IMPROVEMENTS TO THE WATER SUPPLY, WASTEWATER DISPOSAL, AND SOLID WASTE MANAGEMENT SYSTEMS FOR THE ANÓN CARMELITA COMMUNITY, PONCE-JAYUYA, P.R.

Civil and Environmental Engineering Senior Design Project

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ABSTRACT

Anón Carmelita is a rural community of 1,160 inhabitants located in the mountain area of Ponce-Jayuya, Puerto Rico. Currently, the Jauca River provides the water that is consumed by the community. Since the water is not filtered and the disinfection is not adequate, it does not comply with the Safe Drinking Water Act (SDWA). The sewage generated at each housing unit is disposed either in septic tanks/cesspools or directly over the terrain. The solid wastes are handled by the Ponce Municipality weekly and disposed at the Ponce sanitary landfill. The recycling materials are recovered weekly by the Recycling Center La Pica located in Jayuya, Puerto Rico.

Several alternatives were analyzed to improve the water supply, wastewater and solid waste management systems. The selected options were: the use of a water supply aqueduct, septic tanks with double compartment and infiltrator chambers, an aerobic composting, a collection route, and designated container for recyclable and compostable solid waste. These are the most feasible options from an environmental, public health, sustainability and economical perspective.

BACKGROUND

Anón Carmelita is a community composed of 232 rural housing units. A population growth analysis forecasted that the community will not increase in the next 25 years and its water peak hour demand will remain at 152,878 GPD. The current water source provides 616,896 GPD.

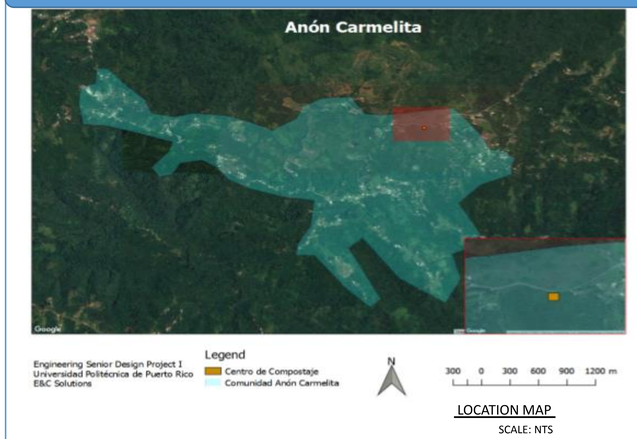
The existing water supply system does not comply with the SDWA drinking water standards. This was confirmed by the water quality data provided by the Puerto Rico Department of Health and by the sampling and analysis done during the study period. Therefore, a water quality improvement is needed in order to satisfy the regulatory parameters established by the Environmental Protection Agency (EPA).

According to a survey conducted at the community, each unit disposes its sewage either in septic tanks/cesspools or discharges over the adjacent terrain. These practices represent an environmental and public health risk. A solid waste production study indicated that in the next 25 years the community will continue generating approximately 6,009 lb/day of garbage, which includes 2,103 lb/day of organic matter and 2,344 lb/day of recyclable materials. In order to reduce the amount of garbage that is conveyed to the Ponce sanitary landfill, the diversion (by recycling and composting) of such material from the disposal landfill facility is recommended.

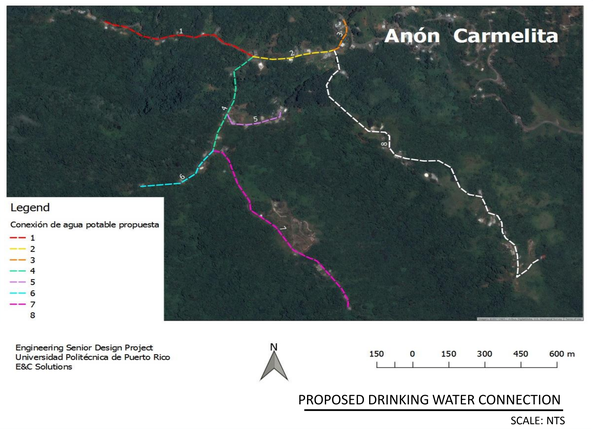
OBJECTIVES

a. Improve the existing water supply system in order to comply with the SDWA,
b. upgrade the wastewater management system, and
c. develop an integrated solid waste management plan.

To achieve these objectives the alternatives were evaluated taking into consideration the following factors: sustainability, feasibility of implementation / construction, health and safety, economical, social, and environmental aspects.

