PREDESIGN DESIGN REPORT

SOLAR AQUATICS SYSTEM™
WATER RECLAMATION FACILITY

FOR THE

CORTES FOOD COOP
CORTES ISLAND, BRITISH COLUMBIA

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PREPARED BY

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SECTION 1 SOLAR AQUATICS SYSTEM PRINCIPLES

1.1 SYNTHESIS OF NATURAL & CONVENTIONAL TECHNOLOGIES

Solar Aquatics technology duplicates, under controlled conditions, the natural water purification processes of streams and wetlands. Housed within a greenhouse to optimize conditions for biological activity, wastewater is circulated through ecologically engineered aquatic environments where the contaminants and nutrients are metabolized or incorporated into living plant tissue. At the end of the process, fine pore membranes and ultraviolet light ensure complete pathogen-free reclaimed water for aquifer recharge and subsurface drip irrigation of trees and landscaping.

1.2 ADVANCED WASTEWATER TREATMENT

The Solar Aquatics System^{TM} (SAS) water reclamation technology for the Cortes Food Co-op (CFC) will process raw sewage effluent to advanced tertiary treatment levels. This is to allow the reclaimed water to be used in a subsurface drip irrigation system.

1.3 QUALITY ASSURANCE QUALITY CONTROL

The system will include a process design with full quality assurance and quality control components and operational strategies. These will include a simplified system with gravity flow for the majority of the treatment process, trained operators and remote access control system.

1.4 RESOURCE EFFICIENT DESIGN

The most important investment is in a good thermal envelop and a focus on the longevity of components. Ultimately, buildings created with this philosophy use far less energy over their lifecycle.

1.5 EXPANDABILITY

The CFC-SAS is initially capable of treating 11 m^3/day and expandable as subsequent buildings and users wish to come online. This expandability can be as simple as adding the second 11m3/day train of Solar Tanks and additional Filter Rack components.

1.6 RENEWABLE ENERGY

Our intention is to incorporating site-related resources (geothermal / passive and active solar, perhaps wood heat, etc) within the design and construction stage. Again the focus is to be on passive, integrated systems such as building mass storage (using pex pipe in mass walls and floors), seasonal storage of summer heat, proper orientation and glass selection for optimal gains, heat recovery from outgoing water.

1.7 PROTECTION OF NATURAL SYSTEMS

The SAS is designed to produce high quality water for reuse as irrigation water or to recharge aquifers. Discharging to lakes or streams is not under consideration. Reuse to plants and recharge of the aquifer would best be accomplished through a drip irrigation system.

1.8 Revenue Generator

The SAS is designed to clean water for reuse and to grow valuable plants both in the process tanks, on special greenhouse wall shelving, above the system in an suspended hydroponic growing system and in the landscapes surrounding the facility. Healthy, local food is an important step in creating local food self-reliance and can help make the project more self-sustaining.

Another revenue stream for the community will come from the "eco tourism" impacts as people arrive specifically to study the system. For example, the Solar Aquatics in Bear River, Nova Scotia was the key reason for a 37% increase in tourism, in its first year of operation, directly related to the SAS Plant attracting some 10,000 people. People are looking for answers to reducing their ecological footprint and this kind of technology with its solar architecture and ecology-based systems are inspiring to many.

1.9 Chemical Free

The Solar Aquatics System™ technology relies on biological functions to treat wastewater. No chemicals are required. Bioaugmentation (adding beneficial bacteria) and composting lead to a decrease in sludge production and associated remediation costs.

1.10 Odour & Noise Control Systems

Odour control is achieved by maintaining a completely aerobic process. In addition, placing the process in a greenhouse enclosure and covering open tanks with aquatic plants also reduces odours. Noise is very low because all pumps are submersible and all aeration uses submersible pumps in microbubble aeration devices.

1.11 Residuals

Residuals in the form of sludge and plant biomass will be processed at the treatment facility, using worm composting to produce a safe, usable soil amendment. This function may require safe processing and meeting the BC Biosolids Regulations.

1.12 RECLAIMED WATER CAPABLE

The SAS is designed to take raw sewage to an unrestricted access, reuse level and negotiations with the Ministry of Health and the Ministry of Environment will be important to realize the full reuse potential. After advanced treatment, reclaimed water could be used in an edible shelterbelt, community gardens, forest land, fire smart shelterbelt, park areas, ponds and marsh habitat. For example, a pond could function as a multipurpose, Ecosystem Pond (ESP). The ESP will simultaneously perform the following:

- Reservoir: store reclaimed water for irrigation and potential other uses over time.
- Habitat: support an open water marsh habitat,
- Aquaculture: accommodate aquaculture of various freshwater fish species,
- Discharge Zone: The ESP acts to meet the requirements of discharge where surface water and ground discharge are not engaged in favour of summertime reuse irrigation.

