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## CHAPTER 8

### ENERGY GENERATION

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#### 8.1 Energy Demand

The subdivision project will consist of a residential sector coupled with a marina service area. Both sectors will target the full time retired and part time residential inhabitants. The residential component will comprise of different size lots and amenities such as the marina services, retail shops and docking facilities. These facilities at full operation will require an overall constant, adequate and reliable source of energy.

The energy requirements of this project are expected to be mainly for domestic and semi-commercial purposes. Industrial activity, if any will be limited to the boat storage areas, construction work, and maintenance activities. The energy requirements are described in Table 8.1. The daily energy demand at full occupancy and operation will be about 9,911 kilowatt hours.

**Table 8.1** Projected Energy Demand for Palm Harbour

Type	Description	Quantity	Unit Equivalent	Yearly Energy Use (8,000 kwh)	Daily Demand (kwh)
A	Estate Lots	12	1.0	96,000	266.7
B	Large Subdivision Lots	37	1.0	296,000	822.2
C	Small Subdivision Lots	22	1.0	176,000	488.9
D	Canal Side Lots	306	1.0	2448,000	6,800.0
E	Commercial Lots	42	1.5	504,000	1,400.0
F	Marina	5	1.0	40,000	111.1
G	Others	1	1.0	8,000	22.2
<b>Totals</b>		<b>425</b>		<b>3,764,000</b>	<b>9,911.11</b>

\* Other facilities include the marina piers, security equipments, road side and walkways illuminations etc.

Typical two – four bedroom dwelling was used to calculate the energy requirements for the proposed subdivision which includes lighting and the use of common domestic appliances.

The construction demand will be based on the size of the lots and the availability of equipment. Since the project development will be constructed by phases, it is difficult to calculate the total construction demand. It is anticipated however, that a typical lot will require about 200-400 kwh of energy for its construction.

This demand is necessary to power the construction equipment such as band saws, drills, chargers, cutters, welding equipment etc. All of the construction energy demand will be gotten

from a portable gas powered generator that will meet and exceed the projected energy requirement.

## **8.2 Energy Supply Sources**

Today's technological advances have produced a wide range of household appliances and gadgets that demand a steady source of energy, and the proposed development is no exception. Energy sources are an important component in determining the project's viability, especially considering the projected energy demand for the development.

This important factor will be instrumental in maintaining the operation of the proposed project with the least environmental impact and at a reasonable cost. With this in mind, the following section summarizes the various sources of energy that will be used.

### **8.2.1 Primary Source**

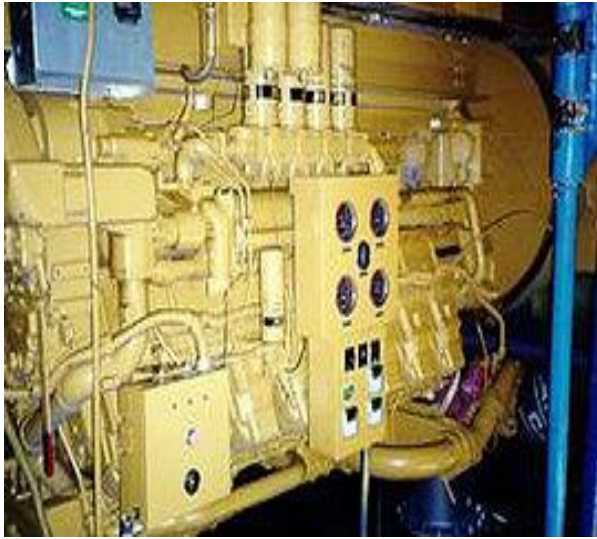
The project site is located about two miles east from the Southern Highway and therefore equidistant from the nearest transmission line. The Stann Creek District is already connected to the Belize Electricity Limited National grid. BEL is the sole provider of electricity throughout the country and the transmission lines runs perpendicular to the All Pines/Haney Farms junction. There are presently no distribution lines that have been installed on this road even considering the projects that have been proposed and that are currently in operation.

