3. Water Supply

Introduction

For the past few decades, technology has advanced rapidly and many various processes have been invented to suit the needs of our everyday lives. A lot of these processes require at least one or more sources of energy whether it is electrical, heat, coal or fossil fuels that consume a colossal amount of the world's natural resources. Many organizations nowadays are heavily invested in finding alternative methods to preserve these resources and they are looking more and more into sustainable procedures to find the most appropriate solution for these problems. The current world population have reached six billion and tends to increase to approximately nine billion by the year 2050 according to UN's Population Division. When this is correlated to the quantity of natural resources that has been spent, it is not surprising to find that the world is perilously running out of these essentials.

Water is another fundamental source for human needs beside food and a crucial factor to the progression of their everyday lives. Many uses of water include agricultural, industrial, household, recreational, and environmental activities. Although the sea covers three-quarters of the earth surface, the desalination process which convert saline water to fresh water is currently very expensive compared to other sources of water. Only 3 percent of water on the earth is fresh water and over two thirds of this is frozen in glaciers and polar ice caps. Moreover, water demand already exceeds water supply in many parts of the world, and many more areas are expected to experience shortage of water in the near future due to excessive population growth.

Samui Island is Thailand's top tourist attraction, especially after the Indian Ocean tsunami tragedy in late 2004. While the Andaman Sea on the west coast of Thailand is recovering healthily from this catastrophe, the tourism industry has been heavily depleted as many foreigners are anxious to set foot there in case history repeats itself. Places which have been prosperous in the past, like Phuket and Krabi, have seen an alarming drop in the number of visitors since then. As a result, many tourists now choose Samui Island as their main vacation destination.
Partly due to their westernised culture and a diminutive chance of a tsunami striking, the majority of the population on Samui Island are actually tourists who constantly come to visit throughout the year. With this rapidly increasing rate of population, there is also the rise in the consumption of other resources, especially in fresh water supply. Although Samui Island has receives a lot of rainfall throughout the year, it is very difficult to collect the rain water as they tend to surge or dissipate back into the sea due to the nature of the Island. Therefore, there is actually very little amount of raw water kept in the reservoir that can be filtered into clean, usable water.

In 2002, Samui Island suffered a rain water drought for 5 months, and it was impossible to generate clean water after the reservoir has been dried out. Obviously, this had a profound secondary effect on the number of tourists visiting the Island and it was the responsibility of Provincial Waterworks Authority (PWA) to relieve this problem. They issued instructions and came up with three separate plans for the solution: short-term solution, mid-term solution and long-term solution. Evidently, methods to increase the capacity of the water reservoirs was incorporated into all these plans so there will be enough water to distribute even in the summer period (January to April), which is a high tourist season.

The Action Team suggested that, apart from increasing the capacity of the water reservoirs and increasing the level of productivity

accordingly in each area depending on population density, it is necessary to educate the locals on the principle of using water efficiently and to promote the value of water in general. For example, using filtered water for agricultural purposes, having appropriate amount of clean water stored away for water drought occasion, decreasing the wastewater to below 25% in households, or saving water throughout daily activities can be of significant importance to the long-term preservation of the water resources.

Existing Data

The water system management on Samui Island is presently in the care of the Provincial Waterworks Authority (PWA). The water supply on the Island was first established in 1977 by Local Water Treatment Authority before it was passed on to the PWA on 22 August 1989. The site was located on the Hin Lad waterfall, which is in the western region of the island approximately 2-3 kilometres south of the Sheriff office.

Figure 1. Water treatment plant at Hin Lad

Prior to that, the water supply system simply involves the extraction of raw water from the waterfall, passing it through a series of basic filter and then distributing it to the community nearby. In the beginning, the clean water would only be available to those who are near the source; mainly residents and government owned buildings near the Nathon market. For more isolated areas outside the vicinity of the Nathon market, the primary water sources are from ponds, reservoirs and small waterfalls.