Drip irrigation is the other proven method of distributing reclaimed water to edible shelterbelts, market garden farming operations, small constructed wetland habitats and to aquifer recharge. Drip irrigation can be multifunctional in that in the growing season it can feed plants clean water with built-in nutrients and in the winter can recharge the aquifers, depositing phosphorus in the soils of the root zones for summer use.

SECTION 2 AN ENGINEERED ECOSYSTEM

2.1 GENERAL DESCRIPTION

The Solar Aquatics process combines ecological engineering principles with standard wastewater treatment concepts. By combining the biological components that work in natural water purification processes with proven wastewater treatment components, the Solar Aquatics process provides an enhancement on natural and conventional treatment processes.

The Solar Aquatics process uses fixed film substrate in the forms of plant roots and Aerobic Tank surfaces to provide habitat for microbes. The process also uses suspended growth biomass within the wastewater moving through the system. Activated sludge (hungry microbes from the end of the aerobic portion of the process) is recycled to the blending tank (BT) for reseeding high levels of these beneficial bacteria into the raw wastewater entering the system. By optimizing the conditions in the greenhouse, ecosystems that develop provide a higher degree of biodiversity (i.e. a wide range of plants and animal species) than other biological treatment technologies, thereby treating a wider range of contaminants and making this system more stable and resilient to shock loadings of contaminants.

2.2 WASTEWATER SYSTEM DESIGN CRITERIA

2.2.1 Wastewater Characterization & Treatment Level:

The preliminary design for this facility has assumed the characteristics for domestic sewage. To maintain the most options, it is recommended that the highest level of effluent water quality be pursued. This will provide for the safest possible reuse of reclaimed water. See table below:

Parameter	**Influent**	**Effluent**
BOD5	250 mg/L	<10 mg/L
Turbidity	250mg/L	<5 mg/L
pH	6-9	6-9
fecal coliform	10^4-10^5/100 ml	<2.2 colonies/100ml

2.2.2 Flow Rates

The system will initially be designed to treat 11 m3/day (2420 Imp gallons/day). The entire facility could be planned to accommodate an expansion of an additional 11 m3 to create a total of 22m3/day and stay within the Ministry of Health jurisdiction.

2.3 SYSTEM COMPONENT DESCRIPTIONS

2.3.1 Headworks

Grit Chamber (GC)

Incoming wastewater from the project's collection system will be received in a below-grade tank that consists of a cylindrical grit chamber. This tank will collect grit, which is removed periodically by septic pump truck and landfilled. This component will be designed for the whole, anticipated flow. The grit chamber is to be integrated with a duplex pump station to bring raw sewage to a Bar Screen and Surge Blending Tank (SBT)

Surge Blending Tank (SBT)

The SBT will equalize intermittent flows from the community. Degritted sewage will flow through a bar screen on top of the SBT. This tank will be mixed by aeration. The SBT will also receive recycled sludge flows. A portion of the sludge will be recycled to allow reseeding of microorganisms to the beginning of the system. The SBT will also be equipped to receive bioaugmentation (adding microbes to increase the populations and diversity) if required. The effluent from the SBT will flow by gravity directly to the Solar Tanks in the Greenhouse at a relatively constant flow like a natural stream. The fully aerobic SBT act as odour control and load equalization process. The influent wastewater will flow from the SBT via a motorized valve to 2-11 m3/day trains of Solar Tanks (ST).

2.3.2 Water Reclamation System

Solar Greenhouse

A solar design that works in the cold, sunny winters and the warm sunny summers is the preferred approach. A detailed building energy simulation is performed by the design team to get the right levels of insulation, proper orientation and the types of glass, etc.

Solar Tanks (ST)

Aerated cylindrical tanks, filled with plants, optimize conditions for photosynthetic and non-photosynthetic microbes including: algae, bacteria, other micro-organisms, higher plants, snails and other aquatic animals that make up the ecosystem food chain involved in the natural purification of wastewater. Plant root systems act as a living media, a habitat for bacteria and many other aquatic organisms. The plant roots act as nets to trap "food" as it flows through the system so that the food chain can do its work.

