SECTION I INTRODUCTION

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GUIDANCE FOR DESIGN OF LARGE-SCALE
ON-SITE WASTEWATER RENOVATION SYSTEMS

SECTION I INTRODUCTION

A. General

The intent in issuing this new document remains the same as when "Seepage and Pollutant Renovation Analysis for Land Treatment, Sewage Disposal Systems" (Healy and May-1982) was published; that is, to emphasize the use of basic scientific and engineering principles and sound engineering judgement in designing on-site wastewater renovation systems (OWRS). That is not to say that the Department does not require design standards. There is a need to establish certain minimum standards in order to protect the public health and the environment. Such standards are presented in a separate document issued by the Department entitled "Standards for Design of Large-Scale On-Site Wastewater Renovation Systems" (hereinafter the "Design Standards") and are based on reasoned evaluation of findings obtained from a review of relevant literature and the performance data obtained from monitoring operations of existing on-site wastewater treatment systems that had been designed based on the Healy and May-1982 publication.

The reader will note that the words "wastewater (sewage) disposal" are not a part of the vocabulary used in this document. To quote David Venhuizen, an engineer specializing in the design and management of on-site systems[1] and fervent advocate of decentralized wastewater management systems: "There is no such thing as disposal of [waste] water - it doesn't go away and it doesn't stay where we put it. We are merely sending it on its journey through the hydrologic cycle."

Domestic wastewater contains pollutants, including certain microorganisms and chemicals, which can be harmful to humans and/or the environment. The microbial pollutants include pathogenic bacteria, protozoa and viruses. Nitrogen, Phosphorus and synthetic organic chemicals are the chemical constituents of domestic wastewater that are of major concern with respect to contamination of ground water. Heavy metals may also be present in the wastewater, but in very low concentrations that are usually removed by electrochemical binding to soil particles. Additional discussion of the pollutants in domestic wastewater is given in following sections of this document.

An on-site wastewater renovation system (OWRS) consists of wastewater pretreatment facilities followed by a subsurface wastewater absorption system (SWAS). While domestic wastewater receives some pretreatment, either in a septic tank or other pretreatment facilities, the effluent from these facilities still contains pollutants that can adversely affect human health or the environment.

[1] Venhuizen, D. 2002. Decentralized Digest 366, 5/11/02. [A national list server for discussion of onsite/decentralized wastewater treatment system management issues.]

When the pretreated wastewater is discharged to the subsurface via a properly designed SWAS it is further renovated as it travels through the subsurface soils and eventually reaches and commingles with the ground water. The ground water in turn is eventually extracted via wells for various water supply purposes, including drinking water, or discharges to surface waters that are used for many purposes.

Therefore, the chief objective for design, construction, operation and maintenance of a SWAS and the associated pretreatment facilities must be to renovate the wastewater so as to protect the public health and the environment. Most soils have substantial but finite capacities to accomplish the renovation of pretreated domestic wastewater by providing an environment that causes the death or inactivation of pathogens and removal or attenuation of chemical pollutants. It is axiomatic that the pretreated wastewater must remain in the soil for a suitable time to permit such renovation to take place. A corollary objective is to ensure that the wastewater makes intimate contact with the soil particles under suitable environmental conditions so as to effect such renovation. This requires that the soils in which a SWAS are installed have ample hydraulic and renovative capacities and that there are adequate vertical and horizontal separating distances between the SWAS and any point of concern to provide the necessary time and adequate soil contact for the renovation to take place.

While this document is directed toward design, construction, operation and maintenance of large-scale OWRS having design flows greater than 5,000 gpd, including associated wastewater collection systems, the underlying principles involved apply to all on-site systems, regardless of size. The size of a system is a function of the daily rate of wastewater discharge and its bio-chemical characteristics, and the physical characteristics of the site, including: area, shape, topography, depth to the controlling ground water table and soil characteristics. The two basic criteria for judging the adequacy of an OWRS are: "Will the discharge cause pollution?" and "Will the system work?"

