SUSTAINABLE RESORT

PRESENTED BY
ANTHONY WONG KIM HOOI
Group Managing Director
Adjunct Professor
-Taylor’s University
- University Utara Malaysia College of Arts & Sciences
COMMITMENT TO ENVIRONMENT
VISION STATEMENT

- To provide a memorable holiday experience on one of Malaysia’s premier resort islands.
- To establish a model that can be used by other regional resort that want to reduce their impacts upon the local community within an environment that is not overly affected by the resort’s development.
- To offer our guest the best hospitality, service and facilities that can and be recognized as the leading ‘green’ resort in Malaysia.
MISSION

- Provide all our guest a truly unique Malaysian experience to ensure that they return to holiday in the resort.
- Minimizing our impact upon the cultural and natural environment of Langkawi and ensuring positive returns for all resort stakeholders.
AWARDS

ASEAN Green Hotel Standard 2008-2009
Virgin Holidays Responsible Tourism Awards 2008
PM Hibiscus Award 2008-2009
PATA Gold Award 2009, The Europe Award 2010
Malaysia Tourism Award 2008-2009
ASEAN Tourism Standard 2008-2009
ASEAN Tourism Standard 2010-2011
MNS 70th Anniversary Award for Environment Leadership Responsible Tourism Award 2010 (United Kingdom)
Sustainable Resort

4R’s Concept

Reduce

Reuse

Recycle

Rethink
Reduce: Minimising the use of the Earth's resources.

Use smaller meeting room
• We are now using the Meeting Room which is less spacious compared to Desa Ballroom used previously for our daily briefing and small meetings. This is one of our effort in saving energy.

Reduce plastic bottles
• Provide water using jug and glass instead of giving bottled drinking water.
Reuse: Don't just bin it, find ways to make use of it!

Old but usable furniture are reused at staff quarters.

Old roof tiles which are still in good condition are reused for new building.

Old pipes from construction area are reused for channeling rain water to our wetland.

Ice cream container is reused to store food item.
Recycle wood and trunk as signage and landmark

Recycle plywood to make mail box and guest comment box

Recycle Assam tree trunk as key chain

Recycle broken or leftover slates to make decorative walkway

Recycle plywood as “DND” and “Please Clean My Room” signs

Recycle plywood to make mail box and guest comment box
Rearing guppy fish at ponds to control mosquitoes

Reuse used cooking oil for candle lighting

Leftover soaps from guest rooms are recycled to be used as cleaning detergent for toilets.

Homemade organic mosquito repellant using lemongrass juice.

Rethink
Creative ways to develop and improve existing conditions
MENTARI RESTAURANT
Overall concept: Open air concept, natural air flow and lighting, guests can listen to waves and birds chirping.

- Decorative lamps using wine bottle and energy saving bulb
- Using transparent roofs: Natural lighting

- Lamp cover from recycled wood and use energy saving bulb
- Natural lighting and energy saving bulb - save more than 16% of energy lighting

Sustainable Resort
- Lamp stand using reuse water pipe
- Recycled wood use as buffet table
- Spotlights at Mentari Restaurant using energy saving bulbs and aluminum covers.
- Bar: Using natural lighting and natural ventilation
- Using attap dwelling on the roof to cool down the ambient temperature
- Recycled wood and bullock cart as furniture
- Use L.E.D as energy efficiency
FLOW DIAGRAM OF ENERGY CONSERVATION

SPORTLIGHT → ENERGY SAVING BULB + ALUMINIUM FOIL → L.E.D LAMP

Sustainable Resort

The Frangipani Langkawi Resort & Spa
MENTARI KITCHEN
- Do not use air conditioner
- Replaced with glasses window: Allow natural lighting
- Door are grills and use mosquito net to allow cold air flowing in
- Using energy saving bulb in kitchen can save energy
- Lower down the level of energy saving bulb to light up the environment

Sustainable Resort
- Using solar energy to provide hot water supply
- Save energy
- Put food on top of the oven: as a warmer
STAFF CAFETERIA
- Transparent roof used to light up the environment (save energy).
- The glasses window have been taken out to allow the aeration (less usage of fan).
MENTARI PUBLIC TOILET
- Doors are drilled to allow cold air flowing in.
- Wall gap allows hot air flowing out while providing natural lighting.
- Trees provide natural
- Shady and cool down the surrounding
- Rainwater is used to flush toilet.
- Energy saving bulb is used to light up the environment

