluation in Washington requires "enough" soil logs (auger or backhoe pits) within dispersal area and reserve area, depth to groundwater and to probable maximum saturation. Description of topography, drainage channels, structurally deficient soils, erosion characteristics, soil texture and class, and pits are required for examination, final inspection and as-built drawings (Washington State Department of Health, 1995).

Since there are no state-level regulations in California, each county is in charge of wastewater regulation. The regulations are entirely prescriptive with little or no correlation between various counties. The flooding potential must be noted for site evaluation in Texas (Texas Natural Resources Conservation Commission, 1997). The Coastal Management program has little mention of onsite systems other than "Onsite and underground storage systems must prevent release of pollutants to coastal waters."

In Louisiana, the minimum lot size permitted is one acre, unless the lot width is more than 125 feet, then half an acre is sufficient. The percolation test is used for site evaluation together with test pits for examination of soil morphology. In order to use a standard drainfield, the water table must be two feet below the infiltrative surface. The state permits the use of onsite disposal for community systems (Louisiana Department of Health and Hospitals, 1994). Site evaluations in Mississippi must be performed within three days of application and are to be based on soil borings to five feet by an "environmentalist." Slopes must be less than 15 percent, minimum four feet to water table, and a minimum of 40 feet from soil to bedrock (Mississippi Department of Health, 1996).

Alabama also requires that an environmentalist perform the site evaluation. This may require additional tests, a minimum of five soil profile holes, to five feet, unless a limiting horizon intervenes (Alabama Bureau of Environmental and Health Services Standards, 1998). The state of Florida requires a minimum 42 inches of soil below drainfield and allows replacement of severely limiting soil (Florida Department of Health, 2000). A minimum 24 inches of soil is required from the water table to drainfield. The location of the water supply must be determined before a permit is issued in Georgia. The board of health determines the lot size and requires an inspection before backfill. Georgia has no specific requirements on site evaluation (Georgia Department of Human Resources, 2000).

In North Carolina, site evaluation can be performed by boring to a minimum of four feet deep, with the excavation of a pit, if deemed necessary (North Carolina Department of Health, Environment and Natural Resources, 1999). A slope of 15 percent is satisfactory, 15 to 30 percent may be considered, but greater than 60 percent will not. The U.S. Corps of Engineers or the North Carolina division of Coastal Management may approve construction in a natural wetland. Assessment of soil structure, morphology, and clay minerology is required. Wet soils at a depth of less than three feet are considered unsuitable.

Site evaluation standards in Virginia include: no placement in marsh or swamp, maximum 50 percent slope unless terraced but soil absorption systems may be constructed on fill in certain circumstances (Virginia Department of Conservation and Recreation, 1995). OSDS may not be constructed in a sinkhole or a flood plain of more than 24 hours. Five “profile” (auger) holes are required to five feet depth to examine soil color and texture. Loading rates are assigned in four groups from 16 to 91 minutes per inch (min/in) based upon soil classification.

Site evaluation in Maryland requires an assessment of topography, geology, soil classification, and the usual other parameters (Maryland Department of Environment 1992). The evaluator is required to review the history of systems in the area. Soil must be tested at high groundwater conditions. More than four feet of unsaturated, unconsolidated soil is required. In the coastal plain, where four feet unsaturated, unconsolidated soil is not available, the department can approve less than 4 feet of separation. This can be done when the underlying bedrock is a type three aquifer, that is, the aquifer has limited potential for drinking water quality or quantity, or is already polluted, or if the deep, confined, potable aquifer is separated by an aquaclude, and the system will not contaminate drinking water aquifers. The area of lots shall be as delineated in the Groundwater Report, which designates density of development, design, and construction requirements. Most separation distances are 100 feet. In the coastal zone, lot areas cannot be less than two acres. If the bedrock is limestone or dolomite, no deviation is allowed from four feet soil depth to water table.

In Delaware, a licensed site evaluator or a department official performs site inspection. The system is sized by a formula based upon a percolation test (Delaware Department of Natural Resources and Environmental Control, 1985). In New Jersey, all site and soil evaluations are to be performed by a licensed professional engineer (New Jersey Department of Environmental Protection, 1999). Either two pits, or one pit and three borings are required. Munsell color classification charts are used for soil and (previous) fill evaluation. Long-term acceptance rates are based upon both percolation and permeability tests and range from 0.4 to 1.18 gpd/sq.ft of effluent.

The onsite regulations in New York are simple and effective. No OSDS can be constructed on a site that is within the 10-year flood level (New York Department of Health, 1990). Systems can be constructed on no more than 15 percent slope. There must be no less than four feet of available soil above the water table. The loading rate depends upon a percolation test (maximum 60 min/in), and ranges from 0.45 to 1.2 gpd/sq.ft. A design professional or soil scientist is to perform an evaluation.

The local director of health or professional engineer is required to perform the site evaluation in Connecticut (Connecticut Department of Public Health, 2000). A system is designed to technical standards based upon the percolation test and formula. In Rhode Island, the soil evaluator may require the presence of the health department director (Rhode Island Department of Environmental Management, 1998). A percolation test with a range of 0.38 to 1.2 gpd/sq.ft determines the application rate. A percolation rate above 40 min/in is considered unsuitable.

In Massachusetts, percolation tests are required in addition to the examination of the soil profile, landscape details, and hydro-geological properties of the site, performed at any time in the year (Massachusetts Department of Environmental Protection, 1996). Two deep pits are required for each dispersal area, two sloping to five feet without shoring, then after manual inspection, extended to four feet below the infiltrative surface and no less than 10 feet below grade. A method approved by the department is used to establish the influence of tides in the coastal zone.

Nitrogen sensitive areas are subject to special requirements. New systems, in general, must have a percolation rate no greater than 30 min/in, but a subdivision of up to 20 homes can be permitted where the percolation rate is between 30 and 60 min /in. A percolation rate of greater than 60 min/in is considered impermeable. Inspection is required at the time, or within two years of property transfer, as well as at the death of the owner. Any system may be required to upgrade where there is a threat to public health, safety, or the environment. System inspectors need to be professional engineers, board of health agents, etc.

Site evaluation test pits in New Hampshire must be dug to a depth of six feet, or four feet if the property is to be hooked to a public water supply (New Hampshire Department. of Environmental Services, 1997). In Maine, outside shoreland areas the soil depth can be 12 inches while shoreland zone can be15 inches. The minimum depth to bedrock is also 15 inches (Maine Dept. of Human services and Health, 2000). A system can be placed on an “acceptable” fill. The maximum slope permitted is 20 percent. Where groundwater estimates are disputed, the groundwater level may be monitored during an expected season of high groundwater. Setback requirements are tabled and allow 25 feet to a wetland and 100 ft to a shoreline across a wetland.

Maine has continued to operate the existing prescriptive site evaluation and design standards that have been in operation for many years with no significant environmental degradation or public health risks (Maine Dept. of Human services and Health, 2000).

4.4.2 Inspections

Code sections about inspections from coastal states are important in that they specify how and when inspections are to be performed as discussed below. Connecticut has a very detailed section about inspection and is reproduced in appendix C. Inspectors are given two days to complete inspections (Connecticut Department of Public Health, 2000). Delaware's code provides good information and explains how a site evaluation is to be conducted (Delaware Department of Natural Resources and Environmental Control, 1985).

The Maine code section is also outstanding from the perspective of plumbing inspectors who perform those job activities in that state (appendix C). Note the emphasis on defects in material and workmanship. This code also specifies special circumstances in coastal areas (Maine Dept. of Human services and Health, 2000).

Massachusetts' code recognizes the influence tides have on high groundwater levels. They also spell out United States Department of Agriculture (USDA) soil methodology (Massachusetts Department of Environmental Protection, 1996). This technique is more defendable than the standard percolation test (Winneberger, 1973). This code provides details about inspecting systems at time of real estate transfer. It was controversial when first instituted, but can be extremely worthwhile in increasing the confidence that existing systems continue to function properly.

New Hampshire's code section deserves mention for hydric soils determination (New Hampshire Department. of Environmental Services, 1997). The New Jersey code may be of assistance in that it provides a detailed description of USDA methodology, including definitions (New Jersey Department of Environmental Protection, 1999).

Rhode Island's code is unique in that it calls for regulatory staff to witness soil pits (Rhode Island Department of Environmental Management, 1998).

Oregon shows it is serious about the use of the reserve area (Oregon Department of Environmental Quality, 2000). The code requires two soil pits, with one in the area of the system installation and the second in the reserve area. Washington State permits inspection to be conducted by a local health officer, or a qualified designer, a designer/installer, or a qualified installer (Washington State Department of Health, 1995).

4.4.3 Percolation Test Requirements

Percolation tests have been used for over 50 years to assess the capacity of the soil for wastewater effluent. It provides the rate of the drop of water in a test hole of specific diameter and does not measure the rate of movement through the soil. However, relative permeability data will provide some index of the ability of soil to transmit water. Where required, the soil percolation test must be conducted at the optimal depth based upon the soil profile textures indicating permeable conditions. Extreme care should be taken while installing a system on slowly permeable soils that have a relatively high fine material, such as silt and clay.

The percolation test procedure is similar in coastal states but is no longer used in South Carolina. The primary difference is in the number of test pits (usually one per dwelling or lot), horizontal distance between them, limiting layer, and dry/wet weather requirements, and personnel administering/certifying the test. The proposed depth of construction is taken into consideration when it is performed.

Additional tests may be required in areas where soil structure varies, depending upon the presence of a limiting layer, or as warranted by the department due to the size of the required dispersal area or other requirements. In the case of subdivisions and mobile home parks, test bores may be required for planning purposes. Test bores to determine groundwater elevations and subsurface rock formations shall be made at locations, in numbers and at depths determined by the regulatory agency.

4.4.4 Application Rates (Loading Rates)

The standards in most states are prescriptive and the loading rates are based on the percolation tests. A summary of minimum and maximum application rates in coastal states is presented in Table 4.2. See Appendix C for a typical comprehensive site/soil evaluation performed before an onsite system can be permitted.

Table 4.2 Minimum and Maximum Application Rates in Coastal States

Application Rate (gpd/sq.ft)	AK	WA	OR	TX	MS	FL	SC	NC	VA	MD	DE	NY	CT	RI	MA	NH	ME
Minimum	0.6	0.2		0.3	0.2	0.2	0.1	0.1	0.1	0.6	0.1	0.45	0.4	0.52	0.29		0.2
Maximum	1.2	1.2	1.25	0.6	1.2	1.2	1.2	1.2	0.9	1.8	1	1.2	0.8	1.2	0.74	0.8	0.5

Most states use a table that relates soil texture or percolation rate in min/in to the allowable effluent application rate per one square foot of effective leaching area. Some states provide the information based upon the number of bedrooms. Other modifications include values specific to the width of the disposal trench, separate values for washing machine graywater distribution, different rates for non-residential buildings, and charts for mounds or for pressure distribution systems.

4.4.5 Vertical Separation Distance

Onsite system codes must specify the minimum thickness of unsaturated soils required to adequately treat and renovate septic tank effluent. The EPA design manual states that unsaturated zones between 2 and 4 feet deep provide adequate renovation of septic tank effluent. Some states will give highly treated effluents, such as those from biological treatment filters or aerobic treatment units, a reduced unsaturated zone requirement. This is based on a belief that these effluents contain lower concentrations of organic matter and pathogenic organisms.

Most states place the utmost significance upon one factor, the vertical separation distance between the infiltrative surface and the water table. Some include the separation between infiltrative surface and saturated soil, acknowledging the fact that the tension-saturated zone in the soil may be one to three feet above the water table.

Many, including South Carolina, establish a separation distance above the seasonal high saturation zone established by examining soil morphology, primarily mottling or chroma levels. There is no consideration given to the separation distance after the system is put into operation, that is, no calculations or estimates are made of the rise in water table due to the addition of effluent to the groundwater regime (SCDHEC 1999, and 1994).

Table 4.3 Vertical Separation Distance

State	Distance
WA	12 in to 36 in depending on soil type
MA	4 ft to 5 ft depending on soil type
ME	12 in to 24 in depending on soil type
MI	2 ft
NC	12 in
NY	3 ft for seepage pit
RI	3 ft
SC	6 in from seasonal high water table
FL	2 ft
VA	12 – 18 in depending on soil type and quality of effluent
AL	4 ft

Note: Information presented in the above table were obtained from their different state level regulations

As evident from table 4.3, South Carolina requires the shortest vertical separation distance requirement (unsaturated zone of six inches) of all coastal states. It is clear from the table that the vertical separation distance is mostly based on the soil type. In Alabama, the minimum vertical separation between the lowest part of the drainfield and the water table, as measured during the season of the year with maximum water table elevation, must be at least four feet and six feet if there is underlying bedrock, clay, or other impermeable strata (Alabama Bureau of Environmental and Health Services Standards, 1998).

Massachusetts requires a minimum separation distance of four feet for soils with a percolation rate of more than two minutes per inch, and five feet for two minutes or less per inch (MA Department of Environmental Protection, 1996). However, in Michigan and Maine (Maine Dept. of Human services and Health, 2000) when an elevated sand mound is used, the separation distance is usually 24 inches and can go up to 12 inches of unsaturated soil. Oregon has a much higher separation distance, which is 24 to 48 inches (Oregon Department of Environmental Quality, 2000). In Vermont, the distance is 18 inches when septic tank effluent is used and 12 inches when secondary treatment is used (Vermont Department of Natural resources, 2002).

4.4.6 Horizontal Separation Distance

Virtually every code spells out prescribed distances between components of an onsite system and features, such as, surface waters and wells. South Carolina's code is no exception. South Carolina regulation 61-56 requires the system to be set back five feet from buildings and property lines. No part of the system may be located beneath a building, driveway, or parking area (SCDHEC 1986).

Although the state code specifies a minimum 50-ft setback between systems and a private well, the health authority establishes the setback to public wells. Surface waters, including the mean high water elevation of tidal bodies, ordinary high water elevation of non-tidal waters, and impounded or natural bodies of water, including streams and canals, have a 50-foot setback. Interceptor drains are set back 10 feet if the system is down slope of the drain and 25 feet if it is up slope. A 25-foot setback is required for a drainage ditch. Numerous other coastal states go farther to list features requiring setbacks. A more detailed summary of different requirements in the coastal states is also presented in the following paragraphs.

Table 4.4 provides an overview of the specific horizontal separation distances or setbacks (minimum and maximum range) used for a number of features in the coastal states.

Table 4.4 Range of Horizontal Separation Distances in Coastal States

Feature	Distance
Wall line of any structure or building	5 to 40 see note 1
Property line	5 to 25
Stream, ocean, pond or lake, or vegetation line of wetland	25 to 300 see note 1 Some states classify water bodies
Large trees (Hawaii)	10
Seepage pit (cesspool)	5 to 50 see note 1
Graveyard (Maine)	25
Potable drinking well	50 to 1000 see note 1
Private water well, underground cistern, pump suction pipes	50 to 300 see note 1
Public water wells	50 to 400 see note 1
Water supply lines	5 to 75 see note 2
Sharp slopes, breaks	10 to 50
Easement lines	5 to 10
Other soil absorption system	20 to 50
Natural or manmade drainage feature, embankment, cut, groundwater Interceptor drains	5 to 75 Many states use minimum distance for upslope and more than double the distance for downslope
Rock outcrops (Maryland)	25
Elevation of spillway crest water level In a water supply reservoir	50 to 500
Stream tributary to a water supply reservoir	50 to 200
Stream not to a tributary of a water supply reservoir	25 to 200
Storm water retention pond from flood elevation	50
Intermittent streams	20 to 50
Irrigation canals/wells	10 to 50 see note 1
Swimming pools	10 to 35 see note 1, 3
Sinkhole	50 to 300 see note 1
Non-potable drinking water well	10 to 50
Storm sewer (Florida)	10

Note: 1. In many states the minimum distance is to the septic tank, and the distance to the absorption field is twice or more.
2. Pressure lines have minimum distance. Suction lines are from 30 to 75 ft.
3. In Connecticut, above ground pools require 10 ft. separation. Below ground pools require 25 ft.

Alabama calls for 5 feet of horizontal separation between all onsite system components and property lines, dwellings and potable water lines; 10-foot separation to in-ground swimming pools, 25 feet from any natural or man-made drainage feature; 50 feet between any tank and surface waters, public or private water sources. A 100-foot separation is required between the effluent disposal field and the potable water source (Alabama Bureau of Environmental and Health Services Standards, 1998).

Sinkholes require a 300-foot setback unless a professional geologist report indicates no danger of contamination of groundwater aquifers. Sewage tanks and effluent disposal fields cannot be located under dwellings, buildings or permanent structures, nor can a driveway or parking area cover these features unless they are designed by a professional engineer to resolve all the factors affecting the proper functioning of the field. Connecticut does an excellent job of spelling out required separation distances. It is reproduced in appendix D and may be helpful in this instance, since the state relies on percolation rates to classify soils (Connecticut Department of Public Health, 2000).

Delaware uses the term isolation distances to give clarity to the setback concept (Delaware Department of Natural Resources and Environmental Control, 1985). Florida has an extensive number of location and installation standards reproduced in appendix E (Florida Department of Health, 2000). Enhanced features of this code include: a setback distance between systems and wells that takes into account the larger cone of influence for a well pumping a larger volume of water. The code sets minimum lot size as a function of platting date and water source (public or private). Separate location and installation requirements are specified for the Florida Keys and for performance based systems (Florida Department of Health, 2000). Special drainfield location and sizing criteria are provided for areas with shallow discontinuous limestone formations, commonly referred to as karst areas.

Georgia requires a 50-foot setback between a septic tank and wells/springs, sink holes or suction water lines (Georgia Department of Human Resources, 2000). Tanks should be located down gradient from such features when possible. Tanks must be set back at least 25 feet from lakes, ponds, streams, watercourses and other impoundments. A 10-foot setback is required between tanks and property lines and pressure water supply lines. Finally a 15-foot setback is required for between tanks and drainage ditches or embankments.

Separate distances are listed between absorption fields and the various features. There is a 100-foot setback to existing or proposed wells, springs, or sinkholes. A 50-foot setback is required between a field and surface water, including wetlands. A 10-foot setback is needed for between absorption fields, water supply lines, and buildings with basements. A five-foot setback is required for buildings without basements, other structures, drives, and property lines. A 15-foot setback is required from an embankment or a trash pit.

Hawaii also breaks setback distances for various parts of an onsite system. Hawaii uses four categories: cesspool, treatment unit, seepage pit, and soil absorption system. Cesspools and seepage pits generally require the larger setbacks. Large trees have a setback from these features (Hawaii Department of Health, 1991).

Maine provides a table quantifying reductions from a standard 100-foot setback between a new 1,000 gpd disposal field and a private well (Maine Dept. of Human services and Health, 2000). Reductions are allowed as a function of depth of well casing or liner seal. If an abutter places a well on an adjoining lot after a certain date, the setback can be reduced to two times the distance the well is located from the common property line, but in no case less than 60 feet. Replacement systems have an entirely different set of setback distances. This is the only state to specify a setback to burial sites or graveyards.

Maryland requires a 25-foot setback from steep (> 25 percent) slopes (Maryland Department of Environment 1992). Flood plain soils and rock outcrops also receive a 25-foot setback. A 300-foot setback is required for from the elevation of spillway crest water level in a water supply reservoir, and 200 feet from a stream tributary to a water supply reservoir. Streams not tributary to a water supply reservoir receive a 100-foot setback, as do bodies of water not serving as potable water supply sources. A water well system located in an unconfined aquifer must have a 100-foot setback. In a confined aquifer, the required distance is reduced to 50 feet.

Massachusetts has an extensive list of setbacks, as reproduced in Appendix D (MA DEP, 1996)**.** It is one of the few states that specify a setback to wetlands, both isolated (50 ft to soil absorption fields) and bordering surface water supplies (100 ft).

Mississippi requires a 5-foot setback from a dwelling and 10 feet from property lines. Sewage tanks can be no closer than 50 feet from any private or public water source. The effluent disposal field is to be located at a lower elevation and at least 100 feet from a water source. The disposal field area cannot be used for vehicular traffic or parking. Subsurface wastewater disposal fields located on slopes less than eight percent grade are set back as a function of the soil type (100 feet for coarse to medium sand, fine sand, loamy sand, sandy loam, silty clay and clay; 50 feet for loam, silt, silt loam, sandy clay loam, silty clay loam and clay loam). On slopes greater than eight percent, a uniform 100-foot setback is used for recreational waters, shellfish harvesting waters, and other sensitive areas. The code specifies that frequently flooded areas will not be approved for OSDS (Mississippi Department of Health, 1996).

New Hampshire is unique in that a minimum down gradient setback distance to property lines is a function of the estimated flow generated in gallons per day (New Hampshire Department. of Environmental Services, 1997). Septic tanks and leach beds are listed separately as are dry wells and sewer lines. Larger setback distances are required for municipal wells (400 feet) and community wells (200 feet). New Jersey divides components into six possible categories: building sewer, septic tank, distribution box, disposal field, seepage pit, and dry well (New Jersey Department of Environmental Protection, 1999).

North Carolina requires varying setbacks to water bodies depending upon their classification (North Carolina Department of Health, Environment and Natural Resources, 1999). The setback ranges from 50 to 100 feet. A 15-foot basement setback is called for, as are a property line setback of 10 ft, and a building foundation setback of 5 feet. Drainage systems have varying setbacks depending on whether they are up slope, side slope or down slope. Groundwater lowering devices and ditches receive a 25-foot setback, whereas swimming pools get a 15-foot setback. A setback of 20 feet is required for between other nitrification fields. Setbacks for large volume systems are also include in the code.

Oregon provides a basic, dual setback (tank versus disposal area) matrix in its code that is reproduced in Appendix D. It goes beyond most states in that the setback is to be maintained by the entire disposal area, including the replacement area (Oregon Department of Environmental Quality, 2000). Rhode Island earns the distinction of giving setback distances to privies (Rhode Island Department of Environmental Management, 1998).

Texas provides setback distances from a number of features for sewage treatment tanks, lined evapotranspiration beds, soil absorption systems, and sewer pipe with watertight joints. An unusual inclusion is a setback distance for sharp slopes and breaks. A one-foot setback is required for easement lines, and 15 foot is required for swimming pools (Texas Natural Resources Conservation Commission, 1997). Washington has a well-written and comprehensive list of minimal horizontal separations as reproduced in Appendix D. It includes a setback listing from a properly abandoned well (Washington State Department of Health, 1995).

4.4.7 Wastewater Flow Rates

The sources and an accurate characterization of wastewater are very important factors in proper wastewater system design. Wastewater is classified into two basic categories: residential and non-residential.

a) Residential

Wastewater from single or multi-family condominiums, apartments, mobile homes and small subdivisions fall under residential types of wastewater. Table 4.5 provides an overview of residential daily sewage flow rates various coastal states use. As seen in Table 4.5, the residential flow rates vary from state to state along the coastal region. Residential wastewater flow rates are determined in a several ways. The wastewater flow rates for a single family or a multi-family dwelling in coastal states are based upon the number of persons or bedrooms. However, the most widely used method for flow-rate measurement of residential systems is by using the total number of bedrooms.

The flow rates for single family or multi-family dwelling range from 100 gpd per bedroom to 150 gpd per bedroom. South Carolina specifies a flow rate of 120 gpd per bedroom. Wastewater flow rates generally range from 75 to 120 per bedroom in most coastal states. Actual requirements vary widely when the home has two bedrooms or less (single family or multi-family dwelling or apartments). However, most states require a 1,000-gallon for a three-bedroom dwelling. When there are three or more bedrooms, residential flow rates vary from 75 to 150 gpd/bedroom. In the case of mobile home parks, the recommended flow rates are 225 to 300 gpd per space or 75 gpd/person. For retiree mobile home parks, the flow rates (per site) are 100 to 150 gpd/bed (homes for the aged) or 75 gpd/person.

An alternative method of estimating the wastewater flow rate is to meter the actual water use. The wastewater flow can be calculated based upon the metered water use data in lieu of the estimated sewage flows shown in Table 4.5. For metered flow consideration, accurate and authentic weekly, monthly, or quarterly water-use data is required. Data needs to be collected over a period of time (usually 12 months). In addition, information from similar wastewater sources in the same geographical area, such as type, size, etc., might be needed as well. When using the actual water-use data, a safety factor of 1.5 to 2.0 is usually applied. The numerical value of the safety factor used depends upon the frequency of water use monitoring (weekly, monthly or quarterly) information collected on particular home or a group of homes.

Other considerations for estimating sewage flow include water conservation devices, such as, low-flow toilets, showerheads, faucets and other types of fixtures. To obtain any reduction in the flow-rate estimation, data about these devices should be presented along with the permit for an OSDS. Permanent fixtures, such as low flow toilets, are more readily permitted a reduction in flow rate. More detailed discussion on water conservation and household appliances is presented in Chapter 7.

Table 4.5 Estimated residential wastewater flow rates in coastal states

Coastal State	Single/Multi-family Dwellings or Apartments (per unit) (2 bedrooms or less- gpd)	Three bedrooms or more, (gpd)	Additional per bedroom (gpd)	Mobile Home Parks (per space-gpd)
Alabama	300 (75 per person		250	
Alaska	1000 (Minimum)		250	
Delaware	120 per bedroom		250	
Florida	100 per bedroom; (add 50 per other occupant)		100	250 (less than 4 spaces connected to shared onsite system)
Hawaii	100			250
Louisiana	250 for one bedroom; 300 for two bedrooms	400		250
Maine	180 per dwelling	270	90	
Massachusetts	110 (300 minimum for system design)			300
New Hampshire	225 per bedroom	Add 150 (2 or more bedrooms)		Based on the number bedrooms
North Carolina	120 per bedroom (60 per person)		120	
Oregon	300 (450 min/establish/day); 30/unit condo, apartment, multi-family	75 additional for third	75 additional for third and after (450 min/establish /day)	250 (750 min/establish/ day)
Rhode Island	75 per person			75
South Carolina	890; 120 (per apartment per room)	1000	250	
Texas	225	300	75	75
Virginia	75 per person			75
Washington	240	360	120	

b) Non-residential

In general, wastewater from non-residential sources is classified as commercial, recreational, eating and drinking establishments, institutional, and miscellaneous. Table 4.6 shows the various types of wastewater sources under each category. The flow rates for various non-residential sources vary widely across the different coastal states. A detailed matrix of specific flow rates for the different non-residential wastewater categories is given in Appendix F.

Table 4.6 Wastewater sources of non-residential categories

Type of Establishment	Source
Commercial	Airlines, Auto service station, Bakery, Barber/Beauty shops, Bus service areas, Country club, Offices, Drive-in theaters, Factories, Hotels, motels, Movie theaters, Stores, Work camps, Retail buildings, Bed and breakfast, Warehouses, Fire stations, Rooming houses, Visitor center, Meat market
Recreational	Camps, Campgrounds, Seasonal cottages, Bath house, Fairgrounds and parks, Marinas, Swimming pools, Tennis courts, Bowling alleys, Dance halls, Amusement centers, Skating rinks, Gymnasiums, Ski areas, Beach Clubs
Eating and Drinking	Bars/Lounges, Restaurants, Coffee shops, Cafeterias, Ice cream stands, Delicatessen
Institutional	Churches, Institutions other than hospitals, Non-commercial laundry, Schools, Day care centers, Hospitals, Dormitories, Prisons, Health Clubs
Miscellaneous	Kennels, Doctor and dental offices, Banquet Halls, Flea Markets, Town Halls, Dining Halls

Regulatory requirements for non-residential wastewater generators are different when it exceeds a certain daily flow as well as wastewater characteristics. It is important that the wastewater characteristics be taken into account since that would directly affect the performance of the system

4.4.8 Alteration and Repair

Many state codes require regulatory officials to issue an operating permit before a malfunctioning system can be restored (a repair), or a building can be modified/expanded in such a way that sewage characteristics increase or change in character (an alteration).

South Carolina's state code contains only basic provisions and lacks important concepts. It makes repair permits optional as deemed necessary by the health authority. Instead of helpful guidance, the code says the health authority may authorize the best possible method of repair. A 50 percent replacement area is only required for alternative or experimental (temporary) systems and three kinds of commercial systems (food service facilities, laundromats and car washes). The code prevents construction and repair permits from being issued when a public sewer is accessible (SCDHEC 1986).

Alaska allows emergency repairs to be conducted without written approval. The state code specifies the qualifications of people who install or modify conventional onsite systems (a registered engineer, supervised by a registered engineer, or a person whose work is inspected by a registered engineer). A homeowner may seek approval to install or modify a conventional onsite system that serves their owner-occupied, single-family home or owner-occupied duplex (Alaska Department of Environmental Conservation, 1999).

Alabama allows a verbal authorization by the local health department to repair a system, providing that proper documentation of the conversation is on file with the health department regarding repair work to be performed. After repairs have been completed, the repaired portion cannot be covered without authorization from the local health department (Alabama Bureau of Environmental and Health Services Standards, 1998). Connecticut requires the owner to show sufficient area on a lot with suitable soils for a replacement system before authorizing building additions (Connecticut Department of Public Health, 2000).

Delaware defines an emergency repair as repair of a failing system where immediate action is necessary to repair a broken pressure sewer pipe (Delaware Department of Natural Resources and Environmental Control, 1985). The code makes the distinction between an alteration permit for increasing the projected daily sewage flow into an existing system and a repair permit to restore a malfunctioning system. In both cases, once the procedure is completed, the applicant must obtain a “Certificate of Satisfactory Completion” from the department. A home with a malfunctioning system that cannot be repaired must be abandoned in accordance with these regulations.

Florida has very complete regulations regarding alterations and repairs (Appendix G). One of the best features of the section is the way it states which criteria are to be preserved in fitting a repair in a limited site (Florida Department of Health, 2000). For instance, the first prescriptive standard to be waived is the setback to building foundations and property lines. The last prescriptive standard to be loosened is setback of system to a private potable well. This system recognizes the need for discretion with guidance at the local level. It also makes distinctions between residential and commercial system repairs.

Mississippi does not require repairs to be approved by the health department. However, after the health department notifies an owner of a system malfunction, a property owner has 30 days to repair the system and must take adequate measures as soon as is practical to abate an immediate health hazard (Mississippi Department of Health, 1996). Hawaii gives the engineer designing the wastewater system flexibility and design responsibility (Hawaii Department of Health, 1991).

Massachusetts defines an emergency repair as pumping a tank to prevent backup or breakout, and repairing or replacing structural components (i.e., a broken tee). A registered sanitarian or professional engineer is required to prepare plans and specifications. Registered sanitarians are limited to systems designed to discharge 2,000 gallons of sewage per day or less. If the plan for a new system or an upgrade of an existing system involves encroaching upon the setback to property lines, the plan must be signed and sealed by a licensed land surveyor (Massachusetts Department of Environmental Protection, 1996).

Maryland allows a holding tank to be used to resolve existing onsite sewage disposal failures when community sewer facilities are not available or onsite repair is not possible (Maryland Department of Environment 1992). That option is not recommended. Maine also has a comprehensive code section, which is reproduced in its entirety in Appendix G (Maine Dept. of Human services and Health, 2000). The definitions are especially good in the section. This state's language may be of interest because it has special requirements for ocean front (shore) properties.

Georgia requires that repairs, replacements, or additions to existing systems be permitted and inspected (Georgia Department of Human Resources, 2000). Rhode Island defines the term alteration as any modernization, modification or change in the size or type of an existing system (Rhode Island Department of Environmental Management, 1998). If a residence is increased by more than one bedroom, or a non-residential structure's flow is increased by more than 25 percent, owners must obtain a new system permit.

New Hampshire allows non-commercial systems to be repaired in place "in kind" without having to submit plans (New Hampshire Department. of Environmental Services, 1997). In kind refers to the size, location, depth, and type of design that existed before repair and/or replacement, and that the proposed use will not change or the flow increase. A state permitted installer shall perform repair and replacement work, except people may do the work for their own private home.

The installer is required to complete a questionnaire regarding why the system failed, as well as other details about the new system. If an innovative/alternative technology is approved, in exchange for the benefit of an operational approval, the owner must promise to replace the system with a conventional system should the innovative/alternative system fail to operate lawfully. The owner at the registry of deeds shall record the covenant.

New Jersey has a comprehensive repair section that is reproduced in the appendix G (New Jersey Department of Environmental Protection, 1999). The section follows a logical sequence for expansion of existing functioning systems (desiring expansion) all the way through malfunctioning systems. The regulation allows the use of a holding tank as a last resort. New York requires that 50 percent of the required treatment useable area be set aside for future expansion or replacement whenever possible (New York Department of Health, 1990).

North Carolina has extensive code language regarding alteration and system repair as reproduced in appendix G (North Carolina Department of Health, Environment and Natural Resources, 1999). As the soil and climactic conditions are closest to those found in the study area, this code deserves extensive scrutiny. Beneficial aspects of this code are that it gives proprietary system specifications and allows interceptor drains. Washington has code that is short, although clear and specific (Washington State Department of Health, 1995). It arranges the applicant's options in a logical manner. It provides a table allowing some discretion should the repair or replacement system not be able to meet the vertical or horizontal separation distances required by code (Appendix G).

Texas allows a professional engineer to submit a waiver of review for planned modification to a system already in use. Emergency repairs are allowed if the repair is made for the purpose of abating an immediate health hazard or nuisance, there is no significant increase in treatment facilities, and the department is notified within 14 days (Texas Natural Resources Conservation Commission, 1997).

Virginia describes conditions that are prima-facie evidence of a failing sewage disposal system (Virginia Department of conservation and Recreation, 1995). These include the presence of raw or partially treated sewage on the ground's surface or in adjacent ditches or waterways, or exposure to insects, animals, or humans. Groundwater pollution or backup of sewage into plumbing fixtures may also be an indication of a system failure. A 100 percent repair area exclusively for the repair system must be identified on a site before a provisional approval can be granted. If the percolation rate of the site exceeds 45 minutes per inch, only a 50 percent repair area is required.

4.4.9 Density / Lot Size

There are a wide variety of acceptable densities and lot sizes in state codes. This issue is very controversial and political. The smallest acceptable lot size encountered is in Hawaii and Rhode Island (10,000 square feet of land area being acceptable). The largest lot size required (two acres) is in Maryland (Maryland Department of Environment 1992). Some states provide for nitrogen-reducing systems to increase allowable densities (Florida and Delaware). North Carolina is unique in having developed a formula for the allowable density of commercial development. All codes have a date before which lots of record are not held to density limitations (North Carolina Department of Health, Environment and Natural Resources, 1999). South Carolina's state code does not specify a lot size, but does require the applicant to state the lot's size at time of application (SCDHEC 1986).

In Alabama, for single-family dwellings, the lot size needs to be large enough to construct the original OSDS and to provide an area for duplication of that system. When an approved public water supply is proposed as the source of water for a lot, the minimum lot size shall be 15,000 square feet of land area per dwelling unit. When an individual well is proposed as the source of water for a lot, the minimum lot size shall be 20,000 square feet of land area per dwelling unit (Alabama Bureau of Environmental and Health Services Standards, 1998).

For residential dwellings in Delaware, the maximum siting density shall be one (1) dwelling unit per one-half (1/2) acre. A smaller lot size may be allowed for systems that reduce nitrogen load in effluent prior to discharge to the SAS (Delaware Department of Natural Resources and Environmental Control, 1985).

Florida requires that each lot have a minimum area of at least one-half acre, and either a minimum dimension of 100 feet or a mean of at least 100 feet on the side bordering the street and the distance formed by a line parallel to the side bordering the street drawn between the two most distant points of the remainder of the lot may be developed with a water system and OSDS, provided the projected daily sewage flow does not exceed an average of 1,500 gallons per acre per day. Subdivisions and lots using a public water system may use OSDS provided there are no more than four lots per acre, the projected daily sewage flow does not exceed an average of 2,500 gallons per acre per day, and that all distance and setback, soil condition, water table elevation, and other related requirements applicable are met (Florida Department of Health, 2000).

Local county boards of health or zoning authorities in Georgia can set higher minimum lot sizes than state standards (Georgia Department of Human Resources, 2000). The minimum lot size is one acre with a minimum lot width of 150 feet and a maximum sewage flow of 600 gpd for those with non-public water supply. For lots with a public water supply, half acre is minimum size, 100 feet is minimum width, and 1,200 gpd is maximum sewage flow.

Residential developments in Hawaii require 10,000 square feet of land area for each individual wastewater system; total development of an area shall not exceed 50 single-family residential lots or exceed 50 dwelling units (Hawaii Department of Health, 1991).

In Louisiana, for parishes in which the parish governing authority has enacted and enforces a formal sewage permitting system (requiring approval of individual sewage disposal systems by the state health officer prior to issuing any parish permits) and when the lots or sites in question meet any of the following criteria (Louisiana Department of Health and Hospitals, 1994):

a. minimum area of 22,500 square feet and a minimum frontage of 80 feet.
b. minimum area of 16,000 square feet and a minimum frontage of 80 feet where an approved individual mechanical plant is to be used, and

c. minimum area of 12,000 square feet and a minimum frontage of 60 feet where an approved individual mechanical plant is used followed by a modified absorption field.

Maryland issues variances for existing lots or parcels and a variance may be granted to the minimum two-acre lot size requirement (Maryland Department of Environment 1992). It is done in a manner so that a lot will provide for a safe and adequate water supply and sewage disposal system that will not impact reservoirs and streams used as potable water supplies. Based on percolation rate, lots using a public water supply range from 15,000 to 30,000 sq.ft. Lots using individual wells range from 20,000 to 40,000 sq.ft.

Lot size is established by local zoning regulations in Massachusetts (Massachusetts Department of Environmental Protection, 1996). Flow within nitrogen sensitive areas is limited to 440 gal/acre/day. Nitrogen sensitive areas are areas contributing to recharge of public water supplies, lots served by both private wells and onsite systems, and nitrogen sensitive embayment (not delineated yet). The 440 gpd limit may be exceeded when using innovative or alternative technologies that reduce nitrogen to an equivalent nitrogen load. Flows may be either 550 or 660 gpd depending upon the technology used.

In Maine a lot on which a single-family dwelling unit is located shall contain at least 20,000 square feet (Maine Dept. of Human services and Health, 2000). If a lot abuts a lake, pond, stream, river, or tidal area, it shall have a minimum frontage of 100 feet on the water body as well as any greater frontage required by local zoning.

General lot guidelines in New Hampshire call for a minimum of 20,000 contiguous square feet, and at least 4,000 sq.ft must be suitable for placement of an individual sewage disposal system (New Hampshire Department. of Environmental Services, 1997). However, slope and soil group may require a larger lot size, and the state uses a table which lists slope and soil group and displays the minimum lot size and factor for sewage loading for a single family residence with both an on-lot water supply and on-lot sewage disposal system. These range from 30,000 to 90,000 sq. ft. with factors for sewage loading ranging from 1 to 3.

For individuals with a public water supply, lots must be at least 50 percent of the area for on-lot water supply, or 20,000 sq.ft., whichever is larger. In cluster subdivisions served by a community water system, slope and soil group determine size, which ranges from 13,068 to 39,185 sq.ft. Each lot must be of sufficient size to accommodate an effluent disposal area twice the size specified for the sewage load.

Instead of specifying a lot size, Oregon code states sufficient usable area available to accommodate an initial and replacement system (Oregon Department of Environmental Quality, 2000). In Rhode Island, 10.000 sq. ft. is the minimum lot size for a home with an OSDS (Rhode Island Department of Environmental Management, 1998).

Subdivisions of single family residences in Texas, platted or designed after January 1, 1988, and served by a public water supply but using individual subsurface methods for sewage disposal, shall provide for individual lots having surface areas of at least half an acre, or shall have a site-specific design by a registered professional engineer or registered professional sanitarian, and approved by the department or its designee. In no instance shall the area available for such a system be less than two times the design area (Texas Natural Resources Conservation Commission, 1997).

In subdivisions platted or designed after January 1, 1988, for single family residences where each lot maintains an individual water supply well and OSDS with a subsurface soil system, the plat shall show the approved well location, and a sanitary control easement around the well within a 150-foot radius in which no subsurface system may be constructed. A watertight unit or lined evapotranspiration bed with leak detection capability may be placed closer to the water well than 150 ft, provided the minimum separation distances are not violated.

To minimize the possibility of waterborne diseases transmission due to the pollution of the water supplied for domestic use, each lot in platted subdivision shall contain no less than one acre, or shall have a site-specific design by a registered professional engineer or a registered professional sanitarian, and approved by the department or its designee. At no instance should the area available for such systems be less than two times the design area. Minimum size lot for a subdivision in Vermont with a private well is 20,000 sq.ft (Vermont Department of Natural resources, 2002). If there is a public water supply, minimum lot size is 10,000 sq.ft. Ninety percent of the minimum required area should be at least one foot above the flood plain of any lake or stream affecting the subdivision.

Washington determines minimum lot size by the type of water supply and the soil type. For a lot with public water supply, size varies from 12,500 sq.ft. to two and one half acres. For an on-lot water supply, the range in lot size is from one to two and one half acres (Washington State Department of Health, 1995).

4.4.10 Pumping Requirements

In general, how often a septic tank needs to be pumped depends upon the tank size and number of people, and habits of that particular household etc. Garbage disposals and high water-use appliances also affect pumping frequency that can be estimated by using Table 4.7 recommended by the Pennsylvania State University Cooperative Extension Service (Robillard 1990).

Most coastal states have very little information or guidance on the pumping requirements of a septic tank, pump tank, grease traps, and other tanks. In Massachusetts, grease traps are to be inspected monthly and are cleaned whenever the grease is 25 percent of the trap or at least once every 3 months. Manufacturer recommendations are to be followed when proprietary products are used (Massachusetts Department of Environmental Protection 1996). Table 4.8 presents an overview of the pumping requirements in a few of the coastal states that address this issue in their regulations.

Table 4.7 Estimated septic tank pumping frequency in years

Tank size (gallons)	Household size (number of people) 1	2	3	4	5	6
500	5.8	2.6	1.5	1.0	0.7	0.4
750	9.1	4.2	2.6	1.8	1.3	1.0
900	11.0	5.2	3.3	2.3	1.7	1.3
1,000	12.4	5.9	3.7	2.6	2.0	1.5
1,250	15.6	7.5	4.8	3.4	2.6	2.0
1,500	18.9	9.1	5.9	4.2	3.3	2.6
1,750	22.1	10.7	6.9	5.0	3.9	3.1
2,000	25.1	12.4	8.0	5.9	4.5	3.7
2,250	28.6	14.0	9.1	6.7	5.2	4.2
2,500	31.6	15.6	10.2	7.5	5.9	4.8

Table 4.8 Pumping frequency requirements in coastal states

State	Septic Tank	Holding Tank
Alabama		Portable-as needed others-weekly as minimum
Oregon	Dosing tank as per manufacturers specifications	Max-12 months
Florida		Portable-as needed
Massachusetts	Sludge within 12 in or less of bottom of tee; Top of scum within 2" top of outlet tee; Bottom of scum within 2" bottom of tee; Usually every 3 years, yearly with grinder;	
Maine		Once/year
Mississippi	Solids have reached 1/3 depth – every 3-5 yrs	
New Hampshire	Inspect once/year, pump when combined thickness scum, sludge equals 1/3 depth	Alarm To Indicate Full, needs pumping
New Jersey	Information sent to homeowner about inspection. Recommended frequency of pumping (not stated in regulations).	

The pumping frequency of a septic tank or a pump tank is highly variable, and conducting periodic inspections can help determine whether it needs to be pumped or not.

4.5 Beaufort County Study

Soil permeability tests were performed on six sites in the northern half of Beaufort County to see if they were suitable for OSDS. A small number of auger holes were dug to examine the soil morphology at depths of no more than two feet. A portable permeameter was used to measure soil permeability on all the test sites. Table 4.9 presents the soil permeability and test locations are indicated in Figure 4.1.

Figure 4.1 Soil Test Locations In Beaufort County

Table 4.9 Site Evaluation data from six sites in Beaufort County

Site	Latitude deg/min N	Longitude deg/min W	Elevation (feet)	Soil Description	Permeability gpd/sq.ft	Site No.
Katie Parker lane, St. Helena Island			13	Silty fine sand	45	**1**
Irongate drive	32/27.69	80/46.88	30	Sandy silt/organic clay	4.4	**2**
Joe Frazier road Burton	32/25.92	80/45.72	25	Sand organic silt/loam	4.4	**3**
Elementary School, Whale Branch bridge	32/1.95	80/84.59	10	Silty fine sand	114	**4**
Gardens Corner/Sheldon	32/35.97	80/47.56	20	Silty sand fill over clay/silt	2.9	**5**
Whimby Creek 6 landing	32/34.58	80/40.42	≥5	Sandy clay	0.5	**6**

The upper horizons showed a measured permeability of 45 gpd/sq.ft (2.1 E-5 m/sec). An effluent plume would travel at a rate of approximately 170 days per 100 ft. At other sites on less permeable soils, the permeability was measured at three to five gpd/sq.ft indicating an effluent plume travel rate of approximately 2,000 days per 100 ft. leading to effective attenuation of potential pathogens. The most permeable soils were found on St. Helena Island. This is very fine, silty, quartz sand, typical of eroded or erased former wind-formed dune formations. There was evidence of seasonal high saturation level.

In addition to the soil permeability tests, there were different occasions when various sites in the county were visited. There were no visible signs of failure or malfunctioning during that time. However, it should be noted that the scope of this study was not to perform a complete sanitary survey. The favorable soil conditions in the southern half of the county indicate that there should be few soil related OSDS malfunctions. This is corroborated by the fact that there were no reported malfunctions during site visits.

The soils of St. Helena Island lend themselves to individual OSDS at an economic (reasonably high) density of development. However, the soils north of Whale Branch River are less accommodating. The soils are much less permeable, and the terrain is still essentially flat. The water table is high, and groundwater and effluent movement is slow. In the northern part of the county, above the Whale Branch River the soil is less suitable for an effective OSDS. Soil maps available were also used, reviewed, and correlated for this purpose. The basic performance criteria used to determine malfunction or failure of OSDS during these visits was ponding or surfacing of wastewater.

It was observed during this limited time that the systems have been adapted to the site conditions, and other alternative methods provide, and can continue to provide, effective treatment and containment for the sewage disposal needs of the Beaufort county. Based upon the review of available soil and sub-soil data and the assessment of the manner of effluent flow in soil horizons (see research studies discussed below), it did not seem that OSDS contributed in any measurable way to microbiological contamination of the Beaufort county waterways.

4.6 Soil Hydraulics and Plume Dynamics

It should be understood that the effluent from an onsite sewage disposal system (septic system) initially forms a distinct “pool” of effluent beneath the dispersal area that lies within and is surrounded by the natural groundwater. The “pool” then begins to flow away laterally (horizontally) in the general direction of the prevailing or induced hydraulic gradient.

In a flat landscape the effluent may disperse in all directions, that is, a spreading circle. The “pool” known as an effluent plume tends to remain as a distinct layer that mixes very little with the local groundwater. The water in the soil is affected by the tide but only as a change in pressure, which accurately follows the water level in the estuary. There is very little actual water movement, and, thus, very little mixing between the plume and the groundwater.

Precipitation falling on the ground surface will penetrate and seep down to the plume creating a layer of freshwater above the effluent. This may be significant as the movement of the groundwater can be as slow as 100 ft per year, and in sandy soils, much of the average 45 inches per year rainfall of will be absorbed. With a void ratio of 50 percent, and losing 15 inches to evaporation and transpiration, 30 in of infiltrating rainwater would create a layer 60 inches deep in 12 months.

The two predominating soil types in the region will have differing reactions to rainstorm events. In the sandy soil areas, that surface run-off will only occur with a tropical storm that brings 6 to 8 inches or more in 24 hours. In the areas with the silt/clay soils under shallow layers of sand, it is to be expected that a storm with only two inches will generate significant surface run-off.

Surface run-off will carry any microbial contaminants from domestic and wild life into the fresh and tidal waterways of the county. Surface run-off from impervious areas (roofs, roads, parking lots, and any paved areas) will carry similar contaminants under all but the lightest precipitation events. It is considered unusual for an individual septic system to contribute any contaminants to surface run-off during a storm event. The system may become temporarily flooded, but the effluent will be contained below ground and will disperse into the soil horizon as the flood levels drop.

Septic tank effluent entering the soil absorption system will contain three basic constituents, soluble and solid organic matter measured by its 5 day BOD, the plant nutrients, nitrogen and phosphorus, and the potential pathogens, bacteria, and viruses. Much of the BOD_5 will be removed by the biological activity in the bio-mat of the soil absorption trench. Much of the phosphorus will pass into the soil but will be adsorbed by the minerals in the soil particles. The nitrogen will be in the form of ammonia as it leaves the trench, but if the effluent passes through soil that is only partially saturated, nitrifying bacteria in the soil will oxidize the ammonia to nitrate.

Flowing laterally once it reaches the influence of the water table, both ammonia and the nitrate may be selectively absorbed by plant roots. If below root level, the nitrogen will travel unchanged for considerable distances. Reaching the estuary or salt marsh, the effluent will pass through an organically rich area of sediments. If in the nitrate form, bacteria living in an oxygen-deprived state will use the oxygen of the nitrate for respiration, thus effectively de-nitrifying the plume. If the nitrogen is still in the form of ammonia, the plants of the salt marsh will remove much of the nitrogen. This process will be less effective in winter.

In passing through partially saturated soil, the bacteria and viruses will be severely attenuated by the process of adsorption to soil particles and predation by the micro flora of the soil. If passing only through a saturated soil horizon, there will still be attenuation of the bacteria and viruses, but at a slower rate. The effluent plume will travel laterally 50 to several hundred feet and take several months to emerge into the estuary or salt marsh. During this passage through the soil, the potential pathogens will be attenuated both by the effects of time and by the same predation of native bacteria within the soil.

There is considerable concern that pathogens and contaminants originating from septic tank drainfields may reach individual and community water supply wells, and there are many reports of research seeking to prove the connection. Much of this research was performed in aquifers of relatively coarse sand and does show pathogen transport through relatively large distances and within the commonly applied distances for separation between well and system. On the other hand, there are few reports available on studies that have sought to be neutral or to show that water supply wells are not necessarily at risk.

Research Studies

One study by Check in Nova Scotia, Canada, showed that three laboratory model studies made to replicate lateral flow sand filters treating septic tank effluent removed 95 percent of BOD_5 and completely removed both total and fecal bacteria after maturation with a total lateral path 16 feet long (Check, 1994). A study of viral attenuation showed that no viruses were able to survive the passage through the filter in two of the sands used in the models (both fine sand) and were severely attenuated in the third.

Field studies under colder conditions at sites with mature lateral flow filters showed the same attenuation of BOD_5 but greater survival of both fecal and total coliform bacteria, showing 98 percent reduction through the filter. If the same rate of reduction occurs, the bacteria would not be detectable at 100 feet.

A study by Grunnet and Oleson (Grunnet, 1976) of the attenuation on micro-organisms following injection by infiltration basin into glacio-fluvial sands in Denmark showed almost complete removal of coliforms, E.coli and coliphages after traveling 160 meters (525 feet). A large population of heterotrophic bacteria was found widely distributed throughout the stratum and are responsible for the attrition of potential pathogens and organic matter. The authors' interpretation of the pattern of flow of the plume may be faulty in that the indicator organisms were found in the upper two meters. It is probable that the local groundwater is flowing under the effluent plume and the plume does not extend to the base of the aquifer as indicated.

A study by Filip, Seidel and Dizer of the pollution risk on sewage irrigation fields in West Berlin in use since 1890, showed that enteric viruses were detected in only seven of 87 samples at different soil depths. No viruses were detected in groundwater samples (Filip, 1983).

A study by Gersberg, Lyon, Brenner and Elkins on the attenuation of viruses in artificial wetlands in California showed a 99 percent removal in a retention time of five days (Gersburg, 1987). On the other hand, a study by Vaughn, Landry and Thomas on the attenuation of viruses from the leaching system of an apartment complex on Long Island, New York, showed viruses traveled 57 meters (187 feet) to an observation well. The aquifer is coarse-grained sand, and the effluent distribution system uses a series of leaching pits in a relatively small area for the 120 apartment units. It is unlikely that an efficient bio-mat would form in these circumstances or that the subsoil micro flora could efficiently scavenge the effluent for pathogens (Vaughn, 1982).

Chapter 5
Standards and Guidance for Wastewater Technologies

5.1 Introduction

The standards and guidance information presented in the following sections are on a number of wastewater technologies permitted and currently used in South Carolina. There may be differences in the application of these technologies within different regions of South Carolina. Variance and allowance may be provided in certain areas depending on the type of restrictions and limitations. As in almost all cases, if there are differences in these standards involving local jurisdictional rules, regulations, ordinances, policies, procedures, or practices, the local standards take precedence. Application of the recommended standards is at the full discretion of the local health officer. The recommended standards are provided partly in a typical rule language to assist those local jurisdictions where adoption in local rules is the preferred option.

Presented below in table 5.1 is a summary of the wastewater site evaluation report developed by the South Carolina Bureau of Health from July 2000 to June 2001. This table shows the trend and provides a good understanding of the current technology options in the county (SCDHEC, 2001).

Table 5.1 Wastewater site evaluations for Beaufort County and South Carolina

Site/System Information	Beaufort County		South Carolina	
	Percent	Number	Percent	Number
Sites acceptable for conventional systems	35.8	286	60.93	15,911
Sites acceptable for alternative systems	54.8	437	24.37	5,545
Total number of acceptable sites	90.7	723	94.3	21,456
Sites not acceptable for onsite systems	2.89	23	2.75	626
Installations approved - conventional	36.47	190	74.29	13,700
Installations approved – alternative	63.53	331	25.7	4,742
Systems with pumps	7.29	38	3.64	671

Only a third of the sites in Beaufort County are suitable for onsite systems when compared to two-thirds in the state as reported. About 63 percent of the systems installed during this one-year period were alternative systems. The alternative treatment and disposal options for domestic wastewater are wide-ranging, from generic technology/engineered designs to proprietary products. In this chapter, a review of appropriate choices of technologies (mostly generic) widely used in most coastal states will be reviewed and recommendations included. There are a number of variations in design and configuration. Specific proprietary technology choices are well listed in the ISTDS reference guide of the SC DHEC.

The permitting of all the different technologies discussed in the following sections is a standard procedure. An installation permit must be obtained from the local health jurisdiction before installation of an OSDS. In some cases an operational permit may be necessary as well. A local health officer or appropriate regulatory personnel should be present before the system is backfilled. The perpetual maintenance of these units is very important for the long viability of these onsite systems.

There are several options, such as recording the requirement for an ongoing maintenance contract on the property deed, issuing an operating permit with the requirement for holding a maintenance contract, or requiring a management entity to provide O&M assurance. Some of the different types of management entities include: cities & towns, public utility districts, water & sewer districts, special-use districts, corporations, and homeowner associations with demonstrated capacity to assure long-term management.

5.2 Septic Tank

The septic tank is the most common pretreatment unit used in a wastewater system. A septic tank has one or two compartments and separates the floating oils, greases, and debris from the settled solids, leaving a partially clarified effluent in the middle (Bedinger, 1997).

5.2.1 Residential Septic Tank

These guidelines for residential septic tank size generally refer to one - to three-family dwellings. Many states specify single-family or duplex homes and classify other dwellings as "other than individual family" or "other than single family." Figure 5.1 (a and b) shows a cross-sectional view of a single and multi-compartment concrete septic tank with the various ports and accessories.

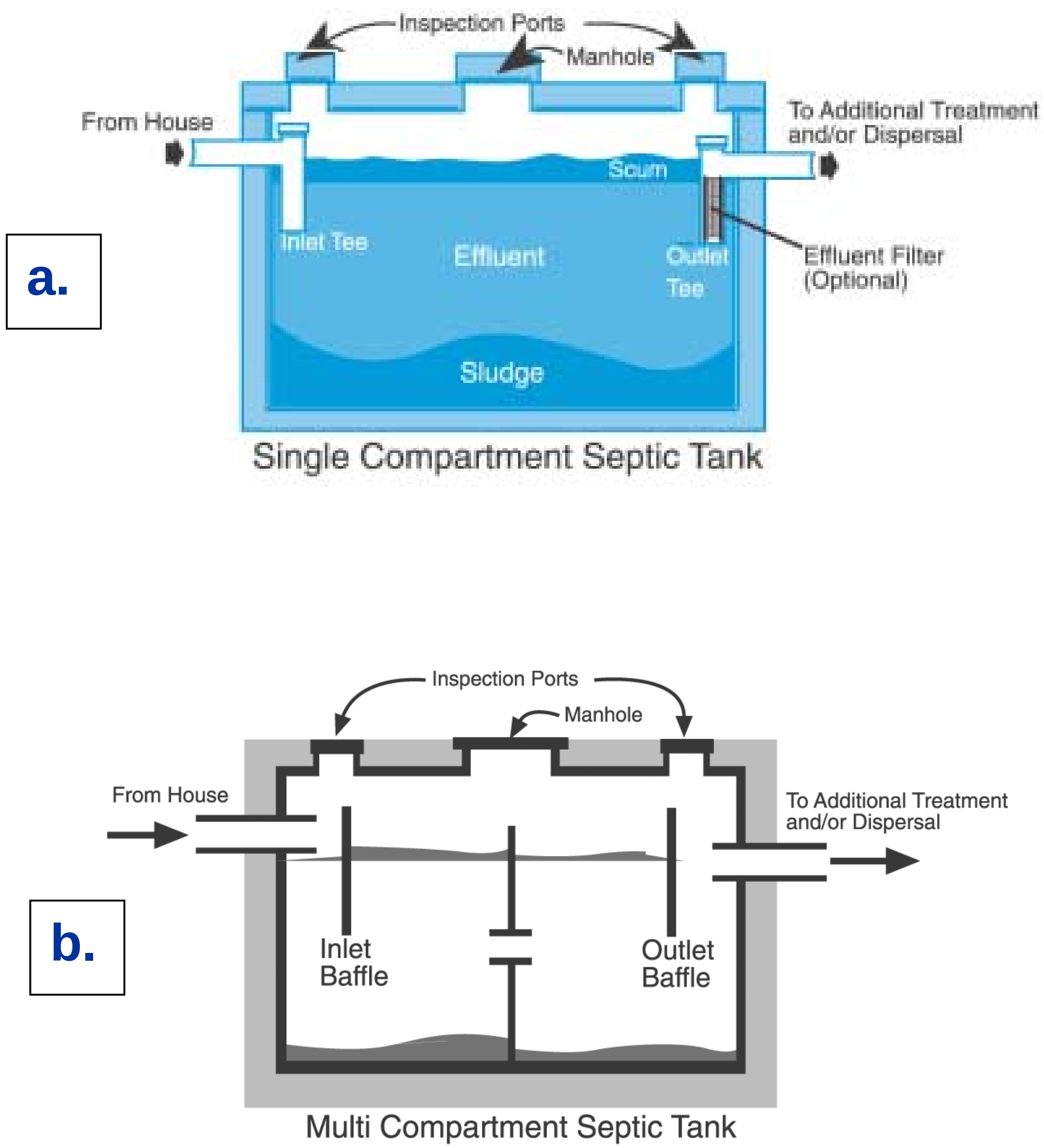


Figure 5.1 Cross-sectional view of single and two-compartment septic tanks

The underlying rationale is that sewage flow rates increase as the number of people using facilities increases, and most states group large residences, multiple dwelling units, and places of business or public assembly into a different category with different guidelines and specifications.

Most states have standard sizing and design requirements that are not very different from each other. However, there can be specific requirements on the type of material, thickness is of the wall, top, and bottom, baffle location and depth; compartment size, effluent filters (outlet filters), etc. Manufacturers recommendations should be followed when proprietary products are used.

Table 5.2 provides a summary of the number of bedrooms and minimum capacity volume of septic tanks for single and multi-family dwellings in the coastal states. Most coastal states determine the minimum residential septic tank capacity by the number of bedrooms in the home, or in some cases, based on a certain percentage of the design flow or minimum hydraulic detention. Minimum capacity ranges from 500 to 1,500 gallons. In general, the most commonly used septic tank is 1,000 gallons for a three-bedroom home. The majority of states add 250 gallons capacity per additional bedroom, with the assumption that there are two people per bedroom. Mississippi adds 150 gallons of capacity for each person exceeding two per bedroom (Mississippi Department of Health, 1996).

In Florida and Louisiana, the size of the tank is based on the average sewage flow. The septic tank and pump capacity is provided in their code relating to the average flow up to 5,000 gpd. Although most states do not have very specific requirements for blackwater and graywater, Florida has guidelines for a separate graywater tank and drainfield system (Florida Department of Health, 2000). This allows a reduction in size of the blackwater system by no more than 25 percent with a minimum capacity of a 900-gallon tank. Florida requires a 250-gallon tank for graywater with a maximum flow of up to 75 gpd. When the flow is over 75 gpd, the size will be determined similar to the combined flows.

Table 5.2 Residential septic tank sizing criteria in coastal states

Coastal State	Minimum Capacity	Bedrooms	Additional Capacity		Additional Capacity
Alabama	750 gal	3 or 4	1,000 gal		
		>4 Bedrooms	250/Bedroom		
Alaska/Connecticut	1,000 gal	>3 Bedrooms	250/Bedroom		
Delaware	1,000 gal	>4 Bedrooms	250/Bedroom		
Florida	900 gal	Based On Flow			
Georgia	1,000 gal	>4 Bedrooms	250/Bedroom	Grinder	Add 50 percent
Hawaii	750 gal	3 Bedrooms	900 gal		
		4 Bedrooms	1,000 gal		
		5 Bedrooms	1,250 gal		
Louisiana	500 gal	2 1/2 Times Daily Flow			
Maine	750 gal	3 Or 4	1000 gal		
		5 Bedrooms	1,250 gal		
		Each Additional	250/Bedroom		
Maryland	750 gal	3 Bedrooms	1,000 gal		
		Each Additional	250/Bedroom		
Massachusetts					
	1,500 gal or 200 percent Flow or 48 Hr detention			Grinder	Two compartment tank
Mississippi	750 gal	3 Bedrooms	1,000 gal	Occupant	
	48 Hr Detent-Ion	4 Bedrooms	1,200 gal	>2/Bedroom	150 gal
		Each Additional	300 gal		
New Hampshire	1,000 gal	3 Or More	250/Bedroom	Grinder	Add 50
New Jersey	1,000 gal			Grinder	Add 50 percent
New York	1,000 gal	Each Additional	250/Bedroom	Grinder	Add 250 gal
North Carolina	750 gal	3 Bedrooms	900 gal		
		4 Bedrooms	1,000 gal		
		Each Additional	250/Bedroom		
		>5 Bedrooms	Equation		
Oregon	1,000 gal	>4 Bedrooms	1500 gal		
Rhode Island	1,000 gal	4 Or More	250/Bedroom		
South Carolina	890 gal	3 Or 4	1,000 gal		
		Each Additional	250/Bedroom		
Texas	750 gal	Each additional	250/Bedroom		
Virginia	750 gal	3 Bedrooms	900 gal		
		4 Bedrooms	1,200 gal		
		5 Bedrooms	1,500 gal		
Washington	900 gal	4 Bedrooms	1,500 gal		
		Ea Additional	250 gal		

Louisiana requires tank capacity at two-and-one-half times estimated average daily design flow. However, a single bedroom home may use a 500-gallon tank (Louisiana

Department of Health and Hospitals, 1994). Massachusetts requires a minimum liquid capacity of 200 percent of the design flow or a minimum hydraulic detention time of forty-eight hours, whichever is greater (Massachusetts Department of Environmental Protection, 1996).

Hydraulic detention time standards are set at twenty-four hours in Delaware and forty-eight hours in Alabama, Massachusetts, Mississippi and Virginia. New York also specifies a minimum liquid surface area per bedroom and adds seven square feet of surface area for each bedroom (New York Department of Health, 1990).

Garbage disposals, also known as grinders, require additions to tank capacity in five states. While three states require that system capacity be increased by 50 percent, New York adds 250 gallons to tank size (New York Department of Health, 1990), and Massachusetts requires that that a two-compartment tank or two tanks in series be used (Massachusetts Department of Environmental Protection, 1996). Grinders are prohibited in Massachusetts when an elevated septic tank is in use.

Most states require an approved effluent or outlet filter to be installed as per manufacturer specifications. The outlet filter must be placed above the seasonal water table as indicated by gray mottles. Other general requirements include a watertight and structurally sound tank that is built of non-corrosive material.

All tanks must have interlocking type joints and be sealed with waterproof corrosion-resistant sealant. Expanding grout material can be used to seal tanks and risers. Some grouts will shrink and crack over time, thus allowing the tank to leak well after the tank is backfilled. Bentonite backfill around the tank seams and pipe entrances will accomplish this goal.

Epoxy can also be used to seal some kinds of joints, but the weather conditions must be ideal. When grout is used, a sanded collar may be needed to assure that inlet and outlet pipes do not leak. Applying PVC glue while it's wet to the collar creates a sanded collar. Rubber grommets around smaller inlet and discharge pipes, conduit, and junction box penetrations are also effective in controlling leaks.

None of these coastal states has a statutory requirement for how often septic tanks must be pumped out. Most follow the philosophy of informing the public of the need for inspections and giving specific standards for conditions that indicate that the tank should be emptied. Massachusetts requires yearly pumping with a grinder (Massachusetts Department Environmental Protection, 1996). New Hampshire requires inspections once per year (New Hampshire Department. of Environmental Services, 1997).

Holding tanks must be emptied once/year in Maine (Maine Dept. of Human services and Health, 2000) and Oregon (Oregon Department of Environmental Quality, 2000). Sand filter systems must be inspected every three years in Oregon, and Delaware requires pumping of the septic tank for the sand filter system every three years.

5.2.2 Commercial Category

The commercial category includes residential “other than single family” in many states, “other than one- to three-family dwellings” in Maine (Maine Dept. of Human services and Health, 2000), and “large residences, multiple dwelling units, places of business, or public assembly” in North Carolina (North Carolina Department of Health, Environment and Natural Resources, 1999). Institutions, industry, commercial, and nonresidential are included

These are systems designed to handle larger volumes of sewage than a single dwelling, and almost all use an estimated sewage flow/day as the basis for their specifications. Connecticut uses the estimated daily flow to determine minimum tank size (Connecticut Department of Public Health, 2000).

Four states use 150 percent of design flow, and Delaware uses 150 percent of the peak flow (Delaware Department of Natural Resources and Environmental Control, 1985).

Five states use 200 percent of design flow, and Louisiana uses 250 percent of average flow for determining the liquid capacity of the septic tank (Louisiana Department of Health and Hospitals, 1994). Table 5.3 provides an overview of commercial septic tank flow and size considerations.

Table 5.3 Septic tank specifications for commercial use in coastal states

Coastal State	Flow/Day	Minimum Capacity	Design Specifications
Alabama	24 hours	750 gal	Separate provisions for spa, hot tub, and hydraulic detention time 48 Hours
Alaska	200 percent		EPA design manual
Connecticut	24 hours	1,000 gal	Many design and construction specifications. Hydraulic detention time 2 hour at peak flow
Delaware	1.5 X peak	1,000 gal	24-hr detention time. Flow >1,500 gpd: 1,125+0.75q
Florida	Based on average flow/day	900 gal	Specifies design and approval. Multiple dwellings connected to one system Add 75 gal/Dwelling
Georgia	24 Hr		Two compartment Tanks
Louisiana	2.5x average flow	500 gal	
Maine	150 percent flow	750 gal	Multiple compartments or tanks if >2,000 gal/day
Maryland	150 percent flow		>1500 gal/day: V=1,125 + 0.75q
Massachusetts	200 percent flow	1,500 gal	Specifies design For > 1,000 gal/day
Mississippi	200 percent flow	750 gal	Specifies design, Less capacity required if baffles or filters. 48 hours hydraulic detention time.
New Hampshire	150 percent flow	1,000 gal	>1,500 gpd: V=1,125 + 0.75 Q
New Jersey	150 percent flow	1,000 gal	Specifies multiple compartment tanks. >1,500 gpd: V=1125+0.75 Q
North Carolina	200 percent flow	750 gal	>600 gpd, <1,500 gpd: 1.17q+500. >1500 gpd, <4,500 gpd: 0.75q+1125. >4,500 gpd: V=Q
Oregon	200 percent flow	1,000 gal	
Rhode Island	Up To 500 gpd	1,000 gal	
	5-1,500 gpd	2 X daily flow	
	>1,500 gpd	1,500+ 100 percent	
		Daily flow	
South Carolina	< 593 gpd	890 gal	
	593-1500 gpd	1.5 X daily flow	
	>1,500 gpd	1,125+75 percent daily flow	Requires professional engineer
Virginia		750 gal	Minimum hydraulic detention time 48 Hours

Note: < denotes less than and > denotes greater than

Florida provides a table with a range of flow volumes and the corresponding septic tank capacity required (Florida Department of Health, 2000). The most commonly used formula to calculate the volume of a tank is:

$$V=1{,}125 + 0.75\ Q$$

where V = net volume of septic tank in gallons and

Q = peak daily wastewater flow in gallons.

This formula is frequently used for volumes greater than 1,500 GPD. Six states specify a hydraulic detention time that ranges from 2 hours at peak flow in Connecticut to 48 hours in four states (Connecticut Department of Public Health, 2000). There are many more design specifications for these systems than for the smaller residential OSDS. Alaska refers directly to the EPA design manual for onsite wastewater treatment and disposal systems. Other states list requirements for multiple compartment tanks or septic tanks in series. South Carolina requires a professional engineer for flow greater than 1,500 GPD.

5.3 Aerobic Treatment Unit

Aerobic treatment units (ATUs) provide aerobic biological decomposition of wastewater by providing an oxygen-rich environment using a mechanical device. Bacteria that thrive in this environment break down and digest the organic matter found in the wastewater. ATUs come in different configurations and sizes and incorporate a variety of approaches, including air pumps, air injectors, lift pumps, and biological-contact surfaces (such as pipes, fabric, grids, gravels, and rotating disks). They are almost always proprietary systems or in the form of a septic tank with modifications and operate on the principle of activated sludge treatment.

Most ATUs have three-compartment tanks, the first as a simple primary settlement tank from where the effluent passes to the central aeration tank (see figure 5.2). Here an impeller aerator or some mechanical device provides oxygen to the mixed liquor of the reaction tank. In other systems, the impeller is replaced with a compressor, diffuser or bubbler. Some units may incorporate a fixed or mobile substrate to encourage attached growth of the active microbial population. The mixed liquor passes to the final settlement chamber before being sent for further treatment or dispersal.

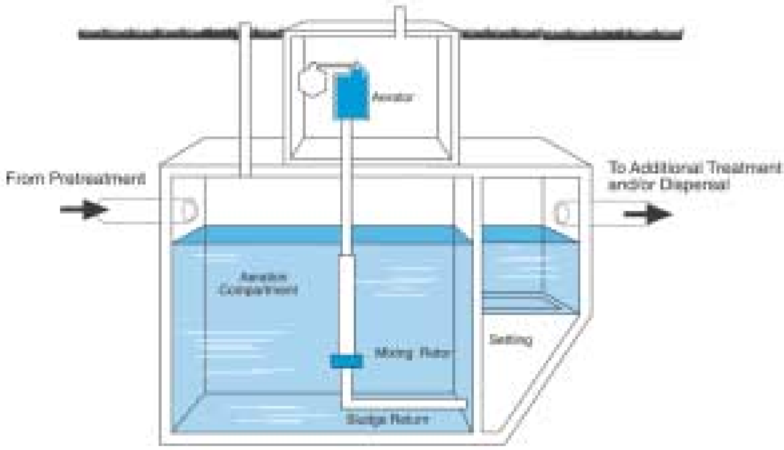


Figure 5.2 Cross-sectional view of an ATU

A disinfection unit, either chlorine or ultraviolet, may be installed. Where the unit discharges to the surface (stream or ditch), the unit will require a National Pollutant Discharge Elimination System (NPDES) permit, which is administered in most cases, by the state environmental agency. Where treatment and disinfection is required for protection of an aquifer (insufficient treatment by the soil), sampling of the effluent may be required to ensure adequate treatment and disinfection.

Application

The use of a particular type of ATU can be based on the type of wastewater. Different types are: typical-strength residential wastewater; high-strength non-residential or commercial wastewater (such as at restaurants, grocery stores, mini-marts, group homes, medical clinics, etc.); and high-strength residential wastewater. Relatively consistent and uniform wastewater loading patterns is necessary for an ATU to perform well, which is typically the case for residential flows.

The overall performance might be lower when infrequently or intermittently used due to the repeated start-up periods. However, the duration of, and performance levels during, start-up may vary from manufacturer to manufacturer. Operation and maintenance functions performed by maintenance providers can reduce the performance variability caused due to infrequent or intermittent use.

Those states that allow aerobic treatment units to be installed require third-party testing and sometimes certification. National Sanitation Foundation (NSF) Standard 40 is the national standard for the testing of aerobic treatment units (NSF, 1978). Louisiana requires testing by an independent testing laboratory or an unbiased institution (Louisiana Department of Health and Hospitals, 1994). Mississippi requires a third-party certifier accredited by the American National Standards Institute (Mississippi Department of Health, 1996). Some states do not specify who certifies plants. Most states award some benefit for the installation of a Class I ATU.

In Florida, the drainfield size in a sandy soil is reduced 25 percent (Florida Department of Health, 2000). Texas allows spray irrigation of chlorinated ATU effluent (Texas Natural Resources Conservation Commission, 1997). Hawaii and Maryland specifically state that drainfield size reductions are allowed. Critical issues with ATUs are requiring a trained operator to take responsibility for the ongoing maintenance of the unit and ongoing service contracts to pay them. A detailed and comprehensive code section on ATUs is found in the North Carolina, Oregon, and Washington state codes (appendix H).

Wastewater Characteristics

The products must be tested in accordance to NSF Standard 40 for residential wastewater systems. In some cases, an additional testing protocol may be required to include a stress-testing program designed to evaluate the unit under extreme or adverse conditions for that specific application. Prior approval of the additional testing program may be necessary.

By design and performance characteristics, some ATUs tested in typical-strength residential wastewater settings (NSF Standard No. 40) may be used to treat higher-strength wastewater. A licensed engineer or a designer must specify the equipment and products for that specific site and application, which must be consistent to all manufacturers' requirements. Table 5.4 shows an NSF standard (Class I and II) for residential, influent, wastewater characteristics.

Table 5.4 Summary of NSF Standard No. 40 for aerobic treatment units

Performance Designations	Wastewater Characteristics		Required Test Protocol
	Influent	Effluent	
NSF[(1)] Class I	$CBOD_5$: 100 - 300 mg/L [(2)]	$CBOD_5$: ≤25 mg/L [(2)] ≤40 mg/L [(3)]	NSF Std. No. 40[(4)]
	TSS: 100 - 350 mg/L [(2)]	TSS: ≤30 mg/L [(2)] ≤45 mg/L [(3)]	
	pH: No standard specified	pH: 6.0 - 9.0	
	No bacterial standard specified	No bacterial standard specified	
NSF[(1)] Class II	$CBOD_5$: 100 – 300 mg/L [(2)]	$CBOD_5$: Not more than 10 percent of samples >60 mg/L	NSF Std. No. 40[(4)]
	TSS: 100 - 350 mg/L [(2)]	TSS : Not more than 10 percent of samples > 100 mg/L	
	pH: No standard specified	pH: 6.0 - 9.0	
	No bacterial standard specified	No bacterial standard specified	

(1) NSF – National Sanitation Foundation.
(2) 30-day average.
(3) 7-day average.
(4) NSF *International* Standard for Wastewater Technology / Residential Wastewater Treatment Systems. Standard No. 40 – January 1999

Courtesy: Washington State Department of Health, 2000

Adequate performance information must be provided with the testing of certain parameters such as BOD, TSS, etc. for the required period of time. The influent and effluent characteristics of ATUs should be based on the typical- and high-strength residential wastewater and high-strength non-residential wastewater as used by NSF for testing and certification.

