Subsurface Sewage Treatment and Disposal Systems

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Regulatory Jurisdiction

- Connecticut General Statutes Section 22a-430
- CGS Section 22a-430(f), establishes and define the categories of discharges.
- Federal Safe Drinking Water Act:

  These systems are also regulated as Class V injection wells under the Underground Injection Control (UIC) program.

- Section 22a-430-1 of the Regulations of Connecticut State Agencies includes delegation of authority for discharges of 7,500 gallons per day or less through subsurface sewage disposal systems to the CT DPH.

- A subsurface sewage disposal system is defined as a system consisting of a house sewer, a septic tank followed by a leaching system, any necessary pumps or siphons, and any groundwater control system on which the operation of the leaching system is dependent.

CT DEEP regulates:

- Discharges greater than 7,500 gallons per day to any one lot through one or more household or commercial subsurface sewage disposal systems.
- Discharges through a “community sewerage system”
- Discharges using “alternative sewage treatment systems”.

Community Sewerage System

A “community sewerage system” is defined as “any sewerage system serving two or more residences in separate structures which is not connected to a municipal sewerage system or which is connected to a municipal sewerage system as a distinct and separately managed district or segment of such system”

(C.G.S. § 7-245 (3))

Alternative Sewage Treatment System

"Alternative sewage treatment system" is defined as "a system serving one or more buildings on one property which utilizes a method of treatment other than a subsurface sewage disposal system and which involves a discharge to the waters of the state". (C.G.S. § 7-245(2))

Permits

Any person initiating or maintaining a discharge must apply for a permit.

Individual Permit

- All existing and proposed discharges employing alternative treatment
- System must be designed based on the DEEP criteria
- Application fee: $4,975
- Public Notice
- 30-day comment period
- Request for a hearing
- Approval of construction plans and specs.
- As-built information
- Permit issuance (10 years)
- Annual Fee of $1,110

Permits

General Permit

- This General Permit authorizes discharges of Domestic Sewage through one or more Systems at an Existing Site or New Site to groundwater or to a holding tank (under specific circumstances).
- The use of an Alternative Sewage Treatment System or any other discharge of water, substance or material into the waters of the state **is not authorized** by this General Permit.
- The use of Large Capacity Cesspools **is prohibited** in accordance with Title 40 of the Code of Federal Regulations (CFR) Sections 144.85 and 144.88.
- Permittee must submit a registration for each proposal
- Fast process
- Site wide nitrogen analysis.
- Wastewater management plan

General Permit

TYPE OF REGISTRATION	PROPOSED ACTIVITY	SUBMIT TECHNICAL PLAN [Section 4(c)(3)(A)]	SUBMIT WASTEWATER MANAGEMENT PLAN (WMP) [Section 4(c)(3)(B)]	FEE [Section 4(c)(1)]
Registration of an Existing Site with Community Systems ≤ 7,500gpd from all Systems	All	Required with Registration that includes a System Modification or Proposed System	Required within 2 years of Approval of Initial Registration if no System Modification or Proposed System	$250
Registration of a previously authorized Site pursuant to Section 3(b)(1)(C)	No System Modification or Proposed System	Not Required	Required within 1 year of Approval of Initial Registration for System Modification or Proposed System with no Design Flow increase	
Modification of a Registration for any Site	System Modification or Proposed System	Required with Registration that includes a System Modification	Required with Registration for System Modification or Proposed System with Design Flow increase	
Registration of an existing Site > 7,500 gpd from all Systems	No System Modification or Proposed System	Required with Registration	Required within 1 year of Approval of Initial Registration for System Modification or Proposed System with no Design Flow increase	$3,000
Registration of a New Site	No System Modification or Proposed System	Not Required	Required with Registration	
Registration of a New Site	System Modification or Proposed System	Required with Registration	Required with Registration	$6,000

DEEP Administrative Process

Pre-Application-- Preliminary Discussion

- Type of project
  - Residential, Municipal, Commercial, Mixed Use
  - Size (# bedrooms, occupancy, square footage)
- Design flow
- Site resources (wells, wetlands, watercourses)
- Proposal for Site Testing (soils & GW)
- Method of Wastewater Treatment & Disposal