Sustainable Resort
SWIMMING POOL
- Excess rainwater is used to wash pool deck daily.
- More safe compare to previous
- Use little amount of chlorine to clean the pool.
- Depth: 2fts (baby pool)
- Depth: 4fts (adult pool)
- Using atap dwelling on the roof to cool down the temperature (Pool Hut)
- The big tree provide shade
- Energy saving bulb is use to light up the environment at swimming pool area
- Use L.E.D lamp to light up the environment
KOI POND
- Harvesting rain water for watering, storing up to 8,800gal / 40,005L rain water including surface runoff through road side drain.
- Simple filters (coral) used to replace electrical pump filters, more daily cleaning but zero electricity usage.
Broken slates and marbles are recycled to make decorative walkway.
RUBBISH CHUTE
- This rubbish chute speeds up the collection process and minimizing carbon dioxide released by running engine.

- The rubbish chute is next to the main dump site, utilizing natural lighting and natural ventilation.

- No fan installed yet able to maintain minimal odour.

- Rainwater is used to clean the interior part.
Flow of the waste

- Guest rooms around the resort
- Staff kitchen and toilet
- Mentari Restaurant and toilet

Plastic bags, plastic and paper packaging

Plastic bags, plastic and paper packaging and kitchen waste

Rubbish Chute

Sustainable Resort
WATER TANKS
- Conserve water by recycling rain water for watering
- Rain gutter channel rain water to the tanks
- There are total of 85 tanks, 70 big tanks (880 gallon) and 15 small tanks (550 gallon) installed around the resort.
- The tanks are connected together sequentially. Heavy particles will settle at the bottom
- Untreated Rainwater: irrigation, flush toilet, and laundry uses.
FRANGIPANI GREEN SPA
- Open concept that allow the air flow in and out freely.
- Allow the natural lighting enter the spa.
- Transparent roof used to light up the environment (save energy).
- Wall gap allows hot air flowing out while providing natural lighting.

- The plants around the spa help reduce the ambient temperature and provide shade.
SALT WATER POOL

Sustainable Resort
- Non-toxic / pollutant free pool
- No stinging/ irritation of eye
- Natural healer for wound
- Backwash discharge can be safely used for lawns
- Maintenance: sodium bicarbonate (soluble in water and not harmful to the environment)
- Salt is softer on skin. A cheaper alternative to traditional chlorine swimming pool as do not require treatment chemicals.

Sustainable Resort
ROOF GARDEN
Absorbs rainwater (no need of irrigation)

Provides natural insulation (lowers temperature inside the building)

Combats the heat island effect

Creates habitat for insects/migratory species

Decreases the total water runoff

Filter water pollutants, carbon dioxide and heavy metals.

Insulates building for sound (private functions)

Increases agricultural space (for future plans)
Water runs off to the rain harvesting tank, used for watering the lawn and the surrounding landscape.

A good drainage system allows water absorbed through the grass channeled into it.
ROYAL SUITE
The integrated slope is to enable maximum flow of rainwater towards the lawn.

The degree of slant ensures no stagnant water.
GUEST ROOM

Sustainable Resort
- Transparent roof – allows penetration of sunlight.
- Large glasses window allow the sunlight to enter the room.
- Broken mosaics are reused for pathway.
SEMI-OUTDOOR SHOWER
Wall made of natural Laterite rock. (Laterite rock; abundant moisture for hydrolysis during weathering and relatively high oxidation potential).

- Transparent roof – allows the sunlight to penetrate through

- Enjoy nature while showering, listening to chirping of birds and overseeing greeneries.

- Creeper plants: (Eg: Japanese Ivy) – plants grown on walls helps to retain moisture to ensure insulation and absorption of solar radiation.)
SOLAR PANEL
- Non polluting device
- Usage of renewable energy (zero usage of electricity)

Financial benefits
- Very little maintenance
- Attractive investment due to added value
FRONT OFFICE
Open concept to allow good aeration and usage of daylight

- Bottles has been reused as lamp cover
- Wood incorporated in between is to cooling effect.