Pretreatment

The testing of a specific brand or type of ATU will determine the need for pretreatment prior to the wastewater entering into the unit. For those ATUs using an external trash tank or septic tank (single or multiple) compartment to pretreat wastewater, the following must be considered: a tank of at least equivalent design and volume capacity is required as a component of the OSDS, and a conventional two-compartment septic tank may be used in the place of a single compartment tank, if consistent with the manufacturer's recommendations.

In cases where pretreatment is not required or recommended, it is required only when the ATU manufacturer recommends the installation of a pretreatment tank in specific settings or applications consistent with the manufacturer's recommendation.

Location and Model/Size

ATUs should be installed level on undisturbed soil, and if leveling is necessary, it must be placed on a bed of sand. The outlet of the ATU should be placed above the seasonal groundwater as indicated by gray mottles. It should not be located where surface water collects, since water may enter the unit and cause flooding. This would result in improperly treated wastewater to be discharged into the drainfield or the surface body of water. Minimum horizontal separation distances should be maintained.

The model or size of the ATU should be based on the recommendation of the manufacturer to match the daily design wastewater flow anticipated from the dwelling. For those units with high-strength residential and non-residential applications, the wastewater loading parameters (BOD, TSS, etc.) might have to be taken into account in addition to the design wastewater flow.

Access and Monitoring

Ground-level access ports must be sized and located to facilitate installation, removal, sampling, examination, maintenance, and servicing of components or compartments that require routine maintenance or inspection. They must be sufficiently sized and located to facilitate visual inspection and removal of mechanical or electrical components, removal of components that require periodic cleaning or replacement, visually inspecting and collecting samples, and, removing (manual or pumping) accumulated residuals. Access ports must be protected against unauthorized intrusion. Acceptable protective measures include, but are not limited to, padlocks or covers that can be removed only with tools.

Proper mechanisms or processes must be in place to detect failure of electrical and mechanical components critical to an ATU. Failure-sensing devices must be able to notify the owner of failures. The mechanism must deliver a visible and audible signal. A clearly legible, visible, and permanent label or plate with instructions for obtaining service must be in a permanent location.

The plate can be located on the front of the electrical control box, (only if the ATU has an electrical control box or panel) and on the tank, aeration equipment assembly, or riser at a location accessed during maintenance cycles and inspections. Each plate must include manufacturer's name and address, model number, serial number, rated daily hydraulic capacity of the system, and the performance expectations as determined by performance testing and evaluation.

A properly designed, constructed, and installed sampling port should be available to provide easy access for collecting wastewater samples from the effluent stream. Sampling ports are used for diagnostic activities and/or confirming to the regulatory compliance requirements. Pressurized transport and collection of the samples is easier than gravity flow. The ports may be located within the ATU or other system component (such as a pump chamber) provided that the wastewater stream being sampled is representative of the effluent stream from the ATU.

5.4 Mound

The principal components of a mound system (Figure 5.3) are a pretreatment device (usually a septic tank, conventionally sized), pump chamber (pump and controls), and the mound (Figure 5.4). The mound consists of a filter media, infiltration bed, distribution system, and soil cap and topsoil cover (Converse, 1990 and 2000).

A mound is made up of a soil cover that can support vegetation and a fabric-covered coarse gravel aggregate in which a network of small-diameter perforated pipes is placed. The network pipes are designed to distribute the effluent evenly through the aggregate and onto the sand media, where effluent is treated and passes to the plowed basal area (Solomon, 1998).

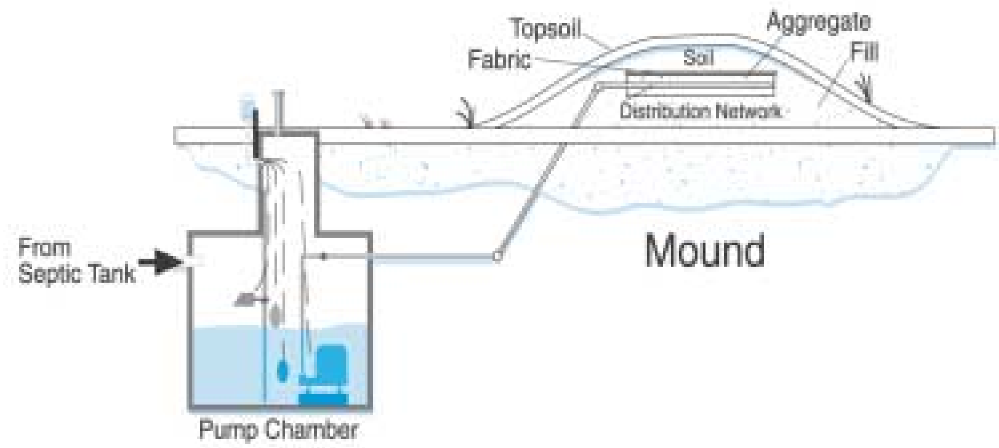


Figure 5.3 Typical Mound System

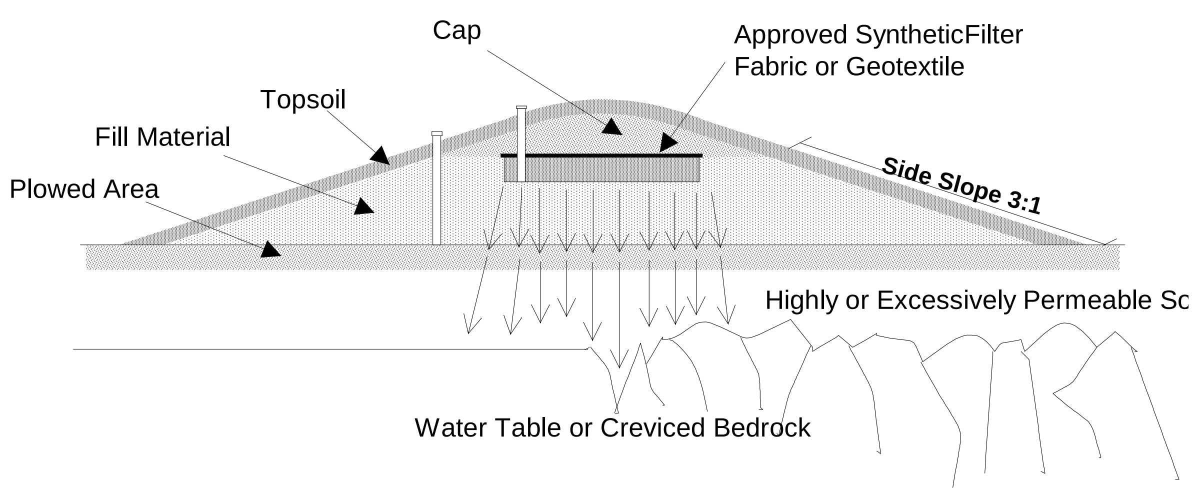


Figure 5.4 Cross-section of a Mound

Septic tank effluent, pumped from the pump chamber to the distribution system in the infiltration bed, flows through the filter media where it undergoes physical, chemical, and biological treatment before it passes directly into the underlying natural soil for disposal. Mounds are an excellent treatment and disposal option where conventional OSDs are not viable due to site-limiting conditions.

General Standards and Protocols

Mounds are pressure-dosed systems that lie above the soil surface designed to overcome site restrictions such as slow or fast permeability soils, shallow soil cover over creviced or porous bedrock, and high water table. It provides additional treatment capacity to that natural environment, producing an effluent equivalent or better than a conventional OSDS. Typical mound design and sizing information including examples of complete mound design is presented in Appendix H.

The proper siting, design, pre-construction planning, site preparation, filter media selection, construction, and maintenance will ensure the long-term viability of these systems. Quality control throughout the process cannot be overemphasized. The following critical issues need to be addressed when choosing the mound, such as: accurate soil type and depth determination, long and narrow plug flow concept installed along the topographical contour of the site adhering to the specific siting, design, construction, and maintenance conditions which when not fully met lead to operational problems, and careful selection and placement of filter media.

In general, mounds are an option for sites that cannot maintain a two-foot vertical separation between the bottom of a mound and a restrictive layer of rock, clay, or water table. Several factors such as site evaluation, dwelling placement, surface drainage issues, and topography should be considered before the construction of a mound.

Location

The mound should be located in open areas for exposure to sun and wind where evaporation and transpiration will be maximized. It should not be constructed over areas prone to flooding, very poorly drained; hydric, or stony soils; drainage way; depressions; or swale. Any runoff upslope must be diverted from the mound. Good design practice must consider drainage constraints for both up gradient and down gradient area drainage. Additional site evaluations and/or testing may be required to analyze the site before siting the mound system.

A mound can be situated on a crested site where the effluent will move laterally down both slopes, on a level site that allows lateral flow in all directions and on a sloping site where the effluent moves in one direction. On level sites, with slowly permeable soils, groundwater-mounding issues should be taken into account. The mound should be placed on the upper part of the slope and not the base. On a site with a complex slope, it should be located to avoid treated wastewater accumulating in one area downslope.

Sites with large trees, numerous smaller trees, or large boulders are less desirable for a mound system because of difficulty in preparing the surface and reduced infiltration area available beneath the mound. The amount of soil available for receiving and transmitting treated wastewater away from the mound can be considerably reduced due to the tree roots, stumps, and boulders that are like rock fragment, as they occupy space.

If sufficient area for the mound is not available, the stump should be cut off at ground level without disturbing the native soil. Sizing the mound bigger to accept the effluent should compensate for the lost area. Considerable care should be taken to prepare the soil infiltrative surface when dealing with such less than ideal conditions.

Minimum Soil Depth

A mound system design should address site and soil conditions that would be able to successfully treat and move the wastewater away from the system. It must not affect the subsequent doses that will be applied to the mound. A minimum of 18 inches of undisturbed, unsaturated, original soil as measured from ground surface is required for placement of a mound. A minimum of 12 inches of undisturbed, unsaturated, original soil is required when the mound is preceded by an intermittent sand filter or other types of pretreatment.

It has been suggested that high water table, including seasonally perched water table, should be greater than 10” beneath the ground surface. High water table can be determined by visual observation, interpretation of soil mottling or other criteria. High water table checks are required when vertical separation (or in the case of mounds, soil depth) is suspected to be less than 24 inches and are required by local health jurisdictions to accurately identify the location of high water tables. The checking and evaluation of water table levels become critical in system design, function, and protection of public health as potential soil depth decreases. Table 5.5 lists some of the recommended soil and site criteria for a Wisconsin mound (Converse, 1990 and 2000).

Table 5.5 Recommended soil and site criteria for Wisconsin mound

Parameter	Value
Depth to water table (permanent/seasonal)	10 inches
Depth to crevice bedrock	2 feet
Depth to non-crevice bedrock	1 foot
Site slope	25 percent
Filled site	Yes[A]
Over old systems	Yes[B]
Flood plains	No

A - Suitable according to soil criteria (texture, structure, consistence)
B – The area and back fill must be treated as fill, as it is a disturbed site
Courtesy: University of Wisconsin-Madison, College of agricultural and life sciences

Ground Slope Limitations and Setbacks

A mound can be installed on a maximum ground slope of about 20 percent with customary construction equipment (Converse, 1990 and 2000). On slopes greater than 20 percent, special care and consideration must be given to the slope stability, installation techniques, and design elements of “long and narrow” mound. Qualified and experienced engineers, geologists, soil scientists, or others, depending on the site conditions, may be required to be involved in the design and construction of the mound.

Setbacks are measured between the perimeter of the basal area of the filter media and the respective features. Recommended setback distance from property lines, driveways, buildings, ditches or interceptor drains, or any other development that could either impede water movement away from the mound or channel groundwater to the mound area is 10 feet up gradient and 30 feet down gradient. The setback from a well, suction line, or surface water is 100 feet up gradient and 100 feet down-gradient. Other minimum setbacks must be maintained as well.

Influent Characteristics

A mound should receive only pretreated effluent that is at least equal to that provided in a conventional two-compartment septic tank, before discharge to a mound. Wastewater from non-residential sources or high-strength wastewater from residential sources must receive pretreatment sufficient to lower the waste-strength to the level of that commonly found in domestic residential septic tank effluent before discharge to a mound.

Mound systems have inherent limitations when treating wastewater that is higher in strength than what is considered normal domestic wastewater. The BOD and TSS applied to the mound should be typical-residential strength (around 220 and 145 mg/L). Higher strength wastewater and non-domestic sources (such as restaurants, hotels, bed and breakfast establishments, industrial and commercial wastewater sources, etc.) should be individually evaluated for treatability and degree of pretreatment required prior to a disposal into the mound.

Minimum Land Area / Density

The use of a mound system does not provide for a reduction in the minimum land area requirements. Site development incorporating a mound must meet the minimum land area requirements established in state and local codes. A reserve area with suitable site conditions for a mound installation must be set aside. The reserve area must be equal to 100 percent of the normally required mound area, totally separate from the initial mound area, able to meet all of the design requirements, including soil depth, soil type, slope restrictions, and setbacks, etc., and remain fully protected to prevent damage to soil and any adverse impact on the immediate surroundings that may affect the installation of the replacement mound system or its function.

Installation

Proper vehicles must be used at the site when installing a mound. Proper installation techniques will avoid leaving the equipment parked or running while over the fill and not performing locked track turns on the fill. Adopting sound installation practices should prevent the compaction of the fill material. Care should be taken when placing the filter media, preparing the bed, shaping the mound, and adding the topsoil cover. The soil should be prepared before construction using a spring-loaded agricultural chisel plow or other acceptable apparatus or method. A rototiller is generally not recommended and usually prohibited. A local health officer or other appropriate representative must perform site inspections before, during, and after construction of the mound system.

Monitoring Ports

Each mound fill should have a minimum of two monitoring ports, one placed in the infiltration bed down to the gravel-sand interface, and one downslope from the bed down to the sand-native soil interface. Another useful monitoring port is one through the sand-native soil interface several inches into the native soil.

5.5 Filters - Sand and Gravel

Sand filters (SF) and gravel filters (GF) are a viable addition or alternative when site conditions are not conducive for proper treatment and disposal of wastewater. Sand and gravel filters can be used on sites that have shallow soil cover, inadequate permeability, high groundwater and limited land area (Solomon, 1998). The basic components of the filter system is a primary treatment unit(s) (a septic tank or ATU) followed by a sand or gravel filter sent to a dispersal field or trench. There are two types of filter operations: intermittent and recirculation.

Intermittent filters (Figure 5.5a) are designed such that pretreated wastewater passes through the media once while in the case of a recirculating filter (Figure 5.5b) a portion of the wastewater is recirculated through the filter. Sand and gravel are commonly used media, but anthracite, mineral tailings, bottom ash, sized crushed glass, etc. have been used when appropriate media specifications can be met. A Media specification for some of the commonly used filters is listed in Appendix H.

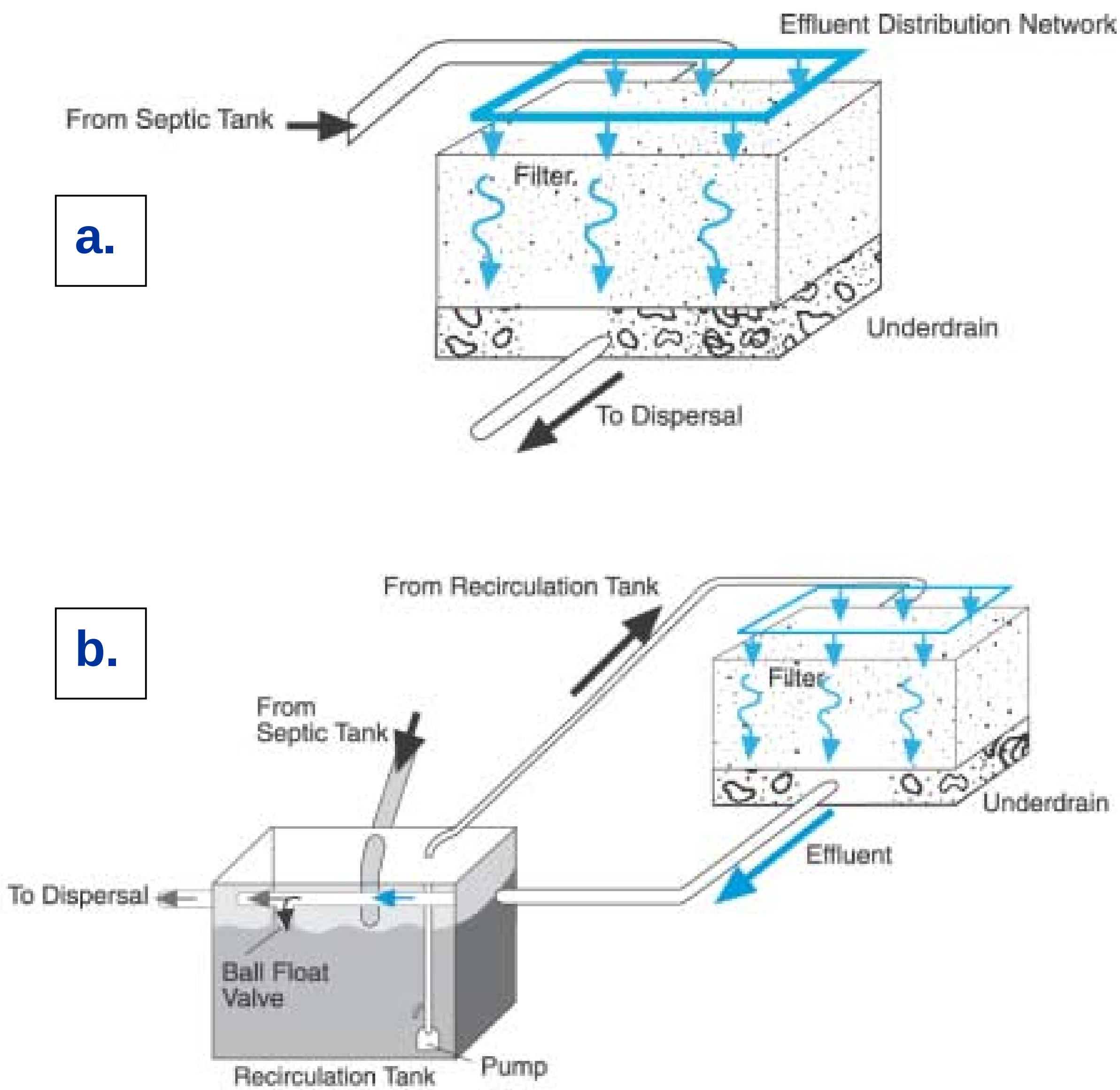


Figure 5.5 – Typical flow through a sand or gravel filter

Sand filters remove contaminants through physical, chemical, and biological means. Although physical and chemical processes play an important role in the removal of many particles, the biological processes play the most important role. The wastewater undergoes biodegradation when it comes in contact with a biological community attached to the surfaces of the filter media. This process requires unsaturated downward flow of the effluent through the filter media.

A watertight container should be used to contain the media either below or wholly or partially elevated from the surface of the ground. The surface of the bed is intermittently dosed with effluent that percolates through the media to the bottom of the filter. After being collected in the underdrain, the treated effluent is then recirculated or sent for further treatment or dispersal by gravity or pressure. Disinfection of wastewater is also done prior to dispersal when required.

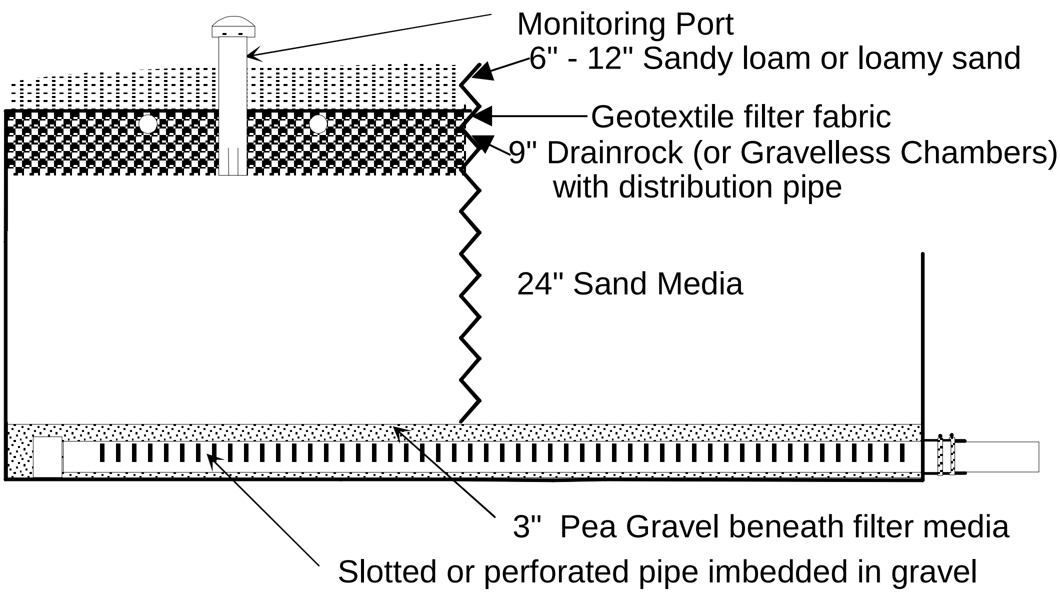


Figure 5.6 - Typical cross-sectional view of a sand filter

A typical cross-sectional view of a filter is shown in figure 5.6. This technology can be used on sites with shallow soil conditions where treatment must be accomplished before dispersal. Recirculating SF effluent may be discharged to as little as 12 inches of vertical separation. Media filters are also used as part of a mitigation strategy when horizontal separations are reduced. Proper sizing of the pump, fittings, and controls is a very important design consideration. See appendix G for more design and installation information.

Wastewater Characteristics

Sand filters are designed for treating residential-strength wastewater (around 220 mg/l BOD_5 or 145 mg/l TSS). Long-term operation is increased when lower wastewater strengths without increased flow rates are used. Higher-strength residential and non-domestic wastewater such as restaurants, hotels, bed and breakfast establishments, and industrial and commercial wastewater sources must be individually evaluated for treatability and degree of pretreatment. This should be done prior to the effluent reaching the SF. Appropriate flow rates must be used for both residential and non-residential applications. For non-residential applications, a minimum wastewater design flow equal to 150 percent of the estimated daily flow should be used. Recirculating filters are smaller in size and less prone to hydraulic and organic overloading.

Pretreatment

A properly sized septic tank, preferably a two-compartment with an outlet filter, must precede the sand or gravel filter. However, a single-compartment tank with a pump vault may be used. Pretreatment with some other wastewater sedimentation or primary treatment unit may be used instead of a septic tank. The septic tank must be designed in compliance with all necessary standards and specifications. An outlet filter should be installed to protect the discharge orifices from being plugged by particles larger than the orifices. If the wastewater is from a non-domestic source, influent to the filter must be equivalent to residential strength septic tank effluent. An ATU or other treatment process may be needed to bring the influent level acceptable for the sand or gravel. The minimum setback requirements for the filters can be the same as septic tanks.

Installation

When the container for the media is constructed onsite, a PVC liner (usually 30 mil) is used and should be protected by a 3-inch layer of sand beneath it. The filter media should be of uniform density to avoid any differential settling of the media. The media can be poured into the container two different ways depending on the moisture content.

When the intermittent filter media is dry, it can simply be poured to fill the sand filter frame, then settle lightly (not compacted) to allow about 5 percent settling by volume. If the media is moist enough and cannot be poured, it should be placed in successive 6-inch lifts with each lift lightly settled. This would prevent large voids in the bed that could collapse when dosed. Walking on the sand, then raking (with hand tools) into the corners, along the sides, around the pump well (if applicable), and around monitor ports will provide the light settling. This should be done to prevent compaction that will reduce infiltration rates and oxygen exchange potential. A geotextile filter fabric must be placed on the gravel bed. The cover soil must be capable of maintaining vegetative growth while not impeding the passage of air (sandy loam or coarser). There should be no soil cover placed over the drain rock to encourage oxygenation of a GF.

Monitoring

Appropriate monitoring ports must be installed in a SF and GF. Two observation ports must be installed if the effluent exits the filter through the underdrain by gravity flow. The first observation port must be installed to the bottom of the drainrock/top of the media interface while the second observation port must be installed to the bottom of the underdrain. The pumpwell may be used as a second observation port if the effluent exits the filter through it.

Disposal Component

Direct discharge of effluent from a sand or gravel filter to surface water or upon the ground surface should be based on the effluent quality in relation to its risk and impact on the water quality, environment, and public health. Subsurface dispersal is recommended when disinfection is not used. If this surface or groundwater discharged, the effluent must meet the standards for the receiving environment. The required treatment performance levels of a sand and gravel filter will determine the design. Allowances may vary according to treatment performance levels. Dispersal area must meet the minimum horizontal separation distances as specified. The size and design of the disposal component must be consistent with the methods and procedures.

Design

The design of a sand and gravel filter must be approved by the local health or other appropriate jurisdiction before construction can begin. All site inspections before, during, and after the construction must be accomplished by local health, other appropriate jurisdiction, or by a designer or engineer appointed by the appropriate jurisdiction.

Appendix G presents filter media specifications and other design standards for sand and gravel filters. They must meet either the Coarse Sand Media or ASTM C-33 specification for particle size graduation. Using coarse media in sand filters reduces the risk of clogging, and provides the needed degree of treatment when wastewater is stronger than expected, flows are high, or other unexpected factors occur that induce clogging. It is recommended that lower volume with a higher dosing frequency will produce the same treatment efficiency. Small doses of wastewater make better contact with the bacteria and reduce saturation, allowing for sufficient diffusion of oxygen into the system.

When using finer media (ASTM C-33), it has been observed that there is a high possibility for clogging. Several factors, such as too large a percentage of fines (passing a No. 100 sieve), may cause finer material to be suspended on top and reduce the infiltrative capacity and the higher loading rate. A pit with a PVC liner or a concrete or fiberglass vessel may be used to contain the media. Typical design and construction information for the media container is presented in Appendix H.

Dosing of wastewater must comply with the pressure distribution standards and guidance. This requirement applies to all pressure distribution related components. The wastewater must be applied to the top of the filter media, or sprayed upward against the top of gravelless chambers. Time dosing is commonly used, and the dosing frequency or dose volume is dependent on the media specification used with the filter. The timer must be set to dose the filter to ensure that appropriate dose volumes are delivered to the filter.

Wastewater travels through untreated if the dose volume exceeds the water holding capacity of the filter media, since the applied liquid fills the pore spaces. However, if the dose volume does not exceed the water-holding capacity of the media, the applied wastewater will flow around the sand grains in a thin film, maximizing oxygen diffusion and maximizing contact between the organics in the wastewater and the microbial growth on the media. The filter media meeting the Coarse Sand Media specification has a lower water-holding capacity than the sand meeting the ASTM C-33 specification. Thus, a smaller dose volume or higher dosing frequency is required to promote the unsaturated film-like flow. Because of the larger unit wetted surface area of ASTM C-33 sand, a larger volume of wastewater may be applied at one time without exceeding its water-holding capacity. The large surface allows unsaturated flow conditions to occur at a higher dose volume or lower dosing frequency.

The filtrate may be collected and discharged from the bottom of the filter by either a gravity-flow underdrain, or a pumped-flow pumpwell system. When the filters are membrane-lined, gravity flow underdrains must exit through a boot**.** See Appendix H for standards on installation and testing of the boot and exit pipe.

5.6 Pressure Distribution Drainfields

Pressure distribution systems were developed as an alternative to conventional drainfields to eliminate problems such as: (1) clogging of soil from localized overloading, (2) achieve uniform application of wastewater throughout the drainfield area, (3) reduce the potential for breakout or seepage on slopes, (4) treat and dispose of effluent higher in the soil profile, (5) mechanical sealing of the soil trench during construction, (6) anaerobic conditions due to high saturation, and (7) high water table (Solomon, 1998). These systems have design features that overcome shallow placement such as narrow trenches, continuous trenching, pressure dosed with uniform distribution of the effluent, design based on areal loading and resting, and reaeration between doses.

Pressure distribution applies effluent uniformly over the entire absorption area such that each square foot of bottom area receives approximately the same amount per dose at a rate less than the saturated hydraulic conductivity of the soil. This process promotes soil treatment performance by maintaining vertical unsaturated flow at all times and also reduces the degree of clogging in finer textured soils.

The main components of a pressure distribution system (see figure 5.7) consists of a pretreatment component to separate the major solid materials from the liquid, a screening device to protect the pump and drainfield orifices from solids, and a means to deliver specified doses of effluent, under pressure, to the distribution system. The distribution system consists of small, 1 to 2 inch diameter laterals with small discharge orifices. A pressure head is created within the laterals, usually by means of a pump or siphon. Pressure distribution is also a required component for mounds, sand filters, and other types of biological media filters.

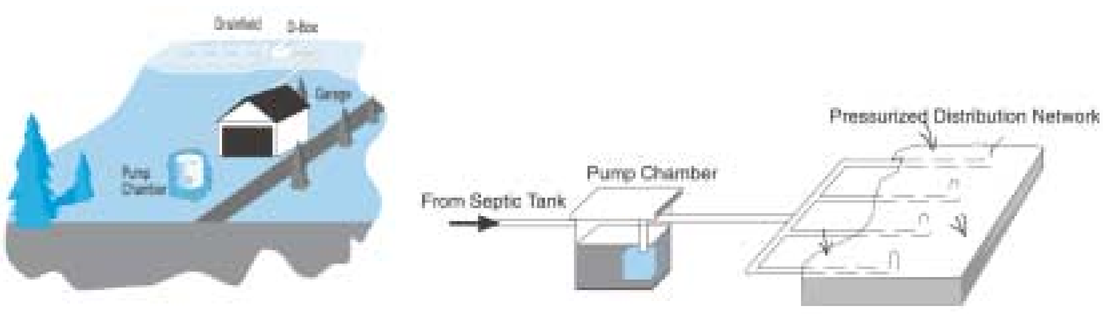


Figure 5.7 Layout of a Pressure Distribution System

Pretreatment

A properly sized septic tank, preferably a two-compartment tank with an outlet filter, must precede the pressure distribution system. However, a single-compartment tank with a pump vault may be used. The septic tank must be designed in compliance with all necessary standards and specifications. It should be watertight to level above the groundwater with a minimum of 20-inch diameter watertight, secured (bolts or equivalent) access riser that extends to the ground surface. Riser lids must be equipped with airtight gaskets to eliminate nuisance odors.

An outlet filter should be installed to protect the pressure distribution drainfield discharge orifices from plugging by particles larger than the orifices. It also protects the effluent pump from damage due to particles that exceed the pump's capacity to pass (may be an issue with some types of pumps). The filter must be able to perform these functions without loss of performance between routine service events and requiring service at a normal routine. It should be constructed of durable, non-corroding materials able to draw liquid from the "clear zone" of the septic tank, and designed, constructed, and installed for easy and thorough cleaning.

All pump chambers must be structurally sound and conform to the septic tank standards. The pump tank must have an internal volume sufficient to provide the daily design flow volume, dead space below the pump inlet for sludge accumulation, and sufficient depth to provide full-time pump submergence, when required. An additional emergency storage volume of at least 75 percent of the daily design flow is suggested (may include volume to flood capacity in both the pump tank and the septic tank).

Pumps, Fittings, and Controls

The pump selected must be capable of meeting the minimum hydraulic flow and head requirements for the proposed OSDS. It should be fitted with unions, valves, and electrical connections easily removed and/or replaced from the ground surface. Pumps and electrical hook-ups must conform to all state and local electrical codes. An air vacuum release valve or a suitable device to avoid siphoning must be provided when any portion of the pump fittings or transport line is at a higher elevation than the drainfield. When a check valve is used, a vent hole should be installed upstream from the check valve, to keep the pump volute filled with effluent.

Siphons may also be used in a pressure distribution system. However, they are flow-dependent and cannot provide evenly spaced doses, nor limit the daily volume. Where siphons are used, the following requirements apply: (1) The area to be dosed must be downhill from the siphon chamber and according to manufacturer's instructions for minimum elevation differential; (2) Effluent must be screened before entering the siphon chamber; (3) Siphon must be installed to allow access for maintenance; and (4) Cleaning, and dose counter(s) must be incorporated into the design and installation. Siphons can only be used where timed dosing is not required or where some system or arrangement delivers effluent to the siphon chamber evenly over a 24 hour period and at a rate that is not greater than the maximum design flow for the system.

At a minimum, all pressure distribution systems must include an electrical control system that will meet the functional and reliability requirements for pressure distribution. The controls and components should be listed by Underwriters Laboratories (UL) or equivalent, secure from tampering, and resistant to weather (minimum of NEMA 4). They should be located outside, within line of sight of the pump chamber. All control panels must be capable of accommodating cycle counters and elapsed time meters for all pumps equipped with both audible and visual high-liquid level alarms placed in a conspicuous location. Float switches must be mounted independent of the pump and transport line so that they can be easily replaced and/or adjusted without removing the pump.

Drainfield

The pipe materials must meet ASTM D2241 Class 160 or equivalent and use ASTM D1785 for schedule 40 and schedule 80 PVC pipe. A manifold should be designed to deliver equal flow to all the lateral orifices while minimizing friction loss. While their patterns vary, the most common are the center and end manifolds**.** See Appendix H for different types of laterals connected to the manifold. The check valves and flow control valves shown shown in Appendix H are assumed to be an integral part of the manifold. When check valves are installed, they must be easily accessible and removable for servicing and replacement. The laterals are a network of one- to two-inch small, diameter pipes, placed at a shallow depth of 12 to 18 inches. Laterals in the pressure distribution systems are the most important design aspect of the system.

Variation in orifice discharge rates within any one lateral must not be more than 10 percent, and over the entire distribution system must not be more than 15 percent. The squirt height difference must not exceed 21 percent (10 percent flow difference) between orifices on any one lateral, and must not exceed 32 percent (15 percent flow difference) for the entire system. A minimum residual pressure of 0.87 pounds per square inch (psi) (2 feet of head) is required for systems with 3/16 inch diameter orifices and larger, and 2.18 psi (5 feet of head) is required for systems with orifices smaller than 3/16 inch.

Other factors that complicate accurate calculation of the orifice flow rate are accurate drilling of holes, class of pipe, size of pipe, and slight variations in the friction coefficients used for fittings. Prediction of the actual flow is more accurate for some designers when using a slightly higher coefficient. It is critically important that the same coefficient be used through the design process.

Other acceptable standards are to add 10 percent to the total flow after the calculations or to design to more than minimum residual head. Orifices must not be smaller than 1/8 inch in diameter**.** See Appendix H for more details on the typical orifice size, orientation, and spacing. Orifice shields may be the half-pipe design, the local cap type, or another design that accomplishes the same end result. Gravelless systems might have a different size, orientation, and spacing of the orifice.

The trench or bed shall be installed when all the site and soil conditions have been met. The bottom of the trench must be level (± 0.5 inches) as in any drainfield. The bottom and sides of the trench must not be smeared. An acceptable geotextile must be used on top of the gravel before backfilling in the case of gravel-filled trenches and beds. Laterals must run parallel to the contour of the ground on sloping sites.

Dosing

When used in mounds, sand filters, and other applicable technologies, the pump controls must be capable of meeting the functional requirements for pressure distribution, deliver prescribed dose sizes uniformly to the orifices in the distribution network, and evenly spaced doses over a 24 hour period. They must also be capable of providing prescribed resting periods between doses, not to exceed the design volume for each 24 hour period is delivered to the receiving component with controls and components listed by Underwriter's Laboratory or equivalent. See Appendix H Timed and demand dosing.

Timed dosing is usually recommended on all pressure distribution systems since it enhances performance, reliability, and protection from abuse. The length of each dose (produces gallons per dose), and the interval between doses (which determines the number of doses per day), is controlled by a timing device whenever a dose volume is in the pump chamber. It is based on the need to control the size of doses to the coarser and single-grained soils and treatment media. It also prevents hydraulic overload of the receiving component.

Usual sources of hydraulic overload are excessive water use in the facility or groundwater infiltration into the septic tank or pump chamber. The number of pump cycles should be adjustable and in sufficient number to meet the design needs of the system. As the number of dose cycles increases, the dosing rate should be reduced. When more than 6 or 8 doses are delivered in a 24 hour period, features mainly to reduce the volume per dose should be designed into the system.

The dosing frequency may vary depending on the specific type of the system. Intermittent aeration to the infiltrative surface is necessary as it encourages the degradation of the clogging materials by aerobic bacteria. Saturated conditions within the drainfield should be avoided by dosing small volumes at a reasonable frequency. Large, less frequent doses are more suitable in finer-textured soils since saturated flow is less likely, thus not affecting the performance. When a system is first put into use in sands, the rapid infiltration rates can lead to pathogen contamination of shallow groundwater. Therefore, systems constructed in these soils should receive smaller doses at a lower frequency to prevent saturated conditions, and hence, inadequate treatment.

Cleanouts and Monitoring Ports

Cleanout and monitoring ports are to be installed at the distal end of each lateral**.** Each lateral must have threaded removable caps or plugs for cleaning the laterals and for monitoring the lateral pressure, and be large enough to allow access to caps or plugs with hands, tools, etc., from the ground surface as shown in figure 5.8. It should be open and slotted at the bottom and void of gravel to the infiltrative surface to allow visual monitoring of standing water in the trench or bed.

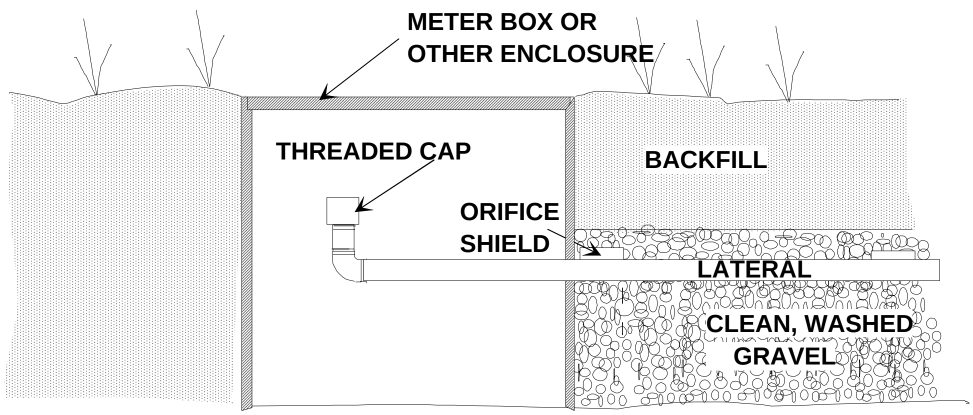


Figure 5.8 Cleanout and Monitoring Port

5.7 Gravelless Drainfield

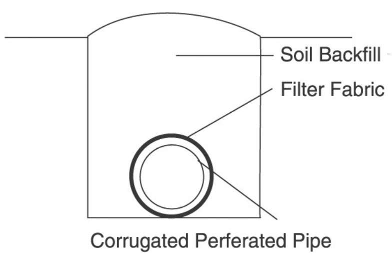
Gravelless systems use material other than gravel or rock to provide the infiltrative surface onto which wastewater is distributed along the length of the trench. The gravelless systems addressed in following sections represent several different types: pipe, chamber, and gravel-substitutes (National Small Flows Clearinghouse, 1997). While the specifics of these types differ, their purpose is to meet (or exceed) the characteristics and function of gravel in a conventional gravel-filled drainfield.

Gravel in a conventional drainfield provides a non-deteriorating media, void space (for the passage and temporary storage of septic tank effluent), presents an interface with the infiltrative surface—trench bottom and side-wall soil—(for absorption of the wastewater), and maintains the integrity of the excavation, supporting the soil back-fill and cover. The advantages of installing a gravelless drainfield become clear when and where suitable gravel is either unavailable, expensive, or where site conditions make moving gravel about difficult or time consuming.

Another benefit of using gravelless drainfields is improving the infiltrative capacity of the soil that may otherwise be impacted and compressed by dumping it from a front loader of a backhoe and silt from improperly washed gravel that could reduce the infiltrative capacity after installation.

Gravelless Pipe Drainfield

There are two types of gravelless drainfields: single-pipe, and multiple-pipe. Figure 5.9 shows a typical cross-section of a single-pipe gravelless drainfield. Multiple-pipe drainfields are relatively new and not widely used.



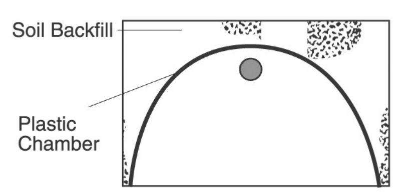


Figure 5.9 Cross-sectional view of a large-diameter gravelless drainfield and chamber system

The most commonly used type is the single pipe, which is a large-diameter pipe (typically 8"-10" inside diameter, 10"-12" outside diameter) wrapped in a layer of geotextile material. Serial distribution is more commonly used than parallel distribution in a trench typically less than 24" wide (15"-18").

Gravelless Chambers

Gravelless chambers are molded chambers of various dimensions that replace the gravel-supported void space with chamber-supported void space (see figure 5.10). The trench or bed bottom infiltrative surface is fully exposed, sidewalls are generally louvered, and the top is generally solid.

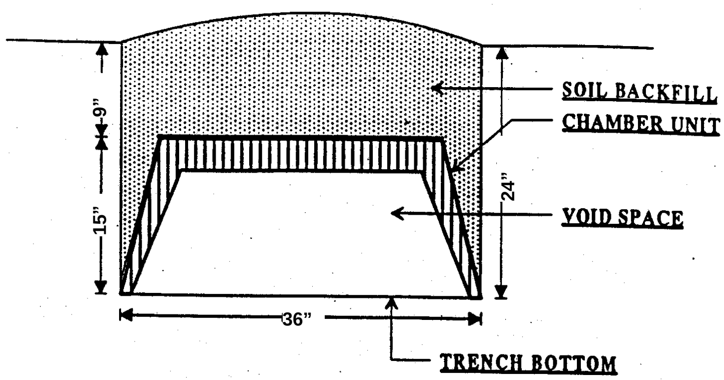


Figure 5.10 Typical Gravelless Chamber Drainfield, Cross-Section

They are placed in the bottom of the trench and connected from end-to-end. Native soil material is backfilled, and a solid plate is installed at each end for structural support. A geotextile barrier is placed between the chamber and soil backfill.

Gravel-substitute

The disposal option that is most similar to the gravel-filled drainfield is the gravel-substitute drainfields (see figure 5.11). Media in this type of a drainfield may be loose or contained for ease of installation and/or as part of the required design. The particular shape and configuration of the substitute media may provide additional void space within the trench or bed depending on how the units are placed and the depth and width of the drainfield trench.

A geotextile material is placed on top of the substitute media as a barrier to soil backfill infiltration. Some manufacturers (due in part to the shape of their product) use barrier materials such as 60 pound untreated building paper. To assure long-term protection in loose soils such as uniform sands, non-deteriorating geotextile barrier material may be needed. In all cases, the manufacture's recommendations should be followed.

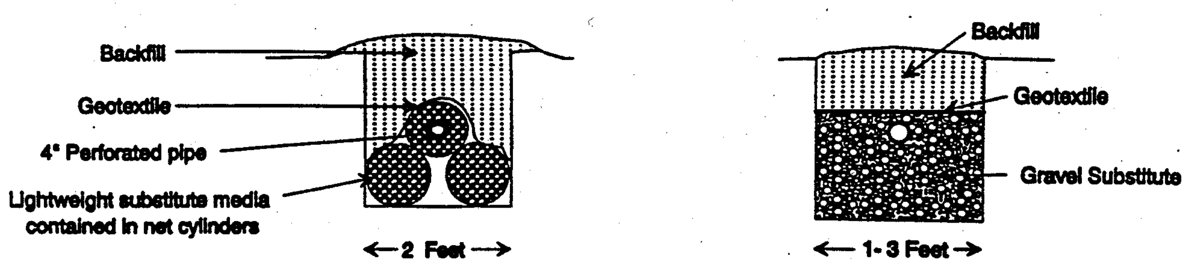


Figure 5.11 Types of Gravel Substitute Drainfields

General Standards and Protocols

Almost all the gravelless disposal options available today are proprietary in nature, except for the large-pipe gravelless option. These units are approved when the manufacturer demonstrates the performance of the units. The SC DHEC as referenced in the ISTDS guide currently approves a number of these products. They need to meet or exceed the performance criteria equal to that provided by gravel in a conventional gravel-filled drainfield.

The gravel substitute material must not decay, deteriorate, or leach chemicals or byproducts when exposed to sewage and the subsurface soil environment. Void capacity and storage volume must be established by drainfield materials, design, and installation, and maintained for the life of the drainfield that may be met on a lineal-foot, or on an overall drainfield-design basis.

The effluent should be distributed to the entire intended area of disposal. In most cases, the drainfield is sized based on the trench or bed bottom area only. Sidewall is usually not considered in terms of drainfield sizing, except where total annual recharge is less than 12 inches per year. The integrity of the material used in the trench or the bed is very important and must withstand the physical forces of the soil sidewalls and soil back-fill.

Drainfield life span is another critical factor that depends on factors such as accuracy of initial drainfield design, matching the site and soil characteristics to the anticipated facility use and wastewater generation; quality of materials and methods used in the installation of the drainfield; and care of use (operation) and timeliness of maintenance on the system.

The selection of an appropriate wastewater-to-soil application rate is critical to the treatment performance of the drainfield and the length of time that treatment performance is achieved. Gravelless drainfields generally are installed with reduced configurations when compared to conventional gravel-filled drainfields. While this approach may be satisfactory due to unique elements of the product designs, these smaller drainfields may impact the life of the drainfield. Drainfield performance over the long term needs to be observed and analyzed as additional field experience with these systems is gained.

Gravelless drainfields may be used on sites where soil and other site conditions are suitable for a conventional septic tank and drainfield system. On sites not suitable for conventional septic tank and drainfield, they may be used in conjunction with sand filters, ATUs, etc, due to the better effluent quality. The soil types and depths, setbacks, and other site evaluation and location requirements found in appropriate subsections must be satisfactorily met. Gravelless drainfields may be used by incorporating any combination of design elements such as gravity-flow distribution, pressurized distribution, drainfield dosing, and alternating drainfields.

Soil/Site Conditions

The type of soil present will determine the loading rate and configuration of the gravelless drainfield. Wastewater that meets secondary-treatment standards may be discharged to a gravelless drainfield. Trench configurations must be used only for lower loading rates, while the bed configuration may be used in soils that can take a higher loading rate. The use of a gravelless drainfield does not provide for a reduction in the minimum land-area requirements in most states. Site development incorporating gravelless drainfields must meet the minimum land-area requirements established in state and local codes. An area equal to 100 percent of the gravel-filled drainfield should be available for the drainfield area proposed for an onsite sewage system using gravelless drainfield products.

Influent Wastewater Characteristics

Residential wastewater must receive pretreatment at least equal to that provided in a conventional two-compartment septic tank, before discharge to a gravelless drainfield. Non-residential or high-strength wastewater from residential sources must receive sufficient pretreatment to lower the waste strength to the level of that commonly found in domestic residential septic tank effluent before discharge to a gravelless drainfield.

Design and Installation

Most gravelless drainfield technologies are proprietary products and must be designed and installed according to the manufacturer's instructions, in a manner that is consistent with these standards, state, and local rules (as listed in SC DHEC ISTDS guide). When there is a conflict or inconsistency, the local health officer must be contacted. In addition to the general performance criteria, there are no specific requirements for manufactured products. Other design standards relative to vertical separation and method of wastewater distribution are soil type and required use of pressure distribution, soil type and pretreatment to level, and minimum depth of gravelless drainfield trench. The size of the gravelless drainfield, based upon type-specific drainfield design values for effective infiltrative surface area, must be taken into account.

Vertical separation varies depending on method of effluent distribution, either by gravity or pressure. A minimum of three feet is used for gravity-flow distribution and two feet for a pressure distribution that must be established by design and maintained during installation. In sites with inappropriate soils, pressure distribution or certain secondary treatment standard levels will be required. Gravelless drainfields must be installed at a minimum depth of 6 inches into original, undisturbed soil.

Drainfield sizing

Sizing a drainfield varies with the type and configuration of gravelless drainfield products. The amount of gravel needed for a conventional gravel-filled drainfield must first be calculated. This is calculated by dividing the daily design flow by the application rate according to soil type. A trench or bed is usually sized based on the bottom area only without taking into account the sidewall infiltration.

For a single-pipe, gravelless drainfield, the required length of pipe using the effective areas for the appropriate diameter is calculated. The effective area per lineal foot of pipe is calculated based upon the outside diameter of the pipe. For a gravelless chamber drainfield, the required length of chamber is calculated by using the effective area for the particular chamber. The effective area per lineal foot of chamber is based upon the actual dimensional width of the chamber at the trench or bed bottom, not the nominal size or product marketing description.

In the case of gravel substitute drainfields, the substitute media must be in the same size range as gravel (3/4" to 2½"). The square feet of trench bottom area required are equal to that of a conventional gravel-filled drainfield while the amount of infiltrative surface per lineal foot of gravel substitute trench is equal to the trench-bottom area covered by the gravel substitute. A minimum of 30 percent void volume under compression conditions encountered in the soil trench must be provided by the gravel substitute. The gravel substitute media must also provide total void volume per square foot of trench bottom equivalent to, or greater than, that in a gravel-filled trench.

A gravelless chamber drainfield may be designed and installed when 100 percent of the area required for a gravel-filled drainfield is established and dedicated (for initial and replacement fields). Additions should be taken into account during design, layout, and installation of the drainfield, if needed in the future. For systems using pressure distribution, pumps and controls may be modified to meet the performance requirements of the expanded or additional drainfield.

Drainfield size reduction for chamber systems varies according to the type of soil. The most common reduction allowed is 40 percent across most of the country. There are also lower levels of reduction when the soils are not conducive and in some cases no reduction is allowed at all. See Appendix H on the soil types and typical reductions allowed.

Other design features, such as trench separation, maximum lateral lengths, vertical separation, maximum width and depth of trench, minimum depth of soil backfill, suitable backfill, required pretreatment, setbacks, etc., must be the same as for conventional drainfields. Gravelless drainfield manufacturers and designers of onsite systems should share the responsibility with the homeowners when a reduced size drainfield is installed. Proper verification of the application of a certain gravelless technology should be done and not be applied for all soils and sites.

5.8 Waterless Toilets

Introduction

Waterless toilets, as the name indicates, use little to no water, providing a solution to sanitation and environmental problems in unsewered, rural, and suburban areas. In the U.S., homeowners with onsite wastewater treatment systems may install waterless toilets if their distribution system cannot safely handle septic tank effluent or if they live in environmentally sensitive areas. Diverting excrement and flush water from the flow removes more then 90 percent of the pollution, leaving only graywater to manage.

Waterless toilets do not rely on a flow of water to carry wastes to a treatment area. Composting toilets, pit privies, and incinerating toilets are examples of waterless toilets. Pit privies are generally simply a hole dug in the earth with a building for privacy over the surface. The excrement is open to insects, is foul smelling, and does not have suitable conditions for composting to occur, thereby allowing contamination of underlying groundwater. In an incinerating toilet, energy derived from electricity or propane is used to rapidly raise the temperature of a fireproof container where excrement and toilet paper have been deposited. The high temperature causes excrement to evaporate and combust, leaving a dry ash. The energy costs with this method are high, making it impractical for all but a few situations.

Composting of human waste and subsequent utilization of the dried matter for fertilizer has occurred in many cultures throughout history. The finished composted end-product is similar to leaf humus from the forest floor, dry and with the smell of rich garden soil.

A composting (or biological) toilet system contains and processes excrement, toilet paper, carbon additive, and, sometimes, food wastes (Solomon, 1998). Unlike a septic system, a composting toilet system relies on unsaturated conditions where aerobic bacteria break down wastes, just as in a yard-waste composter. If sized and maintained properly, a composting toilet breaks down waste from 10 percent to 30 percent of its volume.

Process Description

The primary objective of composting toilet systems is to contain, immobilize, or destroy pathogens, thereby reducing the risk of human infection to acceptable levels without contaminating the environment or negatively affecting the life of its inhabitants. This should be accomplished in a manner that is consistent with good sanitation (minimizing the availability of excrement to disease vectors, such flies, and limiting contact with unprocessed excrement).

Some systems are large units that require a basement for installation. Others are small, self-contained appliances that sit on the floor of the bathroom. Composting toilets (Figure 5.11) are well-ventilated containers that provide the optimum environment for aerobic decomposition of human excrement.

Temperature, moisture, and ventilation are all controlled to maximize the composting process. Adequate airflow through the material is maintained by mixing or by forcing air flow with a fan. The materials being composted should have a loose texture to allow air to circulate freely within the pile. Aerators such as mixers, mesh, grates, and air channels help increase the surface area of the composting mass that is exposed to air.

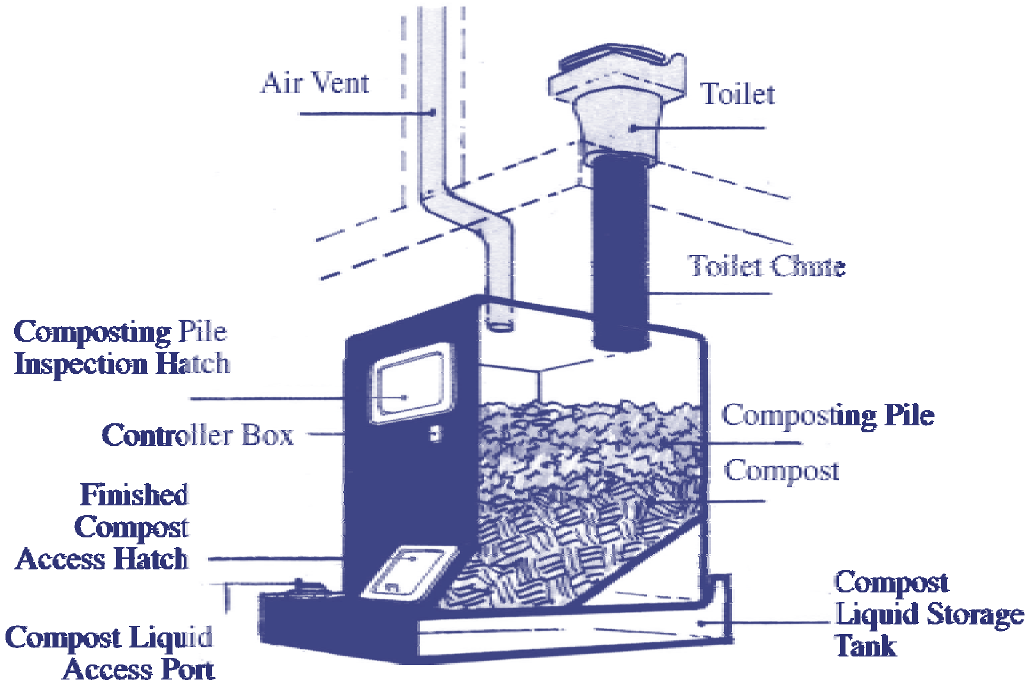


Figure 5.12 Cross-sectional view of a typical composting toilet

The ideal moisture content will be about 45-70 percent, and excess leachate must be allowed to drain away. Concentrated salt and ammonia from urine are toxic to the composting organisms, so if additional liquid is needed, it should be water. Some systems separate urine from stools at the toilet, and add it to the graywater treatment system.

In most composting toilet systems, mesophilic (68° to 112° F) composting is at work. Achieving thermophilic rates (113° to 160° F) would require either further heating the composter or retaining heat better by venting less, which might result in odors and insufficient oxygen. Most small manufactured compost toilets have heaters and thermostats to maintain an internal temperature of 90° to 113° F.

Moldering toilets support psychrophilic organisms, whose optimum temperature is above 41°F and below 68°F. These systems are sized much larger than mesophilic composting systems to allow for their reduced processing rate. Moldering is also the last phase after mesophilic processes have completed degradation of carbohydrates and fats. As the process cools, fungi and actinomycetes slowly digest the cellulose and lignin in plant matter, such as woodchips and toilet paper. In composting, natural soil organisms decompose excrement into humus with less than 200 mean probable number (MPN) per gram of fecal coliform. This humus can then be buried or hauled away by septage haulers. The leachate may be piped to a septic tank or added to a graywater treatment process.

There are numerous manufactured and site-built systems on the market. Additionally, plans are available for owner-built systems. Continuous composters have a single chamber in which additional material is added at the top, while finished materials are removed from the bottom. Batch composters are actually two or more bins that are filled and allowed to cure without the addition of new material.

Standards and Protocols

Composting toilets are approved for use in South Carolina under Regulation 61-56, without specific mention of graywater treatment. The standard governing minimum materials, design, construction, and performance of composting toilet systems is the American National Standard/NSF International Standard ANSI/NSF 41-1998: Non-liquid Saturated Treatment Systems. Since most systems available today are proprietary in nature, the design and installation of all waterless toilets should be in accordance to the manufacturer's recommendations. The same would also apply for the owners-built systems because of the non-standardized design and installation practices.

Operation and Maintenance

In general, operation and maintenance for composting toilet systems does not require trained technicians and can be done by the homeowner. If the systems become more widespread, owners may prefer to contract out this service. Composting systems may require organic bulking agents to be added to provide a source of carbon for bacteria, as well as keeping the pile porous for proper air distribution. Leaves, sawdust, grass clippings, or finely chopped straw have all been used. Periodic mixing or raking is suggested for single-chamber, continuous systems.

Each system has specific requirements for temperature and moisture control, airflow, and control of leachate. Some have electrical sensors to alert the operator of out-of-range measurements. The other required maintenance step is removing the finished end-product (anywhere from every 3 months for a cottage system to every 2 years for a large central system). If proper composting has taken place, the end product should be inoffensive and safe to handle.

Chapter 6
Evaluation of Standards for Household Appliances

6.1 Introduction

In this section, "household appliances" will be considered as any appliance that can contribute effluent to an onsite wastewater system whether it be located in a residential, commercial, or industrial setting. The appliances evaluated will come under the following general headings – toilets, faucets, showers, clothes washers, and dishwashers. These appliances or devices play a direct role in the overall reduction of wastewater flows. Although the following sections do focus on the residential flows, many of the strategies and concepts can be directly applied to non-residential systems.

6.2 Regulatory and Code Information

Regulations for the design, construction, installation, quality of materials, location, operation, maintenance, and use of household appliances are part of plumbing codes and their referenced standards. These standards include:

American National Standards Institute (ANSI)
American Society of Mechanical Engineers (ASME)
American Society of Sanitary Engineers (ASSE)
American Society for Testing Materials (ASTM)
American Welding Society (AWS)
American Water Works Association (AWWA)
Canadian Standards Association (CSA)
Cast Iron Soil Pipe Institute (CISPI)
Federal Specifications (FI)
International Code Council (ICC)
National Sanitation Foundation (NSF), and
Plumbing and Drainage Institute (PDI).

South Carolina does not have a specific statewide plumbing code, but it has required municipalities and counties (Section 6-9-10, South Carolina Code of Laws) to establish building departments and adopt building codes, including plumbing codes, as provided by the Southern Building Code Congress International, Inc (SBCCI).

Section 6-9-50 of the SC Code of Laws reads in part, "Municipalities and counties shall adopt by reference only the latest editions of the following nationally recognized codes and the standards referenced in those codes for the regulation of construction within their respective jurisdictions: building, residential, gas, plumbing, mechanical, fire, and energy codes as promulgated, published, or made available by the Southern Building Code Congress International, Inc. (SBCCI) and the National Electrical Code, as published by the National Fire Protection Association."

The International Plumbing Code 2000 – International Code Council (ICC), which is compatible with the SBCCI code, is currently in force in Beaufort County. The onsite wastewater regulation currently used in Beaufort County, the South Carolina Individual Waste Disposal System Regulation, contains only one section that makes any specific reference to appliances - Section IX, Commercial Grease Traps, Lint Traps and Oil/Water Separators. It might be noted that building code enforcement personnel must be certified by the South Carolina Building Codes Council (Section 6-9-5). Section 6-9-60 sets out the composition of the Building Codes Council and authorizes it to modify adopted codes, at the request of local jurisdictions, if local physical or climatological conditions warrant.

6.3 International Code Council

The International Code Council (ICC) was established in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these nonprofit organizations developed the three separate sets of model codes used throughout the United States. Although regional code development has been effective, the nation's three model code groups responded by creating the International Code Council. Table 6.1 provides a summary of the plumbing related codes adopted by the coastal states at the local and state levels of government.

Table 6.1 International Code adopted by different coastal states

Coastal States	IBC	IPC	IPSDC
Alabama	L	L	L
Alaska	X	L	
Connecticut		X	
Delaware	L	X	
Florida		X	
Georgia	X	X	
Maine	L	L	L
Maryland	X	L	
Massachusetts	A		
Mississippi	L	L	
Missouri	L	X	L
New Hampshire	A	A	
New York	A	A	
North Carolina	X	X	
Rhode Island	X	X	
South Carolina	X	X	
Texas	L	X*	L
Virginia		X	

Source: Adapted from International Code Council, Revised 04/22/02

Notes: Abbreviations stand for the International Building Code (IBC); International Plumbing Code (IPC); International Private Sewage Disposal Code (IPSDC).
A= Adopted, but yet to be effective; **X**= Effective statewide; **L**= Adopted by local governments; *- Acceptable for local adoption.

There are substantial advantages in combining the efforts of the existing code organizations to produce a single set of codes. Code enforcement officials, architects, engineers, designers, and contractors can now work with a consistent set of requirements throughout the United States. Manufacturers can put their efforts into research and development rather than designing to three different sets of standards, and can focus on being more competitive in worldwide markets. Uniform education and certification programs can be used internationally. A single set of codes may encourage states and localities that currently write their own codes or amend the model codes, to begin adopting the International Codes without technical amendments. This uniform adoption would lead to consistent code enforcement and higher-quality construction.

Code organizations can now direct their collective energies toward wider code adoption, better code enforcement, and enhanced membership services. All issues and concerns of a regulatory nature now have a single forum for discussion, consideration, and resolution. Whether the concern is disaster mitigation, energy conservation, accessibility, innovative technology, or fire protection, the ICC provides a single forum for national and international attention and focus to address these concerns.

6.4 Water Conservation - Why Conserve Water?

It is estimated that an average of 26,100 mgd of water is used for both indoor and outdoor residential purposes. The water use varies considerably by region, climate, and weather conditions (especially temperature and rainfall), socioeconomic factors and other customer characteristics. Factors such as household income, water use, occupancy rates, efficiency of plumbing fixtures and appliances, cost of water and wastewater services, lifestyle, landscape requirements, outdoor water-use practices, and awareness of conservation needs have a direct impact on the water use in a single-family home.

Even in locations where potable water is not scarce, water conservation is important because wasteful habits can deplete water reserves quicker than it is possible to replenish them. Water conservation also has an effect on how much wastewater is produced, thereby having a direct impact on the performance and life of an OSDS. This extends the life of onsite systems, improves performance of treatment plants that have flows near design capacity, and reduces operating costs of treatment plants.

Communities faced with having to build new wastewater facilities may be able to delay or reduce the size of those facilities with a comprehensive water program. Thus, a reduction in the amount of wastewater due to water conservation practices can be extremely beneficial to an onsite or community wastewater system. In addition, water efficiency measures can also lower the water, sewer, and energy bills of the homeowner, thus reducing the water utility operating cost.

Table 6.2 shown below indicates the potential water savings when low-flow fixtures are used. Detailed discussion of these engineering practices is presented in the following section.

Table 6.2 Potential water savings from low-flow fixtures

Fixture (a)	Fixture Capacity (b)	Water Use (gpd)		Water Savings (gpd)	
		Per Capita	2.7-Person Household	Per Capita	2.7-Person Household
Toilets(c)					
Low-flow	1.6 gallons/flush	6.4	17.3	N/A	N/A
Conventional	3.5 gallons/flush	14.0	37.8	8.0	20.5
Conventional	5.5 gallons/flush	22.0	59.4	16.0	42.7
Conventional	7.0 gallons/flush	28.0	75.6	22.0	58.3
Showerheads(d)					
Low-flow	2.5 (1.7) gpm	8.2	22.1	N/A	N/A
Conventional	3.0 to 5.0 (2.6) gpm	12.5	33.8	4.3	11.7
Conventional	5.0 to 3.O (3.4) gpm	16.3	44.0	8.1	22.0
Faucets					
Low-flow	2.5 (1.7) gpm	6.8	18.4	N/A	N/A
Conventional	3.0 (2.0) gpm	8.0	21.6	1.2	3.2
Conventional	3.0 to 7.0 (3.3)gpm	13.2	36.6	6.4	17.2
Toilets, Showerheads and Faucets Combined					
Low-flow	N/A	21.0	56.7	N/A	N/A
Conventional	N/A	34.5	93.2	13.4	36.4
Conventional	N/A	54.5	147.2	33.5	90.4

Adapted from: Vickers (1996), copyright © American Water Works Association
Note:N/A = not applicable; gpm = gallons per minute; gpd = gallons per day;
(a) Low-flow = post-1994
Conventional = pre-1980 to 1994
(b) For showerheads and faucets: maximum rated fixture capacity (measured fixture capacity). Measured fixture capacity equals about two-thirds of the maximum.
(c) Assumes four flushes, per person, per day; does not include losses through leaks.
(d) Assumes 4.8 shower-use minutes per person per day at 80 psi.
(e) Assumes 4.0 faucet-use minutes per person per day at 80 psi.

Water efficiency programs should be tailored to the local conditions, taking into account various factors to determine the proper mix of efficiency measures and the priorities of the program. Any program that is implemented must include the local utilities and the user. The following sections will include information on the different water conservation methods and practices for the various household appliances, including some suggestions on behavioral modifications.

While many states encourage water conservation in their onsite regulations, South Carolina does not mention it. Although the current plumbing code for Beaufort County reflects the national standards for maximum water use, these requirements are not as effective as they could be unless a water conservation program is implemented. If no extra measures are taken, the per capita hydraulic load on wastewater systems will gradually decline as new water-saving fixtures and appliances are installed, and older plumbing is removed. To take full advantage of the new standards, positive steps, such as replacing or retrofitting old fixtures, leak control, and modifying water use habits, are recommended (Figure 6.1).

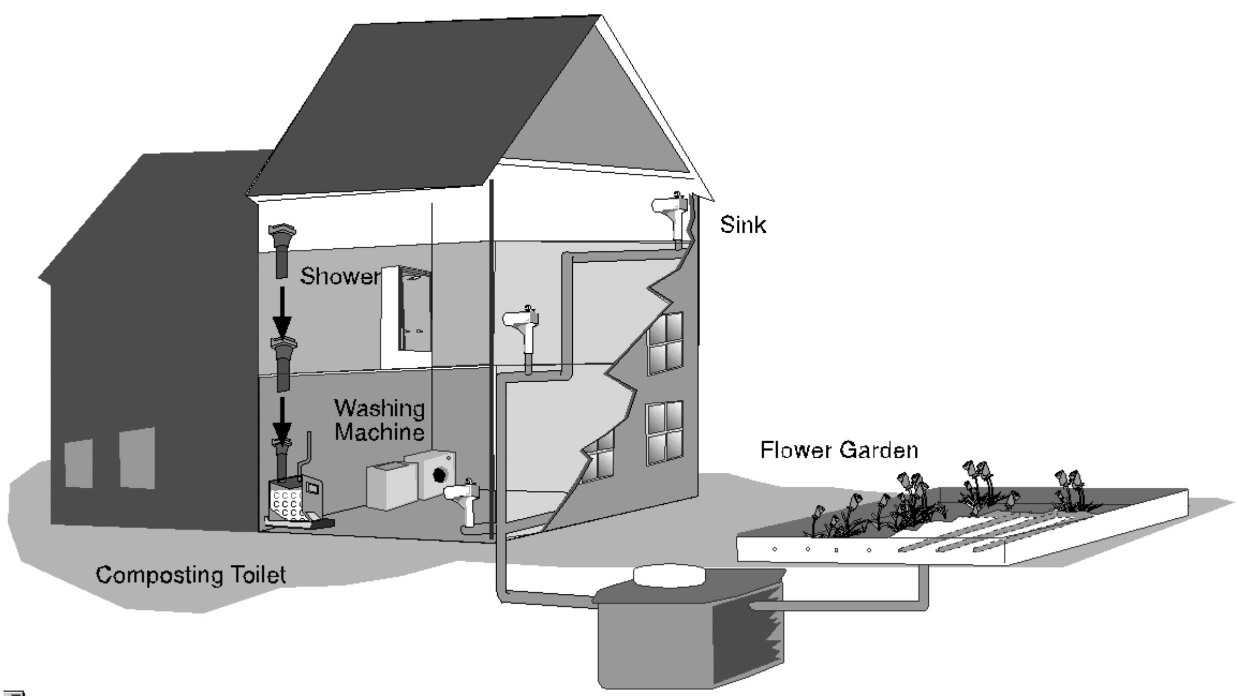


Figure 6.1 Typical graywater recycling in a single-family residence

While it is recognized that such a program is not usually initiated by a wastewater agency (more commonly a drinking water utility), there is no reason a wastewater program cannot support such an initiative. Massachusetts was the first state, in 1989, to require 1.6 gallons per flush (gpf) toilets (MA DEP, 1996). Over the next few years, sixteen states followed suit until, in 1992, the U.S. Energy Policy Act (EPAct) was passed by Congress and signed by President George H. W. Bush. The EPAct established, for the first time, national maximum allowable flow and use rates for plumbing fixtures. These flow and use rates became effective in South Carolina in 1994 and are reflected in the current Beaufort County plumbing code.

6.5 Engineering practices for plumbing fixtures and appliances

One way to reduce wastewater flow is to adopt engineering practices based on modifications in plumbing, fixtures, or water-supply operating procedures on the customer's side of the meter. Installing water-saving devices and repairing leaky pipes, faucets, and toilets could save thousands of gallons of water per person each year.

Pressure Reduction

The maximum water flow from a fixture operating on a fixed setting can be reduced if the water pressure is reduced, since flow rate is related to pressure. For example, a reduction of water use (about one-third) can be observed when there is a reduction from 100 psi to 50 psi at the outlet. For homes served by wells, reducing the system pressure can save both water and energy. Since many water-using fixtures (such as washing machines and toilets) use a controlled amount of water, a reduction in the water pressure will have little effect on water use at these locations. The reduction in water pressure should be done by a plumber and can reduce the likelihood of leaking water pipes, leaking water heaters, and dripping faucets. It can also help reduce dishwasher and washing machine noise and breakdowns in plumbing systems.

Low-flow Plumbing fixtures

Low-flow plumbing fixtures and retrofit programs are one-time conservation measures for new construction or for replacing conventional fixtures in an existing structure. The low-flow fixtures can be implemented with little or no additional cost over their lifetime. A partial extract from that code, Table 604.4, Maximum Flow Rates and Consumption for Plumbing Fixtures and Fixture Fittings, is presented in Table 6.3 below.

Table 6.3 Maximum Flow Rates for Plumbing Fixtures and Fixture Fittings

Plumbing Fixture or Fixture Fitting	Maximum Flow Rate or Quantity
Water Closet (Toilet)	1.6 gallons per flushing cycle
Urinal	1.0 gallons per flushing cycle
Shower head	2.5 gpm at 60 psi
Lavatory (faucet) – Private	2.2 gpm at 60 psi
Lavatory (other than metering) –Public	0.5 gpm at 60 psi
Lavatory (metering) –Public	0.25 gallons per metering cycle
Sink faucet	2.2 gpm at 60 psi

There are some exceptions to these flows for such things as emergency showers, service sinks, clinical sinks etc., but overall, these standards have led to a decreasing per capita water usage since, and even before, their adoption.

Toilets and Urinals

Water use by toilets is the largest single residential source of water demand. At present, the average demand is 18.5 gallons per capita per day (gpcpd), or 26.7 percent of water used in a family home that is not trying to conserve. The average flush volume in such a home is 3.48 gallons per fixture (gpf). From a study in 1984, the demand was 22.0 gpcpd and 5.5 gpf. Thus, it can be seen that the efficiency of toilets has been improving. If the maximum flows in the present code were fully implemented, the demand would be 8.2 gpcpd, and toilets would use 18 percent of the total household demand. Water use by urinals, mainly used commercially, has followed a similar trend. Residential effluent that does not contain wastewater from toilets or urinals is usually called graywater, and the waste from toilets and urinals is termed black water.

There are numerous toilet and urinal models and technologies available, but all have to meet the maximum flow rates in the plumbing code. Toilets are now available that use as little as 1 gallon per flush, and urinals that are waterless. There are also waterless toilets (that receive both feces and urine) that utilize various composting or incineration processes to treat waste. These systems require extra maintenance and care in their use and it is not clear that they are acceptable for residential use on a long-term basis. It is recommended that if such systems are proposed, that provision be made on the lot for installation of a full-sized system in the future. Theoretically, these systems would not require an onsite permit since they use no water, but there are always other requirements for the use of water – hand washing, showers, kitchen facilities etc. - where an onsite permit is required.

The present SC Individual Waste Disposal Systems Regulations do not contain any provision for gray or black water. Only 12 states even mention graywater or blackwater in their regulations, and of these, only California provides a detailed set of requirements for the use of graywater for irrigation. Five other states, Connecticut, Florida, Hawaii, New Jersey, and Texas provide for separate dispersal fields.

It is recommended that the whole matter of waterless toilets, separate plumbing systems, and the use of graywater be examined in detail, and a policy be adopted to deal with such proposals. The International Plumbing Code (IPC-Section 301.3) requires all plumbing fixtures that receive water or waste to discharge to the sanitary drainage system of the structure. In order to allow for the utilization of a graywater recycling or irrigation system, the SC plumbing code would need to be revised. Such a revision is outlined in Appendix C of the code of the IPC.

Faucets

Faucets are utilized in kitchens and lavatories (bathrooms) and as the source of water for other appliances. Normally, kitchen faucets are designed to utilize the full flow allowed in the code (2.2 gpm at 60.0 psi) since they are used for filling pots and containers. Lavatory faucets, used mainly for hand washing, are designed with flows as low as 1.5 gpm. As with other appliances and fixtures, water use by faucets has been declining since prior to 1980. This is due to improved design and new aerating and restricting devices.

Garbage Disposal Units

Water used by kitchen faucets includes that used by garbage disposal units. It is estimated that approximately 48 percent of U.S. households have such a device connected to the kitchen sink. Since garbage disposal units add excess solids to a septic tank, their use should be discouraged, but if they are being proposed to be used, the liquid volume of the system should be increased by at least one third and outlet filters should be required. It should be noted if existing systems have such units, it might be necessary to arrange more frequent pump-outs.