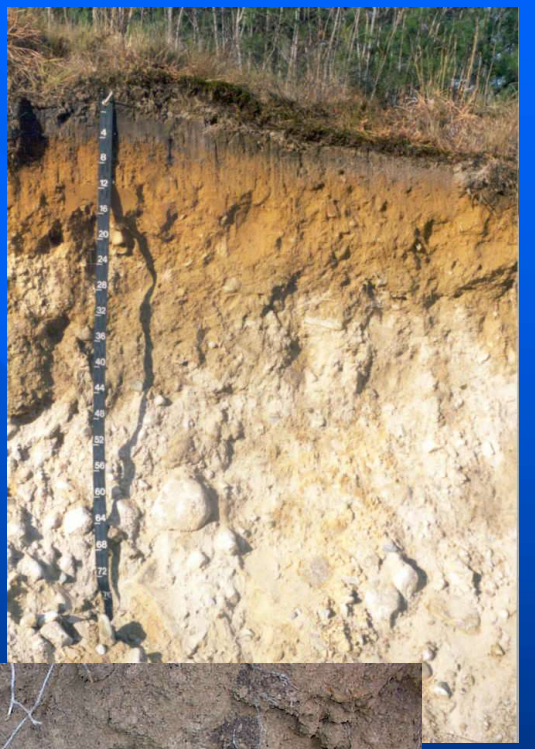
Site Evaluation

This can be achieved through

- Test pits
- Borings
- Hydraulic conductivity sampling
- Ground water monitoring
- Slug tests
- General observations of the site, hydro-geological setting: how does the water moves on site?

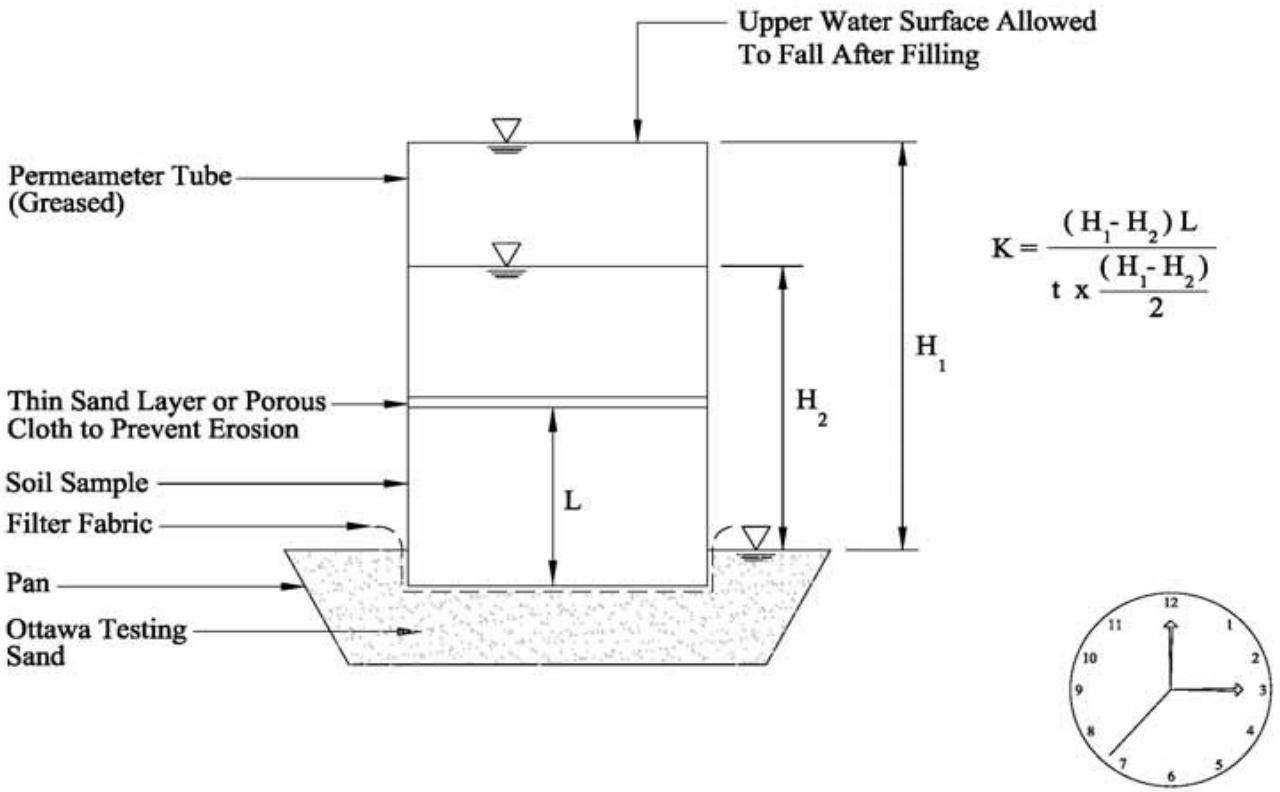
We ask the engineer to let the local health department know that we are investigating the site. The local sanitarian is welcome to participate and get information on the project.