Presently, the water supply has a sufficient pipe system covering all of the residential and commercial areas on the Island. The only exceptions are those households which are mountainous or in high terrain, since it would be inappropriate and uneconomical to invest in a water-pump powerful enough to supply only a few households. However, according toFrom a research that was carried out by the Action Team in 2003, it was found that out of 17,000 households, only 23.5% (2003) have access to clean water supply. Moreover, Due to the increasing number of tourists visiting the Island throughout the year, the general amount of water consumption will also increase through the months. The statistics shows that in September 2003, there are 4,318 households registered using the water supply and comparing that to more recent data which was collected in May 2006, there are now 7,404 households. This shows approximately 70% increase in just over 2 years and with the rapid growth rate of Samui Island, all the indications point to a sharp increase in the water demand level.

Table 1. The quantity of clean water produced and sold on Samui Island (1998 – 2003)

Year	Clean water Sold		Clean water Produced		Max. Demand
	(mil cu.m./yr.)	(cu.m./day)	(cu.m./day)	(cu.m./hr)	(cu.m./hr)
[1]	[2]	[3]	[4]	[5]	[6]
1998	1.10	3,014	3,767	157	204
1999	1.11	3,041	3,801	158	206
2000	1.26	3,452	4,315	180	234
2001	1.53	4,192	5,240	218	284
2002	1.73	4,740	5,925	247	321
2003	1.61	4,411	5,514	230	299

[2] – data from PWA.
[3] = [2] x 1,000,000 / 365 (average demand)
[4] = [3] x 1.25 (Water Loss in pipeline assumption is 25%)
[5] = [4] / 24
[6] = [5] x 1.30 (Peak demand assumption is 30%)

The Source of Water Supply on Samui Island.

Samui is considered as one of the Continental Islands which is located in the Gulf of Thailand, where there are also 25 other smaller land masses located nearby. The Island itself is the largest and inevitably most prosperous which covers approximately 231 square kilometers of land. There is a large mountainous area located right in the middle of island. The altitude varies from 100 m to 635 m and the summit of that mountain is located at Taay Kwai, where it is 635 m above sea level. Around 53.77% of these mountainous areas are covered by mixed deciduous forests or coconut trees, which acts as an instigator for a number of important water sources such as the Lipa Yai River, the Maenam River, the Ta Jine River and the Na Muang River.

Like the rest of Thailand, Samui Island does not have many climate changes. There are only two seasons: the summer and the monsoon season. The summer usually starts from February and lasting until April. During this period, the rain is scarce and temperature tends to rise unambiguously. However, the wind is calm and the sea water crystal clear, making it the perfect time for tourism. The monsoon season starts from around May to January; as from May to October, there is a tropical storm coming in from the south-eastern part of the Andaman Sea., and from November to January, the monsoon sweeps in from the Chinese Sea, through the north-eastern part of Thailand. As a result, there is a lot of rain throughout the year.

Figure 2. Hin Lad water fall

The average amount of rainwater the year is 1,919 mm. Approximately 59.9% of this rainwater is thought to be gathered between January and October, while the total number of rainy days has been averaged to 158.5

days/year, (the data was taken from the meteorological department between 1968 and 1990).

The rainwater on Samui Island typically forms a stream or a river which flows down from the mountains located at the centre of the island. The main watercourses on Samui Island are located at:

1. Lipa Yai:

   This waterway originated from the centre of the island and provides the source of water for the Hin Lad waterfall. The river flows through various hills and valleys, which covers around 9.4 square kilometres of land. Thus, this would mean that approximately 9.0 million cubic meters of rainwater is gathered per year within that area.

2. Lipa Noi:

   The main source of water is the same as that of the Lipa Yai River, but it branches out and flows into the sea via Baan Lipa Noi.

3. Skej:

   Originates in the hills of Taay Kwai and the river flows into the sea past the Krajud reservoir. The whole area covers 4.7 square kilometres of land and the average amount of rainwater collected here is 4.62 million cubic meters per year.

4. Ta Lamai:

   Originates from Kow Yai and Kow Plu, where the two streams meet and integrate into a river which flows into the gulf in Lamai. The whole area covers 4.5 square kilometres of land and the average amount of rainwater collected here is 4.46 million cubic meters per year.