Showers

Water use by showers has been declining since before 1980. Showers installed prior to 1980 used an average of between 5.0 to 8.0 gpm. Those installed between 1980 and 1994 had flow rates of between 2.75 and 4.0 gpm. Since 1994, showers have to have a maximum flow of 2.5 gpm at 60 psi. Showerheads are available with flows as low as 1.5 gpm. Since most people do not use showers at the maximum flow rates, it has been found that the average flow rate is less than the maximum with demand averaging 11.6 gpcpd.

Clothes Washers

Research completed by the American Water Works Association and published as *Residential End Uses of Water* in 1999 estimated that clothes washers (for those homes that use them) average 15 gallons per capita per day. This represents 21.7 percent of indoor water use in a typical single-family, non-water-conserving home. Improved designs offer the potential for tremendous savings in both water and energy use in these appliances.

The move toward more efficient clothes washer design is being driven by the need for energy conservation. The National Appliance Energy Conservation Act of 1987 set minimum energy efficiency requirements for twelve types of appliances. Energy Star is a federal program to identify and promote energy efficient products. Clothes washers with Energy Star certification use 40 percent less energy and up to 50 percent less water. Only a small percent (estimated 12 percent of the market) of washers currently sold in the US meet Energy Star standards.

The nonprofit Consortium for Energy Efficiency has been promoting the benefits of the higher standards to the public, utilities, legislative bodies and manufacturers. In many areas of the country, utilities participate in rebate programs to encourage the purchase of the high efficiency appliances. In May 2001, following NAECA timelines, Congress passed new energy efficiency standards for clothes washers. In 2004, the minimum energy standard will be 20 percent higher than the current federal standard, and in 2007, the minimum standard will be 35 percent higher. Tax incentives for manufacturers were proposed, as the higher efficiency machines are more expensive than conventional models.

High-efficiency, residential, standard 14-pound-capacity clothes washers, available in the U.S. since the late 1990s, use a maximum of 27 gallons of water (hot and cold) per load (gpl). This is in comparison to an average of 51 gpl between 1980 and 1990 and 56 gpl prior to that. Although top-loading washers can be designed for increased efficiency, front-loading, horizontal-axis machines have many design features that give them an edge over conventional designs

Top-loading machines have to submerge clothes totally for the wash and rinse cycles. The front-loader tumbles the clothes through a shallow pool of water, using less water and energy in the process. This tumbling action is usually gentler on clothes. Front-loaders automatically match the water level with the amount of laundry and extract water better in the spin cycle, saving energy needed for drying. Because a smaller volume of water is used for washing, less cleaning products are used. All front-loaders qualify for Energy Star ratings.

Currently, prices for high efficiency models range from $600-$1000, overlapping with the higher end of the prices for conventional washers. As the new energy efficiency requirements force changes in design, it is hoped that prices will decrease. Average residential savings for water and energy costs have been estimated to range from $80-$100 per household per year, equaling a payback period from two to ten years, depending on utility rates and frequency of washer use. A faster payback period will be achieved with a rebate or other financial incentive such as a tax or utility bill credit.

High-efficiency clothes washers can be installed to replace existing high-volume washers without special considerations. The International Plumbing Code has standards for clothes washer installation (Section 406). The present SC regulations require a lint filter for commercial Laundromats on the sewer line before the main septic tank (the only state with such a requirement).

It is reported that lint does not settle out in the septic tank but remains in suspension. If it is not removed before it arrives at or leaves the tank, it will carry over to the drainfield. Since lint consists of fibers, both natural and synthetic, this carry-over could contribute to blockage of the dispersal pipes and eventual failure of the field. There are lint traps that can be placed on the discharge line from residential clothes washers and maintained by the homeowner. This needs to be discussed as a possible requirement. It is recommended that effluent filters be required on septic tanks, and within the context of a management entity, this may solve the problem.

Dishwashers

Surveys reveal that approximately 50 percent of households in the U.S. have automatic dishwashers. Water use by dishwashers comprises one of the smallest portions of indoor residential water demand, averaging one gallon per capita per day. The water and energy efficiency of dishwashers installed in the U.S. has improved considerably since the mid-1990s, due to energy efficiency requirements of the National Appliance Energy Conservation Act of 1987. This legislation prompted manufacturers to reduce the hot water and heating energy use of dishwashers.

Since 1995, water-efficient dishwashers have used a maximum of 7.0 gallons per load (gpl). Dishwashers installed from 1990 to 1995 used between 9.5 to 12.0 gpl. Prior to 1990 the gpl was approximately 14.0. There are many energy-saving models available; a recent listing showed 141 dishwashers in 21 brands that met trials requiring 26 percent less energy than the federal standard. The majority of energy used is during the hot-water cycle. All dishwashers manufactured in the U.S. have a booster heater that raises and maintains the temperature of the hot water.

The water- and energy-efficient models are cost-competitive with less efficient models. Installation requirements are detailed in the International Plumbing Code (Section 409). Current SC regulations require grease traps on the discharge from commercial food preparation establishments. These are not recommended for residential dishwashers.

6.6 Utility-Based Efficiency Measures

Some of the many utility-based water efficiency measures include metering, rate structures, leak detection and repair programs, and pressure reduction programs. These are some first steps a local utility can take toward conserving water. Rate structures and metering are ways to encourage customers to use less water and not waste the resource. It creates awareness as to how much water is used, which would be evident by the customer's bill. These messages may encourage customers to install water-efficient devices and repair all leaks.

More recently, communities have started revising the rate structures to signal that future supply would cost more than the present supply, and that peak supply costs will be higher than the base supply to discourage excessive water use. New rates that are implemented should be gradual to allow for periodic evaluation of their effectiveness and their revenue impacts. Also, when there is a rate increase, customers should be provided with information on ways to reduce their water bills. Despite high initial costs, programs for finding and repairing leaking water mains and laterals can be very cost-effective.

These programs are particularly effective in communities that have large, old, and deteriorating systems. Many water systems deliver water at a pressure higher than what customers need, thus resulting in inefficient water use. Although installing pressure-reducing valves is cost effective, it should be noted that, in some cases, they might have a negative impact on some homes with systems already designed and installed. Care should be taken to ensure adequate fire flow is maintained.

6.7 Behavioral Practices for Residential Users

In addition to using water-saving devices, there are personal habits that an individual can practice to use water efficiently, thereby reducing the overall consumption in a home. Adopting new habits of using water more efficiently could save thousands of gallons of water per person each year. Behavioral practices of residential users can be applied both indoors in the kitchen, bathroom, and laundry room, as well as outdoors. Described below are some measures that can be taken for more efficient water use.

In a kitchen, for heavy cleaning of pots and dishes, recycled water can be used if it is followed by a clean rinse. It is best if the least possible amount of soap or cleaning agent is used. In addition, presoaking dishes will cut down on rinse water. Dishes can be scraped with used paper napkins in order to clean off food without using water. Rinsing all of the dishes at once will decrease the number of on/off cycles for the faucet. If a dishwasher is used, wash only full loads. Defrosting without using water can also help to conserve water by planning ahead to thaw frozen foods in the refrigerator. For immediate defrosting where water is necessary, having low consumption (2 gpm) faucet aerators can decrease the water used.

Water can be saved in the bathroom by not keeping the faucet on while brushing teeth or shaving. Taking short showers or baths and turning the water off while soaping can also save water. With respect to laundry, adjusting water levels in the washing machine to match the size of the load can save water. If a washing machine does not have a variable load control, use the washer only when it is full. If washing is done by hand, do not keep the water running; instead use a tub filled with water. Reuse the wash and rinse water as much as possible.

Other water-saving options include covering a swimming pool when it is not in use to reduce water loss by evaporation; discouraging restaurant servers from bringing you water unless you request it or from automatically refilling your empty water glass; and using cups to collect the water at drinking fountains, which prevents some of the water from going down the drain. To save water when washing a car, clean the car in sections and rinse in short spurts with a hose. Try to wash the car in a spot where shrubs or hedges are close by so that they may receive some of the water. Also, rainwater can be collected and used to reduce the amount of water taken from community water reserves.

Community-wide water-conservation programs can also include water use surveys, plumbing fixture retrofit kits, rebate or incentive programs for low-flow toilet replacement, and informational/educational programs.

Chapter 7
Recommendation Summary and Conclusion

Introduction

Beaufort County's concern about the need to manage its over 20,000 onsite/decentralized wastewater systems is both timely and appropriate. Beaufort County, along with other local, state and national agencies, are currently focusing on the benefits of institutionalizing the management of onsite/decentralized wastewater treatment and dispersal systems. Key elements of an effective community onsite management system (OMS) are planning, performance requirements, site evaluation, design, construction/installation, operation and maintenance, training, public education, inspection and monitoring, and financial assistance. This chapter summarizes community onsite wastewater management recommendations detailed in preceding sections of this report.

1. Onsite/decentralized Wastewater Management Planning

Planning an effective community OMS in Beaufort County integrated with its comprehensive land use planning activities is essential. **Therefore, it is recommended that the Beaufort County Planning Department (BCPD) personnel be an integral resource providing information and support for the county's onsite wastewater management efforts**. **It is further recommended that planning regions be identified (six planning areas), programmatic goals established, and interagency activities be coordinated by the planning group (BCPD).** This will ensure that community onsite wastewater management issues are integrated into future growth and development of the county.

Planning and zoning are closely related, planning sets guidance and policies, while zoning provides a detailed regulatory framework. **Therefore, it is recommended that zoning regulations specify performance requirements for individual or clustered systems installed in unsewered areas.** This will limit or prevent development on sensitive natural resource lands or in critical areas and encourage development within urban growth areas serviced by sewer systems.

A regular review of planning and zoning activities as they relate to community onsite wastewater management activities is strongly recommended, thus enabling the county to anticipate growth and development trends as well as the role of onsite wastewater management in minimizing impacts on the watershed and on public health.

2. Onsite/decentralized Wastewater Management Performance Approach

It is recommended that a performance-based approach be instituted in the county. Generally, performance requirements are based on broad goals to eliminate health threats from contact with inadequately treated effluent or direct/indirect ingestion of contaminants and standards for water quality and public health protection. **It is recommended that quantitative and qualitative goals be established**. The NESC proposes that the system designer ensure that qualitative and quantitative goals are met.

It is suggested that the state consider an amendment to regulations or the adoption of new legislation to permit both performance-based site evaluation and new OSDS design. It is also recommended that a detailed description of performance-based design is best left to the workshop and field trip environment, (as is the subject of performance-based site evaluation), as it requires an introduction to soil hydraulics and the use of many examples, which can be very site specific (Appendix B).

The adoption of new regulations is most easily facilitated by revising existing regulations by minor amendment and by adding new sections that are more easily accepted by the regulatory staff, practitioners, and the public (Appendix J). **It is recommended that the format remain the same, in that the regulations should cover the basis of the ordinance accompanied by a detailed technical guidance document specific to**

OSDS (standards for site evaluation, design and construction). This will help make technological advances and changes without the need to amend the underlying legislation.

It is recommended that Beaufort County look at a combination of management approaches (model 1 to 3) due to the number of variations and differences within the county. The application of model 1 to 3 should be set, based on factors such as relative risk to public health and the environment, and type of OSDS in use. However, at this point it would be most logical to start planning for the implementation of model 1 and gradually work toward higher conformance models as more data and resources become available. Models 4 and 5 should be an eventual goal at least in some parts of the county since there are areas with moderate to high environmental sensitivity where drinking water sources, shellfish beds etc. exist.

3. Design, Construction, and Installation Considerations

It is advisable that performance requirements, site conditions, and wastewater characterization information drive the selection of appropriate treatment technologies within Beaufort County. **It is recommended that design protocols address the use of water conservation fixtures, impacts of different pretreatment levels on hydraulic and treatment performance of soil-based systems, and the operation and maintenance requirements of different treatment and soil dispersal technologies.** They should include a required pre-design or pre-construction meeting between DHEC, the management entity (if it does not have permitting powers), the designer, and the owner of the property.

All of these parties have a stake in the design and questions for which they need answers that should be given and understood by all before the installation proceeds. **It is recommended that a protocol be as complete as possible, featuring a rational, defensible evaluation procedure for proposed designs and materials specifications not anticipated when the original review protocol was developed.**

The protocol should be dynamic, continuously reviewed, and updated as new information and experience is gained.

It is strongly recommended that the Beaufort County regulatory board develop a guidance document for approved technologies, both generic and proprietary. This would standardize design and performance requirements for installers, homeowners and others involved. Some of the key parameters and standards to be addressed are herein discussed.

When designing a system, it is suggested that the most limiting or significant parameters, including some ancillary factors, be considered to accommodate hydraulic and mass pollutant load variations. In general, the potential variability in wastewater characteristics in a particular residence or a cluster of homes should be accounted for by conservative predictions or safety factors.

It is recommended that great care should be taken in predicting wastewater characteristics without underestimating or overestimating the safety factors. It should also take into account the cost involved in measuring, monitoring, and actually analyzing various parameters. For known technologies with extensive testing and field data, the management agency can institute performance requirements prescriptively by designating system type, size, construction practices, materials to be used, acceptable site conditions, and siting requirements.

It is recommended that the septic tank be watertight, with two compartments and effluent filters at the outlet of the septic tank to prevent excess solids from flowing into the dispersal area. Septic tanks should be fitted with risers to provide easy access for location and inspection/maintenance**. It is also recommended that sealing horizontal and vertical joints with an appropriate elastomeric sealing compound can prevent the ingress of subsurface groundwater or stormwater.**

It is recommended that the use of secondary treatment technologies be based upon applicability and appropriateness in the context of protecting public health and reducing the risk to the environment. Use of proprietary technologies should be allowed if the technology is tested and verified by a nonprofit, third party, or reliable entity. **After approval, it is recommended that a comprehensive guidance document be developed for each approved technology.** Manufacturers' recommendations should be followed when using proprietary products to ensure the systems function properly.

Vertical separation distances to the limiting layer vary based on the characteristics of the soil. Other contributing factors include: the level of pretreatment, pressure or gravity distribution, organic and hydraulic loading rate, setbacks, hydraulic gradients, mounding, etc. **A performance-based site evaluation (see Appendix B) and use of secondary levels of treatment is recommended in sensitive areas.** The actual separation distance in most coastal states with similar conditions is no less than 12 inches.

Most states constantly revise their vertical separation distances as more data and insight are available. The vertical separation distance ranging from 12 – 24 inches with some level of secondary treatment is the most common in the majority of coastal states**.** **USEPA recommends a more conservative separation distance of 18" to 24". When the seasonal water table is less than 12 inches, it is recommended that the permit go through an increased level of review and permitting.** However, it is also strongly suggested that the 12-inch separation should be included as an option as part of a variance. **Mounding analysis is recommended for lower flows but should be required for flows greater than 2,000 gpd as required in certain coastal states.** The procedure developed by OCRM for mounding analysis could be used.

The horizontal separation distances in almost all coastal states are prescriptive between the different features and the OSDS**.** **It is recommended that setbacks be set after the attenuation study is completed. Setback distances that can be applied**

immediately include: drilled or deep well - 50 ft., shallow or dug well - 100 ft., distance to mean high water mark – 100 ft., downslope boundary – 30 ft., other boundary – 10 ft., and building foundation or bathing pool – 10 ft. Also, these setbacks should be established based upon the removal of pathogens and nutrients and amended after the study.

It is recommended that a system designer or installer have a good understanding of the relationship between the soil properties and soil hydraulics, and an OSDS. It is further recommended that application rates be based upon the texture, structure, and consistency of each horizon. When the effluent strength exceeds typical wastewater characteristics, it is suggested that the loading rates be proportionately reduced. It is recommended that gravity and pressure distribution requirements be set for each site based upon a performance-based site evaluation. Drainfield reductions of 20-40 percent can be permitted depending on the soil type, type of technology, effluent quality, and geometry used.

It is recommended that Beaufort County Health Department take into consideration housing density by requiring minimum lot sizes according to the soil conditions, overall hydraulic loading, the proximity of water sources, and the collective performance of OSDS. It is further recommended that an adequate replacement area be available to accommodate a system in case the original system malfunctions beyond repair.

It is further recommended that any repairs or alterations to a conventional, alternative or innovative system be undertaken only after a repair permit is obtained from the Beaufort County Health Department. Any repair to the system should be done in accordance to the rules and regulations of the health department. **It is also recommended that older systems that did not meet the standards be brought into compliance with the current code. Subsequent to repair, it is recommended that the system repairer provide a certification by the engineer,**

plumber, electrician or the appropriate person that the repairs were completed in accordance to the approved repair plan.

It is recommended that flow rates, especially from nonresidential sources, include monitoring actual flow rates and its specific wastewater characteristics. Although using data from similar sources provides a good baseline, the peak flow for all these establishments should be considered when designing the system. This enables regulatory agencies to set a more conservative flow rate to design a system that will be capable of handling peak flows without affecting the performance.

More investigation is recommended; however, there is little doubt that the density of development, based upon onsite sewage disposal, should be about an acre per single-family home. Commercial, institutional, and industrial development may require substantial areas of land for subsurface sewage disposal.

It is recommended that mass pollutant loads in wastewater be reduced by improving user habits, using products (bathing, laundering, dishwashing etc.) that contain a significantly lower amount of pollutants, and using water conservation devices can be an effective source-reduction strategy. When a garbage disposal unit is used, it is suggested the system size be increased as done in the state of New Jersey. A significant reduction in the amount of grease, suspended solids, and BOD can be achieved by eliminating the use of garbage disposals. It can also result in a slight reduction of nitrogen and phosphorus loads from vegetables and food-related material entering wastewater.

Site conditions in Beaufort County are not very conducive for nutrient removal. **It is strongly suggested that a comprehensive nutrient reduction strategy with reasonable goals, including significant and measurable improvement in the environmental quality, be developed. It is further suggested that source reduction goals be adopted, such as reducing areas that are severely impacted by a certain percentage (over a 10–20 year period), and ensuring that no coastal**

area now termed healthy develops symptoms of nutrient enrichment. It is recommended that stricter requirements be established in "nitrogen-sensitive areas" by limiting new nitrogen discharging sources. Requirements should be based on relative risks to drinking water sources and ecological sensitivity.

Using nutrient reduction technologies in very sensitive areas is recommended. It should be noted that adding a nutrient removal step to the wastewater treatment does increase the cost of the system. **It is suggested that a monitoring program for nutrient reduction be established to develop more effective ways to locate, identify, and collect consistent and competent data accurately.** The program should address all sources of variability and uncertainty, as well as cause and effect relationships. A successful monitoring program should require input from those that will be using the data such as scientists, local officials, homeowners, and decision makers.

A draft "Request for Proposals" is included in Appendix K. It is suggested that this template be amended or used as the basis for developing a document applicable to the county.

4. Operation and Maintenance

To be effective, it is recommended that housing unit occupants served by onsite/decentralized wastewater treatment and dispersal systems within the county play a pivotal role in system operation and maintenance activities. It is further suggested that occupants be aware of issues such as the possible harm that may be caused to soil-based systems as a result of driving heavy vehicles over the ground surface and paving those areas resulting in cutting off the free-flow of oxygen to those systems. It is essential that residents understand the possible effects to onsite systems of adding strong toxic compounds, oils, and greases along with the favorable benefits of water conservation.

Specific operation and maintenance protocols for individual technologies will vary considerably. **It is strongly suggested that the periodic pump-out of conventional**

septic tanks be instituted within the county's onsite management system (OMS). It is recommended, a.) Residential – inspection at not less than three year intervals with mandatory pumping and inspection at six years, or less, if the three-year inspection so indicates; b.) Commercial (food, shops, restaurants, and similar) - inspection at two years, pumping at four years, or as needed. It is also recommended that the county operation and maintenance program be organized- to avoid such unnecessary expenses as purchasing unproven compounds marketed to improve septic tank and soil absorption system performance.

Mechanical systems such as activated sludge-based units may require servicing 3 to 4 times per year ensuring that aeration tank solids concentrations are maintained within appropriate design specifications. **It is recommended that mechanical systems be periodically inspected to ensure proper operation of electro-mechanical components. It is recommended that Beaufort County assess modem or internet-based control packages capable of monitoring systems to reduce the frequency of site inspections, thus keeping manpower costs within acceptable parameters.**

It is recommended that a countywide inspection program to monitor system performance be introduced to help reduce the risks of system failures and, therefore, decrease long-term operating costs as well as lowering the risk of ground water or surface water contamination. Annual inspection of conventional systems and a much higher inspection frequency for alternative, innovative and experimental systems should be initiated. It is recommended that Beaufort County's operation and maintenance program implement design (e.g., riser to the surface), accessibility to system records by field personnel, and automated monitoring practices to ensure its effectiveness.

The county may consider the use of private service providers to implement the OMS. However, such an approach would require the training and certification of service providers. **It is recommended that should the county pursue this approach, it would be preferable to work with an established training center and existing**

training/certification program such as the National Environmental Training Center for Small Communities at the NESC.

It is further recommended that the county give consideration to the implementation of a renewable operating permit program within the OMS. To achieve this, the county would need to establish periodic permit renewals at specified intervals (e.g., 1-5 years), reissued after documentation is submitted that operation, maintenance, and monitoring tasks have been completed. **It is recommended that the county OMS require that verification licensed/certified service providers be retained by system owners and that the county be contacted by service providers if contracts are allowed to lapse.**

5. Household Appliances

It has been noted that in the recent years, regulatory approaches have served as a powerful tool in establishing water conservation requirements for every customer sector. **It is recommended that this tool be appropriately used to effect change in plumbing code amendments that require conservation measures, thus producing a profound impact on every sector. It is recommended that the current plumbing code be referenced in the new onsite regulations, obviating the need to enumerate water saving devices or strategies. It is also recommended that the matter of gray water and waterless toilets be addressed.**

It is recommended that where garbage disposal units are proposed, the regulations be amended to require increased septic tank capacity (one third) and septic tank effluent filters. It is also suggested that effluent filters be installed, as they are especially important to trap lint from clothes washers, requiring separate lint filters after the washer.

It is recommended that the issue of waterless toilets, separate plumbing systems, and the use of gray water be examined in detail and a policy be adopted. The International Plumbing Code (Section 301.3) requires plumbing fixtures that receive water or waste to discharge to the sanitary drainage system of the structure. **In order to allow for the use of gray water, recycling, or irrigation system, therefore, it is recommended that the plumbing code be revised.**

Low-flow toilets, urinals, and other plumbing fixtures and appliances are recommended in new buildings, in addition to a program to retrofit existing homes. In general, front-loading clothes washer models may become the choice for communities trying to save water and energy. **It is recommended that utilities and public-interest groups offer rebates to buyers of front-loading machines.** But even without such incentives, the prices of certain models have come down, making their use economical. **To take full advantage of the new standards, positive steps, such as replacing or retrofitting old fixtures, leak control, and modifying water use habits, is recommended.**

It is recommended that a blueprint for a successful water conservation program be carefully designed and implemented. It is further recommended that the steps in the planning process include the following elements:

- Identify the goals and objectives of the program
- Develop the water-use profile and forecast anticipated future demand.
- Evaluate the facilities required for both the present and future.
- Identify and evaluate all aspects of the proposed conservation measures.
- Identify and assess incentives to users adopting such a program.
- Compile and analyze all benefits and costs associated.
- Choose appropriate incentives in relation to each conservation measure.
- Develop a comprehensive plan and implement it.
- Review and integrate conservation and supply plans, modifying forecasts.
- Measure, monitor, evaluate, and revise the program as needed.

Conservation and demand management alternatives are recommended, as they can be more cost effective with limited or no environmental impact compared to conventional strategies. It is suggested that the utility and or agency engage in a

dynamic and more open process than conventional approaches to water supply planning. It is recommended that all stakeholders (public, engineers, water and wastewater mangers, planners, administrators, local policymakers, businesses, environmental groups, nonprofit organizations, and others) be active participants in this process from the beginning to end and not just during the public hearing or approval stage.

6. Education and Training

It is recommended that the public be educated and engaged in building support critical to various elements of the OMS. It is further suggested to keep local officials, decision makers, private sector and other stakeholders involved in the process by organizing regular public meetings, public announcement slots in the local media (print and visual), mailings, etc. Training will depend upon the complexity of the OSDS and needs to be developed simultaneously. **It is recommended that the county develop effective ways to collect, compile, and catalog useful data and other relevant information in a central repository.** The county may also consider data and records of systems installed being stored electronically with the overlay of GIS and GPS information.

It is recommended that strategically selected demonstration (pilot) projects to facilitate the adoption of proven innovative onsite, cluster, and small community sewage disposal technologies and management systems be conducted in communities located in the county. Demonstration projects should typically involve the following components:

- design, construct, implement, maintain, and manage technologies;
- provide relevant information and technical assistance maximization of efficiencies through partnerships;
- assist in creating OMS;
- provide for training and public education; and
- circulate information about project results.

It is recommended that outreach and information dissemination be an integral part of the process. A comprehensive outreach and dissemination strategy should be developed at the outset targeting all stakeholders and audience, and reviewed/revised periodically. It is further recommended that participating communities design educational plan for local contractors, homeowners, and regulators. It is also recommended that results, observations, and lessons learned be distributed at the local, state, and regional level.

7. Monitoring Programs

Most states in the U.S. lack a coherent, consistent strategy to monitor the effects of failure or malfunction of OSDS. It is difficult to estimate the economic and ecological impact with any accuracy. **It is recommended that a monitoring program be developed that would involves local, state, federal, and other institutions in agreeing to use consistent measures of physical, chemical and biological properties as well as standard procedures and quality assurance and quality control (QA/QC).** Sites strategically selected for long-term monitoring will help to better understand causes and impacts and would help develop appropriate mitigation strategies. **It is further recommended that a monitoring program include tracking the long-term effectiveness of different management approaches and revising current practices where needed.**

8. Financial Support

Funding is an essential component and the backbone of a successful OMS, without which activities such as planning, inspection, enforcement etc., cannot be properly implemented. **It is recommended that all sources that can provide grants, loans, or cost-share to replace or retrofit failing systems be reviewed to assist county residents.** National resource providers like the Rural Community Assistance Program, NRWA, and state extension services are generally equipped to provide funding assistance. Many regional resources exist throughout the country providing similar services. Funding agencies are listed in Appendix K.

Conclusion

Core commitment from local leaders is an essential ingredient in moving the county forward, building on its initial commitment to enable a countywide Onsite Management System. The county needs to execute a Community Self Assessment (COMSAT) that fosters awareness and provides the factual basis for conscious wastewater management decisions to set the backdrop for the development of an acceptable policy position. Such a position should be based on the assessment findings along with recommendations made by stakeholders (CWTF) and professional groups (NESC etc.). An effective OMS plan will require the input, cooperation and resources of the Beaufort County Planning Department to ensure effective implementation of the countywide wastewater management policy. Furthermore, integrating appropriate, affordable technologies and strategic management necessitates the enabling of programs within the management system to meet policy objectives and systems performance targets.

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Appendix A

EPA Models Of Management

Management Program 1: Inventory and Maintenance Reminders

Objective: To ensure conventional decentralized systems are sited and constructed properly in accordance with appropriate state/tribal/local regulations and codes, are periodically inspected and, if necessary, repaired by the owner. The regulatory authority maintains a record of the location of all systems and periodically provides owners with notices regarding preventive operation and maintenance recommendations (Table A-1).

Table A-1: Management Program 1: Inventory and Maintenance Reminders

PROGRAM ELEMENT	ACTIVITY
Planning	**(REGULATORY AUTHORITY)** Program rules and regulations should be coordinated with state/tribal/ local planning and zoning and other water related programs.
Performance Requirements	**(OWNER)** Prevent direct and indirect human contact with raw and partially treated wastewater. Install watertight and structurally sound treatment tanks.
Site Evaluation	**(REGULATORY AUTHORITY)** Codify criteria for treatment site characteristics that will prevent unacceptable impacts on ground water and surface water resources. Codify prescriptive requirements for site evaluation procedures. **(OWNER)** Hire a licensed/certified site evaluator to perform site evaluation.
Design	**(REGULATORY AUTHORITY)** Codify prescriptive, pre-engineered designs that are suitable for treatment sites meeting the prescriptive site criteria. **(OWNER)** Hire a licensed/certified contractor or designer to design system.
Construction/ Installation	**(REGULATORY AUTHORITY)** Administer a permitting program for system construction, which includes regulatory authority acceptance of proposed system siting and design plans and a final construction inspection for assurance of permit compliance. **(OWNER)** Hire a licensed/certified contractor to construct system.
Operation & Maintenance	**(REGULATORY AUTHORITY)** Provide owner with educational materials regarding system care. Provide owner with timely reminders to perform scheduled preventive maintenance. **(OWNER)** Hire a licensed/certified pumper/hauler to perform necessary maintenance.

Table A-1 (contd..)

PROGRAM ELEMENT	ACTIVITY
Residuals Management	**(REGULATORY AUTHORITY)** Administer a tracking system for residuals hauling and disposal in accordance with 40 CFR, Part 503, Use and Disposal of Sewage Sludge, 40 CFR, Part 257, and applicable state/tribal/local requirements by licensed pumpers/haulers.
Training/ Certification/ Licensing	**(LICENSING BOARD/REGULATORY AUTHORITY)** Develop and administer training, testing, and licensing program for site evaluators, contractors, pumpers/haulers, and inspectors. **(SERVICE PROVIDER)** Obtain appropriate license to practice.
Public Education/ Involvement	**(REGULATORY AUTHORITY)** Educate owners on purpose, use, and care of treatment system. Provide technical guidelines for service providers.
Inspections/ Monitoring	**(REGULATORY AUTHORITY)** Administer/perform inspection programs for high risk systems, or at point-of-sale, and/or change-in-use of properties.
Enforcement	**(REGULATORY AUTHORITY)** **Negotiate compliance schedules for correcting documented non-compliance items.** Administer enforcement program including fines and/or penalties for failure to comply with compliance schedule. **(Owner)** Comply with terms and conditions of the negotiated compliance schedule.
Record Keeping	**(REGULATORY AUTHORITY)** Administer a database inventory (locations, site evaluations, record drawings, permits, and inspection reports) of all systems within the jurisdiction.
Institutional support/ Financial Assistance	**(REGULATORY AUTHORITY)** Provide inventory of financial assistance programs available to owners.

Management Program 2: MAINTENANCE CONTRACTS

Objective: To provide management control of system maintenance by requiring that maintenance contracts between the owner and maintenance provider be maintained over the service life of the system. Maintenance contracts allow use of more complex mechanical treatment options (Table A-2).

Table A-2 –Management Program 2: Maintenance Contracts

PROGRAM ELEMENT	ACTIVITY
Planning	**(REGULATORY AUTHORITY)** Program rules and regulations should be coordinated with state/tribal/ local planning and zoning and other water related programs.
Performance Requirements	**(REGULATORY AUTHORITY)** Establish minimum maintenance requirements for systems. **(OWNER)** Maintain valid contract with licensed/certified operator. Prevent direct and indirect human contact with raw and partially treated wastewater. Install watertight and structurally sound treatment tanks.
Site Evaluation	**(REGULATORY AUTHORITY)** Codify criteria for treatment site characteristics that will prevent unacceptable impacts on ground water and surface water resources. Establish alternative site acceptance criteria for systems with enhanced pretreatment. Codify prescriptive requirements for site evaluation procedures. **(OWNER)** Hire a licensed site evaluator to perform site evaluation.
Design/ Installation	**(REGULATORY AUTHORITY)** Codify prescriptive, pre-engineered designs that are suitable for treatment sites meeting the prescriptive site criteria. **(Owner)** Hire a licensed/certified contractor or designer to design system.
Construction/ Installation	**(REGULATORY AUTHORITY)** Administer a permitting program for system construction, which includes regulatory authority acceptance of proposed system siting and design plans a final construction inspection for assurance of permit compliance. INVENTORY NEED? **(OWNER)** Hire a licensed/certified contractor to construct system.

Table A-2 (contd..)

PROGRAM ELEMENT	ACTIVITY
Operation & Maintenance	**(REGULATORY AUTHORITY)** Require owner to attest periodically that he/she holds a valid contract with a licensed/certified operator to perform scheduled and any necessary system maintenance. Require owner to submit maintenance report signed/sealed by licensed/certified operator immediately following scheduled maintenance. Provide owner with educational materials regarding system care. **(OWNER)** Hire licensed/certified operator to perform scheduled maintenance as required.
Operation & Maintenance	**(REGULATORY AUTHORITY)** Require owner to attest periodically that he/she holds a valid contract with a licensed/certified operator to perform scheduled and any necessary system maintenance. Require owner to submit maintenance report signed/sealed by licensed/certified operator immediately following scheduled maintenance. Provide owner with educational materials regarding system care. **(OWNER)** Hire licensed/certified operator to perform scheduled maintenance as required.
Residuals Management	**(REGULATORY AUTHORITY)** Administer a tracking system for residuals hauling and disposal in accordance with 40 CFR Part 503 Use and Disposal of Sewage Sludge, 40 CFR Part 257, and applicable state/tribal/local requirements by licensed pumpers/haulers.
Training/ Certification/ Licensing	**(LICENSING BOARD/REGULATORY AUTHORITY)** Develop and administer training, testing, and licensing program for site evaluators, contractors, haulers/pumpers, inspectors, and operators. (**SERVICE PROVIDER)** Obtain appropriate license to practice.
Public Education/ Involvement	**(REGULATORY AUTHORITY)** Educate owners on purpose, use, and care of treatment system. REMINDERS? Provide technical guidelines for service providers.

Table A-2 (contd..)

PROGRAM ELEMENT	ACTIVITY
Inspections/ Monitoring	**(REGULATORY AUTHORITY)** Administer/perform inspection programs for high-risk systems, or at point-of-sale, and/or change-in-use of properties. Administer program for monitoring timely submittals of acceptable maintenance reports. **(OWNER)** Attest to the Regulatory Authority that a valid contract with a licensed/certified operator to perform scheduled and any necessary system maintenance is executed. Submit a maintenance report signed/sealed by a licensed/certified operator immediately following scheduled maintenance.
Enforcement	**(REGULATORY AUTHORITY)** Negotiate compliance schedules for correcting documented non-compliance items. Administer enforcement program including fines and/or penalties for failure to comply with compliance schedule. **(OWNER)** Comply with terms and conditions of the negotiated compliance schedule.
Record Keeping	**(REGULATORY AUTHORITY)** Administer a database inventory (locations, site evaluations, record drawings, permits, and inspection reports) of all systems within the jurisdiction Administer an owner/operator maintenance contract compliance system.
Institutional Support/ Financial Assistance	**(REGULATORY AUTHORITY)** Provide inventory of financial assistance programs available to owners.

Management Program 3: Operating Permits

Objective: To issue renewable and revocable operating permits to system owners that stipulate specific and measurable requirements for their systems and POSSIBLY periodic submittals of compliance monitoring reports. The specific performance requirements (Table A-3) are based on risks to public health and water resources posed by wastewater dispersal in the receiving environment. Operating permits allow the use of decentralized systems on sites with a greater range of site characteristics.

Table A-3 - Management Program 3: Operating Permits

PROGRAM ELEMENT	ACTIVITY
Planning	**(REGULATORY AUTHORITY)** Program rules and regulations should be coordinated with state/tribal/ local planning and zoning and other water related programs.
Performance Requirements	**(REGULATORY AUTHORITY)** Establish performance requirements for receiving environments. Establish minimum maintenance requirements for systems. **(OWNER)** Operate system to comply with performance requirements stipulated in the operating permit. Prevent direct and indirect human contact with raw and partially treated wastewater. Install watertight and structurally sound treatment tanks.
Site Evaluation	**(REGULATORY AUTHORITY)** Codify prescriptive requirements for site evaluation procedures. **(OWNER)** Hire a licensed site evaluator to perform site evaluation.
Design	**(REGULATORY AUTHORITY)** Administer plan review program for engineered designs to meet stipulated performance requirements. Require emergency operation and contingency plans during design review to prevent catastrophic failures. Codify prescriptive, pre-engineered designs that are suitable for treatment sites meeting the prescriptive site criteria. **(OWNER)** Hire a licensed/certified contractor or designer to design system.
Construction/ Installation	**(REGULATORY AUTHORITY)** Administer a permitting program for system construction, which includes regulatory authority acceptance of proposed system siting and design plans. Require designer's certification that system construction complies satisfactorily with approved plans. MORE INSPECTION OVERSIGHT OR REPORTING REQUIREMENTS? **(OWNER)** Hire a licensed/certified contractor to construct system.

PROGRAM ELEMENT	ACTIVITY
Operation & Maintenance	**(REGULATORY AUTHORITY)** Administer a program of operating permits that are renewable upon documented compliance with permit stipulations. Require owner to submit maintenance report signed/sealed by licensed/certified operator immediately following scheduled maintenance or monitoring as stipulated by the operating permit. Provide owner with educational materials regarding system care. **(OWNER)** Operate and maintain the system in accordance with the stipulated operating permit conditions.
Operation & Maintenance	**(REGULATORY AUTHORITY)** Administer a program of operating permits that are renewable upon documented compliance with permit stipulations. Require owner to submit maintenance report signed/sealed by licensed/certified operator immediately following scheduled maintenance or monitoring as stipulated by the operating permit. Provide owner with educational materials regarding system care. **(OWNER)** Operate and maintain the system in accordance with the stipulated operating permit conditions.
Residuals Management	**(REGULATORY AUTHORITY)** Administer a tracking system for residuals hauling and disposal in accordance with 40 CFR, Part 503, Use and Disposal of Sewage Sludge, 40 CFR, Part 257, and applicable state/tribal/local requirements by licensed pumpers/haulers.
Training/ Certification/ Licensing	**(LICENSING BOARD/REGULATORY AUTHORITY)** Develop and administer training, testing, and licensing program for site evaluators, contractors, haulers/pumpers, inspectors, and operators. **(SERVICE PROVIDER)** Obtain appropriate license to practice.
Public Education/ Involvement	**(REGULATORY AUTHORITY)** Educate owners on purpose, use, and care of treatment system. SPECIFIC GUIDANCE, LISTS OF APPROVED SP, MORE ED/INVT? Provide technical guidelines for service providers.

Table A-3 (contd.)

PROGRAM ELEMENT	ACTIVITY
Inspections/ Monitoring	**(REGULATORY AUTHORITY)** Administer/perform inspection programs for high risk systems, or at point-of-sale, and/or change-in-use of properties. Administer program for monitoring timely submittals of acceptable compliance maintenance reports. **(OWNER)** Submit compliance monitoring reports to Regulatory Authority as stipulated in operating permit. Submit compliance inspection report signed/sealed by a licensed/certified inspector prior to applying for renewal of operating permit.
Enforcement	**(REGULATORY AUTHORITY)** Negotiate compliance schedules for correcting documented non-compliance items. Administer enforcement program including fines and/or penalties for failure to comply with compliance schedule. Require system inspections by certified inspector at time of operating permit renewal. **(OWNER)** Comply with terms and conditions of the negotiated compliance schedule.
Record Keeping	**(REGULATORY AUTHORITY)** Administer a database inventory (locations, site evaluations, record drawings, permits, and inspection reports) of all systems within the jurisdiction. Administer a tracking system for operating permits. Administer a compliance reporting database.
Institutional Support/ Financial Assistance	**(REGULATORY AUTHORITY)** Provide inventory of financial assistance programs available to owners. MORE?

Management Program 4: RME Operation and Maintenance

Objective: To ensure that decentralized systems consistently meet the stipulated performance requirements (Table A-4) by issuing the operating permit to a responsible management entity that accepts the responsibility for performance of systems within its service area.

Table A-4 – Management Program 4: RME Operation and Maintenance

PROGRAM ELEMENT	ACTIVITY
Planning	**(RME)** Program rules and regulations should be coordinated with state/tribal/ local planning and zoning and other water related programs.
Performance Requirements	**(REGULATORY AUTHORITY)** Establish performance requirements for receiving environments. Establish minimum maintenance requirements for systems. **(RME)** Operate system to comply with performance requirements stipulated in the operating permit. Prevent direct and indirect human contact with raw and partially treated wastewater. **(OWNER)** Install watertight and structurally sound treatment tanks.
Site Evaluation	**(REGULATORY AUTHORITY)** Codify prescriptive requirements for site evaluation procedures. **(OWNER)** Hire a licensed site evaluator to perform site evaluation.
Design	**(REGULATORY AUTHORITY)** Administer plan review program for engineered designs to meet stipulated performance requirements. Require emergency operation and contingency plans during design review to prevent catastrophic failures. Codify prescriptive, pre-engineered designs that are suitable for treatment sites meeting the prescriptive site criteria. **(OWNER)** Hire a licensed/certified contractor or designer to design and construct system in accordance with any RME/RA specifications.
Construction/ Installation	**(REGULATORY AUTHORITY)** Administer a permitting program for system construction, which includes regulatory authority acceptance of proposed system siting and design plans. **(RME)** Require designer's certification that system construction complies satisfactorily with approved plans. **OWNER)** Hire a licensed/certified contractor to construct system.

PROGRAM ELEMENT	ACTIVITY
Operation & Maintenance	**(REGULATORY AUTHORITY)** Administer a program of operating permits that are renewable upon documented compliance with permit stipulations. Require owner to submit maintenance report signed/sealed by licensed/certified operator immediately following scheduled maintenance or monitoring as stipulated by the operating permit. DOESN'T RME DO OR HIRE SP? Provide owner with educational materials regarding system care. PROTOCOLS? **(RME)** Operate and maintain the system in accordance with the stipulated operating permit conditions. Submit compliance monitoring report signed/sealed by a licensed/certified operator as stipulated by operating permit.
Residuals Management	**(REGULATORY AUTHORITY)** Administer a tracking system for residuals hauling and disposal in accordance with 40 CFR, Part 503 Use and Disposal of Sewage Sludge, 40 CFR, Part 257, and applicable state/tribal/local requirements by licensed pumpers/haulers.
Training/ Certification/ Licensing	**(LICENSING BOARD/REGULATORY AUTHORITY, RME)** Develop and administer training, testing, and licensing program for site evaluators, contractors, haulers/pumpers, inspectors, and operators. (Service Provider) Obtain appropriate license to practice.
Public Education/ Involvement	**(RME)** Educate owners on purpose, use, and care of treatment system. Maximize public involvement through advisory and review boards and with outreach and involvement activities.
Inspections/ Monitoring	**(REGULATORY AUTHORITY, RME)** Administer/perform inspection programs for high risk systems, or at point-of-sale, and/or change-in-use of properties. Administer program for monitoring timely submittals of required compliance reports. **(RME)** Conduct system performance and environmental monitoring programs required by RA. Submit compliance monitoring reports to Regulatory Authority as stipulated in operating permit. Act on compliance inspection reports signed/sealed by a licensed/certified inspector prior to applying for renewal of RA operating permit.

PROGRAM ELEMENT	ACTIVITY
Enforcement	**(REGULATORY AUTHORITY)** Negotiate & approve compliance program with RME, owner, or both for correcting documented non-compliance. Administer enforcement program including fines and/or penalties for failure to comply with compliance schedule. **(RME)** Require system inspections by certified inspector at time of operating permit renewal. Implement terms and conditions of compliance schedule for correcting system performance. **(OWNER)** Pay for correcting system performance problems.
Record Keeping	**(RME)** Administer database inventory (locations, site evaluations, drawings, permits, and inspection reports) of all systems. Administer a tracking system for operating permits and a compliance reporting database. **(REGULATORY AUTHORITY)** Administer financial, management, and technical audits of RME.
Institutional support/ Financial Assistance	**(RME)** Assure financial & legal support necessary for RME success. Provide inventory of financial assistance programs available to owners. Seek grants & loans to support infrastructure construction, rehabilitation, and replacement.

Management Program 5: RME management

Objective: To provide professional management of the planning, siting, design, construction, operation, and maintenance of decentralized systems (Table A-5) by a responsible management entity that owns and manages individual and cluster systems within its service area.

Table A-5 – Management Program 5: RME management

PROGRAM ELEMENT	ACTIVITY
Planning	**(RA, RME)** Program rules and regulations should be coordinated with state/tribal/ local planning and zoning and other water related programs.
Performance Requirements	**(REGULATORY AUTHORITY)** Establish performance requirements for receiving environments. Set all oversight/permitting requirements for RME and conduct oversight program. **(RME)** Operate systems to comply with performance requirements stipulated in the operating permit. Conduct system and environmental monitoring and submit reports as required by RA in permit. Meet all compliance schedules set by RA
Site Evaluation	**(REGULATORY AUTHORITY)** Codify prescriptive requirements for site evaluation procedures. **(RME)** Conduct or hire a licensed site evaluator to perform site evaluation.
Design	**(REGULATORY AUTHORITY)** Administer plan review program for engineered designs to meet stipulated performance requirements that include emergency operation and contingency plans to prevent catastrophic failures. (**RME)** Conduct design meetings with designer, site evaluator, and owners to assure common understanding. Conduct or hire a licensed/certified contractor or designer to design and construct system in accordance with any RME specifications.
Construction/ Installation	**(REGULATORY AUTHORITY, RME)** Administer a permitting program for system construction, which includes regulatory authority acceptance of proposed system siting and design plans. **(RME)** Hire a licensed/certified contractor to construct system. Require designer's certification and as-built drawings to show that system construction complies with approved plans.

PROGRAM ELEMENT	ACTIVITY
Operation & Maintenance	**(REGULATORY AUTHORITY)** Administer a program of operating permits that are renewable upon documented compliance with permit stipulations. **(RME)** Provide licensed/certified operator immediately following scheduled maintenance or monitoring as stipulated by the operating permit. Provide owner with educational materials regarding system care. Submit compliance monitoring report signed/sealed by a licensed/certified operator as stipulated by operating permit.
Residuals Management	**(REGULATORY AUTHORITY, RME)** Administer a tracking system for residuals hauling and disposal in accordance with 40 CFR, Part 503, Use and Disposal of Sewage Sludge, 40 CFR, Part 257, and applicable state/tribal/local requirements by licensed pumpers/haulers.
Training/ Certification/ Licensing	**(LICENSING BOARD/REGULATORY AUTHORITY/RME)** Develop and administer training, testing, and licensing program for site evaluators, designers, contractors, O/M providers, and inspectors, and operators. **(RME)** Implement specific supplemental training & certification program for service providers.
Public Education/ Involvement	**(RME)** Involves and educates system users in the management program
Inspections/ Monitoring	**(REGULATORY AUTHORITY)** Set all monitoring and reporting requirements in permit granted to RME **(RME)** Administer/perform inspection programs for high-risk systems, or at point-of-sale, and/or change-in-use of properties. Administer program for monitoring & timely submittal of compliance reports to regulatory authority as stipulated in operating permit. Submit compliance inspection report signed/sealed by a licensed/certified inspector prior to applying for renewal of operating permit.

PROGRAM ELEMENT	ACTIVITY
Enforcement	**(REGULATORY AUTHORITY)** Negotiate compliance program & schedules with RME for correcting documented non-compliance problems. **(RME)** Administer enforcement program including fines and/or penalties for failure to comply with compliance schedule. Require system inspections by certified inspector at time of operating permit renewal. Comply with terms and conditions of compliance schedule for correcting non-compliant system.
Record Keeping	**(RA)** Administer financial, management, and technical audits of RME. **(RME)** Administer a database inventory (locations, site evaluations, record drawings, permits, and inspection reports) of all systems within the jurisdiction Administer a tracking system for operating permits. Administer a compliance reporting database.
Institutional Support/ Financial Assistance	**(RME)** Provide the legal and financial support to assure RME sustainability. Provide inventory of financial assistance programs available to service population. Seek grants and loans to fund system replacements, repairs and future needs.

Appendix B

Performance Based Site Evaluation©

Introduction

In a soil adsorption system we are returning wastewater to the groundwater regime and are concerned mainly with two functions of the soil, subsoil, and bedrock environment. The two functions are a) soil hydraulics and b) soil treatment. The laws of physics govern the first; the second is governed by the principles of chemistry, biology, and physics.

In a *performance-based* approach to a site evaluation, our concern is "If we put this effluent into the ground, how will it leave the boundary of the site and what will be its condition?" An estimate is made of the hydraulic carrying capacity of the building lot, the probable elevation of the existing groundwater and the quality of the effluent plume and its ultimate fate as it leaves the boundary of the site.

An equally important question for the evaluator could be, "Is an onsite solution the most appropriate for this development?"

Concerning soil hydraulics, the existing conditions of the site will normally include a saturated groundwater table at some depth below the surface, either in the soil or in the bedrock. If there are low permeability or impervious layers in the soil, there may be several groundwater regimes beneath the site, and we will mainly be concerned with the uppermost, but we should not disregard the others. The groundwater system is already dealing with precipitation and evapo-transpiration events both upstream and on the site. The groundwater will exist in three basic phases or zones of full saturation, tension saturation, and partial saturation (or the vadose zone).

All three phases are already in motion and, unless the water table is solely within the bedrock, moving predominantly laterally across the site, and all phases are obeying Darcy's law of the flow of fluids in a porous medium. There will be seasonal fluctuations in the height of the zones but in general the flow will be lateral and under the influence of a hydraulic gradient or difference in elevation of the water table across the site. *It should be emphasized that although there may be some vertical flow of the effluent plume beneath the soil adsorption bed, once the plume has reached the tension saturated zone, the moisture in all of the zones (saturated, tension saturated, and vadose) both above and below the water table will in fact be moving laterally under the influence of the hydraulic gradient. (Pask)*

Adding effluent to the site will and must raise the level of the water table and will affect the local hydraulic gradient, but both the existing groundwater and the effluent plume must obey Darcy's Law. Simply stated, Darcy's Law says that the velocity of groundwater flow is proportional to both the hydraulic gradient and to the hydraulic conductivity or permeability of the soil. This principle is inviolate and means that, among other things, nothing that we do to the effluent before placing it in the soil horizons can change the effect of Darcy's Law. Darcy's Law does, however, enable us to predict what will happen when we add the effluent and enables us to make best possible use of a site or to optimize its performance.

Under the best circumstances the site evaluation will take place before the parcel of land is subdivided, but in too many cases, the subdivision has already been made and the evaluator is faced with a "fait accompli." All too often the house may have already been built upon the site.

For a single family home, we must assume the worst case scenario for the current or future occupant. Two teenage football players showering twice a day and changing clothes three times a day will occupy each bedroom. This is the reason for the unreasonable loading rates dictated by regulations. For a cluster system serving five, ten or twenty homes, the law of averages begins to have effect and loading rates can be assumed to be at, or near, the average.

Concerning effluent treatment, the soil can be relied upon to perform both secondary and tertiary treatment. At the soil interface, an active biological treatment zone will develop by colonization of opportunistic bacteria and other organisms. In the presence or partial absence of oxygen, facultative bacteria will remove much of the particulate and dissolved organic material in the effluent. Ammonia may be oxidized to nitrate and much of the BOD_5 will be absorbed as a source of energy. What remaining organics pass through this biomat layer will be further acted upon by bacterial colonies deep within the soil and by filtration and adsorption onto the particles of soil.

This natural biological treatment is analogous to the action deep within a ***slow sand filter*** for potable water. In this application, 99+ % of organics and pathogenic organisms are removed from river waters within a distance of two and a-half feet and at rates of flow somewhat greater than those to be expected in normal soils at average gradients. The principle difference is in the higher content of dissolved oxygen in the slow sand filter.

The lateral flow intermittent sand filter achieves similar reductions in septic tank effluent with much lower dissolved oxygen content but with a flow path length of 12 feet.

There may also be ion exchange capability for many years that will reduce the passage of phosphates to the groundwater.

The availability of oxygen will determine the conversion of urea to ammonia and of ammonia to nitrate. It is common to find both forms of nitrogen in a septic tank effluent soil absorption system. The significance of these chemical compounds will depend upon the local precipitation pattern, agricultural practices and trends in groundwater history in the area. Decisions as to whether to require the use of more expensive secondary or tertiary treatments to mitigate these effects is a local or state public health issue.

Site Hydraulic Capacity (SHC)

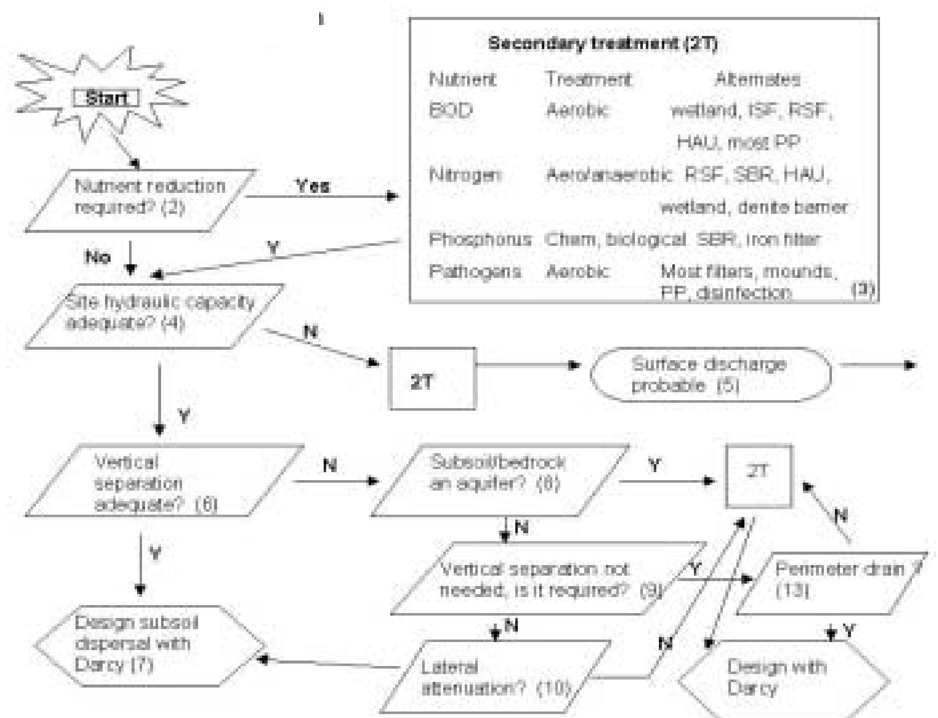
What is the hydraulic capacity of the site, and, perhaps, what is the hydraulic capacity of the subdivision? The nature of the local subsurface geology will most probably be extremely varied, but it is possible to make informed estimations based upon a limited site evaluation tempered by local knowledge. Once we have estimated the hydraulic capacity, we can begin to determine what form of pretreatment will be required to bring the effluent to a suitable condition for discharge into the subsurface environment. Perhaps it is appropriate to review the process of choice of treatment before discussing the actual site evaluation. In this way, we will be better able to direct that evaluation and perhaps reduce its complexity.

Selection of Treatment Process

The process of treatment selection may best be described by the use of a decision diagram. Once this has been followed only a few times, the diagram can be put aside as the process becomes self-evident. Many of the decisions are dictated by local regulation. Some regulations are based upon rules of thumb, and as more appropriate, choices based upon good science and local experience become apparent, then consideration should be given to modifying the prescriptive regulation.

It may be repeated at this point that installing a secondary treatment process cannot affect the SHC. The reduction in organic load as a result of the treatment may enable a reduction in the area of the soil adsorption system by increasing the Soil Absorption Rate (SAR), but this will not affect the required spread of the system across the site (minimum length along the contour).

Figure B-1: Online Sewage Disposal Systems – Selection/Decision Diagram



Box 1

A Decision Diagram (Figure B-1) has been developed to aid in the choice of any required secondary treatment process and is shown as in the figure below-***Onsite Sewage Disposal Systems – Selection / Design - Decision Diagram.*** Following are the comments on the decision diagram:

Box 2
Is nutrient reduction required? This is essentially a watershed issue. There are inland waters and coastal estuaries that are being affected by nutrients and pathogens. Groundwaters in arid areas are or are becoming affected by recharge of treated wastewater both urban and rural. In sensitive areas nutrient reduction will become increasingly regulated.

Box 3
Details of performance and design parameters of secondary treatment for nutrient reduction are covered elsewhere in this manual.

Box 4
It is arguably equally logical to phrase the question "What will be the height of groundwater mounding?" but this form leads the decision process forward before a design is chosen and before the soil adsorption system is laid out.

Box 5
This conclusion will not be acceptable in many states. The alternative of extending the site boundary may be the only alternative to rejection of the site or of development restrictions. (See also Box 13)

Box 6
The question can be treated as a function of Box 4. If the site capacity is twice the design load and the original water table is at twice the required separation distance down, then the vertical separation distance can be assumed to be accommodated under operational conditions. Larger systems and complex sites will require further calculation.

Box 7
This is the easy, least costly solution and assumes that treatment in the soil regime will be adequate.

Boxes 8 & 9
If the bedrock is not an aquifer and has no potential as such (minimal yield or high salinity) there may be no logical reason to protect the groundwater from further minimal degradation. However, local regulation may require this protection.

Box 10
If the effluent plume will travel laterally for sufficient distance before reaching a potential abstraction point or surface water seepage, vertical separation may not be necessary, but may be required by regulation.

Boxes 11 & 12
If the bedrock is an aquifer or there is inadequate lateral attenuation, then secondary treatment is necessary. In extreme cases disinfections maybe appropriate. Savings to

offset the high cost of the secondary treatment may be realized in a reduction in the total length or area of the soil absorption system.

Box 13
Artificial reduction of the water table may be expensive.

Lot Topography
The surface features important in a site evaluation include: slopes, rock outcrops, watercourses, surface drainage paths, traffic areas, and types of natural vegetation.

The top few feet of soil are typically more permeable than subsequent depths due to root penetration, weathering, etc. As a result, in most cases water, either from rainfall or from an onsite sewage disposal system, it tends to flow down a slope through this permeable layer until such time as it is able to penetrate the deeper soil, evaporate, break to the surface, or enter a watercourse.

Steep slopes in combination with poor soil conditions make the design, installation and operation of an acceptable onsite disposal system difficult or even unacceptable. As a rough guideline, even with reasonably good soil, the following maximum slopes apply:

Type of System	Maximum slope	
Mound	l0%	(6 deg.)
Multiple Trench	15%	(9 deg.)
Contour Trench	30%	(17 deg.)

The location of a disposal system on a slope is important. Groundwater moving down the slope too near the surface can be contaminated by intercepting the effluent before the latter is adequately treated. Run-off from up-slope areas may flood the bed. Thus, poorly drained soils, shallow soils, areas of high groundwater level, or areas receiving large volumes of run-off should be avoided.

Assuming other parameters are constant, the best location for a system on a slope is at or near the crest. Areas further down the slope may require up-slope interceptor trenches to catch and divert surface run-off and/or groundwater away from the disposal field.

The overall slope on the lot also can affect the foundation elevation, whether or not pumping is required, and the type and design of disposal system. For example, on a lot with little slope, plumbing could not be installed in a full basement without pumping up to the disposal system, which is no more than two feet below grade. However, on a sloping lot pumping may not be necessary. A long narrow system installed parallel to the contour is preferred on a sloping lot. It not only blends into existing grades, but also spreads the effluent across a longer slope interface and, therefore, is more likely to function satisfactorily.

Rock outcrops on a lot indicate limited soil cover over bedrock. If untreated effluent enters fractures in bedrock, it can contaminate wells hundreds of feet away. The bottom of the pipe, in any disposal system, should not be less than three feet above bedrock. In order to prevent contamination of watercourses, the following distances are recommended between any part of a disposal system and a watercourse, in the absence of prescriptive legislation:

Primary treatment (septic tank) only	150 ft.
Secondary treatment	100 ft.
Tertiary treatment (with sand filter)	50 ft.

Vehicular traffic should not be allowed to travel over a disposal bed. Even if pipes were installed such that they would not be crushed, compaction could damage the disposal field.

Soil Morphology

In conducting the site evaluation, our interests in the soil morphology are primarily a) To assess whether the soil will provide adequate treatment to septic tank effluent and b) To assess whether the soils will transmit the effluent plume from the site in a condition that will not harm the environment in its passage to and within the surface waters and ocean. Although local and national soil names and terminology will be familiar to soil scientists working in the locality, it also may be advantageous to use universal engineering terminology to describe the soils so that experience may be shared across state and national boundaries. Accordingly, this section has been written using engineering descriptions of soils, but it is expected that local knowledge and terminology will be translated and blended into any training sessions for the professions.

Soil conditions are the most important parameter in site evaluation and system design. An estimate must be made of the ability of the soil to accept the effluent from the disposal system. This is not an easy task. Installation of the system itself may change absorption capacity and clogging of the soil interface, which may take place at some future date, but cannot be measured now.

Assessment of the soil's ability to accept the effluent is a judgment decision based on soil properties and past experience, combined with the results of a test such as the percolation test, which gives some indication of permeability. A more objective approach is to combine an assessment of the soil morphology with site measurements of the subsoil permeability or site saturated hydraulic conductivity. Details of such tests are given at the end of this section.

Some soil properties that are useful in assessing the soil suitability include:

a) texture
b) structure
c) depth
d) color
e) density.

Soil texture is the relative amount of gravel, sand, silt, and clay content. Some soil classes and ways of identifying them are given in Figure 2.7.5-1 in the EPA Design Manual. When water passes through soil, it goes through the voids between soil particles and not the solid particles themselves.

In most cases this means that the larger the voids or pore spaces, the faster the water will pass through the soil. If a sand is compared to a clay, it can be appreciated that the sand has many large voids between relatively large particles whereas the voids between the small clay particles are so small that little, if any, water can pass through. A sand has a high permeability, a clay a very low permeability. A soil can be poorly graded, that is, essentially composed of grains of a single size. This grain size will dictate the permeability. On the other hand a well graded soil, which contains grains of all sizes, may have the spaces between one size of grain completely filled with grains of smaller sizes, continuing down to the smallest grain size of all. This soil will have a permeability, or hydraulic conductivity, that may be less than the innate permeability of that smallest grain size. For example, take a soil that consists only of 33 % stones and 67% clean sand. It will have a permeability of approximately two-thirds of clean sand alone.

As effluent from a disposal field passes through a reasonably graded soil, particulate matter is physically filtered out in a relatively short distance. Most bacteria, viruses, or other potentially disease-causing organisms (pathogens) are not able to pass through long distances of unsaturated soil. They may be retained within the first few feet of soil until the numbers are greatly reduced in the hostile environment. In saturated soils, the organisms may travel greater distances.

If effluent enters a coarse gravel with little or no fine material (silt and clay particles) it will pass through the voids unfiltered and so quickly that pathogens can travel hundreds of feet. The ideal soil on a lot would be several feet of silty sand. Unfortunately, this is not a common soil condition in all states or regions of states.

In some soils, individual particles tend to group together into blocks or units called peds. If these peds have a characteristic shape for a soil, it is said to have structure. The space between these peds, and how they are aligned, can influence the ability of water to move within the soil and may indeed affect a percolation or permeameter test, giving a false impression of high permeability. The presence of peds may be dependent upon the soil moisture content and upon the penetration of frost. Both of these conditions will be drastically altered upon construction of a soil adsorption system and the ped structure will often disappear. Soil hydraulic conductivity attributable only to soil structure should not be used as the basis for design. For the purpose of these guidelines, the only further mention of structure will be in a following section concerning construction damage.

The depth of permeable soil may determine lot dimensions and system design. Other site characteristics must also be considered in combination with soil depth. For example, a system installed in a very shallow soil on a lot with a steep slope is more likely to malfunction than similar soil conditions on lot with only a moderate slope. If the depth of suitable soil over permanent water table or fissured bedrock is not enough to adequately treat the effluent, then it is possible that contaminants could enter wells in the area. Regulations may require a minimum separation distance between the bottom of the distribution bed and highly permeable soil or fissured bedrock, of three feet or more. In some cases, if this depth of soil is not naturally present on the lot, a mound system can be constructed. Some types of vegetation, such as alders and rushes, tend to grow in certain areas. These may be an indication of saturated soils.

Soil color is a property that is useful in soil assessment. Color and color patterns provide clues toward estimating the ability of a soil to absorb water. There are color charts available for soil color determination. Much of soil color is due to the presence of iron. When there is no air in the soil, iron exists in a state that is grayish. When air is abundant in the soil, the soil is well drained, and iron is in a state which is yellowish or reddish. If, over a long period of time, a soil has been alternately wet and dry, it may show defined spots or blotches or different color, possibly with a gray or dark predominant color; this is known as mottling. This would indicate that at times (usually spring and fall) this soil is saturated, i.e., poorly drained. On the other hand a well-drained soil would be a relatively bright color (often reddish yellow) and be free of mottling to at least a four foot depth.

Soil density or degree of compaction can influence the ability of soils to accept water. Two soils with similar textures can have different permeabilities if their densities are different. The denser a soil becomes, the smaller the pore spaces are and the slower the rate of water movement. The natural soil conditions in the Northern States and Canada are mainly the result or the last glacier age. In many glacial areas, the soil is composed of glacial till, an assortment of material ranging from rocks to clay, which was deposited beneath the ice and subject to great compactive forces. The permeability of glacial till can be very low. Other areas have soils consisting of sediments, deposited by melt water streams, that tend to be less compact. Although the top few feet of till tends to have been loosened by weathering (frost) and root action, it is common to find increasing compaction with depth and extremely dense and impervious till below a couple of feet. Soil can also be compacted by actions such as running over it with heavy machinery.

The soil properties mentioned, i.e., texture, structure, depth, color, and density can best be described for a site by digging an observation pit. For safety, the pit should be no more than four feet deep, with sloping sides and an entrance ramp for easy access and escape in the event of a soil slide. If the pit is dug by backhoe and verification of groundwater conditions is required, the pit may be taken to a greater depth. Inspection should then be carried out from the surface with the aid of samples of soil recovered by the machine bucket. A soil profile can then be recorded based on the variation in soil characteristics with depth.

Table B-1 - Textural Properties of Mineral Soils

Soil Class	Dry Soil	Moist Soil
Sandy Gravel	Loose stones and single grains that feel gritty. Squeezed in the hand, the soil mass falls apart when the pressure is released.	Squeezed in the hand, soil forms a cast that crumbles when touched. Does not form a ribbon between thumb and forefinger.
Silty Sand	Aggregates easily crushed; very faint velvety feeling initially but with continued rubbing the gritty feeling of sand soon dominates.	Forms a cast that bears careful handling without breaking. Does not form a ribbon between thumb and forefinger.
Sandy Silt	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized, soil has velvety feel that becomes gritty with continued rubbing. The cast bears careful handling.	Cast can be handled quite freely without breaking. Very slight tendency to ribbon between thumb and forefinger. Rubbed surface is rough.
Clayey Silt	Aggregates are firm but may be crushed under moderate pressure. Clods are firm to hard. Smooth flour like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon between thumb and forefinger. Rubbed surface has broken or rippled appearance.
Silty Clay	Very firm aggregates and hard clods that strongly resist crushing by hand. When pulverized, the soil takes on a somewhat gritty feeling due to the harshness of the very small aggregates that persist.	Cast can bear much handling without breaking. Pinched between thumb and forefinger, forms a ribbon whose surface tends to feel slightly gritty when dampened and rubbed. Soil is plastic, sticky, and puddles easily.
Clay	Aggregates are hard; clods are extremely hard and strongly resist crushing by hand. When pulverized, soil has a gritty-like texture due to the harshness of numerous very small aggregates, which persist.	Casts can bear considerable handling without breaking. Forms a flexible ribbon between thumb and forefinger and retains plasticity when elongated. Rubbed surface has a smooth, satin feeling. Sticky when wet and easily puddles

This test is performed on a sample of soil that has been moistened as necessary and worked, to form a reasonably plastic ball of soil. The amount of water to add, preferably by spray bottle, is best judged by experience.

Table B-2 - Hand Assessment of Soil Particle Size

Ribbon Test	Moist Cast Test	Feel Test	Shine Test	Mean Values Sand, Silt, Clay	Permeability Range (very approximate)
Squeeze soil between thumb and forefinger	Squeeze ball of soil in the palm	Rub portion of soil between thumb and forefinger	Rub small ball of soil on polished surface	%	M/sec *10^6
None	No cast	Grainy with little floury material	None	92, 3, 5 (1)	30 to 50
None	Very weak cast (no handling)	Grainy with slight floury material	None	80, 15, 5 (2)	10 to 30
None	Very weak cast (no handling)	Grainy with moderate floury material	None	60, 37, 3 (3)	4 to 8
None	Weak cast (Handles with care)	Grainy with considerable floury material	None	65, 23, 12 (4)	3 to 5
Flakes	Weak cast (careful handling)	Floury with slight graininess	None	20, 66, 14 (5)	2 to 4
Flakes	Weak cast (careful handling)	Very floury	None	8, 86, 6 (6)	1 to 3
Barely begins to ribbon	Good cast (handles readily)	Fairly soft & smooth with evident grain	None	40, 42, 18 (7)	0.8 to 1
Short & thick (to 30 mm)	Moderate cast	Very substantial grain	Slightly shiny	60, 12, 28 (8)	0.5 to 0.7
Fairly thin, breaks readily, barely supports own weight	Strong cast	Moderate graininess	Slightly shiny	33, 33, 33 (9)	0.4 to 0.6
Fairly thin, breaks readily, barely supports own weight	Strong cast	Smooth & floury	Slightly shiny	10, 57, 33 (10)	0.3 to 0.5
Thin, fairly long, (50-75 mm), holds own weight	Strong cast	Substantial graininess	Moderately shiny	50, 10, 40 (11)	0.2 to 0.4

Source: Nova Scotia Department of Agriculture and Marketing, Soil Assessment Division

Site hydraulic Capacity (2)

Turning back to the problem of determining the site hydraulic capacity, there are at least three approaches. One is to perform a relatively simple analysis based upon an estimate of soil permeability by visual/tactile examination of soil samples from test pits and auger holes. The second is to augment this analysis by measurement of conductivity in several auger holes. The third is to measure the recharge of fresh water into a pilot absorption trench.

One or more test pits should be dug (four feet or less in depth, conforming to OSHA Safety guidelines) to examine the soil morphology and structure (discussed earlier in this chapter). One or more of the test pits can be extended, with caution and no personnel entry, to check for proximity of the water table. Several proprietary and at least one generic design of in-situ permeameter are available for measurement of soil permeability in the upper horizons, by hand augured hole. A minimum of three measurements should be taken, the total number depending on the complexity of the site. An estimate of bedrock permeability may be required in marginal cases. This may be available from local well records. Local knowledge may suggest a safe (low) regional parameter.

Within the coastal plain, due to the almost flat terrain, the available hydraulic gradient to move the groundwater (accumulated precipitation) is quite low and the water table will rise and fall according to rainfall patterns. When effluent is added to this environment, it will initially form a mound and the effluent will move in all directions. The easiest way to analyze this situation is to use the inverse of well theory and calculate the profile of an inverted cone of depression. If a point source of application is used, the inverted cone will rise above ground level, but with conventional spread of drainfields, the flat top of the truncated cone of elevation can be maintained below the ground surface. The calculations to estimate the height of mounding created requires information on the depth of the aquifer, the hydraulic conductivity (permeability) of the soil and the dimensions of the drainfield. The principle is illustrated in Figure B-2 with a chart of elevations for one depth of aquifer in Figure B-3. The principle can be applied to most forms of soil absorption system.

Figure B-2

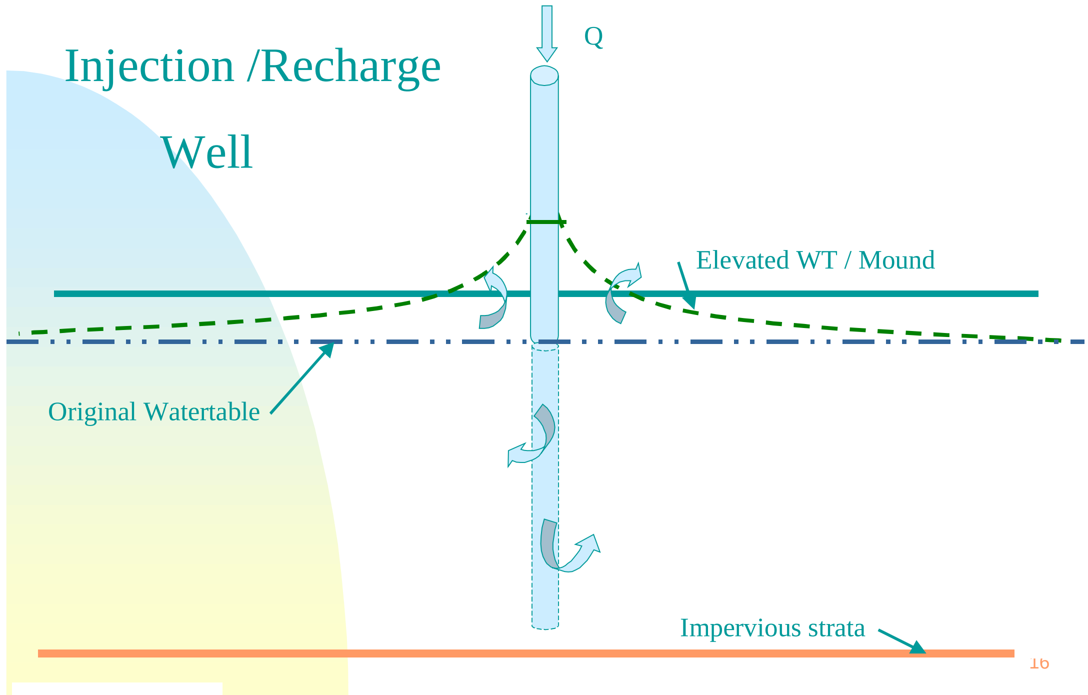
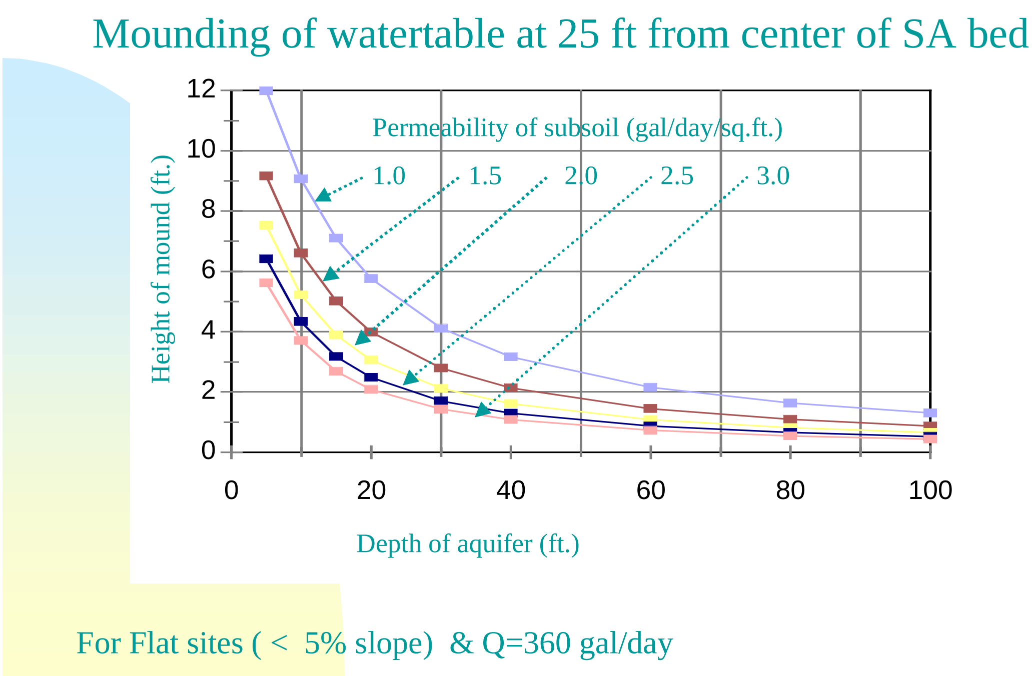


Figure B-3



Outside of the coastal plain, the majority of sites are not perfectly flat and, therefore, have a discernable gradient. This can be used as the limiting approximation of hydraulic gradient of the combined effluent plume and of the existing groundwater. If the site is perfectly flat, there will be no gradient to move the water, and the water table is likely to be at the surface. If the water table is sufficiently low and the permeability high, it may be appropriate to measure the gradient by piezometer wells installed by hand or powered auger.