Sustainable Resort
Presented by Anthony Wong Kim Hooi
RAINWATER TREATMENT STATION
2 Sand filters and 2 253.7nm UV lamp to treat water
WATER MANAGEMENT
Water management is the activity of planning, developing, distributing and managing the optimum use of water resources. In an ideal world, water management planning has regard to all the competing demands for water and seeks to allocate water on an equitable basis to satisfy all uses and demands. This is rarely possible in practice. In The Frangipani Langkawi Resort & Spa, we have our own ways to conserve water and our main objectives are to achieve sustainability in water supply and to reduce dependency on government-supplied treated water.
Ways of Water Conservation

A. Water tanks for harvesting rainwater

Rainwater is harvested for irrigation purpose. We installed 22 water tanks by 2007, amounting 12,730 gallons (48,188 Liters or 48.188 cubic meters) of recycled water stored. As Government-supplied water was charged at RM1.20 per cubic water, we were able to save RM57.83 for every 12,730 gallons of rain water harvested in 2007. We have successfully cut down our water bill by 50%.

Right now there are a total of 85 water tanks 70 big tanks (880 gallon) and 15 small tanks (550 gallon) installed around the Resort. Rainwater from these tanks is channeled to taps located around the resort area. Now, we have 69,850 gallons (264,382 Liters or 264.382 cubic meters) of recycled water storage. We are able to save RM317.26 for every 69.850 gallons of rainwater harvested.

Furthermore, rainwater is harvested from roof of our Restaurant and is channeled to water tank located at public toilet for its toilet flushing and excess rain water also use to wash pool deck daily.
Ways of Water Conservation

B. Underground water from well for watering the organic garden as treated water is not required for this purpose

Tube well 01 at the location of borehole is at N06.28046’E099.72993’. The depth of the well is 61m and water is pumped at 10m³ per hour for 24 hours (240 m³ everyday). The well water channels the water to wetlands (to dilute the waste discharge before further treatment by the aquatic plants in the pond). The water in the pond is used for watering the lawn and the plants in the resort. Currently, we have three wells at organic farm which is located in the resort itself. One of the Tube well 01 located in Langkawi, Kedah. Borehole location is at N06.28046'E099.72993'.
Heat island effect is a key factor in water usage. The lawn and landscapes require a large amount of water due to evaporation and transpiration. Outdoor residential water use varies greatly depending on geographic location and season. The weather pattern determines that the water needed for external use increases tremendously due to high transpiration and evaporation. One strategy of water conservation in landscaping is by using plants which grow in water which at the same time cleanses and filters the water. Plants such as *Eichhornia crassipes* (Water Hycianth), *Nelumbo nucifera* (Water Lily), *Chrysopogon Zizaniodes* (Vetiver), *Ipomoea aquatica* (Water Spinach) living in the pond help conserve soil by stabilizing the soil, managing the water quality, protecting against soil erosion and against pest and weeds. For instance; *Vetiveria zizanioides* or better known as Vetiver has the capability of blocking the water runoff on the surface of the water, besides slowing down the velocity of the water which increases the velocity of the filtration. The clump of Vetiver plants can protect against splash erosion and retain soil moisture and withstand against soil evaporation. Needed irrigation is scheduled to specific time in the early morning and late evening to reduce evaporation.
Landscaping at the wetland

(Graph extracted from Langkawi/weather chart)
Water Storage at Fish Pond

The water used in the fish pond is direct rain water which goes through a simple conventional sand filtering system which is incorporated in the drainage system. The pond also assists in harvesting rain water. Excessive rain water from the road and pond flows into storage compartment in front of the pond filled with sand, stones and coals which purifies (eliminating heavy metals components) the water before releasing into the pond. It can store up to 2830 gallons of water. Excess water is used for irrigation for plants around the front office and the lawn.