5. Baang Namjued:

   Originates from Kow Plu where it flows out into the sea around Baan Hua Thanon. The whole area covers 1.2 square kilometres of land and the average amount of rainwater collected is 0.9 million cubic meters per year.

6. Ta Ret:

   Originates from Kow Yai and flows out around the province of Maret.

7. Seeya:

   Originates from Kow Yai again and flows out into the sea near the Na Muang province.

8. Jarakae:

   This area covers 5.0 square kilometres of land and the average amount of rainwater collected is 4.87 million cubic meters per year.

9. Maenam:

   This area covers 8.3 square kilometres of land and the average amount of rainwater collected is 7.48 million cubic meters per year.

Apart from these natural sources of water, there are other means of water storage (i.e. dams and water reservoirs) constructed mainly for agricultural use. They are located at:

1. Hin Lad:

   Rain water from Lipa Yai where there are water pipes connected to and from the Krajud reservoir. The average amount of rainwater collected here is 8.0 million cubic meters per year.

2. Na Muang:

   Located in front of the Na Muang waterfall, where it distributes water to the farming areas on the west side of the Ta Seaw River. The average amount of rainwater collected is 1.3 million cubic meters per year.

3. Maenam:

   Gathers water from the Maenam river, which is then used for agricultural purposes. The average amount of rainwater collected here is 2.4 million cubic meters per year.

4. Ta Sok:

   This located around Kow Plu, which covers around 3.0 km^2 of land and the average amount of rainwater collected here is 2.3 million cubic meters per year.

5. Bang Namjued:

   Gathers water from the Bang Namjued river. The average amount of rainwater collected here is 0.9 million cubic meters per year.

6. Wang Sow Tong:

   This is located at the Ma Ret province on the Ma Ret river. The average amount of rainwater collected here is 2.4 million cubic meters per year.

7. Wang Hid Lad:

   This was constructed near the river at Maenam market. The average amount of rainwater collected here is 2.0 million cubic meters per year.

8. Pung Pae:

   This was constructed at the Pung Pae River in Baan Tung Kyow for agricultural purposes. The average amount of rainwater collected here is 0.8 million cubic meters per year.

Some of the water flows from the mountain will be collected in a large water storage which the locals call 'Pru' or commonly known as a reservoir. This can either be created naturally or it can be man-made, each of them has its own advantages and disadvantages. The reservoirs which have the most influence on the water supply system on Samui Island are:

1. The Chaweng Reservoir

   This reservoir is located in the northeastern part of the Island. It is the largest natural reservoir on the Island with the total area of approximately 450 rai. It is 2 – 3 metres deep and has the storage capacity of approximately 1.6 million cubic meters. The catchment area is around 7 square kilometers and the average amount of rainwater collected is 6.0 million cubic meters per year. However, due to the increase in population and construction works, the water cannot flow in the sub terrain – through and along the ground like in the past; so the only source of water that replenishes the reservoir is the rainwater. There are also problems with wastewater from the area surrounding the reservoir. The main concern is in the Lam Din area, which is heavily populated, the wastewater could not pass through the appropriate treatment processes before flowing into the reservoir. As a result, the water in the reservoir is not suitable for converting into drinking and usable water. There have been letters of complaint from the community to the local authorities to avoid using water from the Chaweng Reservoir because of its poor quality.

Therefore, orders were issued to stop using the reservoir on a daily basis unless there are shortages of water supply.

Figure 3. Chaweng Reservoir

2. The Na Muang Reservoir

This reservoir is located on a flat terrain in the southeastern part of the Island where mountains surrounding the area. The total area is about 300 rai but the actual usable area is 250 rai. The reservoir has around 5 – 6 metres deep with the original capacity of 480,000 cubic meters, but after the water drought in 2002, there were short-term plans (from 2003 – 2004) to develop and increase its capacity. Nowadays, the Na Muang Reservoir has a capacity of 800,000 cubic meters and it is also the most important source of water storage on Samui Island.