Test Pits



Tube and Core Samples

Permeability Test



Hydraulic Conductivity Test vs. Percolation Test
The two tests are not interchangeable.

Permeability tests

- Defined boundaries
- Saturated conditions
- Known dimensions
- Known hydraulic conditions

Percolation tests

- Run with unknown boundary conditions
- Affected by soil moisture and capillarity
- By trial and error and left to interpretation

Conceptual Design

- Development of a conceptual design report
- Conceptual design must address two basic issues:
  - Will the system function hydraulically?
  - Will the system protect the waters of the state from pollution?
- Submittal of conceptual design report
- Review, comment and revise

Note: *At this point the local health department should also be informed of the proposal*

Application Process

- Consultant submits application with revised conceptual design, application fee ($4,975), and public notice of application.
- DEEP public notices its Tentative Determination to issue a permit which begins a 30-day public comment period.
- Public hearing held if requested, if not Commissioner makes final determination, addresses any comments and authorizes review and approval of construction plans and specifications.

Approval Process

- Consultant for applicant submits construction plans and specifications.
- Review, comment, revise.
- DEEP issues Approval to construct system with associated conditions including:
  - » ***Notification of DEEP & Local Health Department***
  - » Construction of system by licensed installer
  - » Construction oversight by design engineer
  - » Submittal of contract with licensed operator (if alternative treatment is proposed)
  - » Submittal of As-built drawings upon completion

Permit Issuance

- Upon receipt of As-built drawings and documentation that the system has been installed in accordance with the approved plans and specifications, a permit to discharge is issued.
- The permit is issued for ten years with an annual fee of $1,110.
- The permit contains: specific terms and conditions, effluent limits, monitoring, maintenance and operation requirements and a reporting schedule (monthly, quarterly, semiannually)
- The permittee is required to submit discharge monitoring reports to the DEEP and ***the local health department*** (and WPCA for community systems).

General Permit

- Preliminary process – like Individual Permit
- Site testing and conceptual design are developed before filing the registration
- Approval of construction plans and specifications and approval of the WMP with terms and conditions
- As-built information

Basic Design Principles

DEEP Criteria for Site and System Evaluation

Design Information

- Determine design flow
- Hydraulic conductivity (site testing)
- Ground water gradient (site investigation)
- Soil porosity (from literature)
- Nitrogen concentration
- Phosphorus concentration
- Phosphorus sorption capacity of the soil (from literature)

Hydraulic Analysis

Site and System Hydraulics

- System Hydraulics – The quantity of effluent that can be applied to a mature biological mat. Variables include wastewater strength, soil permeability, leaching structure configuration, and means of effluent application(ie gravity vs pressure).