In view of this fact, Palm Harbour Development is considering the installation and use of diesel generators as its primary source of producing electrical energy. The recommended source of electrical energy was chosen because power failure is common throughout Belize and there is a need for a continuous supply of energy over an extended period of time. The use of diesel generators will probably be supplemented by electrical energy provided by BEL in the future. It is anticipated that the electrical energy will reach the project site as the area develops.

It is uncertain, however, when this process will be facilitated but what is certain is that any impact related to diesel generation will be drastically reduced once connected to BEL's distribution lines.

The development will therefore install diesel generators to produce and meet the electrical demand as stated in Table 8.1. The project will utilize three diesel generators with a combined capacity of 2,000 KW a day. Generators will be purchased according to the project's energy demand. These generators will eventually be used as back up generator units once the project is connected to the national grid. Section 8.5 describes the mitigation measures that will be employed for the generators.

These generators will be housed in sound attenuated enclosures to minimize the noise pollution and will be installed in the Utilities Zone of the proposed subdivision project (see Plate 8.1 and 8.2). The Utility Zone will be hidden away from the resident and visiting population and will be located on the southwestern portion of the project. Trained technicians and skilled workers will service and maintain the generators in good working order.



**Plate 8.1.** Typical diesel generator



**Plate 8.2.** Generator sound attenuation house

### 8.2.2 Secondary Source

Secondary sources of energy can be obtained from many alternative sources such as geothermal, solar, wind, tidal, natural gas and nuclear energy. Based on these options and their availability, solar and wind energy are recommended as alternative sources but their use however, is limited to night time lighting.

These two options can be used along with the primary energy source. The site has a good potential for solar and to a lesser extent wind power but these should be chosen as optional. The various options for energy generation are compared in Table 8.2. These options, however, are secondary sources of energy which are designed to reduce the overall dependence on the generators.

**Table 8.2** Selection of Secondary Sources for Palm Harbour

Criteria	Solar Power	Wind Energy	National Grid
Installation Cost	High	High	High
Operation Cost	Low	Low	Low
Reliability	Dependent on available radiant energy	Dependent of wind speed	Reliable
Environmental Impact	Low	Low	Low
Capacity	Requires battery storage for nighttime use	Requires large windmill to electrify a house	Able to work continuously at times.

The recommended secondary source will be from the national grid supplier providing that the proposed development installs the necessary provisions in the future. This accomplishment will probably come when the area further develops.

In lieu of the aforementioned secondary source, the project development will consider the combination of solar and wind energy to supplement the primary source. This is important since the secondary source experiences power failure from time to time and there is a need for a continuous supply of energy over an extended period of time.

From an environmental standpoint the use of solar or wind power is preferred as it results in very low environmental pollution. Both of these sources have zero emission. However both these options cost significantly higher than a diesel generator to install and operate.

Solar power is only able to operate during the day when radiant energy is available even though the electricity generated may be stored in battery cells for use at a later time. This increases the cost of this option. Wind energy is dependent on the duration of the wind as well as the wind speed. Wind energy also requires more space as the installed wind vanes occupy a large amount of space. Wind vanes usually measure a minimum of 75 feet in diameter. Thus for this project these will not be appropriate.

### **8.3 Power Transmission Lines**

Once the diesel generators are operational, power transmission lines along with transformers will need to be installed. Since the development will be carried out in phases and sub-phases, most of the power transmission lines will be laid underground. This will increase the aesthetic appeal of the project site as well as reduce the risk of fallen power lines in the event of a storm. However, underground cable systems have to be insulated and are more expensive, and have a higher maintenance cost.

The route with the least environmental impact will be followed throughout the project for all the phases. However, the final design layout and routes of the power transmission lines will be approved by a certified Electrical Engineer.

### **8.4 Fuel Management**

The proposed development will require fuel for its operational purpose, especially for the powering of the generators. The fuel sources required by the subdivision are readily available from the commercial sector. The fuel demand will be according to the different infrastructures and residents and most importantly the operational hours of the generators. The following sections summarize the different fuel demands along with alternative fuels.

