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Sewerage Planning and Wastewater Treatment for Sabang, Puerto Galera

GEF/UNDP/IMO Regional Programme on Partnerships in Environmental Management for the Seas of East Asia

SEWERAGE PLANNING AND WASTEWATER TREATMENT FOR SABANG, PUERTO GALERA

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EXECUTIVE SUMMARY

A sewerage collection system and central wastewater treatment facility is being proposed for Sabang, Puerto Galera. The area in consideration is the main tourist area of Barangay Sabang. This would include Sabang Beach, Big Lalaguna and Small Lalaguna. A total composite sewer area of 127,697 m^2 covers the area of concern. This report outlines four options in the development of a sewerage collection and wastewater treatment program. The four options follow from the predetermined sites for the wastewater treatment facility. The total costs for the different options are as follows

Table 1 : Comparison of Options 1 – 4 Base Costs

Item	Option 1	Option 2	Option 3	Option 4
1. Treatment Facilities	52,500,000	57,500,000	52,500,00	52,500,00
2. Sewerage Collection System including outfall	39,833,336	36,338,458	37,494,385	41,859,286
3. Land Acquisition (not included)				
TOTAL (P Million)	**91.3**	**93.8**	**90.0**	**94.4**

INTRODUCTION

This report details the preliminary costing of the sewerage collection system and wastewater treatment facility for Sabang, Puerto Galera. The details presented herein will serve as the basis for the pre-feasibility study and bidding documents to be prepared in the next phase of the project. The actual design of the sewerage collection system and wastewater treatment facility will be determined by the individual bidders in the course of their study on the most cost effective and efficient system for the area. Since sewerage planning follows the general contour and topography of the land, the route and pipe sizes for the collection system will not vary much from the schemes proposed in this report. The different sewerage pipe routing, follows the most cost effective paths as determined by the author of this report. There will be more latitude in the options available for the centralized wastewater treatment systems. For purposes of costing, sequencing batch reactor system is proposed. Benchmark costs for wastewater treatment systems in the Philippines will be used as the basis for the costs.

SITE CHARACTERISTICS
SABANG, PUERTO GALERA

Sabang is one of the 13 barangays in the municipality of Puerto Galera. It is located at the northern tip of a promontory that juts out from Mainland Mindoro. White sandy beaches and proximity to dive sites has propelled this area as a prime tourist destination. Among the barangays in Puerto Galera, Sabang has developed quite extensively in terms of hotel and guest infrastructure. These are the site data for Sabang

Table 2. Sabang Data

Total Area	4.8 km^2
Population	2,752 (Yr. 2000, local residents)
Number of Resorts	62
Number of Rooms	775
Commercial Establishments	301
Households	603 (Yr. 2000)
Average Household size	5 persons / household

Site Development

The development of Sabang shows very little evidence of proper urban planning. The streets and alleys are narrow. Open drains are visible in many pedestrian paths. The property limits are many times marked by very narrow alleys to allow for passage of people. Houses and establishments are very close to each other. The following pictures shows the conditions on-site.

Figure 1. Public pedestrian pathways following property lines.

The haphazard manner of development in the area has led to cramp conditions in Sabang area. Conditions are not as congested in Big Lalaguna and Small Lalaguna but similar conditions also exist in pocket areas in these areas.

Wastewater projection

Volumetric Flowrate is the most significant parameter in the design of the sewerage collection system. Wastewater engineering design gives a general, technical criteria for flow velocity to avoid the build-up of sediments:

Flow velocity > 0.6 m/sec

Maintaining this velocity within the sewer collection system will keep the pipes free from solid deposits. Slope of the pipe is the main determinant of velocity and will figure in the design of pipe layout.

In actual design, empirical values are used in the design of the sewer collection system. Pipe size is determined by volumetric flowrate. This flowrate is determined from a study of the sources. The following table gives the different empirical parameters used in determining volumetric flowrate as gathered from different sources, and as used in the Philippines.

Table 3. Empirical Data – Wastewater Generation Rate

Estimating the various components of flow (No existing sewer network)		
Method 1		
a)	Domestic and commercial flow	
	1. 70 to 90% of water consumption	
	2. 50 to 100 gpcd per acre	
	3. 15,000 to 60,000 gpd/acre	
b)	Commercial Flow	25,000 gpd/acre
c)	Industrial Flow	10,000 – 15,000 gpd/acre
d)	Infiltration Flow	
	1. 2000 – 200,000 gpd/mi/cap	
	2. 300 - 1,500 gpd/acre	
	3. 20 – 200 gpd	
Method 2		
a)	First class subdivision	65 – 75 %
	Medium class subdivision	80%
	Condominiums/Apartments	90 – 100%
b)	Commercial / Institutional	
	Office	1.5 L/s per 1000 employees
	Hotels and Motels	1 L/s per 100 rooms
	Schools	1 L/s per 1000 students
	Hospitals	1 L/s per 100 beds
	or	
	Flow Area = 0.6 L/s/ha = 51.84 m^3/h.day	
c)	Industrial Area = 0.6 L/s/ha	
d)	Infiltration = 0.20 L/s/ha	
	Range = 200 – 28,000 L/ha.day	
	Minimum sewer main = 200 mm	
	Minimum service house connections = 100 mm	

Catchment Areas

The topography of the project sites shows us three distinct catchment areas. These are;

1. Sabang basin
2. Small Lalaguna basin
3. Big Lalaguna basin

Each of these catchment basins form the hydrological demarcations which will be distinct sewage collection areas. Each catchment basin will use gravity flow to collect the wastewater generated from individual households/resorts. At least one lift / pumping station will be needed in each of these catchment basins. These lift stations will centralize the collection of the wastewater for treatment. Gravity flow has been maximized to the extent possible in order to reduce the energy costs. The political delineation of Barangay Sabang covers an area of 4.8 km2. Of this only 127,697 m^2 will be covered under the sewerage collection project.

Soil characteristics

The geology of the area shows a distinct metamorphic structure which is amenable to excavation. Several resorts along Sabang have employed excavation of the mountainside to provide more area for their structures. This is evident in the excavation work done in Adam's resort located in the border of Big and Small Lalaguna. This has revealed a consistent homogenous consistency of the underlying rock. Placement and embedding of sewage collection pipes will be easier with such a soil structure.

DESIGN PARAMETERS

The following parameters are the basis for the design of the sewerage collection system and the wastewater treatment plant specifications.

*Topograph*y – determination of the catchment areas is an important first step in the design of the sewerage collection system. Flow by gravity needs to be maximized to reduce operating costs.

Volumetric Flowrate – In order to determine volumetric flowrate, the following data are needed: number of households, number of guest rooms, per capita water useage. In this report, the area method was seen to give a more conservative estimate of flow. In the case of sewer design, conservative is taken to mean, the higher approximation of flow. Therefore, this was used as the method of choice in determining the volumetric flowrate.

Cost effectiveness – The system has to be done at the least cost but at the same time still has to be effective in its intended function. In this case the sewerage collection system needs to comprehensively collect the contaminated water and the wastewater treatment facility needs to effectively remove the contaminants.

Type of Wastewater – The area in consideration is characterized as mixed domestic / commercial. In wastewater engineering, this translates to a definite range of contaminant concentrations. Values will not vary much from this range.

DETEMINATION OF VOLUMETRIC FLOWRATE

The volumetric flowrate will determine the capacities of the wastewater treatment plant and the sewerage collection system. A 20 year design life of the system was used as a basis for design.

For designing the capacity of the wastewater treatment facility, current wastewater flowrate will be estimated from sources. The table below shows the calculation for current wastewater flow.

Table 4. Current Wastewater Volumetric Flowrate

	Source	persons	Wastewater li
1.	850 households x 5 pax per household (120 li/cap.d)	4250	510,000
2.	800 guest rooms x 5 pax per room (200 li/cap.d)	4000	800,000
3.	800 guest rooms 1 resort employee per guest room (120 li/cap.d)	800	96,000
4.	269 Non-resort establishments 5 employees / establishment (120 li/cap.d)	1345	161,400
	Sub Total		1,567.4 m^3/day
	Infiltration	X 2	
	TOTAL		3,134.8 m^3/day

A volumetric flowrate of 3500 m^3/day will be used as basis for design of the wastewater treatment facility. The per capita wastewater generation are taken from benchmark figures for Metro Manila.

For the sizing of the sewerage collection system, a 20 year design period will be used.The area method was used in the calculation of the maximum wastewater to be generated. Please refer to Annex D for the detailed calculations. Given the total area of the catchment area, and assuming full development of this area, the ultimate value for wastewater generation can be estimated. Annex B shows the total catchment area. Total area is computed to be 127,697 m^2. Using the maximum benchmark figure for flow from domestic and commercial sources of 60,000 gpd/acre, a 20 year maximum wastewater flow of 7,163 m^3 /day average flow. This figure will be used in the design of the sewerage collection system.

POSSIBLE SITES FOR WASTEWATER TREATMENT SYSTEM

Determination of candidate sites was an important initial activity in the study. The LGU accompanied the author to do a site survey of available idle land in the area. The sewerage collection plan and therefore costs all proceed from this information.

Based on a survey of the area, four candidate sites for the wastewater treatment facility were identified.

Option 1 – Ridge top Small Lalaguna
Option 2 - Cliffside of possible reclamation area is Small Lalaguna
Option 3 - Empty lot behind Small Lalaguna
Option 4 – Behind Big Lalaguna

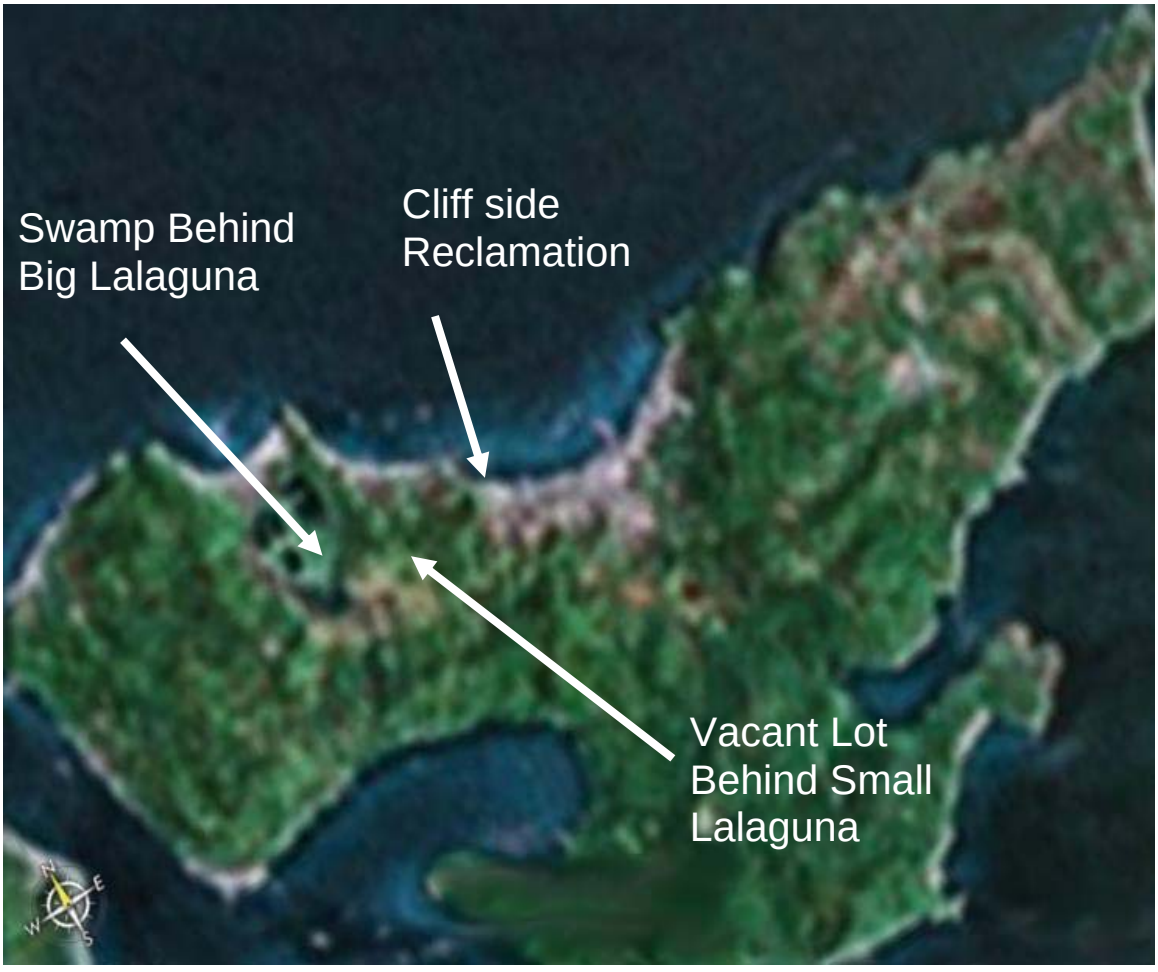


Figure 1. Map of Sabang showing possible areas for site of wastewater treatment facility

Option 1 and Option 3 – Empty lot behind Small Lalaguna. This site presents another option for locating a compact wastewater treatment facility. As seen in the picture, the

site starts out as flat land, then slowly slopes towards an inclination reaching about 30 meters.

Option 1 has the treatment facility located at the top of the ridge shown in the picture. This option would have the wastewater pumped up to 30 m. The treated effluent will flow by gravity over the ridge to a larger area and discharge into the area behind Big Lalaguna.

Option 3 will use the flat area before the ridge. This option is also feasible with proper odor mitigation. This area is close to some resorts and households and will therefore have to be much more stringent in terms of odor control. There are low cost options now-a-days for controlling odor. Aeration tanks and sumps will have to be fully enclosed to prevent emanation of odor and to facilitate collection and treatment of offgases. The treatment facility may be located on the slope of this site. Excavation of the slope may be done and the tanks embedded in the earth.

Option 2. Cliff Side in Small Lalaguna

This option presents savings in terms of sewerage pipe construction and operating costs due to its proximity to the sources of wastewater. Its location also reduces the need to provide pump wastewater over the natural ridges of the area. The pathway shown in the picture may be reconstructed to hide the sewage collection pipes. This site though would require higher construction costs for the wastewater treatment facility. First of all, reclamation of the site would have to be carried out prior to construction. The structures would also have to be built to withstand possible forces from wave action during extreme storm events. This option would also present a minimal risk of complaints due to odor because of its distance from existing resorts and the continuous wind action in the area.

