Literature Review

List of Figures

2.5 Literature Review

The literature review section is a compilation of research directly related to the Samoa Hostel solar shower greywater design project. Included are an appendix of supporting data and a list of references for further investigation of the topics. The topics covered are client criteria, how a greywater system works, composition of greywater, greywater laws, water quality considerations with greywater, filtration, uses of treated greywater, greywater systems, system planning, leachfield design, and wetland plants.

2.5.1 Client Criteria

The client criteria are high educational value, effective treatment of the greywater, and safety. The educational value criterion should be achieved by making the greywater treatment process as visible as possible to the visitors of the hostel. The second client criterion is that the greywater being fed into the system should be effectively treated and not be allowed to pool. The last client criterion is to reduce safety hazards by not allowing contact with the greywater (Armstrong 2010).

2.5.2 How a Greywater System Works

A greywater system collects water that has been used in domestic applications and reuses it instead of disposing of it to the sewer. Clothes washing machines, bathtubs, and showers all generate greywater. Greywater does not include human waste or water with food waste, which is known as blackwater. It is typically grey in appearance due to it being composed of a mixture of food soaps, cleaning agents, and oils (Ludwig 2010). Greywater treatment and use is subject to laws that vary by enforcing agency.

2.5.3 Composition of Greywater

There are a variety of pollutants in greywater. Greywater collected from a shower will have high concentrations of degradable organic material such as oils from the skin, and residues from soaps and shampoos (Ludwig 2010). There is also a possibility of the greywater becoming contaminated by small amounts of feces when collected from a shower (Ludwig 2010). There are small amounts of nitrogen in greywater, compared to blackwater, but there can be a high level of phosphorus from detergents and soaps (Ludwig 2010). Concentrations of all of these pollutants in greywater can be limited by restricting the types of products being introduced at the source of the greywater. If nutrient rich and synthetic chemical soaps are avoided then the system can treat the greywater with greater ease (Ludwig 2010). If the greywater system uses plants then special attention must be paid to what enters the system because bleaches, artificial dyes, and other cleaning agents containing harsh chemicals can kill the plant life in the system (Ludwig 2010).

2.5.4 California Greywater Law

Greywater use in the state of California is currently governed by the California Plumbing Code 2007 CPC, Title 24, Part 5, Chapter 16A, Part I – Nonpotable Water Reuse Systems, as seen in Appendix B, and commonly referred to as Chapter 16A. Section 1602A.0 of the California Plumbing Code (CPC) defines greywater as wastewater from bathtubs, showers, and clothes washing machines, but not from kitchen sinks and toilets. According to its Certificate of Compliance, Chapter 16A reduces the number of non-compliant greywater systems by making legal compliance regarding the construction of greywater The Truth Tank Greywater System TLA systems easily achievable (Department of Housing and

Community Development (HCD) 2010). Chapter 16A achieves this goal by lowering permitting requirements in comparison to previous legal regulations for the three systems it describes: the clothes washer system, the simple system, and the complex system (HCD 2010).

2.5.4.1 General Greywater System Requirements

According to Section 1601A.0, subsection A, a constructed greywater system cannot be attached to any potable water system without a device that will prevent backflow of any greywater. Section 1601A.0, subsection E, requires that all greywater systems incorporate design that allows the user the option of diverting greywater to either the sewer system or irrigation system and that this function be clearly labeled and easily accessible. Section 1601A.0, subsection G, states that greywater is not allowed to pond or runoff, and that it may not reach any storm sewer system or surface water. Section 1601A.0, subsection H, requires that human contact be avoided except as required to maintain the system. Subsection H also requires that the discharge of any greywater irrigation or disposal field be at least two inches below a level of mulch, rock, soil, or solid shield of some kind. Section 1601A.0, subsection I, states that greywater may not be used to irrigate root crops or edible parts of food crops that touch the soil (HCD 2010).

2.5.4.2 The Clothes Washer System Requirements

Section 1602A.0 defines a clothes washer system as a greywater system collecting only water from a clothes washing machine. According to Section 1603A.1, subsection one, a construction permit is not required for a clothes washer system, unless a local government such as a city or a county has enacted regulations requiring it for the area where the system is to be built. Subsection one also requires that an operation and maintenance manual be provided and stay with the building through the life of the system, and that any new owner of the property be notified of the existence of the greywater system.

2.5.4.3 The Simple and Complex System Requirements

Section 1602A.0 defines a simple system as a greywater system with a discharge of 250 gallons (947 L) per day or less and a complex system as a greywater system with a discharge of 250 gallons (947 L) per day. Both systems follow the general requirements listed above, as well as their own specific permitting requirements. According to Section 1603A.1, subsection two, a simple system and a complex system require a construction permit specific to that type of system, unless exempted by the enforcing agency. It further states that the enforcing agency will consult with any public system providing drinking water to the dwelling before allowing an exemption from the permit.

2.5.5 Water Quality Considerations with Greywater

There is an array of topics to help determine the water quality of greywater, such as: biochemical oxygen demand, nitrogen and phosphorus, solids and turbidity, and purification.