Rain water used in fish pond and excess water used to water the lawn and surrounding landscapes.
WATER & ENERGY CONSUMPTION
## Saving from water conservation measures

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Per Room Water Consumption (m³)</th>
<th>Rate (RM/m³)</th>
<th>Average Per Room Water Consumption (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>3.62</td>
<td>1.2</td>
<td>4.35</td>
</tr>
<tr>
<td>2007</td>
<td>2.61</td>
<td>1.2</td>
<td>3.13</td>
</tr>
<tr>
<td>2008</td>
<td>1.46</td>
<td>1.2</td>
<td>1.76</td>
</tr>
<tr>
<td>2009</td>
<td>2.36</td>
<td>1.2</td>
<td>2.84</td>
</tr>
<tr>
<td>2010</td>
<td>2.70</td>
<td>1.2/1.48/1.54/1.56</td>
<td>3.44</td>
</tr>
<tr>
<td>2011 (As of April)</td>
<td>2.14</td>
<td>1.56</td>
<td>3.34</td>
</tr>
</tbody>
</table>
The graphs shows a clear reduction of water consumption on average. The water usage reduced tremendously until year 2008 as there were tanks installed to harvest rainwater and air-condition water and the building designed to collect and direct maximum rainwater to the lawn. However, there was a slight increase from 2009 until 2010 as there were installation of salt water pool and upgrading of swimming pool. In addition, the hot season has increased the water intake by plants and lawn. The resort is taking some effective measures to reduce the water consumption.
## Saving from water conservation measures

<table>
<thead>
<tr>
<th>Month (2011)</th>
<th>Per Person Water Consumption (m³)</th>
<th>Rate (RM/m³)</th>
<th>Per Person Water Consumption (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.83</td>
<td>1.56</td>
<td>1.30</td>
</tr>
<tr>
<td>Feb</td>
<td>1.02</td>
<td>1.57</td>
<td>1.60</td>
</tr>
<tr>
<td>March</td>
<td>1.46</td>
<td>1.56</td>
<td>2.28</td>
</tr>
<tr>
<td>April</td>
<td>1.06</td>
<td>1.56</td>
<td>1.65</td>
</tr>
</tbody>
</table>

Sustainable Resort
### Saving from energy conservation measures

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Per Room Energy Consumption (kWh)</th>
<th>Rate (RM/kWh)</th>
<th>Average Per Room Energy Consumption (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>61.28</td>
<td>0.288/0.323</td>
<td>18.93</td>
</tr>
<tr>
<td>2007</td>
<td>70.42</td>
<td>0.323</td>
<td>22.75</td>
</tr>
<tr>
<td>2008</td>
<td>50.70</td>
<td>0.323/0.408</td>
<td>18.30</td>
</tr>
<tr>
<td>2009</td>
<td>43.20</td>
<td>0.397/0.408</td>
<td>17.23</td>
</tr>
<tr>
<td>2010</td>
<td>49.88</td>
<td>0.397</td>
<td>19.71</td>
</tr>
<tr>
<td>2011</td>
<td>31.85 (As of April)</td>
<td>0.397</td>
<td>12.65</td>
</tr>
</tbody>
</table>

Our energy consumption has gone down by 48%. 

The Frangipani Langkawi Resort & Spa
Organic Duck & Chicken Rearing

Duck rearing
- Rearing ducks in-situ at the resort organically.
- To serve duck meat at resort’s restaurant and to sell duck eggs to salted egg producer.
- To reduce food cost, to reduce carbon footprint of food supply transportation & to be self-sustained.
- Ducks are fed with kitchen waste such as leftover rice and wild water spinach grown at wetland.

Chicken rearing
- To rear “kampung” chicken in-situ at the resort.
- To supply chicken eggs and meat to the kitchen.
- To reduce food cost, to reduce carbon footprint of food supply transportation & to be self-sustained.
WASTEWATER TREATMENT SYSTEM
The Frangipani Langkawi has its own man-made wetland which used to treat the wastewater in the resort. There is two type of wastewater – black water and gray water. Black water generally refers to the sewage waste, whilst the gray water is the wastewater that generate from sinks, baths and laundry. The wetland area is approximately 0.5855 acre (2.369 m²) with maximum depth 1.2 – 1.7 m depending on season and it is the first of its kind to be built in Malaysia. The wetland water has always monitored with help from local public university and private laboratories to ensure the water quality in the wetland is acceptable under Malaysian standard. The generation of black water and gray water in the resort are shown in the flow chart below.

The flow chart of black water and gray water generation in the resort.
Man-made Wetland

First point
Water mimosa (*Neptunia spp*): to reduce total nitrogen and phosphorus’s values; absorb organic compounds and suspended solids

Second point
*Thalia Geniculata*: absorbs nutrients and stabilizes the suspended solids.

