GLOBAL WATER STEWARDSHIP

Global Water Stewardship: Palmar Sur, Costa Rica
2017/18 Problem Statement

View of Palma Sur looking Southwest
Photo by James Drews

Project Understanding

- Location: Palmar Sur, Costa Rica
- Population: 1985 currently with expected growth of about 50 people per year. San Marcos 511, El Hangar 462 , Zona Americana 212, Palmar Sur roughly 800. Nearby 11 de Abril has roughly 500 people.
- Number of water services (commercial and residential): 329
- Water usage: Design = 200 L/person/day; Actual: To be calculated from consumption document in reference file
- Average Precipitation: 3,900 mm/yr
- Average Temperature: 79 degrees Fahrenheit

Typical influent

Parameter	Concentration 2017 (mg/l)
BOD5	280
TSS	220

Required Effluent

Parameter	Maximum Level (mg/l)
BOD5	50
TSS	50

There are very few centralized treatment systems in Costa Rica. In the rural areas, septic systems are very common, with greywater often being discharged directly overland. The leach fields are very small and very shallow. Although law states the leach fields must stay within each individual property, they often do not. Also, the groundwater table is often high, 2.5 to 5 meters deep which does not allow for the proper detention of the effluent.

The area of concern is a specific collection of communities known as of Palmar Sur, Costa Rica. Palmar Sur is a community in the central- south part of Costa Rica about 100 km south of Quepos, located near the Pacific Ocean in the province of Puntarenas. The community is surrounded by plantations, estuaries, mangroves and marshes. There is another community known as Once de Abril that is nearby, to the east of Palmar Sur, which should be considered in the design for probable future expansion. However, the primary focus should be on Palmar Sur.

Palmar Sur itself is physically divided by an airport runway, and its population can be divided into several different sections. Each section is primarily residential, but the socioeconomic statuses, and current utilization of septic tanks vary. The need for a sanitary wastewater solution is still needed for each section. Additionally, the entire population is relatively stable with no current plans for major development. Any new development that may go in the area within the design life of the treatment facility would be required to build their own sewer and treatment systems. Documents outlining the different sections of Palmar Sur, can be found by following the link in the reference section of this document.

The community has both individual septic tanks and collective community septic tanks. Most of Palmar Sur has collective septic tanks, but there are some areas that have individual septic tanks that directly discharge to waterways (see map in reference documents). In total, there are 94 septic tanks for 391 users (homes). 11 de Abril has 143 users (homes) on individual septic tanks. There is some sanitary sewer infrastructure already in place in Palmar Sur (see reference documents). There is no existing sanitary sewer infrastructure in 11 de Abril.

The local utility has been proactive in seeking a centralized treatment solution, and has an idea of what they would like for a solution in terms of a collection system, and the actual treatment system. Using existing infrastructure is recommended as a cost saving measure, if feasible. In terms of the treatment process, Palmar Sur would like a low maintenance, aesthetic and natural looking process. Constructed wetlands should be strongly considered. Lagoons, and other low operation treatment options should also be examined and evaluated..

The septic tanks in the community are either poured in place concrete or plastic structures with no standard sizing, location or plumbing being used. The use of plastic for septic tanks is much cheaper than concrete. However, the plastic ones break more frequently due to the change in pressure from pumping the septic tanks. The home owners are responsible for pumping their septic tanks, and are legally obligated to do so, but there is no control to ensure that they do.

In Costa Rica, especially in the 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 going into septic tanks or treatment system. Toilet paper is disposed of along with the other solid waste. A lot of refuse in rural areas is burned.

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 once a sewer main is constructed in front of a property, the property owner has to pay for the service whether they connect to it or not.

Treatment Site Location

Palmar Sur, unlike most Costa Rican communities, already has two publicly owned land options set aside, with another private land site potentially available. For land options, see below:

Site # 1 – Zona Americana

Owner	**Palmar Sur ASADA (public utility)**
Size	**To be scaled from Snitcr.go.cr**
Price	**$0**

Considerations

- Near ZonaAmericana's disposal site
- Appears to be out of any protected zones (subject to verification).

Site # 2 – San Marcos

Owner	**Palmar Sur ASADA (public utility)**
Size	**To be scaled from Snitcr.go.cr**
Price	**$0**

Considerations

- Large tract of land allows for various treatment options
- Land appears to be dry and relatively high, next to a canal that flows into Pacific Ocean.
- Needs pumping from Zona and Palmar Sur South
- ASADA requires this land to look natural, and be a nature/water/wetland park.
- ASADA preference

Site # 3 El Hangar

Owner	**Private**
Size	**To be scaled from Snitcr.go.cr**
Price	**Unknown**

Considerations

- Unknown Price
- Privately owned
- Appears to be out of any protected zones (subject to verification).
- Ease of acquisition uncertain

Palmar Sur prefers to use Site #2, as aforementioned studies have recommended this site due to the relatively large size, ease of acquisition, and location. Using Site #2 would allow 11 de Abril to gravity flow into the treatment site. However, pump stations would likely be needed for the two Palmar Sur sections of town.

