APPLICATION OF GREEN TECHNOLOGY IN PERHENTIAN ISLAND WATER SUPPLY SCHEME

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1.0 INTRODUCTION

The project was implemented by the Water Supply Department, Ministry of Energy, Green Technology and Water (MEGTW) in year 2006. Sumai Engineering Sdn. Bhd. and Summit Baruliman Sdn. Bhd. Joint Venture, and HLA Associates Sdn. Bhd. were appointed as the Contractor and Engineering Consultant for the project respectively.

The project is located in Besut District of Terengganu State. The project sites are located at the mainland and Perhentian Island of Terengganu as shown in **Figure 1.1**.

Perhentian Island consists of two islands by the names of Perhentian Kecil Island and Perhentian Besar Island.

2.0 OBJECTIVE OF THE PROJECT

The objective of the Project is to supply potable water of 1.36 million liter per day to meet the projected water demand of Perhentian Island up to design horizon year of 2015.

3.0 EXISTING WATER SUPPLY SYSTEM AT PERHENTIAN ISLAND

Currently there is a water treatment plant (WTP) located at Perhentian Besar Island being operated by SATU. Raw water for the WTP is sourced from underground tube wells and is only adequate to supply to residential area at Kg Pasir Hantu. The schematic diagram of the existing system is shown in **Figure 3.1**. Thus, Chalets/ Resorts operators are forced to operate their own tube wells to obtain water required for their premises consumption. Generally, raw water yield from tube wells at Perhentian Island is not sustainable and could not produce adequate yield during dry season.

Two major pollutants from the existing Water Supply System are emission from generator sets which being used to generate electricity for operating the WTP and tube well pumps and the alum sludge from the WTP which is channeled to the sand bed in the WTP compound.

4.0 APPLICATION OF GREEN TECHNOLOGY

4.1 GENERAL

Perhentian Island has been gazetted by the Government as one of the Marine Park in Malaysia. Topography of Perhentian Island is largely covered with secondary forest vegetation with chalets/

resorts scattered along the sandy coastline. The only community settlement at Perhentian Island is Kg Pasir Hantu.

In view of the project site is located within the Marine Park, Environmental Impact assessment (EIA) and Environmental Management Plan (EMP) have been conducted to ensure the project is implemented in an environmental friendly manner. MECTW has emphasized on the green technology concept when implementing the Project. The aspects considered are as follows :-

- Energy Efficiency,
- Green Structure,
- Green Construction Method.

4.2 ENERGY EFFICIENCY

The existing water supply system at Perhentian Island requires total pumping head of approximate 60m before it being distributed to the consumers. As mentioned in section no. 3.0, waste polluting the environment in the form of gas emission from generator sets and alum sludge are being produced as by-product of WTP.

For Pulau Perhentian Island Water Supply Scheme, water from the mainland will be flowed to the existing reservoir by gravity, thus, it has eliminated the use of diesel in the island for distributing the water to consumers.

The average pumping head required for the Pulau Perhentian Island Water Supply Scheme is approximately 30m only compared to 60m for existing system to supply to existing reservoir at Kg Pasir Hantu. The schematic of the scheme is as shown in **Figure 4.1**.

Generally, the Scheme has reduced the usage of fossil fuel and gas emission, and eliminate the alum sludge which are detrimental to the ecology system at Perhentian Island.

4.3 GREEN STRUCTURES

Green structures encompass the choice of the construction material whose contents and methods of construction have the smallest possible impact on the environment and natural resources. This concept has been incorporated in the following structures which form part of the Perhentian Island Water Supply Scheme :-

- Pumping station,
- Submarine pipeline,
- Reservoir at Perhentian Island.

4.3.1 Pumping Station

The pumps adopted in this Project is shrouded type which is suitable for outdoor installation and noise level produced by this pump is significantly lower compared to other type of pump.

By taking into consideration of these characteristic, it was decided that a concrete sump as shown in **Figure 4.2** instead of building be built to house the pumps and associated pipes, valves and fittings. Footprint of the concrete sump is generally about one third (1/3) of the area required by pump house.