Option 4 – Swamp behind Big Lalaguna

There is a large undeveloped area behind Big Lalaguna which is perennially flooded. The wastewater treatment options for such an area may provide possibilities to use some low cost options such as lagoons, polishing ponds and engineered reed beds. This will lower the cost of treatment. There is a substantial distance though from Sabang. This area is also separated from Sabang and Small Lalaguna by a high 30 m. ridge. A higher operating cost will be incurred due to the pumping of the wastewater over the ridge. But this may be offset by lower operating cost of the wastewater treatment facility due to the larger available area. Low cost options for wastewater treatment need a larger area.

WASTEWATER TREATMENT FACILITY

The technical options for the waste water treatment facility in Sabang will vary according to the candidate site. As discussed in the previous section there are three candidate sites identified by this author.

Wastewater Characteristics

The sources of wastewater in Sabang, is a mix of domestic and commercial wastewater. Typically, the contaminants will include toilet waste, grey water and restaurant wastewater. There are a few laundry operations which contribute to a substantial surfactant load. The LGU was not able to provide us with actual analysis of wastewater parameters for us to use as basis for design. The area though is not unusual and therefore typical values may be assumed. Data from similar areas such as Boracay and Metro Manila have also verified the assumed ranges. The following parameters characterize the wastewater generated by Sabang, Puerto Galera

BOD5	=	100 – 300 ppm
TSS	=	50 - 200 ppm
pH	=	6-7.5

The BOD5 values will approach the maximum values during the dry season when dilution due to rainwater runoff is minimal.

Technical Options

This report will attempt to list the different options available in the local market as far as the author of this report is concerned. A combination of these different options is also possible. For purposes of discussion, each technology will be discussed separately. This is by no means an exhaustive list of options. Bids which offer systems outside of this list will still be considered.

The following options listed below have existing examples in the Philippines and are possible systems to be proposed for the project. Modifications to these generic, conventional options are expected to be offered by different service providers / contractors. This will be considered during the evaluation of the technical bids.

Table 5. Wastewater Treatment Technologies in the Philippines

1. Activated Sludge System
An aerobic flocculent sludge slurry system with many example in the Philippines. Occupies more area than the newer systems derived from Activated Sludge. Examples existing in the Philippines are Makati Sewage Treatment Plant and UP central wastewater treatment facility. The conventional system typically has an 8 – 10 hour aeration time. The extended aeration version of this system may have 20-24 hour hydraulic retention time. Facilities for returning sludge to the aeration system are an integral part of this system.
2. Batch-wise or Semi batch-wise processes
Under this system are a number of processes, the most popular in the Philippines is the Sequencing Batch Reactor. Similar processes exist such as the Intermittently Decanted Extended Aeration (IDEA) System. These batch-wise processes offer space and energy savings. A 1000 m3/day facility may occupy as little as 200 m2. It is amenable to modular construction and therefore will adopt to the demand as it increases. Existing facilities; Ford Philippines, Nepomall Dagupan, Caltex Sta. Rosa, Century Park Hotel.
3. Attached Growth Processes
Prime examples under this classification are Trickling Filters and Rotating Biological Contactors (RBC). These systems may offer space saving benefits if designed correctly. Aeration equipment such as blowers are not normally used. Energy savings may be realized. Existing facilities – Sta. Lucia Mall, ADB headquarters, Central Azucarera de Don Pedro.
4. Oxidation Ditch Processes (Carousel System in Europe)
A very robust system which operates efficiently and consistently. Civil structures tend to be a quite expensive. Area requirement is quite high. Energy requirement is similar to SBR systems. There is an efficient removal of Nitrogen form the wastewater due to the alternating aerobic and anaerobic stages in the system. Existing Facilities: Baguio City Wastewater Treatment System, Boracay Wastewater Treatment System, Mactan International Airport Wastewater Treatment System.
5. Membrane Bioreactor Systems
This system is similar to an SBR or Activated Sludge system. The difference is in the sludge separation system. A membrane is used to separate clarified/filtered effluent. Advantages of this system are the small space requirement and the direct reuse of the filtered water for non-potable uses. Disadvantage is the high cost of the replacement filter and the need for technical personnel to run the facility. Membranes are replaced at least once a year. Existing Facility: Lagen Resort, El Nido, Palawan.
6. DEWATS system
This system is steadily gaining a following in the Philippines and Indonesia due to the savings in capital and operating cost. This system is being promoted by the Bremen Overseas Research and Development Agency (BORDA). It involves the development of improved anaerobic septic tank like systems for initial treatment, followed by more anaerobic filters and finally a natural aerobic bed or lagoon. The tanks are built underground with the exception of the polishing aerobic filters and lagoons.
7. Natural Treatment Systems
These new systems offer an engineered option for the treatment of settled wastewater. The use of soil, plants, sun and water to filter and biooxidize contaminants is a well studied and demonstrated feature. Advantages; very low operating cost, aesthetic appeal. Disadvantages; Large area requirement, need for pretreatment (septic tanks). Existing Facilities: Bayawan Fishermans Village, Laba eh Laundry Service, Nasugbu, Absolut Distillery.

Minimum Criteria for Wastewater Treatment Facilities

The following guidelines will apply as basis for assessing the various technical bids

1. Design Volumetric Flowrate is 3500 m^3 /day. This figure represents average flow. Provisions for an increase of 100% of volumetric flowrate over 20 years should be included.
2. For Aerobic biological systems
    a. minimum of 6 hours hydraulic retention time.
    b. Design MLSS of at least 2000 ppm
3. Proposed systems using enzymes / bioactive substances by themselves will not be accepted.
4. Must have a proper plan for
    a. Sludge management
    b. Odor control
    c. Disinfection before discharge
5. Structural resistance to corrosion due to proximity to the sea
6. Compliance with Effluent Discharge Standards (current regulation is DENR Administrative Order 35). Flexibility to adopt to more stringent standards as foreseen in the new IRR of the Philippine Clean Water Act.

Recommendations – Wastewater Treatment Facility

The following recommendations are presented by the author as appropriate wastewater treatment facilities for each site considering the site conditions and space available. These recommendations are not binding and are merely the technical opinion of the author. Bidders may opt to present other options.

Option 2 and 3 both present areas with very little land availability

- SBR process. Modular tank construction. Underground sump tank as buffer tank.
- DEWATS processes may be considered.

Option 1. This ridge top site has more available area.

- Aerobic Biological process such as SBR, Activated sludge. Roughing trickling filter may be used to reduce BOD as a pre treatment or post-treatment.
- Polishing pond or other natural treatment process may be used to provide post treatment.

Option 4. The area behind Big Lalaguna is quite expansive. Low cost options may be considered.

- Any of the Biological treatment processes (Activated Sludge, SBR, IDEA, Oxidation Ditch, RBC)
- Polishing Ponds and Constructed Wetland Systems
- DEWATS systems.
- Roughing Trickling Filter may be considered as flows are coming from a height.

COST OF WASTEWATER TREATMENT FACILITY

Benchmark cost of conventional systems in the Philippines is given as

P 10,000 to 30,000 / m^3 installed capacity

The cost of the system will not vary much from these industry benchmark costs. We shall use the average benchmark cost as basis for costing the wastewater treatment facility.

Table 6. Benchmark Costs – Wastewater Treatment Systems

Volumetric Flowrate	3500 m^3 / day
Benchmark cost	P 15,000 / m^3 capacity
Total Cost	P 52.5 M

For Option 2, an additional P 5 M is added due to proximity to the sea. Construction will have to employ more reinforcement in the structure.

DISCHARGE AND DISPOSAL

For all four options, a sea outfall is included in the technical description and costing. These outfalls are located close to the proposed wastewater treatment facility. The length of these sea outfalls varies according to the site. On the average, they are several hundred meters from the sea shore. It is recommended that a multi-port diffuser be used in the sea outfall. An oceanographic study needs to be done to determine the best depth and location of the sea outfall considering the currents and eventual dilution possible. The discharge of treated effluent in

the area will have a much smaller impact than the current practice of direct discharge of untreated sewage in the near shore area. The photo on the right shows an existing discharge into the waters of Sabang. There are numerous discharges of this type currently existing along the coast of Sabang, Big Lalaguna and Small Lalaguna.

REUSE AND RECYCLE

There is also the option to reuse and recycle the treated wastewater coming from the wastewater treatment facility. The treated wastewater may be treated to a level such that it is appropriate for non-potable uses. Among the options under non-potable water useage are;

- Toilet flush water
- Irrigation of public landscaped areas
- Public use – fountains, firefighting

Caution must be exercised in the use of treated wastewater since there is still the risk of pathogen contamination. A disinfection process is an integral part of the design requirement of the wastewater treatment facility. This will render the treated wastewater fit for non-potable water use only as listed above. Other uses with a high risk of human contact should not be considered.

There are numerous benefits in considering the option to reuse the treated wastewater. Total external water demand is reduced, water costs are lowered, less impact on the environment. There are also drawbacks in the reuse of treated wastewater. Additional infrastructure costs are required due to an additional distribution system exclusively for non-potable water, double piping system in the resorts and households, and occurrence of occasional discoloration of the reused wastewater. Reuse of wastewater as toilet flush is common. This has been practiced in Hong Kong and locally, the island resorts in El Nido reuse and recycle their wastewater as toilet flush.

A recycling system would necessitate the construction of a service reservoir tank on one of the ridges to provide pressure for gravity flow.

SEWERAGE COLLECTION – TECHNICAL DESCRIPTION

Current Practice in the Philippines

In year 2002, basic sanitation services are accessible to only 81% of the urban populace while in the rural areas coverage is only 61%.

Sewerage network connections is a mere 7% in Metro Manila; 2% nationwide (Year 2005). Sewerage is virtually non-existent in rural areas.

The design practice adopted is for the life span of the pipe materials to approximate only the life of the loan, usually 25 years. It is actually unnecessary to design the sewer system for 25 years or more but the pipe is assumed to last more than 25 years. However, in present situation, the life span of sewer system being laid using Cast Iron Pipes, even shorter due to the extreme conditions of Metro Manila – clayey and polluted soil, flat and deltaic terrain, tropical temperature as well as high rainfall and frequent earthquakes.

For underground pipelines, the main problem is corrosion. We define corrosion as the reaction between a material and its environment that produces a deterioration of the material and its properties. Replacement of deteriorated pipes are frequent after 15 years it was laid off and create traffic jams, dust, mud, noise etc. The underground pipelines must therefore be long lived to minimize the hardships and chaos they would create for the community in case of their replacements or repairs.

The practice in the Design of pipes is to specify beforehand a uniform class or grade of pipes based on the requirements without specific regard for corrosion (i.e. soil, electrolysis and stress corrosion, etc) and other design conditions. Analysis of the corrosiveness of the soil is not being conducted before or after bid.

The above practice may have arisen from a misunderstanding of the design paradigm of both ISO and AWWA. Under the ISO, only the minimum requirements are specified in the standard and it is the design engineer who is responsible for taking into consideration the various conditions, particularly underground corrosion, which affects the long term performance of the project. In present practice however, designs are general and not made specific for each varying condition within the project area and special condition such as encountered bridges and highways i.e. vibration, impact loading, etc.

Under the AWWA paradigm, the design engineer is not encouraged to perform in depth design since the initial design process is already encapsulated into a look up table. That is, pipe thickness is already tabulated from a given set of pressure and external loading conditions. Consequently, corrosion the most important design parameter is overlooked.

OPTIONS AND COSTS

This section presents a comparison of the different technical alternatives for providing a sewerage system in the selected urbanized areas of the Municipality of Puerto Galera, Mindoro. The alternatives were selected based on the selected Barangays and areas in consideration.

DESIGN CRITERIA

The following major design criteria and standard adopted from the MWSS Design guidelines and other Standards for Sewer systems. This Design Guidelines and Standard is the primary basis for the formulation of the recommended technical option.

Sewer System

Existing and proposed road networks and concentration of prospective developments within the service area generally influence the sewer system layout. Pipe sizes are determined based on peak-hour requirements plus the infiltration inflow during high tide and wet weather condition. The minimum allowable pipe diameter for house service area is 100 mm dia. while for sewer main is 200mm dia. The maximum pipe diameter will vary depending on the velocity, slope and flow requirements in the proposed system. The types of pipes to be used in the systems are the High Density Polyethylene Spiral pipe (HDPE).

Flow Velocity in the Sewer System

The flow velocity in the sewer system will be limited to a maximum of 3m/s and a minimum of 0.6m/s during peak-hour conditions.

TECHNICAL OPTIONS

Proposed Service Area

The delineated service areas, which have been included in the preliminary design and cost analysis in this study, are Sabang, Big Lalaguna, Small Lalaguna.

Identification of Options

Four (4) technical options were prepared for considerations by the LGU and to select the option which will fall within the parameters of the financing scheme. The description of the individual sites is given in pages 5-6 of this report. A main determinant in the costs is the site of the wastewater treatment facility. Costs for the following options are summarized in the succeeding table.