The simplified calculation is made by assuming that the groundwater is moving under the influence of gravity (hydraulic gradient) laterally, in one direction, and that the effluent is to be applied in a single absorption trench laid along a natural contour the full width of the site. The end effects of the trench are ignored, as it can be assumed that a neighboring property owner can do likewise.

Applying Darcy's Law, the maximum Site Hydraulic Capacity SHC is given by :

SHC = L * h * i * k sat.

Where: L = effective width of site at right angles to probable direction of low of groundwater

h = height of available unsaturated subsoil to receive effluent

i = the average site slope or hydraulic gradient

k sat. = average saturated hydraulic conductivity of available unsaturated soil.

Where the seasonal water table is sufficiently low or in a more permeable bedrock, the effective effluent flow may be vertical (i = 1) Determination of the SHC may be assisted by reference to Diagram n and Decision Diagram n.

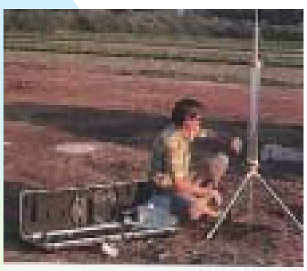
For larger systems for small communities and for more complex sites, it is recommended that the test trench or trenches be constructed to measure the SHC by observing the infiltration of clean water.

A suggested protocol for the trench test is to dig a narrow shallow trench (12 in. wide by 12 in. deep) along a contour of the site for a distance of 20 feet. Fit a float valve (as used in flush toilets) attached to a peg driven in the trench bottom and set to close at a flooded depth of six inches. Attach the hose to a metered water supply or mobile tanker truck or trailer. Monitor the flow into the trench daily for a minimum of three days, preferably seven days. When steady state conditions are reached probe auger holes up-slope and down-slope to determine the extent of water mounding and whether the flow is primarily lateral, vertical, or a combination of both.

It will be safe to assume that the end effects of the trench account for less than 50% of the flow and the site saturated hydraulic capacity per foot of site width will be not less than 1/40 of the measured total daily flow into the 20 foot test trench. The safe loading rate, to allow for generation of partially saturated flow conditions beneath and adjacent to the final construction, would be between one-quarter and one-half of this figure.

Measurement of Field Saturated Hydraulic Conductivity

It is generally agreed that the standard percolation test, however carefully carried out, is not a reliable indicator of the saturated hydraulic conductivity of soil. However, there are methods of performing a more reliable and repeatable estimation of this parameter. One method is derived from the Shallow Well Pump-in Test described by Boersma. The somewhat complicated original apparatus has been subsequently revised and simplified in the patented Guelph Permeameter (Figure B-4) developed at Guelph University, Ontario, Canada, The Compact Constant Head Permeameter developed by Amoozegar and the unpatented simple generic Nova Scotia Permeameter developed by Pask. All of these devices are based upon maintaining a constant depth of water in an augured hole using a constant head apparatus developed as a laboratory instrument by Marriotte. All of these permeameters are available commercially. Details for construction of the Nova Scotia device may be obtained from the National Environmental Services Center (NESC).



Guelph Permeameter

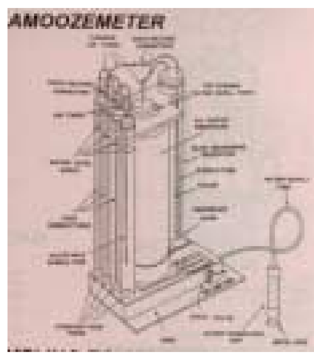


Figure B-4 : Measurement of permeability

Measurement of the Field Saturated Hydraulic Conductivity may be made at any depth of interest, but is typically measured at a depth between 12 and 14 inches, representing the normal depth of a soil absorption trench. A hole of 1.5 to 3 inches in diameter is made with a suitable hand auger, trimmed to shape, and loose soil is removed. If the sides of the hole are smeared, typically in moist soils with moderate clay content, this may be treated by use of a spiral wire brush or other tool.

A marker, such as a toothpick, is pushed into the side of the hole as a reference point and dimensions of the hole are recorded. Coarse sand may be placed in deeper holes to support the permeameter and the sides of the hole. The commercial permeameters may be set in place before opening the appropriate valves and settings.

The Nova Scotia permeameter is normally manufactured to produce a flooded depth of 200 mm and a hole of 80 mm diameter and is simply filled with water through the delivery pipe and quickly inverted into the hole. The level of water in the reservoir tube of the permeameter is recorded every 5 or 10 minutes as appropriate, noting the level to 1 mm and the time to 1 second. After an initial rapid flow the rate will settle down to a constant flow after 20 to 30 minutes, when a final reading may be taken.

From the measurements taken, calculate or note :

Depth of water maintained in hole	h meters
Radius of hole	r meters
Rate of flow of water into the hole	q cu. meters/second

Several formulae may be used to calculate the field saturated hydraulic conductivity, Ksat, all derived from Dupuit's well theory:

Where, q = flow of water into borehole, h = depth of water in borehole, r = radius of borehole

Boersma

$Ksat = q(\log_n(h/r+((h/r)^2-1)^{0.5})-1)/2PI\ h^2$

Glover solution recommended by Amoozegar

$Ksat = q(\sinh\text{-}1(h/r) - ((r/h)^2 + 1)^{0.5} + (r/h)) / 2PI\ h^2$

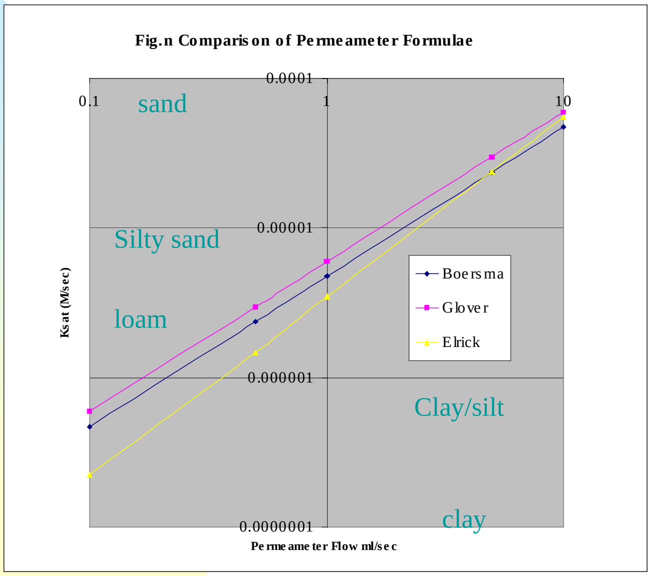
Elrick and Reynolds

$Ksat = qc/ (2\ PI\ h^2 + PI\ r^2\ c + 2\ PI\ h / y\ )$

For h = 0.2 & r = 0.04,	c = 2.
For most structured soils, medium & fine sands	y = 12
For unstructured fine soils	y = 4.0
For clays	y = 2.0

Figure B-5 shows the relationship between the three formulae for three different soil types. The three formulae are well within the margins of variability that one would expect in any field evaluation. The Elrick and Reynolds formula is the most conservative for the critical, low permeability soils.

Figure B-5: Comparison of Permeameter formulae



Input

hole diameter=3in

depth of hole=18in

depth of water=8in

Appendix C

Site Inspections Regulations

CONNECTICUT SITE INSPECTION

SITE INVESTIGATION

The importance of the site investigation cannot be over-emphasized. A careless or incomplete site investigation, which fails to identify soil limitations, such as seasonal high ground water or underlying ledge, is the cause of a high percentage of sewage disposal system failures. Certain planning must be done even before going to the site, and the investigation itself must be sufficiently thorough as to identify all the soil conditions, which could affect sewage disposal. Reinvestigation is expensive and time consuming, and therefore is unlikely to be done simply to obtain information, which was overlooked initially. If the investigation is done properly, immediately afterwards it should be possible to make a general conclusion as to the suitability of the site for sewage disposal purposes and specific recommendations for the design of the sewage disposal system. In certain cases, additional investigation for maximum ground water levels may be necessary, but it should be possible to develop a procedure and schedule for obtaining this information on the basis of the original site investigation.

PREPARING FOR THE SITE INVESTIGATION

There is a considerable amount of information relative to land use and development which sanitarians and engineers should review and be familiar with before making any site investigation.

First of all, the investigator should know the type and size of the building, which is proposed for the site. Obviously, large commercial buildings or apartments would require larger sewer disposal systems than single-family homes, and, therefore, the area of the site to be tested must be larger.

The investigator should also be familiar with local planning and zoning requirements. For instance, if 100 foot setbacks are required from watercourses, it would be foolish to test any area located within 100 feet of a stream. If the property to be tested is located within an approved subdivision, it is probable that the site has been tested previously. These tests results should be reviewed, if available, prior to the investigation, since they might be helpful in indicating the type of soil conditions to look for. The availability of public water supply mains and public sewer should also be checked prior to the investigation because these would have considerable bearing on determining the suitability of the site and the location of the sewage disposal system. A water supply well would not be necessary if the public water supply were available, and more of the lot area could be used for sewage disposal purposes. If public water supply is not available, it would mean that there may be wells on adjacent lots which must be located, either from review of health department records prior to the investigation, or from inquiries made during the investigation.

Reserve area for enlargement of the leaching system will not be required if public sewers were scheduled within five years, so that the area to be tested could be reduced. Also, it would be likely that the sewage disposal system would be located between the proposed building and the street to facilitate the future sewer connection. It also may be necessary to check information regarding the location of high volume public water supply wells and public water supply reservoirs and watersheds. Special design considerations may apply in these locations, and the investigator should be aware of it before he goes on to the site.

Certain types of soil and geological information may be available on maps published by the U.S.Government. Review of these maps will be helpful in indicating the type of soil conditions to expect, but should not be used in place of a site investigation. The U.S. Geological Survey publishes a series of topographic maps on a scale of 1:24,000 showing ground contours, hydrographic features, such as streams, swamps, etc., streets and buildings. An effort should be made to locate the site to be tested on these maps before making the investigation. If this is not possible, the appropriate map should be taken along, and the site located on the map in the field.

An experienced investigator can tell much about a site from its location in the general topography of the area. The U.S.G.S. also publishes surficial geology maps which classify the soils overlying bedrock on the basis of their geological formation. The classification is not detailed, but can be helpful in identifying such features as flood plains, alluvial terraces and drumlins, which exhibit certain characteristic soil conditions. The National Cooperative Soil Survey published by the Soil Conservation Service, uses a more detailed soil mapping system. Soils are classified on the basis of certain characteristics, such as texture, structure, color consistency and drainage. The maps reflect soil profiles to a depth of about 5 feet. Therefore, they may be generally useful for evaluating soils for subsurface sewage disposal purposes. However, they are not sufficiently accurate to be used in place of a site investigation. Their main value is in indicating wetlands or soils with a seasonally high ground water table, which must be carefully evaluated before any sewage disposal system is designed. See the Chapter on “Soil Identification” for a more detailed discussion of the use of the soil survey maps.

Certain arrangements should be made by the applicant or his representative for the scheduled time of the investigation. Normally, a backhoe and operator, another person with a hand shovel, and about 40 gallons of water are required. It also would be desirable to have on hand several 10 foot lengths of rigid plastic pipe which could be placed in the deep pits as monitoring wells for ground water before backfilling. A plot plan must be provided. As a minimum, the plan must show property lines accurately and indicate some landmarks which can be located easily in the field, such as stone walls, fences, survey markers or numbered utility poles. Property lines should be flagged or staked where suitable landmarks are lacking or are difficult to find, such as in proposed subdivision lots located away from existing roads. It may be necessary to do some clearing of trees and brush on the site to make it accessible to digging equipment. The owner, builder, or engineer must be available on the site at the time of the investigation in order to answer any questions, which the investigator may have.

Engineers and developers should carefully consider testing needs prior to hiring a backhoe for site testing. If deep leaching structures are contemplated, such as galleries or pits, conventional rubber tired backhoes may have great difficulty in digging a deep enough test hole for evaluation. In such cases, it may be economical to rent a large, track-mounted backhoe for rapid, definitive exploration. Terrain and weather conditions may also dictate tracked equipment for efficient testing.

DETERMINING WHEN TO MAKE THE SITE INVESTIGATION

In general, site investigations may be made at any time of the year. However, on some sites it may not be possible to determine the maximum ground water level accurately unless the investigation is made during the season when the ground water is high. The Public Health Code gives the director of health the authority to require that the maximum ground water levels in areas of special concern be determined by investigation made between February 1 and May 31, or at such other times as the ground water is determined to be near its maximum level by the State Department of Public Health.

This does not mean that all testing for ground water must be done at this time, even for areas of special concern. This frequently is unnecessary, and can present a hardship, both for the property owner and for the local health department. There are many sites where the maximum ground water level can be determined quite accurately by other methods, such as soil mottling. If there is general agreement between the engineer and the sanitarian as to the maximum ground water level and the design of the sewage disposal system, additional ground water investigation during the wet season may not be required. This is more fully discussed in the chapter on "Determining the Maximum Ground Water Level".

While the maximum ground water level almost always occurs sometime between February 1 and May 31, there may be other times when the level is sufficiently high to allow a reasonably accurate determination to be made of the maximum level. The State Department of Public Health utilizes monitoring information supplied by the U.S. Geological Survey, which documents monthly ground water levels in various locations throughout the state. When levels are found to be at or above mean springtime elevations, the allowable testing period may be extended by the State Department of Public Health. Variations in water levels in the U.S.G.S. wells are used as an indicator of the general ground water levels within a town or region.

The range of such variations may be quite different from well to well, however, depending on the construction of the well and its geological and topographical location. Water level readings in observation wells cannot be used to adjust ground water level readings taken at other locations. For instance, the water level in an observation well which seasonally rises and falls about three feet may be observed to be one foot below its normal maximum. This does not mean that the maximum ground water level at another location can be determined by adding one foot to the observed level at that location, since the ground water level at that particular location may rise and fall seven feet during the year.

The real danger in making site investigations during a dry season is not the inability to determine the maximum ground water level accurately, since this also can be done by additional investigation or monitoring during a wetter season. Rather, it is the possibility that a seasonal ground water condition may be completely overlooked. This probably is more likely to occur where the soils are fairly well drained, than where the soils are poor and evidence of seasonal ground water is obvious.

For this reason, some town health departments do not allow site investigations to be made during certain months of the year. Fortunately, experience has shown that 80 to 90 percent of the time that an investigator had failed to identify a seasonal ground water condition was when the investigation was made during the months of July, August or September. Therefore, there probably is some basis for restricting site investigations during those months. However, there is little justification for requiring all site investigation to be made only during the wet season, since a trained and careful investigator should be able to make a valid assessment of ground water conditions at most times of the year. A technique sometimes used in dry soil conditions in order to enhance coloration and improve identification of mottles is to moisten the side of the test hole with water from a spray bottle.

MAKING THE SITE INVESTIGATION

Before any test holes are dug, the investigator must determine the location of the property lines, the probable building location and the location of existing wells on adjacent property. It should be kept in mind that the sewage disposal system normally is located down slope from the building served, in order to allow gravity flow without placing the leaching system too deep in the ground.

Some investigators make the mistake of testing the highest part of the property because it appears to have the best soil. In fact, this would be the least likely area to be used for sewage disposal purposes. The well, if required, should be located on the higher portion of the lot, uphill from the sewage disposal system. However, the location of both well and sewage disposal system may depend on the location of wells and sewage disposal systems on adjacent lots.

Once a likely location has been selected, the probable depth of the leaching system must be decided. Leaching systems on level lots are usually somewhat deeper than on sloping lots, and if it is necessary to locate the sewage disposal system upgrade from the building, it could be quite deep. If leaching pits or deep leaching galleries are used, the bottom of the leaching system could be up to eight or ten feet deep. It also should be determined from the builder whether or not basement fixtures will be used. Split-level houses and raised-ranch houses usually require deeper sewers, since sanitary fixtures are on the lower floor. The builder should be questioned about this. It should also be determined whether or not there will be any regarding done in the area of the building and sewage disposal system, since this will affect the depth to which the soil must be tested.

MINIMUM NUMBER OF DEEP TEST AND PERCOLATION HOLES

A minimum of two or three deep test holes should be dug in the area of the proposed leaching system to a depth of four feet below the probable bottom of the deepest leaching unit. Such holes are normally at least seven feet deep and may be considerably deeper. At least one percolation test should be conducted at the probable depth of the bottom of the primary and reserve leaching system areas. A much greater number of deep pits and percolation tests should be made if there are any significant variations in the soil characteristics, either in depth or from location to location, or if shallow ledge rock is found.

An effort should be made to lay out a series of test holes in a grid arrangement where the sewage disposal system is large and will cover a considerable area, since this would provide more meaningful information than randomly located holes. At each test hole, the soil should be identified and the depth to ledge and ground water noted. When determining the percolation rate for sizing purposes, the Technical Standards require that it be based on representative test results. The number of percolation tests performed should be a function of the consistency of the results.

If the soil conditions throughout the primary system area (and the reserve area if located directly downgrade of the proposed primary area) are consistent and the two initial percolation tests resulted in rates that are within the same sizing category then there would not be a need for further testing. However if the initial test results are not consistent then multiple percolation tests would be required. Tests would be concluded when 3 out of 4 percolation tests (75% or greater) resulted in rates, which are within one sizing category. The location of each deep test and percolation hole must be measured from a landmark and recorded on the plot plan or in the field notes.

To avoid confusion, a north orientation should be determined or assumed in the field, and marked on the plot plan. The U.S.G.S. maps are helpful for this purpose. This should be the responsibility of the engineer or surveyor, if one is involved in the investigation. If the test holes indicate a probable seasonal high ground water condition, an. effort should be made to obtain as much information as possible relative to existing and proposed drainage improvements. Existing and proposed storm drains in the street should be noted because they may be necessary if foundation or curtain drains are required. Note also should be made of potential surface water drainage problems which might be caused by building or regarding, both on the property being investigated and on the adjacent property. These should be addressed on the sewage disposal plan before it is approved.

Appendix K8, CT site inspection regulations
Section 19-13-B103
January 1, 2000

Sec. 19-13-B103e. Procedures and Conditions for the Issuance of Permits and Approvals. No subsurface sewage disposal system shall be constructed, altered, repaired or extended without an approval to construct issued in accordance with this section. No discharge shall be initiated to a subsurface sewage disposal system without a discharge permit issued in accordance with this section. Such permits and approvals shall be issued and administered by the local director of health.

c) Application for Permit or Approval.

(1) No investigation, **inspection** or approval of a subsurface sewage disposal system shall be made, or permit issued without an application by the owner in accordance with the following requirements

(2) Applications for permits shall:

(A) Be on forms identical to Form #1 in the Technical Standards; or

(B) Be on forms prepared by the local director of health and deemed by the Commissioner of Public Health as equivalent to Form #1 in the Technical Standards; and

(C) Have attached a plot plan of the lot, which shall be a surveyor's plan if available or one prepared from information on the deed or land records.

(3) All the requested information shall be provided. If the information is not provided, it shall be indicated why it is not available or the application may be determined incomplete, and be rejected.

(g) **Inspection.**

(1) The local director of health shall **inspect** all subsurface sewage disposal systems for compliance with Subsection 19-13-B103d and the approved plans for construction prior to covering and at such other times as deemed necessary.

(2) After construction, and prior to covering, the subsurface sewage disposal system installer shall notify the local director of health the site is prepared for **inspection**. Such **inspection** shall take place as soon thereafter as feasible, but not later than two (2) working days after receipt of the request unless the owner agrees to an extension.

(3) A final **inspection** report shall be prepared by the local director of health on forms deemed by the Commissioner of Public Health as equivalent to Form #3 in the Technical Standards.

(4) A record plan of the sewage disposal system, as built, shall be required by the local director of health.

(j) Records.

Copies of completed applications, investigation reports, review and **inspection** forms and as-built plans or record drawings of each sewage disposal system, certified as complying with this Section, shall be kept in the files of the town or health district for a minimum of ten years.

(k) Rights of Applicant.

(1) All site investigations, **inspections**; review of plans and issuance of permits or approvals by the local director of health shall be made without unreasonable delay.

(2) When requested in writing by the applicant, the local director of health shall designate in writing within 20 working days the requirement(s) of Section 19-13-B103d

or 19-13-B103e of these regulations which prevents such investigation, **inspection**, review, permit or approval.

(3) Any final decision of the local director of health made in regard to these sections shall be made in writing and sent to the applicant. Any decision adverse to the applicant or which limits the application shall set forth the facts and conclusions upon which the decision is based. Such written decisions shall be deemed equivalent to an order, and may be appealed pursuant to Section 19-103 of the General Statutes.

State of Connecticut Department of Public Health
FORM #1

APPLICATION FOR PERMIT TO CONSTRUCT OR REPAIR A SEWAGE DISPOSAL SYSTEM

APPLICATION NO.____________________

To the Director of Health Town Of.__________________________Date:___________________

Application is hereby made for permit to construct a sewage disposal system for a:___________
____(Residence, Store, Restaurant, etc.)

Located at:____
(Street Address, Lot Number, Subdivision Name, Map, Block, Lot, etc.)

New System______________Addition_________________Repair____________Other_______
Owner___________________Address_________________Tel.No.______
Installer_________________Address_______________________ Tel.No.___________

Installer License No.____________
In accordance with detailed information stated below
Application fee paid_____________Signed____________________________
(Owner or duly authorized representative)

____

GENERAL INFORMATION

Subdivision Approval_______Date________Lot size_____________sq.ft.
On Public Water Supply Watershed_______On Designated Wetland__________
SCS Soil Classification________________________Public Sewer Scheduled________________
______
(Date)
If residential, number of bedrooms________Flood Zone____________________
If non-residential, design criteria:____
(Sanitary Facilities, No. of Employees, Meals Served, etc.)

Basement Fixtures_________Foundation Drains_________Special Equipment_________

ENGINEER'S PLAN REQUIRED TEST DURING WET SEASON

Water Supply________________________________Type Well_____________________________
Well Location Approved_______________________Yield______________
Satisfactory Sample________ (Date)
Well Driller's Name____________________Address______________________________

WATER SUPPLY APPROVED

State of Connecticut Department of Public Health
FORM #2

INVESTIGATION FOR SEWAGE DISPOSAL SYSTEM

APPLICATION NO.____________________________

Owner________________________________Location_____________________________

PERCOLATION TESTS: (Record all Tests)_______SOIL MOISTURE:_______________
(Date) (high, med., low, etc.)

TEST READINGS

	HOLE		HOLE		HOLE		HOLE
Time	Reading	Time	Reading	Time	Reading	Time	Reading

TABULATION OF TEST RESULTS

Hole	Location	Depth (Inches)	Presoak/Hours	Minimum Percolation Rate Mins/Inch

OBSERVATION PITS: (Record all pits)________________Groundwater Table_____________________
(Date) (Near max., Below max., etc.)

SOIL DESCRIPTIONS

	PIT	PIT	PIT	PIT

TABULATION OF TEST RESULTS

Pit	Location	Depth	Ledge At	Ground Water At	Soil Mottling, At

LOCATION DRAWING

SPECIAL CONDITIONS   CONCLUSIONS

System design larger than 2,000 g.p.d .____
Water supply watershed________________
Possible seasonal high groundwater______
Watercourse, marsh or pond____________
Possible seasonal flooding______________
Limited suitable area__________________
Excessive Slope (over 25%) ____________
Marginal soil (30-60 mins/inch)__________
Shallow ledge (less than 5 ft.)__________
Underlying tight soil (less than 4 ft.)_______
Other______________________________

Suitable for sewage disposal____________
Unsuitable for sewage disposal__________
Additional investigation required_________
Retest during wet season_______________
Monitor groundwater thru wet season_____
Engineer's plan required_______________

DESIGN RECOMMENDATIONS

______
______
______
______
______

Investigated by______Title__________________________

Confirmed/witnessed by_____Title__________________________
Comments:

State of Connecticut Department of Public Health
FORM #3

CHECK LIST- REVIEW OF PLAN/INSPECTION OF SEWAGE DISPOSAL SYSTEM

APPLICATION NO.________
Owner_____________Location_______________________Date Rec'd_______________
Plan prepared by______________________Title____________________Address____________
____
Site Investigation__________________________________Investigated by___________ {Date}
Bench mark location_____________________________________Elevation________________
Design Percolation Rate____________________________Mins./inch at hole(s) _____________
If residential, number of bedrooms______________If nonresidential, estimated daily flow______

HOUSE SEWER (INVERT LEVELS)
Depth at foundation wall________________Depth at septic tank____________________

SEPTIC TANK
Cleanout located________________ft. from__________________and_________ft. from______
______
Manufacturer_________________________Size________gals. Depth to cleanout__________

LEACHING SYSTEM
Description ____
Effective area_________________________sq.ft. Required effective area_________________
sq.ft.
Spacing between units_______________________ft. 100 % reserve area provided______

Bottom of leaching system 18 inches above maximum water table ____________
Bottom of leaching system 4 feet above ledge rock ________________________
Bottom of leaching system__________________________inches below final grade.
Pumping required.____________________Curtain drain required____________
Serial distribution____________________________Level system___________________

SEPARATING DISTANCES
Well Located_____________ft.__________from________and_________ft. from______
______ft.
Distance sewage system to well on property______ft. To water service_______________ft.
To well on adjacent property___________________ft. To property line________________ft.
To house served______________________ft To dwelling adjacent property____ft.
To nearest watercourse________________ft..To nearest ground or surface water drain____ft.

Reviewed/**inspected** by__________________________________Title_______________

PLAN/INSTALLATION APPROVED_____________DATE___________________

INSPECTION FEE PAID____

Sec. 19-13-B104c - <u>General Provisions</u>

(f) Persons who intend to conduct **site investigations** for the purpose of designing or constructing any septage or sewage disposal system within the scope of these regulations shall notify the local director of health of the time and place of such **site investigations**. Notice shall be provided to the local director of health in a timely manner to allow attendance at such **site investigations** by the director of health.

(g) Persons who propose sewage or septage disposal systems within the scope of this regulation shall submit plans for such systems to the Commissioner of Public Health and the local director of health. Plans shall be submitted in a timely manner to allow review and comment on such plans to be directed to the Commissioner of Environmental Protection. Such plans shall be prepared by a professional engineer registered in the State of Connecticut and shall include a report of the findings of all **site investigations**, the basis of design, a preliminary or final design and other information necessary for the preservation and improvement of public health.

(d) <u>Site Investigation.</u>

(1) The local director of health or a professional engineer registered in the State of Connecticut representing the applicant shall make an investigation of the site proposed for the subsurface sewage disposal system and report the findings and recommendations of the investigations on a form identical to Form #2 in the Technical Standards to include:

- (A) A record of soil test location, measures and observations.
- (B) Soil percolation results.
- (C) Observations of Groundwater and ledge rock.
- (D) A conclusion as to the suitability of the site for subsurface sewage disposal.
- (E) Special requirements for design of the system, or further testing which shall be in accordance with the most recent edition of the Technical Standards.

(2) Prior to the **site investigation**, the applicant shall:

- (A) Provide for the digging of a suitable number of percolation test holes and deep observation pits in the area of the proposed leaching system and extending at least four feet below the bottom of the proposed leaching system, at the direction of the local director of health;
- (B) Provide water for performing the percolation tests;
- (C) If required by the local director of health, locate by field stakes or markers the sewage disposal system, house, well or property lines.

(3) The **site investigation** shall be made within ten working days of application unless otherwise required by subsection 19-13-B103d (e).

(4) The local director of health shall:

(A) Assure the accuracy of the findings of soil tests and deep observation pits; and

(B) When the maximum groundwater level is in doubt the local director of health shall investigate pursuant to Section 19-13-B 103d(e).

(5) The size of the leaching system shall be based on the results of soil percolation tests made in the area of the proposed leaching system or on other methods of determining the soil absorption capacity in accordance with the Technical Standards.

(6) In areas of special concern, or for leaching systems with a design sewage flow of 2,000 gallons per day or greater, the local director of health may require from the applicant whatever further testing or data necessary to assure that the sewage disposal system will function properly. Further testing may be required prior to or subsequent to issuance of the approval to construct. Such tests may include permeability tests, sieve analysis or compaction tests of natural soil or fill materials, and the installation of groundwater level monitoring wells, or pipes, as well as additional observation pits and soil percolation tests.

(e) <u>Submission of Plan.</u>

(1) Every plan for a subsurface sewage disposal system shall be submitted to the local director of health.

(2) Every plan for a subsurface sewage disposal system shall include all information necessary to assure compliance with the requirements of Section 19-13-B103d of these regulations, and contain as a minimum the following information: the location of the house sewer. The location and size of the septic tank, the location and description of the leaching system, property lines, building locations, watercourses, ground and surface water drains, nearby wells and water service lines.

(3) Where required by the local director of health under subsections 19-13-B 103d(c) and (e) of these regulations, the plan shall be prepared by a professional engineer, registered in the State of Connecticut, and shall be forwarded by the local director to the Commissioner of Public Health, together with his comments and recommendations.

(4) No plan shall be submitted directly by the applicant or engineer to the Commissioner of Public Health, unless requested by the local director of health.

(f) <u>Approval to Construct.</u>

(1) Upon determination that the subsurface sewage disposal system has been designed in compliance with the requirements of Section 19-13-B103d of these regulations, the local director of health shall issue an approval to construct. Approvals to construct shall be valid for a period of one year from the date of their issuance and shall terminate and expire upon a failure to start construction

within that period. Approvals to construct may be renewed for an additional one year period by the local director of health upon a demonstration of reasonable cause for the failure to start construction within the one year period.

(2) Each subsurface sewage disposal system shall be constructed by a person licensed pursuant to Chapter 393a of the General Statutes. Such person shall notify the local director of health at least twenty-four hours prior to commencement of construction.

(3) The Commissioner of Public Health shall approve in accordance with Subsection 19-13-B 103d(c) plans for a subsurface sewage disposal system to serve a building, the design sewage flow from which is two thousand gallons a day or greater prior to issuance of an approval to construct by the local director of health.

(4) Approval to construct a subsurface sewage disposal system in an area of special concern shall not be issued until twenty days following submission of the plans to the Commissioner of Public Health in accordance with subsection 19-13-B103d (e), unless earlier approved by the Commissioner.

Appendix K9, Section 106.0 Duties And Powers Of Plumbing Inspectors

106.1 General: The **plumbing inspector** shall enforce all the provisions of this code. He or she shall act on any question concerning the method or manner of construction and the materials to be used in the installation of a system, except as may be specifically provided for by other requirements of this code.

106.2 Application for the disposal system permits: The **plumbing inspector** shall receive applications for disposal system permits, issue permits for the installation of systems, **inspect** the premises for which such disposal system permits have been issued, and enforce compliance with the provision of this code.

106.3 Notices and orders: The **plumbing inspector** shall issue all necessary notices or orders pertaining to removal of illegal or unsafe conditions, the requirement or necessary safeguards during construction, and compliance with all requirements of this code for the safety, health, and general welfare of the public.

106.4 **Inspections**: The **plumbing inspector** shall make all the **inspections** required in this code. The **plumbing inspector** may engage such expert opinions as may be deemed necessary to report upon unusual technical issues that may arise, subject to the approval of the municipal officers.

106.5 Credentials: The **plumbing inspector** shall carry proper credentials of the office while **inspecting** any and all systems and premises in the performance of his or her duties.

106.6 Annual Report: At least annually, the **plumbing inspector** shall submit to the municipal officers of the jurisdiction a written statement of code enforcement activities in form and content as shall be prescribed by such authority.

SECTION 110.0 FEES

110.2.2 **Additional inspection fee: Inspections** and fees, in addition to those mandated by these Rules, may be required by the LPI, through adoption of a local ordinance. Additional inspections may also be required by the LPI when work is found to be incomplete at a prearranged inspection, when work is found to be unsatisfactory or when access cannot be obtained at a prearranged date and time. In such cases, additional inspection fees may be assessed by the municipality with the entire additional fees being retained by the municipalities.

SECTION 111.0 **INSPECTIONS**

111.1 Required: It shall be the duty of the **plumbing inspector** to enforce the provisions of this code and to make such **inspections** as may be required by this Section.

111.2 Required **inspections**: Any violations of the approved plans and disposal system permit shall be noted. The holder of the disposal system permit shall be notified of any such discrepancies.

111.3 **Plumbing inspector's** right of entry: In the discharge of duties, the **plumbing inspector**, with the consent of the property owner, occupant, or owners agent, shall have the authority to enter at any reasonable hour any structure or premises in the jurisdiction to enforce the provisions of this code. Reference 30-A MRSA §4213. If entry is refused, the LPI can seek a court order for entry.

111.4 Department official's right of entry: In the discharge of duties, department officials, with the consent of the property owner, occupant, or owners agent, shall have the authority to enter at any reasonable hour any structure or premises to enforce the provisions of this code. If entry is refused, the Department can seek a court order for entry.

111.5 **Inspection** required: The LPI shall make two **inspections** as follows:

111.5.1 Prior to covering the system: An **inspection** shall be made after installation of the system components, including stone, pipes or proprietary devices, tanks, hay, filter fabric, and fill beneath and beside the disposal area, but before backfill is placed above the disposal system components. This **inspection** shall include any curtain drains, diversion ditches, berms or other measures outlined on the design to improve the function of the system, and

111.5.2 After stabilization: An **inspection** shall be made within six months to assure the system has been adequately stabilized, seeded and mulched.

111.6 Notification required: The **plumbing inspector** shall be notified at least 24 hours before the system is ready to be **inspected**.

111.7 Preparation for **inspection**: When a system is ready for **inspection**, the installer shall make such arrangements as will enable the **plumbing inspector** to **inspect** all parts of the system. The installer shall have present the proper apparatus and equipment for conducting the **inspection** and shall furnish such assistance as may be necessary in making a proper **inspection**.

111.8 Covering of work: No part of a system may be backfilled until it has been **inspected** and approved. If any part is covered before being **inspected** and approved, it shall be uncovered at the discretion of the **plumbing inspector** and at the expense and risk of the owner.

111.9 Defects in materials and workmanship: If **inspection** discloses defective material, design, siting, or poor construction that does not conform to the requirements of this code, the nonconforming parts shall be removed, replaced, and **reinspected**.

111.10 Installer's statement of compliance: The State shall provide a form (HHE-238) for the LPI to be given to the homeowner, or the homeowners agent, at the time of issuing the permit. This form will allow for the installer or **inspector**, in the case of an engineered system or a multi-user system, to provide a written statement to the owner, or agent, that the system was installed in compliance with this code and the conditions of the permit.

SECTION 112.0 WORKMANSHIP

112.1 General: All work shall be performed, installed, and completed in a workman like and acceptable manner commensurate with the specific requirements of this code, or generally accepted practices if not specifically addressed by this code, and the standards referenced herein.

SECTION 11 3.0 VIOLATIONS

113.1 Unlawful acts: It shall be unlawful to install, extend, alter, repair, or maintain systems except in conformity with this code.

113.2 Notice of violation: The **plumbing inspector** shall serve a notice of violation and order on the person responsible for the installation of work: in violation of the provisions of this code; in violation of a detailed statement or a plan approved thereunder; or in violation of a disposal system permit or certificate issued under the provisions of this code. Such orders shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

113.3 Prosecution: If the notice of violation and order are not complied with promptly, the **plumbing inspector** shall request the legal counsel of the jurisdiction to institute the appropriate proceedings at law or in equity to restrain, correct, or abate such violation, or to require removal or termination of the unlawful use of any system in violation of the provisions of this code or of the order or direction made pursuant thereto.

113.4 Penalties: Any person who shall violate a provision of this code, or who shall fail to comply with any of the requirements thereof, or who shall install work in violation of an approved plan or directive of the **plumbing inspector**, or of a disposal system permit issued under the provisions of this code, shall be subject to the penalties in Title 30-A M.R.S.A. §4452.

SECTION 114.0 STOP WORK ORDER

114.1 Stop work order notice: Upon notice from the **plumbing inspector** that work is being done contrary to the provisions of this code, such work shall be immediately stopped. The stop work order shall be in writing and shall be given to the owner of the property involved, or to the property owner's agent, or to the person doing the work. It shall state the conditions under which the work may be resumed.

114.2 Unlawful continuance: Any person who shall continue any work after having been served with a stop-work order, except such work as the person is directed to perform to remove a violation or unsafe condition, shall be considered in violation of this code.

SECTION 115.0 CERTIFICATE OF APPROVAL

115.1 Approval: After the required **inspection**, or, in the case of multiple **inspections**, when the final **inspection** indicates the work complies in all respects with this code and the permit application, a certificate of approval shall be issued by the **plumbing inspector**.

115.2 Thirty (30) day temporary use: Upon request of the holder of a disposal system permit, the **plumbing inspector** may issue a 30 day temporary authorization of use before the entire work covered by the disposal system permit shall have been completed. This authorization may be given only if such portion or portions of the system may be put into service safely prior to full completion without endangering health or public welfare.

SECTION 116.0 UNSAFE CONDITIONS

116.1 General: All installations, regardless of type, that are unsanitary or that, constitute a hazard to human life, health, or welfare are hereby declared a nuisance and shall be abated by repair and rehabilitation or removal.

116.2 Structures: No portion of a structure shall be located on any part of a disposal field.

SECTION 117.0 MUNICIPAL RECORDS

117.1 Required: The municipality shall keep official records of applications for disposal system permits received, disposal system permits and certificates issued, fees collected, reports of **inspections**, and notices and orders issued.

117.2 Record retention: The disposal system permit and associated records shall be maintained until such time as the realty improvement served by the proposed or existing system is removed or connected to a public sewer.

117.3 Record availability: These records shall be available upon request for **inspection** by personnel of the department and the public.

117.4 Associated records: The municipality shall also maintain and keep on file copies of the following documents:

117.4.1 Applications: Applications for disposal system permits and plans and specifications for the construction, installation or alteration of systems, including all forms and data submitted by the applicant;

117.4.2 Modifications: Modifications to plans or applications made subsequent to the issuance of a disposal, system permit to construct, install, or alter systems;
117.4.3 **Inspections**: Reports of construction **inspections** made prior to issuance of a certificate of approval for a system;
117.4.4 Certificates of approval: Certificates of approval issued for systems; and
117.4.4 Malfunctioning systems: **Inspection** reports, plans, and specifications for repair or alteration of malfunctioning systems or components of malfunctioning systems.

SECTION 118.0 LOCAL ORDINANCE

118.1 General: The municipality may adopt local ordinances as allowed by MRSA Title 30-A §4211.

118.2 Definition: For the purpose of this code, the term "local ordinance" means any municipal ordinance that is more restrictive than any provision in these Rules.

118.2 No less stringent: The municipality shall not adopt an ordinance that is less stringent than this code.

118.3 Notification: In order for the Department to keep track of local requirements that may differ from the minimum requirements contained herein, any municipality that adopts a local ordinance is requested to send a copy of the ordinance to the Department.

SECTION 119.0 APPROVED SYSTEM USAGE

119.1 General: No system may be used nor shall any waste water be directed to any component/system until a certificate of approval has been issued or the **plumbing inspector** has issued a temporary authorization of use in compliance with Subsection 115.2 of this code.

SECTION 120.0 UNORGANIZED AREAS

120.1 Scope: This Section governs the appointment of **plumbing inspectors** and the administration of this code in unorganized portions of the State of Maine where there is no local form of government.

120.2 **Plumbing inspector** appointment: The Department may appoint **plumbing inspectors** in the unorganized areas. The appointed **plumbing inspector** is responsible for performing all the administrative and enforcement duties prescribed in this Chapter.

120.3 Lack of **plumbing inspector**: If a **plumbing inspector** has not been appointed, the following procedure shall be utilized.
120.3.1 Permit issuance: The Department is responsible for performing all the administrative and enforcement duties prescribed in Section 106.0.
120.3.2 Installers statement of compliance: The State shall provide a form (HHE-238) for the **Site Evaluator** to give to the homeowner, or the homeowner's agent, at

the time of the **site evaluation**. This form will allow the installer or **inspector**, in the case of an engineered system or a multi-user system, to provide a written statement to the owner, or agent, that the system was installed in compliance with this code and the conditions of the permit. This form will then be sent to the department.

120.3.3 Certificate of approval: The Department will issue a certificate of approval for the system, upon receipt of the installer's statement compliance.

CHAPTER 4
SITE EVALUATION REQUIREMENTS
SECTION 400.0 GENERAL

400.1 Scope: This Chapter governs the evaluation of and requirements for system sites.

400.2 General: The selection of a site for each system is based upon a licensed site evaluator's evaluation of those site characteristics that may affect the functioning of the system. Each system (and every part thereof) shall be sited and designed so that, with adequate installation and maintenance, it will function in a satisfactory manner and will not create a nuisance or source of foulness, pose a threat to public health or safety or to the environment, or otherwise adversely affect the quality of surface water or ground water.

400.3 When a site evaluation is required: A site evaluation is required for all newly designed a) subsurface sewage disposal systems, b) Pit privies, and c) Holding Tanks.

400.4 Suitable soil conditions: A disposal field shall be located upon soils with the following minimum depths to limiting factors:

400.4.1 All systems located outside the shoreland zone area of major waterbodies/courses shall be located on soils with a minimum depth to seasonal groundwater table or hydraulically restrictive horizon of 12 inches and a minimum depth to bedrock of 12 inches. See Table 600.2, 600.3, and 600.4.

400.4.2 All systems located within the shoreland zone area of major waterbodies/courses shall be located on soils with a minimum depth to seasonal groundwater table or hydraulically restrictive horizon of 15 inches and a minimum depth to bedrock of 15 inches. See Table 600.2, 600.3, and 600.4.

400.5 Setback distances: For disposal system setback distances see Chapter 7 and Tables 700.2, 700.3 and 700.4.

400.6 Soil profile and condition: The soil profile and condition used for the design of a disposal field shall be based upon original soils at the site, except when the fill is considered as equivalent to original soils, as provided for in Section 405.0. The soil profile and condition used for the design of a disposal field shall be representative of the most limiting conditions beneath all disposal fields. In addition, the soil conditions beneath the down slope fill material extensions for engineered disposal fields shall be evaluated and reported.

400.7 Location of the system: A system shall be located entirely on property owned or controlled by the owner of the system. The owner of the proposed system may locate the system or components on an abutting and/or neighboring site, provided the neighboring property owner executes an easement in perpetuity for the construction, operation, replacement, and maintenance of the system, giving the system's owner authorization to cross any land or right-of-way between the two parcels. The easement shall be filed and cross-referenced in the Registry of Deeds and the municipality's office prior to issuance of a disposal system permit. The easement shall provide sufficient buffer around the disposal field and fill material extensions for future replacement and maintenance of the system.

400.8 Slope: The slope beneath a disposal field site shall not exceed 20% and shall accommodate the required fill material extension within 100' of the disposal field. (See footnotes in Table 700.2, 700.3 and 700.4).

400.9 Surface runoff: The disposal field site shall not be subject to the accumulation of surface runoff. The property owner may utilize surface water diversions, provided they are installed as prescribed by the site evaluator.

400.10 Existing subsurface ground water drains: Ground that contains subsurface ground water drainage systems or the remnants of abandoned subsurface ground water drainage systems may be unsuitable for the installation of a disposal field. If determined to be a problem, this may be corrected by removing the ground water drains or permanently sealing the outlets of the ground water drainage system.

SECTION 401.0 APPLICATION FOR DISPOSAL SYSTEM PERMIT

401.1 Contents: Applications for permits to install disposal systems shall include the following information:

401.2 Observation hole logs: A detailed description of the soil profile and condition, pursuant to Section 403.0;

401.3 Soil Profile/Condition and Design Classes: The soil profile/condition and design classes, classified pursuant to Table 600.1;

401.4 Design flows: The projected design flow of wastewater and method of calculation;

401.5 Elevations: The elevation of the bottom of the disposal field(s), the top of the distribution pipes or proprietary disposal devices within the disposal field(s). The number of ground surface elevation measurements taken within and around a disposal field shall be sufficient to adequately determine the required elevation of the disposal field and the extent of the associated fill material extensions; and

401.6 Scaled plan: The site plan shall be drawn at a scale that clearly depicts the following site features that directly affect the system design and compliance with this code within at least a 100 foot radius around systems with design flows less than 1,000 gallons per day, 200 foot radius around systems between 1,000 and 1,999 gallons per day and at least a 300 foot radius around engineered systems (systems greater than 1,999 gallons per day).

401.6.1 Location of system: The location of the proposed system including, but not limited to, disposal fields, pump/dosing tanks, distribution pipes, fill material extensions with their shoulders and limits and when their location is critical due to elevations or setbacks, septic tanks and grease interceptors.

401.6.2 Property boundaries: The boundaries of the lot as indicated by the property owner;

401.6.3 Existing manmade features: Locations of existing and proposed structures, roadways, water wells and disposal fields on the same lot and on abutting or neighboring lots to show compliance with the setbacks in Tables 700.1, 700.2, 700.3, and 700.4.

401.6.4 Water bodies: Location of all surface water bodies, natural and artificial, and all springs;

401.6.5 Surface water diversions: Location of existing and proposed surface water diversions;

401.6.6 Observation hole locations: Locations of all observation holes;

401.6.7 Wetlands: The boundaries of any potential wetland area as prescribed by Chapter 15;

401.6.8 Depths of fill material: Depths of fill material required;

401.6.9 Elevation Reference Point: The elevation and location of a system reference point set at elevation zero and located outside the fill extension areas (preferably within 100 feet of the field). Elevation Reference Points must be referenced to an easily located, reasonably-expected-to-be-permanent feature, for example, a fire hydrant, a surveying monument, a structure, etc. Elevations shall be given in inches above or below the ERP (Elevation Reference Point) except for large systems, those greater than 1,000 GPD, which may use a reference point set to the datum for the entire project and may use elevations in feet and decimal, and

401.6.10 System ties: Three measurements from two or more known horizontal reference points, or two horizontal reference points with a compass bearing, to a minimum of two proposed disposal field corners. System ties shall be located outside the fill extension areas and preferably within 100 feet of the disposal field(s).

401.6.11 Staked Corners: All four corners of the disposal field shall be staked by the site evaluator and/or engineer. Wooden stakes or wire flags are recommended to use as stakes.

SECTION 402.0 LOCATION, DEPTH, AND MINIMUM NUMBER OF OBSERVATION HOLES

402.1 General: Because Maine soil conditions can change dramatically within a few feet, more than one observation hole is often necessary to allow a site evaluator to better define the true soil conditions beneath a proposed disposal field. Observation holes used for design purposes shall be located at representative points clearly within the footprints of proposed non-engineered subsurface wastewater disposal fields.

402.2 Minimum number of observation holes: The number of observation holes shall be sufficient to determine the soil and site characteristics beneath the entire disposal field.

402.3 Minimum depth of observation holes: The minimum depth of observation holes is based upon the soil horizons and conditions present at the site of a proposed disposal field, as follows:
402.3.1 Hydraulically restrictive horizons: Observation holes shall extend at least 12 inches into the hydraulically restrictive horizon to check for bedrock except that no excavation is required greater than 48 inches in depth.
402.3.2 Seasonal ground water table: Observation holes shall extend at least 12 inches below the seasonal ground water table to check for bedrock except no excavation is required greater than 48 inches in depth.

402.4 Dig Safe Law: The "Dig Safe Law" requires notification if other than hand tools are utilized to dig observation holes (See 23 MRSA §3360-A(D)) Telephone: 1-888-225-4977.

SECTION 403.0 SOIL PROFILE DESCRIPTION
403.1 General: Observation holes are used to determine the soil and site characteristics important for subsurface wastewater disposal.
403.2 Soil profile description: For each observation hole used for design purposes, the site evaluator shall indicate each recognizable soil horizon or parent material, not including bedrock. For each observation hole, the site evaluator shall provide the following information:
403.3 Soil horizon thickness: Depth and thickness of each soil horizon including the organic horizon lying upon the mineral soil surface;
403.4 Soil color: Soil color;
403.5 Soil texture: Soil texture class;
403.6 Soil consistence: Soil resistance to penetration;
403.7 Soil profile: Soil profile class;
403.8 Soil drainage: Depth to seasonal water table, as determined by mottling, organic streaking, concretions, thickness and color of the "B" horizon, thickness of the "E" horizon and/or other soil morphological features indicative of a seasonal water table. See Section 404.1 for sites with plow layers greater than 7 inches thick, Section 404.0 for ground water table monitoring and Section 405.0 for filled sites.
403.9 Bedrock: Depth to bedrock;
403.10 Hydraulically restrictive horizons: The presence of hydraulically restrictive soil horizons; and
403.11 Disturbed ground: The presence of disturbed ground.
403.12 Reporting: The site evaluator shall report soil profile data on a standardized application form for a disposal system permit provided by the Department.

Section 404.0 On-Site Monitoring Of Seasonal High Groundwater Table Conditions

404.1 When used: When the "A" or "Ap" (plow layer) horizons are greater than 7 inches thick or the site evaluator is unable to determine the seasonal groundwater table depth at the proposed disposal field site by direct soil profile observation or by soil drainage class/moisture regime using Table 400.1. Groundwater monitoring documentation may be provided which shows that soil mottling, or other color patterns, at a particular site are not an indication of seasonally saturated soil conditions. Documentation shall be made by directly measuring seasonal groundwater levels and temperatures in accordance with the procedures cited in this Section.

404.1.1 Groundwater table modifications: Seasonal groundwater table monitoring documentation shall be provided for sites where an attempt has or is being made to lower the seasonal water table level, to verify that soil mottling or other color patterns at a specific site are not a true indication of seasonally saturated soil conditions or high groundwater levels or that site modification has successfully drained a particular site to make it suitable for subsurface wastewater disposal in compliance with these Rules.

404.1.2 Monitoring responsibility: A Maine Licensed Site Evaluator shall be responsible for establishing and conducting the monitoring program. The Licensed Site Evaluator shall be responsible to adequately determine site conditions, properly locate and install monitoring wells on site, and accurately collect monitoring data.

404.1.3 Monitoring program proposal: A Maine Licensed Site Evaluator shall submit a completed proposal to the Department and the LPI prior to initiating any monitoring program. A preliminary scaled plan shall be submitted by the site evaluator which illustrates the location of proposed monitoring well, property lines, dwelling(s), disposal system(s), terrain slopes, existing well(s), artificial drainage, and natural surface drainage. Logs of soil profiles observed, proposed monitoring well depths, a description of procedures and equipment to be employed to collect accurate monitoring data, and other pertinent information shall also be provided.

404.1.4 Departmental approval: The Division of Health Engineering shall approve the monitoring program prior to its initiation. Failure to request prior approval from an applicant is considered cause not to accept any results of a monitoring program.

404.1.5 Monitoring well construction: Monitoring wells shall consist of 2 inches minimum diameter solid PVC pipe which extends above the soil surface a minimum of 24 inches for ease of location. This pipe shall be placed a minimum of 3 inches into a 6 inch minimum thick layer of clean stone or gravel that is placed at the base of the excavation. Compacted native soil shall be installed in the area between the pipe and the excavation. Monitoring wells shall have a vented cover and the pipe shall be surrounded by a mounded seal extending 6 inches down from the ground surface consisting of a layer of puddled clay, bentonite, or a bentonite/grout mixture or native soil material, to prevent direct entry of precipitation or other contaminants. Site conditions may require modifications of monitoring well design, in which case the Division of Health Engineering shall be consulted.

404.2 Monitoring well observation period: Groundwater level and temperature monitoring shall be done during the time of year when seasonal high groundwater table conditions are expected to occur. The first observation shall be made on or before April

1st. Subsequent groundwater level readings shall be made at least every seven days until June 15th or until the site is determined to be unacceptable, whichever comes first. Seasonal ground water table depths below the mineral soil surface and the soil water temperatures shall be recorded.

404.3 Site conditions: Sites to be monitored shall be carefully checked for ground water drainage tile and open ditches that may have altered natural seasonal ground water table.

404.4 Witnessing the location and installation of monitoring wells: The property owner shall give the plumbing inspector permission to witness the excavation and installation of the monitoring wells. The plumbing inspector may require a maximum of 15 days written notice prior to witnessing the location and installation of the monitoring wells.

404.5 Minimum number and location of monitoring wells: There shall be at least two monitoring wells plus an additional well for every 300 gpd design flow above 300 gpd. The site evaluator shall locate the monitoring wells so that the wells will reveal representative groundwater table conditions in the soils beneath the footprint of the proposed disposal field and fill material extensions.

404.6 Monitoring well depth: In general, monitoring wells shall extend to a depth of at least 3 feet below the ground surface, except that special soil conditions may require different monitoring well depths, such as the following: In permeable soils that overlie a hydraulically restrictive soil horizon, monitoring wells shall terminate within the mottled soil horizon above the hydraulically restrictive soil horizon; in cases where a mottled soil horizon lies above a permeable unmottled soil, wells shall terminate in the lower part of the mottled horizon. The site evaluator shall determine the depth of the monitoring wells for each site. However, for complex situations, the Division of Health Engineering shall be consulted prior to installation of the monitoring wells.

404.7 Monitoring well data calibration: Climatic conditions may cause significant year to year fluctuations in the highest seasonal groundwater table. Monitoring well data shall be compared with water resources conditions information obtained from the United States Geological Survey (USGS) to determine whether the observed seasonal high groundwater table is at or near its normal level. The Division of Health Engineering shall be consulted if USGS data indicate above or below normal groundwater levels. In addition, specific unusual climatological events occurring during the monitoring period shall be recorded, such as heavy rainfall. Comparison results shall be included with a monitoring report as prescribed in Subsection 404.9.

404.8 Determination of seasonal high groundwater table conditions: Acceptable or unacceptable seasonal high groundwater table conditions, based on depth and temperature measurements, as modified by water resources information described in Subsection 404.7, shall be determined in accordance with the following Subsections:

404.8.1 Water table is found at depths greater than allowed in Table 600.2 or 600.4: If the water table is found at depths greater than the minimum allowed in Table

600.2 or 600.4, monitoring shall continue until June 15th or until the site has been determined to be unacceptable as prescribed in Subsection 404.8.2.

404.8.2 Water table is found at depths shallower than allowed in Table 600.2 or 600.4: If the water table is found at a depth shallower than allowed in Table 600.2 or 600.4, and, if the corresponding soil water temperature is at or above 41°F, the site shall be considered unacceptable, and the site evaluator shall notify the Department in writing. If the corresponding soil water temperature is below 41°F, monitoring shall continue until June 15th or until the site has been determined to be unacceptable.

404.9 Reporting findings: If monitoring discloses that a site is acceptable, the applicant may submit an application for a disposal system permit that includes a written monitoring report prepared by the investigating site evaluator. The monitoring report shall provide monitoring well locations, ground elevations at the monitoring wells, soil profile descriptions, measurement data and dates of measurement depths to observed water tables, and soil water temperatures, as well as supporting data indicating that monthly precipitation amounts are within the normal range.

404.10 Monitoring well abandonment: At the completion of the monitoring program, all monitoring wells located within the footprint of the proposed disposal field and fill extensions shall be abandoned and sealed to prevent the migration of surface water or potential contaminants to the subsurface. Monitoring well pipe shall be completely removed and the excavation filled with compacted native soil.

Section 405.0 Filled Sites

405.1 Bedrock and Soil drainage conditions: Where the surface of the ground has been raised by the addition of fill material over the original soil, the Design Class is to be determined based upon the texture of fill or the original soil, whichever is finer and the depth to the most limiting soil horizon. Measurement is to be taken from the original ground surface except as provided for in Section 405.2.

405.2 Fill considered equivalent to original soil: The plumbing inspector shall review and approve the use of existing fill soil as the equivalent to original soil for design purposes when the site evaluator demonstrates that:

a) The fill material is of suitable texture, consistency, depth, extent and structure to be equivalent of original soil for design purposes, and,

b) The fill has been in place since July 1, 1974, and

c) The area of the fill soils include, at a minimum, the disposal field and its extensions, and

d) The texture of fill is sandy loam or coarser, and the fill is relatively free of foreign material including organic material, and,

e) The fill is placed in compliance with all pertinent regulations.

Appendix D

Separation Distance Regulations

CONNECTICUT LOCATION GUIDELINES SECTION 19-13-B103
II LOCATION OF SUBSURFACE SEWAGE DISPOSAL SYSTEMS

The following minimum separating distances (Table D-1) are required and shall be maintained between any part of an OSDS and the item listed below.

Table D-1: Minimum Separating Distances

		TABLE No. 1	
Item		Separating Distance	Special Provision
A.	Suction pipe well, spring or domestic water. Required withdrawal rate Under 10 gal per min 10 to 50 gal per min Over 50 gal per min	 75 feet 150 feet 200 feet	(1) Separation distance shall be doubled where the soil has a minimum Percolation rate faster than 1inch/min (also see Standard VIII A) (2) Separation distance shall be increased as necessary to protect the sanitary quality of a public water supply well
B.	Human habitation on adjacent property	25 feet	
C.	Building served	15 feet	Building shall have no footing drains
D.	Any open water course	50 feet	When located on a public water supply watershed, this distance shall be rescued as necessary to not less than 25 feet on lots in subdivision plans approved prior to the effective date of this regulation and thereafter recorded as required by statute
E.	Public water supply reservoir	100 feet	
F.	Any surface or groundwater drain constructed of tight pipe	25 feet	Drains constructed of cast iron pipe with rubber joints accepted equal (see Table 2-c) are exempted from this requirement, except that no such drain shall cross a leaching system
G.	Groundwater intercepting drains, footing or foundation drain located up gradient from sewage disposal system	25 feet	Solid pipes listed in Table 2-c are exempted from this requirement
H.	Loose or open jointed, perforated, slotted or previous pipe drain located down gradient from sewage disposal system	50 feet	No such drain shall be constructed down gradient from the leaching system on the same property for the purpose of collecting sewage effluent no matter what the separating distance
I.	Top of embankment	15 feet	
J.	Property line	10 feet	
K.	Portable water line which Flows under pressure	10 feet	
L.	Below ground swimming pool	25 feet	
M.	Above ground swimming pool	10 feet	Includes hot tubs

MASSACHUSETTS

12/27/96 310 CMR - 512

15.210: Setback Requirements and Loading Limitations for Locating and Designing Systems

15.211: Minimum Setback Distances

(1) All systems must conform to the minimum setback distance for septic tanks and soil absorption systems, including reserve area, measured in feet and as set forth below (Table D-2). Where more than one setback applies, all setback requirements shall be satisfied.

Table D-2: Minimum Setback Distances

Features	Septic Tank	Soil Absorption System
Property Line	10	10
Cellar Wall or		
Swimming Pool (inground)	10	20
Slab Foundation	10	10
Water Supply Line (pressure)]	10[1]	10[1]
Surface Waters (except wetlands)	25	50
Bordering Vegetated Wetland (BVW), Salt Marshes, Inland and Coastal Banks	25	50
Surface Water Supply - Reservoirs and Impoundments	400	400
Tributaries to Surface Water Supplies	200	200
Wetlands bordering Surface Water Supply or Tributary thereto	100	100
Certified Vernal Pools	50	100[2]
Private Water Supply Well or Suction Line	50	100
Public Water Supply Well	[2]	[2]
Irrigation Well	10	25
Open, Surface or Subsurface Drains which discharge to Surface Water Supplies or tributaries thereto	50	100
Other Open, surface or subsurface drains (excluding foundation drains) which intercept seasonal high groundwater table [3]	25	50
Other Open, Surface or Subsurface Drains (excluding foundation drains)	5	10
Leaching Catch Basins & Dry Wells	10	25
Downhill Slope	not applicable	15[4]

[1] Disposal facilities shall also be at least 18 inches below water supply lines. Wherever sewer lines must cross water supply lines, both pipes shall be constructed of class 150 pressure pipe and shall be pressure tested to assure watertightness.

[2] The required setback shall be 50 feet where the applicant has provided hydrogeologic data acceptable to the approving authority demonstrating that the location of the soil absorption system is hydraulically downgradient of the vernal pool. Surface topography alone is not determinative.

[3] Surface or subsurface drains, which will regularly or periodically intercept the seasonal high groundwater table and carry that groundwater away from an area must meet the specified setbacks.

[4] The setback distance shall be measured from a naturally occurring downhill slope, which is not steeper than 3:1 (horizontal: vertical). A minimum 15-foot horizontal separation distance shall be provided between the top of the peastone in the soil absorption system and the adjacent downhill slope. For a system located in an area with any adjacent naturally occurring downhill slope steeper than 3:1, slope stabilization shall be provided in accordance with best engineering practice which may include construction of a concrete retaining wall constructed in accordance with 310 CMR 15.255(2).

(2) No system shall be constructed within a Zone I of public water supply well or wellfield. No system shall be upgraded or expanded within a Zone I of a public water supply well or wellfield unless a variance is granted pursuant to 310 CMR 15.410 through 15.415.

(3) All setback distances from water bodies shall be measured from the bank of the water body. All setback distances from wetlands shall be measured in accordance with the criteria of the wetlands protection act and 310 CMR 10.00, from the most landward edge of the following features: bordering vegetated wetland as defined in 310 CMR 10.55(2); salt marsh as defined in 310 CMR 10.32(2); top of inland bank as defined in 310 CMR 10.54(2); or top of coastal bank as defined in 310 CMR 10.30(2). In the event of disputes concerning landward boundary of resources subject to the Wetlands Protection Act, the boundary shall be as delineated by the municipal Conservation Commission or the Department in accordance with 310 CMR 10.00, as amended, and relevant interpretive guidance documents.

15.212: Depth to Groundwater

The minimum vertical separation distance of the bottom of the stone underlying the soil absorption system above the high groundwater elevation shall be

(a) four feet in soils with a recorded percolation rate of more than two minutes per inch;
(b) five feet in soils with a recorded percolation rate of two minutes or less per inch.

15.213: Construction in Velocity Zones and Floodways

(1) No septic tank or humus/composting toilet shall be constructed in a velocity zone on a coastal beach, barrier beach, or dune, or in a regulatory floodway, except a septic tank that replaces a tank in existence on the site as of March 31, 1995 that has been damaged, removed or destroyed, where placement of the tank outside of the velocity zone or regulatory floodway, either horizontally or vertically, is not feasible. Where reconstruction of a system in existence on March 31, 1995 occurs or reconstruction of a building or buildings is allowed in accordance with the wetlands protection act and 310 CMR 10.00, it shall be presumed to be feasible to elevate the tank if the building is elevated above the velocity zone or regulatory floodway.

(2) No soil absorption system shall be constructed in a velocity zone on a coastal beach, barrier beach, or dune, or in a regulatory floodway, unless
(a) the system is to serve a building or buildings that were in existence on March 31,1995 or reconstruction of such building or buildings where allowed in accordance with the wetlands protection act and 310 CMR 10.00;
(b) there is no increase in design flow from such building or buildings;
(c) no connection to a public sewer or shared system is available;
(d) the owner or applicant cannot site the system elsewhere;
(e) the septic tank or humus/composting toilet is sited outside of the velocity zone or regulatory floodway, either horizontally or vertically;
(f) the system achieves required separation from high groundwater elevation required by 310 CMR 15.212; and
(g) any portion of the soil absorption system that is within the velocity zone or regulatory floodway is a leaching bed or trench system or any other system constructed in accordance with the wetlands protection act and 310 CMR 10.00.

OREGON

340-71-220 STANDARD SUBSURFACE SYSTEMS.

(i) **Setbacks** in Table D-3 can be met:

(A) Surface Waters Setbacks. **Setback** from streams or other surface waters shall be measured from bank drop-off or mean yearly highwater mark, whichever provides the greatest separation distance;

(B) Lots Created Prior to May 1, 1973. For lots or parcels legally created prior to May 1, 1973, the Agent may approve installation of a standard or alternative system with a setback from surface public waters of less than one hundred (100) feet but not less than fifty (50) feet, provided all other provisions of these rules can be met;

(C) Water Lines and Sewer Lines Cross. Where water lines and building or effluent sewer lines cross, **separation distances** shall be as required in the State Plumbing Code;

(D) Septic Tank **Setbacks**. The Agent shall encourage the placement of septic tanks and other treatment units as close as feasible to the minimum separation from the building foundation in order to minimize clogging of the building sewer.

Table D-3 - Minimum Separation Distances

From Items Requiring **Setback**	From Septic Tank and Sewage Disposal Area Including Replacement Area	Other Treatment Units. Effluent Sewer and Distribution Units
1. Groundwater Supplies.	100'	50'
2. Temporarily Abandoned Wells.	100'	50'
3. Springs:		
• Upgradient.	50'	50'
• Downgradient.	100'	50'
*4. Surface Public Waters:		
• Year round.	100'	50'
• Seasonal.	50'	50'

* This does not prevent stream crossings at pressure effluent sewers.

Table D-3 (contd.)

From Items Requiring **Setback**	From Septic Tank and Sewage Disposal Area Including Replacement Area	Other Treatment Units. Effluent Sewer and Distribution Unit
5. Intermittent Streams:		
• Piped (watertight not less than 25' from any part of the on-site system).	20'	20'
• Unpiped.	50'	50'
6. Groundwater Interceptors:		
• On a slope of 3% or less.	20'	10'
• On a slope greater than 3%: Upgradient.	10'	5'
7. Irrigation Canals:		
• Lined (watertight canal).	25'	25'
• Unlined:		
• Upgradient.	25'	25'
• Downgradient.	50'	50'
8. Cuts Manmade in Excess of 30 Inches (top of downslope cut):		
• Which Intersect Layers that Limit Effective Soil Depth Within 48 Inches of Surface.	50'	25'
• Which Do Not Intersect Layers that Limit Effective Soil Depth	25'	10'
9. Escarpments:		
• Which intersect Layers that Limit Effective Soil Depth.	50'	10'
• Which Do Not Intersect Layers that Limit Effective Soil Depth,	25'	10'
10. Property Lines.	10'	5'
11. Water Lines.	10'	10'
12. Foundation Lines of any Building, Including Garages and Out Buildings.	10'	5'
13. Underground Utilities.	10'	-

Table D-4

Minimum length of disposal trench (linear feet) required per one hundred fifty (150) gallons projected daily sewage flow determined from soil texture versus effective soil depth.

Effective Soil Depth	Soil Group A	B	C
18" to Less than 24"	125	150	175
24" to Less than 36"	100	125	150
36" to Less than 48	75	100	125
48" or more	50	75	125

* Soil Group A - Sand, Loamy Sand, Sandy Loam.
Soil Group B - Sandy Clay Loam, Loam, Silt Loam, Silt, Clay Loam.
Soil Group C - Silty Clay Loam, Sandy Clay, Silty Clay, Clay.

Table D-5

Minimum length of disposal trench (linear feet) required per one hundred fifty (150) gallons projected daily sewage flow determined from soil texture versus depth to temporary groundwater.

Depth to Temporary Groundwater	Soil Group A	B	C
24" to Less than 48"	100	125	150
48" or More	50	75	125

* Soil Group A - Sandy Loamy Sand, Sandy Loam.
Soil Group B - Sandy Clay Loam, Loam, Silt Loam, Silt, Clay Loam.
Soil Group C - Silty Clay Loam, Sandy Clay, Silty Clay, Clay.

340-71-330 NONWATER-CARRIED FACILITIES.

(1) No person shall cause or allow the installation or use of a nonwater-carried waste disposal facility without prior written approval from the Agent.

EXCEPTIONS:

-1- Temporary use pit privies used on farms for farm labor shall be exempt from approval requirements.

-2- A Sewage Disposal Service business licensed pursuant to OAR 340-71-600 may install portable toilets without written approval of the Agent, providing all other requirements of this rule except Table D-6 **setbacks** are met.

(2) Non-water carried waste disposal facilities may be approved for temporary or limited use areas, including but not limited to recreation parks, camp sites, farm labor camps, or construction sites, provided all liquid wastes can be handled in a manner to prevent a public health hazard and to protect public waters, provided further that the separation distances in **Table D-6** can be met.

EXCEPTION: The use of portable toilets shall not be allowed for seasonal dwellings.

Table D-6 - Minimum Separation Distances for Nonwater-Carried Waste Disposal Facilities

	Self-Contained Nonwater-Carried Waste Disposal	Unsealed Earth Type Privies, Gray Water Waste Disposal Sump and Seepage Chambers
Groundwater supplies including springs and cisterns	50'	100'
Surface public waters, excluding intermittent streams	50'	100'
Intermittent streams	50'	50'
Property line	25'	25'

64E-6.005 LOCATIONS AND INSTALLATION

All systems shall be located and installed so that with proper maintenance the systems function in a sanitary manner, do not create sanitary nuisances or health hazards and do not endanger the safety of any domestic water supply, groundwater or surface water. Sewage waste and effluent from onsite sewage treatment and disposal systems shall not be discharged onto the ground surface or directly or indirectly discharged into ditches, drainage structures, groundwaters, surface waters, or aquifers.
To prevent such discharge or health hazards:

(1) Systems and septage stabilization facilities established after the effective date of the rule shall be placed no closer than the minimum distances indicated for the following:
(a) Seventy-five feet from a private potable well as defined in Rule 64E-6.002(44)(a), or a multi-family water well as defined in Rule 64E-6.002(44)(c).
(b) One-hundred feet from a public drinking water well as defined in Rule 64E-6.002(44)(b) if such a well serves a facility with an estimated sewage flow of 2000 gallons or less per day.
(c) Two-hundred feet from a public drinking water well as defined in Rule 64E-6.002(44)(b) if such a well serves a facility with an estimated sewage flow of more than 2000 gallons per day.
(d) Fifty feet from a non-potable water well as defined in Rule 64E-6.002(39).
(e) Ten feet from any storm sewer pipe, to the maximum extent possible, but in no instance shall the setback be less than 5 feet.
(f) Fifteen feet from the design high-water line of retention areas, detention areas, or swales designed to contain standing or flowing water for less than 72 hours after a rainfall or the design high-water level of normally dry drainage ditches or normally dry individual-lot stormwater retention areas.

(2) Systems shall not be located under buildings or within 5 feet of building foundations, including pilings for elevated structures, or within 5 feet of mobile home walls, swimming pool walls, or within 5 feet of property lines except where property lines abut utility easements which do not contain underground utilities, or where recorded easements are specifically provided for the installation of systems for service to more than one lot or property owner.
(a) Sidewalks, decks and patios shall not be subject to the 5-foot setback, however, drainfields shall not be installed beneath such structures. Any tank located beneath a driveway shall have traffic lids as specified in Rule 64E-6.013(1)(h). Concrete structures, which are intended to be placed over a septic tank, shall have a barrier of soil or plastic material placed between the structure and the tank so as to preclude adhesion of the structure to the tank.
(b) Systems shall not be located within 10 feet of potable water lines unless such lines are sealed with a water proof sealant within a sleeve of similar material pipe to a distance of at least 10 feet from the nearest portion of the drainfield. In no case shall the sleeved water line be located within 24 inches of the onsite

sewage treatment and disposal system. The sleeved water line shall not be located at an elevation lower than the drainfield absorption surface. Non-potable water lines shall not be located within 24 inches of the system without backflow preventers or check valves being installed on the water line so as to preclude contamination of the water system.

(c) Systems shall be setback a minimum of 15 feet from groundwater interceptor drains.

(3) Except for the provisions of s. 381.0065(4)(g)1. and 2., F.S., systems and septage stabilization facilities shall not be located laterally within 75 feet of the boundaries of surface water bodies. Systems and septage stabilization facilities shall be located a minimum of 15 feet from the design high water line of a swale, retention or detention area designed to contain standing or flowing water for less than 72 hours after a rainfall, or the design high water level of normally dry drainage ditches or normally dry individual lot storm water retention areas.

(4) Suitable, unobstructed land shall be available for the installation and proper functioning of the system. At least 75 percent of the unobstructed area must meet minimum setback requirements of subsections (1) and (3) above to allow for drainfield repair or system expansion. The minimum unobstructed area shall:

(a) Be at least 2 times as large as the drainfield absorption area required by rule. For example, if a 200 square feet drainfield is required, the total unobstructed area required, inclusive of the 200 square feet drainfield area, would be 400 square feet. Unobstructed soil area between drain trenches shall be included in the unobstructed area calculation.

(b) Be contiguous to the drainfield.

(c) Be in addition to the setbacks required in subsection (2) above.

(5) Onsite sewage treatment and disposal systems if installed in fill material, the fill shall be required to settle for a period of at least 6 months, or has been compacted to a density comparable to the surrounding natural soil. The fill material shall be of a suitable, slightly limited soil material.

(6) To prevent soil smear and excessive soil compaction, drainfields shall not be installed in soils with textures finer than sand, loamy sand, or sandy loam when the soil moisture content is above the point at which the soil changes from semisolid to plastic.

(7) Onsite sewage treatment and disposal systems shall be installed where a sewerage system is not available and when conditions in ss. 381.0065(4)(a)-(g), F.S., are met. Onsite graywater tank and drainfield systems may, at the homeowners' discretion, be utilized provided blackwater is disposed into a sanitary sewerage system when such sewerage system is available. Graywater systems may, at the homeowners' discretion, be utilized in conjunction with an onsite blackwater system where a sewerage system is not available for blackwater disposal.

(a) The minimum area of each lot under s. 381.0065(4)(a), F.S., shall consist of at least 1/2 acre (21,780 square feet) exclusive of all paved areas and prepared road beds within public rights-of-way or easements and exclusive surface water bodies.

(b) The determination of lot densities under s. 381.0065(4)(b), F.S., shall be made on the basis of the net acreage of the subdivision which shall exclude from the gross acreage all paved areas and prepared road beds within public or private rights-of-way or easements and shall also exclude surface water bodies.

(c) Maximum daily sewage flow allowances specified in ss. 381.0065(4)(a),(b), and (g), F.S., shall be calculated on an individual lot by lot basis. The acreage or fraction of an acre of each lot or parcel of land shall be determined and this value shall be multiplied by 2500 gallons per acre per day if a public drinking water well serving a public system as defined in 64E-6.002(44)(b)1., 2., or 3. is utilized, or be multiplied by 1500 gallons per acre per day if a public drinking water well serving a public water system as defined in Rule 64E-6.002(44)(b)4., or a private potable well is utilized. Contiguous unpaved and noncompacted road rights-of-way, and easements with no subsurface obstructions that would affect the operation of drainfield systems, shall be included in total lot size calculations. Where an unobstructed easement is contiguous to two or more lots, each lot shall receive its pro rata share of the area contained in the easement. Surface water bodies shall not be included in total lot size calculations. Rule 64E-6.008(1), Table I, shall be used for determining estimated average daily sewage flows.

(d) Platted residential lots shall be subject to the requirements set forth in subsections 381.0065(4)(g)1. and 2., F.S.