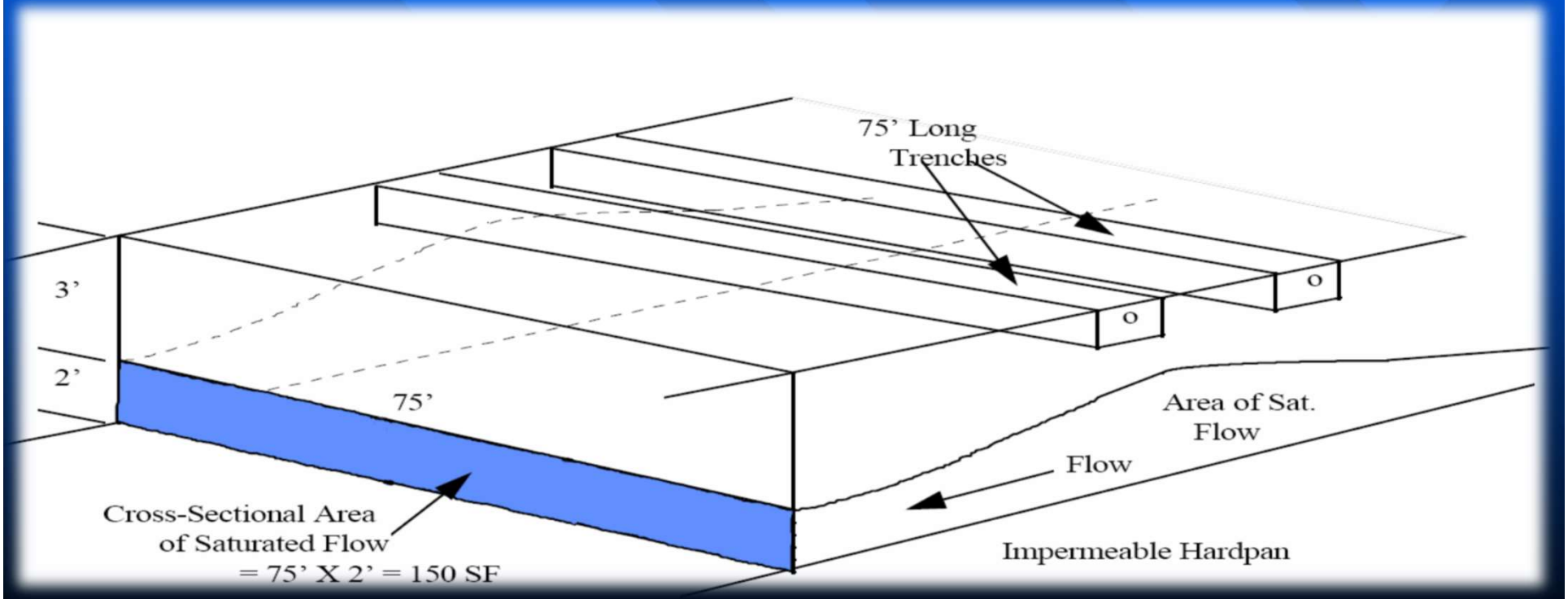
- Site Hydraulics – The ability of the site to transmit the design flow during seasonal high groundwater conditions for sufficient distances to achieve pollutant renovation and meet established treatment goals and objectives. Variables include soil permeability, groundwater depth and gradient, and site constraints such as bedrock and surface water bodies.

System Hydraulics

- What size system is needed for the design flow?
- Calculate LTAR [rate of flow through biomat]
- Calculate effective area = Design flow/LTAR
- Calculate effective leaching area for the leaching structure
- The DEEP is requiring a hydraulic reserve incorporated into the system.

Site Hydraulics

- How high will groundwater mound?



Hydraulic Analysis

The hydraulic analysis is performed by:

- Two dimensional analysis: Darcy's Law
- Three dimensional analysis
- Pump tests
- Hydraulic load test
- Numeric or computer modeling

Wastewater Renovation

Wastewater Renovation

Pollutants are removed through:

- Physical processes such as filtration
- Biodegradation processes (transforming the pollutants in harmless or less harmful substances);
- Sorption (adsorption, absorption, chemisorption and chemical precipitation);
- Biological processes (result in the death or decay of pathogenic microorganisms).

Wastewater Renovation

BOD and TSS removal is achieved through filtration, settling and biological processes through the system.

Wastewater Renovation

Bacteria and Viruses

- The biomat formation and the soil column are capable of reduce pathogens by greater than 3 log or 99.9%.
- Unsaturated flow conditions must be maintained under the leaching field (3 feet of vertical separating distance between the bottom of the leaching structure and the mounded seasonal high water table).
- Additional removal/inactivation is achieved through horizontal or vertical travel time.
  - 21 days time of travel through the soils to the point of environmental concern (wetland, body of water or a property line) should be provided as determined by calculating the groundwater velocity through the soils.
  - v=d/t
  - v= k * i/ n
  - For sensitive receptors such as a drinking water well that distance shall be increased to 56 days.

Wastewater Renovation

Nitrogen:

- Up to 40% nitrogen is removed in the septic tank and leaching field.
- The unsaturated soils underneath the leaching field can nitrify the ammonia and through dilution by rainfall, the nitrogen concentration can be reduced to meet the drinking water standards to the point of environmental concern.
- Advanced treatment: nitrification and denitrification

Wastewater Renovation

Phosphorus

The phosphorus is removed in the unsaturated zone beneath the leach field by sorption processes.

- The soil must have the capacity to treat phosphorus as evidenced by a six (6) months absorption capacity and demonstrated by a phosphorus sorption analysis.
- If necessary biological phosphorus removal is proposed.

Use of Alternative Treatment Technologies

- The DEEP allows the use of Alternative Treatment Technologies for nutrient reduction where an applicant can show that the treated effluent can be applied via pressure distribution to a system which can function hydraulically and provide additional treatment for bacteria, virus and phosphorus.