Even though Palmar Sur prefers Site #2, Sites #1 and #3 should be evaluated as well. Verify that using Sites #1 and or #3 would not be as advantageous as Site #2.

Additional Project Considerations

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

1. The location of the treatment facility needs to be adequately sized for anticipated flow, future growth, with rainfall taken into account.
2. Treatment facility should be designed to be able to treat to a level of 50 mg/L BOD and 50 mg/L TSS.
3. Due to the socioeconomic status of the community, user fees must be lower than 5,000 colones, per month.
4. The location of the treatment facility needs to be easily attainable and needs to be located in an area which is not at risk of flooding. Additionally, be aware of and protect existing drinking water sources. Treatment site location also needs to be evaluated for ease of construction and potential impacts of nearby homes and businesses. The average and maximum flows for the proposed collection system need to be determined.
5. Take special care to not disturb the airport runway.
6. Polyethylene pipe has been recommended for construction, because of ground shifting, however, this should be verified during design.
7. The septic tank leach fields are very small and shallow. The native soils are not conducive to treatment through a leach field.

Project Approach

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

Design Objectives & Constraints

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

1. The project must take into consideration the local weather and heavy rainfall.
2. The equipment must have a high level of reliability. The resources are not available for many equipment breakdowns.
3. The equipment must have a level of redundancy to maintain treatment if some equipment is in temporary disrepair.
4. The solution must have a low operation and maintenance cost due to the residents' limited income. Special consideration will be given to designs that are energy efficient and/or partially self-sustaining from an energy standpoint.
5. The project capital cost must be low due to limited funding.
6. The project 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 only be able to operate the system part time, so the system should be fairly self-operational.

7. The wastewater treatment equipment must be easily replaceable with parts readily accessible.
8. Treatment equipment would presumably be compatible with the existing electrical system.
9. Consider simplicity (less O&M the better) in design whenever possible.
10. It is recommended that the teams design for the year 2038 (20 years). Provide justification with any variances.
11. Design for Palmar Sur, but it is recommended that provisions for 11 de Abril are included.

Design Basis

Each submittal shall include a summary of the following items as needed for the project:

1. What should be the pipe size, depths and slopes?
2. With houses being located lower than the roadway, where is the most feasible location for a potential collection system (under roadway, rear yards, etc.)?
3. How should the collection system convey flow to the centralized treatment facility?
4. What pipe bedding and cover should be used?
5. What manhole spacing should be used?
6. What design should be used for the centralized treatment facility? What would be the required footprint and depth of this facility? Will it fit into the plots of land available?
7. What degree of expandability should be built into the design? Would this be acceptable by the Village? How much would this help with the ongoing operation and maintenance costs? What will be the design year? What will be the design average daily flow and peak hour flow?
8. What type of odor control should there be, if any?
9. Should the equipment be provided through a US equipment supplier or a Costa Rican equipment supplier?
10. Should back-up power provisions be made in the design since power outages happen frequently? If not, should a holding tank be included at the treatment system to store water during times of power outage?
11. What Supervisory Control and Data Acquisition (SCADA) systems, if any, should be at the treatment system? Should the SCADA system be operational-based or monitoring-based?
12. What is the maximum level of water in the discharging waters? What will the hydraulic grade line be for the rest of the treatment system and collection system?
13. What is the maximum level of water in the nearby waterways? Will that affect your site selection?
14. With electrical rates as high as $0.25/kWh, alternative electrical or systems utilizing low energy consumption are encouraged.
15. Develop a realistic project timeline with critical milestones.
16. Consider maintenance requirements that may involve temporarily taking certain systems out of operation in the design and how to account for demand during maintenance
17. Develop Engineer's Opinion of the Cost of Construction
18. Develop an Operations and Maintenance forecast for 10 and 20 year timelines

Reference Information

Information obtained by CSWEA on the Palmar Sur project has been saved here for your use:
https://drive.google.com/drive/folders/0Bw06nT_-xNofbjV5SFBWRm5JM0k

Teams are encouraged to use credible sources for additional information needed to complete their designs. Coordination with an academic advisor and/or water treatment professional(s) is highly encouraged.

Refer to the WEF and CSWEA websites or contacts for the latest design competition guidelines: http://wef.org/PublicInformation/page.aspx?id=136 and http://cswea.org/SYP/Competition/ If the posted guidelines are outdated, teams are advised to use the previous year's guidelines. Deadlines will be similar to years previous, but interested teams should contact their CSWEA student representative for more information.