#### **8.4.1 Domestic Fuel**

The project will require cooking fuel such as butane and propane for the individual residents. These fuels will be used for cooking and refrigeration if necessary and will be stored using the recommended guidelines. Each resident will store these fuels at the back of each dwelling with the proper containment measures.

The transportation of butane and propane will be the responsibility of the supplier, who will follow the recommended guidelines for the transportation of Hazardous Materials. The supplier

will also be responsible for the refilling and/or replacement of any faulty or corroded container. Cylinders can also be filled in Dangriga or any butane outlet and taken to the project site. It is anticipated that the cylinders will range from 100 lbs to 250 lbs.

#### **8.4.2 Operational Fuel**

The project also will require fuel for the powering of the generators and servicing of the marina boats along with other miscellaneous uses. The primary fuel that will be stored is diesel fuel followed by gasoline fuel and these will be transported to the site by either a 3,000 or 9,000 gallons fuelling truck. The generators will be located in the Utility Zone whilst the marina service station will be located on the north east section of the subdivision.

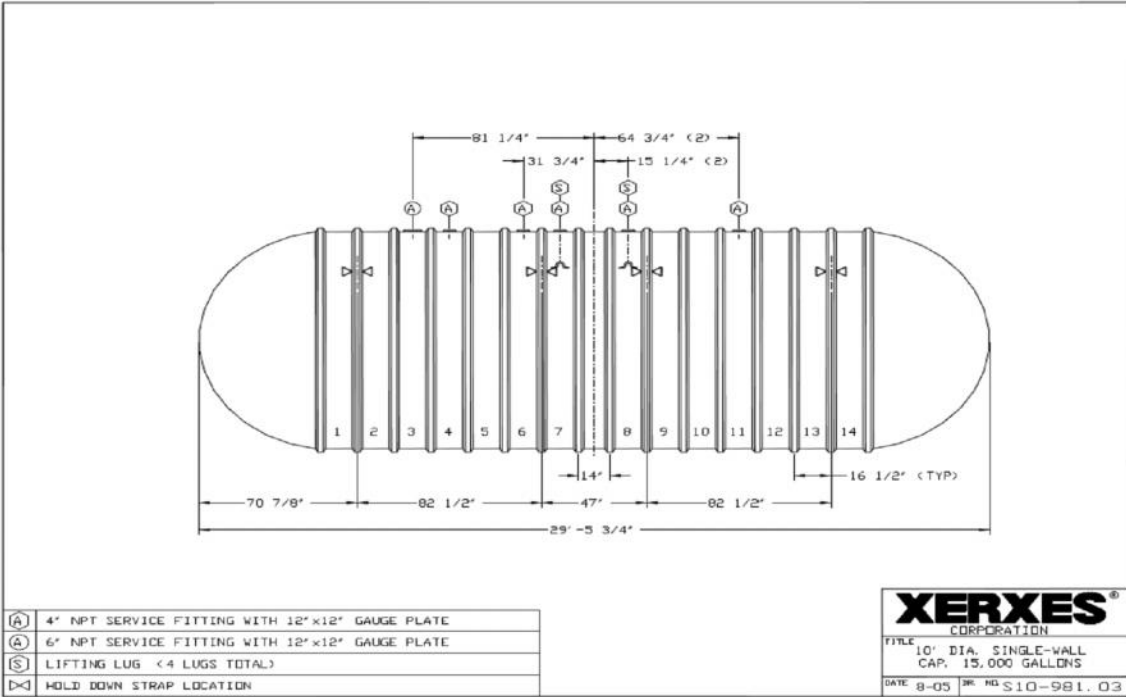
For this reason the diesel fuel tanker will then take the fuel to the Utility Zone and discharge the fuel into the respective holding tanks. The handling of fuel will follow the standard protocol for the loading and unloading of fuel on land and near a water body. The fuel demand for the generators of this capacity can range anywhere from 30 gallons/hr to 75 gallons/hr. Presently, Haney Shrimp Farm practices good fuel management (See Plate 8.2) where the fuel is stored in a containment structure.