Option 1

This option covers the whole catchment area with a sewer area of approximately 127,697 sq.m. within the seashore. The development of a Wastewater treatment plant located at the top of the hill approximately 30 m elevation from the shoreline. The proposed sewerage system will have at least four (4) pumping stations with varying capacities. Two (2) pumping stations will be located at Barangay Sabang, one (1) in Big lalaguna and one (1) in Small lalaguna. The total number of manholes in this alternative is 32. The total length of the pipes is 4,383 L.M. The pipes sizes will vary from 200mm diameter to 450mm diameter main and the houses connection will vary from 100mm diameter to 150mm diameter. The sewerage system will operate on combined conventional and modified sewer system based on the actual conditions and terrain of the area. This is the more flexible alternative when it comes to the development of its wastewater facilities based on area, location, environmental aspects, economics and social aspects. The total construction cost of sewer line including the pumping stations of Alternative 1 will amount to about **₱ 39.833** million. **Figure 2, shows the Alternative 1 Sewerage plan drawing.**

Option 2

This option also covers the proposed sewerage collection area of approximately 127,697 sq.m. within the seashore. The proposed wastewater treatment plant in this option is located at the seashore beside the cliff in Sabang area. This area is potentially a good site for reclamation. The proposed sewerage system will also have at least four (4) pumping stations with varying capacities. Two (2) pumping stations will be located at Sabang, one (1) in Big Lalaguna and one (1) in Small Lalaguna. All pumping stations will be located along the seashore. Construction of a wastewater treatment plant in this area will cost more compared to the other sites. This is due to the need for reinforcements in the civil structures due to the proximity to the sea. The total number of manholes for this option is 31. The total length of the pipes is 3,904 L.M. The pipes sizes will vary from 200mm diameter to 450mm diameter main and the houses connection will vary from 100mm diameter to 150mm diameter. The sewerage system will operate on combined conventional and modified sewer system based on the actual conditions and terrain of the area. The total construction cost of sewer line including the pumping stations of Alternative 2 will amount to about **₱ 36.340** million. **Figure 3, shows the Option 2 Sewerage plan drawing.**

Option 3

This option is in the same site as option 1. The difference is in the site of the wastewater treatment plant which will be located at the back of small Lalaguna in the flat portion of the lot, below the proposed wastewater treatment plant of alternative 1. The elevation of the proposed wastewater is approximately 6 m elevation from the shoreline. This is below the 30 m height propose for option 1. The proposed sewerage

system will have at least four (4) pumping stations with varying capacities. Two (2) pumping stations will be located at Sabang, one (1) in Big Lalaguna and one (1) in Small Lalaguna near the proposed site. The total number of manholes in this alternative is 32. The total length of the pipes is 4,033 L.M. The pipes sizes will vary from 200mm diameter to 450mm diameter main and the houses connection will vary from 100mm diameter to 150mm diameter. The sewerage system will operate on combined conventional and modified sewer system based on the actual conditions and terrain of the area. This alternative however, has a disadvantage due to its location. The lack of a buffer zone between the proposed plant and the surrounding resorts, (less than 15 m), makes it prone to complaints due to occasional odor. The total construction cost of sewer lines including the pumping stations of Option 3 will amount to about **₱ 37.50** million. **Figure 4, shows the Option 3 Sewerage plan drawing.**

Option 4

This option is also the similar to option 1. The wastewater treatment facility in this option is located at the Big Lalaguna area below the hill, behind the resorts. It is approximately 10 m elevation from the shoreline. This elevation represents the needed lift in hydraulic gradient for resorts close to the shore. The proposed sewerage collection system will have at least four (4) pumping stations with varying capacities. Two (2) pumping stations will be located at Sabang, one (1) in Big Lalaguna near the proposed treatment plant and one (1) in Small Lalaguna. The total number of manholes in this option is 36. The total length of the pipes is 4,683 L.M. The pipes sizes will vary from 200mm diameter to 450mm diameter main and the houses connection will vary from 100mm diameter to 150mm diameter. The sewerage system will operate on combined conventional and modified sewer system based on the actual condition and terrain of the area. This alternative has an advantage over alternative 2 and alternative 3 in regard to the possible wastewater treatment facilities. The large area available makes it appropriate for the application of some low cost systems such as polishing ponds and lagoons and natural treatment systems. The area is also relatively isolated, and therefore there is a sufficient buffer area between the plant and the existing community. The total construction cost of the sewer line including the pumping stations of Alternative 4 will amount to about **₱ 41.86** million. **Figure 5, shows the Option 4 Sewerage plan drawing.**

Detailed computations are given in Annex E.

Evaluation of Alternatives

The basic construction costs of the proposed alternatives are summarized as follows:

Table 1 : Comparison of Options 1 – 4 Base Costs

Item	Option 1	Option 2	Option 3	Option 4
4. Treatment Facilities	52,500,000	57,500,000	52,500,00	52,500,00
5. Sewerage Collection System including outfall	39,833,336	36,338,458	37,494,385	41,859,286
6. Land Acquisition (not included)				
TOTAL (P Million)	**91.3**	**93.8**	**90.0**	**94.4**

Operating Costs

Annual Operation and Maintenance

	Item Description	option 1	option 2	option 3	option 4
1	Personnel Cost	1,945,657.83	1,945,657.83	1,945,657.83	1,945,657.83
2	WWTP Treatment Chemicals	153,300.00	153,300.00	153,300.00	153,300.00
3	Power, Light and Water	8,462,878.80	8,484,137.87	9,110,300.27	10,233,500.27
4	Maintenance, Materials and Hardware	85,243.38	85,243.38	85,243.38	85,243.38
5	Fuel	93,600.00	93,600.00	93,600.00	93,600.00
5.1	Vehicle and Equipment	18,540.00	18,540.00	18,540.00	18,540.00
5.2	Genset (optional only)	-	-	-	-
6	Overhead	19,456.58	19,456.58	19,456.58	19,456.58
7	Sludge Disposal	124,220.81	124,220.81	124,220.81	124,220.81
9	**Total**	**10,902,897.40**	**10,924,156.47**	**11,550,318.87**	**12,673,518.87**

ANNEX A
Scope of Work of Sewerage Planning and Wastewater Treatment

Specific tasks. *The tasks expected from the consultant in the implementation of this SOW are as follows:*

Area : Sabang, Puerto Galera

1. Conduct site inspection of Sabang, Puerto Galera, in collaboration with the LGU engineering office and other LGU officials.
2. Obtain relevant maps such as topographical map, and other data as needed in sewerage and wastewater management planning
3. Determine sewerage collection design parameters from existing data and verify accuracy of this data.
4. Determine likely / possible sites for central wastewater treatment facility/ies.
5. Determine different configurations and options in the sewage collection plan for Sabang.
6. Prepare preliminary drawings showing main sewerage collection pipes. Different options may be shown including conventional, combined and simplified sewerage systems may be compared.
7. Determine appropriate wastewater treatment systems based on parameters such as area available, treatment efficiency, compliance with local standards, operating anad maintenance costs.
8. Determine total costs of the different technical options.
9. Prepare a comprehensive report in collaboration with the LGU engineering office and other LGU officials to be submitted to PEMSEA.
10. Submission of draft report for review/acceptance by PEMSEA.
11. Submission of final report, taking into consideration the comments of PEMSEA.

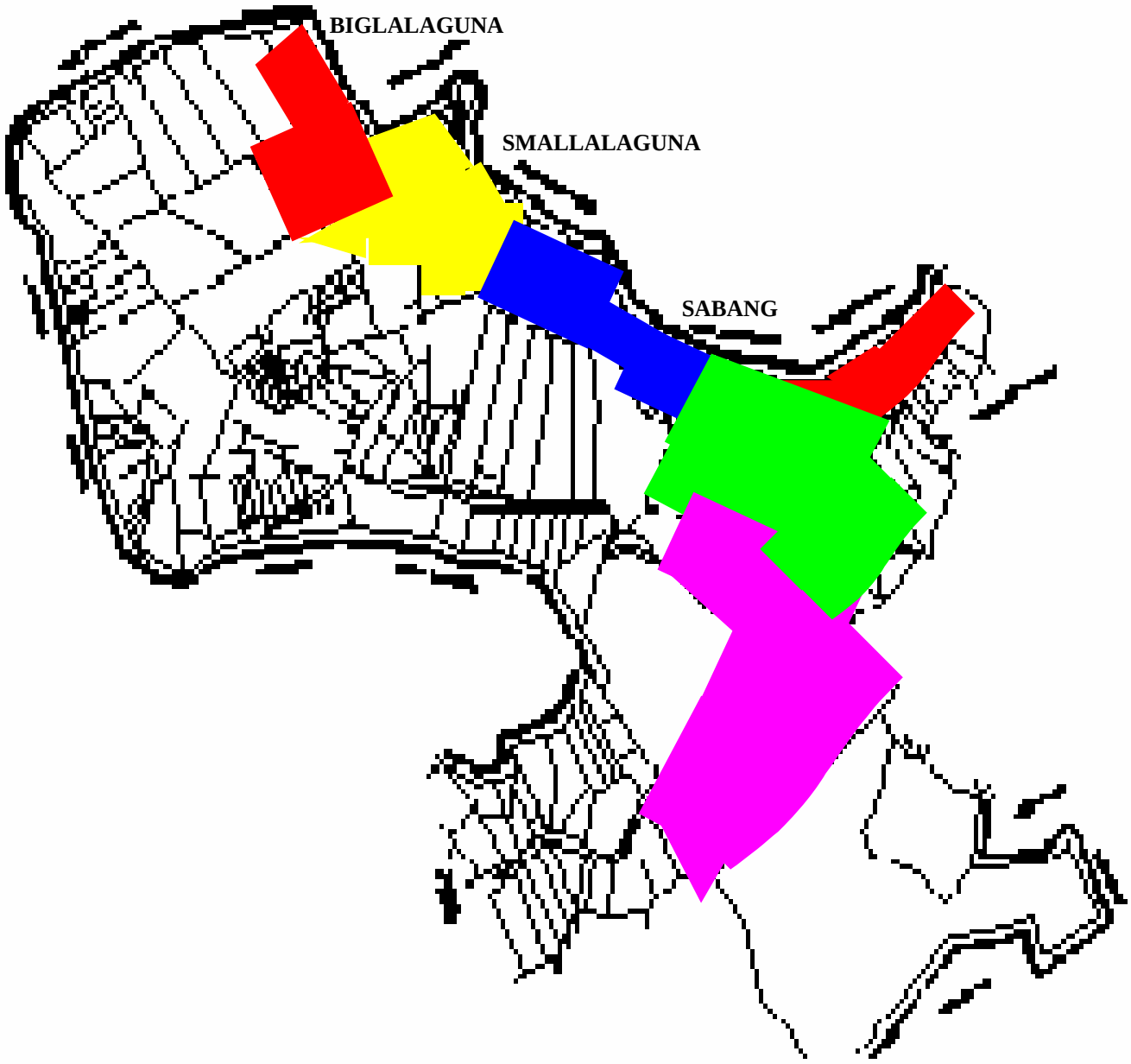
Deliverables. *The execution of the tasks described above will result in the following deliverables:*

12. Comprehensive report on the different options for the management of wastewater from Sabang.
13. This report will include the following:
    a. Domestic/tourist population forecast to 2026
    b. Hydraulic and organic loading estimates/characteristics, based on domestic and tourist population forecasts, with validation of estimates/characterization based on data collected from similar locations elsewhere in the Philippines (e.g., Boracay)
    c. Sewerage collection map detailing catchment areas with relevant appurtenances, based on forecast services to 2026, such as size/length of pipes, manholes, and pumping stations. Maps will be rendered in

AutoCad.

d. Sites for possible wastewater treatment facilities
e. Required technical performance standards for the proposed sewerage system, in accordance with national regulations as well as local government standards and objectives regarding development and sustainability of a world class tourist destination
f. Technical options for achieving such standards with regard to the sewage treatment plant
g. Capital and operating costs for the different sewerage options mentioned above.
h. Recommended sewerage options based on economic considerations and in accordance with the expectations of the public sector.

ANNEX B SEWERAGE COVERAGE AREA



TOTAL AREA DELINEATION

127,697 SQ.M.

COMPANY	TITLE:
PEMSEA	**SEWERAGE AREA DELINEATION**

ANNEX C Pump Sizing (Sample Calculation)

PUMP SIZING CALCULATION

,

1. Static water level , SWL = 5 m below NGL
2. Pumping Water level, PWL = 6 m below NGL
3. Pump setting, PS = 10 m
4. Discharge capacity = 26.12174 lps 5.87

5. pipe diameter = 100 mm dia. 7.631

II. FORMULA USED:

1. $V = 0.8492\ C\ R^{0.63}\ S^{0.54}$ (HAZEN WILLIAM FORMULA)

where , V = Ave. Pipe Velocity, m/sec
C = Friction factor
R = Hydraulic radius (Liquid Area divided by wetted perimeter or D/4, for full pipe, m
S = Hydraulic gradient or frictional headloss per unit lenght of pipe, m/m

2. hf = S x L

where, hf = friction head, m
S = Hydraulic Gradient, m/m
L = Lenght of pipe ,m

3. BKW = Q x TDH/ 102 x e

where, BKW = Brake Power Required
Q = Capacity of pump, lps
TDH = Total Dynamic Head ,m
e = Pump Efficiency, in decimal

III. EQUIVALENT LENGHT OF VALVES & FITTINGS

The equivalent lenghts of straight pipe (m) used for headloss for valves and pipe fittings were based on hydraulic institute institute pipe friction manual.

IV. CALCULATIONS:

1. STATIC HEAD, Hs

$Hs = Z_1 + Z_2$

= 10 m

2. PUMP COLUMN FRICTION HEAD, hf_1

From headloss chart for standard pipe ,friction loss for 4 in (100 mm dia.) standard pipe at

lps						
26.12174	or	414	gpm	is about	1.75	m/100m

Lenght of column = 10 m

$$hf_1 = \text{fric. loss} \times \frac{\text{lenght of column}}{100} = 3 \times 47 / 100 = 0.175$$

3. The disharge head friction headloss , hf_2 , from chart head loss for discharge 90 deg. elbow is about 0.13 m.

hf_2 = 0.13 m

4. DISCHARGE PIPING FRICTION HEAD, hf_3 ,

Pipe O.D. = 114.3 mm dia.
I. D. = 102 mm dia.
Pipe Material = Steel
C = 100

$V = Q / A = 0.015 / 0.7854\ (0.102)^2 =$ 3.197 m/sec

$S = (V / 0.8492 \times C\ R^{0.63})^{1/0.54} = ((1.346 / 0.8492 \times 100 \times (0.102/4)^{0.63})^{1/0.54}$

= 1.665E-01 m/m

$hf_3 = S \times L = 0.033 \times 47.26 =$ 0.167 m

5. TOTAL DYNAMIC HEAD, TDH (m)

$TDH = H_s + h_{f1} + h_{f2} + h_{f3} = 54.6 + 0.8225 + 0.13 + 1.59$

= 10.47 m.

6. BRAKE KW REQUIRED BY PUMP.

BKW = Q x TDH/102 x e = 11 x 57.14/102 x 0.55 = 4.876 KW

BHP = **7** HP, use submersible pump HP

ANNEX D.