4.3.2 Submarine Pipeline

Submarine pipeline with approximate length of 17.8 km will convey the potable water from the mainland to Perhentian Island. This structure is designed in such a way that it is not disturbed by external forces. The external forces which could disturb the integrity of submarine pipelines are wave and current action and very often by an unstable sea bottom. Large safety factors shall be provided in the structural design to counter these types of force as the magnitude of the forces is always difficult to predict. This means also huge natural resources are required for submarine pipeline made of the rigid materials such as steel or cast iron due to their limitation on deformation strain before burst or leakage, i.e. the pipeline have to be heavily loaded or buried deep in the sea bottom.

By using HDPE pipe which is flexible in nature, the flexible submarine piping concept replaced the high safety factor, which is required for rigid pipe in connection to extraordinary forces.

Figure 4.3 shows typical submarine pipeline with collar weight ready to be lowered to the seabed.

4.3.3 Reservoir at Perhentian Island

A 1.82 million litre capacity reservoir which acts as a buffer to meet the peak water demand will be built at Perhentian Island. Careful thought on minimising the negative environmental impacts of reservoir construction have been given prior to reservoir siting and determination of construction material for reservoir.

The reservoir site located at Kg Pasir Hantu and next to Telekom transmission tower was chosen based on the above mentioned criteria.

The reservoir is located in a marine environment where material resistant to chloride and sulphate is paramount important. Two types of construction materials had been considered as reservoir wall, i.e. reinforced concrete and stainless steel Grade 304. For Perhentian Island Water Supply Scheme, stainless steel Grade 304 was chosen over reinforced concrete due to its smallest impact on the environment in terms of construction debris and consumption of natural resources. Stainless steel wall section is also much thinner and faster to build compared to reinforced concrete wall, these translate into saving on fossil fuel. Similar stainless steel reservoir is shown in **Figure 4.4**.

4.4 GREEN CONSTRUCTION METHOD

Green construction method is a way to search for method of construction which has the smallest impact on the environment.

Two construction methods deemed to be the green preferred construction method adopted in Perhentian Island Water Supply Scheme are as follows :-

- Jetting Sled and Concrete Mattress,
- Horizontal Directional Drilling.

4.4.1 Jetting Sled and Concrete Mattress

The 355 mm diameter submarine pipeline was lower down to the trench using jetting sled as shown in **Figure 4.5**. However during the process, sand particle will be churned up and this may, to certain extent, pose danger to the coral reef which is generally found at the area with water depth less than 10 m. As mitigating measures, the following were adopted :-

- Smaller capacity jetting sled for trenching work in the Marine Park area and utilization of silt curtain to minimize transportation of sediment flume created by jet-trenching process.

- Minimum lay barge anchors in the Marine Park.

- Minimum trenching at the Marine Park area when water depth is less than 15 m, concrete mattress have been used to protect the pipeline from boats anchors and also to provide the required stability against environmental forces. Concrete mattress as shown in **Figure 4.6** also acts as artificial coral reef.

4.4.2 Horizontal Directional Drilling (HDD) Method

One of the challenges of this Project is to lay the pipe from Mama's Chalet to Teluk Dalam located at Western and Eastern of Perhentian Besar Island respectively. This pipeline could be laid either along the coastline or by cross country. The latter route which is along the jungle track, is shorter, was chosen to minimise the deforestation and damage on coral reef cause by soil erosion.

The terrain from Mama's Chalet to Teluk Dalam is hilly with ground level varies from 2m to 59m. It was part of the design requirement for the pipeline invert level to be lower than 35m, i.e. 24m below than maximum ground level of 59m.

Should the open cut method is adopted, it will involve clearing of large forest area and cause adverse effect to the fauna and flora.

In view of this, an environmentally friendly method, HDD similar to tunneling method was adopted to lay 150m in length of the pipeline across the hilly area. The profile of the pipeline and HDD work are as shown in **Figure 4.7** and **4.8** respectively.

5.0 CONCLUSION

In conclusion, the design and construction procedures are complied to EIA requirement, construction and pipe laying methods adopted in this Project are adhered strictly to EMP to

minimize the damage to the environment. Green technology concept has also been applied successfully in this project and the benefits obtained are as follows:-

- Less fossil fuel consumption to supply potable water to the consumer,

- A sustainable water supply system,

- Reducing waste and pollution by changing mode of potable water production,

- Promoting the growth of tourism industry with reliable and quality potable water supply system.