For this reason, fuel for the generators will be stored in two- 5,000 gallons Above Ground Storage Tank (AST) contained in a reinforced concrete containment wall. Fiber glass piping will be used for the fuel transmission lines. The containment wall will be constructed so as to hold 110% of the volume of the tank. This volume will supply the project generators site and with the necessary fuel needed for development and operation.

A similar procedure will be carried out for the marina service station whereby fuel for the service station will be stored in Above Ground Storage Tanks contained in a reinforced concrete containment wall. The tanks will be doubled wall with all the specifications stated in Figure 8.1. The containment wall will be constructed so as to hold 110% of the volume of the biggest tank. It is anticipated that a 4,000 gallons diesel tank along with a 500 gallon gasoline tank will be utilized for the marina services. The fuel dispenser along with the dispenser hose will be located in the containment wall. The fuel dispenser at the service will be managed by a trained service attendant.

The fuel supply will be managed by Palm Harbour with the assistance of a designated fuel supplier. The installation of the AST tanks will follow the environmental clearance process, which requires the application of operation of a service station, and follow up inspections by relevant authorities, including DoE and the National Fire Service (NFS). The transportation of fuel will be the responsibility of the supplier and Palm Harbour, who will follow recommended guidelines for the transportation of Hazardous Materials.

The accidental spill of fuel will be avoided as much as possible. An Oil Spill and Fire Contingency Plan will be developed to address all issues pertaining to spills, leaks and fires both on the island and at sea. The plan will contain mitigation measures (booms, kits); clean up processes as well as the required training for safety and health. Additional information is explained in Chapter 12.



**Fig. 8.1** Typical Above ground storage tanks



**Plate 8.3** Fuel Tanks in Containment Structure at Haney Farm

## 8.5 Impacts and Mitigative Measures

The installation of the diesel generators will create negative environmental impacts in the following areas:

- ❑ Orientation to the site will focus on the environmental contributions of these structures. Management should place these towers in less visible locations provided there is enough wind. It should also be possible to hide the lower portions behind small trees.
- ❑ Negative impacts will result from the siting and placement of the diesel generator. These are in the form of diesel and waste oil spills and leaks. All spills and leaks will be mopped up and disposed of according to the environmental guidelines. All waste oil or contaminated fuel will be removed and stored and disposed by an accredited recycler.
- ❑ Negative impacts will result from the operation of the generators. Noise displacement will be minimized by individual engine houses enclosed in a central generator building with acoustic tiling.
- ❑ Batteries from the system will eventually wear out and will have to be replaced. In view of their toxic nature they will be removed from the site and stored for recycling

**Table 8.3** Matrix of potential environmental impacts as a result of power generation

Category of Project Activity	Preferred Options for Carrying out Project Activity	Direct and Indirect biological and physical Impacts	Recommended Mitigative Measures	Residual Impacts Mag/ Dir/ Dur/ Slope
<b>A. Construction Phase:</b>	1.0 Diesel Generators	Excessive noise pollution	Use silencers on muffler, route muffler pipes underground. Use acoustic tiling on wall of shed, use generator housings	low/ dec/ short/ local
		Pollution risk due to accidental spill from fuel and oil storage tanks	Place fuel tank in an enclosed bond wall with 110% capacity of fuel tank	
			Transport fuel in designated fuel trucks	
		Air pollution and combustion fumes	Keep machines properly serviced used recommended fuels and additives only	
	2.0 Backup Diesel Generator System	Same as above	Same as above	

Category of Project Activity	Preferred Options for Carrying out Project Activity	Direct and Indirect biological and physical Impacts	Recommended Mitigative Measures	Residual Impacts Mag/ Dir/ Dur/ Slope
<b>B. Operational Phase:</b>	1.0 Diesel Generators	Excessive noise pollution	Enclose engine in generator house having acoustic tiling. Route mufflers underground to muffle vibrations.	low/ dec/ short/ local
		Pollution risk due to accidental spill from fuel and oil storage tanks	Place fuel tank in an enclosed bond wall with 110% capacity of fuel tank	
			Transport fuel approved fuel trucks	
	Air pollution and combustion fumes	Keep machines properly serviced used recommended fuels and additives only		
	2.0 Backup Diesel Generator System	Same as above	Same as above	