Improvements to the Water Supply, Wastewater Disposal and Solid Waste Management Systems for the La Cuesta Community in Coamo, Puerto Rico

Community Development Engineering

Civil and Environmental Engineering Senior Design Project WI-16 and SP-17

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Abstract

Non-PRASA communities are known for their limitations to connect to potable water and sewer systems from the Puerto Rico Aqueduct and Sewer Authority (PRASA). These types of communities normally operate in conditions that challenge their opportunity of compliance with the Environmental Protection Agency (EPA) National Drinking Water Regulations. The Community Development Engineering (CDE) team worked on the improvements for La Cuesta, a rural community located in the Pasto ward in the Northeast of Coamo, which consists of 50 households. The community extracts its drinking water through a well system, located 1,050 feet above sea level.

Wastewater management in the La Cuesta Community is an issue because the households do not have adequate septic tanks. In terms of solid waste management, CDE evaluated several ways to diverge generated waste from landfills and reduce the cycle of disproportionate generation and disposal.

The alternatives that have been selected were focused on the wellbeing of the community, the environment, the feasibility of implementation of the project, and the economic factors that are attached to the project itself.

Water Supply Design

Water Distribution Tank

The community's water distribution tank needs a capacity of 18,998 gallons. The existing tank only has a capacity of 13,424 gallons, meaning that there is a deficit of 5,574 gallons. A new rectangular distribution tank will be constructed with internal dimensions of 10ft wide, 10ft long, and 10ft high. It will have a capacity of 5,984 gallons. The tank will be connected in series to the existing distribution tank for a total of 19,408 gallons. The water chlorination system will be located on the lid of the tank, and will use calcium hypochlorite tablets. The Capital cost will be of $32,110.

Filtration

The filter to be installed is the Harmsco® LT2 Pleated Microglass Cartridge which complies with the EPA Safe Drinking Water Act. It consists of two filtration stages: cyclonic filtration to remove big particles, and then the water is filtered by the cartridge.

- Filter pore diameter: 1 µm
- Pre-filtration unit pore diameter: 5 µm
- Capital cost: $6,420

Water Distribution Network

The installation of a new water distribution network of 4in and 2in diameter of PVC material is proposed. By installing a new water distribution network with pressure relief valves the community will have less breakage on the water distribution reducing service interruptions.

Table 1: New Water Distribution Network Details

Pipeline Sections	Pipe Material	Pipe Diameter	Total Length	Pressure Relief Valves
10	PVC	4"	5,612 ft	3
3	PVC	2"	460 ft	-

- Capital Cost: $55,155

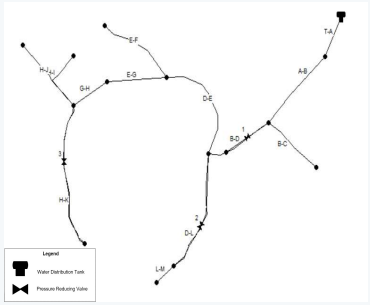

Figure 3: Water Supply Network (EPANET®)

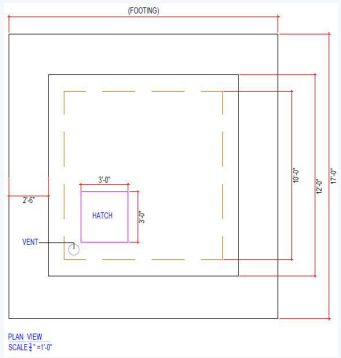

Figure 2: Top View of New Water Distribution Tank

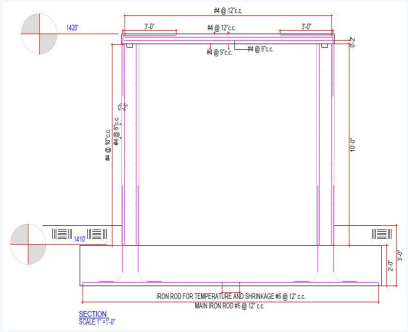

Figure 3: Section View of New Water Distribution Tank

Water Supply Project Schedule

The total construction time for water supply improvements is 82 days.