SABANG, PUERTO GALERA SEWER SYSTEM

MH no.		Area, sqm.		FLOW, Q (m3/day)			Actual Discharge, Qa	Elevation, m		Pipe Length m	Ground Slope	Pipe Size, mm	Minimum Slope	Maximum Slope	Ideal Slope	Ideal Velocity	Capacity Q Qc, cum/sec	Remarks
From	To	Increment	Total	Qave	Qpeak	Qinfil.		From	To									
MH1	MH2	3,313	3,313	185.83	557	93	0.008	30.00	29.80	50	0.00400	200	0.00220	0.08257	0.00400	0.66	0.021	Adequate
MH2	MH3	4,000	7,313	410.23	1,231	205	0.017	29.80	29.40	50	0.00800	200	0.00220	0.08257	0.00800	0.93	0.029	Adequate
MH3	MH4	3,200	10,513	589.75	1,769	294	0.024	29.40	29.20	40	0.00500	250	0.00220	0.06132	0.00500	0.86	0.042	Adequate
MH4	P1A	2,156	12,669	710.72	2,132	355	0.029	29.20	29.20	25	0.00000	300	0.00190	0.04809	0.00190	0.60	0.042	Adequate
P1A	MH5	750	13,419	752.79	2,258	376	0.030	29.00	29.20	50	0.00400	300	0.00190	0.04809	0.00400	0.87	0.061	Adequate
MH5	MH6	4,375	17,794	998.23	2,995	498	0.040	29.20	29.40	50	0.00400	300	0.00190	0.04809	0.00400	0.87	0.061	Adequate
MH6	MH7	5,375	23,169	1,299.79	3,899	649	0.053	29.40	29.60	50	0.00400	300	0.00190	0.04809	0.00400	0.87	0.061	Adequate
MH7	PSTA.1	1,644	24,813	1,392.00	4,176	695	0.056	29.60	29.80	50	0.00400	350	0.00170	0.03915	0.00400	0.96	0.092	Adequate
PSTA.1	PSTA.3	-	24,813	1,392.00	4,176	695	0.056		-	90		100			-	-	-	pump
PSTA.3	STP	-		-	-	-	-			30		100			-	-	-	pump
		24,813								485								

MH no.		Area, sqm.		FLOW, Q (m3/day)			Actual Discharge, Qa	Elevation, m		Pipe Length, m	Ground Slope	Pipe Size, mm	Minimum Slope	Maximum Slope	Ideal Slope	Ideal Velocity	Capacity Q Qc, cum/sec	Remarks
From	To	Increment	Total	Qave	Qpeak	Qinfil.		From	To									
MH8	MH9	3,625	3,625	203.36	610	102	0.008	30.00	29.85	30	0.00500	200	0.00220	0.08257	0.00500	0.74	0.023	Adequate
MH9	MH10	4,000	7,625	427.76	1,283	214	0.017	29.85	29.70	40	0.00375	200	0.00220	0.08257	0.00375	0.64	0.020	Adequate
MH10	PSTA3	-	7,625	427.76	1,283	214	0.106	29.70	29.55	35	0.00429	400	0.00160	0.03277	0.00429	1.08	0.136	Adequate
		7,625								105								

MH no.		Area, sqm.		FLOW, Q			Actual	Elevation, m		Pipe	Ground	Pipe Size, mm	Minimum	Maximum	Ideal	Ideal	Capacity Q	Remarks
From	To	Increment	Total	Qave	Qpeak	Qinfil.	Discharge, Qa	From	To	Length, m	Slope		Slope	Slope	Slope	Velocity	Qc, cum/sec	
MH17	MH16	2,375	2,375	133.24	400	67	0.005	30.00	29.90	50	0.00200	200	0.00220	0.08257	0.00220	0.49	0.015	Adequate
MH16	MH15	11,788	14,163	794.52	2,384	397	0.032	29.90	29.80	60	0.00167	300	0.00190	0.04809	0.00190	0.60	0.042	Adequate
MH15	MH14	8,800	22,963	1,288.20	3,865	643	0.052	29.80	29.60	40	0.00500	300	0.00190	0.04809	0.00500	0.97	0.068	Adequate
MH14	PSTA2	9,250	32,213	1,807.12	5,421	902	0.073	29.70	29.60	30	0.00333	350	0.00170	0.03915	0.00333	0.88	0.084	Adequate
PSTA2	MH13	-	32,213	1,807.12	5,421	902	0.073	29.60	29.20	35	0.01143	350	0.00170	0.03915	0.01143	1.62	0.156	Adequate
MH13	MH12	469	32,681	1,833.42	5,500	915	0.074	29.50	29.40	38	0.00267	400	0.00170	0.03277	0.00267	0.86	0.108	Adequate
MH12	MH11	688	33,369	1,871.99	5,616	934	0.076	29.40	29.30	40	0.00250	400	0.00160	0.03277	0.00250	0.83	0.104	Adequate
MH11	MH10	5,575	38,944	2,184.74	6,554	1,090	0.088	29.30	29.20	40	0.00250	400	0.00160	0.03277	0.00250	0.83	0.104	Adequate
MH10	PSTA3	-	38,944	2,184.74	6,554	1,090	0.088	29.20	29.10	35	0.00286	400	0.00160	0.03277	0.00286	0.89	0.111	Adequate
PSTA3	STP	-	38,944	2,184.74	6,554	1,090	0.194	29.10	pump	30	pump	pump	pump	pump	pump	pump	pump	pump
		38,944								398								

MH no.		Area, sqm.		FLOW, Q			Actual	Elevation, m		Pipe Length, m	Ground Slope	Pipe Size, mm	Minimum Slope	Maximum Slope	Ideal Slope	Ideal Velocity	Capacity Q	Remarks
From	To	Increment	Total	Qave	Qpeak	Qinfil.	Discharge, Qa	From	To								Qc, cum/sec	
MH32	MH31	6,175	6,175	346.42	1,039	173	0.014	70.00	69.00	65	0.01538	200	0.00220	0.08257	0.01538	1.29	0.041	Adequate
MH31	MH30	6,178	12,353	692.98	2,079	346	0.028	69.00	67.00	60	0.03333	200	0.00220	0.08257	0.03333	1.91	0.060	Adequate
MH30	MH29	11,063	23,415	1,313.58	3,941	656	0.053	68.00	67.00	58	0.01739	300	0.00190	0.04809	0.01739	1.80	0.128	Adequate
MH29	MH27	2,700	26,115	1,465.05	4,395	731	0.059	67.00	66.50	60	0.00833	300	0.00190	0.04809	0.00833	1.25	0.088	Adequate
MH27	MH25	3,750	29,865	1,675.43	5,026	836	0.068	66.50	65.00	50	0.03000	300	0.00190	0.04809	0.03000	2.37	0.167	Adequate
MH25	MH23	8,125	37,990	2,131.24	6,394	1,064	0.086	66.00	62.00	65	0.06154	300	0.00190	0.04809	0.04809	3.00	0.212	Adequate
MH23	MH22	2,100	40,090	2,249.05	6,747	1,123	0.091	62.00	60.00	50	0.04000	300	0.00190	0.04809	0.04000	2.74	0.193	Adequate
MH28	MH26	4,375	4,375	245.44	736	123	0.010	65.00	63.00	50	0.04000	200	0.00220	0.08257	0.04000	2.09	0.066	Adequate
MH26	MH24	5,850	10,225	573.62	1,721	286	0.023	63.00	41.00	58	0.38261	200	0.00220	0.08257	0.08257	3.00	0.094	Adequate
MH24	MH22	2,300	12,525	702.65	2,108	351	0.028	62.00	60.00	50	0.04000	200	0.00220	0.08257	0.04000	2.09	0.066	Adequate
MH22	MH20	2,250	54,865	3,077.93	9,234	1,536	0.125	60.00	40.00	100	0.20000	300	0.00190	0.04809	0.04809	3.00	0.212	Adequate
MH21	MH20	500	500	28.05	84	14	0.001	40.50	40.00	30	0.01667	300	0.00190	0.04809	0.01667	1.77	0.125	Adequate
MH18	MH19	600	600	33.66	101	17	0.001	41.00	40.50	30	0.01667	200	0.00220	0.08257	0.01667	1.35	0.042	Adequate
MH19	MH20	350	950	53.30	160	27	0.002	40.50	40.00	25	0.02000	200	0.00220	0.08257	0.02000	1.48	0.046	Adequate
MH20	P1A		56,315	3,159.27	9,478	1,577	0.128	40.00	29.20	30	0.36000	300	0.00190	0.04809	0.04809	3.00	0.212	Adequate

56,315 780

		Qave	Qpeak	Qinfil.	Discharge, Qa	
TOTAL AREA CONSIDERATION =	127,697	7,163.78	21,491	3,576	25,066.85	FLOW

0.0561

ANNEX E. SEWER COSTS

Project : **PUERTO GALERA SEWER SYSTEM**
Location : **SABANG, PUERTO GALERA, MINDORO**
Subject : **COST ESTIMATES-SEWER LINE (option 1)**
Date: **June 2006**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST	UNIT COST VAT	VAT	TOTAL MARK-UP			TOTAL VALUE	TOTAL	
								OCM	PROFIT	%		INDIRECT COST	COST
PART I	**PIPELINES AND RELATED CIVIL WORKS**												
A	HDPE Pipelines				3,404,964.65		408,595.76	5%	6%	11%	374,546.11	783,141.87	4,188,106.51
B	MH COVER				480,000.00		57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
E	Pavement Demolition				1,668,000.00		166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
F	Surface Restoration				1,751,400.00		175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
G	Over-Excavation for Pipelines				10,346,542.95		692,714.30	5%	6%	11%	1,138,119.72	1,830,834.02	8,381,842.97
H	Miscellaneous				8,629,399.87		482,195.54	5%	6%	11%	949,233.99	1,431,429.53	10,060,829.40
	Total "Part-I" - PIPELINES AND RELATED CIVIL WORKS				26,280,307.47		1,983,045.60	5%	6%	11%	2,890,833.82	4,873,879.42	27,358,652.89
PART II	**CIVIL WORKS**												
A	Structures and Civil Works				2,290,624.00		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,742,359.90
D	Line and Profile Survey				109,562.50		6,068.45	5%	6%	11%	12,051.88	18,120.33	127,682.83
	Total "Part-II" - CIVIL WORKS				2,400,186.50		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,870,042.73
PART III	**ELECTRO-MECHANICAL EQUIPMENT WORKS**												
A.1	Submersible Pump Complete with Accessories				3,600,000.00		432,000.00	5%	6%	11%	396,000.00	3,996,000.00	4,428,000.00

A.3	Valves and Fittings (G.I. Pipe)				360,000.00		43,200.00	5%	6%	11%	39,600.00	399,600.00	442,800.00
A.4	HDPE Fittings				2,591,681.40		311,001.77	5%	6%	11%	285,084.95	2,876,766.35	3,187,768.12
	Total"Part-III" - ELECTRO-MECHANICAL WORKS				6,551,681.40		786,201.77	5%	6%	11%	720,684.95	1,506,886.72	8,058,568.12
PART IV	**SPECIAL ITEMS**												
A	Bonds, Insurances and Interests							1%		1%	360,234.12	360,234.12	360,234.12
B	Temporary Site Facilities, Project Organization and Resource Movement									1%	360,234.12	360,234.12	360,234.12
C	Project Signs and COA Signboards				71,236.73		4932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D	Service Vehicle for Resident Engineer				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E	Resident Engineer's Office				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Total"Part-IV" - SPECIAL ITEMS				791,236.73		4932.01				749,904.28	754,836.30	1,546,073.03
	TOTAL OF PART I TO IV				**36,023,412.10**		2,973,946.64	6%	6%	13.0%	4,613,391.70	7,587,338.33	**39,833,336.76**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST		VAT	TOTAL MARK-UP			TOTAL VALUE	Total	
								OCM	PROFIT	%		INDIRECT COST	COST
	PART I - PIPELINES AND RELATED CIVIL WORKS												
A	PIPELINES												
A.1	SEWER LINES, HDPE SPIRAL PIPES												
	1.1 1000mm (36")	LM		6,712	0.00	805.42	0.00	5%	6%	11%	0.00	0.00	0.00
	1.2 800mm (32")	LM		5,671	0.00	680.57	0.00	5%	6%	11%	0.00	0.00	0.00
	1.3 600mm (24")	LM		3,364	0.00	403.66	0.00	5%	6%	11%	0.00	0.00	0.00
	1.4 500mm (20")	LM		2,304	0.00	276.45	0.00	5%	6%	11%	0.00	0.00	0.00
	1.5 450mm (18")	LM		1,748	0.00	209.76	0.00	5%	6%	11%	0.00	0.00	0.00

	1.6 400mm (16")	LM	688	1,459	1,003,081.75	175.08	120,369.81	5%	6%	11%	110338.99	230,708.80	1,233,790.55
	1.7 350mm (14")	LM	150	1,036.25	155,438.03	124.35	18,652.56	5%	6%	11%	17098.18	35,750.75	191,188.77
	1.8 300mm (12")	LM	718	1,150.41	825,422.05	138.05	99,050.65	5%	6%	11%	90796.42	189,847.07	1,015,269.12
	1.9 250mm (10")	LM	40	365.07	14,602.70	43.81	1,752.32	5%	6%	11%	1606.30	3,358.62	17,961.32
	2.0 200mm (8")	LM	558	750.21	418,244.31	90.03	50,189.32	5%	6%	11%	46006.87	96,196.19	514,440.50
	2.1 150mm (6")	LM	1,000	365.07	365,067.50	43.81	43,808.10	5%	6%	11%	40157.43	83,965.53	449,033.03
	2.2 100mm (4")	LM	1,000	239.20	239,200.00	28.70	28,704.00	5%	6%	11%	26312.00	55,016.00	294,216.00
	2.3 150mm (6") G.I. Steel pipe	LM	130	2,088.62	271,521.12	250.63	32,582.53	5%	6%	11%	29867.32	62,449.86	333,970.98
	2.4 100mm (4") G.I. Steel pipe	LM	100	1,123.87	112,387.20	134.86	13,486.46	5%	6%	11%	12362.59	25,849.06	138,236.26
ST-A	Sub-Total for Pipelines		4,383	28,376.59	3,404,964.65	3,405.19	408,595.76	5%	6%	11%	374546.11	783,141.87	4,188,106.51
B	MH cover												
B.1	600mm MH cover												
	1.1 800mm (32")	set	32	15,000.00	480,000.00	1,800.00	57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
	4.1 75mm (3")	set	0	2,704.32	-	369.29	-	5%	6%	11%	-	-	-
ST-B	Sub-Total for mh cover			17,704.32	480,000.00	2,169.29	57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
C	OVER-EXCAVATION FOR PIPELINES												
C.1	Below 1.2m to 3.5m depth (trench excavation)	cm	9,686	350.00	3,390,187.50	35.00	339,018.75	5%	6%	11%	372,920.63	711,939.38	4,102,126.88
C.2	MH Excavation and Backfilling	cm	138	350.00	48,384.00	35.00	4,838.40	5%	6%	11%	5,322.24	10,160.64	58,544.64
C.3	Pumping Sta. Excavation and Backfilling	cm	5,400	350.00	1,890,000.00	35.00	189,000.00	5%	6%	11%	207,900.00	396,900.00	2,286,900.00
C.4	Hauling	cm	4,567	350.00	1,598,571.45	35.00	159,857.15	5%	6%	11%	175,842.86	335,700.00	1,934,271.45
C5	Pavement Demolition	cm	2,780	600	1,668,000.00	60.00	166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
C6	Surface Restoration	cm	500	3,500	1,751,400.00	350.00	175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
C7		cm						5%	6%	11%			
ST-G	Sub-Total for Over-Excavation For Pipelines			5,500.00	10,346,542.95	550.00	692,714.30	5%	6%	11%	1,138,119.72	2,172,774.02	8,381,842.97