Figure 4. Na Muang Reservoir

3. The Krajud Reservoir

This reservoir is located in the western part of the Island. It covers 42 rai of land with the depth of approximately 5 – 6 metres. It used to have a capacity of 250,000 cubic meters, but like the Na Muang Reservoir, it was included in the short-term plan as issued after the water drought in 2002. Presently, the Krajud Reservoir can store up to 350,000 cubic meters of water, it also acts as a main source of water supply for the treatment plant located at the Hid Lad waterfall. There are a few minor difficulties however, as the reservoir is located near the sea, and the seawater tends to penetrate through the reservoir and contaminates the water. To counter this, plastic sheets are laid down at the bottom of the reservoir.

Figure 5. Krujud Reservoir

Apart from the surface water that flows above ground, there are also sub-terrain water sources on Samui Island. These sources are divided into three types as follows:

1. Granitic Aquifers:

This type of source is made out of granite and diorite and can be found in the central part to the eastern side of the Island. There is actually very little depth in these bowels and cracks can be found on the surface of

the rocks at approximately 10 gallons per minute, while some spots rise to 20 gallons per minute.

2. Chao Phraya Aquifers:

   This type of source is mainly found in areas consist of residues on the banks of rivers that are flat and smooth. These areas are common on the beaches in the northern, southern and western parts of the Island. Normally, these aquifers are water sources which forms around a pond and usually has a depth of approximately 30 metres. The amount of water gathered here is 100 – 150 gallons per minute. The purity of the water is excellent.

3. Metamorphic Aquifers:

   Can be found in small areas on southwestern part of the island. This type of aquifers is very shallow and therefore it could not contain much water.

The water sources on Samui Island are still insufficient. The best method for the water supply system is to distribute clean water to residential or commercial areas located near the sources.

Water Treatment Plant

There are two water treatment methods to produce clean water on Samui Island:

1. Conventional WTP:

   This is a standard method that allows the raw water to coagulate and then all residues and other excesses are filtered out. The purified water is collected and distributed into the water supply system.

2. Reverse Osmosis (RO) Plant:

   Sea water is converted into clean, usable water through various processes and procedures.

The water supply system and the treatment plants can generate and circulate clean water at the rate of 80 cubic meters per hour. There are four water treatment plants located around the Island:

1. Hid Lad Waterfall:

   Located next to the waterfall where the Provincial Waterworks Authority (PWA) of Samui Island is also situated. This water treatment plant uses the conventional method. In the past, this treatment plant had capacity of 250 cubic meters per hour or 6,000 cubic meters per day. After budgets were given to the development of the water supply of the whole island, the Hid Lad Treatment Plant has the capacity of 450 cubic meters per hour or 10,800 cubic meters per day.

2. Na Muang Reservoir:

   This plant is located next to the Na Muang reservoir. At the beginning, it had the capacity of 100 cubic meters per hour or 2,400 cubic meters per day of clean water. However, after complete the expansion in 2004; it has the capacity of 250 cubic meters per hour or 6,000 cubic meters per day of clean water, also by conventional process.

3. R.O. Plant:

   Due to the lack of water sources, especially in the heavily populated areas such as the Chaweng beach, the PWA has brought in a private water supply management company called ‘East Waters Co. Ltd’ to construct a treatment plant using the R.O process in Bo Phut district.

This involves bringing in seawater and filtering it through a fine membrane which sifts out the salt. The rate of production is presently at 2,500 cubic meters per day. This treatment process is necessary as it is also important to prevent any knock-on effects it may have on the tourism industry and helps the improvement of the water supply system on the Island.

4. Mobile Plant Unit:

In 2004, the Public Works Authority arranged to bring a mobile plant unit to the Chaweng Reservoir with the production rate of 120 cubic meters per hour or 2,880 cubic meters per day. This was mainly to make the public gain confidence that the water supply shortage was not serious. However due to the uncertain of the locals about the purity of the water at the Chaweng Reservoir, the Public Works Authority issued a decree to permit the use of this source only in emergencies.