(e) When portions of a lot or lots which were platted prior to January 1, 1972 are combined in such a manner that will decrease the total density of the subdivision, pre-1972 lot provisions shall apply. However, the maximum setback possible to surface water bodies shall be maintained with a minimum setback of 50 feet.

(8) Notwithstanding the requirements of this section, where an effluent transmission line consists of schedule 40 PVC or consists of schedule 20 PVC enclosed in a sleeve of schedule 40 PVC, the transmission line shall be set back from private potable wells, irrigation wells or surface water bodies by the maximum distance attainable but not less than 25 feet when installed.

Vertical separation distances

Texture. The term texture refers to the relative proportion of various size groups of individual soil grains in a mass of soil. Specifically it refers to the proportion of sand, silt, and clay.

1. Soil Classification. For the purpose of this chapter soils have been categorized into four groups based on texture as follows:

a. Texture Group I - sand and loamy sand;

b. Texture Group II - sandy loam, loam, and sandy clay loam. Texture Group II soils are subdivided into Texture Group Iia and IIb soils. Texture Group IIa soils consist of sandy loam soils with percolation rates less than 31 minutes per inch and no structure development. The remainder of soils within this texture group are Texture Group IIb soils;

c. Texture Group III - silt loam, clay loam, silty clay loam; and

d. Texture Group IV - sand clay, silty clay and clay.

Article 2.
Systems Using Naturally Occurring Undisturbed Soil.
12 VAC 5-610-594. In-ground systems.

A. An in-ground system is a system which utilizes a natural, undisturbed soil horizon to treat and disperse effluent where the infiltrative surface is placed 18 inches or more beneath the original surface of the ground. In-ground systems include, but are not limited to, conventional septic tank drainfield systems, chamber systems, alternative aggregate systems, enhanced flow systems, and pressure dosed systems.

B. Septic tank effluent. Septic tank effluent may be utilized in an in-ground system when all of the site and soil criteria of this subsection are met. Also see Table D-9.

1. Horizon. The soil horizon(s) for the 18 inches immediately below the installation depth shall not show the presence of any limiting factor. Limiting factors include bedrock, seasonal or permanent water table, pans, or other impervious strata.

2. Separation distances. Table D-8 contains the minimum setback distances between an absorption field and various structures or topographic features.

3. Estimated or measured infiltration rates. The estimated or measured infiltration rate shall not exceed 120 minutes per inch within any part of the sidewall area of the trench or within 18 inches of the infiltrative interface where effluent encounters undisturbed soil.

C. Soil criteria when utilizing secondary effluent. Secondary effluent may be utilized in an in-ground system when all of the criteria of this subsection are met. Also see Table D-9.

1. Horizon. The soil horizon(s) for the 12 inches immediately below the installation depth shall not show the presence of any limiting factor. Limiting

factors include bedrock, seasonal or permanent water table, pans or other impervious strata.

2. Separation distances. Table D-8 contains the minimum setback distances between an absorption field and various structures or topographic features.
3. Estimated or measured infiltration rates. The estimated or measured infiltration rate shall not exceed 120 minutes per inch within the sidewall area of the trench, if any, or within 12 inches of the infiltrative interface where effluent encounters undisturbed soil.

Article 3. Systems Using Fill Material.
12 VAC 5-610-597. Fill systems.

A. Fill systems are systems where the infiltrative surface and some portion of the treatment medium is comprised of fill material and not a naturally occurring undisturbed soil. Fill systems may be located in-ground, shallow-placed, or above ground. Fill systems addressed in these regulations are the Wisconsin Mound system, the noncarbonaceous mountain colluvium system, and the sand-on-sand system.

B. Elevated Sand Mounds. Septic tank effluent may be utilized with elevated sand mounds. Pretreatment shall be required when effluent strength exceeds residental strength wastewater and may be required where hydrologic conditions meet the minimum criteria contained in this chapter. For the purpose of siting an elevated sand mound, the criteria in Table 4.4 shall apply. For the purposes of establishing minimum setback distances between an elevated sand mound and various structures or topographic features, the mound shall be considered an absorption field and distances shown in Table 4.2 utilized.

C. Sand-on-sand systems. Sand-on-sand is a process of modifying a soil absorption system site using fill material, which is similar in texture to the original, naturally occurring material. Filling is accomplished in accordance with 12 VAC 5-610-965.

1. Criteria for utilizing septic effluent. Septic tank effluent may be utilized with sand-on-sand systems. For the purpose of siting a sand-on-sand system, the criteria in Table 4.4 shall apply. Sand-on-sand systems may be utilized with septic tank effluent when the following criteria are met:

a. Soil texture. In order to assure effluent dispersal under adverse conditions, while maintaining adequate treatment capacity, shallow-placed systems are limited to Texture Group I and IIa soils. The use of Texture Group IIb, III and IV soils for sand-on-sand systems is prohibited.

b. Soil structure. Sand-on-sand is restricted to soils classified as entisols (i.e., a young soil with no horizon development) and which have a texture of sand, loamy sand, coarse sandy loam, or sandy loam texture.

c. Depth of soil. A minimum of 18 inches of naturally occurring undisturbed soil, measured from the ground surface, is required before encountering soils with bedrock, or a seasonal or permanent water table. Additionally, to assure adequate hydraulic dispersal capacity, no restictive horizons may occur within 30 inches of the ground surface.

d. Separation distances. Table D-8 contains the minimum setback distances between an absorption field and various structures or topographic features.

e. Estimated or measured infiltration rates. When siting a sand-on-sand system, the estimated or measured infiltration rate shall not exceed 30 minutes per inch within the sidewall area of the trench or within 18 inches of the infiltrative interface where effluent encounters undisturbed soil.

f. Slope. Sand-on-sand is prohibited where the slope of the original site exceeds 5%.

2. Criteria for utilizing secondary effluent.

a. Depth of soil. A minimum of 12 inches of soil, measured from the ground surface, is required before encountering bedrock, or a seasonal or permanent water table. Additionally, to assure adequate hydraulic dispersal capacity, no restrictive horizons may occur within 24 inches of the ground surface.

b. Separation distances. Table D-8 contains the minimum setback distances between an absorption field and various structures or topographic features.

c. Estimated or measured infiltration rates. The estimated or measured infiltration rate shall not exceed 30 minutes per inch within the sidewall area of the trench, if any, or within 18 inches of the infiltrative interface where effluent encounters undisturbed soil.

D. Fill systems in mountain colluvium. The criteria for conventional, in-ground trench systems contained in Table D-9 shall be complied with to the greatest extent possible. However, fill material consisting of colluvial soil derived from sandstone (noncarbonaceous) in the mountainous area may be considered on a case-by-case basis for placement of subsurface soil absorption systems.

Table D-7 - Minimum Separation Distances for Pretreatment Units, Conveyance Lines, and Header Lines.

Structure or Topographic Features	Minimum Horizontal Distance
Building Foundations	10
Basements	20
Water Wells (all classes)	50
Cisterns (Bottom Elevation Lower than Ground Surface in Area of	
Pretreatment Unit)	100
Shellfish Waters	70
Natural Lakes & Impounded Waters and Streams	50 (1)
Developed Springs (when the spring is down slope)	100
Drainage Ditches:	
Ditch Bottoms above Seasonal Water Table	10
Ditch Bottom below Seasonal Water Table and Ditch Normally	
Contains Water	50
Lateral Ground Water Movement Interceptor	50 (2)
Low Point of Sink Holes When Placed within the Bowl of the Sink Hole	100
Utility Lines	10
1See also Table 4.2	
2See also 12 VAC5-610-950.C.3 for upslope placement of LGMI	

Table D-8 - Minimum Separation Distances.

Structure or Topographic Features	Soil Texture Group	Min distance (ft) from bottom or Sidewall of Subsurface Soil Absorption System Trench	
		Vertical	Horizontal
Property Lines	I, II, III, IV	----	5
Building Foundations	I, II, III, IV	----	10
Basements	I, II, III, IV	----	20
Drinking Water Wells			
Class IIIA or IIIB	I, II, III, IV	----	50
Class IIIC or IV	I, II, III, IV	----	100
Cisterns (Bottom Elevation Lower			
Than Ground Surface in Area of	I, II, III, IV	----	100
Subsurface Soil Absorption System)			
Shellfish Waters	I, II, III, IV	----	70
Natural Lakes & Impounded Waters	I, II, III, IV	----	50
Streams	I, II, III, IV	----	50 a
Developed Springs (when the spring is			
down slope)	I, II, III, IV	----	200 e
Rock and Rock Outcropping	I, II, III, IV	1.5	1.5
Pans and Impervious Strata	I, II, III, IV	1.5	1.5
Drainage Ditches:			
Ditch Bottoms above Seasonal			
Water Table	I, II, III, IV	----	10
Ditch Bottom below Seasonal	I	----	70 a
Water Table and Ditch Normally	II	----	70 a
Contains Water	III	----	50 a
	IV	----	50 a
Water Table Depressor System	I	6 b	70
	II	3 b	70
	III	2 b	50
	IV	2	50
Lateral Ground Water	I	----	70 c 10 d
Movement Interceptor	II	----	70 c 10 d
	III	----	50 c 10 d
	IV	----	50 c 10 d
Low Point of Sink Holes When Placed			
within the Bowl of the Sink Hole	I, II, III, IV	----	100
Utility Lines	I, II, III, IV	----	10

a The set back distance may be reduced to 10 feet in Group III and IV soils and 20 feet in Group I and II soils if the subsurface soil absorption system is designed to produce unsaturated flow condition in the soil.
b Vertical Distance to the invert of the drain tile in the water table depressor system.
c Absorption trench up slope from interceptor.
d Absorption trench down slope from interceptor.
e Arc of 180 degree up slope of spring and 100 ft. down slope.

Table D-9 - Summary of Separation Distances between Systems Using Naturally Occurring Undisturbed Soils and Limiting Site Factors.

	In-Ground System 1		Shallow-placed System 1	
Site Factor	Septic Tank Effluent	Secondary Effluent	Septic Tank Effluent	Secondary Effluent
Bed Rock	18"	12"	n/a	18 "(2)
Restriction	18"	12"	n/a	18"
Shrink-Swell Soil	18"	12"	n/a	18"
Slope	50.00%	50.00%	n/a	50.00%
Perc Rate	5-120 mpi	5-120 mpi	n/a	5-45 mpi (3)
Water Table	18"	12"	n/a	12"

1 The separation distances for in-ground and shallow-placed systems are measured from the trench bottom or other infiltrative interface vertically down to listed site factor.

2 See also 12 VAC 5-610-596.C.2
3 See also 12 VAC 5-610-596.C.1

WASHINGTON

246-272-09501 Location.

(1) Persons shall design and install OSS to meet the minimum horizontal separations shown in Table D-10, Minimum Horizontal Separations:

Table D-10 - Minimum Horizontal Separations

Items Requiring Setback	From edge of disposal component and reserve area	From septic tank, holding tank, containment vessel, pump chamber, and distribution box	From building sewer, collection, and non-perforated distribution line[1]
Non-public well or suction line	100 ft.	50 ft.	50 ft.
Public drinking water well	100 ft.	100 ft.	100 ft.
Public drinking water spring[3]	200 ft.	200 ft.	100 ft.
Spring or surface water used as drinking water source[2,3]	100 ft.	50 ft.	50 ft.
Pressurized water supply line[4]	10 ft.	10 ft.	10 ft.
Properly decommissioned well[5]	10 ft.	N/A	N/A
Surface water[3]			
Marine water	100 ft.	50 ft.	10 ft.
Fresh water	100 ft.	50 ft.	10 ft.
Building foundation	10 ft. [6]	5 ft. [6]	2 ft.
Property or easement line [6]	5 ft.	5 ft.	N/A
Interceptor / curtain drains/ drainage ditches			
Down-gradient[7]	30 ft.	5 ft.	N/A
Up-gradient[7]	10 ft.	N/A	N/A
Down-gradient cuts or banks with at least 5 ft. of original, undisturbed soil above a restrictive layer due to a structural or textural change	25 ft.	N/A	N/A
Down-gradient cuts or banks with less than 5 ft. of original, undisturbed, soil above a restrictive layer due to a structural or textural change	50 ft.	N/A	N/A

[1] "Building sewer" as defined by the most current edition of the Uniform Plumbing Code. "Non-perforated distribution" includes pressure sewer transport lines.

[2] If surface water is used as a public drinking water supply, the designer shall locate the OSS outside of the required sanitary control area.

[3] Measured from the ordinary high-water mark.

[4] The local health officer may approve a sewer transport line within 10 feet of a water supply line if the sewer line is constructed in accordance with section 2.4 of the department of ecology's "Criteria For Sewage Works Design," revised October 1985, or equivalent.

[5] Before any component can be placed within 100 feet of a well, the designer shall submit a "decommissioned water well report" provided by a licensed well driller, which verifies that appropriate decommissioning procedures noted in chapter 173-160 WAC were followed. Once the well is properly decommissioned, it no longer provides a potential conduit to groundwater, but septic tanks, pump chambers, containment vessels or distribution boxes should not be placed directly over the site.

[6] The local health officer may allow a reduced horizontal separation to not less than two feet where the property line, easement line, or building foundation is up-gradient.

[7] The item is down-gradient when liquid will flow toward it upon encountering a water table or a restrictive layer. The item is up-gradient when liquid will flow away from it upon encountering a water table or restrictive layer.

(2) Where any condition indicates a greater potential for contamination or pollution, the local health officer or the department may increase the minimum horizontal separations. Examples of such conditions include excessively permeable soils, unconfined aquifers, shallow or saturated soils, dug wells, and improperly abandoned wells.

(3) The horizontal separation between an OSS disposal component and an individual water well, spring, or surface water can be reduced to a minimum of 75 feet, by the local health officer, and be described as a "conforming" system upon signed approval by the health officer if the applicant demonstrates:

(a) Adequate protective site specific conditions, such as physical settings with low hydro-geologic susceptibility from contaminant infiltration. Examples of such conditions include evidence of confining layers and or aquatards separating potable water from the OSS treatment zone, excessive depth to groundwater, down-gradient contaminant source, or outside the zone of influence; or

(b) Design and proper operation of an OSS system assuring enhanced treatment performance beyond that accomplished by meeting the vertical separation and effluent distribution requirements described in WAC 246-272-11501(2)(f) Table IV; or

(c) Evidence of protective conditions involving both 3(a) and (b) of this section.

(4) Persons shall design and/or install disposal components only where:

(a) The slope is less than forty-five percent (twenty-four degrees)

(b) The area is not subject to: (i) Encroachment by buildings or construction such as placement of swimming pools, power poles and underground utilities; (ii) Cover by impervious material; (iii) Vehicular traffic; or (iv) Other activities adversely affecting the soil or the performance of the OSS.

(c) Sufficient reserve area for replacement exists to treat and dispose 100% of the design flow;
(d) The land is stable; and
(e) Surface drainage is directed away from the site.

(5) A local health officer may allow expansion of an existing on-site sewage system adjacent to a marine shoreline that does not meet the minimum horizontal separation between the disposal component and the ordinary high water mark required by WAC 246-272-09501 Table I, provided that:
(a) The system meets all requirements of WAC 246-272-11501;
(b) The system complies with all other requirements of WAC 246-272-09501 and WAC 246-272-17501;
(c) Horizontal separation between the disposal component and the ordinary high water mark is 50 feet or greater; and
(d) Vertical separation is 3 feet or greater with a conventional gravity drainfield, or 2 feet or greater with a conventional pressure distribution drainfield.

APPENDIX E

Design Daily Flow Summary/Range

Table E-1. Commercial Establishments

Number	Type of Establishment	Flow Rates (gpd)
1	Airline Catering (per meal served)	3
2	Airport (per passenger not including food)	4 - 5 (150 min./establish/day)
3	Airport (per employee)	10 -15 15 per 8-hr shift
4	Auto Service Station (per public restroom)	325 - 630 150 -no gas; 450 min for sys design
5	Auto Service Station (per car serviced)	5 - 250 500 min./establish/day 10 (/car serviced); 15(/employee)
6	Auto Service Station (per island)	125 (+ add. Fuel pump) - 500(per1st +300/add. pump)
7	Bakery (per bakery)	10 (+40 for deli)(per 100 sq. ft) 100 (+15 per employee)
8	Barber Shops (per chair)	50 - 100 150 (+35 per operator)
9	Barber Shops (per station)	300
10	Beauty Salon (per chair)	75 - 200 150 (+35 per operator)
11	Bus Service areas not including food (per passenger)	5 5(+15/employee)
12	Country Club not including food (per member)	20 - 100 (2,000 min./establish/day)
13	Country Club (add. Per member or patron)	25
14	Country Club, dining room, snack bar, or lunch room (per seat)	10
15	Country Club, lockers and showers (per locker)	20
16	Country Club (per employee)	15 per 8-hr shift
17	Day workers at offices (per person per 8 hr shift)	15-35
18	Drive-in theatre	5-20, 1,000 min./est/ day
19	Factories and plants (exclusive of industrial wastes) per shift	15 - 35 150min./establish/day
20	Factories and plants w/ showers (per shift)	15 - 35 300min./establish/day
21	Factories or Industrial plant without cafeteria (per person)	15

Number	Type of Establishment	Flow Rates (gpd)
22	Factories or Industrial plant with cafeteria (per person)	20 - 25
23	Hotels, motels and rooming houses (per room)	45 - 200 600min./establish/day
24	Hotels, w/o private baths (per room)	100 - 130 500min./establish/day
25	Motels (per room)	40 - 130 400min./establish/day 120(per room); 40(per person)
26	Motels w/ kitchens (per room)	50 - 175 500min./establish/day
27	Movie Theaters (per auditorium seat - not including food)	3 -5 300min./establish/day
28	Stores (per public toilet)	200 - 550 (+15 / employee +20/shower)
29	Stores	0.1 - 0.2 (by sq. ft.) 200 - 400 (absolute) 1 - 2 (per parking space)
30	Work or construction camps	50 - 60 1,000min./establish/day (40/person w/ chemical toilets)
31	Office (avg 200 sq.ft/person - gross area)	6 - 30
32	Small Retail building < 2000 sq. ft - gross area	50 - 300 200min. for system design
33	Large Retail/Commercial building per sq. ft of gross area	0.075 - 0.1 200min. for system design
34	Bed & Breakfast (per establishment)	60 - 225 (+75 per rental room) 440min. for system design
35	Bed & Breakfast (w/Restaurant open to public	110 (+35 per seat); 1,000 min allowable system
36	Boarding houses (per house)	50 -- 225 + 50/boarder
37	Warehouses	35absolute 15 (/ employee / 8-hr shift)(+100/loading bay)(+1 /self storage units (upto 200 units))
38	Fire stations	5
39	Rooming Houses w/ meals	40 - 60
40	Rooming Houses w/o meals	40 - 65 absolute 180 (/house +30 /roomer) 1,000min./establish/day

Number	Type of Establishment	Flowrates (gpd)
41	Visitor center (per visitor)	5 – 6 (+15/employee)
42	Meat Markets (per 100 s. ft of market floor space)	50 10 (+75 / 100 sq. ft) 100(per shop)(+15 per employee)
43	Meat Markets (add. Per market employee)	25 10(+200 /water closet)

Table E-2. Recreational Establishments

Number	Type of Establishment	Flow rates (gpd)
1	Camps, day (no meals served)	10 - 60 15/camper + 15/employee 300 min./establish/day
2	Camps, RV, trailer or campground w/ individual sewer hookup - no central toilets/ showers (per space)	50 - 150 35/person 100(+10/person) 500 min./establish/day
3	Camps, resident w/mess hall (per person)	10 - 25
4	Camps, day w/mess hall (per person)	3 - 15(+3/meal)
5	Camps, day, washroom & toilets (per person)	10 - 35 100 min./establish/day
6	Camps, trailer w/o sewer hookup (per site)	50 - 200 300 min./establish/day
7	Camps, w/central bath houses-toilets and showers (per space)	35-100
8	Camps w/ toilets only (per space)	25 - 50 25/ person 500 min./establish/day
9	Camps, Resorts (night and day w/ limited plumbing)	35 - 65 25/camper +15/employee C66
10	Cottages and small dwellings w/ seasonal occupancy (2 person / bedroom min.)	25 - 200 50/bed +15/employee(50 /cabin +50/bed) 100 /person (350 min./unit/day
11	Dump station (per RV/trailer space)	12 - 75 10/ site
12	Bath house (per person)	10 - 20
13	Fairgrounds and parks, picnic w/ bath houses, showers, and flush toilets	10 - 25 2/attendee
14	Fairgrounds and parks, picnic (toilet waste only)	5 - 10 3/person
15	Marinas (toilet waste only, per boat slip)	10-100 (+10/slip) 500 min. for system design
16	W/bath houses(per boat slip)	20-30
17	Swimming pools and bath houses	10 –15, 10: 15/ employee 1,000 / 800 sq. ft. 300 min./establish/day

Recreational flow rate	Type of Establishment	Flow Rates (gpd)
18	Luxury camps, per person	75 - 100 2,000 min./establish/day
19	Indoor Tennis courts, per court	250 - 400 300;(+15/employee; 1 design flow for any eating spaces)
20	Outdoor Tennis courts, per court	150 - 250
21	Theaters, Sporting Events per seat	3 - 10
22	Bowling alley per lane	50 - 200 +5/patron if food is served
23	Dance Halls	2 - 15 5/attendee +1/employee
24	Assembly Areas (per seat)	2 - 12
25	Amusement Center (per sq. ft)	2 3/seat
26	Skating Rink (per seat)	5 (3000 min allowable for sys design) same as gyms
27	Gymnasium (per occupant)	10 - 25 +15/employee
28	Gymnasium (per spectator)	3 +15/employee
29	Public Park, toilet waste only (per person)	4 -10 +15/employee 150 min./establish/day
30	Public Park, bath house, showers, And flush toilets (per person)	10 -15 +15/employee 300 min./establish/day
31	Ski areas (w/o cafeterias)	10
32	Ski areas (w/ cafeterias)	15
33	Beach club	25 (per person)

Table E-3. Eating and Drinking Establishments

Number	Type of establishment	Flow rate (gpd)
1	Bars / Lounges (per seat)	10 - 50 +15/employee C93
2	Bars / Lounges (add per pool table or video game)	15 - 100
3	Bars / lounges (per customer)	6 - 35 +(15 - 35)/employee
4	Restaurants (along freeways, per seat)	70 - 180
5	Restaurants (toilet and kitchen wastes per patron)	10 - 70 15/sq. ft of dining area 5(sanitary waste only) +15/employee
6	(additional for bars and cocktail lounges)	2 - 5
7	Restaurants (kitchen wastes per meal served)	3 -35 20(/indoor seat + 7/outdoor seat + 15/employee) 300 min./establish/day
8	Restaurants (w/ paper service per meal served)	1.5 - 75 for 24-hr service 1.5 - 20 operating less than 16 hr/day 30 (/indoor seat + 10/outdoor seat + 15 /employee) 3 or more meals/day
9	Restaurants (w/o toilets) per meal served	4 - 35
10	Drive -in Restaurant (per car space)	5 -100 30(+15/employee) 150/seat; 100 min./establish/day
11	Fast-food Restaurants (per seat)	15 – 350 100 or 1/meal served +15 /employee(no seats); 20 /indoor seat + 7/outdoor seat+ 15 /employee) 1,000 min./establish/day
12	Coffee Shop	5
13	Cafeteria	5 30/sat + 15/employee(open to public); 15/seat +15/employee (not open to public)
14	Ice cream stands	150 per stand + 15/employee
15	Delicatessen (food prepared)	100 per deli or 1/meal served + 15/employee
16	Delicatessen (no food prepared)	50 per deli + 15/employee

Table E-4. Institutional Establishments

Number	Type of establishment	Flow rate (gpd)
1	Churches (per auditorium seat - not including food)	1 - 5
2	Additional per meal served	1 - 10
3	Sunday School, per pupil	2
4	Domiciliaries (per bed space)	100 - 200 150(+15/employee) 150 (/resident); 150(/bed); 15(/employee) 100 (+5/meal served) 120, 60/bed w/o laundry service
5	Institutions other than hospitals (per bed space)	100 - 200 1,250 min./establish/day 125/bed;+15/employee 100 (+5/meal served)
6	Laundry Non-commercial (per machine per day)	400 - 750 +15/employee 2,500 min./establish/day Discharge to ISDS prohibited
7	(per load)	15 - 50
8	Schools, Boarding	65- 250 75(+15/employee or teacher) 3,000 min./establish/day
9	Schools (per student)	10 - 75 5 - 15 Elementary, 9 -20 Jr. High, 12 - 20 High School 10(+15/employee or teacher) 450 min./establish/day 10-15 w/o cafeteria, gym and showers
10	Schools (with cafeterias)	10 - 20 10(+4/ cafeteria)
11	Schools (with cafeterias, gym, and showers)	3 - 25 25 if containing laboratories 10 - Elementary, 20 - Secondary & Middle 750 min./establish/day
12	Schools (kitchen)	3-20 8 – Elementary 15 Secondary & Middle 750 min./establish/day
13	Kindergarten	10

Number	Type of establishment	Flow rate (gpd)
14	Day care Center (no meals prepared)	10 - 20 10 /child; +15/adult; +25/employee-Serving meals
15	Hospitals (per bed)	200 - 300 150(+15/employee) 200 (+5/meal prepared) 250(150/bed Mental Hospitals) 2,500 min./establish/day
16	Dormitory/Community College (per student)	15 - 75
17	Prison (per inmate)	125 - 150 (+15/employee)
18	Health Club	5 (/member Civic Club) 10(/participant);(+/spectator and +15/employee)

Table E-5. Miscellaneous

Number	Type of establishment	Flow rate (gpd)
1	Kennel Dog Runs, per run - roof must be provided	0.2 10(vet clinics per animal) 50 (per Kennel) 250(vet Clinics per Practitioner); (+15/employee/8-hr shift); (+20/Kennel)
2	Doctor and Dental offices (per practitioner)	200 - 500 200 - 450 Dental office per chair 80/medical staff; (+5/patient +15/employee)
3	Doctor and Dental offices (add. Per employee)	5 - 35 (+5 - 10/patient)
4	Dental and Medical Offices w/ Examination room, (per sq. ft of gross area)	25 - 500
5	Banquet Halls (per seat)	5 - 25
6	Flea Market open 3 days or less per week (per non-food service vendor space)	15
7	Flea Market (add. Per food service establishment using single service articles only per 1,000 sq. ft of floor space)	50
8	Flea Market (per limited food service establishment)	25
9	Town Halls	5
10	Town Offices	15 / employee; 5 /transient
11	Dining Halls (per seat)	5

Appendix F

Repair/Alteration Regulations

FLORIDA

64E-6.015 PERMITTING AND CONSTRUCTION OF REPAIRS

All repairs made to a failing onsite sewage treatment and disposal system shall be made only with prior knowledge and written approval from the DOH county health department having jurisdiction over the system. Approval shall be granted only if all of the following conditions are met:

(1) Any property owner or lessee who has an onsite sewage treatment and disposal system which is improperly constructed or maintained, or which fails to function in a safe or sanitary manner shall request from the DOH county health department, either directly or through their agent, a permit to repair the system prior to initiating repair of the system. A permit shall be issued on Form DH 4016, hereby incorporated by reference, only after the submission of an application accompanied by the necessary exhibits and fees. Form DH 4015, 10/96, hereby incorporated by reference, shall be used for this purpose, and can be obtained from the department. Applications shall contain the following information:

- (a) A site plan showing property dimensions, the existing and proposed system configuration and location on the property, the building location, potable and non-potable water lines, within the existing and proposed drainfield repair area, the general slope of the property, property lines and easements, any obstructed areas, any private or public wells, or any surface water bodies and stormwater systems in proximity to the onsite sewage system which restricts replacement or relocation of the drainfield system. The existing drainfield type shall be described. For example, mineral aggregate, non-mineral aggregate, chambers, or other.
- (b) The size of the septic tank or other treatment tank currently in use and the approximate square footage and elevation of the drainfield existing on the site.
- (c) The quantity and type of waste being discharged to the system. Where water use records cannot be obtained, estimates shall be made from values found in Rule 64E-6.008, Table I.
- (d) The soil textures encountered within the existing and proposed drainfield areas, and the estimated water table during the wettest season of the year.
- (e) Any unusual site conditions which may influence the system design or function such as sloping property, drainage structures such as roof drains or curtain drains, and any obstructions such as patios, decks, swimming pools or parking areas.
- (f) The person performing the site evaluation shall provide a brief description of the nature of the failure which is occurring.

(2) Site evaluations necessary to obtain the above referenced information shall be conducted at the expense of the owner or lessee by department personnel, by an engineer who is registered in the State of Florida, or by other qualified persons as per Rule 64E-6.004(3). Site specific information may be obtained by the

applicant through examination of department records of permits previously issued for the site.

(3) When a repair is to be performed on a failing system in which the contractor will be using any method other than drainfield addition or replacement, the following additional permit application information shall be submitted to the county health department by the contractor. This is in addition to the information required in Rules 64E-6.015(1) and (2).

(a) The process used to repair the system. For example, hydrogen peroxide treatment or high-pressure injection of air alongside the drainfield. Such information shall include the manner in which the proposed repair will take place. The manufacturer's recommended method for product use, quantities and concentration of product, shall be included in this information.

(b) Any chemical compound to be introduced into the system in an effort to repair the system shall be identified by chemical composition or trade name, including the concentration and quantity of product used. The method of product introduction shall be stated. For example, product introduced through the distribution box.

(c) Any repair method proposed which intends to physically disrupt the absorption surface shall include a drawing of the drainfield system that includes a diagram of the sites where the absorption surface will be disrupted. The depth of each disruption shall be recorded at each site.

(4) Where the absorption surface of the drainfield is within 6 inches of the wet season high water table, an alternative repair method addressed in 64E-6.015(3) shall not be used. The existing drainfield shall be removed and a replacement drainfield shall be installed in accordance with all other repair criteria, including separation from seasonal high water table and drainfield sizing. Rule 64E-6.015(6)(f) shall be used to determine septic tank conformance.

(5) The department shall make every effort to issue a permit within 2 working days after receiving the application for system repair. Repair permits shall be valid for 90 days from the date of issuance. However, if the system is maintained to not create a sanitary nuisance, a repair permit shall be extended for one 90 day period.

(6) Construction materials used in system repairs shall be of the same quality as those required for new system construction. Aggregate and soil in spoil material from drainfield repairs shall not be used in system repair in any manner.

Undamaged infiltration units, pipes and mechanical components may be reused on the original site. Any spoil material taken off site shall be disposed of in a permitted landfill or shall be limed and stockpiled for at least 30 days to prevent a sanitary nuisance. Offsite spoil material stockpile areas shall meet the prohibition requirements of Rule 62-701.300(2), FAC. The resulting lime-treated material shall not be used for drainfield repair, or construction of any onsite sewage treatment and disposal system. Any use of the lime treated material shall not cause a violation of Chapter 386 F.S., and shall not impair groundwater or surface water. Mineral aggregate and soil in spoil material may, at the option of the septic tank contractor and the property owner, be buried on site if limed before burial. Lime amount must be sufficient to preclude a sanitary nuisance.

Depth of seasonal high water table to the spoil material must be at least six inches. Setbacks for buried spoil material shall be the same as for onsite sewage treatment and disposal system drainfields. A minimum of six inches of slightly or moderately limited soil shall cover the spoil material and shall extend to at least five feet around the perimeter of the burial site. Any failing system shall, at a minimum, be repaired in accordance with the following criteria:

(a) System repairs shall comply with minimum setbacks and separations as specified in Rule 64E-6.005. If current required setbacks and separations cannot be met, lesser setbacks as specified shall be maintained. For repairs only, if current required setbacks given below cannot be attained, absolute minimum setbacks shall be met. When site conditions exist which allow either absolute or current required setbacks to various features, current required setbacks shall be maintained from features with the highest protection factor. Setbacks to features with lower protection factors shall be reduced to the maximum setback or separation attainable, with no less than the absolute minimum setback allowed. A standard gravity flow system is to be used when possible to achieve the appropriate separations of absorption surface to seasonal high water and effective soil depth.

2. Table F-1 and F-2 values are for subsurface and filled systems if the existing drainfield cannot be used as part of the repair. Mound trench systems shall be sized 10 percent larger than the values below and 20 percent larger if absorption beds are installed in the mound. The amount of drainfield installed during the repair shall not be less than the amount the system had prior to the repair.

Table F-1 - Residential Sizing for Slightly Limited Soil Textures

Number of Bedrooms	Square Feet of Trench Area	Square Feet of Absorption Bed
1	75	100
2	150	200
3	225	300
4	300	400
Add per bedroom	75	100

Table F-2 - Residential Sizing for Moderately-Limited Soil Textures

Number of Bedrooms	Square Feet of Trench Area	Square Feet of Absorption Bed
1	100	125
2	200	250
3	300	375
4	400	500
Add per bedroom	100	125

(d) Repairs of commercial systems installed prior to 1983 shall be based on the following criteria:

1. Sewage flows shall be determined from values found in Table I of 64E-6.008 or on the highest monthly flow for the previous 18 month period from documented water use records, whichever is higher.

2. Failed drainfields shall at a minimum, meet the sizing criteria specified below.
a. If sufficient room is available, the existing drainfield can be left in place and used as part of the system. A new drainfield equal in size to, and separate from, the existing failed drainfield shall be added.
b. Sewage loading rates to trench or absorption bed bottom areas shall be in accordance with the values in Table F-3 which are applicable to subsurface and filled drainfield systems if the existing drainfield is replaced with a new drainfield.

Mound trench systems shall be sized 10 percent larger than the values below and 20 percent larger if absorption beds are installed in the mound.

Table F-3 - Drainfield Sizing for Commercial Systems Installed Prior to 1983 in gallons/square foot/day

	Trenches	Absorption Beds
Slightly limited textures	1.00	0.80
Moderately limited textures	0.65	0.50

(e) Where the cause of system failure is determined to be from root clogging of the distribution box or drainfield line of a system, and where removal of the root mass and replacement of damaged drainfield material will restore the system to its original design function, upon inspection and verification of the repair work by the health unit, permit satisfaction will be considered to be achieved.

(f) A tank need not be replaced as part of the repair if the health unit determines the tank to be structurally sound, constructed of approved materials, and if such tank has an effective capacity within two tank sizes of the capacities required by Table II. In addition, the tank shall be pumped and a solids deflection device shall be installed as a part of the outlet of the tank if one is not currently in place.

(g) Repairs to a system shall not be located within 2 feet of a sleeved and sealed potable water line or 2 feet from non-potable water lines.

(h) If the total drainfield area exceeds 1000 square feet, or if the tank is too low to permit gravity flow into the drainfield, the drainfield shall be dosed. The requirements of Rule 64E-6.014(3) shall be used for dosing requirements.

(i) Setbacks from an existing system to a public well shall not be decreased from existing setbacks, but shall be increased where practical to achieve the required setbacks as per Rule 64E-6.005(1)(b) and (c).

(7) If a repair cannot be made utilizing the standards in (6) above, all available area for drainfield repair shall be assessed and the repair permit shall allow for the maximum size drainfield that can be accommodated in the available area while allowing for the system to be installed above the wet season water table. Total removal of the existing drainfield and replacement of the drainfield in its original location shall be authorized if there is no additional area to enlarge the system. Setbacks to wells, surface water bodies, and other pertinent features that are less than the setbacks in (6) above shall not be reduced below existing setbacks. Nothing in this section shall be construed to allow a drainfield to remain in the wet season water table. The appropriate requirements for bottom of drainfield absorption surface to wet season water table separation in Table V shall be adhered to in all repairs.

(8) If soil replacement is to be performed on any repair, the requirements of Footnote 3., Table III, shall be adhered to.

(9) System repairs shall be performed by persons who are qualified to do so as set forth in Part III of this rule.

(10) Except as provided for in (7) above, the amount of drainfield installed during the repair shall not be less than the amount the system had prior to the repair.

(11) Rule 64E-6.004(7) shall be used in conjunction with this section when permitting a repair in which the property has been divided after the original permit was issued.

(12) For inspection purposes when a drainfield is repaired using a physical disruption method, such as air injection, the contractor shall mark the location of each injection site in an easily identifiable manner.
(a) The county health department shall inspect repairs to determine that the absorption surface of the repaired drainfield is at least six inches above the wet season high water table, to determine the repair process was completed according to the information provided with the repair permit application and to determine the repair site is free of sanitary nuisance conditions.

(b) The county health department shall keep a separate file for repairs completed using physical disruption methods. These records shall be used to provide periodic follow-up evaluations of a sampling of these systems to determine the general long-term effectiveness of this type of repair. The follow-up protocol and evaluation procedure shall be provided by the Bureau of Onsite Sewage Programs.

Specific Authority: 381.0011(13), 381.006, 381.0065(3)(a), 489.553(3) and 489.557(1) FS. Law Implemented: 154.01,
381.001(2), 381.0011(4), 381.0012, 381.0025, 381.006(7), 381.0061, 381.0065, 381.0067, 386.041, FS. History - New 3-17-92,
Amended 1-3-95, 2-13-97, Formerly 10D-6.0571, Amended 2-3-98, 3-22-00.

Maine

SECTION 104.0 REPAIRS AND MAINTENANCE

104.1 Disposal system permit not required: A disposal system permit is not required for minor repairs or replacements made as needed for the operation of pumps, siphons or accessory equipment, the clearance of a stoppage, or sealing of a leak in the septic tank, holding tank, pump tank, or building sewer.

104.2 Disposal field modification, repair or alteration: Any modification, repair or alteration of the disposal field, other than the addition of fill requires the decision of the Local Plumbing Inspector as to whether or not a permit is required. If a permit is required, such modification, repair or alteration shall be as prescribed by a Maine Registered Professional Engineer or a Maine Licensed Site Evaluator and shall be considered a disposal field for permitting purposes.

104.3 Maintenance: All new and existing systems shall be maintained in a safe and sanitary condition. All service equipment, devices, and safeguards required by this code, or that were required for a system by previous subsurface waste water disposal codes, shall be maintained in good working order when installed, altered, or repaired.

104.4 Property owner's responsibility: The property owner or property owner's agent shall be responsible for the safe and sanitary maintenance of the system at all times.

No practical alternative: Due to site conditions, lot configuration, or other constraints, the replacement, repair or alteration of an existing system, in full compliance with this code, is not achievable without the employment of extraordinary measures or cost.

SECTION 105.0 APPROVAL

105.2 Modifications: When there are practical difficulties involved in carrying out the provisions of this code, the Department may vary or modify such provisions upon a variance request by the applicant. Variances may be granted provided that the intent of this code is observed and public health, safety, and welfare are assured. The variance request for modifications and the final decision of the plumbing inspector or the Department shall be in writing and officially recorded with the variance application in the permanent records of the jurisdiction. See Chapter 20.

SECTION 117.0 MUNICIPAL RECORDS

117.4.2 Modifications: Modifications to plans or applications made subsequent to the issuance of a disposal system permit to construct, install, or alter systems;

SECTION *3*01.0 GENERAL DEFINITIONS

Alteration: Any change in the physical configuration of an existing system or any of its component parts. This includes the replacement, modification, installation, addition, or removal of system components, or increase in size, capacity, type, or number of one or more components. The term "alter" shall be construed accordingly.

SECTION *17*01.0 EXISTING DISPOSAL SYSTEMS

***17*01.1 Alterations:** Alterations made to a system for reasons other than a change of use, as described in Section *17*02.0, may be approved by the plumbing inspector provided that all requirements of this Section are met.

***17*01.1.1 Application for disposal system permit:** Any modification, repair or alteration of the disposal field, other than the addition of fill requires the determination of the Local Plumbing Inspector as to whether or not a permit is required. If a permit is required, such modification, repair or alteration shall be as prescribed by a Maine Registered Professional Engineer or a Maine Licensed Site Evaluator and shall be considered a disposal field for permitting purposes.

***17*01.1.2 Conformity with this code:** Alterations to any system shall be made with such that the components being altered conform to the requirements of this code as closely as possible, as determined by the plumbing inspector.

***17*01.2 Existing overboard discharge:** Any individual discharging treated or untreated waste water or having a valid license to discharge waste water to the waters of the state may install a system as a replacement system.

SECTION *17*02.0 EXPANSION OF EXISTING STRUCTURES

***17*02.1 General:** Title 30-A §4211 Subsection 3.B states that, "No person may expand a structure using an existing subsurface wastewater disposal system until documentation is provided to the municipal offices and a notice of the documentation is recorded in the appropriate registry of deeds so that, in the event of a future malfunction of the system, the disposal system can be replaced or enlarged to comply with the rules adopted under Title 22, §42, [this code] and any municipal ordinances governing subsurface wastewater disposal systems. No requirements of this code or ordinances may be waived for an expanded structure."

***17*02.2 Expansion:** As defined in Chapter *3*, an expansion requires larger system components as prescribed in this code. Changes to a structure that are not expected to increase the design flow such as the addition of a living room, a screen porch, sun room, etc. are exempt from the requirements of this Chapter.

***17*02.3 Evaluating system components:** Chapter *5* shall be used to evaluate the capacity of the existing system and to project the increases in capacity needed to serve the proposed expansion.

***17*02.4 Design criteria:** Expanded systems shall meet first-time system design criteria in Tables *6*00.2 and *7*00.2. One-time exempted structures shall meet the design criteria set forth in Tables *6*00.3 and *6*00.4 and Tables 700.3 and 700.4.

17*02.5 One-time *design flow increase: One-time increases in the design flow of a structure or a change in use of a structure such that there is an increase in design flow are allowed without being required to meet first time system requirements, provided the requirements of this Section are met. The following systems are considered *such increases* if:

***17*02.5.1 Single family dwellings, non-primitive system:** The addition or alteration to a single family dwelling served by pressurized water, treatment tank and gray or combined disposal area, when no more than one bedroom is added, or an alternative toilet is being replaced with a conventional water closet. If these requirements cannot be met, and the proposed replacement system significantly improves the situation, the Department would entertain a variance to the Rules.

***17*02.5.2 Single family dwellings, primitive system:** The addition or alteration of a single family dwelling not served by pressurized water, so that no more than one additional bedroom is added. NOTE: The replacement of an alternative toilet with a flush requiring pressurized water is a non-exempted expansion and must meet first time system criteria.

***17*02.5.3 Other structures:** The addition to and/or change of use of a structure, which does not result in more than 25% additional wastewater generation. (Note - providing pressurized water to a structure which previously had hand carried or hand pumped water is considered to be an increase in wastewater greater than 25%); and,

***17*02.5.4 Design criteria:** The design criteria can meet the requirements of Tables *7*00.3, *7*00.4, and if outside shoreland zone, Table *6*00.3, or if within shoreland zone, Table *6*00.4.

***17*02.6 Expansion of systems in shoreland zone:** Structures with disposal systems located within the shoreland zone area of major waterbodies/courses may expand provided that they meet the following requirements:

***17*02.6.1 One-time exemptions:** The expansion meets the definition of a "one-time exemption" in Chapter *3*, Subsection *17*02.5 and substantial compliance in Section *18*03.0, Table 600.4 and Table *7*00.4.

***17*02.6.2 Other expansions:** For other expansions the requirements for first time systems shall be met. See Chapters *6* and *7*.

***17*02.6.3 System must be upgraded:** The expansion system must be installed at the time of expansion. Note: Systems designed for seasonal conversion purposes shall be installed prior to converting the structure's use.

SECTION *17*03.0 SYSTEMS NOT UPGRADED AT THE TIME OF EXPANSION - OUTSIDE OF SHORELAND ZONE

***17*03.1 General:** If the system is located outside of the shoreland zone of major waterbody/course and the property owner elects not to install an approved backup system at the time of the expansion, the expansion can only occur after the requirements of this Section are met (see Title 30-A, 4211.3.B). Note: Systems designed for expansions of nonresidential uses or structures resulting in an increase of more than 25 percent of the existing design flow must be installed at the time of expansion.

***17*03.2 Documentation:** The applicant shall provide a completed HHE-200 to the plumbing inspector showing that, if the existing system malfunctions in the future, the existing system can be replaced or enlarged to comply with this code and any municipal ordinances that apply to systems. The documentation shall include a site plan showing:

***17*03.2.1 System:** The location of the existing system and the location of the replacement or enlarged system;

***17*03.2.2 Lot lines:** The approximate location of the lot lines; and

***17*03.2.3 Wells:** The location of existing wells serving the lot on which the replacement system will be located as well as those within the applicable well setback distances.

***17*03.3 Functional system:** The existing disposal system shall be shown to be functioning properly and installed with applicable permits and approval.

***17*03.4 Registry of deeds:** A notice of the documentation required in Subsection*17*03.2, shall be recorded in the appropriate registry of deeds. The Department will prescribe the form of the notice to be recorded in the County Registry of Deeds.

***17*03.5 Notify abutters:** The person seeking to expand a structure shall send a copy of the notice of documentation, by certified mail, return receipt requested, to all owners of abutting lots.

***17*03.6 Protection of future installation:** After the notice of documentation required in this Section is recorded, no owner of abutting property may install a well in a location that would prevent the installation of the replacement system. The owner of the lot on which the replacement system will be installed may not erect any structure on the proposed site of the replacement system or conduct any activity that would prevent the use of the designated site for the replacement system.

SECTION *20*06.0 REPLACEMENT SYSTEM VARIANCE REQUEST

***20*06.1 Conditions applicable to all replacement system variance requests:** The following conditions apply to all replacement system variance requests regardless of whether final disposition is with the LPI or the Department.

***20*06.1.1 Completed application for a disposal system permit:** A completed application for a permit to install a system or part of a system shall be submitted to the LPI. It shall include complete plans and specifications for the proposed system and other pertinent information as required on the HHE-200 or HHE-233 (holding tank) forms.

***20*06.1.2 Requirement which cannot be met:** The application shall indicate the section(s) and/or provision(s) of the rules for which a variance is being requested.

***20*06.1.3 Basis for a variance request:** The reasons why the condition(s) set forth cannot be met.

***20*06.1.4 Application Review Fee:** The replacement system application review fee, as indicated in Table 110.2 and Table 110.3 shall be submitted to the LPI.

***20*06.1.5 Minimum reduction necessary:** The variance request is for the minimum reduction necessary to any requirement of the rules to accomplish the replacement system installation.

***20*06.1.6 No conflict with local ordinances:** The request for a replacement system variance does not conflict with any local ordinance(s) or other rule(s) or statute(s).

***20*06.1.7 Meets definitions of replacement system:** The replacement system variance request is to correct an existing, legal system which is malfunctioning or to replace an overboard discharge system or qualifies as an exempted expansion outside the shoreland zone of major water course.

***20*06.1.8 Additional engineering or measures:** If pretreatment or other additional measures are being proposed, the application shall show how the proposed system and measures meet applicable sections of the rules, including Chapter *6*.

***20*06.2 Replacement system variance requests which are within the limit of the LPI's authority:** Replacement System Variance Requests may be decided upon by the LPI, without Department review, if the following conditions are met:

***20*06.2.1 Standard conditions:** All of the conditions of subsection *20*06.1 are met:

***20*06.2.2 Setback reductions:** Setback reductions are no greater than allowed in Table *7*00.3;

***20*06.2.3 Minimum soil conditions:** Reductions in minimum soil conditions are no greater than allowed in Table *6*00.3;

***20*06.2.4 Fill extension slope:** The fill extension slope is no greater than 3:1 or 33%;

***20*06.2.5 Wastewater strength:** The BOD5 plus suspended solids content of the wastewater is no greater than that of normal domestic effluent.

***20*06.3 Replacement system variance requests which are beyond the limit of the LPI's authority:** Replacement System Variance Requests which are beyond the LPI's limit of authority must be submitted to the Department for review and disposition. They must meet the following conditions:

***20*06.3.1 Standard conditions:** All of the conditions of subsection *20*06.1 are met;

***20*06.3.2 LPI signature:** The completed application, including HHE-204 or HHE-233 form, has been reviewed and signed by the LPI;

***20*06.3.3 Flexibility:** The Department may be as flexible as is necessary to correct an existing, public health hazard.

New Jersey

N.J.A.C. 7:9A, Page 14
7:9A-3.3 Existing systems

(a) The use of systems in existence prior to the effective date of this chapter may be continued without change provided that these systems were located, designed, constructed and installed in conformance with the standards in effect at the time when they were installed and provided that such systems are not malfunctioning.

(b) When an expansion or a change in use of a commercial building or facility served by an existing individual subsurface sewage disposal system is proposed and such expansion or change will result in an increase in the volume of sanitary sewage (determined as prescribed at N.J.A.C. 7:9A-7.4) or a change in the type of wastes discharged (see N.J.A.C. 7:9A-7.3), the administrative authority shall not approve such an expansion or change unless all of the following conditions are satisfied:

1. All aspects of the location, design, construction, installation and operation of the existing system are in conformance with the requirements of this chapter or are altered so that they will be in conformance with the requirements of this chapter;
2. The expansion or change of use of the building or facility served will not exceed the design capacity of the existing system; and
3. It is demonstrated to the satisfaction of the administrative authority that the existing system is not malfunctioning.

(c) When an expansion or a change in use of a residential dwelling served by an existing individual subsurface sewage disposal system is proposed and such an expansion or change will exceed 100 square feet of habitable living space (as defined in the New Jersey Uniform Construction Code, N.J.A.C. 5:23) and such expansion or change will result in an increase in the volume of sanitary sewage (determined as prescribed at N.J.A.C. 7:9A-7.4) or will result in a change in the type of wastes discharged (see N.J.A.C. 7:9A-7.3), the administrative authority shall not approve such an expansion or change unless all of the following conditions are satisfied:

1. All aspects of the location, design, construction, installation and operation of the existing system are in conformance with the requirements of this chapter or are altered so that they will be in conformance with the requirements of this chapter;
2. The expansion or change of use of the dwelling served does not increase the design flow of the dwelling beyond the design capacity of the existing system; and
3. It is demonstrated to the satisfaction of the administrative authority that the existing system is not malfunctioning.

(d) Alterations made to a system for reasons other than a change of use or expansion as described in (b) and(c) above may be approved by the administrative authority provided that both of the following conditions are met:
  1. If the scope of the alteration is such that it constitutes the practice of professional engineering according to N.J.S.A. 45:8 and the rules adopted pursuant to same, then such alterations shall be made in conformance with plans and specifications signed and sealed by a licensed professional engineer; and
  2. Alterations are made in such a way that those components of the system altered are in conformance with the requirements of this chapter or are closer to being in conformance with this chapter than the original components prior to the alteration.

(e) When alterations are made to correct a malfunctioning system, the alterations shall be made in conformance with (d) above and in a manner that will eliminate the cause of the malfunction and which, with proper operation and maintenance, will not result in future malfunctions.

(f) Alterations to existing malfunctioning subsurface sewage disposal systems, which are regulated under N.J.A.C. 7:14A-7, may be approved by the administrative authority, provided the design flow of the system is less than or equal to 2,000 gpd. A Treatment Works Approval shall be obtained from the Department for the alteration to any existing malfunctioning subsurface sewage disposal system with a design flow greater than 2,000 gpd.

(g) Repairs may be made in the same manner as in the original system, with the exception of cesspools which shall be corrected as prescribed at N.J.A.C. 7:9A-1.6(g), provided that all repairs are approved by the administrative authority.

(h) A person who discharges industrial wastes by means of an existing subsurface sewage disposal system and who has not already applied to the Department for a NJPDES permit shall apply immediately.

(i) A person who discharges sanitary wastes by means of an existing subsurface disposal system, as defined in N.J.A.C. 7:14A-8.1(b)1iv, and who has not already applied to the Department for a NJPDES permit shall apply immediately.

7:9A-3.4 Malfunctioning systems

(a) Indications that an individual subsurface sewage disposal system is malfunctioning include but are not limited to the following:
  1. Contamination of nearby wells or surface water bodies by sewage or effluent as indicated by the presence of fecal bacteria where the ratio of fecal coliform to fecal streptococci is four or greater;
  2. Ponding or breakout of sewage or effluent onto the surface of the ground;
  3. Seepage of sewage or effluent into portions of buildings below ground; or

4. Back-up of sewage into the building served which is not caused by a physical blockage of the internal plumbing.

(b) When an individual subsurface sewage disposal system has been determined to be malfunctioning, the owner shall take immediate steps to correct the malfunction. When it becomes necessary to repair or replace one or more system components or to make alterations to the system, all of the following requirements shall be met:

1. The owner or owner's agent shall notify the administrative authority or its authorized agent immediately upon detection of a malfunctioning system. The owner shall obtain prior approval from the administrative authority or its authorized agent for any repairs or alterations made.
2. Alterations made to correct a malfunctioning system shall meet the requirements of N.J.A.C. 7:9A- 3.3(c). In cases where the alteration does not involve the practice of engineering as defined by N.J.S.A. 45:8-28(b), the administrative authority or its authorized agent may approve plans and specifications prepared by a septic system installer rather than a licensed professional engineer.
3. When the malfunction involves continuous discharge of sewage or septic tank effluent onto the surface of the ground or into a watercourse, the use of the system shall cease until repairs or alterations have been completed in a manner, which is satisfactory to the administrative authority. In such cases, the administrative authority may permit continued occupation of the building served provided that further surface discharge of sewage or septic tank effluent is prevented by installation of a holding tank or use of an existing septic system component as a holding tank. The latter may be accomplished by pumping-out the septic tank, dosing tank, seepage pit or other system component at an adequate frequency to prevent overflow.

(c) The administrative authority may, under certain circumstances, approve as a last resort, the permanent use of a holding tank to correct the problem of a malfunctioning system which cannot be repaired or altered in a satisfactory manner. Such approval may be granted by the administrative authority only if prior written approval has been granted by the Department and one of the following criteria is met:

1. The malfunctioning system serves a single family dwelling or other facility falling within the limitations set forth in N.J.A.C. 7:9-A1.8 and the system was constructed prior to the effective date of this chapter; or
2. The malfunctioning system serves a facility which exceeds the limitations set forth in N.J.A.C. 7:9A- 1.8 but was constructed prior to March 6, 1981, the effective date of the NJPDES rules (N.J.A.C. 7:14A).

(d) The Department and the administrative authority may approve the permanent use of a holding tank to correct the problem of a malfunctioning system only when all of the following facts have been established to the satisfaction of the administrative authority and the Department:

1. The present malfunctioning system poses a threat or a potential threat to ground or surface water quality or public health or safety or the environment;
2. Due to site conditions, lot configuration, financial circumstances or other constraints, repair, or alteration of the system in a manner that will eliminate the cause of the malfunction is not feasible;
3. Public sewers are by practical means not available;
4. Reduction of disposal field hydraulic loading by means of water saving plumbing fixtures will not correct the malfunction; and
5. Assurances are given that the holding tank will be emptied and the contents disposed of in a manner which complies with all applicable local, State and Federal ordinances, statutes and regulations. As a means of confirmation, the owner of the system shall install a water meter and shall submit to the administrative authority on a quarterly basis, evidence of dates and quantities of sewage removed, name of person(s) or firm(s) contracted to remove the sewage, the name of the facility(s) to which the sewage is taken, as well as any other evidence or information which is requested by the administrative authority.

7:9A-3.5 Permit to construct or alter

(a) A person shall not construct, install or alter an individual subsurface sewage disposal system until the administrative authority or its authorized agent has issued a permit for such construction, installation or alteration.

(b) The administrative authority or its authorized agent shall not issue a permit to construct, install or alter an individual subsurface sewage disposal system until an application has been submitted as prescribed in (c) below and, based upon a review of the application submitted, the location and design of the proposed system are found by the administrative authority or its authorized agent to be in conformance with the requirements of this chapter.

(c) The applicant shall submit a complete, accurate and properly executed application to the administrative authority. All soil logs, soil testing data, design data and calculations, plans and specifications, and other information submitted in connection with the subsurface sewage disposal system design shall be signed and sealed by a licensed professional engineer except where N.J.A.C. 7:9A-3.3(d)1 allows otherwise. The application shall include the following information:

1. Key maps showing the approximate boundaries of the lot on a U.S. Geological Survey (U.S.G.S.) topographic quadrangle or other accurate map and on a U.S.D.A. soil survey map, which is available from the Soil Conservation Service ("SCS"). A good quality photo-copy reproduction of the U.S.G.S. quadrangle or U.S.D.A. soil survey map may be used for this purpose. The requirement for a soil survey map does not apply to Essex or Hudson counties, where no modern soil survey is currently available;

2. A site plan, prepared in accordance with N.J.A.C. 13:40-7 and drawn at a scale adequate to depict clearly the following features within a 150 foot radius around the proposed system:

i. Location of all components of the proposed system including, but not limited to, septic tanks, grease traps, dosing tanks, distribution boxes, distribution laterals, disposal fields, interceptor drains and seepage pits;

ii. Boundaries of lot;

iii. Locations of existing and proposed buildings roadways, subsurface drains, wells and disposal areas on same lot and on adjacent lots;

iv. Existing and finished grade topography (two foot contour interval) using absolute elevations or relative elevations referenced to a permanent bench-mark;

v. Location of all surface water bodies, natural and artificial, and all springs or areas of ground water seepage;

vi. Location of existing and proposed surface water diversions;

vii. Location of all outcrops of bedrock;

viii. Conformance with setback requirements as required in N.J.A.C. 7:9A-4.3;

ix. Location of all soil profile pits, soil borings and permeability tests;

x. Location of stream encroachment boundaries for streams within the near vicinity of the site; and

xi. State approved boundaries of any wetland areas or transition areas within the boundaries of the property or within 150 feet of the area of the proposed system. Alternatively, the applicant may submit evidence of compliance with the requirements of N.J.A.C. 7:7A as provided pursuant to N.J.A.C. 7:9A-4.7(b) or (c).

3. Soil logs prepared as prescribed in N.J.A.C. 7:9A-5.3;

4. Soil suitability class(es) determined as prescribed in N.J.A.C.7:9A-5.4;

5. Results of permeability tests performed as prescribed in N.J.A.C. 7:9A-6, including all test data and calculations;

6. Maximum expected daily volume of sanitary sewage and method of calculation;

7. Detailed engineering plans and specifications for all components of the systems; and

8. All data and calculations used in the design of the sewage system.

(d) Applications shall be made using standard forms provided in Appendix B of this chapter or forms provided by the administrative authority which contain all of the information required on the standard forms in Appendix B. The administrative authority or its authorized agent may require additional data or the completion by the applicant of additional application forms.

(9) "Relocation" means the displacement of a residence or place of business from one site to another.

(9a) "Repair" means the extension, alteration, replacement, or relocation of existing components of a wastewater system.

1956 MODIFICATIONS TO SEPTIC TANK SYSTEMS

The following are modifications to septic tank systems or sites which may be utilized singly or in combination to overcome selected soil and site limitations. Except as required in this Rule, the provisions for design and installation of Rule .1955 of this Section shall apply:

(1) SHALLOW SYSTEMS: Sites classified UNSUITABLE as to soil depth or soil wetness may be reclassified as PROVISIONALLY SUITABLE with respect to soil depth or soil wetness conditions by utilizing shallow placement of nitrification trenches in the naturally occurring soil. Shallow trenches may be used where at least 24 inches of naturally occurring soil are present above saprolite, rock, or soil wetness conditions and all other factors are PROVISIONALLY SUITABLE or SUITABLE. Shallow trenches shall be designed and constructed to meet the vertical separation requirements in Rule .1955(m) of this Section. The long-term acceptance rate shall be based on the most hydraulically limiting naturally occurring soil horizon within 24 inches of the ground surface or to a depth of one foot below the trench bottom, whichever is deeper. Soil cover above the original grade shall be placed at a uniform depth over the entire nitrification field and shall extend laterally five feet beyond the nitrification trench. The soil cover shall be placed over a nitrification field only after proper preparation of the original ground surface. The type and placement of soil cover shall be approved by the local health department.

(2) DRAINAGE AND RESTRICTIVE HORIZONS: Sites classified UNSUITABLE as to soil wetness conditions or restrictive horizons may be reclassified PROVISIONALLY SUITABLE as to soil wetness conditions or restrictive horizons when:

- (a) Soils are Soil Groups I or II with SUITABLE structure, and clay mineralogy;
- (b) Restrictive horizons, if present, are less than three inches thick or less than 12 inches from the soil surface;
- (c) Modifications can be made to meet the requirements in Rule .1955(m) of this Section for the separation between the water table and the bottom of the nitrification trench at all times and when provisions are made for maintenance of the drainage systems;
- (d) Easements are recorded and have adequate width for egress and ingress for maintenance of drainage systems serving two or more lots;
- (e) Maintenance of the drainage system is made a condition of any permit issued for the use or operation of a sanitary sewage system; and

(f) Drainage may be used in other types of soil when the requirements of Rule .1957(c) in this Section are met.

(3) GRAVELLESS TRENCHES: Modified nitrification trenches or lines, including large diameter pipe (greater than four inches I.D.), and specially designed porous block systems may be permitted by the local health department.

(a) Gravelless nitrification trench systems may be substituted for conventional trench systems on any site found to be suitable or provisionally suitable in accordance with Rules .1940 to .1948 of this Section to eliminate the need for gravel, minimize site disturbance, or for other site planning considerations. Gravelless nitrification trench systems shall not be used, however, where wastes contain high amounts of grease and oil, such as restaurants.

(i) Large diameter pipe systems shall consist of eight-inch or 10-inch (inside diameter), corrugated, polythylene tubing encased in a nylon, polyester, or nylon/polyester blend filter wrap installed in a nitrification trench, 12 or more inches wide and backfilled with soil classified as soil group I, II, or III. Nitrification area requirement shall be determined in accordance with Rules .1955(b) and .1955(c), or in Rule .1956(6)(b), Table III of this Section, when applicable, with eight-inch tubing considered equivalent to a two-foot-wide conventional trench and 10-inch tubing considered equivalent to a two and one-half-foot-wide conventional trench. The long-term acceptance rate shall not exceed 0.8 gallons per day per square foot. Tubing and fittings shall comply with the requirements of ASTM F-667, which is hereby incorporated by reference including any subsequent amendments and editions. Copies of the standards may be inspected in and copies obtained from the Divison of Environmental Health, P.O. Box 27687, Raleigh, NC 27611-7687 at no cost. The corrugated tubing shall have two rows of holes, each hole between three-eighths and one-half-inch in diameter, located 120 degrees apart along the bottom half of the pipe (each 60 degrees from the bottom center line) and staggered so that one hole is present in the valley of each corrugation. The tubing shall be marked with a visible top location indicator, 120 degrees away from each row of holes. Filter wrap shall be spun, bonded, or spunlaced nylon, polyester, or nylon/polyester blend nylon filter wrap meeting the following minimum requirements:

Unit Weight: Oz/yd= 1.0
Sheet Grab Tensile: MD - 23 lbs.
Trapezoid Tear: MD - 6.2 lbs.
XD - 5.1 lbs.
Mullen Burst:
PSI = 40
Kpa = 276
Frazier Air Perm, CFM/ft] 0.5 "HO: 500"2

Corrugated Tubing shall be covered with filter wrap at the factory and each joint shall be immediately encased in a black polyethylene sleeve which shall continue to encase the large diameter pipe and wrap until just prior to installation in the trench. Large diameter pipe systems shall be installed in accordance with this Rule and the manufacturer's guidelines. The trench bottom and pipe shall be level (with a maximum fall of one inch in 100 feet). Filter wrap encasing the tubing shall not be exposed to sunlight (ultraviolet radiation) for extended periods. Rocks and large soil clumps shall be removed from backfill material prior to being used. Clayey soils (soil group IV) shall not be used for backfill. The near end of the large diameter pipe shall have an eight-inch by four-inch offset adaptor (small end opening at top) suitable for receiving the pipe from the septic tank or distribution device and making a mechanical joint in the nitrification trench.

(ii) A Prefabricated, Permeable Block Panel System (PPBPS), utilizing both horizontal and vertical air chambers and special construction to promote downline and horizontal distribution of effluent, may be used under the following conditions:

(A) the soil and site criteria of this Section shall be met;

(B) in calculating the required linear footage for a PPBPS's nitrification field, the linear footage for the nitrification line as determined in Rule .1955 (b) and (c), or in Rule .1956 (6)(b), Table F-4 of this Section when applicable, shall be multiplied by 0.5 for a 16 inch PPBPS;

(C) installation of the PPBPS shall be in accordance with these Rules except:

(I) the PPBPS trench shall be located not less than eight feet on centers;

(II) the installation shall be in accordance with the manufacturer's specifications; and

(III) the sidewalls of nitrification trenches placed in Group IVa soils shall be raked to open pores which were damaged or sealed during excavation;

(D) where design sewage flow is more than 480 gallons per day, the system shall be pressure-dosed; and

(E) the long-term acceptance rate shall not exceed 0.8 gallons per day per square foot.

(b) Other types of nitrification trenches or lines may be approved by the local health department on a site-specific basis in accordance with Rule .1969 of this Section.

(4) INTERCEPTOR DRAINS: Sites classified as UNSUITABLE as to soil wetness conditions because of the presence of lateral water movement may be reclassified PROVISIONALLY SUITABLE as to soil wetness conditions when such water is intercepted and diverted to prevent saturation of the soil absorption system.

(5) STEEP SLOPES: Stable slopes greater than 30 percent may be reclassified as PROVISIONALLY SUITABLE when:

(a) The soil characteristics can be classified as SUITABLE or PROVISIONALLY SUITABLE to a depth of at least one foot below the bottom of the nitrification trench at the upslope side of the trench;

(b) Surface water runoff is diverted around the nitrification field if necessary to prevent scouring or erosion of the soil over the field; and

(c) The finished grade over the nitrification field site is returned to the original topography and adequately seeded, unless otherwise specified by the local health department.

(6) SAPROLITE SYSTEM: Sites classified UNSUITABLE as to soil depth, with saprolite present, may be reclassified PROVISIONALLY SUITABLE as to soil depth when the provisions of this Paragraph are met.

(a) An investigation of the site using pits at locations specified by the local health department shall be conducted. The following physical properties and characteristics shall be present in the two feet of saprolite below the proposed trench bottom:

(i) the saprolite texture shall be sand, loamy sand, sandy loam, loam, or silt loam;

(ii) clay mineralogy shall be suitable;

(iii) greater than two-thirds of the material shall have a moist consistence of loose, very friable, friable, or firm;

(iv) the saprolite wet consistence shall be nonsticky or slightly sticky and nonplastic or slightly plastic;

(v) the saprolite shall be in an undisturbed, naturally occurring state; and

(vi) the saprolite shall have no open and continuous joints, quartz veins, or fractures relic of parent rock to a depth of two feet below the proposed trench bottom.

(b) Table III shall be used in determining the long-term acceptance rate for septic tank systems installed pursuant to Paragraph (6) of this Rule. The long-term acceptance rate shall be based on the most hydraulically limiting, naturally occurring saprolite to a depth of two feet below trench bottom.

Table F-4 – Saprolite groups and acceptance rates

SAPROLITE GROUP	SAPROLITE TEXTURAL CLASSES	LONG-TERM ACCEPTANCE RATE gpd/ft(2)
I	Sands Sand	0.8 - 0.6
	Loamy Sand	0.7 - 0.5
II	Loams	
	Sandy Loam	0.6 - 0.4
	Loam	0.4 - 0.2
	Silt Loam	0.3 - 0.1

If a low-pressure pipe system is used, the long term acceptance rate in Table III shall be reduced by one-half and the system shall be designed in accordance with Rule .1957(a) of this Section, except that Rule .1957 (a)(2)(B) and Rule .1957(a)(3) shall not apply. Saprolite textural classifications shall be determined from disturbed materials and determined by Rule .1941(a)(1) of this Section. Low-pressure distribution shall be used when the total length of nitrification lines exceeds 750 feet in a single system.

(c) The design daily flow shall not exceed 1,000 gallons.

(d) The nitrification field shall be constructed using nitrification trenches with a maximum width of three feet and a maximum depth of three feet on the downslope side of the nitrification trench. The bottom of a nitrification trench shall be a minimum of two feet above rock or saprolite that does not meet the requirements of Subparagraph (6)(a) of this Rule. However, where SUITABLE or PROVISIONALLY SUITABLE soil underlies the trench bottom, this separation distance may be reduced by subtracting the actual soil depth beneath the trench bottom from 24 inches to establish the minimum separation distance from the trench bottom to rock.

(e) The bottom of any nitrification trench shall be a minimum of two feet above any wetness condition.

(f) Surface and subsurface interceptor drains shall be required on sites with more slowly permeable horizons above the usable saprolite to intercept laterally flowing waters or perched waters.

(g) Exceptions to the provisions of Rule .1950(a) found in Rule .1950 and .1951 of this Section shall not apply to systems installed pursuant to this Paragraph [Rule .1956(6)].

(h) Other saprolite systems may be approved on a site-specific basis in accordance with Rule .1948(d) of this Section.

History Note: Authority G.S. 130A-335(e) and (f);
Eff. July 1, 1982;
Amended Eff. July 1, 1995; April 1, 1993; January 1, 1990; August 1, 1988.

Washington

246-272-16501 Repair of Failures.

(1) When an OSS failure occurs, the OSS owner shall:
- (a) Repair or replace the OSS with a conforming system or a Table F-5 repair either on the:
  - (i) Property served; or
  - (ii) Nearby or adjacent property if easements are obtained; or
- (b) Connect the residence or facility to a:
  - (i) Publicly owned LOSS; or
  - (ii) Privately owned LOSS where it is deemed economically feasible; or
  - (iii) Public sewer; or
- (c) Perform one of the following when requirements in subsections (1)(a) or (1)(b) of this section are not feasible:
  - (i) Use a holding tank; or
  - (ii) Obtain a National Pollution Discharge Elimination System or state discharge permit from the Washington state department of ecology issued to a public entity or jointly to a public entity and the system owner only when the local health officer determines:
    - (A) An OSS is not feasible; and
    - (B) The only realistic method of final disposal of treated effluent is discharge to the surface of the land or into surface water; or
  - (iii) Abandon the property.

(2) Prior to replacing or repairing the effluent disposal component, the OSS owner shall develop and submit information required under WAC 246-272-09001(1).

(3) The local health officer shall permit a Table F-5 repair only when:
- (a) Installation of a conforming system is not possible; and
- (b) Connection to either an approved LOSS or a public sewer is not feasible.

(4) The person responsible for the design shall locate and design repairs to:

(a) Meet the requirements of Table F-5 if the effluent treatment and disposal component to be repaired or replaced is closer to any surface water, well, or spring that is not used as a public water source as prescribed by the minimum separation required in Table 1 of WAC 246-272-09501(1);

Table F-5 - Requirements for Repair or Replacement of Disposal Components Not Meeting Vertical and Horizontal Separations 1,2

Vertical Separation (in feet)	**Horizontal Separation (in Feet$_3$)**		
	< 25	**25 – 50**	**> 50 - ≤100**
<1	T S 1	T S 1	T S 2(**4)**
1-2	T S 1	T S 2(**4)**	Pressure Distribution
>2	T S 2	Pressure Distribution (4)	Pressure Distribution

1 The treatment standards (TS) refer to effluent quality before discharge to unsaturated, subsurface soil.

2 The local health officer may permit ASTM C-33 sand to be used as fill to prevent direct discharge of treated effluent to groundwater, surface water, or upon the surface of the ground.

3 The horizontal separation indicated is the distance between the disposal component and the surface water, well, or spring. If the disposal component is up-gradient of a surface water, well, or spring to be used as a potable water source, the next higher standard level of treatment shall apply unless treatment standard 1 is already being met.

4 Mound systems are not allowed to meet Treatment Standard 2.

(a) Protect drinking water sources;

(b) Prevent the direct discharge of sewage to ground water, surface water, or upon the surface of the ground;

(c) Meet the horizontal separations under WAC 246-272-09501(1) to public drinking water sources;

(d) Meet other requirements of this chapter to the maximum extent permitted by the site; and

(e) Maximize the:

(i) Vertical separation;

(ii) Distance from a well, spring, or suction line; and

(iii) Distance to surface water;

(5) The local health officer shall identify Table F-5 repair permits for the purpose of tracking future performance.

(6) An OSS owner receiving a Table F-5 repair permit from the local health officer shall:

(a) Immediately report any failure to the local health officer;

(b) Monitor the performance of the OSS according to the "Interim Guidelines for the Application of Treatment Standards 1 & 2, using Alternative On-site Sewage Treatment/Disposal Systems" amended August 4,1992, (available upon written request to the department of health) and report the results to the local health officer at a minimum frequency of:

(i) Quarterly when Treatment Standard 1 is required; and

(ii) Annually when Treatment Standard 2 is required;

(c) Comply with all local and state requirements stipulated on the permit.

246-272-17501 Expansions.

The local health officer or department shall require an onsite sewage system and a reserve area in full compliance with the new system construction standards specified in this chapter for an expansion of a residence or other facility.

Appendix G

Overview of Typical Standards for Alternative OSDS

Aerobic Treatment Units (ATU)

North Carolina Regulations

ARTICLE 11 OF CHAPTER 130A, SANITARY SEWAGE SYSTEMS
§ 130A-342. Aerobic systems.

(a) **Individual aerobic sewage treatment plants** that are approved and listed in accordance with the standards adopted by the National Sanitation Foundation, Inc. for Class I sewage treatment plants as set out in Standard 40, as amended, shall be permitted under rules promulgated by the Commission. The Commission may establish standards in addition to those set by the National Sanitation Foundation, Inc.

(b) A permitted plant shall be operated and maintained by a certified wastewater treatment facility operator.

(c) The performance of individual **aerobic treatment plants** is to be documented by the counties and sent to the Department of Environment, Health and Natural Resources annually.

.1957 DESIGN CRITERIA FOR DESIGN OF ALTERNATIVE SEWAGE SYSTEMS

(d) **Individual aerobic sewage treatment units** (**ATUs**) shall be sited, designed, constructed and operated in accordance with this Rule to serve a design unit with a design flow rate of up to 1500 gallons per day, as determined in Rule .1949(a) or .1949(b) of this Section. **ATUs** shall not be used, however, where wastes contain high amounts of grease and oil, including restaurants and food service facilities. The strength of the influent wastewater shall be similar to domestic sewage with Biological Oxygen Demand (BOD) and suspended solids not to exceed 300 parts per million. **ATUs** shall comply with the requirements of the National Sanitation Foundation (NSF) Standard 40 for Individual **Aerobic Wastewater Treatment Plants** and shall be classified as meeting Class I effluent quality. NSF Standard 40 for Individual Aerobic Wastewater Treatment Plants is hereby incorporated by reference including any subsequent amendments and editions. Copies of the standards may be inspected in and copies obtained from the Division of Environmental Health, P.O. Box 27687, Raleigh, N.C. 27611-7687 at no cost. **ATUs** shall bear the NSF mark and the NSF listed model number or shall bear the certification mark and listed model number of a third-party certification program accredited by the American National Standards Institute (ANSI), pursuant to ANSI Policy and Procedures for Accreditation of Certification Programs to certify **ATUs** in accordance with NSF Standard Number 40. The ANSI Policy and Procedures for Accreditation of Certification Programs is hereby incorporated by reference including any subsequent amendments and editions. Copies of the standard may be inspected in and copies obtained from the Division of Environmental Health, P.O. Box 27687, Raleigh, N.C. 27611-7687 at no cost. **ATUs** shall only be permitted where the unit is to be operated and maintained by a certified wastewater treatment facility operator employed by or under contract to the county in which the unit is located, and in accordance with this Rule.