The basic concerns that must be addressed to judge the adequacy of an OWRS are:

- Does the proposed site of a subsurface wastewater absorption system (SWAS) have sufficient land area to accept the size of the system necessary to meet the requirements of the Department?
- Does the soil-ground water regime in which the SWAS is proposed to be located have sufficient renovative capacity to bring the pretreated wastewater into compliance with the required ground water quality standards of the Department before it reaches a point of concern, such as: a potable water supply well, wetland, surface water body or the applicant's property boundary?
- Does the soil-ground water regime in which the SWAS is proposed to be located have sufficient hydraulic capacity to accept and transport the pretreated wastewater for an adequate distance without surfacing or breakout?
- Is or will there be a responsible entity, with adequate and continual authority and assured financial means, to properly construct, operate and maintain the OWRS to the satisfaction of the Department?

To address these concerns, many factors must be thoroughly and methodically evaluated, using the best engineering practice in applying fundamental scientific and engineering principles, and the best information currently available or reasonably obtainable.

The basic purpose of this document is to present information and methodologies that can be used in evaluating these factors and addressing these concerns.

B. Units Of Measure

The U.S. ("English") system of measurement units is utilized in this document, with few exceptions (e.g. mg/L, meters). For those persons who need, or prefer, to work in metric units, a table of U.S. to Metric conversion factors is provided in Appendix D.

C. Terminology

As previously stated, this document stresses the renovation of domestic wastewater. However, at the time this document was written, the governing State Statutes and the Department's Water Quality Standards, Water Discharge Regulations, Rules of Practice and Environmental Permit Application Package all refer to "Sewage", "Domestic Sewage", "Sewage Disposal", "Subsurface Sewage Disposal System", "Leaching System" and like terms. In this document, the following words and terms are equivalent:

This Document	Existing Terminology
Wastewater	Sewage
Domestic Wastewater	Domestic Sewage
Wastewater Renovation	Sewage Disposal
Subsurface Wastewater Absorption System (SWAS)	Subsurface Sewage Disposal System, or Leaching System
On-site Wastewater Renovation System (OWRS)	Land Treatment System, Subsurface Sewage Disposal System

D. Disclaimer

Throughout this document, proprietary commercial products and processes have been mentioned by trade name in order to illustrate a point or to provide a general indication as to what products or processes may be available for use in on-site wastewater renovation facilities. Mention of trade names, proprietary commercial products and processes does not constitute endorsement or recommendation for use by the Department.

E. Departments' Jurisdiction over OWRS

The Department has jurisdiction over the design, construction and operation of: OWRS facilities having a design capacity in excess of 5,000 gallons per day that discharge to any one property, regardless of the number of systems; systems including advanced pretreatment regardless of capacity; and Community Sewerage Systems (those serving more than one residential structure). Under t 22a-430 of the Connecticut General Statutes (CGS), the Department is responsible for issuing State Discharge Permits for operation and monitoring of such systems.

F. Recommended Procedure for Applicant to Follow

Step 1. Applicant and Applicant's Engineer meets with Department staff to discuss the proposed project, obtain Department staff input on the information that will need to be developed to accompany a Discharge Permit Application and schedule site testing. (It should be noted that at this initial meeting, the Department staff, and in many cases the Applicant's Engineer also, are not fully aware of the limitations of a proposed site for an OWRS. Therefore, the information initially requested by the Department may have to be supplemented with additional information after the initial site characterization has been completed.)

Step 2. Applicant submits Discharge Permit Application, conceptual design and supporting documentation to the Department for review. Applicant also issues a public notice of the permit application in a newspaper having circulation in the project area and provides a copy of the notice to the Chief Elected Official of the community in which the project is located, as required by t 22a-6g of the CGS.

Step 3. Review of submitted documentation by the Department's Bureau of Water Management. Upon review of this documentation, the Department staff may request additional information.

Step 4. When the Department is satisfied with the conceptual design of the OWRS, the Department issues a public notice in a newspaper having circulation in the project area stating that on the basis of preliminary review of the permit application and supporting documentation, the Department has made the tentative determination that the proposed OWRS will protect the waters of the State from pollution, and the Department's Commissioner proposes to require the Applicant to submit plans and specifications for the proposed system and such additional information as the Commissioner deems necessary to ensure the protection of the waters of the state from pollution.