Microscreen Filter (MSF)

A fine micro screen removes residual solids (colonies of bacteria) that are then recycled back to the beginning of the process (SBTs).

Sand Filters (SF)

Any solids that pass through the clarifiers are removed in the sand filters before the water enters the Filter Rack.

Filter Rack (FR)

Water from the SF drains to a Filtrate Pump Station (FPS). It is then pumped from the FPS through a Strainer, an Ultrafilter membrane (UF), Turbidity Meter (TM) and Ultraviolet (UV)light to remove all pathogens from the reclaimed water.

Reclaimed Water Tank (RWT)

Restored, reclaimed water leaving the Filter Rack is gathered in the Reclaimed Water Tank (RWT). Clean effluent is stored in a RWT and is used for backwashing sandfilters and ultrafilter membranes. Water in the RWT is to be recirculated through the UV lights continuously to achieve the maximum exposure and thus disinfection. Water is moved from the RWT to ponds or drip irrigation systems.

2.3.3 Biosolids Management

Biosolids Composting

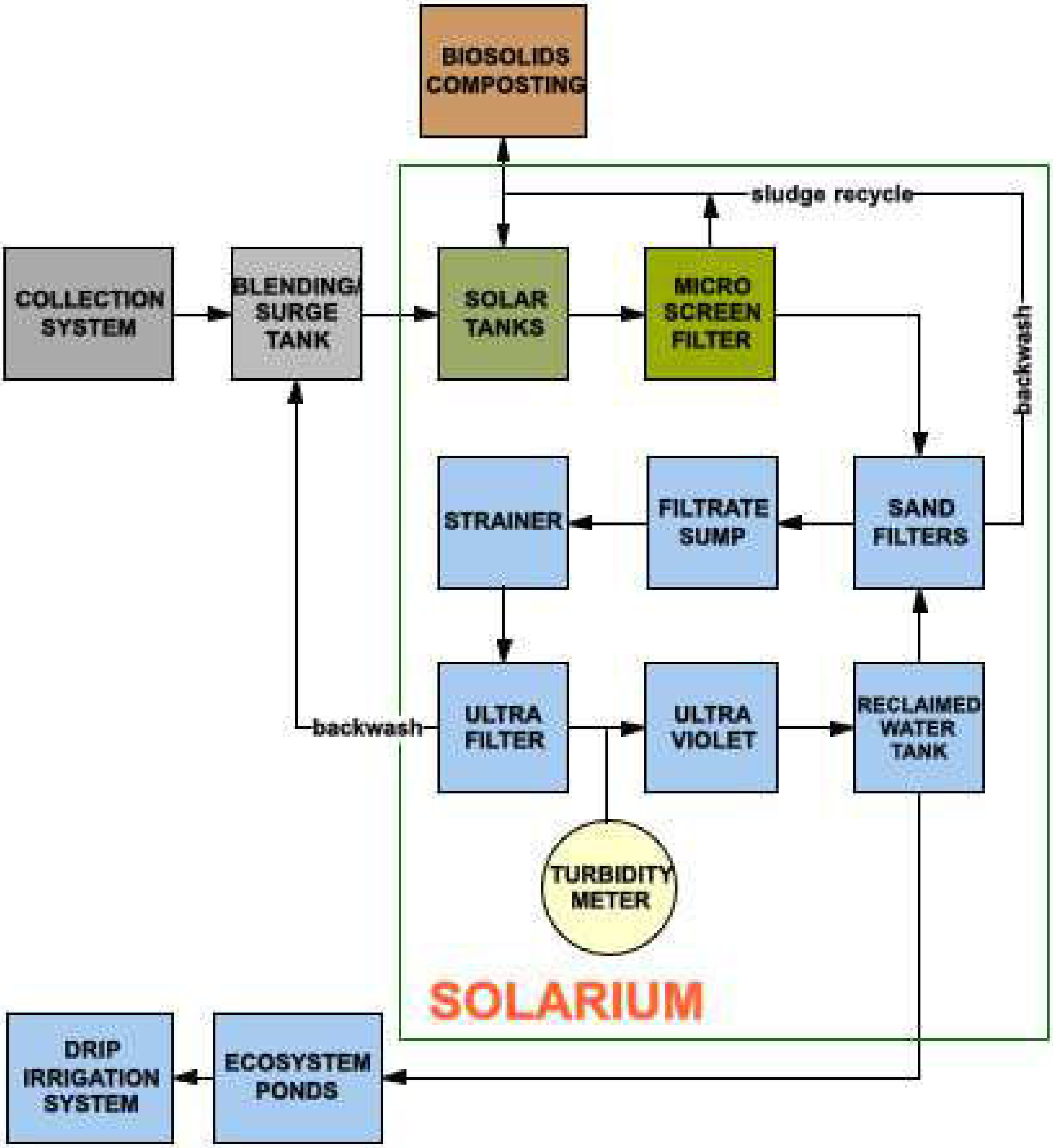
In general, the System produces less sludge than a conventional treatment plant. Solids, in the form of sludge, are removed from the MSF to biological earth filters (BEF) (modified worm composters). Following this aerobic digestion these biosolids can be tested and used to fertilize trees.