(1) **ATUs** shall be constructed and installed in accordance with the plans which have been approved by the Division of Environmental Health and shall comply with all requirements of this Rule. Procedures for plan review and approval shall be in accordance with Rule .1953 of this Section.

(2) The rated capacity of **ATUs** listed as complying with NSF Standard 40 shall not be less than the design daily flow as determined by Rule .1949(a) or .1949(b) of this Section.

(3) The following are minimum standards of design and construction of **ATUs**:

(A) Blockouts in concrete **ATU** inlet openings shall leave a concrete thickness not less than one inch in the plant wall. Inlet and outlet blockouts shall be made for a minimum of four inch pipe and a maximum of six inch pipe. No blockouts or openings shall be permitted below the liquid level of the **ATU**.

(B) The inlet into the **ATU** shall be a straight pipe.

(C) The invert of the outlet shall be at least two inches lower in elevation than the invert of the inlet.

(D) Interior baffle walls in concrete units shall be reinforced by the placing of six-inch by six-inch No. 10 gauge welded reinforcing wire. The reinforcing wire shall be bent to form an angle of 90 degrees on the ends in order to form a leg not less than four inches long. When the wire is placed in the mold, the four inch legs shall lay parallel with the side wall wire and adjacent to it.

(E) Access openings shall be provided in the **ATU** top. Access shall be provided for cleaning or rodding out the inlet pipe, for cleaning or clearing air or gas passage spaces, as an entrance for inserting the suction hose in compartments that are required to be pumped out, to allow for sampling the effluent, and for access to repair or maintain any system components requiring repair and maintenance. All access openings shall have risers sealed to the top of the **ATU** and extended at least to six inches above finished grade and designed and maintained to prevent surface water inflow. Rule .1950(i) of this Section shall also be met.

(F) Concrete **ATUs** shall be constructed in accordance with Rule .1954(a)(9), (10), (11) and (12) and .1954(b)(4) of this Section.

(G) Fiberglass reinforced plastic **ATUs** shall be constructed with materials capable of resisting corrosion from sewage and sewage gases, and the active and passive loads on the unit walls.

(i) **ATUs** shall have the following minimum physical properties:

Ultimate tensile strength:	12,000 psi
Flexural strength:	19,000 psi
Flexural modulus of elasticity:	800,000 psi

(ii) A vacuum test shall be performed on at least one **ATU** of each model number by an independent testing laboratory, in accordance with ASTM D-4021, Standard Specification for Glass-Fiber Reinforced Polyester

Underground Petroleum Storage Tanks, which is hereby incorporated by reference including any subsequent amendments and editions. Copies of the standards may be inspected in and copies obtained from the Division of Environmental Health, P.O. Box 27687, Raleigh, N.C. 27611-7687 at no cost. Unit must withstand negative pressure of 2.5 pounds per square inch (69.3 inches of water) without leakage or failure. Test results shall be included with the specifications that are provided to the state for approval.

(iii) Composition of the finished unit shall be at least 30 percent fiberglass reinforcement by weight. Minimum wall thickness shall be one-fourth inch. However, a wall thickness of not less than three-sixteenth inch may be allowed in small, isolated areas of the ATU.

(iv) Interior and exterior surfaces shall have no exposed fibers or projections, no blisters larger than one-fourth inch in diameter, and no pores or indentations deeper than one-sixteenth inch. The tank shall be watertight.

(H) Prefabricated **ATUs** other than precast reinforced concrete or fiberglass reinforced plastic units shall be approved on an individual basis based on information furnished by the designer which indicates the unit will provide effectiveness equivalent to reinforced concrete or fiberglass reinforced plastic units.

(I) **ATUs** shall bear an imprint identifying the manufacturer, serial number assigned to the manufacturer's plans and specifications approved by the Division of Environmental Health, and the liquid or working capacity of the unit. The imprint shall be located to the right of the blockout or opening made for the outlet pipe on the outside of the unit. **ATUs** shall also be permanently marked with the date of manufacture adjacent to the unit imprint or on the top of the unit directly above the imprint.

(J) The design, construction, and operation of **ATUs** shall prevent bypass of wastewater.

(K) Electrical circuits to the **ATU** shall be provided with manual circuit disconnects within a watertight, corrosion-resistant, outside enclosure (NEMA 4X or equivalent) adjacent to the **ATU** securely mounted at least 12 inches above the finished grade. Control panels provided by the manufacturer shall be installed in a watertight, corrosion-resistant enclosure (NEMA 4X or equivalent) adjacent to the unit or on the side of the facility readily visible from the unit and accessible by maintenance personnel. Conductors shall be conveyed to the disconnect enclosure and control panel through waterproof, gasproof, and corrosion-resistant conduits. Splices and wire junctions, if needed, shall be made outside the **ATU** in a watertight, corrosion-resistant enclosure (NEMA 4X or equivalent) securely mounted adjacent to the unit at least 12 inches above the finished grade. Wire grips, duct seal, or other suitable material shall be used to seal around wire and wire conduit openings inside the **ATU** and disconnect enclosure. The **ATU** shall have an alarm device or devices to warn the user or operator of a unit malfunction or a high water condition. The alarm shall be audible and visible by system users and securely mounted adjacent to the **ATU**, on the side of the facility in clear view of the unit, or inside the finished occupied space of the facility. If mounted outside, the alarm shall meet NEMA 4X standards or equivalent. The alarm circuit or circuits shall be supplied ahead of any **ATU** electrical control circuit overload and short circuit protective devices.

(4) A settling tank shall be required prior to an **ATU** serving a design unit with a design daily flow greater than 500 gallons, as determined in Rule .1949(a) or .1949(b) of this Section. The liquid capacity of the settling tank shall be at least equal to the design daily flow as determined in Rule .1949(a) or (b) of this Section. The settling tank may either be an approved prefabricated septic tank or another tank specially designed for a specific individual aerobic sewage treatment plant and approved by the Division of Environmental Health as a part of the plans for the plant.

(5) Ground absorption systems receiving effluent from approved **ATUs** may be used on sites classified as suitable or provisionally suitable for conventional, modified, or alternative systems in accordance with this Section. The following modifications to siting and design criteria shall be acceptable:

(A) The minimum horizontal setback requirements of Rule .1950(a) of this Section shall be met, except as follows:

(i) Any private water supply source, except any uncased well or spring 50 feet.

(ii) Streams classified as WS-I70 feet.

(iii) Waters classified as SA70 feet.

(iv) Other coastal waters not classified as SA35 feet.

(v) Any other stream, canal, marsh, or other surface waters35 feet.

(vi) Any Class I or Class II reservoir 70 feet, from normal pool elevation.

(vii) Any permanent stormwater retention pond 35 feet, from flood pool elevation.

(viii) Any other lake or pond35 feet, from normal pool elevation.

(B) The requirements of Rules .1955(m), .1956(1), .1956(2), .1956(6), .1957(b)(1), and .1957(b)(2) of this Section shall be met, except as follows:

(i) A low-pressure pipe system shall not be required where the separation between the bottom of the nitrification trench and any soil wetness condition is at least 12 inches, but less than 18 inches, and more than six inches of this separation consists of Group I soils.

(ii) The restriction in Rule .1956(6)(a)(v) of this Section that saprolite be overlain by at least one foot of suitable or provisionally suitable naturally occurring soil shall not apply.

(iii) For new fill systems, a low pressure pipe system shall not be required in order for the minimum separation distance between the trench bottom and any unsuitable soil horizon, rock, or saprolite to be reduced to 18 inches.

(iv) For existing fill systems, the minimum separation requirements of Rule .1957(b)(2)(D) of this Section shall be reduced from 48 to 36 inches for conventional systems and from 24 to 18 inches for low-pressure pipe system.

(C) The maximum long-term acceptance rate shall be increased by 25 percent for any ground absorption system in soils which are Groups I or II with suitable structure and clay mineralogy. No other reductions in linear footage of nitrification trench or system area shall be applied, except where based on an adjusted design daily sewage flow rate granted in accordance with Rule .1949(c) of this Section.

(6) Prior to issuance of an Operation Permit for an **ATU**, the manufacturer or his licensed representative shall certify that the unit has been properly installed and a contract for operation and maintenance shall have been executed between the unit owner and the county in accordance with Rule .1961(b) of this Section. It shall be a condition of the Operation Permit that subsequent owners of an **ATU** execute such a contract.

The contract shall include the specific requirements for maintenance and operation, responsibilities for maintenance and operation, responsibilities of the owner and system operator, provisions that the contract shall be in effect for as long as the system is in use, and other requirements for the continued proper performance of the **ATU**.

A condition of the Operation Permit shall be that the unit continue to perform in accordance with Class I effluent quality requirements of the National Sanitation Foundation (NSF) Standard Number 40 effective on the date the improvement permit was issued.

(7) Performance monitoring shall be carried out by the operator.

(A) During each inspection, the operator shall confirm proper mechanical performance, conduct a visual check for unusual color, clogging, oily film, odors, foam, measure settleable aeration chamber solids, and ascertain the need for removing solids, backwash and cleaning of filters, and other maintenance activities. The ground absorption system shall also be inspected and an evaluation of performance shall be made. The operator shall take the necessary steps to assure that needed maintenance is carried out.

(B) Semi-annually, samples shall be collected by the system operator and analyzed by a state-approved wastewater testing laboratory of the effluent for Five-Day Biological Oxygen Demand, Suspended Solids, and pH. The aeration tank shall be sampled for mixed liquor suspended solids.

(C) Performance monitoring results shall be reported to the local health department and the state quarterly.

(D) Remedial action and additional sampling shall be required if monitoring results or inspection indicate that Class I effluent standards are not met.

History Note: Authority G.S. 130A-335(e),(f); 130A-342; Eff. July 1, 1982;

Amended Eff. April 1, 1993; May 1, 1991; December 1, 1990; January 1, 1990.

Oregon

340-71-345 AEROBIC SYSTEMS.

(1) Criteria for Approval. **Aerobic sewage treatment facilities** may be approved for a construction-installation permit provided all the following criteria are met:

- (a) The facility to be served is a single family dwelling;
- (b) Wastewater strength does not exceed the maximum limits for residential strength wastewater;
- (c) The **aerobic sewage treatment facility (plant)** is part of an approved onsite sewage disposal system;
- (d) The plant has been tested pursuant to the current version of the National Sanitation Foundation (NSF) Standard No. 40, relating to **Individual Aerobic Wastewater Treatment Plants**, and been found to conform with Class I or Class II and other requirements of the standard. In lieu of NSF testing, the Department may accept testing by another agency which it considers to be equivalent;
- (e) The property owner records in the county land title records, in a form approved by the Department, an easement and a covenant in favor of the State of Oregon:
- (A) Allowing its officers, agents, employees and representatives to enter and inspect, including by excavation, the aerobic sewage treatment facility; and
- (B) Acknowledging that proper operation and maintenance of the plant is essential to prevent failure of the entire onsite sewage disposal system; and
- (C) Agreeing for himself and his heirs, successors and assigns, to hold harmless, indemnify and defend the State of Oregon, its officers, representatives, employees and agents for any and all loss and damage caused by installation or operation of the system; and
- (D) Agreeing not to put the land to any conflicting use.

(2) The plant shall:

- (a) Have a visual and audible alarm, placed at a location acceptable to the Agent, which are activated upon an electrical or mechanical malfunction;
- (b) Have a minimum rated hydraulic capacity equal to the daily sewage flow or five hundred (500) gallons per day, whichever is greater;
- (c) Have aeration and settling compartments constructed of durable material not subject to excessive corrosion or decay;
- (d) Have raw sewage screening or its equivalent;
- (e) Have provisions to prevent surging of flow through the aeration and settling compartments;
- (f) Have access to each compartment for inspection and maintenance;
- (g) Have provisions for convenient removal of solids;
- (h) Be designed to prevent:
  - (A) Short circuiting of flow;
  - (B) Deposition of sludge in the aeration compartment;

(C) Excessive accumulation of scum in the settling compartment;
(D) The passage of untreated sewage into the disposal field if the plant malfunctions.

(3) Disposal Field Sizing. Disposal fields serving systems employing **aerobic sewage treatment facilities** shall be sized according to Tables 4 and 5 of these rules. **Where a NSF Class I plant is installed, the linear footage of disposal trench installed may be reduced by twenty (20) percent, provided a full sized standard system replacement area is available.**

(4) Operation and Maintenance:
(a) The supply of parts must by locally available for the expected life of the unit;
(b) The supplier of the plant shall be responsible for providing operation training to the owner;
(c) The supplier of the plant shall provide the owner with an operation and maintenance (O & M) manual for the specific plant installed;
(d) The owner shall remove excess solids from the plant at least once per year, or more frequently if recommended by the O & M manual.

(5) Inspection Requirements. Each **aerobic sewage treatment facility** installed under this rule shall be inspected by the Agent at least once per year (See OAR 340-71-260 (2)).

(6) **Aerobic systems** which serve commercial facilities, or which do not meet the above requirements shall be permitted only by WPCF Permit. Operation and maintenance requirements shall be established in the permit.

Monitoring: Impact of Site Limitations and System Complexity—
The monitoring frequency and level of detail information reported relates to limitations presented by site conditions and system complexity. Monitoring (Figure G-1) and reporting to assure proper function becomes increasingly critical for more vulnerable sites and/or complex systems. This concept, which is applied to all conventional and alternative onsite sewage treatment systems, is illustrated by Tables G-1 and G-2 which may be used to guide decisions related to monitoring and reporting.

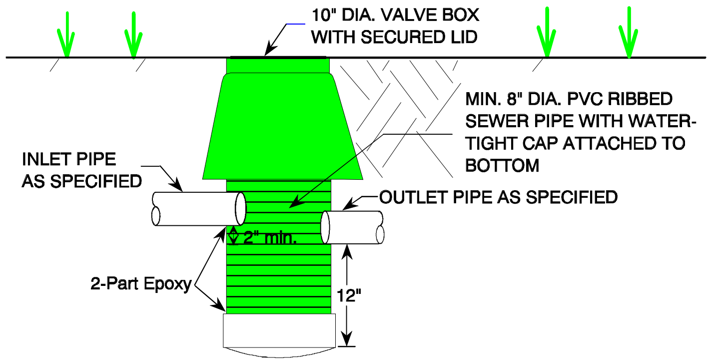
Table G-1 - Relationship Between Site Limitations and System Complexity for Conventional and Alternative Onsite Sewage Treatment Systems

Issue	**Characteristics / Level of Limitation and Complexity** **Lower** 🡐🡐🡐🡐🡐🡐🡐🡐🡐🡐🡐 🡒🡒🡒🡒🡒🡒🡒🡒🡒🡒🡒 **Higher**		
Site Limitation	Meets state rules for *conventional gravity system*	Meets state rules for *conventional pressure distribution system*	**Limitation increases with -** *less* vertical separation, smaller lot sizes, less horizontal separation, and, *greater* surface slope, wastewater flow, wastewater strength, etc.
System Complexity	Gravity-flow (no pumps, controls, etc.)	Pressurized distribution (requires pumps & controls)	**Complexity increases with -** *increasing* reliance upon, or combinations of: pumps; blowers; motors; mechanical, electronic, or computer-operated controls & warning devices; disinfections (materials & equipment); reduction in drainfield size; quality control of artificial (non-original soil) treatment media, etc.

Table G-2 - Suggested Monitoring Frequency Based Upon Site Limitations and System Complexity for Conventional and Alternative On-Site Sewage Treatment Systems

	Level			
Site Limitation	Low	Low	High	High
System Complexity	Low	High	Low	High
Monitoring Frequency	***Low = Annually***	***Medium = Semi-annually***		***High = Quarterly, or greater***

Figure G-1 - Typical In-line Sampling Port



Mounds

Table G-3 - Typical Maximum Bed Width[1]

Type of Restrictive Layer	Available Soil Depth (inches)		
	12 - 18[2]	18 - 24	24 +
Water table or other restrictive layer, excluding non-creviced bedrock.	5 feet	7.5 feet	10 feet
Bedrock, non-creviced.	Not Allowed	7.5 feet	10 feet

Note: [1] The noted bed widths are the maximum cumulative widths permitted for one or more beds on the same downhill plane on a single parcel.

[2] Systems on 12-18 inches of soil may be allowed provided pretreatment consisting of a system meeting special requirements prior to the mound.

Table G-4 - Typical Downslope and Upslope Width Corrections (Multipliers) For Mounds On Sloping Sites (3:1 Side slopes)

Slope as a Percentage	Downslope (I) Correction Factor	Upslope (J) Correction Factor
0	1.00	1.00
2	1.06	0.94
4	1.14	0.89
6	1.22	0.85
8	1.32	0.81
10	1.44	0.77
12	1.58	0.74
14	1.74	0.71
16	1.95	0.68
18	2.21	0.66
20	2.55	0.64

Table G-5 – Typical Infiltration/Loading Rates for Sizing Basal Area for Mound Systems[1]

SOIL TYPE	SOIL TEXTURAL CLASSIFICATION DESCRIPTION	LOADING RATE gal./sq. ft./day
1A	Very gravelly[2] coarse sands or coarser, extremely gravelly[3] soils.	Varies according to system selected and the pretreatment required
1B	Very gravelly medium sands, very gravelly fine sands, very gravelly very fine sands, very gravelly loamy sands.	Varies according to soil type of the non-gravel portion [4]
2A	Coarse sands (includes the ASTM C-33 sand).	1.2
2B	Medium sands.	1.0
3	Fine sands, loamy coarse sands, loamy medium sands.	0.8
4	Very fine sands, loamy fine sands, loamy very fine sands, sandy loams, loams.	0.6
5	Silt loams that are porous and have well-developed structure.	0.45
6	Other silt loams, sandy clay loams, clay loams, silty clay loams.	0.2

Note:

1 Compacted soils, cemented soils, and/or poor soil structure may require a reduction of the loading rate or make the soil unsuitable for conventional OSS systems.

2 Very Gravelly = >35% and <60% gravel and coarse fragments, by volume.

3 Extremely Gravelly = >60% gravel and coarse fragments, by volume.

4 The maximum loading rate listed for the soil described as the non-gravel portion is to be used for calculating the absorption surface area required. The value is to be determined from this table. The filter media loading rate for mound systems is 1.0 gallons/ft^2/day. Therefore, the loading rate for the basal area will not exceed this loading rate.

Mound Filter Media Specification

The standard method to be used for performing particle size analysis must comply with one of the following:

1. the sieve method specified in ASTM C-136 and ASTM C-117

2. the method specified in Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Survey Investigation Report #1, U.S. Department of Agriculture, 1984.

Information concerning these methods can also be obtained from Methods of Soil Analysis, Part I, 2nd edition; A. Klute, editor, ASA Monograph #9, American Society of Agronomy, Madison, WI, 1986.

The sand must meet each of the following specifications:

1. The filter media must meet the following particle size gradation: (Source: ASTM C-33, Specification for Fine Aggregate)

Sieve	Effective Particle Size	% Passing (by Weight)
3/8 in.	9.5 mm	100%
No. 4	4.75 mm	95-100%
No. 8	2.36 mm	80-100%
No. 16	1.18 mm	50-85%
No. 30	0.6 mm	25-60%
No. 50	0.3 mm	10-30%
No. 100	0.15 mm	2-10%

[For No. 200 sieve, see note 4.]

2. The sand must have not more than 45% passing any one sieve and retained on the next consecutive sieve of those shown above.

3. The fineness modulus must not be less than 2.3 nor more than 3.1. The fineness modulus is defined as the sum of the cumulative percentages retained in the sieve analysis, divided by 100, for the sieve sizes shown above.

4. The limit for material that can pass the No. 200 sieve is no more than 3%.

Overview of Typical Mound Design Process

Design of a mound system can be divided into five major steps:

Figure G-2 - Plan View of the mound filter media

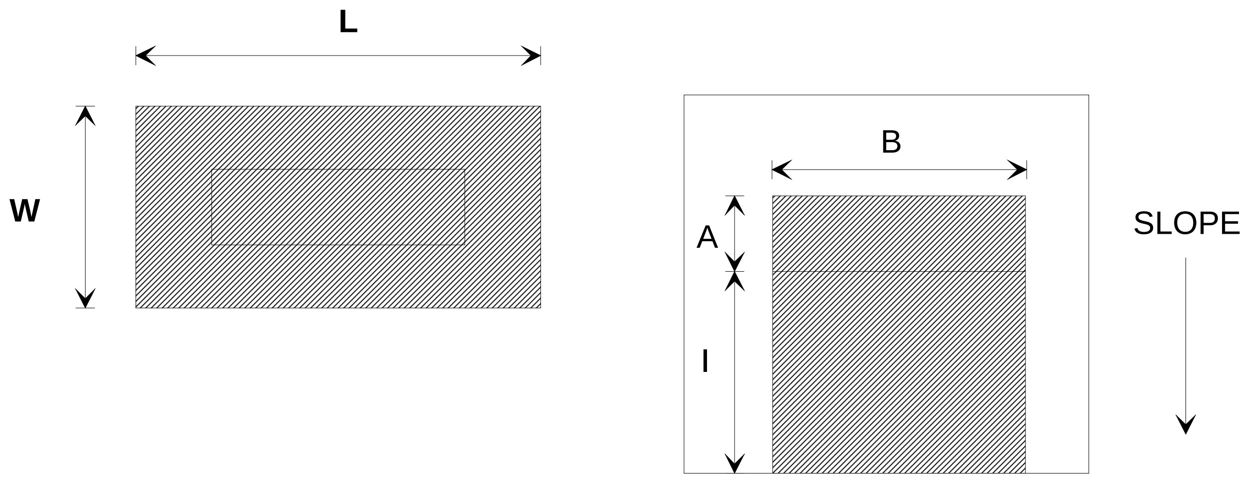


Figure G-3 - Detailed cross-section of mound.

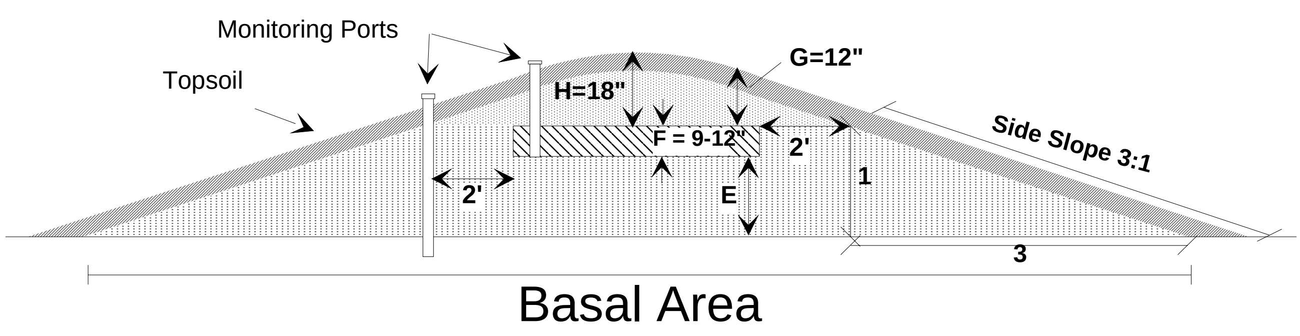


Figure G-4 — Cross-Section of Mound System, Showing Minimum Distances (Note Filter Media Outside Bed)

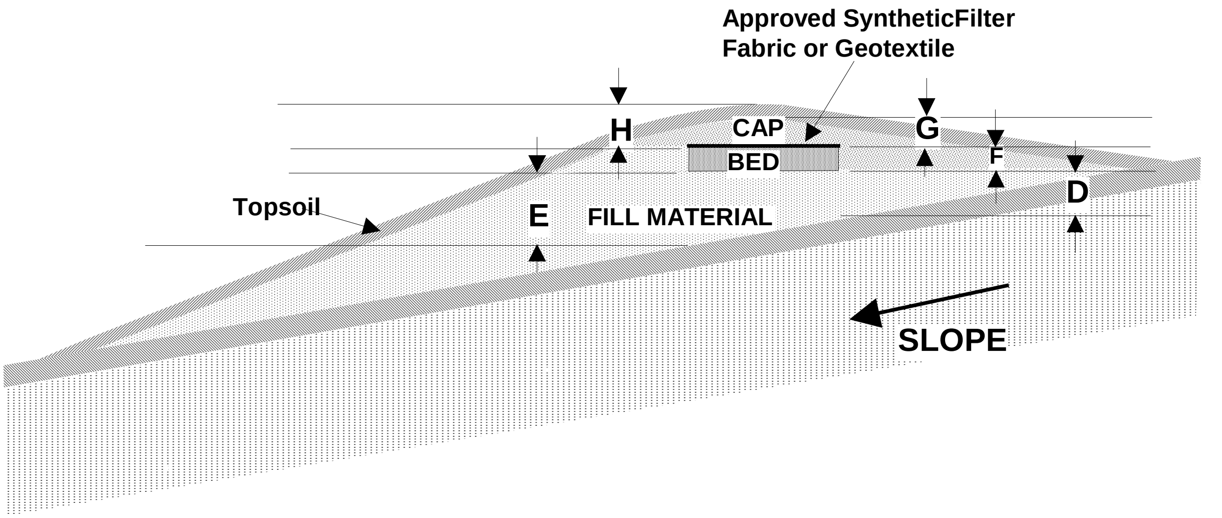
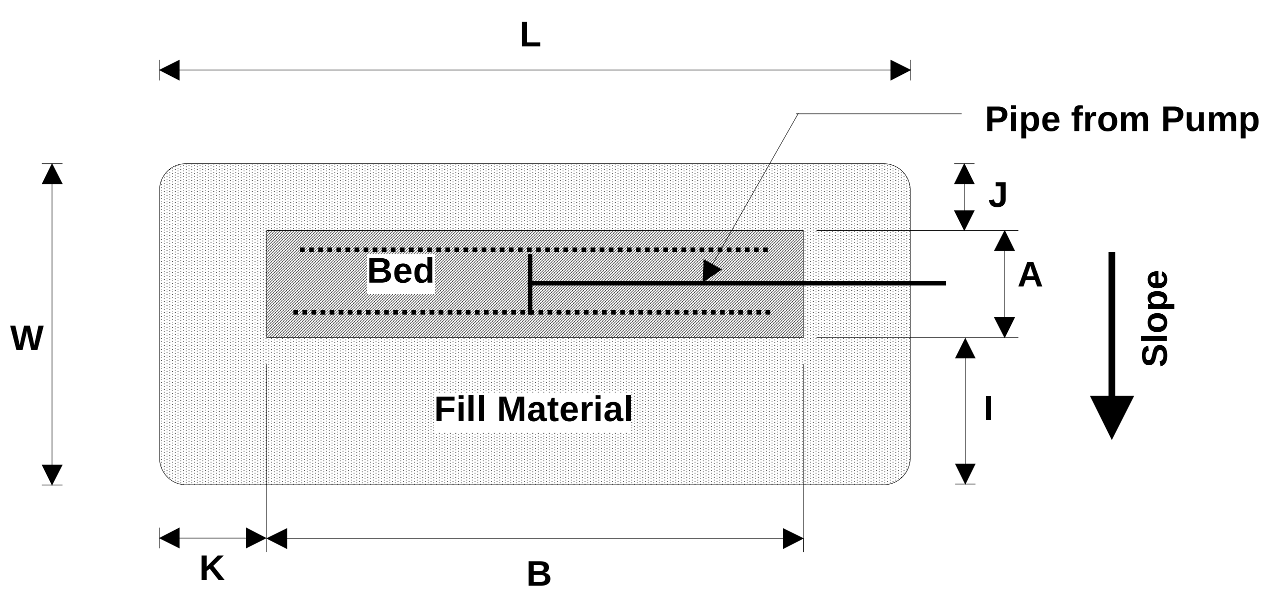


Figure G-5 — Basal Area for Filter Media



Step 1. Site / Soil Evaluation—Evaluate the site and soil characteristics to determine that a mound system is appropriate for the site and the project,

Step 2. Daily Wastewater Load / Pre-treatment Device Determination—Identify the daily wastewater load and the needed level of wastewater pretreatment (septic tank or other pretreatment unit).

Daily design flow (gal/day) = Number of bedrooms x Recommended gal/day.

Step 3. Configure and Dimension the Mound—Configure and dimension the mound:

size the infiltration area (bed) within the filter media,
size the mound height components,
size the filter media length and width,
size the basal area,

The configuration of the mound system responds to the slope, shape, size, and feature characteristics of the site. Other OSDS might have to be chosen if all design and siting criteria cannot be satisfactorily met for the installation of a mound.

3a. Sizing the Infiltration (Bed) Area—

$$\text{Infiltrative Surface (Bed) Area (ft}^2\text{)} = \frac{\text{Daily design flow (gal/day)}}{1.0\ \text{gallons/ft}^2\text{/day}}$$

The bed dimensions (see Figure 8) are calculated as follows:

<u>Bed width (A)</u> = Dependent on soil depth. See Table G-3

$$\text{Bed length (B)} = \frac{\text{Required bottom infiltrative surface area}}{\text{Bed width (A)}}$$

3b. Determining Mound Height—The mound height consists of:

the filter media depth below the bottom of the bed (D & E),
the infiltrative bed depth (F), and
the cap and topsoil depth (G & H).

. Filter Media Depth (D & E)—

<u>Filter media depth below upslope edge of bed (D)</u> = 1 to 2 feet

<u>Filter media depth below downslope edge of bed (E)</u> =1 to 2 feet + [% natural slope as a decimal x width of bed (A)]

Bed Depth (F)— <u>Bed depth (F)</u> = 9 inches (minimum for 1-inch lateral)

Cap and Top Soil (G & H)—

<u>Unsettled cap and topsoil depth at bed center (H)</u> = 18 inches.

Unsettled cap and topsoil depth at bed edges (G) = 12 inches.

3c. Filter Media Length and Width—The length and width of the filter media are dependent upon the length and width of the infiltration area, filter media depth and side slopes of the filter media (no steeper than 3:1).

Filter Media Length (L) = Length of bed (B) + [2 X end slope (K)]

End slope (K) = Filter media depth at center ($\frac{D + E}{2}$ + F + H) X horizontal gradient of selected side slope (3 if 3:1 side slope)

Filter Media Width (W) = Upslope width (J) + downslope width (I) + width of bed (A)

Upslope width (J) = Filter media depth at upslope edge of bed (D + F + G) horizontal gradient of side slope (3 if 3:1) x slope correction factor (see Table G-4)

Downslope width (I) = Filter media depth at downslope edge of bed (E + F + G) x horizontal gradient of side slope (3 if 3:1) x slope correction factor (see Table G-4)

These calculations should result in the filter media extending at least two feet horizontally from the top edges of the bed as noted in Figure G-4. Check to see that this is done.

3d. Basal Area—For level sites, the total basal area [length of filter media (L) x width of filter media (W)] beneath the filter media is available for effluent absorption into the soil. See Figure G-4. For sloping sites, the only available basal area is the area beneath the bed (A x B) and the area immediately downslope from the bed [bed length (B) x downslope width (I)]. It includes the area enclosed by [B x (A + I)]. See Figure G-5. The upslope and end slopes will transmit very little of the effluent on sloping sites, and are therefore disregarded.

It is important to compare the required basal area to the available basal area. The available basal area must equal or exceed the required.

Basal area required = $\frac{\text{Daily flow}}{\text{Infiltration rate of original soil}}$

Basal area available = B x (A + I) on sloping site or
= L x W on level site.

When there is not sufficient area the perimeters of the filter media must increased. The preferred method to increase basal area is to lengthen the bed rather than simply extending the toe of the filter media. Other types of treatment should be used if the mound cannot be long and narrow.

Step 4. Design the Distribution Network—Design, layout, and installation of the pump chamber-to-mound transmission line must consider, and satisfactorily address, the potential for channeling groundwater or surface water to either the mound or the pump chamber causing infiltration-related problems.

Step 5. Construction Plan / Owner's Manual—Develop the site-specific construction plan and owner's manual. The mound system, including the area around the base and downslope, must be protected to prevent damage caused by vehicular, livestock, or excessive pedestrian traffic.

Design Examples of Mounds under different site conditions

1. Shallow permeable soils

Site Conditions:

Slope - 6%
Parcel size - 2 acres
Native soil - silt loam, 27 inches deep to hardpan
Water table - 25 inches
Home size - 3 bedrooms

Step A: Daily Wastewater Load

Daily flow = # bedrooms x Recommended 120 gal/day = 3 x 120 gal/day = 360 gal.

Step B: Design of the Infiltration Area

1. Size the infiltration area

a. Infiltration rate of required filter media = $\underline{1.0\ gal/ft^2/day}$

b. Bottom area of bed = $\dfrac{\text{estimated daily flow}}{\text{infiltration rate of filter media}}$

$$= \frac{360\ gal/day}{1.0\ gal/ft^2/day}$$

$$= \underline{360\ ft^2}$$

2. System configuration

a. Bed width (A) = Select 6 feet.10 feet could have been selected but wasn't due to concerns of the tight soils and relatively shallow slope.

b. Bed length (B) = $\dfrac{\text{Required bottom infiltrative surface area}}{\text{Selected bed width}}$

$$= \frac{360\ ft^2}{6\ ft}$$

$$= \underline{60\ ft.}$$

Step C: Design the Entire Mound

1. Filter media height

a. Depth of filter media

1) Depth at upslope edge of bed (D) = 1 foot (1 foot selected because the native soils were not excessively permeable, there was no creviced bedrock below the top 24 inches, there were at least 24 inches of original soil.)

2) Depth at downslope edge of bed (E) = 1 foot + (% of natural slope as a decimal) X [width of bed (A)]

= 1 + (.06) (6)

= 1.4 feet

b. Bed depth (F) = .75 feet (anticipate 1 inch lateral)

c. Cap and top soil

1) Unsettled cap and topsoil depth at center of bed (H) = 18 inches

2) Unsettled cap and topsoil depth of bed edges (G) = 12 inches

Approximately 6-8 inches of each of the above original unsettled cap and topsoil depths would consist of topsoil, with the remainder being suitable cap material.)

2. Filter media length and width

a. filter media length

Endslope (K)= (filter media depth at center) X (horizontal gradient of selected side slope)

= [(D+E)/2 + F + 1.5] X selected horizontal gradient

= [(1.0+1.4)/2 + 0.75 + 1.5] X 3

= 10.4 feet

filter media length (L) = length of bed (B) + [2 X endslope (K)]
= 60 + [(2) (10.4)]
= 80.8 ft.

b. filter media width

Upslope width (J) = filter media depth at upslope edge of bed (D+F+G)
X horizontal gradient of sideslope
X slope correction factor

= (1.0 + 0.75 + 1.0) (3) (.85)

= 7.0 feet

Downslope width (I)= filter media depth at downslope edge of bed (E+F+G) X horizontal gradient of sideslope X slope correction factor (Table G-5)

= (1.4 + 0.75 + 1.0) (3) (1.22)
= 11.5 feet

filter media width (W) = upslope width (J) + downslope width (I) + width of bed (A)
= 7.0 + 11.5 + 6
= 24.5 feet

3. Check the basal area

On sloping sites the effective basal area is considered to be that area below and downslope of the bed [B x (A+J)].

a) Basal area required = $\frac{\text{daily flow}}{\text{infiltration rate of original soil}}$

$= \frac{360}{0.45}$
$= 800\ ft^2$

b) Basal area available = B x (A+I)

= (60) (6 + 11.5)
$= 1050\ ft^2$

Sufficient area is available. If it wasn't, the downslope width (I) must be increased or the mound made longer until sufficient area becomes available.

Step D: Design of the Distribution Network

2. EXCESSIVELY PERMEABLE SOILS

Site Conditions:

Slope - 6%
Parcel size - 1 acre
Native soil - sandy gravel, mostly coarse sands from surface to at least 6 feet
Water table - not within 6 feet of surface
Home size - 3 bedrooms

Step A: Daily Wastewater Load

3 bedrooms x 120 gal/day = 360 gallons

Step B: Design of the Infiltration Area

1. Size the infiltration area

a. Infiltration rate of required filter media = 1.0 gal/ft^2/day

b. Bottom area of bed = $\frac{360 \text{ gal/day}}{1.0 \text{ gal/ft}^2\text{/day}}$ = 360 feet

2. System configuration

a. Bed width (A) = Select 10 feet.

b. Bed length (B) = $\frac{360 \text{ ft}^2}{10 \text{ ft}}$ = 36 feet

Step C: Design the Entire Mound

1. Filter media height

a. Depth of filter media

1) At upslope edge of bed (D) = 2 feet (2 feet because the top 24 inches are excessively permeable).

2) Depth at downslope edge of bed (E) = 2 feet + (% of natural slope as a decimal) X [width of bed (A)]

= 2 + (.06) (10)

= 2.6 feet

b. Bed depth (F) = .75 feet (anticipate 1 inch lateral)

c. Cap and top soil

1) Settled cap and topsoil depth at center of bed (H) = 18 inches

2) Settled cap and topsoil depth of bed edges (G) = 12 inches

(Approximately 6-8 inches of each of the above original unsettled cap and topsoil depths would consist of topsoil, with the remainder being suitable cap material.)

2. Filter media length and width

a. filter media length

$$\text{Endslope (K)} = \left[\frac{(2.0+2.6)}{2} + 0.75 + 1.5\right](3)$$

$$= \underline{13.7 \text{ feet}}$$

$$\underline{\text{filter media length}} \text{ (L)} = \underline{36} + (2)(13.7)$$

$$= \underline{63.4 \text{ ft.}}$$

b. filter media width

$$\text{Upslope width (J)} = (2.0 + 0.75 + 1.0)(3)(.85)$$

$$= \underline{9.6 \text{ feet}}$$

$$\text{Downslope width (I)} = (2.6 + 0.75 + 1.0)(3)(1.22)$$

$$= \underline{15.9 \text{ feet}}$$

$$\underline{\text{filter media width}} \text{ (W)} = 9.6 + 15.6 + 10$$

$$= \underline{35.2 \text{ feet}}$$

3. Check the basal area

a. Basal area required = $\dfrac{360 \text{ gal/day}}{1.0 \text{ gal/ft}^2\text{/day}} = \underline{360 \text{ ft}^2}$

b. Basal area available = (63.4)(10 + 15.9) = $\underline{1642.06 \text{ ft}^2}$

There is sufficient area available.

Step D: Design of the Pressure Distribution Network

3: SHALLOW PERMEABLE SOILS

Site Conditions:

Slope	-	8%
Parcel size	-	5 acres
Native soil	-	20 inches of sandy loamm to con. glacial till
Water table	-	none noted - water flows downslope on the till layer during periods of high rainfall
Home size	-	3 bedrooms

(After careful and detailed investigation, justification was provided which indicated that the effluent would satisfactorily flow away from site in the 20 inches of soil and that breakouts would not occur downslope that could cause any nuisance or public health hazard potential. A long narrow system parallel to the slope contours is necessary because of the slope and the shallow soil.)

Step A: Daily wastewater load

3 bedrooms x 120 gal/day = 360 gallons

Step B: Design of the Infiltration Area

1. Size the infiltration area

   a. Infiltration rate of medium sand = 1.0 $gal/ft^2/day$

   b. Bottom area of bed = $\frac{360 \text{ gal/day}}{1.0 \text{ gal/ft}^2\text{/day}} = \underline{360 \text{ ft}^2}$

2. System configuration

   a. Bed width (A) = Select 3 feet

   b. Bed length (B) = $\frac{360 \text{ ft}^2}{3 \text{ ft}}$ = 120 feet

Step C: Design the Entire Mound

1. Filter media height

   a. Depth of filter media

      1) At upslope edge of bed (D) = 1.33 feet (16 Inches)
      (Because only 20 inches of original soil exist, 16 inches of filter media need to be added below bed to ensure that a separation of 3 feet exists)

2) At downslope edge of bed (E) = 1.33 + (.08)(3) = 1.6 feet natural slope as a decimal) X (width of bed)

b. Bed depth (F) = 0.75 feet

c. Cap and topsoil

1) Settled depth at center of bed (H) = 18 inches

2) Settled cap at bed edges (G) = 12 inches

2. Filter media length and width

a. filter media length

$$\text{Endslope (K)} = \left[\frac{(1.3+1.6)}{2} + .75 + 1.5\right](3) = \underline{11.1\text{ feet}}$$

Filter media length (L) = 120 + (2)(11.1) = 142.2 feet

b. Filter media width

Upslope width (J) = (1.3 + 0.75 + 1.0)(3)(.8) = 7.4 feet

Downslope width (I) = (1.6 + 0.75 + 1.0)(3)(1.32) = 13.3 feet

Filter media width (W) = 7.4 + 13.3 + 3 = 23.7 feet

3. Check the basal area

a. Basal area required $= \dfrac{360\text{ gal/day}}{0.6\text{ gal/ft}^2\text{/day}} = \underline{600\text{ ft}^2}$

b. Basal area available = (120)(3 + 13.3) = $\underline{1956\text{ ft}^2}$

There is sufficient area available.

Step D: Design of the Distribution Network

Mound Worksheet / Checklist

_______ A. DAILY WASTEWATER FLOW

Daily wastewater flow = # bedrooms X 120 gal/day/bedroom (Minimum)

= __________ X 120 gal/day/bedroom

_______ B. DESIGN OF THE INFILTRATION AREA

1. Size the infiltration area

   a. Infiltration rate of filter media: 1.0 gal/ft^2/day

   b. Bottom area of bed = $\dfrac{\text{Daily wastewater flow}}{1.0 \text{ gal/ft}^2\text{/day}}$

   = ____________ gal/day

   1.0 gal/ft^2/day

   = ____________ ft^2

2. Bed configuration

   a. Bed width (A) = __________________ ft

   b. Bed length (B) = $\dfrac{\text{Bottom area of bed}}{\text{Width of bed}}$ = Bed length

   = ____________ ft^2

   ____________ ft

   = ____________ ft

_______ C. DESIGN THE ENTIRE MOUND

1. Filter media height

   a. Filter media depth

   1) Depth at upslope edge of bed (D) = 1 to 2 ft depending on filter media and original soil
   = ____________ ft

   2) Depth at downslope edge of bed (E)

= Depth at upslope edge of bed + (% slope expressed as decimal X bed width)

= D + (% slope expressed as decimal X A)

= ____________ ft + (_____________ X _____________ ft)

= _____________ ft

b. Bed depth (F) = 0.75 ft (usually for 1 in. laterals)

= _____________ ft

c. Cap and topsoil

1) Depth at bed center (H) = 18 inches

2) Depth at bed edges (G) = 12 inches

2. Filter media length

a. Endslope width (K) = Total filter media depth at bed center X horizontal gradient of sideslope

$$= \frac{D + E}{(2 + F + H) \text{ X horizontal gradient of sideslope}}$$

$$= \frac{\text{\_\_\_\_\_ ft + \_\_\_\_\_ ft}}{(\text{\_\_\_\_\_ ft + \_\_\_\_\_ ft + \_\_\_\_\_ ft}) \text{ X \_\_\_\_\_}}$$

b. Filter media length (L) = Bed length + (2 X endslope width)

= B + 2K

= _____ ft +(2 X _____ ft)

= ______ ft

3. Filter media width

a. Upslope width (J) = filter media depth at upslope edge of bed X horizontal gradient of sideslope X slope correction factor

= (D + F + G) X horizontal gradient X slope correction factor

= (_____ ft + _____ ft + _____ft) X _____ X _____

= ______ ft X _____ X _____

= ______ ft

b. Downslope width (I) =filter media depth at downslope edge of bed X horizontal gradient of sideslope X slope correction factor

= (E + F + G) X horizontal gradient X slope correction factor

= (_____ ft + _____ ft + _____ft) X _____ X _____

= ______ ft X _____ X _____

= ______ ft

b. Filter media width (W) = upslope width + Bed width + Downslope width

= J + A + I

= _____ ft + _____ ft + _____ft

= ______ ft

4. Check the basal area

a. Basal area required = Daily rate / Infiltration rate of original soil

= __________ gal/day / ____________ $gal/ft^2/day$

= ____________ ft^2

b. Basal area available — Is it sufficient? _____ YES _____ NO
1) Sloping site = Bed length X (Bed width + Downslope width)

= B X (A + I)

= ______ ft X (_____ ft + _____ ft)

= ______ ft X ______ ft

= ______ ft^2

2) Level site = filter media length X Fill width

= L X W
= ______ ft X _____ ft
= ______ ft^2

Overview of a Typical At-grade System Design Procedure

Step A. SITE CONDITIONS

Evaluate the site and soils report for the following:

• Surface water movement.

• Measure elevations and distances on the site so that slope, contours and available areas can be determined.

• Description of several soil profiles where the component will be located.

• Determine the limiting conditions such as bedrock, high groundwater level, soil permeability, and setbacks.

Slope- ______%

Occupancy:
One- or Two-family Dwelling, # of bedrooms - ______
Public Facility ______

Depth to limiting factor – ______inches

In situ soil application rate used - ______gal/ ft^2 /day

Step B. DESIGN WASTEWATER FLOW (DWF)

One- or Two-family Dwelling.

DWF = 150 gal/day/bedroom x # of bedrooms

= 150 gal/day/bedroom x ______ # of bedrooms

= ______gal/day

Public Facilities.

DWF = Sum of each wastewater flow per source per day x 1.5

= gal/day x 1.5

= ______gal/day

Step C. EFFECTIVE WIDTH AND LENGTH OF THE DI5TRIBUTION CELL

1. Determine the design loading rate (DLR) for the site.

Select the soil application rate for the most restrictive soil horizon in contact with the distribution cell that matches the soil conditions, which is the design loading rate (DLR) for the site.

DLR= ______ gal/ ft^2/day

2. Determine the distribution cell area.

Calculate the distribution cell area by dividing the daily design wastewater flow (DWF) by the design loading rate (DLR).

Distribution cell area = DWF . DLR Distribution cell area

= ______gpd / ______ gal/ft^2/day Distribution cell area

= ______ ft^2

3. Select an effective distribution cell credit width (A). The effective credit width cannot exceed 10 feet.

A= ______ ft

4. Determine the distribution cell length.

Calculate the distribution cell length (B) by dividing the required distribution area by the effective distribution cell width (A).

B = Distribution cell area / A
B = ______ ft^2 / ______ ft
B = ______ ft

5. Determine the linear loading rate (LLR) if, the soil application rate of any horizon within 12 inches below the distribution cell has a soil application rate of ≤ 0.3 gal/ ft^2/day.

If the LLR exceeds 4.5 gal/ft for such soils, the component must be lengthened to reduce the LLR to 4.5 gal/day/ft or less.

LLR = DWF / B
LLR= ______gal/day / ______ ft
LLR= ______gal/day/ft

Step D. DESIGN OF ENTIRE AT-GRADE COMPONENT.

1. Determine the total width of distribution cell.

For level site, the total width of the distribution cell (TW) is equal to or greater than the effective distribution cell credit width (A).

TW ≥ A
TW = ______ft

For sloping site, the total width of the distribution cell (TW) is equal to or greater than the effective distribution cell credit width (A) + 2 feet.
TW ≥ A+2 feet
TW ≥ ______ft+2 feet
TW = ______ft

2. Determine the overall width (W) of the component.
W ≥TW + 10ft
W ≥ ______ ft+ 10ft.
W = ______ft

3. Determine the overall length (L) of the component.
L ≥B+ 10ft
L ≥ ______ ft+ 10ft.
L = ______ft

4. Horizontal location of distribution lateral in the distribution cell.
______Level site with one effluent distribution lateral; the lateral is located in the center of distribution cell.
______Level site with more than one effluent distribution lateral; the laterals are equally spaced apart with the center two laterals the same distance from center of the cell and the distance from the outside laterals to the edge of the cell being one-half the distance between laterals.
______ Sloping site with one effluent distribution lateral; the effluent distribution lateral is located 2 feet in from up slope edge of total distribution cell.
______Sloping site with more than one effluent distribution lateral; one lateral is located 2 feet down slope from the up slope edge of the distribution cell and the others are down slope of the upper lateral and up slope of the mid point of the distribution cell credit width.

5. Vertical location of distribution lateral in the distribution cell.

Elevation of distribution lateral ≥ elevation of original contour directly under distribution lateral + 6 inches
Elevation of distribution lateral ≥ ______ ft. + 0.5 ft.
Elevation of distribution lateral = ______ ft.

6. Determine the height of the component.
Height over the distribution lateral ≥ 14 inches +nominal diameter of lateral
Height over the distribution lateral ≥ 14 inches + ______ inches

Height over the distribution lateral = ______ inches
Height over the rest of the distribution cell ≥ 12 inches
Height over the rest of the distribution cell = ______ inches

7. Determine the location of observation pipes along the length of distribution cell.
Distance from end of distribution cell to end observation pipes = B / 6
Distance from end of distribution cell to end observation pipes = ______ft. / 6
Distance from end of distribution cell to end observation pipes = ______ft.

Design Example of At-grade System

Step 1. SITE CONDITIONS

Evaluate the site and soils report for the following:

• Surface water movement.

• Measure elevations and distances on the site so that slope, contours and available areas can be determined.

• Description of several soil profiles where the component will be located.

• Determine the limiting conditions such as bedrock, high groundwater level, soil permeability, and setbacks.

Slope- ≤1 %
Occupancy:
One- or Two-family Dwelling, # of bedrooms – 3
Public Facility ______
Depth to limiting factor – 38 inches
In situ soil application rate used – 0.6 gal/ ft^2 /day

Step 2. DESIGN WASTEWATER FLOW (DWF)

One- or Two-family Dwelling.

DWF = 150 gal/day/bedroom x # of bedrooms
= 150 gal/day/bedroom x 3 # of bedrooms
= 450 gal/day

Public Facilities.

DWF = Sum of each wastewater flow per source per day x 1.5
= gal/day x 1.5
= ______gal/day

Step 3. EFFECTIVE WIDTH AND LENGTH OF ITE DI5TRIBUTION CELL

1. Determine the design loading rate (DLR) for the site.

From Table 83.44-1 or -2, Wis. Adm. Code, select the soil application rate for the most restrictive soil horizon in contact with the distribution cell that matches the soil conditions. The soil application rate selected from Table 83.44-1 or-2, Wis. Adm. Code, is the design loading rate (DLR) for the site.

DLR= 0.6 gal/ ft^2/day

2. Determine the distribution cell area.

Calculate the distribution cell area by dividing the daily design wastewater flow (DWF) by the design loading rate (DLR).

Distribution cell area = DWF . DLR Distribution cell area
= 450 gpd / 0.6 gal/ft^2/day Distribution cell area
= 750 ft^2

3. Select an effective distribution cell credit width (A). The effective credit width can not exceed 10 feet.
A= 10 ft

4. Determine the distribution cell length.

Calculate the distribution cell length (B) by dividing the required distribution area by the effective distribution cell width (A).

B = Distribution cell area / A
B = 750 ft^2 / 10 ft
B = 75 ft

5. Determine the linear loading rate (LLR) if, the soil application rate of any horizon within 12 inches below the distribution cell has a soil application rate of ≤ 0.3 gal/ ft^2/day.

If the LLR exceeds 4.5 gal/ft for such soils, the component must be lengthened to reduce the LLR to 4.5 gal/day/ft or less.
LLR = DWF / B
LLR= ______gal/day / ______ ft
LLR= ______gal/day/ft

Step 4. DESIGN OF ENTIRE AT-GRADE COMPONENT.

1. Determine the total width of distribution cell.

For level site, the total width of the distribution cell (TW) is equal to or greater than the effective distribution cell credit width (A).

TW ≥ A
TW = 10 ft

For sloping site, the total width of the distribution cell (TW) is equal to or greater than the effective distribution cell credit width (A) + 2 feet.
TW ≥ A+2 feet
TW ≥ ______ft+2 feet
TW = ______ft

2. Determine the overall width (W) of the component.

W ≥TW + 10ft

W ≥ 10 ft+ 10ft.

W = 20 ft

3. Determine the overall length (L) of the component.

L ≥B+ 10ft

L ≥ 75 ft+ 10ft.

L = 85 ft

4. Horizontal location of distribution lateral in the distribution cell.

__X__Level site with one effluent distribution lateral; the lateral is located in the center of distribution cell.

______Level site with more than one effluent distribution lateral; the laterals are equally spaced apart with the center two laterals the same distance from center of the cell and the distance from the outside laterals to the edge of the cell being one half the distance between laterals.

______ Sloping site with one effluent distribution lateral; the effluent distribution lateral is located 2 feet in from up slope edge of total distribution cell.

______Sloping site with more than one effluent distribution lateral; one lateral is located 2 feet down slope from the up slope edge of the distribution cell and the others are down slope of the upper lateral and up slope of the mid point of the distribution cell credit width.

5. Vertical location of distribution lateral in the distribution cell.

Elevation of distribution lateral ≥ elevation of original contour directly under distribution lateral + 6 inches

Elevation of distribution lateral ≥ 105 ft. + 0.5 ft.

Elevation of distribution lateral = 105.5 ft.

6. Determine the height of the component.

Height over the distribution lateral ≥ 14 inches +nominal diameter of lateral

Height over the distribution lateral ≥ 14 inches + 1.5 inches

Height over the distribution lateral = 15.5 inches

Height over the rest of the distribution cell ≥ 12 inches

Height over the rest of the distribution cell = 12 inches

7. Determine the location of observation pipes along the length of distribution cell.

Distance from end of distribution cell to end observation pipes = B / 6

Distance from end of distribution cell to end observation pipes = 75 ft. / 6

Distance from end of distribution cell to end observation pipes = 12.5 ft.

PLAN SUBMITTAL AND INSTALLATION INSPECTION

Plan Submittal

In order to install a component correctly, it is important to develop plans that will be used to install the component correctly the first time. The following checklist may be used when preparing plans for review. The checklist is intended to be a general guide. Conformance to the list is not a guarantee of plan approval. Additional information may be needed or requested to address unusual or unique characteristics of a particular project. Contact the reviewing agent for specific plan submittal requirements, which the agency may require that are different than the list included in this manual.

General Submittal Information

• Photocopies of soil reports forms, plans, and other documents are acceptable. However, an original signature is required on certain documents.
• Submittal of additional information requested during plan review or and questions concerning a specific plan must be referenced to the Plan Identification indicator assigned to that plan by the reviewing agency.
• Plans or documents must be permanent copies or originals.

Forms and Fees

• Application form for submittal, provided by reviewing agency along with proper fees set by reviewing agent.
• Onsite verification report signed by the county or appropriated state official.

Soils Information

• Complete Soils and Site Evaluation Report for each backhoe pit described; signed and dated by a certified soil tester, with license number.
• Separate sheet showing the location of all borings. The location of all borings and backhoe pits must be able to be identified on the plot plan.

Documentation

• Architects, engineers or designers must sign, seal and date each page of the submittal or provide an index page, which is signed, sealed and dated.
• Master Plumbers must sign, date and include their license number on each page of the submittal or provide an index page, which is signed, sealed and dated.
• Three completed sets of plans and specifications (clear, permanent and legible); submittals must be on paper measuring at least 8-1/2 by 11 inches.

Plot Plan

• Dimensioned plans or plans drawn to scale (scale indicated on plans) with parcel size or all property boundaries clearly marked.
• Slope directions and percent in component area.
• Benchmark and north arrow.
• Setbacks indicated as per appropriate code.

• Two-foot contours to 25 ft. on all sides of system area or include elevations at all four corners of proposed system.
• Location information; legal description of parcel must be noted.
• Location of any nearby existing component.

Plan View
• Dimensions for distribution cell(s).
• Location of observation pipes.
• Pipe lateral layout, which must include the number of laterals, pipe material, diameter and length; and number, location and size of orifices.
• Manifold/force main locations, with materials, length and diameter of each.

Cross Section of Component
• Include tilling requirement, depth and size of aggregate, percent slope, side slope, and topsoil.
• Lateral elevation, position of observation pipes, dimensions and depths of aggregate, and type of cover material such as geotextile fabric, and depth, if applicable.

Component Sizing
• For one and two-family dwellings, the number of bedrooms must be included.
• For public buildings, the sizing calculations must be included.

Tank and Pump / Siphon Information
• All construction details for site-constructed tanks.
• Size and manufacturer information for prefabricated tanks.
• Notation of pump or siphon model, pump performance curve, friction loss for force main and calculation for total dynamic head.
• Cross section of tank / chamber to include storage volumes; connections for piping, vents, and electricity; pump "off" setting; dosing cycle and volume; and location of vent and manhole.
• Cross section of two compartments tanks or tanks installed in a series must include information listed above.

Other
• For design flows greater than 1000 gpd, include the manufacturer, model, and location of a metering device, which accurately, meters the amount of effluent entering the component.

POWTS INSPECTION REPORT
(ATTACH TO PERMIT)

GENERAL INFORMATION

Permit Holder's Name	☐ City ☐ Village ☐ Town of	County	Sanitary Permit No.
State Plan ID No.	Tax Parcel No.	Property Address if Available	

TANK INFORMATION			SETBACKS				
TYPE	MANUFACTURER	CAPACITY	P/L	WELL	BLDG.	VENT TO AIR INTAKE	ROAD
SEPTIC							
DOSING							
AERATION							
HOLDING							

PUMP / SIPHON INFORMATION

Manufacturer:	Model No.	Demand in GPM	Vert. Lift

FORCE MAIN INFORMATION			FRICTION LOSS		
Length	Diameter	Dist. To Well	Component Head	TDH - As Built	TDH - Design

SOIL ABSORPTION COMPONENT

TYPE OF COMPONENT				COVER MATERIAL		
Cell Width	Cell Length	Cell Diameter	Cell Depth	Horizontal Separation	Liquid Depth	No. of Cells

LEACHING CHAMBER OR UNIT	Manufacturer		Model No.
SETBACK INFO.	Property Line	Bldg.	Well	Lake/Stream

DISTRIBUTION COMPONENT / Elevation data on back of form

Header / Manifold		Distribution Pipe(s)			Hole size	Hole Spacing	Obsv. Tubes Inst. & No.
Length	Dia.	Length	Dia.	Spacing			

SOIL COVER

Depth over center of cell:	Depth over edge of cell:	Depth of Topsoil	Seeded / Sodded	Mulched

DEVIATIONS FROM APPROVED PLAN

DATE OF INST. DIRECTIVE:	DATE OF ENFORCEMENT ORDER:
DATE OF REFERRAL TO LEGAL COUNSEL:	

COMMENTS (Persons present, discrepancies, etc.)

COMPONENTS NOT INSPECTED

Plan Revision Required ☐ Yes ☐ No	Date:	Signature of Inspector:	Cert. Number

Sketch on other side

Site Preparation and Construction

Construction Procedures

The following is a step-by-step procedure for mound system construction that has been tried and proven. If these procedures are followed, the potential for future problems should be minimized and the mound system should function properly. Other techniques may also work satisfactorily, but the basic principles of mound system design, construction and operation should not be violated.

1. Check the moisture content of the soil at 7-8 inches deep. If it is too wet, smearing and compaction will result, reducing the infiltration capacity of the soil. Soil moisture can be determined by rolling a soil sample between the hands. If it rolls into a wire, the site is too wet to prepare. If it crumbles, site preparation can proceed. If the site is too wet to prepare, do not proceed until the soil moisture decreases.

2. Stake out the mound area on the site according to the system design, so the infiltration bed runs parallel to the contours. Reference stakes offset from the corner stakes are recommended in case corner stakes are disturbed during construction. If the site conditions do not allow for layout according to the approved design, contact the designer and/or the local health officer.

3. Measure the average ground elevation along the upslope edge of the bed or the upper trench and reference this to a benchmark for future use. This is necessary to determine the bottom elevation of the bed.

4. Determine where the pipe from the pump chamber connects to the distribution system in the filter media. The location and size of this transport pipe is determined from the pressure distribution guideline.

5. Trench and lay the effluent pipe from the pump chamber to the mound. Cut and cap the pipe one-foot beneath the ground surface. Lay pipe below frost line or sloping uniformly back to the pump chamber so that it drains after dosing.

Backfill and compact the soil around the pipe to prevent back seepage of effluent along pipe. This step must be done before plowing to avoid compaction and disturbance of the surface.

6. Cut trees to ground level, remove excess vegetation by mowing. Rake cut vegetation if it is, or will become, matted. Prepare the site using a spring-loaded agricultural chisel plow and plowing parallel to contours.

The function of this preparation is to provide a cleared ground surface with a series of vertical channels to enhance transfer of moisture from the sand fill to the original soil, while inhibiting lateral movement at the sand-soil interface. In addition, the vertical furrows aid in stabilizing the sand at the sand-soil interface in an interlocking fashion.

The site should be plowed using a spring loaded agricultural chisel plow, or other acceptable apparatus or method to prepare the soil before constructing the mound system. Shallow hand-spading the surface is also an acceptable alternative and may be the preferred method on some sites. Rototilling is not an acceptable substitute and must not be done.

The important point is that a rough, unsmeared surface should be left, especially in fine textured soils. Careful observation is required to assure that the soil moisture content is not so high that the soil surface is smeared by the action of the plow. Plowing should not proceed until the soil is sufficiently dry so as not to smear in the plowing process.

If stumps remain, care must be taken in preparing the site. The sod layer should be broken up, yet the topsoil should not be pulverized. The objective of this step is to break up any surface mat that could impede the vertical flow of liquid into the native soil.

Immediate construction after plowing is desirable. Avoid rutting and compaction of the plowed area by traffic. If it rains after the plowing is completed, wait until the soil dries out before continuing construction.

6. Reset the corner stakes, if necessary, using the offset reference stakes and locate the bed or trench areas by staking their boundaries.

7. Extend the transport pipe from the pump chamber (which had previously been cut off) to several feet above the ground surface.

8. Install one or more standpipes (4 inch PVC with the bottom foot perforated, rebar and with gravel or a geotextile around the perforations). At least one must be in the downslope portion of the mound with the bottom at the original surface and the top extending above final grade where it can be capped. Another could be located in the bed extending only from the bottom of the bed to above the final grade. The standpipes allow observations to be made of the water levels. Slotting the caps will facilitate removing the caps to allow access.

9. Place the filter media that has been properly selected around the edge of the plowed area. Keep the wheels of trucks off plowed areas. Avoid traffic on the downslope side of the mound system. Work from the end and upslope sides. This will avoid compacting the soils on the downslope side, which, if compacted, would affect lateral movement away from the mound and possibly cause surface seepage at the toe of the mound.

10. Move the filter media into place using a small track-type tractor with a blade. Do not use a tractor/backhoe having rubber-tired wheels. Always keep a minimum of 6 inches of filter media beneath tracks to prevent compaction of the natural soil.

11. Place the filter media to the required depth, i.e., to the top of the bed. Shape sides to the desired slope.

12. With the blade of the tractor form the infiltration bed. Hand level the bottom of the bed to within ±1/2 inch.

13. Place the coarse aggregate in the bed. Level the aggregate to the design depth.

14. Place the distribution pipes, as determined from the pressure distribution guidelines, on the aggregate. Connect the manifold to the transport pipe. Slope the manifold to the transport pipe. Lay the laterals level, removing rises and dips.

15. Pressure test the distribution system for uniformity of flow.

Place 2 in. of aggregate over the distribution pipe.

Place an approved geotextile material over the aggregate.

Place the soil for the cap and topsoil on the top of the bed. This may be a subsoil or a topsoil. An initial depth of 18 inches in the center and 12 inches at the outer edge of the bed is desired. This creates a slope that assists the surface run-off of precipitation. Also, this layer provides some frost protection. Do not drive over the top of the bed as the distribution system may be damaged.

Seed or sod the mound system.

Sand Filters

Illinois Regulations on Recirculating Sand Filters
Section 905.80 Recirculating Sand Filter

a) General. The recirculating sand filter system (Appendix A: Illustration O of this Part) consists of a septic tank, recirculation tank, open sand filter, and flow splitter. It may be used provided the effluent is discharged in accordance with the requirements of Section-905.110.

b) Septic Tank. The septic tank shall be sized and installed as described in Section-905.40.

c) Recirculation Tank. The recirculation tank volume shall be 500 gallons and the tank shall be equivalent in strength and materials to the septic tank as provided in Section-905.40. No baffles are necessary. An access manhole, as described in Section-905.40(b)(7), shall be provided for pump maintenance or replacement.

d) Sand Filter. The sand filter shall be sized at one square foot of filter surface for every 3 gallons per day of domestic sewage flow. Appendix A: Illustration P of this Part has a size chart for residences based on numbers of bedrooms. Unless otherwise stated in Appendix-A: Illustration P of this Part, the sizes shown are required. The filter media shall comply with requirements of Section 905.70(e) and (f) and shall be 30 inches in depth.

e) Bedding Material. The bedding material for the collection lines shall be the same as that in a buried sand filter. The coarse gravel shall be 3/4 to 2 1/2 inch diameter and the pea gravel shall be from 1/8 to 3/8 inches diameter. A minimum of 2 inches of coarse gravels all be placed on the excavation prior to placement of collection lines.

f) Distribution and Collection Lines. The collection lines shall be constructed of materials as approved in Section 905.20(f) and shall be 4 inches inside diameter perforated piping laid with perforations facing downward. The distribution piping shall have an inside diameter of 1 1/2 inches. The perforated pipe shall have 1/2 to 3/4 inches diameter openings on 3 to 5 inch centers with 2 rows at 120^{o} from each other. Distribution piping shall be spaced on 3 foot centers and shall be located a minimum of 1 1/2 feet from sidewalls.

g) Pumps. The pump shall be a submersible pump designed for corrosive liquids and shall have a capacity of 15 to 25 gallons per minute at the 10 foot total dynamic head (TDH). The pump shall be controlled by a time clock which can be set to activate the pump at one hour or longer intervals. Pump shut off shall be controlled by a low-level float switch which allows the entire contents of the recirculation tank to be pumped during each pump cycle. A high level float switch shall be provided that energizes a visible and audible alarm to indicate pump failure or malfunction. (See-Appendix A: Illustration-Q of this Part)

h) Flow Splitter. The flow splitter shall be designed so that recirculation rates can be controlled between no recirculation and a 5 to 1 recirculation ratio. An example of one type of splitter is shown in Appendix A: Illustration O of this Part.

(Source: Amended at 20 Ill. Reg. 2431, effective March 15, 1996)

Missouri Regulations on Recirculating Sand Filter

The following shall apply to pressure dosed sand filter systems:

A. Conventional pressure dosed sand filters use an intermittent filter with two feet (2') or more of medium sand designed to filter and biologically treat sewage tank effluent from a pressure distribution system at an application rate not to exceed one and twenty-five hundreths gallons per square foot (1.25 gals./sq. ft.) sand surface area per day, applied at a dose not to exceed one-half gallon (1/2 gal.) per orifice per dose. These sand filters may be buried or open.

B. Recirculating pressure dosed sand filters use a recirculating filter with two feet (2') or more of medium filter media designed to filter and biologically treat sewage tank effluent from a pressure distribution system at an application rate not to exceed five gallons per square foot (5 gals./sq. ft.) filter surface per day, applied at a dose not to exceed two gallons (2 gals.) per orifice per dose. These sand filters shall be uncovered and open to the surface.

C. Minimum filter area for these filters shall be as follows:
(I) Conventional pressure dosed sand filters for single family residences shall be a minimum of three-hundred-and-sixty square feet (360 sq. ft.) in surface area with a design sewage flow not to exceed six hundred gallons (600 gals.). If sand filter design flows exceed an average of four-hundred-and-fifty gallons per day (450 gpd), the minimum sand surface will be based on one and twenty-five hundredths gallons per day per square foot (1.25 gpd/sq. ft.); and
(II) Pressure dosed sand filters for commercial facilities shall be sized on the basis of projected daily sewage flow. If the waste strength is proposed to be greater than residential strength waste, pretreatment shall be required which will reduce the biological oxygen demand to levels not to exceed three hundred (300), total suspended solids to levels not to exceed one-hundred-fifty (150), and oil and grease to levels not to exceed twenty-five (25). The minimum sand surface will be based on two to five gallons per day per square foot (2-5 gpd/sq. ft.).

D. Design criteria shall include the following:

(I) Sewage tanks shall be in accordance with section (4) of this rule. Setback distances as shown in Table 1 of subsection (1)(D) and as specified in subsection (1)(E) of this rule shall apply, unless a variance has been allowed by the administrative authority. Tanks shall be watertight and tested in the field. The test shall be performed by filling the tank two inches (2") above the riser inlet. At the end of the first twenty-four (24) hour period, the tank water level should be refilled. After another twenty-four (24) hour period, no more than one inch (1") of water should have dropped from the original reading. All sewage and pump tanks will be supplied with vandal-proof access risers to grade over the pump units. Risers should have a waterproof epoxy seal between the tank and riser;

(II) Pumping systems for a pressure dosed sand filter system should provide pumping apparatus that is capable of filtering gross solids larger than one-eighth inch (1/8") and draw from the clear zone near the outlet side of the sewage tank. This zone is described as the layer of effluent between the sludge and scum layers of the sewage tank. Pumps should be able to deliver adequate head pressure to control orifice plugging. Pumps should be made of a corrosive resistant material such as Type 316 stainless steel, suitable plastic, or 85-5-5-5 bronze. Screens should have at least ten square feet (10 sq. ft.) of surface area, with one-eighth inch (1/8") openings;

(III) Operation controls should be on a timer dose that distributes the average daily flow over an eighteen (18) hour period. Recirculating filters will be set to recirculate five (5) times the average daily flow over a twenty-four (24) hour period. Systems should be designed with a high-water alarm and light signal. Control panels should be located on an exterior location. Control operations should be located in an area available for maintenance;

(IV) Intermittent filter media shall be a mixture of sand or durable inert particles with one hundred percent (100%) passing the three-eighths inch (3/8") sieve; ninety to one hundred percent (90-100%) passing the No. 4 sieve; sixty-two to one hundred percent (62-100%) passing the No. 10 sieve; forty-five to eighty-two percent (45-82%) passing the No. 16 sieve; twenty-five to fifty-five percent (25-55%) passing the No. 30 sieve; ten percent (10%) or less passing the No. 60 sieve; four percent (4%) or less passing the No. 100 sieve; or sand meeting the ASTM-C 33 concrete sand specification minus four percent (4%) or less passing the No. 100 sieve. All drainage rock should be a river washed, hardened and weathered rock. The treatment media will be two inches (2") deep and of a coarse media with an effective size of one and one-half to three millimeters (1 1/2(3 mm) and a uniformity coefficient of less than two (2). Limestone or dolomite is not acceptable for drainage rock;

(V) Recirculating filter media shall be a mixture of sand or durable inert particles with one hundred percent (100%) passing the three-eighths inch (3/8") sieve; seventy-nine to one hundred percent (79-100%) passing the No. 4 sieve; eight to ninety-two percent (8-92%) passing the No. 8 sieve; zero to fifteen percent (0-15%) passing the No. 30 sieve; zero to one percent (0-1%) passing the No. 50 sieve. All drainage rock should be a river washed, hardened and weathered rock. The treatment media will be two inches (2") deep and of a coarse media with an effective size of one and one-half to three millimeters (1 1/2(3 mm) and a uniformity coefficient of less than two (2). Limestone or dolomite is not acceptable for drainage rock; and

(VI) Container designs may be concrete containers consisting of watertight walls and floors to prevent groundwater from infiltrating or effluent from exfiltrating from the filter. All penetrations through the walls shall be watertight. Containers may also consist of a thirty (30) mil polyvinyl chloride liner covering the sand filter bottom and sidewall areas. Polyvinyl chloride liners should be supplied with repair kits and boots for passage through the liner wall. The bottom area of the liner should be bedded in two inches (2") of leveling sand. The liner should be constructed to form a waterproof membrane between the trench bottom and trench walls. The polyvinyl liner should incorporate all seams to be a chemically or heat bonded waterproof seam.

E. The filter design criteria shall include the following:

(I) The interior base of the filter container shall be level or constructed at a grade of one percent (1%) or less to the underdrain pipe elevation;

(II) The underdrain piping shall consist of a pipe with one-fourth inch (1/4") grooves cut every four inches (4") along the pipe length to a depth of one-half (1/2) of the pipe diameter. The bottom of the filter container shall be covered with a minimum of six inches (6") of drain media. The underdrain pipe shall be enveloped in an amount and depth of drainage rock to prevent migration of the underdrain media into the pipe perforations;

(III) A minimum of twenty-four inches (24") of approved filter media shall be installed over the underdrain media. The media shall be damp at the time of installation to insure compaction of the media. The top surface of the media shall be level;

(IV) There shall be a minimum of three inches (3") of clean drain media below the distribution laterals, and sufficient media above the laterals equal to or covering the orifice shields and/or pipe;

(V) Distribution laterals shall be evenly spaced on minimum, thirty inch (30") centers. Orifices shall be placed such that there is one orifice or more on average per six square feet (6 sq. ft.) of sand surface. Orifice holes shall be one-eighth inch (1/8") in diameter. The diameter of the piping manifold and lateral shall be no less than one-half inch (1/2"). The ends of the distribution alterals should be constructed with a means to perform flushing of the piping, collectively or individually, through the operation of a flushing valve. The flushed effluent may be discharged to the sand filter;

(VI) The top of the intermittent media in which the pressure distribution system is installed shall be covered with a breathable nylon or polypropylene spun filter fabric rated at eighty-five hundredths ounce per square yard (0.85 oz./sq. yd.) to eliminate soil intrusion into the filter media. Recirculating filters shall be open-topped.

(VII) The top of the intermittent sand filter area shall be backfilled with a soil cover, free of rocks, vegetation, wood waste, etc. The soil cover shall have a textural class of loamy sand. The soil cover shall have a minimum depth of six inches (6") and a maximum depth of twelve inches (12"). Intermittent sand filters designs may delete soil cover and incorporate three to six inches (3-6") of a quality cypress or cedar mulch over the entire filter area.

(VIII) Where the effluent from a sand filter is to be discharged via a pump, the pump and related apparatus shall be housed in a vandal resistant vault designed to withstand the stresses placed upon it and not allow the migration of drain media, sand or underdrain media to its interior. The vault shall have a durable, affixed floor. The vault shall provide watertight access to the finished grade with a diameter equal to that of a gravity discharge sand filter. The depth of the underdrain and the operational level of the pump cycle and alam shall not allow effluent to come within two inches (2") of the bottom of the sand filter media. The pump off level shall be no lower than the invert of the perforations of the underdrain piping. The internal sand filter pump shall be electrically linked to the sand filter dosing apparatus in such a manner as to prevent effluent from entering the sand filter in event the internal sand filter pump fails; and

(IX) Other sand filters which vary in design from those described in this rule may be authorized by the administrative authority if they can be demonstrated to produce a comparable effluent quality.

F. Effluent from these sand filters may discharge to the ground surface, provided the effluent is maintained on the ownerís property and the following separation distances are maintained:

(I) The discharge shall be a minimum of one hundred feet (100') from private water supply wells; one-hundred-fifty feet (150') from unplugged abandoned wells or wells with less than eighty feet (80') of casing; and three hundred feet (300') from public water supply wells;

(II) The discharge shall be a minimum of one hundred feet (100') from springs; five hundred feet (500') from the edge of surficial sink holes; fifty feet (50') from a classified stream; and twenty-five feet (25') from a stream or open ditch; and

(III) The discharge shall be a minimum of seventy-five feet (75') from property lines.

G. If effluent cannot meet the minimum separation distances as described in subparagraph (6)(G) 2.F., then the effluent must be disposed of into a soil absorption system. The required footage of the soil absorption system may be reduced by up to one-third (1/3) of that required for a conventional soil absorption system. Shallow bury designs should be utilized whenever possible to achieve the best absorption rates.