The notice also states that if the Commissioner approves such plans and specifications, and the proposed system is constructed in full compliance with the approved plans and specifications, the Commissioner proposes to issue a permit for the discharge. Prior to making a final decision to approve or deny any application, the Commissioner must consider comments from interested persons that are received within 30 days of the Public Notice date. If the Commissioner decides that the public interest will best be served thereby, or upon receipt of a petition signed by at least 25 persons, or intervention by an interested party under the Connecticut Environmental Policy Act, a Public Hearing will be held on the application. Notice of any public hearing must be published at least 30 days prior to the hearing in a newspaper having circulation in the project area.

Step 5a. If the Public Notice period expires without receipt by the Department of adverse comments, request for a public hearing or intervention by an interested party, and the Commissioner does not deem a public hearing to be necessary, the Commissioner makes a final determination and the Department advises the Applicant to submit final construction contract documents for the OWRS.

Step 5b. If a Public Hearing is held, a Department Hearing Officer will prepare findings and recommendations for the Commissioner regarding approval or denial of the application.

Step 5c. If a Public Hearing is held and the Hearing Officer's recommendation is affirmative and the Commissioner accepts the recommendation of the Hearing Officer, the Commissioner makes a final determination and the Department advises the Applicant to submit final construction contract documents for the OWRS. This action may be appealed by anyone that is a party to the public hearing proceedings.

Step 6. Final construction contract documents are submitted to the Department Bureau of Water Management for review and approval.

Step 7. When the Department is satisfied with the construction contract documents, it issues an approval to the applicant to proceed with construction of the OWRS in full compliance with the approved final construction contract documents. The Department approval will require that the applicant retain a licensed professional engineer to provide construction services to verify that construction of the OWRS is done in conformance with the approved construction contract documents. Pre-construction meetings with Department staff may be required on certain projects.

Step 8. Upon completion of construction, if the Department finds that the construction is in compliance with the approved construction contract documents, and upon receipt of record drawings with supporting information and the design engineer's verification that the construction is in conformance with approved contract documents, the Department issues a State Discharge Permit to initiate a discharge.

The Department may include certain conditions as part of the permit approval process. Examples of types of conditions include:

a. Preparation of an operation and maintenance manual for the proposed OWRS.

b. Operation of the completed facilities under the direction of a State licensed wastewater treatment plant operator for facilities involving advanced pretreatment of the wastewater.

G. Summary of Basic Design Requirements

The applicant must demonstrate that sufficient land area with suitable soil conditions is available to install an OWRS conforming to the following criteria:

1. The OWRS facilities must be sized on the basis of approved conservative wastewater design flows and wastewater characteristics.

2. The soils in which the proposed subsurface wastewater absorption system (SWAS) will be installed must have sufficient hydraulic capacity, including an appropriate hydraulic reserve capacity as established in the Design Standards, to transmit the pretreated wastewater for a sufficient distance to permit renovation of the wastewater to drinking water quality before it reaches the closest point of concern.

3. To provide for attenuation of organic and inorganic pollutants and pathogens remaining in the pretreated wastewater, the soils in which the proposed SWAS will be installed must have sufficient hydraulic capacity to provide a minimum depth of unsaturated soil beneath the bottom of the SWAS leaching facilities, during mounded seasonal high ground water periods, as established in the Design Standards.

4. Any remaining pathogens that were not removed (by filtration, die-off, or inactivation) in the unsaturated zone below the SWAS must be removed by natural means in the saturated soils down gradient of the SWAS before the commingled effluent/groundwater reaches a point of concern. The required time of travel of the wastewater from the point of disposal to the closest point of concern must conform to the requirements in the Design Standards.

5. Application rates of pretreated wastewater should not exceed the soil capacity for pathogen attenuation.

6. The concentration of total nitrogen in the pretreated and renovated wastewater at the closest point of concern should not exceed the appropriate water quality values established in the Design Standards.