Third point
Water hyacinth (*Eichhornia crassipes*): very efficient in removing suspended materials, BOD, nutrients (nitrogen and phosphorus), organic matter and up take heavy metals (lead, chrome, cadmium, copper, aluminum, nickel, mercury) and pathogens

Final point
Duckweed (*Lemna minor*): absorbs nitrates, phosphate, potassium, calcium, sodium and carbon
Vetiver (*Veteveria zizanioides*): helps to regulate the amount of water and filter sediment-bound contaminants (heavy metals and some pesticides residues)
Water lily (*Nymphaea*): removes cadmium in the water, help reduce algae growth in ponds
Water spinach (*Ipomoea aquatic Forsskal*): provide a large surface area for the growth of beneficial micro-organisms that can enhance nitrogen removal.

The type of plants that planted in the pond (wetland)
Topography of wetland and the flow of the waste water
Neptunia spp is a floating aquatic perennial that roots in the banks or bottoms of water bodies. Its stems grow out of the water surface and are supported by a spongy fibrous material that covers the stems. A form that grows on damp ground has smaller leaves and flowers, and lacks the spongy tissue that surrounds stems. The olive green leaves are divided, like those on a jacaranda, and are arranged in opposite pairs on the stems. When touched, the leaves ‘close up’ in much the same way as in sensitive plant (Mimosa pudica). Yellow ball-shaped flowers are produced in early summer.

Neptunia spp is the first plant used to treat the water. Water mimosa is able to reduce total nitrogen and phosphorus’s values; absorb organic compounds and suspended solids because its stems covered with a spongy fibrons layer. It has the potential to restrict water flow in creeks and channels, so all the suspended solid can settle down slowly. It is a vegetable that can be eaten raw or cooked.
Thalia Geniculata, or more commonly known as Bent Alligator-Flag, is a forb/herb (a forb/herb is a non-woody plant that is not a grass) of the genus Thalia. Its duration is perennial which means it will grow year after year. It is the second plant used to treat the waste water. It absorbs nutrients and stabilizes the suspended solids.
**Eichhornia crassipes** is a free-floating perennial plant that can grow to a height of 3 feet. The dark green leave blades are circular to elliptical in shape attached to a spongy, inflated petiole. Underneath the water is a thick, heavily branched, dark fibrous root system. The **Eichhornia crassipes** has striking light blue to violet flowers located on a terminal spike. Water hyacinth is a very aggressive invader and can form thick mats. If these mats cover the entire surface of the pond they can cause oxygen depletions and fish kills. **Eichhornia crassipes** should be controlled so they do not cover the entire pond.

**Eichhornia crassipes** is very efficient in removing vast range of pollutants, from suspended materials, BOD, nutrients like nitrogen and phosphorus to organic matter. Most importantly, they have high capacity of up taking heavy metals like lead, chrome, cadmium, copper, aluminum, nickel, mercury and pathogens. Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g. amphibians, reptiles, ducks, etc.). After aquatic plants die, their decomposition by bacteria and fungi provides food (called “detritus” for many aquatic invertebrates). **Eichhornia crassipes** has no known direct food value to wildlife and is considered a pest species.
*Lemna minor* is the smallest flowering plant. It floats on the water surface in a bright green layer. *Lemna minor* has no stems and no leaves. Some may have tiny roots. It absorbs nitrates, phosphate, potassium, calcium, sodium and carbon mainly autotrophic growth with atmospheric CO2 as carbon source.

*Lemna minor* is an important food for wild waterfowl and fish both directly and as a source of food for small creature that are in turn eaten by the birds and fish. As it grows, *Lemna minor* absorbs nutrients from the water. Thus it has a useful role in controlling the growth of algae, both by removing nutrients and by shutting out sunlight as the *Lemna minor* covers the water surface. Algae absorb oxygen and as it decays, it further reduces oxygen levels. Algal blooms can thus severely affect aquatic life. By shading the water, *Lemna minor* also keeps it cool and thus allow for more dissolved oxygen. And by covering the water surface, it minimizes water loss through evaporation.
Vertiveria zizanioides known as miraculous grass because it is very beneficial and versatile. Its feature lies in its function in soil, water conservation and erosion control. Veteveria zizanioides helps to regulate the amount of water. Veteveria zizanioides stiff and erect stems that can stand up to high velocity flows and increase detention time. Thick growth forming living porous barrier that can acts as a very effective filter trapping both fine and coarse sediments, as well as sediment-bound contaminants (e.g. heavy metals and some pesticides residues).

