Global Water Stewardship: Santa Teresa, Costa Rica
2024-2025 Problem Statement

Santa Teresa Beach – Santa Teresa, Costa Rica

Project Understanding

- Location: Santa Teresa, Costa Rica.
- Population Estimate: 4,537 (Year 2024) ***Source - (AYA, 2024)***
- Number of Water Services: ***Source - (AYA, 2024)***
    - Residential – 1,225 services
    - Rental Houses – 59 services
    - Hotels – 49 services
    - Restaurants – 42 services
- Water Usage: ***Source - (AYA, 2024)***
    - Average Monthly Consumption - 62,075 m^3
    - Estimated Average Monthly Consumption Per Commercial Property – 50 m^3
- Annual Average Precipitation: 3,500 mm ***[Source – Climate-Data.org]***
- Average Temperature: 24.4 Degrees Celsius ***[Source - Climate-Data.org]***
- Wastewater production can be estimated assuming 80% of water consumed per person will be sent to the sanitary system.
- Infiltration flow for PVC pipe material is 0.25 Liters/sec/km
- Typical **Influent** Characteristics: ***Source - (AYA, 2024)***
    - BOD_5 = 280 mg/L
    - COD = 550 mg/L
    - TSS = 220 mg/L total nitrogen
    - Total Nitrogen = 50 mg/L
    - Total Phosphorus = 20 mg/L

- Required **Effluent** Characteristics; (defined in "Reglamento de Vertido y Reuso de Aguas Residuales (RVRAR)")
    - BOD_5 = 50 mg/L
    - COD = 150 mg/L
    - TSS = 50 mg/L
    - Total Nitrogen= 40 mg/L
    - Total Phosphorus = 10 mg/L
    - Fecal Coliform = 1000 MPN/100mL (If water is to be reused, effluent fecal coliform must be less than 105 MPN/100mL)

Costa Rica has very few centralized wastewater treatment systems. In rural areas, septic tanks are a common way of treating wastewater; greywater is often discharged directly overland. The leach fields are very small and shallow and although the law states leach fields must stay within each individual property, they often do not. Shallow bedrock, poor soils, poor cleaning and maintenance practices, and poor designs often contribute to improper treatment of septic tank effluent. Further exasperating the issue, it is not uncommon for sludge cisterns to dump collected material in rural areas and pollute the surrounding environment instead of trucking the sludge to a distant WWTF.

The community of choice for this year's problem statement is a collection of small coastal villages, with Santa Teresa, Costa Rica being the most prominent and centralized. Santa Teresa and its neighboring villages are in the province of Puntarenas, or Western Costa Rica, and are about 100 miles west of the capital city, San Jose. The community extents include the coastal strip between Cabo Blanco Absolute Nature Reserve and the Caletas-Ario Wildlife Refuge which includes the villages of Malpaís, Carmen, Santa Teresa, Hermosa and Manzanillo.

This community was originally comprised of small fishing villages, which relied on fishing, agriculture, and cattle ranching for income. Today, they largely rely on tourism, with an estimated 200,000-300,000 visitors per year. Population data can be found on Costa Rica's social security agency website, Caja Costarricense De Seguro Social. Use your best engineering judgment regarding projections.

Almost every home and business located within Santa Teresa is connected to a private septic tank. Recent studies suggest there is evidence of malfunctioning septic tanks due to negligence of routine maintenance, which causes contamination by septic tank effluents that do not infiltrate the ground but are washed away by runoff. This situation of mismanagement of wastewater has caused concern on the part of its inhabitants, the tourism sector, the Nicoya Waterkeepers, AyA, and the local utility, all of which advocate for a centralized wastewater treatment system and public collection system.

The local utility has been proactive in seeking a centralized wastewater treatment solution and would like a preliminary conceptual design of a treatment system along with a collection system. The design team must propose three (3) locations for the treatment site. Additionally, the design team must propose three (3) alternative treatment systems (each system may be one type of treatment or a series of treatment processes). The design must include one (1) collection system design and also specify outfall/discharge location of the treatment plant's effluent. The community values the great variety of flora and fauna in the area and the design team should hold this community interest in high regard while considering treatment alternatives. The ultimate design should not impede or negatively affect any of the community interests.