H	MISCELLANEOUS												
H.1	Sand bedding to be furnished and construct by contractor												
	when ordered by the Engineer.	cm	843	301.92	254,477.04	8.55	7,206.37	5%	6%	11%	27,992.47	35,198.84	289,675.88
H.2	Crushed rock bedding to be furnished and installed when ordered by												
	the Engineer.	cm	179	646.62	115,437.90	11.85	2,114.87	5%	6%	11%	12,698.17	14,813.04	130,250.94
H.3	Reinforced concrete encasement to be furnished and installed when												
	ordered by the Engineer. (optional)	cm	1,714	2,500.00	4,285,000.00	104.45	179,033.32	5%	6%	11%	471,350.00	650,383.32	4,935,383.32
H.4	Concrete Blocks/Concrete Anchor block to be furnished and installed												
	when ordered by the Engineer.	cm	877	2,086.04	1,828,411.21	90.40	79,233.61	5%	6%	11%	201,125.23	280,358.85	2,108,770.06
H.5	Rock Excavation	cm	2,906	737.64	2,143,493.31	73.76	214,349.33	5%	6%	11%	235,784.26	450,133.60	2,593,626.91
H.6	Limestone/Coral Excavation	cm	20	129.02	2,580.41	12.90	258.04	5%	6%	11%	283.84	541.89	3,122.29
ST-H	Sub-Total for Miscellaneous			6,401	8,629,399.87	301.91	482,195.54	5%	6%	11%	949,233.99	1,431,429.53	10,060,829.40
	PART II - CIVIL WORKS												
A	STRUCTURES												
A.1	Concrete Manhole & Pumping Sta. structure												
	1.2.1 Concrete MH	cum	152	3,500.00	532,224.00	350.00	193,698.81	5%	6%	11%	58,544.64	252,243.45	784,467.45
	2.1.2 Pumping Sta	cum	502	3,500.00	1,758,400.00	350.00	6,068.45	5%	6%	11%	193,424.00	199,492.45	1,957,892.45
A.2	Line and profile survey	km	4	25,000.00	109,562.50	2,500.00	6,068.45	5%	6%	11%	12,051.88	18,120.33	127,682.83
				7,000.00	2,290,624.00	700.00	199,767.26	5%	6%		251,968.64	451,735.90	2,742,359.90
A.1	Submersible Pump Complete with Accessories and control	set	12	300,000	3,600,000.00	36,000.00	432,000.00	5%	6%	11%	396,000.00	828,000.00	4,428,000.00
A.2	Valves and Fittings (G.I. Pipe)	set	72	5,000	360,000.00	600.00	43,200.00	5%	6%	11%	39,600.00	82,800.00	442,800.00
A.3	HDPE Fittings	set	2,710	956				5%	6%	11%			

					2,591,681.40	114.76	311,001.77				285,084.95	596,086.72	3,187,768.12
	Sub-Total for Proposed Submersible Pump			305,956	6,551,681.40	36,714.76	786,201.77	5%	6%	11%	720,684.95	1,506,886.72	8,058,568.12
	PART IV - SPECIAL ITEMS												
A.	Provide bonds, insurance and interest as specified.	LS	1					1%		1%	360,234.12	360,234.12	360,234.12
B.	Temporary site facilities, project organization and resource movement.	LS	1							1%	360,234.12	360,234.12	360,234.12
C.	Provide and install five (5) project signs and one (1) COA signboard.	LS	1	71,237	71,236.73	4,932.01	4,932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D.	Provide and maintain one (1) service vehicle for the use of Residents Engineer	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E.	Resident Engineer's Office including Engineers Requirements.	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Sub-Total for Special items			791,237	791,236.73	4,932.01	4,932.01	5%	6%		749,904.28	754,836.30	1,546,073.03

Option 2

Project : **PUERTO GALERA SEWER SYSTEM**
Location : **SABANG, PUERTO GALERA, MINDORO**
Subject : **COST ESTIMATES-SEWER LINE (option 2)**
Date: **June 2006**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST	UNIT COST VAT	VAT	TOTAL MARK-UP			TOTAL VALUE	TOTAL	
								OCM	PROFIT	%		INDIRECT COST	COST
PART I	**PIPELINES AND RELATED CIVIL WORKS**												
A	HDPE Pipelines				2,672,073.19		320,648.78	5%	6%	11%	293,928.05	614,576.83	3,286,650.03
B	MH COVER				465,000.00		55,800.00	5%	6%	11%	51,150.00	106,950.00	571,950.00
E	Pavement Demolition				1,668,000.00		166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
F	Surface Restoration				1,751,400.00		175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
G	Over-Excavation for Pipelines				9,568,574.85		614,917.49	5%	6%	11%	1,052,543.23	1,667,460.72	7,440,501.57
H	Miscellaneous				7,693,360.51		422,199.30	5%	6%	11%	846,269.66	1,268,468.96	8,961,829.47
	Total "Part-I" - PIPELINES AND RELATED CIVIL WORKS				23,818,408.56		1,755,505.57	5%	6%	11%	2,620,024.94	4,375,530.51	24,398,405.07
PART II	**CIVIL WORKS**												
A	Structures and Civil Works				2,273,992.00		199,767.26	5%	6%	11%	250,139.12	449,906.38	2,723,898.38
D	Line and Profile Survey				97,587.50		6,068.45	5%	6%	11%	10,734.63	16,803.08	114,390.58
	Total "Part-II" - CIVIL WORKS				2,371,579.50		199,767.26	5%	6%	11%	250,139.12	449,906.38	2,838,288.96

PART III	**ELECTRO-MECHANICAL EQUIPMENT WORKS**												
A.1	Submersible Pump Complete with Accessories				3,600,000.00		432,000.00	5%	6%	11%	396,000.00	3,996,000.00	4,428,000.00
A.3	Valves and Fittings (G.I. Pipe)				360,000.00		43,200.00	5%	6%	11%	39,600.00	399,600.00	442,800.00
A.4	HDPE Fittings				2,229,228.54		267,507.42	5%	6%	11%	245,215.14	2,474,443.68	2,741,951.10
	Total"Part-III" - ELECTRO-MECHANICAL WORKS				6,189,228.54		742,707.42	5%	6%	11%	680,815.14	1,423,522.56	7,612,751.10
PART IV	**SPECIAL ITEMS**												
A	Bonds, Insurances and Interests							1%		1%	331,704.53	331,704.53	331,704.53
B	Temporary Site Facilities, Project Organization and Resource Movement									1%	331,704.53	331,704.53	331,704.53
C	Project Signs and COA Signboards				71,236.73		4932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D	Service Vehicle for Resident Engineer				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E	Resident Engineer's Office				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Total"Part-IV" - SPECIAL ITEMS				791,236.73		4932.01				692,845.11	697,777.12	1,489,013.85
	TOTAL OF PART I TO IV				**33,170,453.33**		2,702,912.27	6%	6%	13.0%	4,243,824.31	6,946,736.57	**36,338,458.98**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST		VAT	TOTAL MARK-UP			TOTAL VALUE	Total	
								OCM	PROFIT	%		INDIRECT COST	COST
	PART I - PIPELINES AND RELATED CIVIL WORKS												
A	PIPELINES												
A.1	SEWER LINES, HDPE SPIRAL PIPES												
	1.1 1000mm (36")	LM		6,712	0.00	805.42	0.00	5%	6%	11%	0.00	0.00	0.00
	1.2 800mm (32")	LM		5,671	0.00	680.57	0.00	5%	6%	11%	0.00	0.00	0.00
	1.3 600mm (24")	LM		3,364	0.00	403.66	0.00	5%	6%	11%	0.00	0.00	0.00
	1.4 500mm (20")	LM		2,304	0.00	276.45	0.00	5%	6%	11%	0.00	0.00	0.00
	1.5 450mm (18")	LM		1,748	0.00	209.76	0.00	5%	6%	11%	0.00	0.00	0.00
	1.6 400mm (16")	LM	309	1,459	450,110.14	175.08	54,013.22	5%	6%	11%	49512.12	103,525.33	553,635.47
	1.7 350mm (14")	LM	150	1,036.25	155,438.03	124.35	18,652.56	5%	6%	11%	17098.18	35,750.75	191,188.77
	1.8 300mm (12")	LM	718	1,150.41	825,422.05	138.05	99,050.65	5%	6%	11%	90796.42	189,847.07	1,015,269.12
	1.9 250mm (10")	LM	40	365.07	14,602.70	43.81	1,752.32	5%	6%	11%	1606.30	3,358.62	17,961.32
	2.0 200mm (8")	LM	558	750.21	418,244.31	90.03	50,189.32	5%	6%	11%	46006.87	96,196.19	514,440.50
	2.1 150mm (6")	LM	1,000	365.07	365,067.50	43.81	43,808.10	5%	6%	11%	40157.43	83,965.53	449,033.03
	2.2 100mm (4")	LM	1,000	239.20	239,200.00	28.70	28,704.00	5%	6%	11%	26312.00	55,016.00	294,216.00
	2.3 150mm (6") G.I. Steel pipe	LM	60	2,088.62	125,317.44	250.63	15,038.09	5%	6%	11%	13784.92	28,823.01	154,140.45
	2.4 100mm (4") G.I. Steel pipe	LM	70	1,123.87	78,671.04	134.86	9,440.52	5%	6%	11%	8653.81	18,094.34	96,765.38
ST-A	Sub-Total for Pipelines		3,904	28,376.59	2,672,073.19	3,405.19	320,648.78	5%	6%	11%	293928.05	614,576.83	3,286,650.03
B	MH cover												
B.1	600mm MH cover												
	1.1 800mm (32")	set	31	15,000.00	465,000.00	1,800.00	55,800.00	5%	6%	11%	51,150.00	106,950.00	571,950.00
	4.1 75mm (3")	set	0	2,704.32	-	369.29	-	5%	6%	11%	-	-	-

ST-B	Sub-Total for mh cover			17,704.32	465,000.00	2,169.29	55,800.00	5%	6%	11%	51,150.00	106,950.00	571,950.00
C	OVER-EXCAVATION FOR PIPELINES												
C.1	Below 1.2m to 3.5m depth (trench excavation)	cm	7,981	350.00	2,793,262.50	35.00	279,326.25	5%	6%	11%	307,258.88	586,585.13	3,379,847.63
C.2	MH Excavation and Backfilling	cm	134	350.00	46,872.00	35.00	4,687.20	5%	6%	11%	5,155.92	9,843.12	56,715.12
C.3	Pumping Sta. Excavation and Backfilling	cm	5,400	350.00	1,890,000.00	35.00	189,000.00	5%	6%	11%	207,900.00	396,900.00	2,286,900.00
C.4	Hauling	cm	4,054	350.00	1,419,040.35	35.00	141,904.04	5%	6%	11%	156,094.44	297,998.47	1,717,038.82
C5	Pavement Demolition	cm	2,780	600	1,668,000.00	60.00	166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
C6	Surface Restoration	cm	500	3,500	1,751,400.00	350.00	175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
C7		cm						5%	6%	11%			
ST-G	Sub-Total for Over-Excavation For Pipelines			5,500.00	9,568,574.85	550.00	614,917.49	5%	6%	11%	1,052,543.23	2,009,400.72	7,440,501.57
H	MISCELLANEOUS												
H.1	Sand bedding to be furnished and construct by contractor												
	when ordered by the Engineer.	cm	703	301.92	212,141.19	8.55	6,007.49	5%	6%	11%	23,335.53	29,343.02	241,484.21
H.2	Crushed rock bedding to be furnished and installed when ordered by												
	the Engineer.	cm	124	646.62	80,240.86	11.85	1,470.04	5%	6%	11%	8,826.50	10,296.54	90,537.40
H.3	Reinforced concrete encasement to be furnished and installed when												
	ordered by the Engineer. (optional)	cm	1,602	2,500.00	4,003,750.00	104.45	167,282.30	5%	6%	11%	440,412.50	607,694.80	4,611,444.80
H.4	Concrete Blocks/Concrete Anchor block to be furnished and installed												
	when ordered by the Engineer.	cm	781	2,086.04	1,628,568.89	90.40	70,573.51	5%	6%	11%	179,142.58	249,716.09	1,878,284.98
H.5	Rock Excavation	cm	2,394	737.64	1,766,079.16	73.76	176,607.92	5%	6%	11%	194,268.71	370,876.62	2,136,955.78
H.6	Limestone/Coral Excavation	cm	20	129.02	2,580.41	12.90	258.04	5%	6%	11%	283.84	541.89	3,122.29

ST-H	Sub-Total for Miscellaneous			6,401	7,693,360.51	301.91	422,199.30	5%	6%	11%	846,269.66	1,268,468.96	8,961,829.47
	PART II - CIVIL WORKS												
A	STRUCTURES												
A.1	Concrete Manhole & Pumping Sta. structure												
	1.2.1 Concrete MH	cum	147	3,500.00	515,592.00	350.00	193,698.81	5%	6%	11%	56,715.12	250,413.93	766,005.93
	2.1.2 Pumping Sta	cum	502	3,500.00	1,758,400.00	350.00	6,068.45	5%	6%	11%	193,424.00	199,492.45	1,957,892.45
A.2	Line and profile survey	km	4	25,000.00	97,587.50	2,500.00	6,068.45	5%	6%	11%	10,734.63	16,803.08	114,390.58
				7,000.00	2,273,992.00	700.00	199,767.26	5%	6%		250,139.12	449,906.38	2,723,898.38
A.1	Submersible Pump Complete with Accessories and control	set	12	300,000	3,600,000.00	36,000.00	432,000.00	5%	6%	11%	396,000.00	828,000.00	4,428,000.00
A.2	Valves and Fittings (G.I. Pipe)	set	72	5,000	360,000.00	600.00	43,200.00	5%	6%	11%	39,600.00	82,800.00	442,800.00
A.3	HDPE Fittings	set	2,331	956	2,229,228.54	114.76	267,507.42	5%	6%	11%	245,215.14	512,722.56	2,741,951.10
	Sub-Total for Proposed Submersible Pump			305,956	6,189,228.54	36,714.76	742,707.42	5%	6%	11%	680,815.14	1,423,522.56	7,612,751.10
	PART IV - SPECIAL ITEMS												
A.	Provide bonds, insurance and interest as specified.	LS	1					1%		1%	331,704.53	331,704.53	331,704.53
B.	Temporary site facilities, project organization and resource movement.	LS	1							1%	331,704.53	331,704.53	331,704.53
C.	Provide and install five (5) project signs and one (1) COA signboard.	LS	1	71,237	71,236.73	4,932.01	4,932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D.	Provide and maintain one (1) service vehicle for the use of Residents Engineer	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E.	Resident Engineer's Office including Engineers Requirements.	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Sub-Total for Special items			791,237	791,236.73	4,932.01	4,932.01	5%	6%		692,845.11	697,777.12	1,489,013.85