Alternative Treatment Technology Use Examples

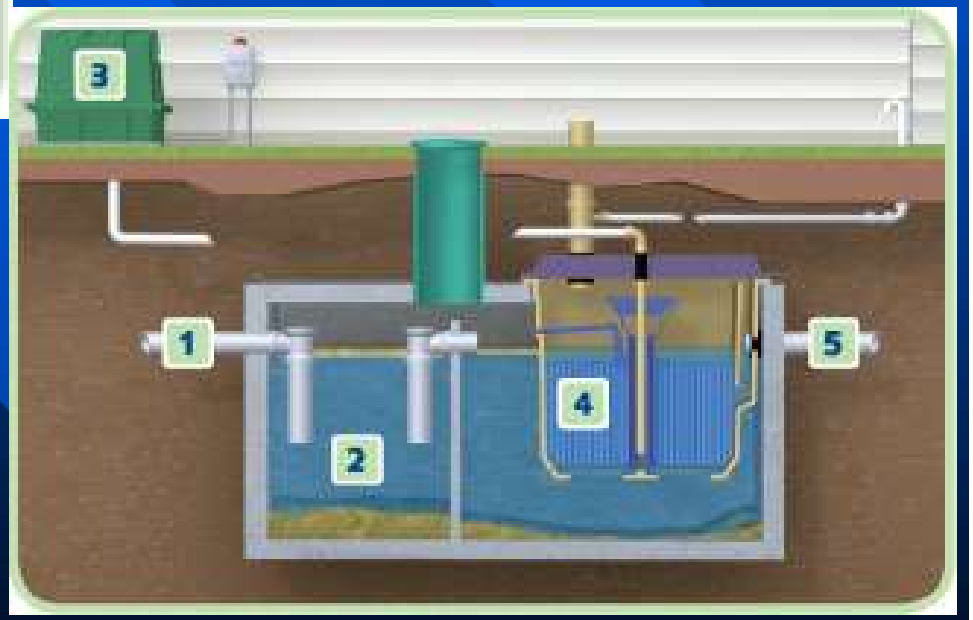
- High strength wastewater generators such as restaurants, grocery stores and schools
- Existing systems with limited area available for nitrogen dilution by storm water
- Sites with high hydraulic capacities but limited area available for nitrogen dilution
- Limited hydraulic capacities and limited area for nitrogen dilution

Types of Alternative Treatment Technologies

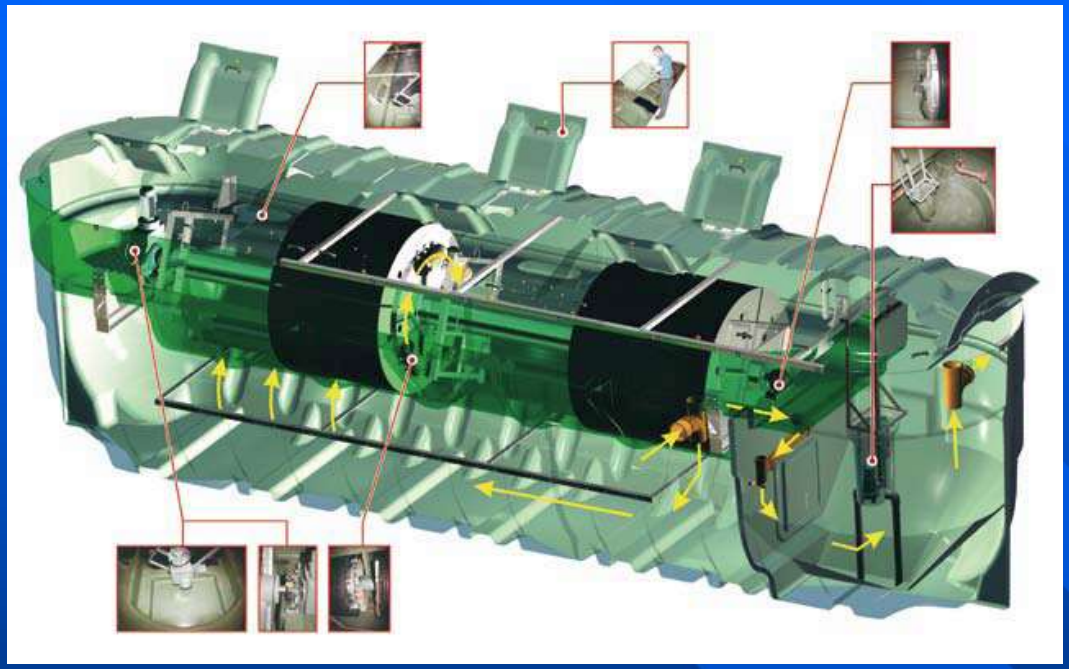
- Trickling Filters (BioClere)
- Fixed film and suspended growth activated sludge (FAST, traditional activated sludge plants, Amphidrome)
- Rotating Biological Contactors
- Recirculating sand filters
- Membrane Filtration (Zenon and Kubota Filters)
- Lateral Sand Filters
- Sequencing Batch Reactors (SBR and Fluydine)