Given the complexity and status of the project, the design team must work on **an optimal site selection** and **a preliminary design proposal**. The design should be as intensive as possible. For example, calculate pump power requirements, select pumps to meet the design parameters, size pipes based on anticipated flows, accurate elevations, and stationing through the provided survey information, etc.

In Costa Rica, especially in rural areas, toilet paper is not disposed of in the toilet. This is due to low water pressure, smaller pipe sizes and general goal to reduce solids entering septic tanks or treatment systems. Used toilet paper is typically collected in trash cans and is disposed of along with other solid waste. Design of wastewater collection and treatment improvements should follow Costa Rican design standards as much as possible, however most teams will use typical U.S. standards for the basis of their design (for example, NR110, Recommended Standards for Wastewater Facilities, etc.). The collection system should be designed so that the piping size will allow for toilet paper to be flushed.

It is Costa Rican law that the property owner is responsible for their individual connection to the sewer main, however, it is necessary to plan for funding the entire connection. It is also Costa Rican law that if you have water service once a sewer main is constructed in front of a property, the property owner must pay for the service whether they chose to connect to the system or not.

Project Approach

For this project, GWS is soliciting designs for a long-term solution to the sanitation problem in this region. In general, the solution approach should be to design a centralized treatment system with a complete collection system.

Additional Information can be found by using the following Google Drive link. 2025 Santa Teresa

Additional Project Considerations

The specific areas of concern with the collection and wastewater treatment system are described as follows:

1. The treatment facility must be adequately sized for anticipated flow, future growth, and with seasonal rainfall variability considered.
2. Seasonal variability of flows due to tourism should also be considered.
3. Treatment facilities should be designed to be able to treat to the desired effluent limits as described in this document.
4. Due to the socioeconomic status of the community, user fees must be lower than 10,000 Colones (Costa Rican currency) per month. Assume the capital cost is covered by some outside source and the user fee will include O&M costs.
5. The location of the treatment facility must be easily attainable and needs to be in an area that is not at risk of flooding and landslides. Additionally, be aware of and protect existing drinking water sources. Treatment site locations also need to be evaluated for ease of construction and potential impacts on nearby homes and businesses. The average and maximum flows for the proposed collection system need to be determined.

Design Objectives & Constraints

The following are the items that should be discussed or implemented as part of the design project. The design that best accomplishes these goals will have the highest likelihood of long-term success.

1. The project must take into consideration the local climate (temperature, high water table, heavy rainfall) and high variability due to tourism.
2. Avoid offensive odors and minimize impacts on landscape aesthetics.
3. All equipment must have a level of redundancy to maintain treatment if equipment fails or is under repair.
4. The solution must utilize a minimum of space and energy.
5. The project capital cost must be minimized.
6. The system must be easy to operate and maintain. There is no wastewater training available in the area or wastewater operators' associations. Local staff will have to be trained on the system operation and maintenance, but may be available only on a part-time basis, so the system should be mostly self-operational.
7. The wastewater treatment equipment must be easily replaceable with parts readily available.
8. Treatment equipment must be compatible with the existing electrical system. 120V is readily available but 240V and 480V may not be.
9. Consider simplicity (less O&M the better) in design whenever possible.
10. It is recommended that the teams design for the year 2045 (20 years). Provide justification with any variances. Consideration should be given to future plant process expansions beyond 2045 in the design and site selection.
11. Use best engineering judgment in consideration of separation requirements for potable water and sewer main. Potable water typically runs along the road Right-of-Way.
12. Designate the following in the report/presentation.
    a. Three (3) proposed treatment plant sites.
    b. Designate one (1) of those three (3) proposed sites as the recommended site location. Three (3) alternate treatment processes.
    c. Designate one (1) of those three (3) proposed treatment processes as the recommended treatment process.
    d. Clearly state the capital cost estimate for full construction of the WWTF and accompanying collection system.
    e. Clearly state the monthly user fees that the community should charge residents that will be a funding source for general O&M of the WWTF and collection system.

Figure 1. General community extents of Santa Teresa and surrounding villages.