Montana Regulations on Intermittent and Recirculating Sand Filters

85 Intermittent Sand Filter System

85.1 General - The utilization of sand filters as a method of providing additional treatment of effluent discharged from a septic tank or aerobic treatment unit may be considered whenever site conditions set forth in Title 16, Chapter 16, subchapter 3 preclude the use of conventional subsurface absorption systems. The design criteria shall include, but not necessarily be limited to, the type of usage, primary treatment, filter media, filtration rate and dosage rate. Sand filters must discharge to a subsurface absorption system. The drainfield used for final disposal may be downsized by 50% as determined by Circular WQB-4, Section 60.302.

85.2 Location

85.201 Intermittent sand filters (ISF) shall not be utilized on sites within 100 feet of the 100 year floodplain.

85.202 ISF systems shall not be installed in areas where creviced bedrock, seasonal high groundwater table or strata having percolation rate slower than 120 minutes per inch occurs within 4 feet of the natural ground surface or where rapid percolation may result in contamination of water bearing formations or surface waters.

85.203 ISF systems shall be located at least 100 feet from a potable individual well water supply or pump suction line. Greater horizontal separation distances may be needed depending on engineering and hydrogeological data and type of water supply.

85.204 ISF systems shall be located at least 10 feet from property lines, buildings, driveways or other subsurface obstructions.

85.205 ISF systems shall be located at least 100 feet from a stream, watercourse, lake, impoundment and any swamp or seep as measured from the outer edge of the system.

85.3 Design

85.301 The minimum area in any subsurface sand filter shall be based upon a flow as determined in Circular WQB-4, chapter 30.

85.302 The application rate for intermittent sand filters shall not exceed 1.2 Gal/Day/sq.-ft.. The sand filter media shall meet ASTM C-33 specifications and shall not have more than 45% passing any one sieve and retained on the next consecutive sieve.

85.303 Collection lines and the bottom of the excavation shall have a slope of 1 percent and 1 collection line shall be provided for each 6 feet of width or fraction thereof. A minimum of 2 collection lines shall be provided. The upper end of the collection line shall be sealed or plugged.

85.304 Distribution lines shall be level and shall be horizontally spaced a maximum of 3 feet apart, center to center.

85.305 The minimum depth of filter media shall be 24 inches. The filter media shall be separated from the gravel or crushed stone by 3 inches of 1/4 inch pea gravel.

85.306 A 30 mil PVC liner shall be used to line the sand filter. A reinforced concrete container shall be required where the filter must be protected from groundwater infiltration.

85.4 Construction

85.401 Gravel or crushed stone shall be placed at a minimum depth of 10 inches around distribution and collection lines.

85.402 The filter shall be covered with 12 to 18 inches of soil.

85.404 Monitoring pipes to detect filter clogging will be required.

85.5 Materials

85.501 The filter media shall have a uniformity coefficient of less than 3.5. The filter media shall be washed and free of clay or silt.

85.502 Gravel or crushed stone shall be washed and shall range in size from 3/4 to 1 1/2 inches for the distribution lines and shall range in size from 1/4 to 1 1/2 inches for the underdrain lines.

85.503 Pea gravel shall be washed and range in size from 1/8 to 3/8 inch.

85.504 The material used to cover the top of the gravel or stone shall be synthetic drainage fabric, two or more layers of untreated building paper or a 4-6 inch layer of straw.

85.505 Pipe used for distribution and collection lines shall meet the appropriate ASTM standard or those of an equivalent testing laboratory. Fittings used shall be compatible with the materials used in the distribution and/or collection lines.

85.506 Materials selected shall be constructed of cement or rigid plastic pipe. If perforated distribution and/or collection lines are used, the perforation shall be at least 1/8 inch and no more than 3/4 inch in diameter and spaced to provide at least the equivalent total opening of comparable diameter foot-long tile laid with 1/4 inch open joints.

85.6 Dosing System Design

85.601 Pressure dosing shall be required for all sand filters.

85.602 Dosing systems shall be designed in accordance with Section 60.7.

86 Recirculating Sand Filters

86.1 When a recirculating sand filter is used, effluent from the septic tank or other primary treatment device must discharge directly to the recirculation tank. The minimum criteria relative to the location, design considerations, materials, dosing and general construction details provided for intermittent sand filters shall also apply to recirculating sand filters except as follows:

86.101 The design of a recirculating sand filter is similar to the design of a intermittent sand filter except that it must be located to permit gravity flow into the top of the recirculation tank from the collection line of the filter.

86.102 The depth of filter media shall be at least 30 inches.

86.103 The maximum application rate shall be 3 gallons/day/ft2 of filter area.

86.104 The liquid capacity of the recirculation tank shall be equal to 750 gallons or 1-1/2 times the daily design sewage flow.

86.105 The filter effluent line, passing through the recirculation tank, shall be provided with a control device that directs the flow of the filter effluent. The filter effluent will be returned to the recirculation tank for recycling or be discharged to the subsurface absorption system depending upon the liquid level in the recirculation tank.

86.106 The recirculating pump shall be of adequate size to recircu-late the daily design sewage flow at least 4 times through the sand filter. The recirculating pump shall be sized to dose the filter every 1/2 hour within a 10 minute period. The dose volume is, therefore, 4 times the daily flow divided by 48. Dosing frequency may be reduced as dictated by climatic conditions to minimize the possibility of freezing of the filter surface.

86.107 The effluent shall be discharged in such a manner as to provide uniform distribution through a system of pipes or troughs supported above the filter surface.

86.108 The filter surface, which is sand rather than gravel, must be raked and leveled on a routine basis. The filter shall be kept free of weed growth and the accumulation of all debris. Where climatic conditions dictate the installation of a cover, it shall be constructed to minimize freezing, support anticipated snow loads and permit air circulation. After extended periods of operation, a crust may develop on the surface of the sand in some areas. When ponding occurs, the upper 1/2 to 1 inch of crust and sand should be removed and discarded. The sand surface may then be raked and leveled and the process continued until a minimum of 24 inches of sand remains. At that time, the filter shall be reconstructed by adding new, coarse sand and the operation of the filter reinstituted.

86.109 A small hole shall be provided on the pump discharge line inside the recirculation tank to allow the discharge line to drain back into the recirculation tank.

Intermittent Sand Filters Specifications

A. Filter Media Specifications

1. Coarse Sand Media Specification

The filter media must meet items a, b, and c, below: (Source: State of Oregon Onsite Sewage Disposal Rules and the State of Wisconsin Single Pass Sand Filter Component Manual)

(a) Particle size distribution:

Sieve	Particle Size	Percent Passing
3/8 in	9.50 mm	100
No. 4	4.75 mm	95 to 100
No. 8	2.36 mm	80 to 100
No. 16	1.18 mm	45 to 85
No. 30	0.6 mm	15 to 60
No. 50	0.3 mm	3 to 15
No. 100	0.15 mm	0 to 4

(b) Effective Particle Size (D_{10}) > 0.3 mm.

(c) Uniformity Coefficient (D_{60}/ D_{10}) < 4.0

2. ASTM C-33 Specification

The filter media must meet items a, b, c, and d, below: (Source: ASTM C-33-99a, specification for Fine Aggregate)

(a) Particle size distribution:

Sieve	Particle Size	Percent Passing
3/8 in	9.50 mm	100
No. 4	4.75 mm	95 to 100
No. 8	2.36 mm	80 to 100
No. 16	1.18 mm	50 to 85
No. 30	0.6 mm	25 to 60
No. 50	0.3 mm	5 to 30
No. 100	0.15 mm	0 to 10 (prefer <4)
	[For No. 200 sieve, see note (d).]	

The sand must have not more than 45% passing any one sieve and retained on the next consecutive sieve of those shown above. The fineness modulus must not be less than 2.3 nor more than 3.1. The fineness modulus is calculated by adding the cumulative percentages of material in the_sample retained in the sieves shown above and dividing the sum by 100. The limit for material that can pass the No. 200 sieve must not be more than 3%.

B. Containment Vessel Standards

B-1. Lined Pit: when a sand filter is constructed in an excavated pit the following criteria are to be met. (Note: The majority of the following liner specification is from the State of Oregon Onsite Sewage Disposal Rules.)

Table G-6 - Unsupported polyvinyl chloride (PVC) shall have the following properties:

PROPERTY	TEST METHOD	
(a) Thickness	ASTM D1593 Para 9.1.3	30 mil minimum
(b) Specific Gravity (Minimum)	ASTM D792 Method A	
(c) MinimumTensile Properties (each direction)	ASTM D882	
(A) Breaking Factor (pounds/inch width)	Method A or B (1 inch wide)	69
(B) Elongation at Break (percent)	Method A or B	300
(C) Modulus (force) at 100% Elongation (pounds/inch width)	Method A or B	27
(d) Tear Resistance (pounds, minimum)	ASTM D1004 Die C	8
(e) Low Temperature	ASTM D1790	-20°F
(f) Dimensional Stability (each direction, percent change maximum)	ASTM D1204 212°F, 15 min.	± 5
(g) Water Extraction	ASTM D1239	-0.35% max.
(h) Volatile Loss	ASTM D1203 Method A	0.7% max.
(i) Resistance to Soil Burial (percent change maximum in original value)	ASTM D3083	
(A) Breaking Factor		-5
(B) Elongation at Break		-20
(C) Modulus at 100% Elongation		±10
(j) Bonded Seam Strength (factory seam, breaking factor, ppi width)	ASTM D3083	55.2

2. Installation Standards:

(a) Patches, repairs and seams shall have the same physical properties as the parent material;

(b) Site considerations and preparation:

(A) The supporting surface slopes and foundation to accept the liner shall be stable and structurally sound including appropriate compaction. Particular attention shall be paid to the potential of sink hole development and differential settlement;

(B) Soil stabilizers such as cementations or chemical binding agents shall not adversely affect the membrane; cementations and chemical binding agents may be potentially abrasive agents.

(c) Only fully buried membrane liner installation shall be considered to avoid weathering;

(d) Unreinforced liners have high elongation and can conform to irregular surfaces and follow settlements within limits. Unreasonable strain reduces thickness and may reduce life expectancy by lessening the chemical resistance of the thinner (stretched) material. Every effort shall be made to minimize the strain (or elongation) anywhere in the flexible membrane liner.

(e) Construction and installation:

(A) Pit / surface / preparation:

(i) bottom of pit:

(I) covered with sand to "bed" liner, adequate in depth (minimum 3") to protect liner from puncture, <u>or</u>

(II) use a non-woven needle-punched synthetic geotextile fabric, in a thickness appropriate to the tasks of protecting the liner.

(III) sides of the pit smooth, free of possible puncture points

(IV) bottom of pit (bedding layer of sand) graded to provide a sloping liner surface, from the outer edge of the filter toward the point of underdrain collection. Slope equal to 8 inches fall overall or one inch of fall per foot of run, whichever is the greatest.

(B) Climatic conditions:

(i) Temperature. The desirable temperature range for membrane installation is 42° F to 78° F. Lower or higher temperatures may have an adverse effect on transportation, storage, field handling and placement, seaming and backfilling and attaching boots and patches may be difficult. Placing liner outside the desirable temperature range shall be avoided.

(ii) Wind. Wind may have an adverse effect on liner installation such as interfering with liner placement. Mechanical damage may result. Cleanliness of areas for boot connection and patching may not be possible. Alignment of seams and cleanliness may not be possible. Placing the liner in high wind shall be avoided.

(iii) Precipitation. When field seaming is adversely affected by moisture, portable protective structures and/or other methods shall be used to maintain a dry sealing surface. Proper surface preparation for bonding boots and patches may not be possible. Seaming, patching and attaching ‘boots’ shall be done under dry conditions.

(C) Boots: When boots are used (required when using a gravity-flow underdrain), the boot and exit pipe must be installed with the following criteria:

- (i) The system designer is to identify the use of a sand filter liner with underdrain and boot as a part of the application for on-site sewage system and provide specifications detailing design and installation requirements.
- (ii) The boot is to be installed by the manufacturer or the manufacturer's representative.
- (iii) The boot outlet is to be bedded in sand.
- (iv) The boot is to be sized to accommodate a 4" underdrain outlet pipe.
- (v) The boot is to be secured to the 4" outlet pipe with two (2) stainless steel bands and screws, and sealant strips as recommended by the manufacturer.
- (vi) The underdrain is to be designed in accordance with Appendix C, Underdrains and exit the side of the liner.
- (vii) An inspection port must be installed in the sewer pipe from the sand filter to the drainfield.
- (viii) Sewer pipe from the sand filter to the drainfield must be ASTM 3034 ring tight.
- (ix) The trench from the sand filter to the drainfield must be back-filled with a minimum 5 lineal feet clay dam to prevent the trench from acting as a conduit for ground water movement towards the drainfield.
- (x) If the boot may be submerged in a seasonal high water table, performance testing of the sand filter/boot for leakage must be conducted in the following manner
  - (A) Block outlet pipe;
  - (B) Fill underdrain gravel with water;
  - (C) Measure and record elevation of water through observation/inspection port;
  - (D) Let stand 24 hours minimum;
  - (E) Measure and record elevation of water through observation/inspection port
  - (F) No allowable drop in the water level.

(D) Liner Placement:

- (i) Size. The final cut size of the liner shall be carefully determined and ordered to generously fit the container geometry without field seaming or excess straining of the linear material;
- (ii) Transportation, handling and storage. Transportation, handling and storage procedures shall be planned to prevent material damage. Material shall be stored in an secured area and protected from adverse weather;
- (iii) Site inspection. A site inspection shall be carried out by local health officer, other appropriate jurisdiction or by a designer or

engineer appointed by the appropriate jurisdiction. and the installer prior to liner installation to verify surface conditions, etc.;

(iv) Deployment. Panels shall be positioned to minimize handling. Seaming should not be necessary. Bridging or stressed conditions shall be avoided with proper slack allowances for shrinkage. The liner shall be secured to prevent movement and promptly backfilled;

(v) Anchoring trenches. The liner edges should be secured frequently in a backfilled trench;

(vi) Field seaming. Field seaming, if absolutely necessary, shall only be attempted when weather conditions are favorable. The contact surfaces of the materials should be clean of dirt, dust, moisture, or other foreign materials. The contact surfaces shall be aligned with sufficient overlap and bonded in accordance with the suppliers recommended procedures. Wrinkles shall be smoothed out and seams should be inspected by non-destructive testing techniques to verify their integrity. As seaming occurs during installation, the field seams shall be inspected continuously and any faulty area repaired immediately;

(vii) Field repairs. It is important that traffic on the lined area be minimized. Any necessary repairs to the liner shall be patched using the same lining material and following the recommended procedure of the supplier;

(viii) Final inspection and acceptance. Completed liner installations shall be visually checked for punctures, rips, tears and seam discontinuities before placement of any backfill. At this time the installer shall also manually check all factory and field seams with an appropriate tool. In lieu of or in addition to manual checking of seams by the installer, either of the following tests may be performed;

(I) Wet Test: The lined basin shall be flooded to the one (1) foot level with water after inlets and outlets have been plugged. There shall not be any loss of water in a 25-hour test period.

(II) Air Lance Test: Check all bonded seams using a minimum 50 PSI (gauge) air supply directed through a 3/16 inch (typical) nozzle, held not more than 2 inches from the seam edge and directed at the seam edge. Riffles indicate unbonded areas within the seam, or other undesirable seam construction.

B-2. Concrete Containment Vessel: to be designed and/or approved by a qualified professional engineer if the following conditions are <u>not</u> met.

1. Above ground tank.

a. Walls

(1) at least 6 inches thick

(2) 4 feet or less in height

(3) rebar reinforcement: 3/8 inch diameter rebar on 2-foot centers horizontally and vertically, with continuous lengths wrapped around the corners.

b. Floor

(1) at least 3 1/2 inches thick

(2) reinforced with steel mesh (CRSI standard #6-1010) to prevent cracking and to maintain water-tightness

c. Tank is to be designed, constructed, and sealed to be watertight.

2. Below ground tank.

Any below-ground concrete tank must be water-tight. The design of any such tank is to be approved by a qualified professional engineer and, where required by local and/or state regulation, the local health officer.

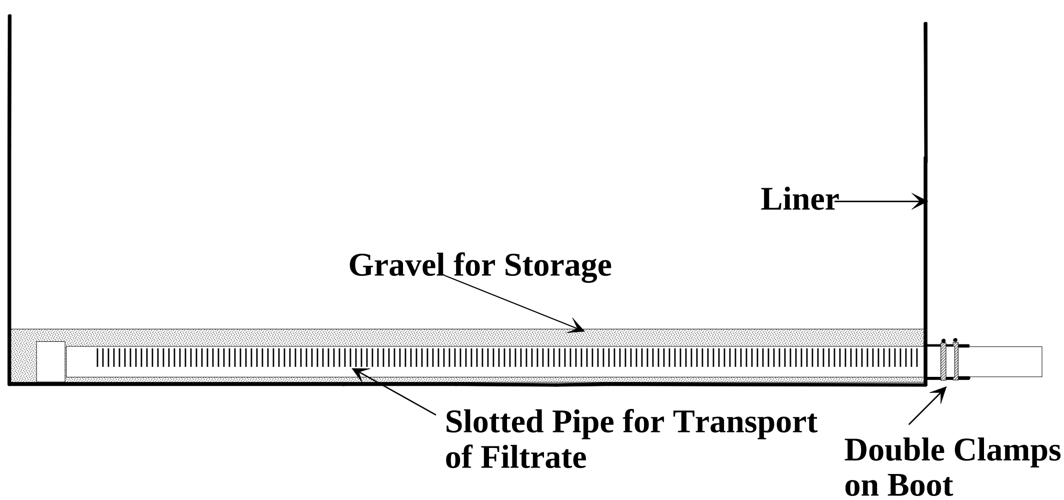
C. Underdrains

1. For Concrete Tanks or Synthetic Membrane-Lined Pits: Either gravity underdrains or pumpwells may be used.

2. Underdrains: Underdrains must be designed with sufficient void storage volume to provide for a single drainfield dose with reserve capacity to maintain unsaturated filter media above the underdrain system. Collection pipe must be sized of sufficient size, with adequate perforations, or slots so that filtrate can flow from the void storage space into the collection pipe rapidly enough to maintain unsaturated filter media above the underdrain system. May be designed in a variety of ways. An example of one of the many types is shown below (Figure G-6):

Place a 3-inch layer of pea gravel over a 6-inch layer of 3/4 to 2-1/2 inch gravel containing the underdrain collection pipe. The purpose of the pea gravel is to restrict the migration of sand into the gravel and pipe in the underdrain. The gravel surrounding the slotted or perforated pipe should be sized larger than the slots or perforations to prevent migration of gravel into the pipe (Figure G-6). For the purpose of calculating void storage space in the medium gravel (3/4 to 2-1/2 inch), 3.0 gallons per cubic foot may be used assuming 40% void space per cubic foot.

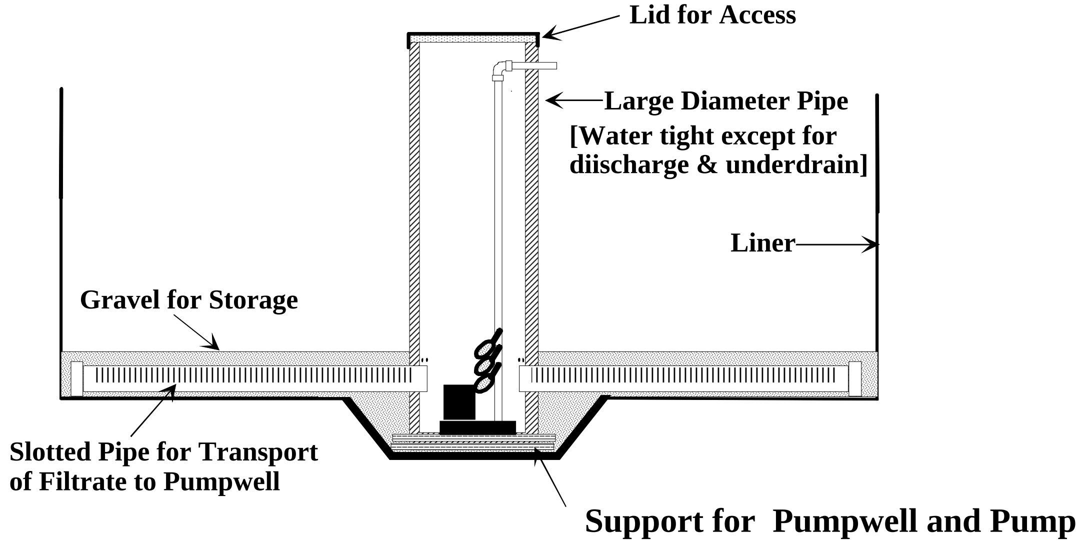
Figure G-6 - Typical Cross-section Of An Intermittent Sand Filter Underdrain



C. Pumpwells

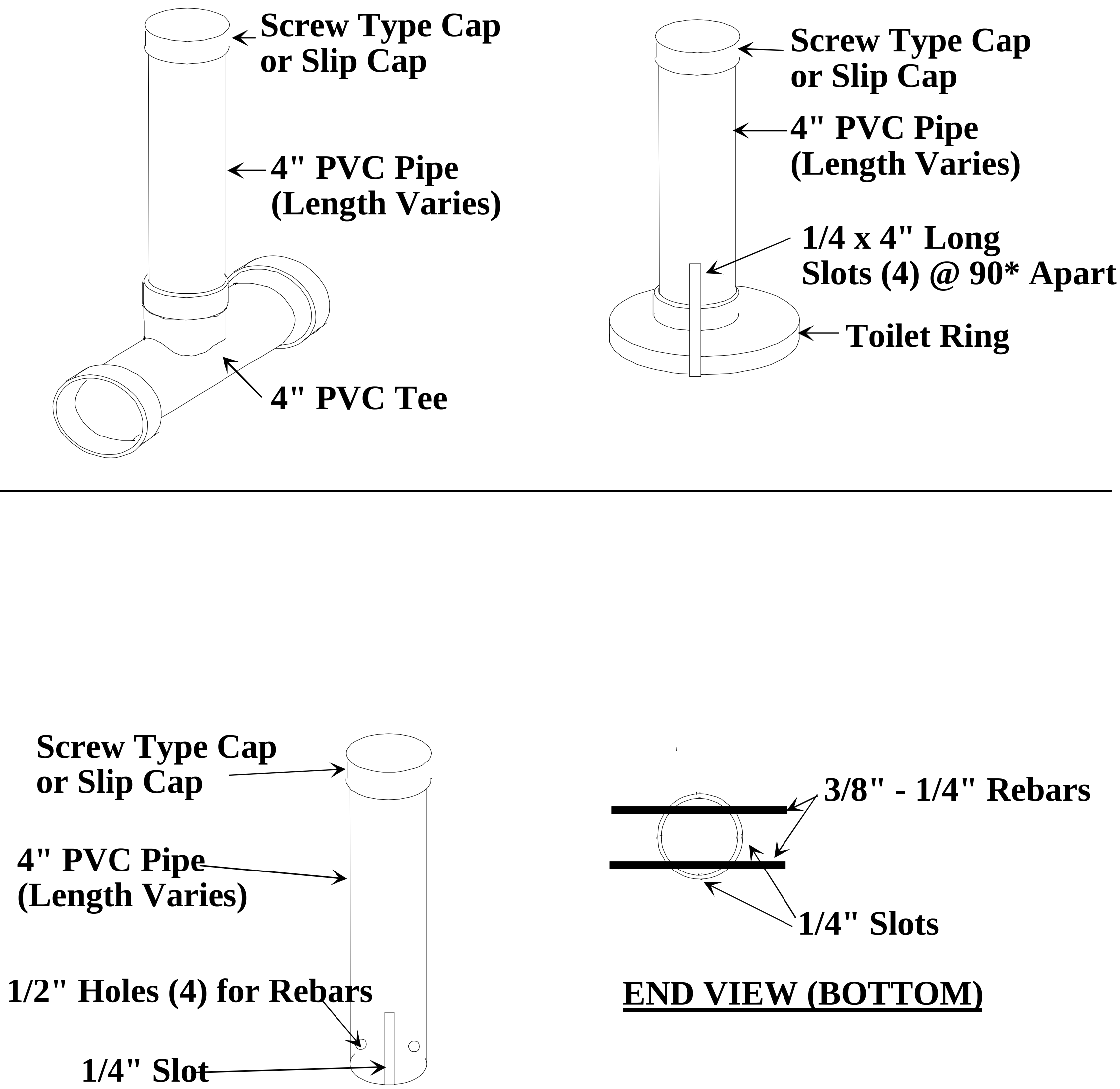
Pumpwells are located within the filter. Filtrate is collected in a underdrain system underlying the filter media and is discharged directly into the pumpwell. They may be designed a variety of ways, but they must be constructed of concrete or plastic sewer pipe. A sufficient number and size of holes must exist in the pumpwell, at the level of the underdrain system, so that filtrate can flow into the pumpwell, from the underdrain void space, as rapidly as the filtrate is pumped out of the pumpwell (Figure G-7). The pumpwell must be adequately supported on both sides of the synthetic membrane.

Figure G-7 - Typical Cross-section of a Pumpwell In A Synthetic Membrane-lined Intermittent Sand Filter



D. Inspection and Monitoring Ports

Figure G-8:



E. Disposal of Contaminated Filter Media

Whenever filter media is removed from a used filter, removing and disposing of contaminated filter media is to be done in a manner approved by the local health officer. Handle this material carefully, using adequate protective sanitation measures. Thoroughly wash hands and any other exposed skin with hot water and soap, following contact with contaminated sand filter media.

This material may be applied to the soil, according to the following (Table G-7), only when approved by the local health officer.

Table G-7 – Application and restriction/timetable

APPLICATION	RESTRICTIONS/TIMETABLE
1. Root crops, low-growing vegetables, fruits, berries used for human consumption.	Contaminated material must be stabilized and applied 12 months prior to planting.
2. Forage and pasture crops for consumption by dairy cattle.	Forage and pasture crops not available until one month following application of stabilized material.
3. Forage and pasture crops for consumption by non-dairy livestock.	Forage and pasture crops not available until two weeks following application of stabilized material.
4. Orchards or other agricultural area where the material will not directly contact food products. Or where stabilized material has undergone further treatment, such as pathogen reduction or sterilization.	Less severe restrictions may be applicable.

Recirculating Gravel Filter Specifications

A. Filter Media Specifications

1. Particle Size Analysis

The standard method to be used for performing particle size analysis must comply with one of the following:

a. the sieve method specified in ASTM D136 and ASTM C-117

b. the method specified in Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Survey Investigation Report #1, US Department of Agriculture, 1984.

Information concerning these methods can also be obtained from Methods of Soil Analysis, Part I, 2nd edition; A. Klute, editor, ASA Monograph #9, American Society of Agronomy, Madison, WI, 1986.

2. Recirculating Gravel Filter Media

All four conditions must be met to satisfy media criteria.

a. Particle Size Distribution:

Sieve	Particle Size	Percent Passing
3/8 inch	9.50 mm	100
No. 4	4.75 mm	0 to 95
No. 8	2.36 mm	0 to 2%
No. 30	0.60 mm	0 to 0.1%

b. Effective Size: 3 mm to 5 mm.

c. Uniformity coefficient: less than or equal to 2.

d. Filter media must be washed.

Note: All other standards remain the same as the intermittent sand filter, except that a perimeter support frame be used to hold the liner during construction. A 2 X $ plywood support (on 2 in minimum centers) is suggested.

GRAVELLESS DRAINFIELDS

Table G-8 - Soil Types and chamber drainfield size reductions

Soil Type	Reduction
Very gravelly[1] coarse sands or coarser, extremely gravelly[2] soils. Very gravelly medium sands, very gravelly fine sands, very gravelly very fine sands, very gravelly loamy sands.	No reduction allowed
Coarse sands (includes the ASTM C-33 sand). Medium sands.	Up to 20% allowed
Fine sands, loamy coarse sands, loamy medium sands. Very fine sands, loamy fine sands, loamy very fine sands, sandy loams, loams. Silt loams that are porous and have well-developed structure. Other silt loams, sandy clay loams, clay loams, silty clay loams.	Up to 40% Reduction Allowed, except in soils with appreciable amounts of expandable clay (see information below)

[1] Very Gravelly = >35% and <60% gravel and coarse fragments, by volume.
[2] Extremely Gravelly = >60% gravel and coarse fragments, by volume.

A. <u>Identifying Soil With Expanding Clay</u>

The following information has been provided by Lisa Palazzi to address the issue of appreciable amounts of expandable clay. Ms. Palazzi is a private-sector soil scientist and a member of the Washington State Onsite Sewage Treatment Technical Review Committee.

A Vertisol is one of the 11 Taxonomic Soil Orders, and is defined as having <u>slickensides</u> (smeared planes within the soil profile) at least 10 inches thick within the top 40 inches of soil, and having 30% clay content and having cracks that open and close periodically. The slickensides and cracks imply that the clay content is primarily expanding clays, as those features occur concurrently only with expanding clays. Vertisols are identified in general textbooks as being generally incapable of supporting septic drainfields, although many septic systems are installed and functioning in Texas Vertisols. This success however, is thought to be a result of their very low rainfall climate.

Expanding clays - such as montmorillonite or smectite or bentonite - can be defined on a mineralogic level as being composed of a 2:1 alumino-silicate crystalline lattice, as compared to non-expanding clays - such as kaolinite (the red Georgia clays) - which have a 1:1 crystal lattice form. From a more practical perspective, they can be defined by a measurement of how much they shrink when taken from a saturated water content to a dry water content. That measurement is called a Coefficient of Linear Extensibility (COLE) and a 9% change is considered definitive of having a significant montmorillonite content. At another scale, the distance between two montmorillonite crystal lattices when dry is reported as being 9.6 angstroms; and when exposed to 50% relative humidity, expanding to 10's or even hundreds of angstroms. So it is obvious that even a very small amount of expanding clay can have a huge effect on soil drainage characteristics. 5-10% content could be considered "appreciable".

It is important to note that there are few areas with expanding clays north of the terminus of the continental glacier (about Tenino for western Washington). Areas south of that, however, could have some Vertisols, although they are not terribly common. If we need a measure of expansion potential, the COLE process could be applied with fairly simple tools. One simply mixes a soil/water solution to the point where the clay soil is almost saturated, but can still be formed into a "worm" or rod-shaped lump. The length of the rod is measured. Then the rod is placed in an oven to dry (250 degrees for about an hour should be enough), then re-measured. If the length of the rod decreases by more than 3-5%, there is probably enough expanding clay to affect soil drainage potential. I chose 3-5% somewhat arbitrarily mainly because it is about one third to one-half that of that used to indicate significant content of montmorillonite (9%).

B. Comparison of Reduced-Size Drainfields in Two U.S. States

Table G-9 shows the comparison between two states with different design flow and application rates.

Table G-9 – Example of two states with different design flow and application rates

Example 1:
3-bedroom residence, Soil Type 1A (Coarse Sand)

		Drainfield Size (sq.ft.)	
State "A"		Full Size	Reduced (20%)
Application Rate: (GPD/Sq.Ft.)	1.2	300	240
GPD/Bedroom:	120		
State "B"		Full Size	Reduced (40%)
Application Rate: (GPD/Sq.Ft.)	0.8	563	338
GPD/Bedroom:	150		

Example 2:
3-bedroom residence, Soil Type 3 (Fine Sand)

		Drainfield Size (sq.ft.)	
State "A"		Full Size	Reduced (40%)
Application Rate: (GPD/Sq.Ft.)	0.8	450	270
GPD/Bedroom:	120		
State "B"		Full Size	Reduced (40%)
Application Rate: (GPD/Sq.Ft.)	0.4	1125	675
GPD/Bedroom:	150		

{State A: Washington; State B: Connecticut (source: R. May, 3/12/98)}

The percentage reduction for gravelless drainfield is based on the size of conventional gravel-filled drainfield. Conventional gravel-filled drainfields are sized by dividing the estimated Daily Design Flow (Washington State WAC minimum of 120 GPD / bedroom [2 persons / bedroom, 60 GPD / person]) by the Application Rate (for the particular soil found at the proposed system site). It is important to realize that different states commonly use different values for daily design flow and soil application rate.

The drainfield size as seen above for state B is 1.4 times to that of state A in example 1 while in the second example State B ends up with a drainfield 2.5 times as large as the drainfield in State A. There will be an impact on the life of these drainfield due to the relationship between the drainfield size to drainfield longevity. The issue of drainfield reduction is not a simple matter and careful design considerations must be given to ensure its long-term viability.

PRESSURE DISTRIBUTION

A. Measure of Performance

How do you conduct a pressure test?

Described below are the steps for conducting a typical pressure test to verify that distribution is uniform with the required minimum residual pressure to ensure proper volume and frequency of the system.

- Measure squirt height

- Minimum squirt height for orifice size:
  3/16" orifice size = 2' or 24" squirt height
  1/8" orifice size = 5' or 60" squirt height
  5/32" orifice size = 5' or 60" squirt height

- Check uniformity of squirt height.

- An alternate method to the squirt height is to attach a clear PVC stand pipe to the end of the lateral. The true residual head is measured from the top of the lateral pipe to the top of the water column.

- Check float placement.
  High-water alarm, "on" level, "off" level, and "redundant off" alarm must activate or deactivate at the elevation called out on the plan. It is recommended that, for simplicity and accuracy, these adjustments be made with the float tree out of the water.

- Ensure that the pump delivers the correct dose to the drainfield.

Demand dose systems:
Verify that "dry" float settings (completed above) send the correct dose to the drainfield when floats are in water. This may require minor adjustments of float placement.*

Timed dose systems:
1. Determine the time required to send a full dose to the drainfield. This can be done by running the system in manual. Be sure there is plenty of water in the pump chamber. Timer run times provided by designers or engineers must be field tested.

2. Using the time obtained above, verify that when the system runs automatically it runs the time required to send the proper dose to the drainfield. This is important because timers are difficult to set, i.e., setting a timer to 2.2 minutes may not ensure a run time of 2.2 minutes. Two steps to speed this process are to start testing with the pump chamber mostly full and to set "off" time temporarily to minutes or seconds.*

* Determination of float activation level in water may take several tries. For both system types, note pump run time that delivers proper dose. Record the results.

3. Verify that the timer off time is the same as that specified in the plan or will dose the system the correct number of times a day. Check this number in minutes and note the off time. One can verify activation levels by use of lights on timer. For instance, if the drainfield is to receive 4 doses per day, the off time should be approximately 6 hours.

Verify that high water alarm does not turn the pump on. If high-water alarm turns the pump on, the system will not be approved.

Timed dose systems only: Verify that the system will dose the correct number of times per day and that no float in the system turns the pump on independent of the timer. A system with a timer override float will not be approved.

If problems are discovered during the functional testing, first contact the designer or engineer. If the wiring needs adjustment, the electrician should be contacted.

In preparation for Health District final inspection, fill the pump chamber.

An additional test for equal distribution, which takes into consideration drain down after the pressure cycle, is described here. However, it is somewhat tedious. For systems with laterals having more than 18 inches difference in elevation, the volume of liquid from an orifice (same size as the others in the laterals) placed in a plug or cap in the end of each lateral can be collected from a complete cycle and measured. The variation between the largest volume and the least volume collected must not be more than 15%. Manifolds should be designed to prevent drainback of the effluent.

Table G-10 - Actual Distances and Squirt Height

Maximum Difference Allowed (Inches)		
Nominal Residual Squirt Height	10% Difference	15% Difference
2 Feet	5 Inches	7.5 Inches
5 Feet	12.5 Inches	19 Inches

B. Advantages / Disadvantages

Different types of dosing, and orifice positions, and siphons

1. Demand Dosing

- Relatively simple, easy, and inexpensive control system
- Not sensitive to heavy use days and will not activate due to heavy flow days
- No protection from hydraulic surges and overload
- Does not meter effluent over a 24-hour period, doses when there is enough accumulation

2. Timed Dosing

- Meters the effluent to the receiving component in discrete, evenly spaced doses
- Promotes unsaturated flow by more frequent small doses
- Protects receiving unit from hydraulic overload
- Sensitive to fluctuations in flow, thus activating the alarm
- More expensive and complicates installation and maintenance
- Effective in detecting groundwater leaking into the tanks

3. Orifices in the 12 o'clock Position

- Laterals remain full or partially full, thus reducing the amount of effluent needed to be pressurized
- Requires shields or chambers to prevent blocking of some orifices with gravel pieces and spread the effluent over a wider infiltrative surface. They have the greatest importance in systems with medium to coarse sand soils or with imported media providing the treatment.
- Effluent in the laterals promotes biological growth resulting in a build-up of sludge/slime and also subject to freezing in cold climates
- Adding a few 6:00 o’clock position orifices or by draining laterals and transport line back to the surge tank can prevent biological growth and freezing issues

4. Orifices in the 6 o'clock Position

- Draining of effluent in the down position between dose cycles may retard biological growth in them and reduce the potential for freezing (design the dose volume to be at least 7 times of the liquid that drains after a dose for equal distribution is a good rule of thumb when the system drains)
- Clogging of the orifice is possible due to the solids in the line seem to accumulate at the distal end
- Although less prone to clogging, they also will require a larger dose volume to pressurize the system, due to laterals draining between pump cycles

- Not suitable for gravelless chambers, as wide a distribution pattern cannot be obtained. Special orifice shields may be needed

E. Siphon Systems

- Do not require electricity with no moving parts
- Can be constructed entirely of corrosion resistant material
- Require very little maintenance
- Do not require external controls as cycling is automatic
- Duplex installations can be made to alternate automatically
- Ability to dose a remote drainfield without a large transport line to the siphon chamber
- Allow the use of small pumps with low energy consumption, to dose a system with high velocity requirements
- No ability to prevent hydraulic overload conditions
- May go into trickling mode until recharged with air, preventing equal distribution of effluent
- Slow to enter fully pressurized phase that can result in unequal distribution on sloped sites
- Available head to pressurize the system is fixed, and errors in design and installation cannot be accommodated

C. Typical Pressure Distribution Design Tables To Evaluate Alternative Lateral Configurations

This section contains tables that can assist a designer to evaluate alternative configurations.

1. Lateral Design Table

Provides a table of maximum lateral lengths for various lateral diameters, orifice diameters and orifice spacings, and includes design criteria used to calculate maximum lateral lengths.

2. ORIFICE DISCHARGE RATE DESIGN AID

Contains a derivation of an equation used to calculate orifice discharge rates and includes a table of discharge rates for various residual heads and orifice diameters.

3. FRICTION LOSS DESIGN AID

Includes a derivation of an equation that can be used to calculate friction losses and a table of constants to simplify the calculation. Also included is a table of friction loss for PVC pipe fittings.

4. MAXIMUM MANIFOLD LENGTHS

Lists the assumptions used to calculate the enclosed tables for maximum manifold length, one for 1/8 inch and 5/32 inch orifices (where the minimum residual head at the distal orifice must be 5 feet) and one for orifices of 3/16 inch and up (where the minimum residual head at the distal orifice must be 2 feet).

Note:
Throughout this section, it is assumed that laterals and manifolds will be constructed using only PVC pipe materials conforming to ASTM standards D-2241 or D-1785.

1. Lateral Design Tables

The maximum allowable length for any lateral is determined by allowable differences in discharge rates between the proximal and distal orifices. These tables assume that $Q_p/Q_d \leq 1.1$;

Where Q_p = the proximal orifice discharge rate
Q_d = the distal orifice discharge rate

The maximum allowable difference in discharge rates is 10% . The maximum allowable lateral length is a function of lateral diameter and orifice diameter and is independent of the residual pressure.

Orifice discharge rates are a function of orifice diameter and residual pressure (see following section on orifice discharge rate design aid discussion). The following Table G-11 gives the maximum lateral length for each orifice diameter, lateral diameter, and orifice spacing.

Table G-11 - Lateral Design Table

			Maximum Lateral Length (ft)		
Orifice diameter(in)	Lateral Diameter (in)	Orifice Spacing (feet)	Pipe Material		
			Schedule	Class 200	Class 160
1/8	1	1.5	42	51	
1/8	1	2	50	62	
1/8	1	2.5	57.5	72.5	
1/8	1	3	66	81	
1/8	1	4	80	96	
1/8	1	5	90	110	
1/8	1	6	102	126	
1/8	1.25	1.5	66	76.5	79.5
1/8	1.25	2	80	92	96
1/8	1.25	2.5	92.5	107.5	110
1/8	1.25	3	105	120	123
1/8	1.25	4	124	144	148
1/8	1.25	5	145	165	175
1/8	1.25	6	162	186	192
1/8	1.5	1.5	85.5	96	100.5
1/8	1.5	2	104	116	120
1/8	1.5	2.5	120	135	140
1/8	1.5	3	135	150	156
1/8	1.5	4	164	184	188
1/8	1.5	5	190	210	220
1/8	1.5	6	210	240	246
1/8	2	1.5	132	141	145.5
1/8	2	2	160	170	176
1/8	2	2.5	185	197.5	202.5
1/8	2	3	207	222	228
1/8	2	4	248	268	276
1/8	2	5	290	310	320
1/8	2	6	324	348	360
5/32	1	1.5	31.5	39	39
5/32	1	2	36	46	46
5/32	1	2.5	42.5	52.5	52.5
5/32	1	3	48	60	60
5/32	1	4	56	72	72
5/32	1	5	65	80	85

			Maximum Lateral Length (ft)		
Orifice diameter (inches)	Lateral diameter (inches)	Orifice spacing (feet)	Pipe material		
			Schedule	Class 200	Class 160
5/32	1	6	72	90	96
5/32	1 1/4	1.5	48	55.5	58.5
5/32	1 1/4	2	58	68	70
5/32	1 1/4	2.5	67.5	77.5	80
5/32	1 1/4	3	75	87	90
5/32	1 1/4	4	92	104	108
5/32	1 1/4	5	105	120	125
5/32	1 1/4	6	120	138	144
5/32	1 1/2	1.5	63	70.5	73.5
5/32	1 1/2	2	76	84	88
5/32	1 1/2	2.5	87.5	97.5	102.5
5/32	1 1/2	3	99	111	114
5/32	1 1/2	4	120	132	136
5/32	1 1/2	5	140	155	160
5/32	1 1/2	6	156	174	180
5/32	2	1.5	96	103.5	106.5
5/32	2	2	116	124	128
5/32	2	2.5	135	142.5	147.5
5/32	2	3	150	162	168
5/32	2	4	184	196	200
5/32	2	5	210	225	235
5/32	2	6	240	252	264
3/16	1	1.5	24	30	
3/16	1	2	28	36	
3/16	1	2.5	32.5	42.5	
3/16	1	3	39	45	
3/16	1	4	44	56	
3/16	1	5	50	65	
3/16	1	6	60	72	
3/16	1.25	1.5	37.5	43.5	45
3/16	1.25	2	46	54	56
3/16	1.25	2.5	52.5	62.5	62.5
3/16	1.25	3	60	69	72
3/16	1.25	4	72	84	88

Lateral Design Table (continued)

			Maximum Lateral Length (ft)		
Orifice	Lateral Diameter	Orifice Spacing	Pipe Material		
(inches)	(inches)	(feet)	Schedule	Class 200	Class 160
3/16	1.25	5	85	95	100
3/16	1.25	6	96	108	114
3/16	1.5	1.5	49.5	55.5	57
3/16	1.5	2	60	68	70
3/16	1.5	2.5	70	77.5	80
3/16	1.5	3	78	87	90
3/16	1.5	4	92	104	108
3/16	1.5	5	110	120	125
3/16	1.5	6	120	138	144
3/16	2	1.5	76.5	81	84
3/16	2	2	92	98	102
3/16	2	2.5	105	112.5	117.5
3/16	2	3	120	129	132
3/16	2	4	144	152	160
3/16	2	5	165	180	185
3/16	2	6	186	198	210
7/32	1	1.5	19.5	24	
7/32	1	2	24	30	
7/32	1	2.5	27.5	35	
7/32	1	3	30	39	
7/32	1	4	36	44	
7/32	1	5	45	55	
7/32	1	6	48	60	
7/32	1.25	1.5	31.5	36	37.5
7/32	1.25	2	38	44	46
7/32	1.25	2.5	42.5	50	52.5
7/32	1.25	3	48	57	60
7/32	1.25	4	60	68	72
7/32	1.25	5	70	80	80
7/32	1.25	6	78	90	90
7/32	1.5	1.5	40.5	45	46.5
7/32	1.5	2	50	54	56
7/32	1.5	2.5	57.5	62.5	65
7/32	1.5	3	63	72	75

Lateral Design Table (continued)

			Maximum Lateral Length (ft)		
Orifice	Lateral Diameter	Orifice Spacing	Pipe Material		
(inches)	(inches)	(feet)	Schedule	Class 200	Class 160
7/32	1.5	4	76	88	88
7/32	1.5	5	90	100	105
7/32	1.5	6	102	114	114
7/32	2	1.5	63	66	69
7/32	2	2	76	80	84
7/32	2	2.5	87.5	92.5	95
7/32	2	3	99	105	108
7/32	2	4	116	124	132
7/32	2	5	135	145	150
7/32	2	6	156	162	168
1/4	1	1.5	16.5	21	
1/4	1	2	20	24	
1/4	1	2.5	22.5	27.5	
1/4	1	3	27	33	
1/4	1	4	32	40	
1/4	1	5	35	45	
1/4	1	6	42	48	
1/4	1.25	1.5	27	30	31.5
1/4	1.25	2	32	36	38
1/4	1.25	2.5	37.5	42.5	45
1/4	1.25	3	42	48	48
1/4	1.25	4	48	56	60
1/4	1.25	5	55	65	70
1/4	1.25	6	66	72	78
1/4	1.5	1.5	34.5	39	39
1/4	1.5	2	42	46	48
1/4	1.5	2.5	47.5	52.5	55
1/4	1.5	3	54	60	63
1/4	1.5	4	64	72	76
1/4	1.5	5	75	85	85
1/4	1.5	6	84	96	96
1/4	2	1.5	52.5	55.5	58.5
1/4	2	2	64	68	70
1/4	2	2.5	72.5	77.5	80

Lateral Design Table (continued)

			Maximum Lateral Length (ft)		
Orifice	Lateral Diameter	Orifice Spacing	Pipe Material		
(inches)	(inches)	(feet)	Schedule	Class 200	Class 160
1/4	2	3	81	87	90
1/4	2	4	100	104	108
1/4	2	5	115	120	125
1/4	2	6	126	138	144

Lateral Design Table (continued)

2. ORIFICE DISCHARGE RATE DESIGN AID

Orifice discharge rates can be calculated using Toricelli's equation:

$$Q = C_d A_o \sqrt{2gh}$$

Where: Q = the discharge rate in ft^3/sec
C_d = the discharge coefficient (unitless)
A_o= the cross sectional area of the orifice in ft^2
g = the acceleration due to gravity (32.2 ft/sec^2)
h = the residual pressure head at the orifice in ft

The formula shown above can be simplified for design purposes by incorporating the discharge coefficient and using conversion factors so that the discharge is given in gallons per minute and the orifice diameter is given in inches. The discharge coefficient depends on the characteristics of the orifice and is usually determined empirically. This value can range from .6 to .8 but a value of .6 was assumed for the purpose of this design aid. The formula therefore simplifies to:

$$Q = 11.79\, d^2 \sqrt{h}$$

Where: Q= the orifice discharge rate in gpm
d = the orifice diameter in inches
h = the residual pressure head at the orifice in feet

Table G-12 gives orifice discharge rates (in gpm) generated using the above formula for various residual pressures (head) and orifice diameters.

Table G-12 – Orifice discharge rates for various residual pressures and orifice diameters

Orifice Discharge Rates (gpm)					
Head (ft)	Orifice Diameter (in)				
	1/8	5/32	3/16	7/32	1/4
2			0.59	0.80	1.04
3			0.72	0.98	1.28
4			0.83	1.13	1.47
5	0.41	0.64	0.93	1.26	1.65
6	0.45	0.71	1.02	1.38	1.80
7	0.49	0.76	1.10	1.49	1.95
8	0.52	0.81	1.17	1.60	2.08
9	0.55	0.86	1.24	1.69	2.21
10	0.58	0.91	1.31	1.78	2.33

For residuals greater than 10 feet or for orifice diameters greater than 1/4 inch, the equation must be used. This is also true if the residual pressure is not a whole number. For large systems use the equation and verify with Table G-12.

Note: Table G-12 was generated assuming that the minimum residual head at the distal orifice is 5 feet when orifices are 1/8 and 5/32 inch in diameter, and 2 feet for larger orifice diameters.

3. FRICTION LOSS DESIGN AID

Friction losses in pipes can be calculated using the Hazen-Williams formula:

Original form: $V = 1.318 * C * R^{0.63} * S^{0.54}$

Where:
- V = velocity (ft/sec)
- C = Hazen-Williams flow coefficient (unitless)
- R = hydraulic radius (ft^2/ft)[8]
- S = slope of energy grade line (ft/1000 ft)

This equation can be modified through algebraic substitutions and using unit conversions to yield a formula that directly calculates friction loss:

$$f = \frac{10.46 L Q^{1.85}}{C^{1.85} D^{4.87}}$$

Where:
- f = friction loss (ft)
- D = actual inside pipe diameter (in)
- L = length of pipe (ft)
- Q = flow (gpm)
- C = Hazen-Williams flow coefficient (unitless)

The Hazen-Williams flow coefficient (C) depends on the roughness of the piping material. Flow coefficients for PVC pipe have been established by various researchers in a range of values from 155 to 165 for both new and used PVC pipe. A coefficient of C = 150 generally is considered to yield conservative results in the design of PVC piping systems.

The equation shown above can be further simplified by assuming that only PVC pipe conforming to ASTM standard D-2241 (or D-1785 for Schedule 40 and Schedule 80 pipe) is used. With this assumption, the inside diameters ("D") for the various nominal pipe sizes can be determined and combined with all other constants to yield the following equation:

$$f = L\left(\frac{Q}{K}\right)^{1.85}$$

Where:
- f = friction loss through pipe (ft)
- L = length of pipe (ft)
- Q = flow (gpm)
- K = Constant from Table 3

K can be determined (Table G-13) for any PVC pipe conforming to the above ASTM standards using the equation $K=42.17*D^{2.63}$.

Table G-13 – Constant "K" for different nominal pipe diameters and classes of pipes

Table for Constant "K"			
Nominal Pipe Diameter	Schedule 40	Class 200	Class 160
1	47.8	66.5	
1.25	98.3	122.9	129.4
1.5	147.5	175.5	184.8
2	284.5	315.2	332.5
2.5	454.1	520.7	551.1
3	803.9	873.3	920.5
4	1642.9	1692.7	1783.9
6	4826.6	4677.4	4932

Friction loss for some PVC pipe fittings, given in terms of equivalent length of pipe, are provided in Table G-14

Table G-14 - Friction Loss for PVC Fittings

Equivalent Length of Pipe (feet) PVC Pipe Fittings				
Pipe Size (in)	90^o Elbow	45^o Elbow	Through Tee Run	Through Tee Branch
.5	1.5	0.8	1.0	4.0
.75	2.0	1.0	1.4	5.0
1	2.25	1.4	1.7	6.0
1.25	4.0	1.8	2.3	7.0
1.5	4.0	2.0	2.7	8.0
2	6.0	2.5	4.3	12.0
2 1/2	8.0	3.0	5.1	15.0
3	8.0	4.0	6.3	16.0
4	12.0	5.0	8.3	22.0
6	18.0	8.0	12.5	32.0
8	22.0	10.0	16.5	38.0

[1] From SPEC-DATA, Sheet 15, Plastic Pipe and Fitting Association, November 1994

4. MAXIMUM MANIFOLD LENGTHS

Tables 5 and 6 can be used to determine maximum manifold lengths for various manifold diameters, lateral discharge rates and lateral spacings. The method used to determine the table values is described below.

Pressurized distribution systems are designed to assure even distribution of effluent throughout the drainfield area. Even distribution maximizes the treatment capabilities and useful life of the absorption area. Completely uniform distribution is difficult or impossible to obtain because of friction losses that occur in all piping networks so we settle for a standard or acceptable variance in orifice discharges throughout the network. The maximum lateral lengths in Table G-11 were developed to assure there will be no more than a 10% variance (drop) in the discharge rates between the proximal and distal orifices in any given lateral. The maximum manifold lengths in the tables below were developed to assure there will be no more than a 15% variance in discharge rates between any two orifices in a given distribution system.

Two assumptions used to develop these tables are: (1) the maximum variance in orifice discharge rates within a network occurs between the proximal orifice in the first lateral connected to a manifold and the distal orifice on the last lateral connected to the manifold and (2) the friction loss that occurs between the proximal orifice of a lateral and the point where the lateral connects to the manifold is negligible.

Using the assumptions mentioned above a computer program was developed to calculate maximum manifold lengths for various manifold diameters, lateral discharge rates and lateral spacings. The program assumes that the discharge rate at the distal orifice of the last lateral in a distribution system is as listed in Table G-11 for a given orifice size at the required minimum residual head. That value is multiplied by 1.1 and 1.15 to determine the maximum allowable discharge rates at the proximal orifices of the last and first laterals in the network, respectively. The residual head (h) that corresponds to those discharges was calculated by manipulating the orifice discharge equation in section 2 and solving for "h".

Using the simplified equation in section 3, the friction loss that occurs across the manifold was calculated for various materials and pipe diameters ("K"), lateral discharge rates ("Q") and lateral spacings ("L"). The program adds the friction loss calculated for successive pipe segments to the residual pressure, which corresponds to the proximal orifice discharge at the last lateral. The combined value is compared to the residual pressure at the proximal orifice of the first lateral until it is equal to or greater than this value. Maximum manifold lengths were calculated as described above for various pipe materials and orifice diameters. Slightly greater manifold lengths were obtained when 1/8 and 5/32 inch orifices were assumed using 5 feet residual pressure at the distal orifice (see Table G-16). These tables were generated using Schedule 40 as the pipe material, which yields the most conservative results (shorter manifold lengths).

Table G-15 - Manifold Length for orifice diameters of 3/16 in. and up with minimum 2 feet of residual head)

Maximum Manifold Length (ft)																																					
Lateral Discharge Rate (gpm/lateral)		Manifold Diameter (inches)																																			
		1 1/4						1 1/2						2						3						4						6					
		Lateral Spacing (ft)																																			
Central Manifold	End Manifold	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10
5	10	4	6	4	6	8	10	6	6	8	12	8	10	10	12	16	18	24	20	22	27	32	42	48	60	34	45	52	72	80	90	72	93	112	144	176	200
10	20	2	3	4				2	3	4	6	8		6	6	8	12	8	10	12	15	20	24	32	30	22	27	32	42	48	60	46	57	72	90	112	120
15	30	2						2	3	4				4	6	4	6	8	10	10	12	12	18	24	20	16	21	24	30	40	40	34	45	52	66	80	90
20	40							2						2	3	4	6	8		8	9	12	12	16	20	12	18	20	24	32	30	28	36	44	54	64	80
25	50													2	3	4				6	9	8	12	16	10	10	15	16	18	24	30	24	30	36	48	56	60
30	60													2	3	4				6	6	8	6	8	10	10	12	16	18	24	20	22	27	32	42	48	60
35	70													2	3					4	6	8	6	8	10	8	12	12	18	16	20	18	24	28	36	40	50
40	80													2						4	6	4	6	8	10	8	9	12	12	16	20	18	21	28	36	40	40
45	90																			4	3	4	6	8	10	6	9	8	12	16	20	16	21	24	30	32	40
50	100																			4	3	4	6	8	10	6	9	8	12	16	10	14	18	24	30	32	40
55	110																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
60	120																			2	3	4	6			6	6	8	12	8	10	12	15	20	24	32	30
65	130																			2	3	4	6			6	6	8	6	8	10	12	15	20	24	24	30
70	140																			2	3	4				4	6	8	6	8	10	12	15	16	24	24	30
75	150																			2	3	4				4	6	8	6	8	10	10	15	16	18	24	30
80	160																			2	3	4				4	6	4	6	8	10	10	12	16	18	24	30
85	170																			2	3					4	6	4	6	8	10	10	12	16	18	24	20
90	180																			2	3					4	3	4	6	8	10	10	12	12	18	24	20
95	190																			2	3					4	3	4	6	8	10	8	12	12	18	16	20
100	200																			2						4	3	4	6	8	10	8	12	12	18	16	20

Instructions: This Table can be used to determine maximum length of a given diameter manifold *or* to determine required minimum diameter for a given manifold length. Known values must include:

1. Manifold - lateral configuration (end or central)
2. Lateral discharge rate "Q" in gallons per minute

3. Lateral spacing in feet

Example A: Central manifold configuration, lateral discharge “Q” = 40 gpm, lateral spacing = 6 ft., manifold diameter = 4 inch; Maximum length = 12 ft.

Example B: End manifold configuration, lateral discharge “Q” = 30 gpm, lateral spacing = 6 ft., manifold length = 18 ft.; Minimum diameter = 3 inch

Table G-16 - Manifold length for orifice diameters of 1/8 in. and 5/32 in. with minimum 5 feet of residual head

Maximum Manifold Length (ft)																																					
Lateral Discharge Rate (gpm/lateral)		Manifold Diameter (inches)																																			
		1 1/4						1 1/2						2						3						4						6					
		Lateral Spacing (ft)																																			
Central Manifold	End Manifold	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10	2	3	4	6	8	10
5	10	6	9	8	12	16	10	8	12	12	18	16	20	14	18	20	30	32	40	30	39	48	60	72	80	48	63	76	96	120	130	100	129	156	204	240	280
10	20	4	3	4	6	8	10	4	6	8	6	8	10	8	12	12	18	16	20	18	24	28	36	40	50	30	39	48	60	72	80	64	81	100	126	152	180
15	30	2	3	4				4	3	4	6	8	10	6	6	8	12	8	10	14	18	20	24	32	30	22	30	36	42	56	60	48	63	76	96	112	130
20	40	2						2	3	4	6			4	6	8	6	8	10	12	15	16	18	24	30	18	24	28	36	40	50	40	51	60	78	96	110
25	50							2	3	4				4	6	4	6	8	10	10	12	12	18	16	20	16	21	24	30	40	40	34	45	52	66	80	90
30	60							2						4	3	4	6	8	10	8	9	12	12	16	20	14	18	20	24	32	40	30	39	48	60	72	80
35	70							2						2	3	4	6			8	9	12	12	16	20	12	15	20	24	24	30	26	36	40	54	64	70
40	80													2	3	4				6	9	8	12	16	10	12	15	16	18	24	30	24	30	36	48	56	70
45	90													2	3	4				6	6	8	12	8	10	10	12	16	18	24	20	22	30	36	42	56	60
50	100													2	3					6	6	8	6	8	10	10	12	12	18	24	20	20	27	32	42	48	60
55	110													2	3					4	6	8	6	8	10	8	12	12	18	16	20	20	24	28	36	48	50
60	120													2						4	6	8	6	8	10	8	9	12	12	16	20	18	24	28	36	40	50
65	130													2						4	6	4	6	8	10	8	9	12	12	16	20	18	21	28	36	40	50
70	140													2						4	6	4	6	8	10	8	9	12	12	16	20	16	21	24	30	40	40
75	150																			4	3	4	6	8	10	6	9	8	12	16	20	16	21	24	30	32	40
80	160																			4	3	4	6	8	10	6	9	8	12	16	10	14	18	24	30	32	40
85	170																			4	3	4	6	8		6	9	8	12	16	10	14	18	20	30	32	40
90	180																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
95	190																			2	3	4	6	8		6	6	8	12	8	10	14	18	20	24	32	30
100	200																			2	3	4	6			6	6	8	12	8	10	12	15	20	24	32	30

Instructions: This Table can be used to determine maximum length of a given diameter manifold *or* to determine required minimum diameter for a given manifold length. Known values must include:

1. Manifold - lateral configuration (end or central)
2. Lateral discharge rate "Q" in gallons per minute

3. Lateral spacing in feet

Example A: Central manifold configuration, lateral discharge “Q” = 40 gpm, lateral spacing = 6 ft., manifold diameter = 4 inch; Maximum length = 18 ft.

Example B: End manifold configuration, lateral discharge “Q” = 30 gpm, lateral spacing = 6 ft., manifold length = 24 ft.; Minimum diameter = 3 inch

Table G-17 – Volume of pipe (gallons per foot)

	Type of Pipe		
Nominal Diameter (in)	PR 160	PR 200	Schedule 40
0.75		0.035	0.028
1	0.058	0.058	0.045
1.25	0.098	0.092	0.078
1.5	0.126	0.121	0.106
2	0.196	0.188	0.174
2.5	0.288	0.276	0.249
3	0.428	0.409	0.384
4	0.704	0.677	0.661
5	1.076	1.034	1.039
6	1.526	1.465	1.501
8	2.586	2.485	
10	4.018	3.861	
12	5.652	5.432	

Appendix H

Proprietary Technology List

A. List of Approved Proprietary Technologies in South Carolina

1. Chamber/Gravelless Systems

    Infiltrator chamber systems
    EEZZ Lay Drain Cylinders
    Eljen InDrain
    Hancor Envirochambers
    Biodiffuser chamber systems
    Cultec Contactor field drain system
    T and J Porous Block Panel Soil Absorption System

2. Aerobic Treatment Units

    Note: these are the approved ATUs listed in SCDHEC manual. All NSF standard 40 approved ATUS are permitted in South Carolina.

    Aquarobic International Mini-Plants
    Biomicrobics FAST
    Clearstream Wastewater Systems,
    Consolidated Treatment Systems Multi-Flo and Nayadic Units
    Jet, Inc. J-500
    Klargester BioDisc
    Multi-flow Waste Treatment Systems
    Norweco, Inc. Singulair Units

B Approved OSDS in Coastal States

Coastal State	Technologies
Alabama	Zabel Aerocell Open Cell Foam Systems; Zabel Riser and Lid Assemblies; Zabel Effluent Filters; Ecoflo Biofilter (peat); and Whitewater ATUs.
Delaware	Clearstream; Biomicrobics FAST; Infiltrator Chambers Cultec Chambers; Zabel Filters; and Rapid Infiltration Basins.
Florida	Ezflow; ADS MPS-13; Infiltrator; Biodiffuser; Hancor Envirochamber; Cultec Contactor; and Tire Chips (Florida Tire Recycling, Inc.Tire Chips, Modern Recycling Inc., Affordable Tire).
Georgia	Infiltrator;Ecoflo; Microseptec EnviroServer; Hydro-Action; Ecopure Peat Biofilters; Cultec Chambers; Norweco; Biodiffuser; Zabel Aerocell; and Infiltrator Chambers.
Louisiana	Mo-Dad-1; Clearstream; Southern Manufacturing; Econo HP; Hydro-Action; Delta Environmental; Hoot Aerobic Systems; BEST; Solar Air; Aqua-Safe; Norweco; and Jet, Inc.
Maine	Norweco; ConSeal; ConWrap; MicroSeptic; Miller Environmental Products, Inc.'s Universal Liner; Aeration Systems; OxyPro Advanced Treatment Unit; Norweco Bio-Kinetic Wastewater Management System; Plastic Tubing Industries, Inc., Multi-Pipe Drainfield System; BioDiffuser Bio 2 and Bio 3; and SeptiTech Combination UV Drip Hose System.
Massachusetts	Biomicrobics; AWT Environmental, Inc.; Cromaglass Corporation; Cultec; Eljen Corporation; Infiltrator Systems, Inc.; Norweco; ADS Biodiffuser; Innovative RUCK Systems, Inc.; and Saneco, Inc. Sand Filter
New Jersey	American Environmental Systems BESTEP-IDEA; Amphidrome System (sequencing batch reactor); Aqueonics trickling filter; Aquarobic sequencing batch reactor; AWT (formerly Eckofin) Bioclere trickling filter; BioMicrobics' Micro-Fast ; Brooks Peat Bed; Cromaglass Denite System (sequencing batch reactor); Delta Whitewater Home ATUS ; Ebb and Flow constructed wetland; Ecoflow peat filter; Ecolo-Chief; ECO RUCK; Enviro-pure peat filter; Geoflow PC WasteFlow pressure drip irrigation system; Klargester BioDisc Treatment Plant (rotating biological contactor); Nayadic; Nite-Less ; Norweco Singulair; Orenco Low Rate Intermittent Sand Filter; Orenco Trickle Filter; Orenco Recirculating Sand Filter; Puraflow peat filter; NPS Wastewater Systems Limited Rotating Biological Contactor; RUCK; Saneco intermittent sand filter; SeptiTech trickling filter; Smith and Loveless FAST; Solviva Biocarbon Wastewater Filter; Spec Airr intermittent sand filter; TRD - 1000 (sequencing batch reactor); Waterloo Biofilter (trickling filter) & Denite System; and Zeoseptic.

Coastal State	Technologies
North Carolina	Aquarobic International; Delta Fiberglass and Environmental Products, Inc.; Bio-Microbics, Inc.Norweco, Inc.; Clearstream Wastewater System, Inc.; "Perc-Rite"Subsurface Wastewater Drip Irrigation System; "Infiltrator"Chambered Sewage Effluent Sub-surface Disposal System; Hancor EnviroChamber; Houck Drainage Systems (HDS) 2003 Triangular, 2012 Triangular, and 2012 Horizontal Drainfield Systems; EEE-ZZZ Lay Drain Company; Cultec "Contactor Model 75, 100, 125 and field drain"; Orenco Systems, Inc. sand filters; "Bio Diffuser" Low Profile Chamber System; Puraflo® Peat Biofilter; Polylok effluent filters; Fist effluent filters; Zoeller effluent filters; SaniTee Effluent Filters; GAG Sim/Tech Filters; Norweco Singular ATU & Sand Filter System Singular ATU; Norweco Bio-Kinetic® System; Geoflow's Subsurface Drip System; Ecoflo® Peat Biofilter System; and Delta's Subsurface Drip System
Rhode Island	Eljen, Cultec; Infiltrator; Zabel effluent filters; GAG SimTech filters; OSI screened Pump Vault and Effluent Filters; Polylok; Bioclere (AWT Environmental); Biocycle; Norweco; RUCK; Fast; and Puraflo
South Carolina	See list in ISTDS Reference Guide
Texas	Alternative Wastewater Systems, Inc.; American Wastewater Systems, Inc.; AWT Environmental, Inc. Biomicrobics, Inc.; Clearstream Wastewater Systems, Inc.; Consolidated Treatment Systems, Inc. Multi-flo & Nayadic; Delta Environmental Products, Inc.;Hydro-Action, Inc.; Jet, Inc. ;H.E. McGraw, Inc.; Microseptec, Inc.; National Wastewater Systems (Solar Air 500, 800, SATXN 500); Nordbeton North America, Inc. Norweco, Inc.; Thomas, Inc.; Ecological Tanks, Inc.; Murphy Cormier, Gen. Con., Inc.; Southern Manufacturing; AquaKlear; Duplantis Concrete Products, Inc.; Mo-DAD-1, Inc.; Bio Weir Filters, Inc.; Norweco, Inc. Filters; Polylok, Inc. Filters; Zabel filters Zoeller filters; Clivus Multrum, Inc. Composting toilets; Sancor Industries Ltd. Composting toilets; and Sun-Mar Corporation Composting toilets.
Virginia	Puraflo; Zoeller ; Aquarobic; Cultec;Infiltrator; Hancor Advanced Environmental Systems, Inc. (Bestep); BioMicrobics; Clearstream Wastewater, Inc.; Clearstream Ecological Systems, Inc.; Delta Environmental, Inc.; Hydro-Action; Jet; MultiFlo; Nayadic; Norweco; and ADS Triple Wall Pipe

Coastal State	Technologies
Washington	Advanced Environmental Systems (AES) Bestep;; AeroDiffuser; Alliance Wastewater Treatment System; Bioclere; Biomax Secondary Treatment System; Cajun Aire; Clearstream Wastewater Treatment System; Clearwater Ecological Systems; EnviroServer; FAST Wastewater Treatment Systems; Five Star 05 Series Rotating Biological Contactor Treatment Systems; Hydro-Action; Jet Aeration Home Aerobic Plant; KEE Process BIODISC Rotating Biological Contactor Systems; *(Product originally approved under the name "Klargester"); Mighty* Mac; Multi-Flo Waste Treatment Systems; Nayadic Residential Sewage Treatment System; Singular Individual Home Wastewater Treatment System; Whitewater Aerobic Treatment Unit; Whitewater Aerobic Treatment Units in combination with the UV "The Disinfector", unit; Nibbler, Jr. Sewage Treatment System; Carousel Composting Toilet; Clivus Multrum Composting Toilet; Composting Toilet System, Inc.; Envirolet Composting Toilet; Phoenix Composting Toilet; Sun-Mar Composting Toilet; CXT Vault toilet; Romtec Vault toilet; Storburn Gas-Fired Incinerator Toilet; Incinolet – Electric Incinerator Toilet; Alternating Intermittent Recirculating Reactor- AIRR; Glendon BioFilter Treatment System; Bio-Diffuser Plastic Leaching Chamber System; Cultec Field Panel System; EnviroChamber Leaching System; Infiltrator Chamber Leach Field System; Goldline GLP Gravelless Leachbed Pipe; and EZflow systems

Note: No proprietary technologies list available in Alaska, California, Connecticut, Maryland, Mississippi, New Hampshire, New York, and Oregon

C. ATU Technology Contact List

EZFlow, LP

Aquarobic Miniplants (from 500 to 5,000 GPD)

Aquarobic International, Inc.
508 Kendrick Lane
Front Royal, VA 22630
Telephone: (540)-635-5200
URL: http://come.to/aquarobic

Biodiffuser Chambers

Advanced Drainage Systems,Inc.

3300 Riverside Drive
Columbus, OH 43221
Telephone: (800)-821-6710
URL: http://www.ads-pipe.com/

Clearstream 500N, 600N, 750N, 1000N, and 1500N Models

Clearstream Wastewater Systems, Inc.
PO Box 7568
Beaumont, TX 77726-7568
Telephone: (409)-755-1500
URL: http://www.clearstreamsystems.com/

Cultec Contactor Chambers

Cultec, Inc.
878 Federal Road
Brookfield, CT 06804
Telephone: (800)-4CU-LTEC
URL: http://www.cultec.com

Ezflow drain pipe with geo-synthetic aggregate

65 Industrial Park
Oakland, TN 38060
Telephone: (877)-368-8294
URL: http://www.ezflowlp.com

Hancor Environmental Chamber Units

Hancor, Inc.
401 Olive St.,

Findlay, OH 45840

Phone: 1-888-367-7473

URL: http://www.hancor.com

Hydro-Action AP-500, G-900, G-1000 and G-1500 Models

Hydro-Action, Inc.
8645 Broussard Road
Beaumont, TX 77713
Telephone: (409)-892-3600
URL: http://www.hydro-action.com/

Infiltrator Chambers and End Plates

Infiltrator Systems Inc.
6 Business Park Road
P.O. Box 768
Old Saybrook, CT 06475
Telephone: (800) 718-2754
URL: http://www.infiltratorsystems.com/

Jet 500, 600, 750, 1000, 1250 & 1500 GPD Media Plants

Jet Inc.
750 Alpha Drive
Cleveland, OH, 44143
Telephone: (440)-461-2000

Multiflo FTB-0.5, FTB-0.6, FTB-0.75, FTB-1.0, FTB-1.5

Consolidated Treatment Systems, Inc.
1501 Commerce Center Drive
Franklin, OH 45005
Telephone: (513)-746-2727
URL: http://www.consolidatedtreatment.com

Nayadic M-6A, M-8A, M-1050A, M1200A, M-2000A

Consolidated Treatment Systems, Inc.
1501 Commerce Center Drive
Franklin, OH 45005
Telephone: (513)-746-2727
URL: http://www.consolidatedtreatment.com

Norweco Singulair Model 960 (500, 750, 1000, 1250 and 1500 GPD systems)

Norweco
Norwalk Wastewater Equipment Company
220 Republic Street
Norwalk, OH 44857-1196
Telephone: (419)-668-4471
URL: http://www.norweco.com

Whitewater DF40, DF50, DF60, DF75, DF100 and DF150 Models

Delta Environmental Products, Inc.
8275 Florida Boulevard
Denham Springs, LA 70727
Telephone: (504)-665-1666
URL: http://www.deltaenvironmental.com

D. Manufactured Composting Toilet Contact List

Alascan
P.O. Box 88
Clear Lake, MN 55319
Telephone: 800 485 4354 and 320 743 2909
URL: http//www.alascan.com

Biolet
45 Newbury street
Boston, MA
Telephone: 800 5biolet
Email: info@BIOLET.COM
URL: http//www.biolet.com

Bio-Sun Systems, Inc.
RR #2, Box 134A
Millerton, PA 16936
Telephone: 800 847 8840
Email: Bio-Sun@ix.netcom.com
URL: http//www.nota.com/bio-sun

Clivus Multrum, Inc
15 Union Street
Lawrence, MA 01840
Telephone: 800 4CLIVUS
Email: forinfo@clivus.com

Composting Toilet Systems, Inc.
P.O. Box 1928
Newport, WA 99156-1928
Telephone: 509 447 3708
Email: cts@povn.com

EcoTech
P.O. Box 1313
Concord, MA 01742-2968
Telephone: 978 369 3951
Email: watercon@igc.org
URL: http//www.ecological-engineering.com/ecotech.htm

Sancor Industries
140-30 Milner Avenue
Scarborough,Ontario
Canada, M1S3R3

Advanced Composting Systems
195 Meadows Road
Whitefish, MT 59937
Telephone: 406 862 3854
Email: phoenix@compostingtoilet.com
URL: http//www.compostingtoilet.com

Sun-Mar Corp
5035 North Service Road, c9-c10
Burlington, Ontario
Canada L7L5V2
Telephone: 905 332 1314
Email: compost@sun-mar.com
URL: http//www.sun-mar.com

Appendix I

Revision of Regulations for Beaufort County

South Carolina Department of Health and Environmental Control
Existing Regulations for Onsite Sewage Disposal Systems

Draft Revision of Regulations for Beaufort County (*with comments in italics*)
V

SECTION I - PURPOSE

A major factor influencing the health of individuals where public sewers are not available is the proper treatment and disposal of human excreta and other domestic waste. Many diseases, such as dysentery, infectious hepatitis, typhoid and paratyphoid, and various types of diarrhea are transmitted from one person to another through the fecal contamination of food and water, largely due to the improper disposal of human wastes. For this reason, every effort should be made to prevent such hazards and to treat and dispose of all human waste so that no opportunity will exist for contamination of water or food, or transmission of human waste by flies or other vectors.

Safe treatment and disposal of all human and domestic waste is necessary to protect the health of the individual family and the community, and to prevent the occurrence of nuisances. To accomplish satisfactory results, such wastes must be disposed of so that:

A. They will not contaminate any drinking water supply.

B. They will not give rise to a public health hazard by being accessible to insects, rodents, or other possible carriers which may come into contact with food or drinking water.

C. They will not give rise to a public health hazard by being accessible to children.

D. They will not violate laws or regulations governing water pollution or sewage disposal.

E. They will not pollute or contaminate any drainage ditch or the waters of any bathing beach, shellfish breeding ground, or stream used for public or domestic water supply purposes, or for recreational purposes.