Option 3

Project : **PUERTO GALERA SEWER SYSTEM**
Location : **SABANG, PUERTO GALERA, MINDORO**
Subject : **COST ESTIMATES-SEWER LINE (option 3)**
Date: **June 2006**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST	UNIT COST VAT	VAT	TOTAL MARK-UP			TOTAL VALUE	TOTAL	
								OCM	PROFIT	%		INDIRECT COST	COST
PART I	**PIPELINES AND RELATED CIVIL WORKS**												
A	HDPE Pipelines				2,891,767.61		347,012.11	5%	6%	11%	318,094.44	665,106.55	3,556,874.15
B	MH COVER				480,000.00		57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
E	Pavement Demolition				1,668,000.00		166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
F	Surface Restoration				1,751,400.00		175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
G	Over-Excavation for Pipelines				9,732,292.95		631,289.30	5%	6%	11%	1,070,552.22	1,701,841.52	7,638,600.47
H	Miscellaneous				8,154,742.07		445,146.78	5%	6%	11%	897,021.63	1,342,168.41	9,496,910.47
	Total "Part-I" - PIPELINES AND RELATED CIVIL WORKS				24,678,202.62		1,822,988.19	5%	6%	11%	2,714,602.29	4,537,590.48	25,420,259.10
PART II	**CIVIL WORKS**												
A	Structures and Civil Works				2,290,624.00		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,742,359.90
D	Line and Profile Survey				100,812.50		6,068.45	5%	6%	11%	11,089.38	17,157.83	117,970.33
	Total "Part-II" - CIVIL WORKS				2,391,436.50		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,860,330.23

PART III	**ELECTRO-MECHANICAL EQUIPMENT WORKS**												
A.1	Submersible Pump Complete with Accessories				3,600,000.00		432,000.00	5%	6%	11%	396,000.00	3,996,000.00	4,428,000.00
A.3	Valves and Fittings (G.I. Pipe)				360,000.00		43,200.00	5%	6%	11%	39,600.00	399,600.00	442,800.00
A.4	HDPE Fittings				2,304,779.40		276,573.53	5%	6%	11%	253,525.73	2,558,305.13	2,834,878.66
	Total"Part-III" - ELECTRO-MECHANICAL WORKS				6,264,779.40		751,773.53	5%	6%	11%	689,125.73	1,440,899.26	7,705,678.66
PART IV	**SPECIAL ITEMS**												
A	Bonds, Insurances and Interests							1%		1%	341,256.55	341,256.55	341,256.55
B	Temporary Site Facilities, Project Organization and Resource Movement									1%	341,256.55	341,256.55	341,256.55
C	Project Signs and COA Signboards				71,236.73		4932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D	Service Vehicle for Resident Engineer				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E	Resident Engineer's Office				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Total"Part-IV" - SPECIAL ITEMS				791,236.73		4932.01				711,949.15	716,881.16	1,508,117.89
	TOTAL OF PART I TO IV				**34,125,655.26**		2,779,460.99	6%	6%	13.0%	4,367,645.81	7,147,106.80	**37,494,385.88**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST		VAT	TOTAL MARK-UP			TOTAL VALUE	Total	
								OCM	PROFIT	%		INDIRECT COST	COST
	PART I - PIPELINES AND RELATED CIVIL WORKS												
A	PIPELINES												
A.1	SEWER LINES, HDPE SPIRAL PIPES												
	1.1 1000mm (36")	LM		6,712	0.00	805.42	0.00	5%	6%	11%	0.00	0.00	0.00
	1.2 800mm (32")	LM		5,671	0.00	680.57	0.00	5%	6%	11%	0.00	0.00	0.00
	1.3 600mm (24")	LM		3,364	0.00	403.66	0.00	5%	6%	11%	0.00	0.00	0.00
	1.4 500mm (20")	LM		2,304	0.00	276.45	0.00	5%	6%	11%	0.00	0.00	0.00
	1.5 450mm (18")	LM		1,748	0.00	209.76	0.00	5%	6%	11%	0.00	0.00	0.00
	1.6 400mm (16")	LM	388	1,459	565,373.35	175.08	67,844.80	5%	6%	11%	62191.07	130,035.87	695,409.22
	1.7 350mm (14")	LM	150	1,036.25	155,438.03	124.35	18,652.56	5%	6%	11%	17098.18	35,750.75	191,188.77
	1.8 300mm (12")	LM	718	1,150.41	825,422.05	138.05	99,050.65	5%	6%	11%	90796.42	189,847.07	1,015,269.12
	1.9 250mm (10")	LM	40	365.07	14,602.70	43.81	1,752.32	5%	6%	11%	1606.30	3,358.62	17,961.32
	2.0 200mm (8")	LM	558	750.21	418,244.31	90.03	50,189.32	5%	6%	11%	46006.87	96,196.19	514,440.50
	2.1 150mm (6")	LM	1,000	365.07	365,067.50	43.81	43,808.10	5%	6%	11%	40157.43	83,965.53	449,033.03
	2.2 100mm (4")	LM	1,000	239.20	239,200.00	28.70	28,704.00	5%	6%	11%	26312.00	55,016.00	294,216.00
	2.3 150mm (6") G.I. Steel pipe	LM	110	2,088.62	229,748.64	250.63	27,569.84	5%	6%	11%	25272.35	52,842.19	282,590.83
	2.4 100mm (4") G.I. Steel pipe	LM	70	1,123.87	78,671.04	134.86	9,440.52	5%	6%	11%	8653.81	18,094.34	96,765.38
ST-A	Sub-Total for Pipelines		4,033	28,376.59	2,891,767.61	3,405.19	347,012.11	5%	6%	11%	318094.44	665,106.55	3,556,874.15
B	MH cover												
B.1	600mm MH cover												
	1.1 800mm (32")	set	32	15,000.00	480,000.00	1,800.00	57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
	4.1 75mm (3")	set	0	2,704.32	-	369.29	-	5%	6%	11%	-	-	-

ST-B	Sub-Total for mh cover			17,704.32	480,000.00	2,169.29	57,600.00	5%	6%	11%	52,800.00	110,400.00	590,400.00
C	OVER-EXCAVATION FOR PIPELINES												
C.1	Below 1.2m to 3.5m depth (trench excavation)	cm	8,336	350.00	2,917,687.50	35.00	291,768.75	5%	6%	11%	320,945.63	612,714.38	3,530,401.88
C.2	MH Excavation and Backfilling	cm	138	350.00	48,384.00	35.00	4,838.40	5%	6%	11%	5,322.24	10,160.64	58,544.64
C.3	Pumping Sta. Excavation and Backfilling	cm	5,400	350.00	1,890,000.00	35.00	189,000.00	5%	6%	11%	207,900.00	396,900.00	2,286,900.00
C.4	Hauling	cm	4,162	350.00	1,456,821.45	35.00	145,682.15	5%	6%	11%	160,250.36	305,932.50	1,762,753.95
C5	Pavement Demolition	cm	2,780	600	1,668,000.00	60.00	166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
C6	Surface Restoration	cm	500	3,500	1,751,400.00	350.00	175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
C7		cm						5%	6%	11%			
ST-G	Sub-Total for Over-Excavation For Pipelines			5,500.00	9,732,292.95	550.00	631,289.30	5%	6%	11%	1,070,552.22	2,043,781.52	7,638,600.47
H	MISCELLANEOUS												
H.1	Sand bedding to be furnished and construct by contractor												
	when ordered by the Engineer.	cm	744	301.92	224,586.52	8.55	6,359.92	5%	6%	11%	24,704.52	31,064.43	255,650.95
H.2	Crushed rock bedding to be furnished and installed when ordered by												
	the Engineer.	cm	179	646.62	115,437.90	11.85	2,114.87	5%	6%	11%	12,698.17	14,813.04	130,250.94
H.3	Reinforced concrete encasement to be furnished and installed when												
	ordered by the Engineer. (optional)	cm	1,714	2,500.00	4,285,000.00	104.45	179,033.32	5%	6%	11%	471,350.00	650,383.32	4,935,383.32
H.4	Concrete Blocks/Concrete Anchor block to be furnished and installed												
	when ordered by the Engineer.	cm	807	2,086.04	1,682,388.64	90.40	72,905.77	5%	6%	11%	185,062.75	257,968.52	1,940,357.16
H.5	Rock Excavation	cm	2,501	737.64	1,844,748.60	73.76	184,474.86	5%	6%	11%	202,922.35	387,397.21	2,232,145.80
H.6	Limestone/Coral Excavation	cm	20	129.02	2,580.41	12.90	258.04	5%	6%	11%	283.84	541.89	3,122.29

ST-H	Sub-Total for Miscellaneous			6,401	8,154,742.07	301.91	445,146.78	5%	6%	11%	897,021.63	1,342,168.41	9,496,910.47
	PART II - CIVIL WORKS												
A	STRUCTURES												
A.1	Concrete Manhole & Pumping Sta. structure												
	1.2.1 Concrete MH	cum	152	3,500.00	532,224.00	350.00	193,698.81	5%	6%	11%	58,544.64	252,243.45	784,467.45
	2.1.2 Pumping Sta	cum	502	3,500.00	1,758,400.00	350.00	6,068.45	5%	6%	11%	193,424.00	199,492.45	1,957,892.45
A.2	Line and profile survey	km	4	25,000.00	100,812.50	2,500.00	6,068.45	5%	6%	11%	11,089.38	17,157.83	117,970.33
				7,000.00	2,290,624.00	700.00	199,767.26	5%	6%		251,968.64	451,735.90	2,742,359.90
A.1	Submersible Pump Complete with Accessories and control	set	12	300,000	3,600,000.00	36,000.00	432,000.00	5%	6%	11%	396,000.00	828,000.00	4,428,000.00
A.2	Valves and Fittings (G.I. Pipe)	set	72	5,000	360,000.00	600.00	43,200.00	5%	6%	11%	39,600.00	82,800.00	442,800.00
A.3	HDPE Fittings	set	2,410	956	2,304,779.40	114.76	276,573.53	5%	6%	11%	253,525.73	530,099.26	2,834,878.66
	Sub-Total for Proposed Submersible Pump			305,956	6,264,779.40	36,714.76	751,773.53	5%	6%	11%	689,125.73	1,440,899.26	7,705,678.66
	PART IV - SPECIAL ITEMS												
A.	Provide bonds, insurance and interest as specified.	LS	1					1%		1%	341,256.55	341,256.55	341,256.55
B.	Temporary site facilities, project organization and resource movement.	LS	1							1%	341,256.55	341,256.55	341,256.55
C.	Provide and install five (5) project signs and one (1) COA signboard.	LS	1	71,237	71,236.73	4,932.01	4,932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D.	Provide and maintain one (1) service vehicle for the use of Residents Engineer	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E.	Resident Engineer's Office including Engineers Requirements.	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Sub-Total for Special items			791,237	791,236.73	4,932.01	4,932.01	5%	6%		711,949.15	716,881.16	1,508,117.89

Option 4

Project : **PUERTO GALERA SEWER SYSTEM**
Location : **SABANG, PUERTO GALERA, MINDORO**
Subject : **COST ESTIMATES-SEWER LINE (option 4)**
Date: **June 2006**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST	UNIT COST VAT	VAT	TOTAL MARK-UP			TOTAL VALUE	TOTAL	
								OCM	PROFIT	%		INDIRECT COST	COST
PART I	**PIPELINES AND RELATED CIVIL WORKS**												
A	HDPE Pipelines				3,837,583.42		460,510.01	5%	6%	11%	422,134.18	882,644.19	4,720,227.61
B	MH COVER				540,000.00		64,800.00	5%	6%	11%	59,400.00	124,200.00	664,200.00
E	Pavement Demolition				1,668,000.00		166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
F	Surface Restoration				1,751,400.00		175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
G	Over-Excavation for Pipelines				10,858,417.95		743,901.80	5%	6%	11%	1,194,425.97	1,938,327.77	9,001,211.72
H	Miscellaneous				9,020,937.29		512,996.97	5%	6%	11%	992,303.10	1,505,300.07	10,526,237.37
	Total "Part-I" - PIPELINES AND RELATED CIVIL WORKS				27,676,338.66		2,124,148.78	5%	6%	11%	3,044,397.25	5,168,546.03	29,049,350.69
PART II	**CIVIL WORKS**												
A	Structures and Civil Works				2,290,624.00		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,742,359.90
D	Line and Profile Survey				117,062.50		6,068.45	5%	6%	11%	12,876.88	18,945.33	136,007.83
	Total "Part-II" - CIVIL WORKS				2,407,686.50		199,767.26	5%	6%	11%	251,968.64	451,735.90	2,878,367.73