Task Name	Duration
1 La Cuesta, Coamo	82 days
1.1 Permit Submittal	1.1 mons
1.2 Construction of Distribution Tank	60 days

Figure 5: Water Supply Project Schedule

Objective

To design improvements to the current drinking water system, wastewater management system and solid waste management for the La Cuesta Community in Coamo, Puerto Rico.

Wastewater Management

The wastewater management design was done using the International Private Sewage Disposal Code. Each household will have a 1,904-gallon double compartment septic tank with two interconnected EnviroFin™ infiltration systems. The tanks' material will be precast plastic, and the infiltration system consists of fibers and textiles that promote biological treatment for the wastewater.

- Capital cost: $9,121 per household

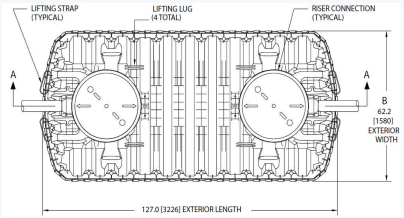

Figure 6: Top View of Septic Tank

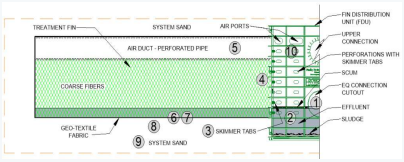

Figure 7: Ten Stages of Treatment of EnviroFin™

Wastewater Project Schedule

Total construction time for wastewater management for the community is 71 days.

Task Name	Duration
1 La Cuesta, Coamo	71 days
1.1 Permit Submittal	1.1 mons
1.2 Decomision of Existing Tanks	34 days
1.3 Instalation of Septic Tanks with Infiltration System	30 days
1.3.1 Excavation/Soil Conditioning Preparations	4 wks
1.3.2 Instalation of Dual Camera Septic Tanks and EnviroFin Infiltration 6 wks	

Figure 8: Wastewater Management Project Schedule

Conclusions

The final alternatives were the following: construction of a new distribution tank connected in series with the existing distribution tank to ensure enough potable water storage and distribution for the community, dual compartment septic tanks with EnviroFin™ infiltration systems for the wastewater management of each household, and an integrated plan for solid waste management that includes an aerobic compost program, a recycling program, and the improvements of waste collection routes. The chosen alternatives allow the fulfillment of the project's purpose, which was to provide designs that will have high viability for solving existing civil and environmental engineering problems at the La Cuesta Community. These alternatives will improve the quality of life of the residents without affecting the quality of the existing natural resources of the community.

La Cuesta Community

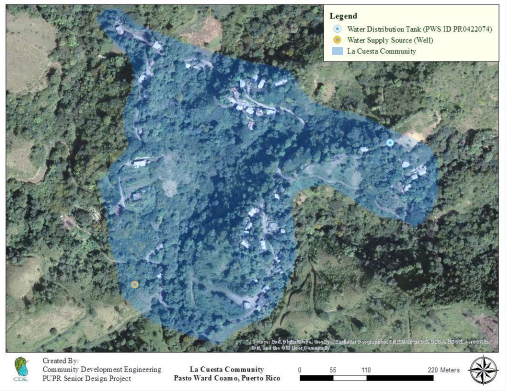

Figure 1: Top View of the La Cuesta Community

Solid Waste Management

The community's solid waste generation is 1,390 lb/day.

Aerobic Composting

- Diverged waste with aerobic compost program: 487 lb/day
- Capital cost: $1,494

Recycling

- Diverged waste with recycling program: 543 lb/day
- Materials to be recycled: polyethylene plastic, paper, cardboard, and scrap metal.
- Capital cost: $1,597

Improvements to Waste Collection Routes

The number of waste collection zones to accommodate the waste generated by various households in the community is four (4). The capital cost is $260.

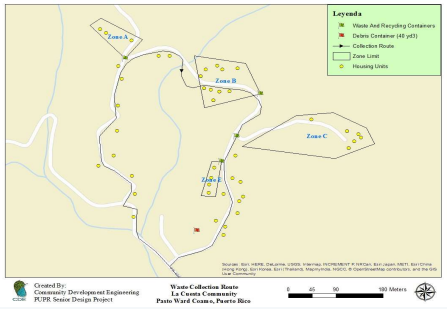

Figure 9: Solid Waste Collection Zones

Acknowledgements

Puerto Rico Department of Health – Drinking Water Division
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