Biomass Composting

Solids in the form of biomass (harvested vegetation) will be passively composted on site in worm compost bins; the resulting material will be used as a soil amendment. The bins require access to air, must be covered and kept moist. Bins can be designed in series to allow worms to travel between bins as compost in one nears completion.

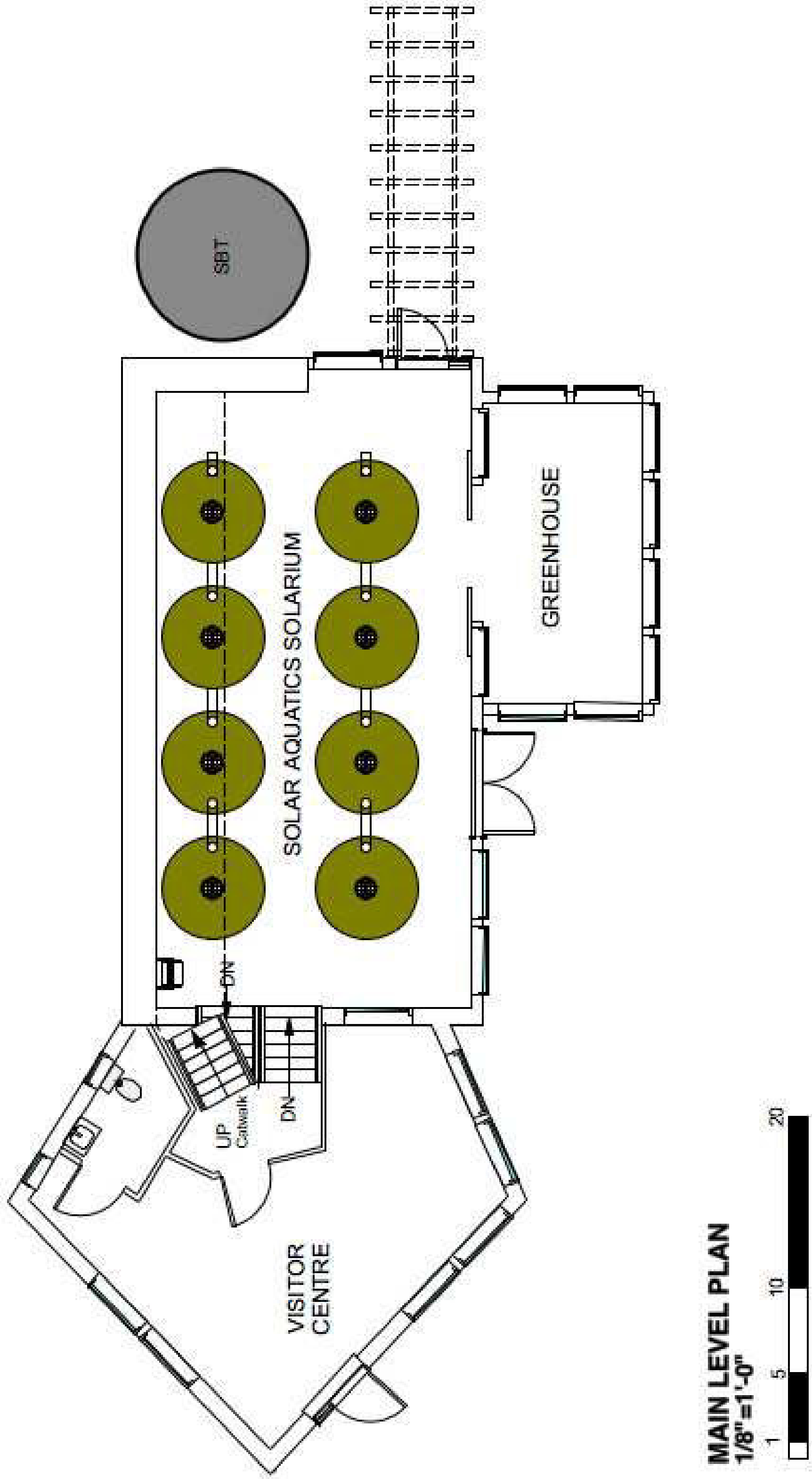
SECTION 4 DRAWINGS

4.1 PRELIMINARY PROCESS FLOW DIAGRAM

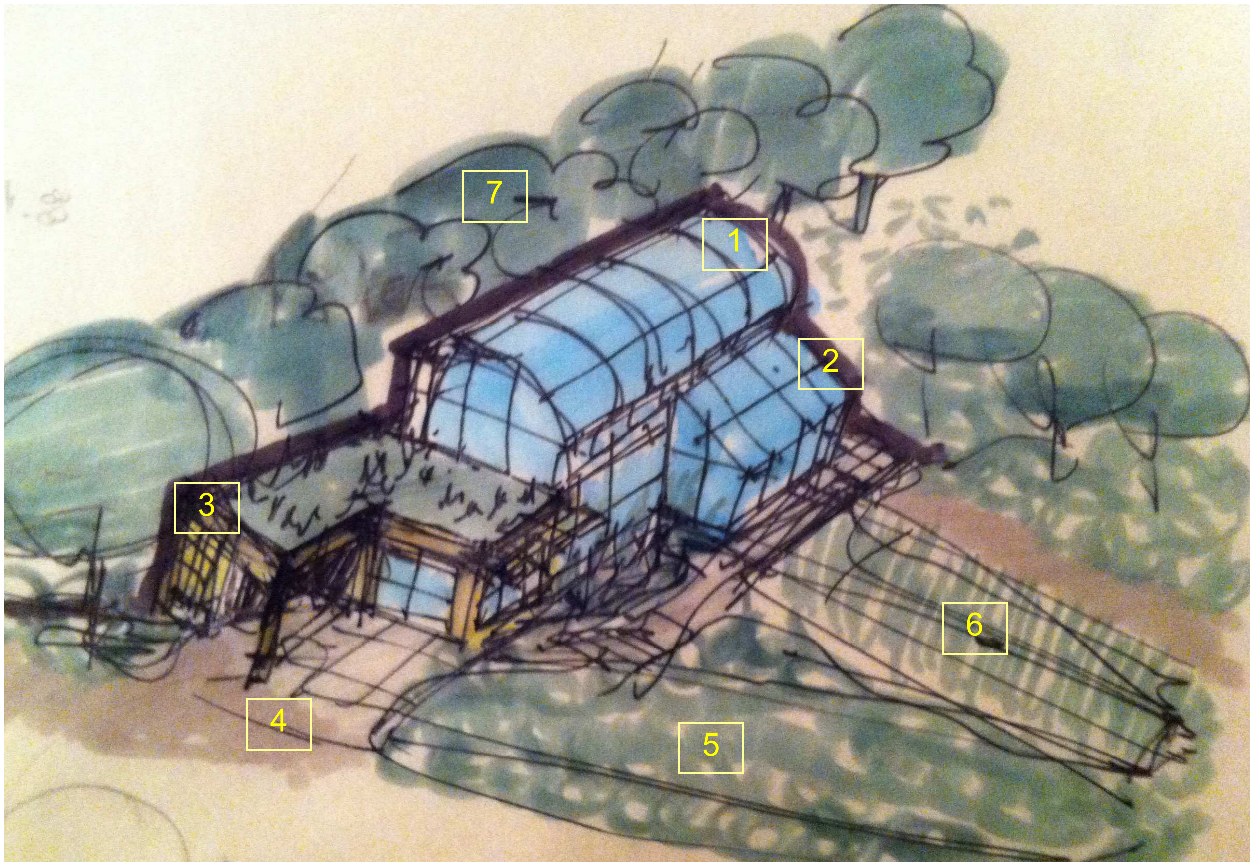


PROCESS FLOW DIAGRAM
N.T.S.

4.2 PRELIMINARY FLOOR PLAN



4.3 Conceptual Sketch



1. SAS Solarium
2. Propagation Greenhouse
3. Visitor Centre
4. Entry Court
5. Berry Patch
6. Constructed Wetland
7. Edible Shelterbelt