



Solar Aquatics Advanced Ecological Tertiary Treatment Plant for a New Corporate Campus

New England Biolabs • Ipswich, Massachusetts

Project Background

New England Biolabs (NEB), a private cooperative of scientists, is a world leader in the production of products for molecular biology research. These products, such as enzymes, are used in gene research, including gene mapping of plants and animals.

To expand its headquarters and laboratories for its staff of 250, the company purchased a 104-acre campus, a former estate, in Ipswich, Mass.

Because of the biological nature of the effluents of the laboratories, the town of Ipswich required the firm to install an advanced wastewater treatment system.

NEB's president and founder, Donald Comb, is committed to nature-based systems. Seeking a system that used optimized natural processes to transform the wastewater to meet state standards, NEB contacted the Ecological Engineering Group (EEG) to design, engineer and construct a Solar Aquatics System®.



Wastewater System Description

Designed for 27,500 gallons per day of wastewater to allow for company growth, the modular Solar Aquatic System (SAS)® treats the campus's wastewater to tertiary and disinfected effluent is permitted for ground water discharge in a sensitive environment.

Operating under controlled conditions, the SAS develops the natural purifying processes found in fresh water streams, ponds, and wetlands. Using sheltered systems that enhance the growth of bacteria, algae, plants and aquatic animals; wastewater flows through a series of tanks, engineered streams, and constructed marshes that metabolize or bind contaminants. A finishing stage, anoxic subsurface flow constructed wetlands, polish and denitrify.

The Solar Aquatics System has been used to treat commercial and residential sewage, septage, stormwater, boat waste, and ice cream processing waste.

Call today to discuss your wastewater management challenge: 1-866-4-ECO-ENG



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Major Component

The Solar Aquatics process uses fixed-film substrate in the forms of plant roots and Solar Tank surfaces. The process also uses suspended growth biomass within the wastewater moving through the system.

The process further combines an element of activated sludge by recycling a portion of secondary sludge to the headworks blending tank for reseeded bacteria and their aerobic predators.

The result is a controlled ecological system that maximizes biological degradation of contaminants. The ecosystems that are developed provide a higher degree of biodiversity than other biological treatment technologies, thereby treating a wider range of contaminants and providing a more stable and resilient system that adapts to effluent changes.

The Solar Aquatics System is made up of four main processing sections: (1) headworks for blending and flow equalizations, (2) translucent Solar Aquatic Tanks® for aerobic biological processing, nitrification and removal of contaminants, (3) integrated subsurface flow constructed wetlands for tertiary treatment with an emphasis on denitrification without continuous addition of supplementary carbon and (4) solids processing for stabilization and composting of sludge, and vegetative waste.

When required, disinfection and polishing components are added to meet state and federal guidelines for reuse for industrial process water, flushing toilets,

irrigation and makeup water for evaporative cooling towers.

The system utilizes a diverse combination of aesthetically pleasing biological components, such as plants, garden-like planters and a greenhouse to speed the removal of organic material and nutrients by bacterial degradation. Algae, bacteria, other micro-organisms, as well as higher plants, snails, and other aquatic animals make up the ecosystem food chain involved in the natural purification of wastewater.

Capital Cost

Process components and controls:	\$613,000
Concrete tankage and floor	\$270,000
Greenhouse (optional)	\$200,000

Operating & Maintenance Costs

The annual O&M cost for the Solar Aquatic system can range between \$2 to \$5 per gallon treated per day. The use of an innovative thermal curtain in the greenhouse is expected to reduce heating costs by 50 to 70%.

Land Area Required

Solar Aquatics Systems have relatively small footprint requirements and are typically less than 0.01 acres per 1,000 gpd for small flows (under 100,000 gpd) and can range up to an acre or more for flows ranging between 0.5 to 1.0 mgd.

For more information see:

www.ecological-engineering.com/solaraquatics.html

The Treatment Process

The treatment process occurs in four stages that can be completed in one day for domestic wastewater. More concentrated wastes, such as septage and dairy wastes, require longer process time.

1. Aeration, Bioaugmentation and BOD Reduction
Air is diffused into the wastewater as it enters the facility. The naturally occurring bacteria are augmented with commercial strains of natural bacteria which, in the presence of air, break down soluble organic chemicals into carbon dioxide and water. The process also degrades fats, starches, and proteins into compounds which can be metabolized by other organisms downstream.

2. Nitrification and First-Stage Nitrogen and Phosphorus Removal
Nitrifying bacterial, algae, and higher plants begin to metabolize nutrients in the waste stream. Ammonia (NH₃) is oxidized into nitrates (NO₃). Nitrates, ammonia, and soluble orthophosphates are metabolized directly by green algae and higher plants. Snails and other zooplankton begin the process of sludge digestion.

3. Nutrient Removal, Reduction of Suspended Solids, and Nitrate Uptake
Higher plants on the surface, with their root masses reaching down into the water column, take nitrates and phosphorus from the waste stream to promote leaf and flower production. Very large populations of grazing zooplankton inhabit the extensive surface area of the roots where the water is filtered.

4. Pathogen Reduction, Filtration and Denitrification
As the water passes through the marsh, solids are filtered in the sand and stone substrate, nitrate is reduced to nitrogen gas and water, and certain pathogenic bacteria are destroyed by the action of the marsh plants, including bullrush, cattail, water iris, and reeds. An optional ultraviolet light at the discharge point disinfects the effluent.