F. They will not give rise to a nuisance due to odor or unsightly appearance.

Where the installation of an individual sewage disposal system is necessary, the basic principles of design, construction, installation and maintenance should be followed.

SECTION 11 - DEFINITIONS

A. GREASE TRAP - A unit designed to remove grease and fat from commercial food preparation wastes.

B. LINT TRAP - A unit designed to remove lint from commercial laundromat wastewater.

C. OIL/WATER SEPARATOR - A unit designed to remove oil and grease from vehicle wash wastewater.

D. INDIVIDUAL SEWAGE TREATMENT AND DISPOSAL SYSTEM - A system designed for the treatment and disposal of sewage by means of the following:

   1. Initial Treatment

      a. Septic Tank - A watertight covered receptacle designed and constructed to receive the discharge of sewage from a building sewer, separate solids from the liquid, digest organic matter and store digested solids through a period of detention and biological conditioning of liquid waste, and allow the clarified liquid to discharge for final treatment and disposal.

      b. Alternate System - Any system for the initial treatment of sewage which deviates from the conventional system described herein and for which standards have been established by the Health Authority.

   2. Final Treatment and Disposal

      a. Conventional Soil Absorption Trench - A trench placed in the soil for the purpose of facilitating final treatment and disposal of sewage effluent and as described in Section VII.

      b. Alternate System - Any system for the final treatment and disposal of sewage which deviates from the conventional system described herein and for which standards have been established by the Health' Authority.

E. HEALTH AUTHORITY - An authorized representative of the South Carolina Department of Health and Environmental Control.

F. PERMIT - A written statement issued by the Health Authority permitting the construction of an individual sewage treatment and disposal system under this regulation.

G. SEWAGE - The liquid and solid human body waste and the liquids generated by water-using fixtures and appliances from any residence, place of business or place of public assembly. For the purpose of this regulation, sewage shall not be construed to include industrial process wastewater.

SECTION III - GENERAL

A. Each dwelling unit building, business or other structure occupied more than two (2) hours per day, shall be provided with approved facilities for the treatment and disposal of sewage. For businesses or facilities not otherwise producing sewage, such as, but not limited to, photo shops in shopping center parking lots, firework stands, etc.; "provide" shall mean accessible to the occupants.

B. It shall be the responsibility of the property owner to ensure that a permit to construct an individual sewage disposal system is obtained from the Health Authority prior to construction of the system.

C. The general contractor (or prime contractor, or person constructing the building) shall not begin construction of the building until a permit to construct an individual sewage treatment and disposal system is issued by the Health Authority. Also, no mobile or modular structure intended for occupancy shall be moved onto the site until the permit to construct has been issued.

D. An individual sewage treatment and disposal system serving more than one (1) piece of deeded property (i.e., multiple ownership) shall be considered as a public collection and treatment facility.

SECTION IV - APPLICATION, PERMIT, APPROVAL

A. APPLICATION

1. The property owner or his agent shall furnish on the application form provided by the Health Authority, correct information necessary for determining the feasibility of an individual sewage treatment and disposal system.

Secion IV, A4

Performance Based Site Evaluation.

Suggestions are provided in Appendix B of this report for additional site evaluation techniques designed to ensure that systems will perform within prescribed standards.

The County may wish to consider allowing site evaluation by licensed professionals.

2. A boundary plat deed or other legal document specifying the lot size and its boundaries shall be furnished by the property owner or his agent.

3. Other pertinent information may be required when deemed necessary by the Health Authority.

4. Before a site evaluation of the lot is performed by the Health Authority, the property owner or his agent may be required to clear site lines and post an identification marker in the front center of the lot and may be required to place stakes at the corners of the proposed building, at the proposed point of stubout, and at the proposed or existing well location.

B. PERMIT

1. It shall be unlawful to construct an individual sewage treatment and disposal system unless a valid permit has been issued by the Health Authority for the specific construction proposed. The system shall be constructed in accordance with the permit. Changes to the construction of the system must be authorized by the Health Authority prior to their implementation. The Health Authority may also require a permit for the repair, extension or alteration of an individual sewage treatment and disposal system, as deemed necessary.

2. The individual sewage treatment and disposal system shall be constructed according to the specifications, as stated in the permit and in this regulation.

3. In the case of repairs to existing individual sewage treatment and disposal systems, the Health Authority may authorize the best possible method of repair that, in their opinion, may improve the operation of the system, regardless of site conditions.

4. The permit shall become void if any of the original conditions upon which it was issued are changed.

C. APPROVAL - Any repair, extension or alteration for which a permit has been issued and all newly constructed systems shall remain in an exposed condition until final inspection and approval has been granted by the Health Authority.

SECTION V - MINIMUM SITE CONDITIONS

A. Soil texture, depth of soil to rock and maximum seasonal high-water table elevation shall meet minimum standards as required by the Health Authority.

B. The maximum seasonal high water table elevation shall not be less than six (6) inches below the bottom of the proposed soil absorption trenches or alternate system.

C. Depth to rock and other restrictive horizons shall be greater than one (1) foot below the bottom of the proposed absorption trenches or alternate system.

D. Where the maximum estimated wastewater flow from a new facility exceeds fifteen hundred (1500) gallons per day, the individual sewage treatment and disposal system shall meet large system standards developed by the Health Authority.

The minimum area for a lot or plot of ground for a single family home shall be as follows :

For soils of hydraulic conductivity of greater than 3 gallons per square foot per day, not less than 0.5 acres

For soils of hydraulic conductivity of less than 3 gallons per square foot per day, not less than one acre.

These areas are based on preliminary calculations to determine the approximate safe hydraulic capacity of a building lot in differing soil conditions in the coastal plain.

E. The area of the lot or plot of ground where the individual sewage treatment and disposal system is to be installed shall be of sufficient size so that no part of the system will be:

(a) within five (5) linear feet of a building or property line, or under a building, driveway or parking area;

(b) within a minimum of fifty (50) linear feet from a private well or within the minimum distance as established by the Health Authority from a public well;

(c) within fifty (50) linear feet of the mean high-water elevation (tidal waters) or ordinary high water (within the banks) elevation (non-tidal waters) of an impounded or natural body of water, including streams and canals;

(d) within ten (10) feet of upslope and twenty-five(25) feet of downslope interceptor drains;

(e) within twenty-five (25) feet of a drainage ditch or within fifteen (15) feet of the top of the slope of embankments or cuts of two (2) feet or more vertical height when the soil absorption area of a trench is to be placed higher in elevation than the invert of a cut ditch or gully.

F. In addition to the minimum space required in Section V.E., minimum repair area shall be set aside as follows:

1. Sites meeting the minimum standards for an altemative/experimental (temporary) system developed by the Health Authority as authorized by this regulation shall have a minimum repair area 50% the size of the original system.

2. Sites utilizing individual sewage treatment and disposal systems serving food service facilities, laundromats, and car washes shall have a minimum replacement area 50% the size of the original system.

G. In addition to the above, if individual sewage treatment and disposal systems serving condominium units and similar type facilities (multiple sewage stubouts from a common bulding or from a cluster of dwellings on small lots) are to be installed in an area where the soil absorption systems will be contiguously located, each site shall be increased in size to 50% over that which is required for a single system. Each site shall be deeded as a lot in conjunction with the specific unit that it serves, and required protective offsets, as described in Section V.E., from adjacent property lines shall apply.

SECTION VI - MINIMUM REOUIREMENTS FOR INITIAL TREATMENT SYSTEM

A. SEPTIC TANK

1. All persons or firms manufacturing septic tanks for use in South Carolina shall submit detailed plans for each size tank to the Health Authority and shall receive written approval for such tanks prior to their installation in the state.

2. The design and construction of each septic tank shall be in accordance with minimum design and construction criteria established by the Health Authority.

3. No septic tank shall be installed which has a net liquid capacity of less than eight-hundred-ninety (890) gallons.

4. Septic tanks serving individual dwellings shall be sized according to the number of bedrooms, as set forth in the following table:

MINIMUM CAPACITIES OF SEPTIC TANKS SERVING INDIVIDUAL DWELLING

Number of Bedrooms	Minimum Net Liquid Capacity
2 or less	890
3 or 4	1,000

* For each additional bedroom, add 250 gallons.

All septic tanks shall be fitted with an approved proprietary effluent filter designed to prevent the flow of excess solids to the drainfield.

5. Septic tanks serving establishments other than individual dwellings shall be sized according to actual flow data, when available, or by estimates of sewage flow, as set forth in standards established by the Health Authority. The following table shall be used in sizing septic tanks for this purpose.

MINIMUM CAPACITIES OF SEPTIC TANKS SERVING ESTABLISHMENTS OTHER THAN INDIVIDUAL DWELLINGS

Actual or Estimated Flow (gal. per day)	Minimum Not Liquid Capacity (gallons)
593 or less	890
593 - 1500	1.5 x Daily Flow
1,500 or greater	1,125 + 75% of Daily Flow

6. When actual or estimated sewage flow exceeds fifteen hundred (1,500) gallons per day, the Health Authority may require that the design of the individual sewage disposal system be prepared by a Registered Professional Engineer licensed by the State of South Carolina.

B. ALTERNATE SYSTEM

1. Where conditions may warrant its use, the Health Authority may consider an alternative system for the initial treatment of sewage.

2. No alternate system shall be used unless standards for the specific system have been established by the Health Authority.

SECTION VII - MINIMUM REQUIREMENTS FOR FINAL TREATMENT AND DISPOSAL SYSTEM

A. GENERAL

1. Only distribution pipe having received written approval from the Health Authority may be utilized in individual sewage disposal systems. This approval shall be based upon the pipes meeting all applicable ASTM standards.

2. The coarse aggregate used in individual sewage disposal systems shall be a material approved by the Health Authority and shall range in size from one-half (1/2) inch to two- and one-half (2 1/2) inches. Fines must be prohibited.

3. Distribution and drop boxes shall be installed when deemed necessary by the Health Authority. When drop boxes are used, they shall be stabilized by undisturbed or manually compacted earth with each soil absorption trench being fed through at least two (2) feet of solid pipe prior to entering the coarse aggregate. The invert of the drop box overflow pipe shall be at the same elevation as the top of the coarse aggregate in the trenches fed by that box. Also, when utilizing serial distribution, the top of the coarse aggregate shall be level. Other methods that affect serial distribution,

such as earthen dams, shall also overflow at the same elevation as the top of the coarse aggregate.

B. CONVENTIONAL ABSORPTION TRENCH

1. Conventional soil absorption trenches must be at least twenty-three (23) inches deep.

2. The distribution pipe and bottoms of the soil absorption trenches shall be as level as possible with a slope not to exceed four (4) inches per one hundred (100) linear feet from the beginning to the end of each trench.

3. The bottom width of the soil absorption trenches shall not be less than eighteen (18) inches, nor more than thirty-six (36) inches, and there shall not be less than seven (7) feet of undisturbed earth between each trench.

4. There shall be at least six (6) inches of coarse aggregate beneath the distribution pipe, five (5) inches surrounding the distribution pipe, and three (3) inches over the pipe. The coarse aggregate shall be level across the trench width.

5. The required number, length and configuration of conventional soil absorption trenches shall be determined by the Health Authority and shall be based upon the number of bedrooms per dwelling or the number of persons using the facilities, and soil conditions.

6. The coarse aggregate over the distribution pipe shall be covered with a strong, untreated pervious material to prevent infiltration of backfill material.

> such as lightweight “geotextile” of non-woven synthetic fabric,

7. The depth of earth over the coarse aggregate shall not be less than nine (9) inches.

C. ALTERNATE SYSTEM

1. Where conditions may warrant its use, the Health Authority may consider an alternate system for the final treatment and disposal of sewage.

> *Additional forms of treatment and dispersal systems are discussed in Chapter 5.*

2. No alternate system shall be used unless standards for the specific system have been established by the Health Authority.

SECTION VIll - CONSTRUCTION CRITERIA

A. On sloping terrain, soil absorption trenches shall be installed so as to follow the contours of the land.

B. All rough grading of the lot shall be done prior to the installation of the individual sewage treatment and disposal system, where deemed necessary by the Health Authority.

C. The area in which the individual sewage treatment and disposal system is located shall be protected from surface water and roof or downspout drainage.

D. All dirt, mud and debris shall be removed from the septic tank before backfilling, and all backfilling around the tank shall be tamped to facilitate stabilization.

E. If septic tank lids are of slab-type construction, all joints shall be calked or covered with heavy roofing paper or similar material.

> *Substitute for E. & F.*
>
> All tanks shall be designed to be watertight when in position. All horizontal and vertical joints shall be sealed with an appropriate elastomeric sealing compound to prevent the ingress of subsurface groundwater or stormwater.

F. If septic tanks are of two-piece construction joined by tongue and groove, the joint shall be cemented to prevent leakage.

SECTION IX - GREASE TRAPS, LINT TRAPS AND OIL/WATER SEPARATORS

A. Commercial food preparation establishments shall be required to have a grease trap on the kitchen wasteline preceding the individual sewage treatment and disposal system. The grease trap shall be designed in accordance with standards established by the Health Authority.

B. All commercial laundromats shall be required to have a lint trap on the laundry sewer line preceding the main septic tank. The lint trap shall be designed in accordance with standards established by the Health Authority.

C. All vehicle wash facilities shall be required to have an oil/water separator on the sewer line preceding the main septic tank. The oil/water separator shall be designed in accordance with standards established by the Health Authority.

> *Vehicle wash facilities may now be classed as "Class 5 Injection Wells"and require DEP permits.*

SECTION X - PUBLIC SEWER ACCESSIBILITY

A. Permits for new individual sewage treatment and disposal systems shall not be issued where public sewer is accessible for connection.

B. Repairs to existing individual sewage treatment and disposal systems shall not be permitted where public sewer is accessible for connection.

SECTION XI - DISCHARGE OF WASTE

No septic tank effluent or filter effluent shall be discharged to the surface of the ground or into any stream or body of water in South Carolina.

SECTION XII - PERMIT FEES

If a fee system is hereafter established by the Department of Health and Environmental Control, proof of payment of the fee shall accompany each application. If such proof is not so presented, the permit shall not be processed until such proof is received.

Responsibility for the sanitary operation, maintenance, repair and replacement of an onsite sewage disposal system shall reside with the owner of the property. The Department will provide information on maintenance requirements, responsibilities and resources. The Department may, after due notice, enter upon the property for the purposes of inspecting the sewage disposal system in order to verify that the system is operating as designed and in a sanitary manner in order to ensure that the health of the population and environment are not compromised. The Department shall serve notice upon the owner to correct any malfunction of the system within a stated period of time.

The owner may contract with a third party to provide for the servicing of the system, but will remain responsible.

The Department may initiate a program of mandatory inspection and maintenance of all onsite sewage disposal facilities or for defined categories of systems. The costs of such a program may be recovered by direct charge or by regular periodic service charge.

SECTION XIII - ENFORCEMENT INTERPRETATION

This regulation is issued under the authority of Section 44-1-140 (11) of the 1976 Code of Laws, as amended, and Section 48-1-10 et -seq. of the 1976 Code of Laws, as amended. It shall be enforced by the Health Authority in accordance with interpretations and public health reasons approved by the South Carolina Department of Health and Environmental Control. The Health Authority may, at its discretion, establish policies and standards concerning all aspects of individual sewage treatment and disposal.

SECTION XIV - PENALTIES

Violations of this regulation shall be punishable in accordance with Section 44-1-150, Code of Laws of South Carolina, 1976, and each day of continued violation shall be a separate offense.

SECTION XV - REPEAL AND DATE OF EFFECT

This regulation shall become effective as provided in Section 1-23-10 et seq. of the 1976 Code of Laws of South Carolina, as amended, and shall repeal Department of Health and Environmental Control Regulation 61-56 of the Code of Laws of South Carolina, 1976.

SECTION XVI - UNCONSTITUTIONALITY CLAUSE

Should any section, paragraph, sentence, clause or phrase of this regulation be declared unconstitutional or invalid for any reason, the remainder of said regulation shall not be affected thereby.

Statutory Authority: Section 44-1-140 (11) and Section 48-1-10 et seq. of the 1976 Code of Laws, as amended.

DHEC/BEH/OWM

Appendix J

Request for proposals

The Beaufort SAMP
Onsite Sewage Disposal Facilities
Preliminary Geotechnical Report
Request For Proposals

I. BACKGROUND

The County of Beaufort is located in the southeast corner of South Carolina. The County is developing a comprehensive onsite sewage disposal system program and has realized that it has insufficient knowledge of the fate of effluent plumes in shallow water table conditions of the coastal zone. Two dimensional models are available that attempt to estimate the state of constituents of a plume as they leave the proximity of the tilefield and progress laterally under the effects of the low hydraulic gradient into the salt marshes and disperse into the estuary waters. However few studies have been made in conditions similar to the hydrogeology of the low country. Of particular concern is the state of nitrogen, phosphorus and potential pathogens. Accordingly, the Board of advisors of the Beaufort SAMP have decided to initiate a twelve month study of four or more representative existing family septic systems to determine the operating conditions and fate of the effluent plume through four seasons of the year. The four systems will be chosen as typical residential systems in two different geological conditions in the county.

II. SCOPE OF WORK

The consultant shall provide a hydro-geological, chemical and biological report to verify and supplement existing USGA and other documented studies, with particular regard to the measurement of hydraulic conductivity of soils at appropriate depths to facilitate the analysis of potential mounding and movement of effluent plumes from individual sewage soil absorption systems. The effluent plume is to be traced and sampled at appropriate regular intervals through twelve months and additional data is to be collected during or immediately after several significant storm events.

1. Review all available published information by USGS on soils, sub-soils and bedrock geology and hydrogeology and the information provided in the study report for the area delineated on the accompanying maps.

2. Examine available information on existing privately owned wells to determine if useful information on hydrogeological conditions might be obtained.

3. Prepare a plan for the placement of a network of additional small diameter borings and placement of piezometers for sample and analysis of soils and subsoils, for the determination of the phreatic surface level and for the insitu determination of saturated hydraulic conductivity at appropriate depths. Estimates of the elevation of seasonal saturation elevation shall be made by examination of soil morphology and color. Indicate if there will be a requirement for additional test pits for such an inspection. It is suggested that a total of 36 borings will be required but the contractor shall state the number, diameter, depth and form of construction that will

be required to complete the analysis. At each site it will be necessary to construct a boardwalk for a distance of 50 feet into the salt marsh to install and service piezometers to intercept the effluent plume. The plume may be traced in the first place by multiple auger holes and the analysis by illutriation of recovered soil samples. It is suggested that each piezometer site should include sampling ports at three different depths. Alternatively a group of three small diameter piezometers may be used. The contractor may elect to conduct the plume sampling entirely by the illutriation of augered samples of soil. A smaller number of piezometers will be required to determine the phreatic surface levels.

4. Present a proposal to Board of the Beaufort County Special Area Management Plan for the proposed construction for approval.

5. The Board will then negotiate permission or easements for the construction and monitoring of the private and constructed piezometer wells.

6. Proceed with the initial tracing of the plume by auger sampling. Construct the approved system of piezometers with appropriate measurements of saturated hydraulic conductivity and standing water levels for one particular date. Provide accurate information on the ground level and elevation of the top of the well casing at each site.

7. Conduct three further measurement and sampling operations at intervals of three months.

8. Provide one manual device for subsequent determination of standing water level by Board personnel.

9. Submit draft report to Board for review.

10. Attend a meeting to present the report and discuss findings with the Board

11. Prepare final report, incorporating all comments, summarizing the findings and make final recommendation. Provide six (6) copies of the final report to the Board.

III. FORM OF PROPOSAL

Qualified contractors are to submit six (6) copies of the proposal to:

Sealed proposals must be submitted, no later than:
(insert date and time)

The proposal is to be submitted on the firm's letterhead, signed by an officer of the company, and shall contain the following:

1. A statement of qualification of the firm submitting the proposal, citing in particular at least three (3) similar projects that have been undertaken by the firm and giving information as follows:

    a. Description of the project.
    b. Itemized cost.
    c. Name, address, and telephone number of clients.
    d. Time necessary to complete the project.

2. An organizational chart and statement of qualifications for the personnel who are to be assigned to the project.

3. An estimated time schedule, prepared by the engineer or hydrogeologist, estimating the time necessary to complete the report.

4. A description by the consultant as to what attributes the firm may have that make it uniquely suited to carry out the work. This may include specialized experience or other material not covered above.

IV. FACTORS FOR EVALUATION AND AWARD OF CONTRACT

Proposals shall be reviewed by the Board and their representatives and advisors, for the following items:

1. Approach in adequately addressing the issues described in the SCOPE OF WORK section.

2. Experience of the proposed personnel relative to the scope of work of this RFP, as well as experience of the company as a whole.

3. The length of time the firm shall require to carry out the work.

4. Results of reference checks.

5. Completeness of the proposal.

The Board reserves the right, without qualification, to select any proposal, to reject any or all proposals, and to apply their judgment with respect to any proposal submitted.

Following a review of all proposals submitted, the Board may select a group of finalists. The firms selected as finalists will be required to participate in an interview session with the Board and their representatives, a cost estimate will be presented.

Once a consulting firm or contractor has been selected, the Board will issue an order to proceed. The firm shall not proceed with any work until the order to proceed has been issued.

V. INQUIRIES

Administrative and technical questions can be presented to representatives of the Board at the following meetings:

- Pre-Proposal Conference: This meeting will be held at the (insert location) (insert date and time). It is **MANDATORY** that prospective bidders attend this conference.

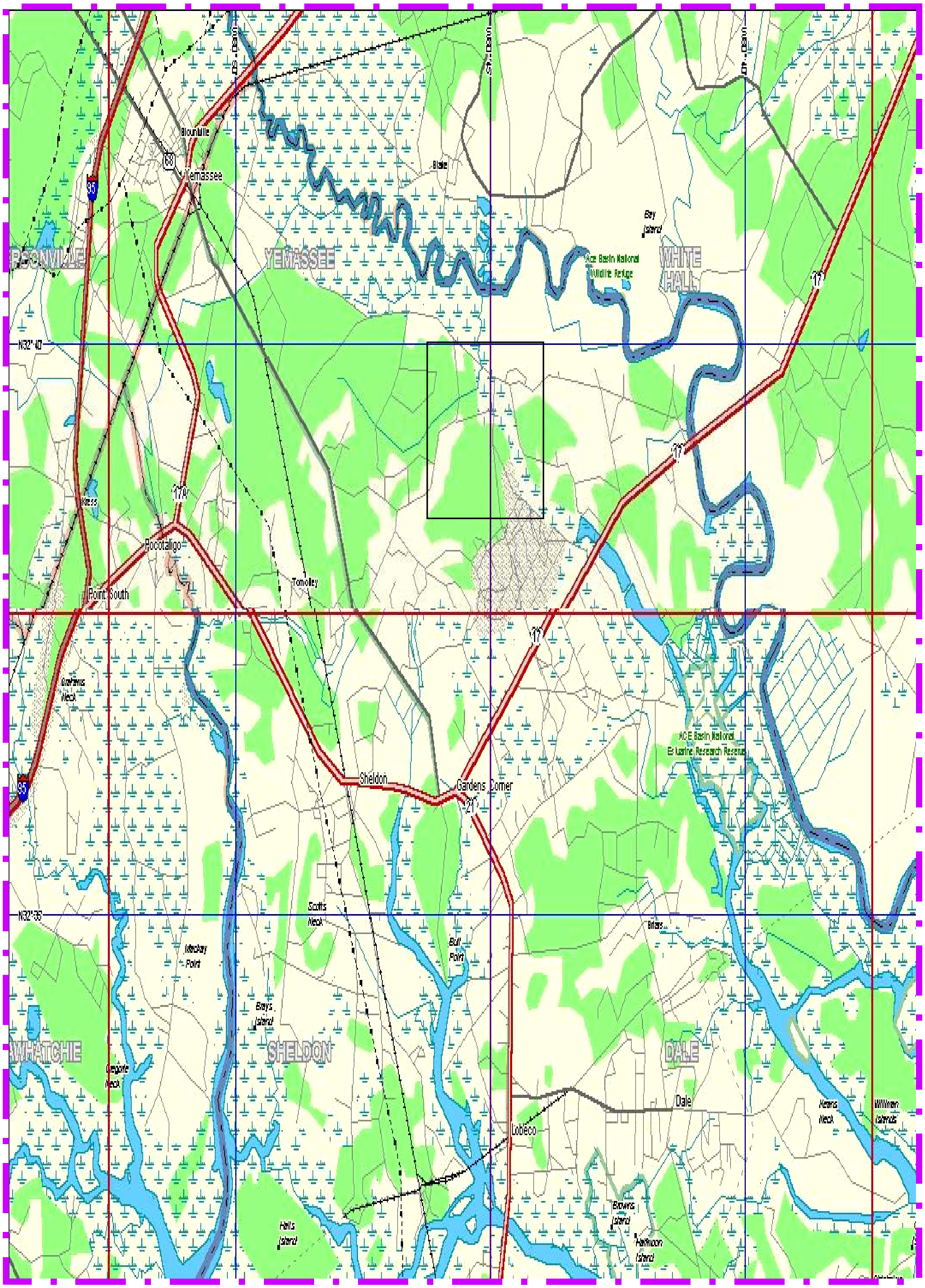
- Pre-Proposal Follow-up Meeting: This meeting will be held at the (insert location) (insert date and time). The purpose of this meeting is to address any follow-up questions that prospective bidders may have. Attendance at this meeting is **NOT MANDATORY**.

Maps

The maps on the following pages are reproductions taken from the USGS topographical 15’ quadrangle.

The black rectangles represent the areas that are to be surveyed for the participating households.

Beaufort County (Rectangle shows area of study)



Appendix K

Funding Sources

List of Funding agencies and programs

1. EPA Office of Wastewater Management - This office offers small communities technical assistance, financial assistance, and education and training. The website at www.epa.gov.owm has information about many programs and links to other sources of information. There is also an Office of Wetlands, Ocean and Watersheds, offering assistance with NPS pollution and stormwater management.

2. Clean Water State Revolving Fund (CWSRF) Program - This program, administered by EPA's Office of Water, provides grants to all states (and Puerto Rico) to capitalize state loan funds to build wastewater facilities. States provide a 20 percent match. Each state's SRF makes low-interest loans to communities for high-priority water quality management activities. (Septic system improvements and replacements and stormwater management facilities are eligible for funding under the CWSRF). Visit http://www.epa.gov/owm/finan.htm for more information.

3. Hardship Grant program of the **CWSRF** was developed to provide funding for improving onsite treatment in low-income regions experiencing persistent problems with OSDS because of financial barriers

4. Nonpoint Source Pollution Program – Authorized under section 319 of the federal Clean Water Act and financed by federal, state and local contributions funds and provides technical support for a wide range of polluted runoff problems including OSDS. Visit http://www.epa.gov/owow/nps for more information.

5. South Carolina Revolving Fund is administered by the Department of Health and Environmental Control. Once a project questionnaire is submitted, DHEC reviews it for project eligibility and, if eligible, it will be ranked in accordance with the CWRSF Integrated Priority Ranking System and placed on the State's Priority List of Projects. Contact state coordinator, State Revolving Fund Section, Bureau of Water, 2600 Bull Street, Columbia, SC 29201 at 803-898-3993 for more information.

6. State Community Development Block Grant (CDBG) Program - The CDBG program, which is funded by the U.S. Department of Housing and Urban Development (HUD), provides grants directly to the states, which then allocate funds to small cities and non-urban counties. Grants may be used for water, sewer, and other projects that protect public health and reduce environmental risk. Seventy percent of grant funds must be used for activities that principally benefit low- and moderate-income persons. On average, grants cover 50 percent of the project cost. Areas undergoing significant economic distress are eligible for grants of up to 80 percent. Contact the state or local HUD agency or call HUD headquarters at (202) 708-1322 or visit www.hud.gov/cpd/cpdcomde.html for more information.

7. Rural Utilities Service (RUS) Water and Waste Disposal (WWD) Program The U.S. Department of Agriculture's Rural Utilities Service WWD Program provides both loans and grants to rural communities (10,000 or fewer residents) for water, wastewater, solid waste, and storm drainage projects. Funds may be used to install, repair, improve, or expand rural wastewater disposal facilities. To be eligible, the community must be unable to get credit elsewhere at reasonable rates and terms. Certain low-income communities may be eligible for grants of up to 75 percent of eligible project costs. The local or regional Rural Development office can be contacted at (202) 720-0962, or visiting the website at www.usda.gov/rus/water/programs.htm. The Rural Housing Service also provides direct loans, loan guarantees, and grants to low or moderate-income individuals to finance repairs or upgrades needed to make the home safe and sanitary. Visit www.rurdev.usda.gov/rhs/individual/ind_splash.htm for more information

8. Economic Development Administration (EDA) Grants for Public Works and Development Facilities - The U.S. Department of Commerce's EDA provides grants to economically distressed areas for public works projects, including water and wastewater facilities. Eligible projects must promote economic development, create long-term jobs, and benefit low-income persons or the long-term unemployed. On average, EDA grants cover 50 percent of project costs. However, grants of up to 80 percent are available for severely distressed communities. For more information, contact the state or regional EDA office in your area or call (202) 482-3081 or visit EDA's Web site at www.doc.gov/eda/.

9. The National Rural Water Association - The NRWA represents rural and small community wastewater systems throughout the US. Offices in each of the contiguous states can help small communities applying for grants and loans for wastewater treatment projects by assisting with the paperwork involved in locating funding sources and guidance through the funding process. South Carolina's office can be reached at www.SCRWA.org. Address is PO Box 479, Clinton, SC 29325. Phone (864) 833-5566.

10. The Rural Information Center (RIC)- The RIC provides information and referral services for rural communities, local officials, organizations and citizens. The website address is www.nal.usda.gov/ric and has a section dedicated to funding sources. For more information call (800) 633-7701.

11. The International City/County Management Association (ICMA) - The ICMA has partnered with a number of organizations to create the Local Government Environmental Assistance Network (LGEAN). This place is for local officials needing environmental management, planning, and regulatory information. For more information visit their website at http://lgean.org or call at (877) 865-4326.

Appendix L

Beaufort County-wide Wastewater Ordinance

<u>**TABLE OF CONTENTS**</u>

Introduction

This chapter provides a conceptual framework for the development of an onsite sewage disposal systems ordinance for Beaufort County, South Carolina. Recommendations contained in the body of this report are herein included within this conceptual framework to provide direction and guidance for ordinance development purposes.

For purposes of this exercise it is assumed that the provisions of this conceptual draft ordinance framework will apply to all territory within the boundaries of Beaufort County, South Carolina and govern the treatment, disposal, operation, and maintenance of Onsite Sewage Disposal Systems (OSDS) serving single or multiple-family residences, places of business, or places of public assembly.

This draft ordinance framework is divided into several specific sections addressing, planning, performance requirements, site evaluations, design, construction, operation, maintenance, training, certification, licensing, public education, public involvement, inspections, monitoring, record keeping, reporting, and violations.

I Planning

It is essential that Beaufort County consider regional and site conditions and impacts in the planning process as well as long-term watershed and public health protection. This is accomplished through the establishment of surface/groundwater setbacks and/or identifying critical areas requiring more protection, and monitoring and modeling pollutant loads countywide with environmental conditions in mind.

Beaufort County Planning Department (BCPD) should be an integral resource providing information and support for the county's onsite wastewater management efforts. Tasks include: identify the planning regions (six planning areas), establish programmatic goals, and coordinate interagency activities of the BCPD. Zoning regulations should specify performance requirements for individual or clustered systems installed in unsewered areas.

A regular review of planning and zoning activities as they relate to community onsite wastewater management activities should be instituted to record and anticipate growth and development trends as well as the role of onsite wastewater management in minimizing impacts on the watershed and on public health. A blueprint for a water conservation program should be designed and implemented.

All potential stakeholders should be identified at the outset and their roles and responsibilities clearly defined. This would be critical in building support for the development and implementation of the ordinance.

II Performance Requirements

Beaufort County should institute a performance-based approach and establish quantitative and qualitative goals by linking treatment standards and relative risk to health and water resources by adopting acceptable site characteristics and/or system types allowed. Require system performance to meet standards that consider water resource values, vulnerabilities, and risks.

III Site Evaluation

Beaufort County should investigate each proposed site. Such an investigation should include evaluating the topography and landscape position, soil characteristics (morphology), soil depth, restrictive horizons, and available space.

Soil profiles should be evaluated at the site by borings or other means of excavation. A determination should be made as to how suitable the soil is to treat and absorb primary or secondary treated effluent. Applicants may be required to perform additional soil evaluations, if necessary. South Carolina Department of Health and Environmental Conservation (SCDHEC)/Beaufort County Health Department (BCHD) should determine the long-term acceptance rates to be used for sites using OSDS.

Depressions should be considered unsuitable with respect to landscape position except when the site complies with requirements of the local health department.

If the SCDHEC/BCHD so directs, the surface area on or around an OSDS should be landscaped to provide adequate drainage.

The interception of perched or lateral ground-water movement should be provided where necessary to prevent soil saturation on or around the ground absorption sewage treatment and disposal system.

Designated wetlands should be considered unsuitable sites for installing OSDS, unless the proposed use is specifically approved.

A. Soil characteristics

The soil characteristics (morphology, horizon, texture, color, structure, etc.) at each site should be evaluated by the SCDHEC/BCHD. They may substitute laboratory and/or field evaluation of permeability determination of the soil based upon particle-size analysis.

B. Soil wetness conditions

Soil wetness conditions caused by a seasonal high-water table, perched water table, tidal water, seasonally saturated soils or by lateral water movement shall be determined by observation of colors of chroma 2 or less (Munsell color chart) in mottles or a solid mass.

If drainage modifications have been made, the SCDHEC/BCHD may make a determination of the soil wetness conditions by directly observing the water surface during periods of typically high-water elevations.

However, colors of chroma 2 or less which are relic from minerals of the parent material shall not be considered indicative of a soil wetness condition. Severely drained soils that do not reflect a soil chroma change should be evaluated for depth to seasonal high-water table. Where a site is unsuitable with respect to soil wetness conditions, further investigation may be needed to ascertain that an OSDS system can be safely installed.

C. Soil Depth

Soil depths to seasonal high-water table (or zone of saturation), saprolite, rock, or parent material shall be considered to determine site suitability. Should a site be unsuitable with respect to depth, further investigation is needed before an OSDS system permit can be approved or denied.

D. Restrictive horizons

Soil profiles are composed of various layers of soil horizons that must be taken into account. SCDHEC/BCHD must make a careful determination as to what type of OSDS will be permitted in soils where restrictive horizons are present. Restrictive horizon means a soil horizon that is capable of perching groundwater or sewage effluent and that is brittle and strongly compacted or strongly cemented with iron, aluminum, silica, organic matter, or other compounds. Restrictive horizons may occur as fragipans, iron pans or organic pans, and are recognized by their resistance in excavation or in using a soil auger.

E. Available space

Sites should have sufficient space available to permit an OSDS to be installed and to function properly. Sites on an existing tract of land, which is to be subdivided, or for any lot created, should also have sufficient available space to permit the installation and proper functioning of an OSDS. Sufficient and suitable space/area shall also be reserved for a replacement system to be installed should the primary system fail.

F. Other applicable factors

Site evaluation should include consideration of applicable factors, such as the:

- proximity of a large-capacity water-supply well,
- potential public health hazard due to possible failures of soil absorption systems,
- potential public health hazard of massive failures of soil absorption systems proposed to serve large numbers of residences, as in residential subdivisions or mobile home parks, and

- sites serving systems designed to handle larger flows such as from a cluster of homes.

With a design flow of greater than 1,500 gallons per day (gpd), the applicant should submit sufficient site-specific data to predict the height of the water table mound that will develop beneath the field (level sites) and the rate of lateral and vertical flow away from the dispersal area (sloping sites). The data submitted should include, as a minimum, soil borings to depths greater than 48 inches, permeability and hydraulic conductivity measurements, water level readings, and other information, required by the SCDHEC/BCHD.

Mounding analysis should be required for flows greater than 1,500 gpd or as determined by the health department. The site may not be suitable for OSDS if the data indicate that the groundwater mound which will develop beneath the site cannot be maintained two feet or more below the bottom of the dispersal area, or it is determined that effluent is likely to become exposed on the ground surface within, or adjacent to, the dispersal field.

G. Soil tests and other required information

When required by the SCDHEC/BCHD (based on geomorphological and historical information), seasonal high-water tables shall be observed only during the rainy season and when both of the following occur:

(1) The cumulative rainfall reaches the total specified on the rainfall map maintained by the DHEC for the region of observation, and

(2) Six inches of rainfall have occurred within thirty days immediately preceding the date of observation.

Using redoxymorphic features to establish the seasonal high-water table allows for this to be done at any time of the year. However, if water table monitoring (using peizometers) is required, then it should be done during rainy seasons with adequate rainfall.

The SCDHEC/BCHD may require that piezometers (shallow groundwater monitoring pipes) be constructed in the vicinity of proposed leaching devices to enable observation of depth to groundwater throughout winter. BCHD may observe seasonal high-water table anytime during the winter water table test period established by (1) and (2) above.

Temporary and brief saturated conditions caused by significant rain events should not provide the sole basis for determining seasonal high-water table for an OSDS design purposes.

If the health department expects the site to have a shrink-swell potential (due to high clay content, generally over 30% clay), additional information may required. A soil texture and bulk density analysis may be required to resolve any question of the extent of shrink-swell potential.

Two or more soil excavations shall be performed for each individual OSDS to demonstrate the suitability of soil conditions to serve new development. If the health officer believes the soil may not meet the requirements of this chapter, additional soil excavations may be required (as deemed necessary) before a repair permit is issued.

A licensed individual (licensed by the state or county or has equivalent or similar education/experience) performing the soil tests should provide an evaluation of soil texture for each soil stratum encountered during the soil excavation. When laboratory analysis of soil texture is required by SCDHEC/BCHD, the testing individual shall collect a sample or samples, as required by the Health Officer, and deliver the samples to an approved soil-testing lab for analysis. The test results shall be forwarded to SCDHEC/BCHD with identification of the sampling location, depth and method. The soil textural classification system shall be the USDA method.

SCDHEC/BCHD may also require any other information necessary to evaluate the proposed system. If, in the opinion of the health department, the land proposed for the individual OSDS has severe soil limitations, or introduction of sewage effluent into the soil may create slope instability, the applicant may be required to submit a technical report at their own expense by a licensed soil scientist, engineering geologist, registered geologist, or similarly qualified soils expert.

H. Lot size requirements

An individual sewage disposal system may be permitted on a parcel of less than one acre in size if the parcel is an existing lot of record that complies with the requirement of this section and if all other requirements of this Chapter are satisfied.

Factors such as proximity or location of the lot to drinking water sources both private and public, Coastal Zone areas, primary groundwater recharge areas and others specific to that site or area should be considered while establishing the lot size. An applicant may conduct a study by a licensed engineer or hydrogeologist according to guidelines established by SCDHEC/BCHD to demonstrate that the property is not within the different constraint areas.

Separate lots of record, and lots shown on a map of a recorded subdivision, shall be deemed to be lots in existence for the purposes of this section as of the date said lots were created by recorded deed, parcel map, or final map. If an owner of record of a lot can furnish satisfactory proof that he or she purchased a lot pursuant to a bonafide contract of sale, the date of purchase of said lot as shown in said contract of sale shall be deemed satisfactory proof of the date of existence of the lot.

IV Design and Construction

The design flow of a residential unit can be determined by using a flow rate of 120 gpd per bedroom. Wastewater flow rates as determined by SCDHEC (Table L- 1) should be used to determine the minimum design daily flow of sewage required to serve different establishments.

Table L-1 - Standards for systems to serve commercial and industrial establishments, institutions and recreational areas

Type of Establishment	**Gallons Per Person Per Day (Unless Otherwise Noted)**
Airports/transportation terminals (per passenger)	3
Apartments – Multiple family (per resident)	50
Barber shops (per chair)	50
Bars/Lounges (per seat)	20
Bathhouses, spas and swimming pools	10
Bowling Alley (per lane)	200
Camps:	
Campground (toilet and shower facilities), no water and sewer hookups	100
Campground with flush toilets, no showers (per site)	150
Construction camps (person)	50
Day camps (no meals served)	15
Resort camps (night and day) with limited plumbing	50
Luxury camps	100
Churches (sanctuary)	
Per seat	2
With kitchen waste per seat	3
Cottages and small dwellings with seasonal occupancy (as residential)	150
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Day care facilities	15
Dwellings:	
Boarding Houses (per bed space)	60
Additional for non-resident boarders	10
Luxury residences with estates (per bedroom)	150
Multiple family dwellings (apartments)	100

Type of Establishment	Gallons Per Person Per Day (Unless Otherwise Noted)
Rooming houses	40
Single family dwellings	75
Factories (gallons per person, per shift exclusive of industrial wastes)	15
Hospitals (per bed space)	250
Hotels with private baths (2 persons per room)	100
Hotels without private baths	50
Institutions other than hospitals (per bed space)	125
Laundromats (gal/machine)	500
Laundries, self-service (gallons per wash, i.e. per customer)	50
Marinas (toilet waste only, per boat slip)	10
Mobile home parks (per space)	250
Motels with bath, toilet, and kitchen waste (per bed)	60
Motels (per bed)	50
Picnic Parks (toilet wastes only) (per picnicker)	15
Picnic Parks with bathhouses, showers, and flush toilets	35
Public parks and rest areas	5
Restaurants per seat per day	50
Restaurants additional for bars and cocktail lounges (per customer), (per seat)	3(15)
Service Stations (per vehicle)	12
Schools	
Boarding	75
Day, without gyms, cafeterias or showers	15
Day, with gyms, cafeteria and showers	25
Day, with cafeteria, but without gyms or showers	20
Swimming pools and bathhouses	10

Type of Establishment	Gallons Per Person Per Day (Unless Otherwise Noted)
Theaters:	
Movie (per auditorium seat)	3
Travel trailer parks with individual water and sewer hook-up (per space)	125
Workers:	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	10

A. For all such uses, pretreatment may be required if the health department determines that the wastewater from any such use is likely to be significantly different from the wastewater produced by domestic uses.

B. Any food facility that generates grease-laden wastewater that is discharged into an OSDS shall install an exterior grease interceptor. The health department shall adopt specifications for the sizing and maintenance of grease interceptors.

C. For any food facility, failure to provide adequate sewage disposal or failure to properly maintain a grease interceptor shall be cause to revoke a food facility's permit.

Low-flow toilets, urinals, and other plumbing fixtures and appliances shall be used when constructing new buildings and while retrofitting existing homes (Table L-2). When homeowners install garbage disposal units, the septic tank capacity shall be increased (one third) and require septic tank effluent filters. Effluent filters should be installed, as they are especially important for trapping lint from clothes washers. Separate lint filters should be required after a high efficiency washer, and before the septic tank.

Design protocols should address the use of water conservation fixtures, impacts of different pretreatment levels on hydraulic and treatment performance, and the operation and maintenance requirements of different treatment and soil dispersal technologies. When designing a system, it is suggested that the most limiting or significant parameters, including some ancillary factors, be considered to accommodate hydraulic and mass pollutant load variations. Great care should be taken in predicting wastewater characteristics without underestimating or overestimating the safety factors.

Table L-2 Flow Rates for Plumbing Fixtures and Fixture Fittings

Plumbing Fixture or Fixture Fitting	Maximum Flow Rate or Quantity
Water Closet (Toilet)	1.6 gallons per flushing cycle
Urinal	1.0 gallons per flushing cycle
Shower head	2.5 gpm at 60 psi
Faucet (kitchen and lavatory)	2.2 gpm at 60 psi or 2.5 gpm at 80 psi
Replacement aerators (kitchen and lavatory)	2.2 gpm at 60 psi or 2.5 gpm at 80 psi
Metering faucets	0.25 gallons per metering cycle

Documented data from a type of facility or a comparable facility justifying a flow rate reduction shall be submitted to SCDHEC/BCHD. The submitted data shall consist of at least 12 previous consecutive monthly total water consumption readings and at least 30 consecutive daily water consumption readings.

Daily readings shall be taken during a projected normal or above normal sewage flow month. A peaking factor shall be derived by dividing the highest monthly flow as indicated from the 12 monthly readings by the sum of the 30 consecutive daily water consumption readings. The adjusted design daily sewage flow shall be determined by taking the numerical average of the greatest ten percent of the daily readings and multiplying by the peaking factor.

An adjusted daily sewage flow rate may be granted contingent upon use of extreme water-conserving fixtures, such as toilets which use less than 1.6 gallons per flush, foot operated or sensor activated faucets with flow rates of one gallon per minute or less, and showerheads with flow rates of two gallons per minute or less. Low flow faucets for both kitchen and bathroom should be used. The use of high efficiency front-loading washing machines should be encouraged. Dishwashers that consume a lower amount of water (about 7 gallons per load) should also be encouraged for new homes and for replacing older models that use a higher volume of water.

The amount of wastewater flow rate reduction shall be determined by the SCDHEC/BCHD based upon the type of fixtures and documentation of the amount of flow reduction to be expected from the proposed facility. Adjusted daily flow rates based upon use of water-conserving fixtures shall apply only to design capacity requirements of dosing and distribution systems and dispersal fields.

Floor drains that are accessible to vehicles shall be prohibited from connecting to a ground absorption system.

B. Location of OSDS

Each OSDS should be located at least the minimum horizontal distance as established by SCDHEC/BCHD from any private water supply source, including any well or spring, any public water supply source, state and federally classified streams, coastal waters, other stream, canal, marsh, or other surface waters, any Class I or Class II reservoir, permanent storm water retention ponds, other lakes or ponds, building foundations or building footings, basements, property lines, water lines, drainage systems, and swimming pools.

Sewer lines may cross a water line when a clear separation distance is maintained, with the sewer line passing under the water line. However, crossing lines should be avoided at all times if possible. Sewer lines shall be constructed of ductile iron pipe or its equivalent and the water line shall be constructed of ferrous materials equivalent to water main standards for a distance of at least ten feet on each side of the point of crossing, with full sections of pipe centered at the point of crossing.

Septic tanks, lift stations, wastewater treatment plants, sand filters, and other pretreatment systems shall not be located in areas subject to frequent flooding (areas inundated at a ten-year or less frequency) unless designed and installed to be watertight and to remain operable during a ten-year storm. Mechanical or electrical components of treatment systems shall be located above the 100-year flood level or otherwise protected against a 100-year flood.

C. Septic tank

A septic tank or dosing tank should be watertight, structurally sound, and not subject to excessive corrosion or decay. Septic tanks, prefabricated concrete tanks or tanks of other material should be constructed in accordance with the plans approved by SCDHEC. Septic tanks and pump tanks should be installed on a level, smooth, and stable base. When necessary, a 4" layer of washed stone may be used to provide a base for the tank.

Septic tanks should be constructed of reinforced concrete, standard weight reinforced concrete blocks, or approved non-corrodible synthetic materials. Metal septic tanks should not be permitted. Sealing horizontal and vertical joints with an appropriate elastomeric sealing compound can prevent the ingress of subsurface groundwater or storm water.

Reinforced concrete and reinforced concrete block septic tanks shall be constructed with steel reinforcing bars placed 16 inches on center vertically and 20 inches on center horizontally with all cells grouted. Concrete septic tank covers shall be reinforced.

The septic tank size required for residences should be 1,000 gallons for three bedrooms or less and 1,500 gallons for four to five bedrooms.

Septic tanks shall have at least two compartments separated by a baffle or equivalent arrangement. The inlet compartment shall have a capacity of not less than two-thirds the total volume. Access to each compartment shall be provided by a manhole 20 inches in minimum dimensions with a close fitting manhole cover equipped with a durable handle to facilitate removal.

Septic tanks shall have an approved effluent filter and access devices. The effluent filter should function without a bypass of unfiltered wastewater, sludge, or scum. The effluent filter case should be designed to function as a sanitary tee with the inlet extending down to between 25 and 40 percent of the liquid depth.

The effluent filter support case shall be solvent welded to a polyvinyl chloride (PVC), Schedule 40 outlet pipe with a minimum diameter of three inches inserted through the outlet connective sleeve creating a watertight and mechanically sound joint and shall extend at least 24 inches beyond the tank outlet. The filter and support case shall be installed and maintained in accordance with the filter manufacturer's specifications. The effluent filter shall be secured in the support case and located under the outlet access opening or manhole.

Septic tanks should be installed so that manhole covers are within 12 inches of the ground surface. If the top of a septic tank is deeper than 12 inches from the ground surface, the tank shall be modified so as to extend the manhole and covers to within 12 inches of the surface. Material used to extend the manhole covers should be constructed of the same material as the septic tank or appropriate material for such purpose. A cleanout to finished grade shall be provided between the house and the septic tank.

A riser shall extend from each manhole cover to the surface of the ground so as to facilitate inspection and maintenance of the septic tank. The riser shall be a larger size than the manhole cover and shall be constructed of durable material.

The pipe or tubing used between the septic tank and the dispersal line shall be a minimum of three-inch nominal size Schedule 40 PVC, polyethylene (PE), or acrylonitrile-butadiene-styrene (ABS) or equivalent with a minimum fall of one-eighth inch per foot. All joints from the septic tank to the dispersal field shall be watertight. The header pipe connecting the septic tank to the distribution line should not be perforated.

Other types of septic tanks may be accepted if they are constructed and installed in accordance with the recommendations of the SCDHEC. Septic tank should be placed in conformance with the following distance requirements as shown in Table L-3.

Table L-3 - Septic tank distance requirements

From Septic Tank To:	Minimum Permitted Distance in Feet
Private water source or wells	50 (drilled wells) and 100 (dug wells)
Public water supply source	100[a]
Stream, well, spring, water course	100
Property line or easement boundary	5
Foundation, structure, bearing weight building overhang	5
Basement	10
Driveway or pavement	5
Public water main or onsite water line	10
Other coastal waters	50 feet from the mean high-water mark
Storm water (permanent retention pond)	50 feet from flood pool elevation
Any other lakes and ponds	50 feet from normal pool elevation

Note: a – Subject to SCDHEC regulations/amendment

Grease traps or grease interceptors should be required at food service facilities, meat markets, and other places of business where the accumulation of grease can cause premature failure of a soil absorption system. The following design criteria shall be met:

- The grease trap shall be plumbed to receive all wastes associated with food handling and no toilet wastes.
- The grease trap liquid capacity shall be sufficient to provide for at least five gallons of storage per meal served per day, or at least two-thirds of the required septic tank liquid capacity.

- Access risers, with a minimum diameter of 24 inches, shall be provided over each chamber, outlet filter, and sanitary tee. The access riser shall extend 6" above finished grade and be designed and maintained to prevent surface water infiltration. The risers shall also have readily removable covers to facilitate inspection, filter maintenance, and grease removal.

Where it has been demonstrated that specially designed grease interceptors will provide improved performance, the grease trap liquid capacity may be reduced by up to 50 percent. Grease interception filters with openings no greater than 1/32" shall be required on the grease trap outlets as well as on the outlet of the septic tanks down flow from the grease trap.

SCDHEC may allow modifications to septic tank systems or sites that may be used alone or in combination to overcome selected soil and site limitations. Specific modifications may be approved by the SCDHEC/BCHD.

Choice of secondary treatment technologies shall be based upon applicability and appropriateness in the context of protecting public health and reducing the risk to the environment. Innovative/Experimental (I/E) systems are any wastewater systems, system components, or devices that are not currently approved by SCDHEC.

D. Innovative/experimental systems

DHEC should review all applications submitted. The application shall include the following information as applicable:

(a) Specification of the type of approval requested as either innovative, experimental or both;

(b) Description of the system, including materials used in construction, and its proposed use;

(c) Summary of pertinent literature, published research, and previous experience and performance with the system;

(d) Results of any available testing, research or monitoring of pilot system or full-scale operational systems conducted by a third-party research or testing organization;

(e) Identity and qualifications of any proposed research or testing organization and the principal investigators, and an affidavit certifying that the organization and principal investigators have no conflict of interest and do not stand to gain financially from the sale of the I/E system;

(f) Objectives, methodology, and duration of any proposed research or testing;

(g) Specification of the number of systems proposed to be installed, the criteria for site selection, and system monitoring and reporting procedures;

(h) Operation and maintenance procedures, system classification, proposed management entity and system operator;

(i) Procedure to address system malfunction and replacement or premature termination of any proposed research or testing; and

(j) Notification of any proprietary information, system, component, or device.

Advanced treatment devices that reduce nitrogen in the effluent prior to discharge to the underlying soil will be required for any system located in sandy soils. Based upon an evaluation of the effectiveness and cost of available technology, the SCDHEC/BCHD shall determine the amount of nitrogen removal required and may waive this requirement for upgrade of existing systems where there will be no bedroom addition, remodels adding more than two-hundred-fifty square feet, or other expansion of use which will result in an increase in volume or strength of wastewater flow.

Innovative/Experimental systems approved by the SCDHEC/BCHD which provide a reduction in nitrogen, Total Suspended Solids and Biological Oxygen Demand of the sewage effluent prior to discharge to the underlying soil should be required for all new systems and upgraded systems serving more than five residential units or serving uses which generate a peak daily discharge of more than 2,000 gallons per day.

The SCDHEC/BCHD may accept sewage disposal permit applications utilizing Innovative/Experimental system designs to upgrade existing systems in order to allow building additions or remodels, and for constructing new systems on lots of record in existence on {Date}. Innovative/Experimental systems may also be proposed to provide enhanced treatment and/or mitigate environmental impacts on parcels created after {Date}, if those parcels can meet the requirements for a standard conventional system. Innovative/Experimental system designs for new systems must be in conformance with installation requirements.

Designs for an Innovative/Experimental system must be prepared by a qualified person such as a registered civil engineer, a registered environmental health specialist, soil scientist, or a registered geologist, experienced in the design of individual sewage disposal systems. Designs for Innovative/Experimental systems should include such technical data as necessary to support deviation from the OSDS regulations, and to demonstrate that the system will function as designed and will not adversely affect surface or groundwater quality. Designs proposed for any use other than repair of a failing system must demonstrate satisfactory performance in soil conditions similar to those encountered in the proposed application. Review and approval of any application for an Innovative/Experimental system requires the concurrence of the state.

The SCDHEC/BCHD may limit the number of permits for Innovative/Experimental designs to serve new development that are issued in any calendar year depending on the type of technologies used. These limits will be removed if experience and water quality monitoring show that the systems of that design type do dispose of sewage without adversely affecting surface or groundwater quality for a minimum period of two consecutive years, with at least one of those years having average or above average annual rainfall at the location of system installation.

If a permit to use an Innovative/Experimental system is not approved due to limits on the annual number of systems approved, the completed application will remain valid for up to two years, and permits will be issued in chronological order based on the date that the application was deemed complete. The SCDHEC/BCHD could withhold approval of additional permits for a particular design type, if experience indicates that the design is not meeting the standards set forth.

As a condition for approving an Innovative/Experimental sewage disposal system the property owner should enter into an agreement with the SCDHEC/BCHD acknowledging and accepting the requirements for using this system.

The Innovative/Experimental system design must be inspected during installation by the design consultant for conformance to the design. A certification in writing that the system, as installed, conforms to the approved design must be submitted by the consultant to the SCDHEC/BCHD prior to final approval of the installation and occupancy of the structure.

The health officer should establish specifications for: submitting applications for use of an Innovative/Experimental; evaluating and approving the design; installing the system; and ongoing maintenance and monitoring of the system.

E. Sewage dispersal

Septic tank effluent should be dispersed into the ground by means of a sewage dispersal system. The type of system used should be approved by the SCDHEC/BCHD based on review of the location and topography of the site, the soil characteristics and groundwater level at the site, and all other relevant factors. The pipe used for distribution should be perforated, have a minimum 3-inch diameter for gravity and 1-inch for pressure, constructed of approved material.

The effective leaching area should include the total of the area of the bottom area and the sidewall area beneath the leach pipe. Soil suitability for sewage disposal should be determined by a combination of exploratory excavation soil logs, and soil structural and textural characteristics. Laboratory analysis of soil texture may be required by the SCDHEC/BCHD.

The health department may approve the use of a trench for dispersal. Any such trench should be 18 inches to 36 inches in width, contain a perforated sewage conductor pipe, and should be filled with rock or other suitable material approved by SCDHEC/BCHD.

The trench depth required would be dependent upon soil conditions, and the trench length required will depend upon sewage loading.

The distance between the trench bottom to the seasonal high water table should be established based on the soil type(s), loading rate, data from previous installations, level of pretreament, other restrictions, setback requirements and the results of a study of contaminant attenuation (wherever possible). Dispersal trench should be placed in conformance with the following distance requirements as shown in Table L-4.

Table L-4. Distances to dispersal trench

From Dispersal Trench and Expansion Area to:	Minimum Permitted Distance in Feet
Private water source or wells	50 (drilled wells) and 100 (dug wells)
Public water supply source	100
Stream, well, spring, water course	100
Property line or easement boundary	5
Foundation, structure, bearing weight building overhang	5
Basement	10
Driveway or pavement	5
Public water main or onsite water line	10
Other coastal waters	50 feet from the mean high-water mark
Storm water (permanent retention pond)	50 feet from flood pool elevation

Trenches should be placed in natural earth and in an unobstructed area. Rock or other approved filter material in the trench should be covered with untreated building paper, synthetic garden fabric, geotextile, or straw prior to backfilling with earth. Trenches should be placed on the contour perpendicular to groundwater flow patterns spaced (center-to-center) at no less than six feet. Layout shall maximize the spreading of effluent in the dispersal area. No single trench shall be more than one hundred feet in length except where a pressure distribution system is designed.

Where multiple trenches are installed on sloping or level ground, effluent distribution should be made through a distribution box or other approved device such that effluent is effectively delivered to each trench. SCDHEC/BCHD should promulgate guidelines for the approval and installation of certain types of distribution devices such as drop boxes, valve boxes, and other approved proprietary devices.

Curtain drains located down gradient from a dispersal field must be at least twenty-five feet from the drain. If an impermeable layer is present, curtain drains must be located at least fifty feet away. Curtain drains located up gradient from a dispersal field must be installed with the bottom of the drain higher in elevation than the top of the dispersal field, or they must be located at least twenty-five feet away. Curtain drains should not be installed in locations that preclude the use of an area necessary for installing or replacing an OSDS that meets the standards of this code on the same parcel or any adjacent parcel.

F. Non-ground absorption systems

The SCDHEC/BCHD may approve incinerating, composting, vault privies, and mechanical toilets only when all of the sewage will receive adequate treatment and disposal. Sewage recycling systems that discharge treated wastewater and meet the state drinking water standards, may be used only for toilet flushing. The BCHD or the state must specifically approve recycled sewage. Such systems shall not be used for body contact or human consumption.

Chemical or portable toilets for human waste may be used at mass gatherings, construction sites, labor work camps, and other remote sites. Chemical or portable toilets proposed for use at a labor work camp should have an operating permit from the SCDHEC/BCHD upon a showing by the owner or controller that the chemical or portable toilet shall be maintained in a sanitary condition. Chemical or portable toilets should have a watertight waste receptacle constructed of nonabsorbent, acid resistant, non-corrosive material. The chemical or portable toilet waste collected should be discharged into an approved sewage treatment and disposal system. Chemical toilets should not be allowed as the primary or the permanent method of wastewater disposal at any permanent food-handling or residential establishment.

V Permitting

A. Individual onsite sewage disposal system - permits.

A sewage disposal permit approved by SCDHEC/BCHD is required before construction or any repair, addition, or upgrade of any individual OSDS. A sewage disposal permit once issued for a structure shall remain valid unless the building permit for the structure becomes invalid, in which case the permit shall become null and void.

However, this provision should not apply to emergency work necessary due to the immediate failure of the existing system, when it is proved to the satisfaction of the SCDHEC/BCHD that such work is urgently necessary and that it is not practical to obtain a permit before commencement of the work. In all such cases, prior approval should be obtained from the health officer and an application for permit must be submitted within 60 business days after commencement of the work. Minor maintenance may be made without permit.

An application for an improvement permit or construction authorization, as applicable, along with a filing fee should be submitted to SCDHEC/BCHD for each site prior to the construction, location, or relocation of a residence, place of business, or place of public assembly. The application shall contain at least the following information:

- Owner's name, mailing address, and phone number,
- Location of property, plat of property or site plan,
- Description of existing and proposed facilities or structures,
- Number of bedrooms or number of persons served,

- Other factors required to determine wastewater system design flow or wastewater characteristics,
- Property use (primary residence, rental, vacation property etc.),
- Type of water supply, and
- Signature of owner or owner's legal representative.

It is the responsibility of the property owner to ensure that a valid permit is obtained prior to the construction or repair of a system and the construction, location, or relocation of a residence, place of business, or place of public assembly. If the installation is not completed within the period of validity (duration for which the permit is valid), the information submitted in the permit application was found to have been incorrect, falsified or changed, or the site is altered, the permit authorization should become invalid and may be suspended or revoked. When a permit has become invalid, suspended, or revoked, the installation should not be commenced or completed until a new permit or construction authorization has been obtained.

Any person who commences any work for which a permit is required without first having obtained a permit shall, if subsequently permitted to obtain a permit, pay double the permit fee or the appropriate fine to be established by resolution of the Board of Supervisors for such work.

Except as may be otherwise provided in this Chapter, an individual OSDS shall not be permitted in any of the following circumstances:

- Where the property line of the parcel upon which the system is proposed to be constructed is within 250 feet of a public sewer and connection to the sewer thereto is determined to be feasible. Feasible means that sewer service is both (a) available by annexation, and (b) that connection is technically feasible based on engineering and technical factors. A connection ban or moratorium in and of itself shall not make a connection infeasible.
- Where the parcel upon which the system is proposed to be constructed is less than one acre in size.

- Where the system is proposed to be installed on a parcel other than the parcel on which it is located.
- On all parcels of land within the projected horizontal distance of about 200 feet of all reservoirs and impoundments as determined by the spillway elevation.
- Within a reservoir watershed, on individual parcels of land less than 2.5 acres beyond the projected horizontal distance of 200 feet from the high-water elevation of reservoirs and impoundments.

A permit once issued for a structure should remain valid unless the building permit for the structure becomes invalid, in which case the sewage disposal permit shall also become null and void. In the event a sewage disposal permit expires, a new application should be required in all cases prior to the issuance of a new permit.

Upon the expiration of any permit issued, the system may not be used or any further work done in connection with the installation or operation of the OSDS until a new permit for such purpose is secured. All work should comply with the regulations currently applicable to OSDS when the new permit is issued. However, where an individual OSDS was previously fully installed pursuant to a permit that has subsequently expired, the system may be used if the health officer finds that the system will function in a safe manner.

B. Procedure upon receipt of an application for a system

In the event an application is submitted for an area of the county for which the SCDHEC/BCHD has inadequate information about soil conditions, the appropriate health department official should inspect the property. After an inspection of the property, he/she may require soil tests, or other tests/evaluation. Such tests/evaluation should be performed at the expense of the applicant, as specified.

If all the information required by the SCDHEC/BCHD is not submitted within 12 months of the date of application, including information relating to any required tests, the application should be deemed null and void. An exception to this provision may be granted if the required information cannot be submitted because of inadequate rainfall, does not occur during a rainy season, or other valid reasons.

After the health officer determines that an application is complete, that all required information has been submitted, and that the proposed system complies with the requirements of this Chapter, he or she shall grant or conditionally grant a “Finding of Compliance.”

C. Exception allowing easements of individual sewage disposal

SCDHEC/BCHD may permit the use of an easement for repairing an OSDS under the following circumstances when:

- It is determined that a satisfactory repair of existing OSDS cannot be obtained on the property upon which it is located.
- It is determined that the property to be used for sewage disposal can provide satisfactory sewage disposal without creating a health hazard or nuisance condition.
- A recorded easement or easements shall guarantee access for use and maintenance of the individual OSDS and transmission piping for as long as needed by the building served by the system. The easement shall be recorded against the deeds of both properties, and can only be removed with prior approval of the health officer.

D. Other permitting requirements

It should be unlawful for a commercial installer to engage in the business of installing OSDS without first obtaining a commercial installer's permit/license/certificate from the BCHD or the state. A commercial installer's permit/license/certificate should only be issued after the applicant has indicated a basic knowledge of the proper design and function of an OSDS.

An installer's permit/license/certificate may be revoked or suspended, if, after a hearing for incompetency, negligence, or misrepresentation in making application for a permit to construct or install an OSDS, or the bond as hereinafter required has been canceled.

Any person feeling aggrieved because of the revocation or denial of a permit by the health officer may, within 10 days of such denial appeal to the County Board of Commissioners and a hearing will be granted. Determination by the Board of Commissioners should be binding upon the applicant.

Prior to the issuance of a commercial installer's permit, the applicant must either post a bond to the Beaufort County health department in a form approved by the prosecuting attorney and executed by a surety company authorized to do business in the state or by two good sureties not connected in business with the applicant and approved by the prosecuting attorney, or be in possession of a bond obtained in accordance with the laws of the South Carolina. The purpose of the bond is to assure the faithful performance of all work being done under terms of these regulations. Any person who may be damaged by a wrongful act of the permitee's failure to perform work in a workman-like manner may sue upon said bond for damages in a sum not to exceed the amount of the bond.

It should be unlawful for any firm or corporation to engage in the business of cleaning any septic tank, or removing accumulations of other sewage without first having obtained a septic tank pumper's permit/license/certificate from the BCHD. Pumping equipment must be presented to the BCHD for inspection.

- The pump tank must be of at least 1,000 gallons in capacity and must be in good repair and of cleanable construction.
- All hoses and pumping equipment shall be kept in a clean and sanitary condition while stored or in transit.
- All discharge valves shall be in good repair, free from leaks and be fitted with watertight caps.
- The name of the operating firm shall be prominently displayed on the sides of the vehicle.

All premises served and equipment used shall be sanitary. Disposal sites should have the written approval of the BCHD and shall be maintained in a satisfactory manner. It should be unlawful to dispose of septic tank pumpings or other accumulated sewage at other than designated and approved disposal sites.

A septic tank pumper's permit/license/certificate may be revoked or suspended if, after a hearing, he has been found to be in noncompliance with the terms of this ordinance. The right to a hearing is set forth in the code.

VI Operation and maintenance

Beaufort County should include ordinance language to address the issue of operating and maintaining of OSDS to ensure that such systems meet performance requirements and minimize risk to the receiving environment. It is essential to know the varying technologies both installed and permitted for the development of an appropriate ordinance language.

All septic tanks using pressure distribution should be maintained for the life of the systems. A valid maintenance contract for advanced systems with a minimum length of two years should be on file with BCHD and renewed within at least 90 days prior to expiration.

Conventional septic tanks should be pumped out every 3 to 5 years and inspected between 2 to 4 years. Mechanical systems such as activated sludge-based units should be serviced 2 to 4 times per year. This ensures that aeration tank solids concentrations do not increase to the point that they are “belched” out with the effluent and cause infiltrative surface clogging or receiving water quality problems, depending upon the unit’s location in the treatment train. Mechanical systems require frequent inspection to assure proper operation of electro-mechanical components.

Proprietary systems should be operated and maintained as per manufacturer’s recommendations. Other advanced secondary wastewater treatment systems should be required to have the necessary operation and maintenance performed at a much higher frequency.

Core operation and maintenance actions required by the BCHD are listed below.

- System owner operation and maintenance educational materials should be distributed,
- Complaint response protocols should be established and made available,
- System owners should be sent out operation and maintenance reminders,
- System owners should use only state certified/licensed operation and maintenance providers,
- System owners shall enter into maintenance contracts for mechanical systems,
- System owners shall report the status of their mechanical systems,
- Renewable operating permits should be available for system owners based upon the reporting of performance of operation and maintenance tasks,
- Publish a list of suitable operation and maintenance providers based on performance reports,
- Require trained, certified service providers, skilled to handle operation and maintenance tasks for all systems in accordance with established protocols,
- Stipulate specific training and certification programs provided and/or supported by the county through training centers or other means,
- Conduct periodic reviews of the performance of operation and maintenance providers,
- Maintain a list of licensed and certified operation and maintenance providers, which should be periodically updated.

County should stipulate system owner responsibilities to ensure that:

- No sewage or effluent is discharged to the surface of the ground, the surface waters, or directly into groundwater at any time.
- No sewage or effluent is backed up into the facility, building drains, collection system, or freeboard volume of the tanks.
- No systems malfunction.

- No system is operated by someone who does not possess the required licensing and/certification.

VII Training, certification and licensing

Beaufort County should require that all system owners, service providers and system operators obtain training, certification and licensing requirements and opportunities as deemed appropriate. Only registered, trained, certified, licensed service providers and system operators should be allowed to operate within the countywide management system. Construction or major repair of an individual OSDS should be made by a contractor with a contracting license, or an equivalent certificate. A system owner may construct or repair a system on his own property when the system serves, or will serve, the building on the property that is neither being offered for sale nor intended to be so offered for sale.

VIII Public education and involvement

Public education maximizes the understanding and involvement of OSDS users within a countywide onsite management system. Beaufort County should provide system owners, service providers and system operators (OMS) with brochures, resource literature, training materials, operation and maintenance protocols and related materials as needed. The county (OMS) should conduct a periodic review of its literature and materials to ensure the information is accurate and current. The county should sponsor a wide variety of public outreach programs. System owners, service providers and system operators should be involved in regular onsite management system reviews and county advisory boards.

The public should be educated and engaged in building support critical to various elements of the OMS. Outreach and information dissemination should be an integral part of the process. Communities design educational plans for local contractors, homeowners, and regulators. Results, observations, and lessons learned should be distributed at the local, state, and regional level.

IX Inspections and monitoring

Beaufort County should periodically document the status of all systems functioning within the jurisdiction. Inspection protocols should be developed and implemented for all inspection halt points (construction inspection, property transfer inspection) as well as technologies operated, maintained and/or managed by service providers and system operators. Construction inspections prior to covering systems should be conducted. Inspections prior to property title transfer should be conducted. Complaint response inspections should be conducted. A planned program for surface and ground water monitoring should be instituted. Periodic operational inspections should be conducted. A comprehensive monitoring program should be developed and implemented to track the long-term effectiveness of onsite technologies allowed within the county.

A copy of the building plans having the approved OSDS design should be kept available at the job site during system installation and until the system is approved by the BCHD. The health officer should make one or more inspections of each new installation. All work authorized by the permit should be inspected by the health officer to insure compliance with all the requirements of this code. A request to the BCHD for inspection must be made during posted office hours at least 7 business days in advance of the commencement of work. In the event the health officer determines there has been an improper installation, he or she may post a stop work order on the job site. A clearance must be obtained before any further work is done on the site.

If installation or workmanship of the disposal system does not meet the requirements of these regulations, the health department personnel should order corrections and require a subsequent inspection to be made.

X Record keeping and reporting

SCDHEC/BCHD should establish and maintain an inventory of all systems, service providers, service contracts, maintenance activities, inspections conducted, and repairs completed for planning and reporting purposes. System performance reports should be developed and maintained by the county for approved and/or experimental technologies. SCDHEC/BCHD should develop effective ways to collect, compile, and catalog useful data and other relevant information in a central repository.

XI Violations

A. Investigation

Upon reasonable cause to believe that a violation of any provision of this chapter or a threat to the public health may exist, the department shall investigate to determine whether such a violation or threat does, in fact, exist. Inspections should be conducted at reasonable times and the inspector should first make a reasonable effort to contact the owner or occupant of the premises. If the inspection requires entry into a building or an area that is designed for privacy, then prior permission should be obtained from the owner or occupant. If permission is denied, then an inspection warrant may be obtained from the appropriate authority.

B. Recording notices of violations

Whenever the health officer has knowledge of a violation, any condition of a permit issued, or any term of an agreement executed, she/he may provide a notice of intent to record a notice of violation to the owner of the property upon which the violation is located. Notice should be provided by posting on the property and by mail at the address listed on the latest assessment roll or at any other address of the owner.

The notice should state that within 30 days of the date of the notice, the owner might request a meeting with the health officer to present evidence that a violation does not exist. In the event that a meeting is not requested and the violation has not been corrected, or, in the event that after considering the evidence the health officer determines that a code violation in fact exists, the health officer may record a notice of code violation in the office of the County Recorder.

At the request of any affected property owner, BCHD should issue a notice of expungement of code violation upon correction of any violation noticed hereunder. The affected property owner at his or her expense may record the notice of expungement. The decision of the health officer shall be final.

C. Violation and Penalty

In the event of a violation of the conditions of any permit issued under this chapter, the property owner/permitee should be given notice of such violation and granted a reasonable time for its correction. If the violation has not been corrected or if the violation or any action constitutes a threat to human life or safety or welfare, then the health officer should notify the property owner/permittee to immediately suspend use of the OSDS, as well as those uses of the property which are likely to result in generating wastewater.

Whenever the health department personnel visits a property to ensure compliance with a permit condition, or a Notice to Correct Violation, and the condition or requirement is not satisfied or the violation has not been corrected, the property owner should be subject to a violation re-inspection fee, the amount to be established by resolution of the appropriate board.

Any person who violates any provision of this chapter should, upon conviction, be guilty of a misdemeanor and subject to a fine of not more than $ 1,000 or by imprisonment for not more than 60 days, or both such fine and imprisonment.

D. Revocation or suspension

A permit issued may be revoked or suspended by the health officer if a violation exists or if the permit was obtained by fraud or misrepresentation. A Stop-Work-Order pending resolution of any proceeding to suspend or revoke a permit. A preliminary meeting may be held with the health department for the permittee to present evidence opposing the proposed suspension or revocation. The health officer should give notice in writing of the suspension or revocation of a permit.

E. Appeal from denial, revocation or suspension

Appealing a decision made by the BCHD may be done by filing a written request with the County Board of Commissioners. A person whose application for an individual sewage disposal permit has been denied, or whose permit once issued has been revoked or suspended, may within 15 days following the date on which the action was taken, file an appeal in writing with the Appeals Commission.

The Board of Commissioners should hear appeals upon receipt of appeal. Upon receiving an appeal, the Appeals Commission should schedule the appeal for hearing at the earliest time possible thereafter that all members of the commission can meet, and normally within 15-30 business days after the date that the appeal is filed.

The appeal should be made in writing and should demonstrate that all of the following circumstances apply to that:

- The property clearly meets all standards and regulations.
- The use of an OSDS on the property does not pose any danger to the public health and safety.
- The approval of the appeal will not result in the granting of a special privilege.

Upon receipt of the written appeal, the health department should cause a full report on the appeal to be made to appeals commission. The report should include the following:

- A statement of jurisdiction, showing the appeal was timely and properly filed.
- A copy of all relevant materials in the file of the BCHD relating to the appeal, including a copy of the permit application, and of any permit issued, and of any orders issued.
- An analysis of the appeal, providing the health department's recommendation with respect to the appeal, and specifically providing an analysis with respect to all of the circumstances.
- A copy of all code provisions relevant to the appeal, including those code provisions relating to the authority and jurisdiction of the Appeals Commission.

The report required should be presented to the members of the Appeals Commission as soon as possible after the appeal is filed, and no later than 5 days prior to the hearing date set, and a copy of the report shall be furnished to the appellant at the same time. After hearing the appeal, the Appeals Commission may affirm, overrule, or modify the action of the health officer. The Commission should not overrule or modify the action of the health officer unless it makes a finding supported by substantial evidence. The action of the Appeals Commission on any matter appealed to the Commission should be final.