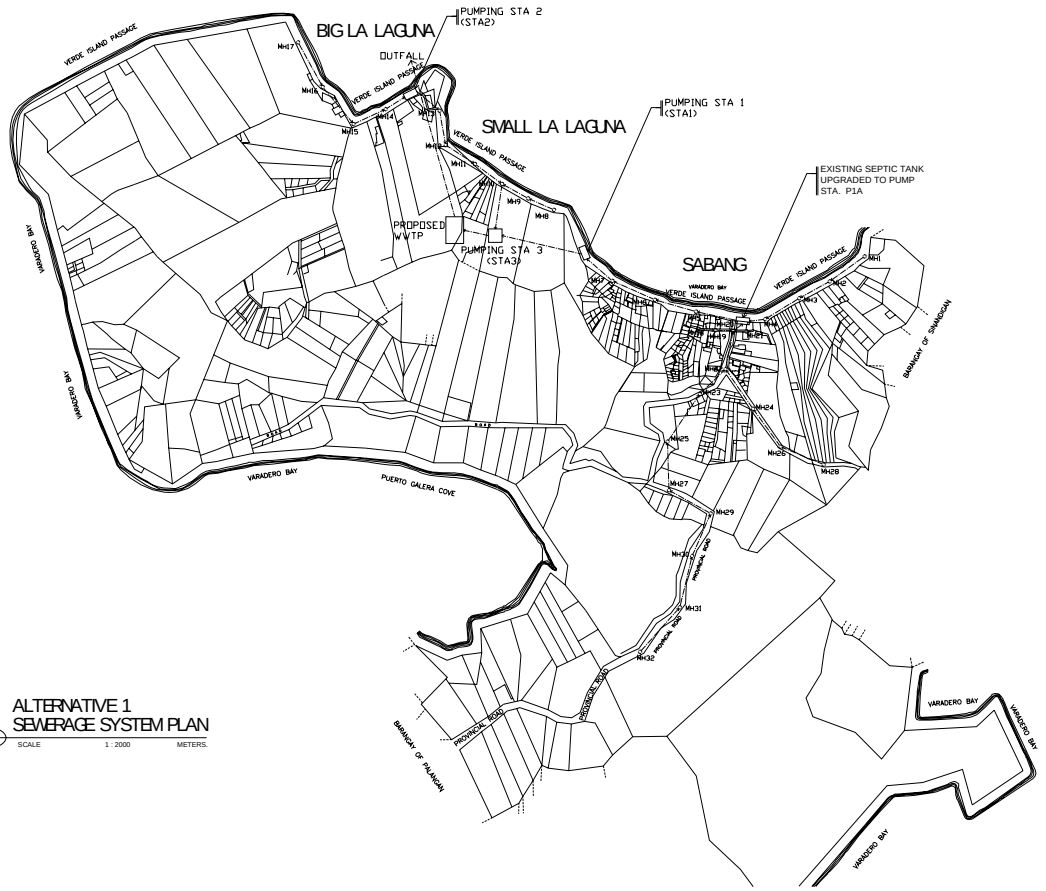
PART III	**ELECTRO-MECHANICAL EQUIPMENT WORKS**												
A.1	Submersible Pump Complete with Accessories				3,600,000.00		432,000.00	5%	6%	11%	396,000.00	3,996,000.00	4,428,000.00
A.3	Valves and Fittings (G.I. Pipe)				360,000.00		43,200.00	5%	6%	11%	39,600.00	399,600.00	442,800.00
A.4	HDPE Fittings				2,830,766.40		339,691.97	5%	6%	11%	311,384.30	3,142,150.70	3,481,842.67
	Total"Part-III" - ELECTRO-MECHANICAL WORKS				6,790,766.40		814,891.97	5%	6%	11%	746,984.30	1,561,876.27	8,352,642.67
PART IV	**SPECIAL ITEMS**												
A	Bonds, Insurances and Interests							1%		1%	376,660.28	376,660.28	376,660.28
B	Temporary Site Facilities, Project Organization and Resource Movement									1%	376,660.28	376,660.28	376,660.28
C	Project Signs and COA Signboards				71,236.73		4932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D	Service Vehicle for Resident Engineer				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E	Resident Engineer's Office				360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Total"Part-IV" - SPECIAL ITEMS				791,236.73		4932.01				782,756.61	787,688.62	1,578,925.35
	TOTAL OF PART I TO IV				**37,666,028.30**		3,143,740.02	6%	6%	13.0%	4,826,106.80	7,969,846.82	**41,859,286.45**

ITEM	WORK ITEM	UNIT	QTY	UNIT COST	ESTIMATED DIRECT COST		VAT	TOTAL MARK-UP			TOTAL VALUE	Total INDIRECT COST	COST
								OCM	PROFIT	%			
	PART I - PIPELINES AND RELATED CIVIL WORKS												
A	PIPELINES												
A.1	SEWER LINES, HDPE SPIRAL PIPES												

	1.1 1000mm (36")	LM		6,712	0.00	805.42	0.00	5%	6%	11%	0.00	0.00	0.00
	1.2 800mm (32")	LM		5,671	0.00	680.57	0.00	5%	6%	11%	0.00	0.00	0.00
	1.3 600mm (24")	LM		3,364	0.00	403.66	0.00	5%	6%	11%	0.00	0.00	0.00
	1.4 500mm (20")	LM		2,304	0.00	276.45	0.00	5%	6%	11%	0.00	0.00	0.00
	1.5 450mm (18")	LM		1,748	0.00	209.76	0.00	5%	6%	11%	0.00	0.00	0.00
	1.6 400mm (16")	LM	838	1,459	1,221,935.95	175.08	146,632.31	5%	6%	11%	134412.95	281,045.27	1,502,981.22
	1.7 350mm (14")	LM	200	1,036.25	207,250.70	124.35	24,870.08	5%	6%	11%	22797.58	47,667.66	254,918.36
	1.8 300mm (12")	LM	768	1,150.41	882,942.75	138.05	105,953.13	5%	6%	11%	97123.70	203,076.83	1,086,019.58
	1.9 250mm (10")	LM	40	365.07	14,602.70	43.81	1,752.32	5%	6%	11%	1606.30	3,358.62	17,961.32
	2.0 200mm (8")	LM	558	750.21	418,244.31	90.03	50,189.32	5%	6%	11%	46006.87	96,196.19	514,440.50
	2.1 150mm (6")	LM	1,000	365.07	365,067.50	43.81	43,808.10	5%	6%	11%	40157.43	83,965.53	449,033.03
	2.2 100mm (4")	LM	1,000	239.20	239,200.00	28.70	28,704.00	5%	6%	11%	26312.00	55,016.00	294,216.00
	2.3 150mm (6") G.I. Steel pipe	LM	180	2,088.62	375,952.32	250.63	45,114.28	5%	6%	11%	41354.76	86,469.03	462,421.35
	2.4 100mm (4") G.I. Steel pipe	LM	100	1,123.87	112,387.20	134.86	13,486.46	5%	6%	11%	12362.59	25,849.06	138,236.26
ST-A	Sub-Total for Pipelines		4,683	28,376.59	3,837,583.42	3,405.19	460,510.01	5%	6%	11%	422134.18	882,644.19	4,720,227.61
B	MH cover												
B.1	600mm MH cover												
	1.1 800mm (32")	set	36	15,000.00	540,000.00	1,800.00	64,800.00	5%	6%	11%	59,400.00	124,200.00	664,200.00
	4.1 75mm (3")	set	0	2,704.32	-	369.29	-	5%	6%	11%	-	-	-
ST-B	Sub-Total for mh cover			17,704.32	540,000.00	2,169.29	64,800.00	5%	6%	11%	59,400.00	124,200.00	664,200.00
C	OVER-EXCAVATION FOR PIPELINES												
C.1	Below 1.2m to 3.5m depth (trench excavation)	cm	10,811	350.00	3,783,937.50	35.00	378,393.75	5%	6%	11%	416,233.13	794,626.88	4,578,564.38
C.2	MH Excavation and Backfilling	cm	138	350.00	48,384.00	35.00	4,838.40	5%	6%	11%	5,322.24	10,160.64	58,544.64
C.3	Pumping Sta. Excavation and Backfilling	cm	5,400	350.00	1,890,000.00	35.00	189,000.00	5%	6%	11%	207,900.00	396,900.00	2,286,900.00

C.4	Hauling	cm	4,905	350.00	1,716,696.45	35.00	171,669.65	5%	6%	11%	188,836.61	360,506.25	2,077,202.70
C5	Pavement Demolition	cm	2,780	600	1,668,000.00	60.00	166,800.00	5%	6%	11%	183,480.00	350,280.00	2,018,280.00
C6	Surface Restoration	cm	500	3,500	1,751,400.00	350.00	175,140.00	5%	6%	11%	192,654.00	367,794.00	2,119,194.00
C7		cm						5%	6%	11%			
ST-G	Sub-Total for Over-Excavation For Pipelines			5,500.00	10,858,417.95	550.00	743,901.80	5%	6%	11%	1,194,425.97	2,280,267.77	9,001,211.72
H	MISCELLANEOUS												
H.1	Sand bedding to be furnished and construct by contractor												
	when ordered by the Engineer.	cm	897	301.92	270,780.96	8.55	7,668.07	5%	6%	11%	29,785.91	37,453.97	308,234.94
H.2	Crushed rock bedding to be furnished and installed when ordered by												
	the Engineer.	cm	180	646.62	116,555.27	11.85	2,135.34	5%	6%	11%	12,821.08	14,956.42	131,511.68
H.3	Reinforced concrete encasement to be furnished and installed when												
	ordered by the Engineer. (optional)	cm	1,714	2,500.00	4,285,000.00	104.45	179,033.32	5%	6%	11%	471,350.00	650,383.32	4,935,383.32
H.4	Concrete Blocks/Concrete Anchor block to be furnished and installed												
	when ordered by the Engineer.	cm	937	2,086.04	1,953,573.42	90.40	84,657.48	5%	6%	11%	214,893.08	299,550.55	2,253,123.97
H.5	Rock Excavation	cm	3,243	737.64	2,392,447.24	73.76	239,244.72	5%	6%	11%	263,169.20	502,413.92	2,894,861.16
H.6	Limestone/Coral Excavation	cm	20	129.02	2,580.41	12.90	258.04	5%	6%	11%	283.84	541.89	3,122.29
ST-H	Sub-Total for Miscellaneous			6,401	9,020,937.29	301.91	512,996.97	5%	6%	11%	992,303.10	1,505,300.07	10,526,237.37
	PART II - CIVIL WORKS												
A	STRUCTURES												
A.1	Concrete Manhole & Pumping Sta. structure												

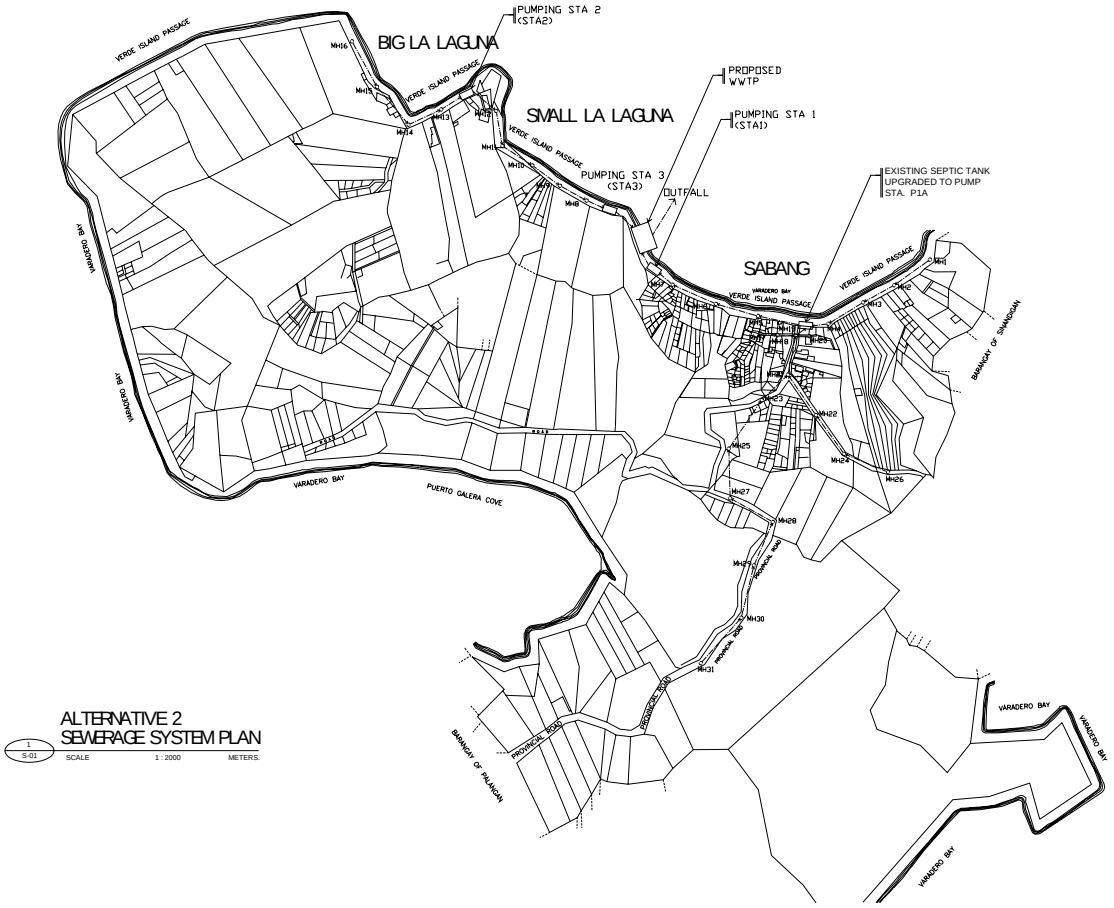
	1.2.1 Concrete MH	cum	152	3,500.00	532,224.00	350.00	193,698.81	5%	6%	11%	58,544.64	252,243.45	784,467.45
	2.1.2 Pumping Sta	cum	502	3,500.00	1,758,400.00	350.00	6,068.45	5%	6%	11%	193,424.00	199,492.45	1,957,892.45
A.2	Line and profile survey	km	5	25,000.00	117,062.50	2,500.00	6,068.45	5%	6%	11%	12,876.88	18,945.33	136,007.83
				7,000.00	2,290,624.00	700.00	199,767.26	5%	6%		251,968.64	451,735.90	2,742,359.90
A.1	Submersible Pump Complete with Accessories and control	set	12	300,000	3,600,000.00	36,000.00	432,000.00	5%	6%	11%	396,000.00	828,000.00	4,428,000.00
A.2	Valves and Fittings (G.I. Pipe)	set	72	5,000	360,000.00	600.00	43,200.00	5%	6%	11%	39,600.00	82,800.00	442,800.00
A.3	HDPE Fittings	set	2,960	956	2,830,766.40	114.76	339,691.97	5%	6%	11%	311,384.30	651,076.27	3,481,842.67
	Sub-Total for Proposed Submersible Pump			305,956	6,790,766.40	36,714.76	814,891.97	5%	6%	11%	746,984.30	1,561,876.27	8,352,642.67
	PART IV - SPECIAL ITEMS												
A.	Provide bonds, insurance and interest as specified.	LS	1					1%		1%	376,660.28	376,660.28	376,660.28
B.	Temporary site facilities, project organization and resource movement.	LS	1							1%	376,660.28	376,660.28	376,660.28
C.	Provide and install five (5) project signs and one (1) COA signboard.	LS	1	71,237	71,236.73	4,932.01	4,932.01	5%	6%	11%	7,836.04	12,768.05	84,004.79
D.	Provide and maintain one (1) service vehicle for the use of Residents Engineer	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
E.	Resident Engineer's Office including Engineers Requirements.	LS	1	360,000	360,000.00			5%	6%	3%	10,800.00	10,800.00	370,800.00
	Sub-Total for Special items			791,237	791,236.73	4,932.01	4,932.01	5%	6%		782,756.61	787,688.62	1,578,925.35



ALTERNATIVE 1
SEWERAGE SYSTEM PLAN

1 / S-01 SCALE 1 : 2000 METERS.