7. The phosphorus in the pretreated wastewater should be removed by the soil before the renovated wastewater reaches the closest point of concern, with no discharge of phosphorus of other than natural origin permitted to any surface water body.

Further information on relevant regulatory requirements and Design Standards for discharge of wastewater to the ground waters of the State can be found in the following publications, which may be obtained from the Connecticut Department of Environmental Protection:

1. Water Quality Standards and Criteria
2. Water Discharge Regulations §b22a-430 of CGS
3. Rules of Practice – § 22a-3a-2 through 6 of the Regulations of Connecticut State Agencies (RCSA)
4. Permit Application for Wastewater Discharges (DEP-PERD-APP-100 and all supporting Documents)
5. “Standards for Design of Large-Scale On-Site Wastewater Renovation Systems” (hereinafter the “Design Standards”)

Most of these documents may also be obtained via the Internet. The Department's web address site is: http://dep.state.ct.us. Care should be taken to assure that documents obtained are the most current ones available.

Applicants and their consultants are urged to obtain a copy of each of these documents and review them prior to initiating a permit application for a discharge of wastewater to the ground waters of the State. (In the case of OWRS, the permit discharge category is: Land Treatment Non-point Source Systems.)

Likewise, applicants and their consultants are urged to attend a preliminary meeting with a staff member of the Department's Land Disposal Section prior to beginning any extensive field work on a proposed OWRS, in order to avoid unnecessary expense and loss of time. However, a desktop review of available information, including anticipated wastewater flows and characteristics, topography, adjacent points of concern, soil, surficial geology and bedrock geology data, and preliminary field test pit investigations should be made to determine if there are any obvious impediments to the use of the proposed site for on-site wastewater renovation.

H. Role of The Principals

The proper siting, design, construction, operation and maintenance of an OWRS are all crucial to the satisfactory performance of these systems, and thus, adequate protection of potable water supplies, ground water, surface water and the public health. Several distinct parties are involved in the development and use of an OWRS. These include: I) Owner/Developer, II) Designer, III) Regulator, IV) System installer and V) Owner/operator.

1. Owner/Developer

This can be the present landowner, potential buyer or the builder. Typical responsibilities of the owner consist of:

a. Responsible party for the project
b. Hires the designer(s) and installer
c. Obtains permit and is responsible for compliance with it
d. Transfers information to subsequent owner

2. Professional Consultant(s)

The design of on-site systems is an interdisciplinary project that may be performed by one or more individuals with specialized skills in several phases of on-site system design. Each consultant should be an individual with appropriate training and licensure or certification in Civil/Sanitary Engineering, Soil Science, Public Health, Hydrogeology or Environmental Science and have experience designing on-site systems. Typical responsibilities of the Consultant(s) include, but are not limited to, the following:

a. Site Evaluation

    1. Assessment of the Site's Suitability

        - Soils
        - Groundwater
        - Bedrock

- Topography
- Hydrogeology
- Isolation from water supplies and other features

2. Site Plan

    - Measurement of Essential Features
    - Topography
    - Soil Logs
    - Groundwater Contours
    - Wetlands
    - Locations of groundwater reaching grade
    - Water Supply Location
    - Detailed and Scaled Map/Plan
    - Subsurface wastewater absorption system (SWAS) location and orientation

3. Site Report

    - Site Hydraulic and Renovative Capacity
    - Reasons for SWAS Location and Orientation
    - Site Limitations

b. System Design

1. Basis of Design

    - Wastewater Source
    - Wastewater Flows and Characteristics
    - Design Loads
    - Hydraulic Loading Cycles
    - Design Parameters for any Enhanced Pretreatment Facilities
    - System Operation Concept
    - Overall Site Development Plan

2. SWAS Design

    - Loading Rates (Hydraulic, Organic, Nitrogen, Phosphorus)
    - Type of Distribution System
    - SWAS Sizing

3. Site Layout

    - Site Modification
    - System Component Placement

4. Final Plan

    - Site Plan
    - Specifications
    - All materials, including earthen storage locations
    - Component Plan and Hydraulic Profiles
    - SWAS Plan and Profiles
    - Details
    - Construction Instructions
    - Restrictions on type and use of equipment
    - General sequence of construction