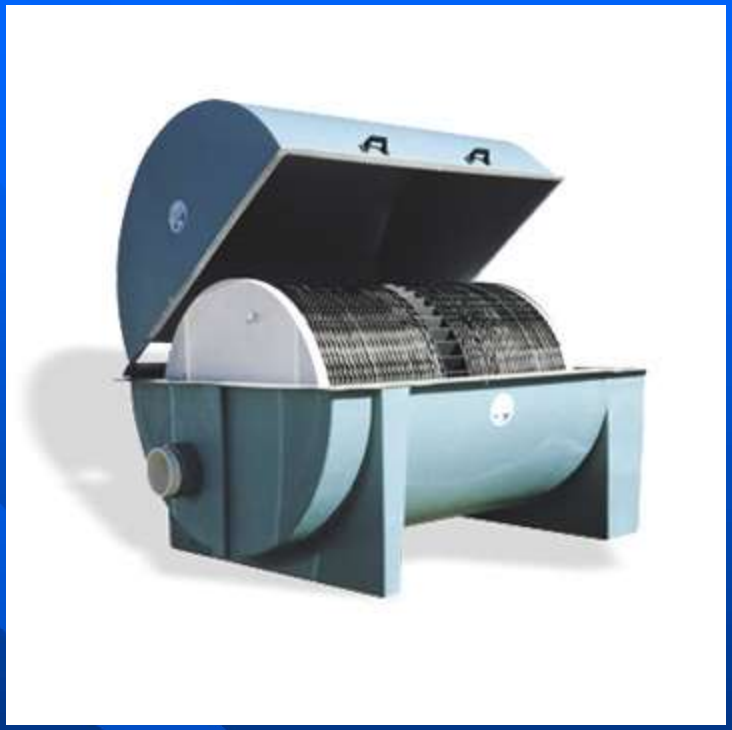
Bioclere (Trickling Filters)

FAST



RBC



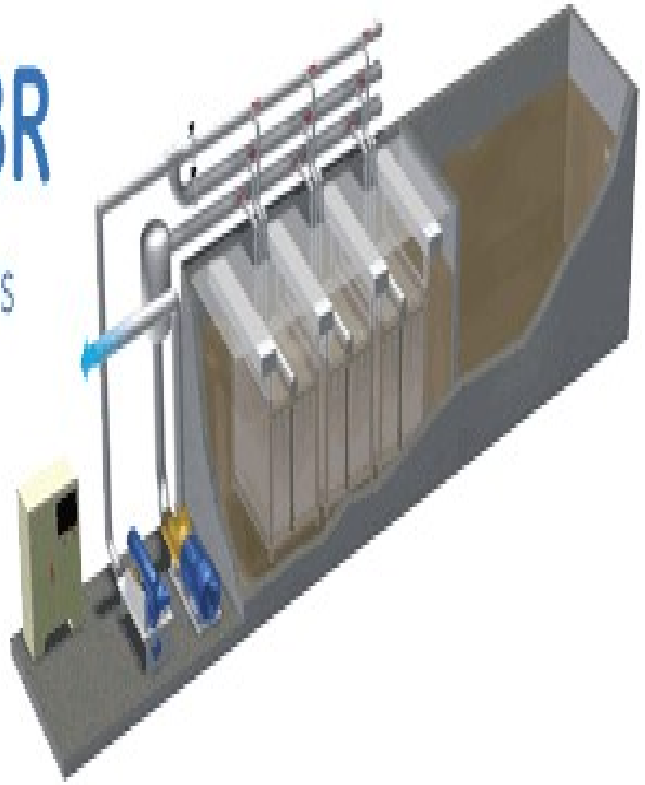


Recirculating Sand Filters

Membrane Filtration

ZeeWeed* MBR

ZeeWeed membrane bioreactors (MBR) produce effluent for discharge or reuse that far exceeds the world's most stringent regulations.



Questions?

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