	SANITARY ENGINEER PRC / PTR TIN / PLACE	PROJECT TITLE / LOCATION SEWERAGE SYSTEM OF PUERTO GALERA , SABANG, SMALL LA LAGUNA & BIG LA LAGUNA PUERTO GALERA, MINDORO	OWNER: MUNICIPALITY OF PUERTO GALERA	SHEET CONTENTS ◎ AS SHOWN	DRAWN BY: CHECKED BY: APPROVED BY: DATE :	PROVISIONS	SHEET NO. S-01

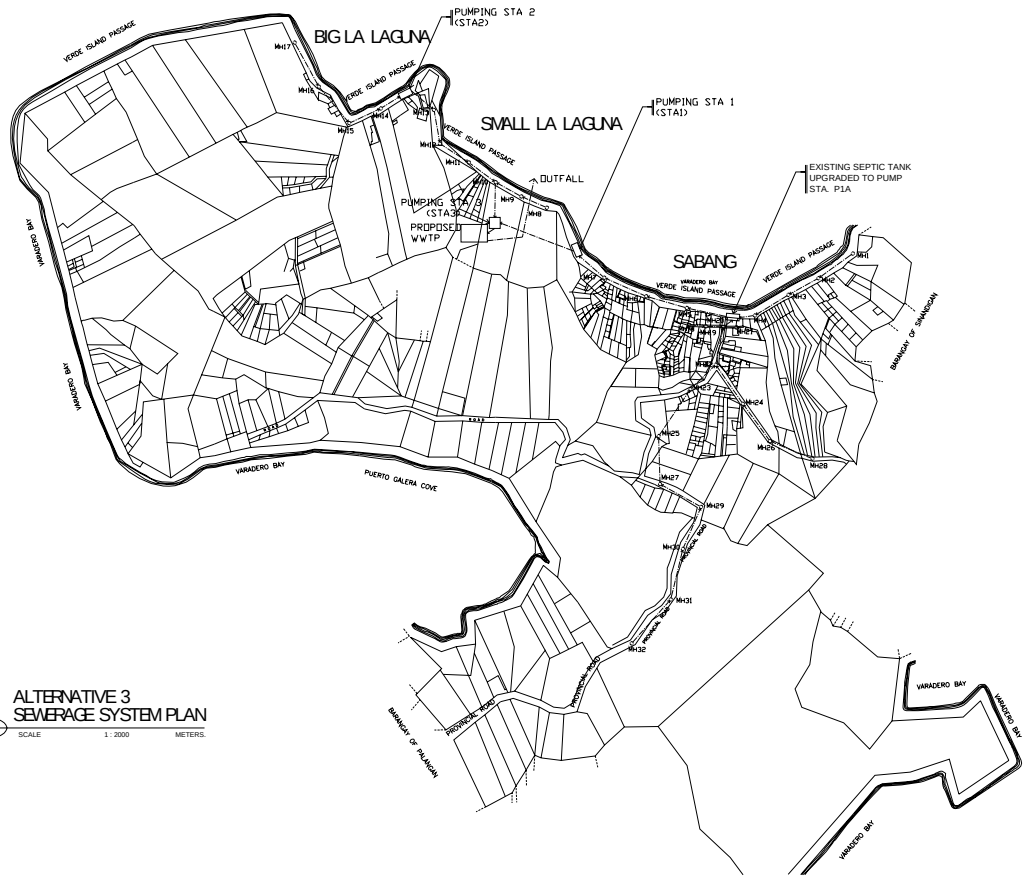


ALTERNATIVE 2
SEWERAGE SYSTEM PLAN

1
S-01

SCALE 1 : 2000 METERS.

	SANITARY ENGINEER PRC / PTR TIN / PLACE	PROJECT TITLE / LOCATION: SEWERAGE SYSTEM OF PUERTO GALERA , SABANG, SMALL LA LAGUNA & BIG LA LAGUNA PUERTO GALERA, MINDORO	OWNER: MUNICIPALITY OF PUERTO GALERA	SHEET CONTENTS ◎ AS SHOWN	DRAWN BY: CHECKED BY: APPROVED BY: DATE :	PROVISIONS	SHEET NO. S-01

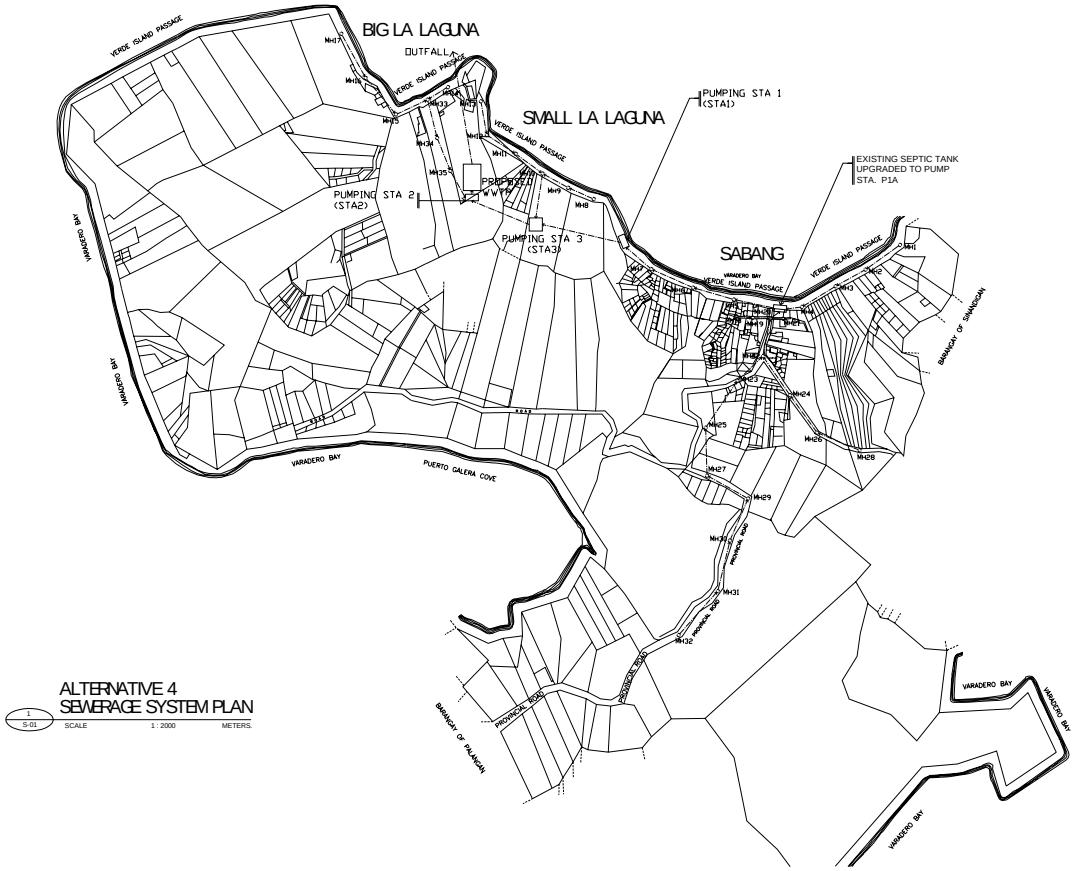


ALTERNATIVE 3
SEWERAGE SYSTEM PLAN

1
S-01

SCALE 1 : 2000 METERS.

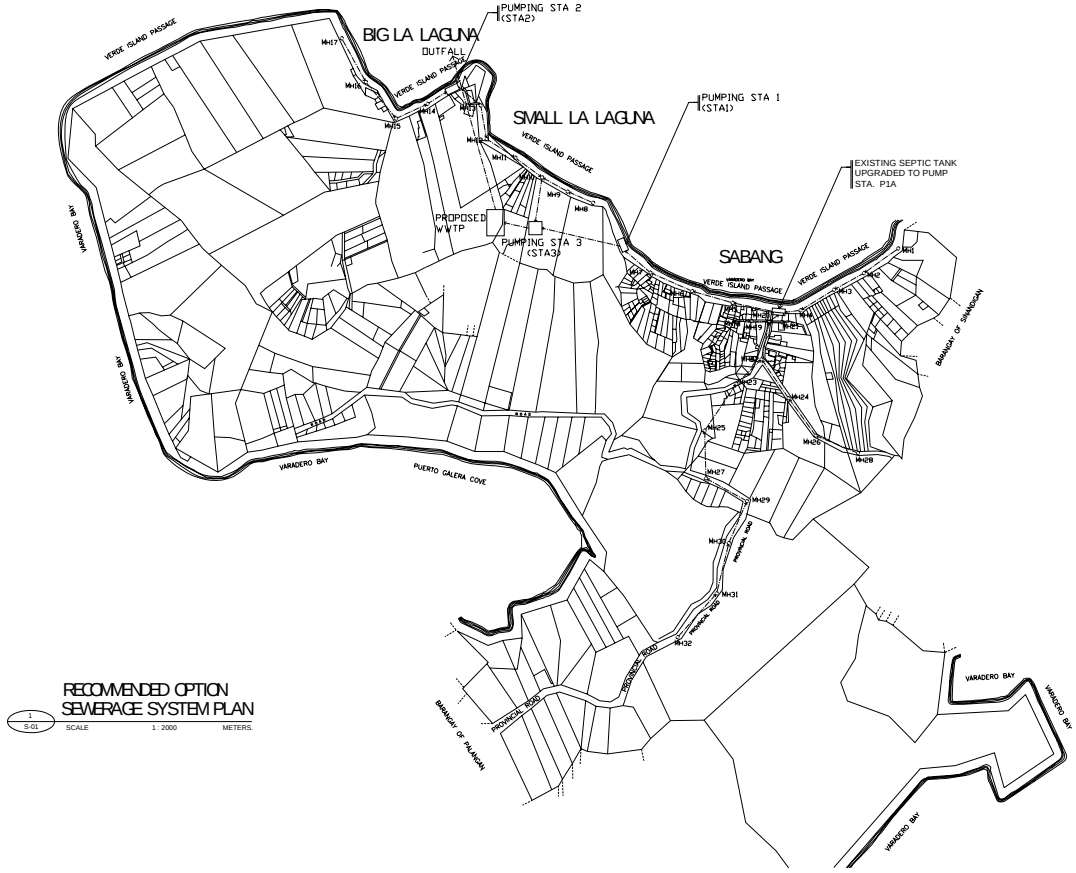
SANITARY ENGINEER PRC / PTR TIN / PLACE	PROJECT TITLE / LOCATION: SEWERAGE SYSTEM OF PUERTO GALERA , SABANG, SMALL LA LAGUNA & BIG LA LAGUNA PUERTO GALERA, MINDORO	OWNER: MUNICIPALITY OF PUERTO GALERA	SHEET CONTENTS AS SHOWN	DRAWN BY: CHECKED BY: APPROVED BY: DATE :	PROVISIONS	SHEET NO. S-01



ALTERNATIVE 4
SEWERAGE SYSTEM PLAN

1 / S-01 SCALE 1 : 2000 METERS.

	SANITARY ENGINEER PRC / PTR TIN / PLACE	PROJECT TITLE / LOCATION: SEWERAGE SYSTEM OF PUERTO GALERA , SABANG, SMALL LA LAGUNA & BIG LA LAGUNA PUERTO GALERA, MINDORO	OWNER: MUNICIPALITY OF PUERTO GALERA	SHEET CONTENTS ◎ AS SHOWN	DRAWN BY: CHECKED BY: APPROVED BY: DATE :	PROVISIONS	SHEET NO. S-01



RECOMMENDED OPTION
SEWERAGE SYSTEM PLAN

1
S-01

SCALE 1 : 2000 METERS.

SEWER PIPE SIZES

MH NO.	SIZES	MH NO.	SIZES	REMARKS
MH1 - MH2	200MMø	MH32 - MH31	200MMø	
MH2 - MH3	200MMø	MH31 - MH30	200MMø	
MH3 - MH4	300MMø	MH30 - MH29	300MMø	
MH4 - P1A	300MMø	MH29 - MH27	300MMø	
P1A - MH5	300MMø	MH27 - MH25	300MMø	
MH5 - MH6	300MMø	MH25 - MH23	300MMø	
MH6 - MH7	300MMø	MH23 - MH22	300MMø	
MH7 - STA1	350MMø	MH28 - MH26	200MMø	
STA1 - STA3	100MMø, G.I.P.	MH26 - MH24	200MMø	
MH8 - MH9	200MMø	MH24 - MH22	200MMø	
MH9 - MH10	200MMø	MH22 - MH20	300MMø	
MH17 - MH16	200MMø	MH18 - MH19	200MMø	
MH16 - MH15	300MMø	MH19 - MH20	200MMø	
MH15 - MH14	300MMø	MH21 - MH20	200MMø	
MH14 - STA2	350MMø	MH22 - MH20	300MMø	
STA2 - MH13	350MMø	MH20 - P1A	300MMø	
MH13 - MH12	400MMø	STA3 - WWTP	150MMø G.I.P.	
MH12 - MH11	400MMø	WWTP - OUTFALL	400MMø	
MH11 - MH10	400MMø			
MH10 - STA3	400MMø			

	SANITARY ENGINEER PRC / PTR TIN / PLACE	PROJECT TITLE / LOCATION: SEWERAGE SYSTEM OF PUERTO GALERA , SABANG, SMALL LA LAGUNA & BIG LA LAGUNA PUERTO GALERA, MINDORO	OWNER: MUNICIPALITY OF PUERTO GALERA	SHEET CONTENTS ◎ AS SHOWN	DRAWN BY: CHECKED BY: APPROVED BY: DATE :	PROVISIONS	SHEET NO. S-01