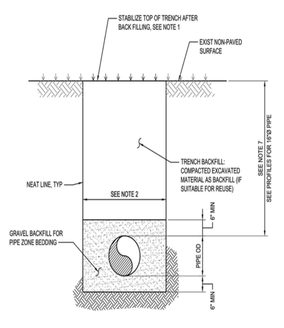


LOCATION MAP
SCALE: NTS

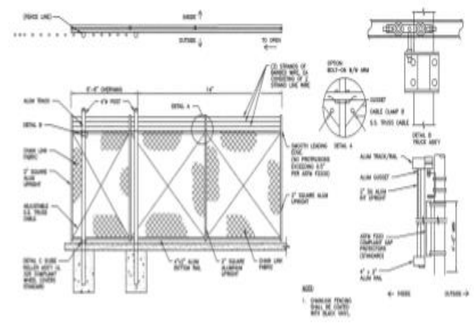


PROPOSED DRINKING WATER CONNECTION
SCALE: NTS

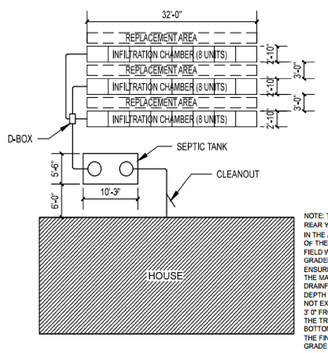
DETAIL – TRENCH IN PAVED AREAS
SCALE: NTS



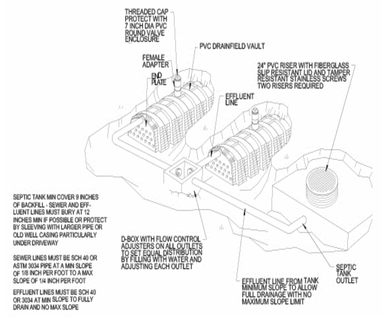
DETAIL – TRENCH IN NON-PAVED AREAS
SCALE: NTS



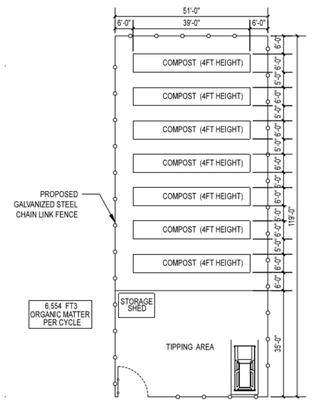
CHAIN LINK FENCE & ACCESS GATE
SCALE: NTS



SEPTIC DESIGN PLAN
SCALE: NTS



INFILTRATION CHAMBER AXONOMETRIC
SCALE: NTS



COMPOST PROGRAM PLAN
SCALE: NTS

DESIGN PROCESS

Several alternatives were evaluated designed in order to improve the water supply, wastewater and solid waste management systems. Comparative tables and Leopold matrices were used to select the most feasible options.

Final designs of the selected alternatives were done utilizing the:

- Puerto Rico Aqueduct and Sewer Authority Design Rules
- Environmental Protection Agency Manuals
- Puerto Rico environmental Quality Board Design Rules
- Puerto Rico Authority of Solid Wastes Guidelines
- American Concrete Institute Codes
- Portland Cement Association Design Manual
- American Society for Testing and Materials International Standards

FINAL DESIGN

Drinking Water:

Anón Carmelita community jurisdiction is divided by two municipalities, Ponce and Jayuya. This causes difficulties in decision making to improvements in the present drinking water distribution system. Due to incompliance with the community's daily demand and water sampling results, the connection to Puerto Rico Aqueduct and Sewer Authority (PRASA) is proposed. Although most of the community already has unused PRASA's water distribution lines, those pipes must be rehabilitated and a small section of the community lacks those lines. The needed piping was designed. The Hogares Seguros Filtration Plant will supply the residents with drinking water. This facility has a maximum design capacity of 0.22 MGD. Currently, the daily average production is 0.11 MGD.

Wastewater:

The suggested septic tank with double compartment and infiltrator chambers was designed following the EPA Underground Injection Control. The proposed septic tanks have a capacity of 1,212 GPD, with three infiltration chambers that includes eight infiltrators of 4 ft. each, for a total length of 32 ft.

Solid Waste:

The community will produce 6,554 ft^3 of organic matter during a five-month composting production cycle. This amount was calculated considering a 5.18 lb/person of solid waste generation per day and that 35% of the garbage is of organic origin. An area of 7,296 ft^2 is required for the aerobic composting.

CONCLUSION

With the connection to PRASA, the drinking water quality will be improved and should satisfy the SDWA standards and will guarantee a safe and secure water for consumption. The elimination of sewage discharges into the ground surface and the usage of the designed septic tanks will reduce the public health risk. The diversion and biodegradation of the organic matter in the aerobic composting system represent a collective benefit by increasing the life of the Ponce landfill facility. The total cost of the alternatives is $252,239.

ACKNOWLEDGEMENTS

We wish to express our gratitude to our mentor, José Borrageros, for granting this opportunity and providing us with guidelines throughout the project. Also, we wish to express our gratitude to the community leader, for providing us with the required information of the community, and to Sani Plant, EQLab, Spec Engineering Services, CSA Group and CH2M that helped us and provided us with the required equipment and information.