Deep, dense and penetrating root system that can reduce and prevent drainage, improve bed stability and nutrient uptake. Finely structure and massive root system which provides an environment that stimulates biological process in the rhizosphere. Veteveria zizanioides is highly tolerant to adverse climatic conditions such as frost, heat wave, draught and flood. Also, highly tolerant to adverse edaphic conditions such as high soil acidity and alkalinity, elevated levels of heavy metals such as arsenic, cadmium, copper, chromium, lead, mercury, nickel, selenium and zinc.
The *Nymphaea* 's leaves shade the water keeping it cool and thus allowing for more dissolved oxygen. The plant also provides hiding places for small aquatic creatures. *Nymphaea* removes cadmium in the water, help reduce algae growth in ponds and add oxygen to the garden ponds itself.

*Ipomoea aquatic Forsskal* is a mild green eaten throughout Asia. Nutritionally, it is very similar to spinach. *Ipomoea aquatic Forsskal*, also known as swamp cabbage, is in the same genus as sweet potato, and a member of the morning glory family. *Ipomoea aquatic Forsskal* grows wild in aquatic environments, but can also be grown in well irrigated fields. *Ipomoea aquatic Forsskal* is a favorite within many Asian cultures. For the floating plants like *Ipomoea aquatic Forsskal*, the plant roots are hanging down beneath the floating wetland and provide a large surface area for the growth of beneficial microorganisms that can enhance nitrogen removal. Because the plants are floating, they are forced to take their nutrients and heavy metals from the water rather than from the sediments.
There are few laboratories which co-operates with us such as University Technology Malaysia and CO2 private laboratory to test the water quality to ensure that the quality is maintained. As of the result, the quality of the water is in Grade A.
Lab Report No.: MKAS-FR-09-1  
Sample Description: Sample 10  
Client: Frangipani Langkawi Resort and Spa  
Date of sample received: 13th July 2009  
Date of report issued: 31st July 2009

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Method</th>
<th>Standard A</th>
<th>Standard B</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>In-situ</td>
<td>40</td>
<td>40</td>
<td>29</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td>6.0-9.0</td>
<td>5.5-8.0</td>
<td>6.77</td>
</tr>
<tr>
<td>BOD₅</td>
<td>mg/L</td>
<td>5210-B</td>
<td>20</td>
<td>50</td>
<td>13</td>
</tr>
<tr>
<td>COD</td>
<td>mg/L</td>
<td>5220-C</td>
<td>50</td>
<td>100</td>
<td>81</td>
</tr>
<tr>
<td>Suspended Solid</td>
<td>mg/L</td>
<td>2540-D</td>
<td>50</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.005</td>
<td>0.005</td>
<td>0.013</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.01</td>
<td>0.02</td>
<td>ND</td>
</tr>
<tr>
<td>Chromium-Hexavalent</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.05</td>
<td>0.08</td>
<td>ND</td>
</tr>
<tr>
<td>Arsenic</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.05</td>
<td>0.10</td>
<td>ND</td>
</tr>
<tr>
<td>Cyanide</td>
<td>mg/L</td>
<td>4500-CN</td>
<td>0.05</td>
<td>0.10</td>
<td>0.001</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.10</td>
<td>0.5</td>
<td>0.005</td>
</tr>
<tr>
<td>Chromium Trivalent</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.2</td>
<td>1.0</td>
<td>ND</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.2</td>
<td>1.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.2</td>
<td>1.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.2</td>
<td>1.0</td>
<td>ND</td>
</tr>
<tr>
<td>Tin</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>0.2</td>
<td>1.0</td>
<td>0.016</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>1.0</td>
<td>1.0</td>
<td>0.048</td>
</tr>
<tr>
<td>Boron</td>
<td>mg/L</td>
<td>4600-B</td>
<td>1.0</td>
<td>4.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>mg/L</td>
<td>ICPMS</td>
<td>1.0</td>
<td>5.0</td>
<td>1.652</td>
</tr>
<tr>
<td>Phenol</td>
<td>mg/L</td>
<td>6420</td>
<td>0.001</td>
<td>1.0</td>
<td>ND</td>
</tr>
<tr>
<td>Free Chlorine</td>
<td>mg/L</td>
<td>4500-C1</td>
<td>1.0</td>
<td>2.0</td>
<td>0.0021</td>
</tr>
<tr>
<td>Sulphide</td>
<td>mg/L</td>
<td>4500-S²</td>
<td>0.8</td>
<td>0.8</td>
<td>0.016</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>mg/L</td>
<td>5520</td>
<td>-</td>
<td>10.0</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Note: ND: Not detected  