5. Operating Plan

c. Construction Oversight

1. Site Layout

    - Bench Marks
    - Stake Out System

2. Pre-construction Conference with Owner, Installer & Regulator
    - Explanation of plans, specifications & construction sequence

3. Construction Administration

    - Site Visits
    - Inspection
    - Component Testing

4. Record Drawings

    - Prepare record drawings including location & depths of components
    - Delivery to owner & regulator

d. Operation and Maintenance Instructions

1. Provision to Owner

3. Regulator/Reviewer

This is the governmental official responsible for regulatory compliance. This individual should be employed by the state, have appropriate training in Civil/Sanitary Engineering, Soil Science, Public Health, Hydrogeology, or Environmental Science and have experience with on-site systems. The regulator/reviewer's responsibilities may include:

a. Witnessing a representative portion of the site testing to:

1. Confirm site conditions
2. Review Designer(s) findings
3. Determine if any additional information is necessary for a thorough evaluation

b. Application Review

1. Assures application is complete
2. Assures all other regulatory requirements are being addressed

c. Technical Design Review

1. Checks plans for regulatory compliance and good design practices
2. Assures that design considers all site and design factors
3. Confirms review and issues in writing

d. Approval/Permit Issuance

1. Produces formal approval document
2. Writes necessary construction, operation, maintenance and reporting conditions
3. Assures all parties advised of decisions

e. Installation Inspection

1. Conducts inspection during construction
2. Inspection prior to backfill
3. Reviews all change orders
4. Reviews designer's construction certification report
5. Review and filing of record drawings

f. Operation & Maintenance Monitoring - May not be the same entity as approving authority

1. Review of approval/permit conditions
2. Review of operation and monitoring submittals
3. Provides owner with maintenance and operation information
4. Maintains all files including record drawing, maintenance and repair records for at least 20 years
5. System re-inspections

g. Enforcement - The regulatory community also maintains an enforcement program

4. System Installer

This is the individual or firm that builds the system. The installer must be state certified as required by the Public Health Code, have received training, and be knowledgeable in the installation of on-site systems. The installer's responsibilities typically include:

a. Pre-construction

1. Site Inspection
2. Plan Review
3. Construction conference with Owner & Designer
4. System Stake Out - confirm with designer

b. Construction

1. Build the system as designed
2. Clear all field adjustments (change orders) with owner, designer & regulator and seek approval
3. Follow the construction plan
4. Utilize good construction procedures
   - Avoid construction of SWAS during high soil moisture
   - Use correct equipment
   - Use specified materials

c. Final Inspection

1. Notation of Change Orders
2. Location of Components
3. Coordinate with Designer to insure the record drawings are correct
4. Coordinate final inspection with Regulator

d. Turnover to Owner

1. System demonstration and component locations
2. Provide Record Drawings to Owner

5. System Owner (Operation and Maintenance)

This is the individual who will actually own and maintain the system. The Owner's responsibilities include:

a. Obtain Record Drawings and Permit Documents and Requirements of local Water Pollution Control Authority

1. From seller
2. Contact designer/regulator for missing information
3. Contact installer for any special construction information

b. Locate system components and benchmark

c. Set-up maintenance schedule

d. Contact regulatory bodies for compliance information and maintenance/operation information

e. Assure permit condition compliance

f. Routine Maintenance - determined by permit requirements and may include:

1. Regular inspection of all permitted facilities
2. Septic tank pumping on regular schedule based on loading and inspection
3. Regular walkover for obvious problems
4. Record inspection/maintenance/repair

g. When facilities served are sold, transfer of permit and all records to Buyer (new owner)

I. Keeping Informed on Continuing and New Research

In keeping with the intent of issuing this document, as discussed on page 1 of this section, it is crucial for persons involved with design and review of OWRS to keep up-to-date and informed on the continuing and new research that is being and will be conducted in this field. This document is by no means an exhaustive compendium of all the knowledge required for design of a fully satisfactory OWRS; rather it is a "living document" that will have to be periodically brought up to date as new information becomes available.

J. References

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