Certified By  
SHAMILA AZMAN  
PhD (Chemistry)
Certificate Analysis in 2010 from myCO2

The Frangipani Langkawi Resort & Spa
Jalan Teluk Baru, Pantai Tengah,
MK Kodawang 07000 Pulau Langkawi,
Attn: Sustainable Dept

CERTIFICATE OF ANALYSIS

The sample(s) which you submitted to us have been analysed and the result(s) shown below:

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>STATION 5-MICROB 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Marking</td>
<td>na</td>
</tr>
<tr>
<td>Date of Received</td>
<td>7-Jul-2010</td>
</tr>
<tr>
<td>Date of Completion</td>
<td>15-Jul-2010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Analysis Result(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH Value</td>
<td>6.62</td>
</tr>
<tr>
<td>BOD-5 days test @ 20 C</td>
<td>12.5 mg/l</td>
</tr>
<tr>
<td>COD - Chemical Oxygen Demand</td>
<td>31.5 mg/l</td>
</tr>
<tr>
<td>Mercury (as Hg)</td>
<td>Not detected (&lt;0.001 mg/l)</td>
</tr>
<tr>
<td>Cadmium (as Cd)</td>
<td>Not detected (&lt;0.001 mg/l)</td>
</tr>
<tr>
<td>Chromium Hexavalent</td>
<td>Not detected (&lt;0.02 mg/l)</td>
</tr>
<tr>
<td>Chromium Trivalent</td>
<td>Not detected (&lt;0.02 mg/l)</td>
</tr>
<tr>
<td>Copper</td>
<td>Not detected (&lt;0.01 mg/l)</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td>Nickel (as Ni)</td>
<td>Not detected (&lt;0.02 mg/l)</td>
</tr>
<tr>
<td>Tin (as Sn)</td>
<td>Not detected (&lt;0.05 mg/l)</td>
</tr>
<tr>
<td>Zinc (as Zn)</td>
<td>0.02 mg/l</td>
</tr>
<tr>
<td>Boron (as B)</td>
<td>0.09 mg/l</td>
</tr>
<tr>
<td>Iron (as Fe)</td>
<td>0.89 mg/l</td>
</tr>
<tr>
<td>Phenol</td>
<td>Not detected (&lt;0.001 mg/l)</td>
</tr>
<tr>
<td>Free Chlorine (as Cl2)</td>
<td>0.03 mg/l</td>
</tr>
<tr>
<td>Arsenic (as As)</td>
<td>Not detected (&lt;0.001 mg/l)</td>
</tr>
<tr>
<td>Cyanide (CH3Cl)</td>
<td>Not detected (&lt;0.02 mg/l)</td>
</tr>
<tr>
<td>Lead</td>
<td>Not detected (&lt;0.91 mg/l)</td>
</tr>
<tr>
<td>E-coli</td>
<td>207000 cfu/100ml</td>
</tr>
<tr>
<td>Total Coliform Count</td>
<td>960000 cfu/100ml</td>
</tr>
<tr>
<td>Oil &amp; Grease</td>
<td>Not detected (&lt;0.2 mg/l)</td>
</tr>
<tr>
<td>Sulphates</td>
<td>Not detected (&lt;0.2 mg/l)</td>
</tr>
</tbody>
</table>

Chong Mai Me
Laboratory Manager
MSc (Research) ANUG, BSc (Hons) Chemistry
(IBM No: A16404169/2001)

Noor Adura Bt. Mat Isa
Microbiologist

This report is strictly not for circulation or advertising purpose and cannot be reproduced except in full without written approval of this laboratory. Symbols 'Not detected' parameter which is not accredited.
Conclusion

From our average cost per occupied room of RM4.35 in year 2006 to RM 3.44 in year 2010, we have successfully reduced our water usage by 40% by the year 2011 although the unit price for water has increased 20.07%.
THANK YOU