Figure 6. Water treatment plant office at Hin Lad

Figure 7. Water treatment plant at Na Muang

Figure 8. RO System water treatment plant at Bo Phut

Figure 9. Mobile water treatment plant at Chaweng

The Water Supply Distribution System

There are two main water pipe lines that circulate around Samui Island. The most recent line has a 300 mm in diameter and another one has a 200 mm in diameter. There is also another pipe line which carries the water source from the Krajud Reservoir straight to the treatment plant that is located at the Hid Lad waterfall. The two main pipe lines were constructed on trail along side the ring road (route 4169) which nearly covers the entire Island. However, there are still some parts of the Island which the main pipes cannot access, for example the Baan Bang Por area (as shown in Diagram 1). The main water pipe line also branches out, leaving smaller pipes to cover areas which lead along the secondary roads. These are areas such as the Nathon district, Lipa Noi, Phang Ka, Hua Thanon, Bang Rak, Bo Phut and Choeng Mon. For the residential areas located in the mountains or high altitude, there is no access to the Island's main water supply as the pipes cannot reach these households. The locals in these areas usually solve their problem by using water from nearby streams or by digging wells.

In general, the water supply system on Samui Island covers a huge majority of the area, and that clean water can be successfully distributed to all the residential, commercial and governmental areas.

Figure 10. Existing water supply distribution pipeline

Conclusion

Currently, there are plenty of rains throughout the year because of its geographical location. This leads to the formation of many rivers and streams which are the essential sources of the water supply. However, due to the rapid growth of tourism and the agricultural development on the Island, there have been a lot of interferences with nature and the reservoirs cannot keep up with this progression. That leads to problems with the distribution of clean water supply, which can have a dramatic effect on the tourism industry.

There are many possible methods to counteract with this problem and this falls into the responsibility of the Provincial Waterworks Authority (PWA), who issued out appropriate plans to develop and expand the size of the reservoirs and the treatment plants to serve the increase in population.

Today on Samui Island, there are two important reservoirs which are crucial to the production of the clean water supply. The first is the Na Muang reservoir, which has a capacity of 800,000 cubic meters and the second one is the Krajud reservoir, which can hold up 350,000 cubic meters of raw water. This adds up to the total of 1,150,000 cubic meters of water storage space. As for the water treatment plants, there are three major locations, at Hid Lad waterfall, the production rate is 450 cubic meters per hour; Na Muang, where the production rate is 250 cubic meters per hour, and the use of the Reverse Osmosis (RO) Plant, which can generate up to 100 cubic meters per hour. This brings the total amount of clean water treated to 800 cubic meters per hour. As mentioned before, the water supply system can circulate the water efficiently around the Island to most areas, with the only exception being at the Bang Por district.

Even if the capacity of the reservoirs and the production rate of clean water can support the level of demand at the moment, it is very unlikely that it would have adequate amount in the future according to the increasing rate of population and the number of tourists visiting the Island each year. The demand for the water supply would undoubtedly increase. If no action is taken, there will be similar problems to that of the water drought which occurred in 2002 and will have a direct effect on the overall development of the island.

To improve the water supply system on Samui Island and prolong its efficiency, it is vital that there are enough reservoirs and capacity to store raw water to meet the demand of the public. The distribution system must also be up to standard and operate with the minimum use of resources, whether it is labour or the amount of raw materials consumed. Lastly, the local authorities would do well to promote the different uses and value of these resources so the community on Samui Island could help each other to preserve the place and keep it as one of the top tourist destination in the world.

Data Analysis & Forecasting

From the statistics regarding the general use of water supply on Samui Island in previous years, and correlating this data to the increase in population each year, there is every indication that there will be a sharp increase in the water demand. This statement can be backed up by looking at the 'Reports on the Progress of Development on the Water Reservoirs and the Production Rate of Clean Water', when the Provincial Waterworks Authority (PWA) has suggested to the Board of Directors of Region 11 during their 5th meeting in 2003. The PWA has the responsibility of making sure that water supply is distributed evenly and efficiently, they have predicted the rate of demand for the water supply and the rate of demand for the raw water in the reservoir during the summer season. This can be seen in Figure 11 below:

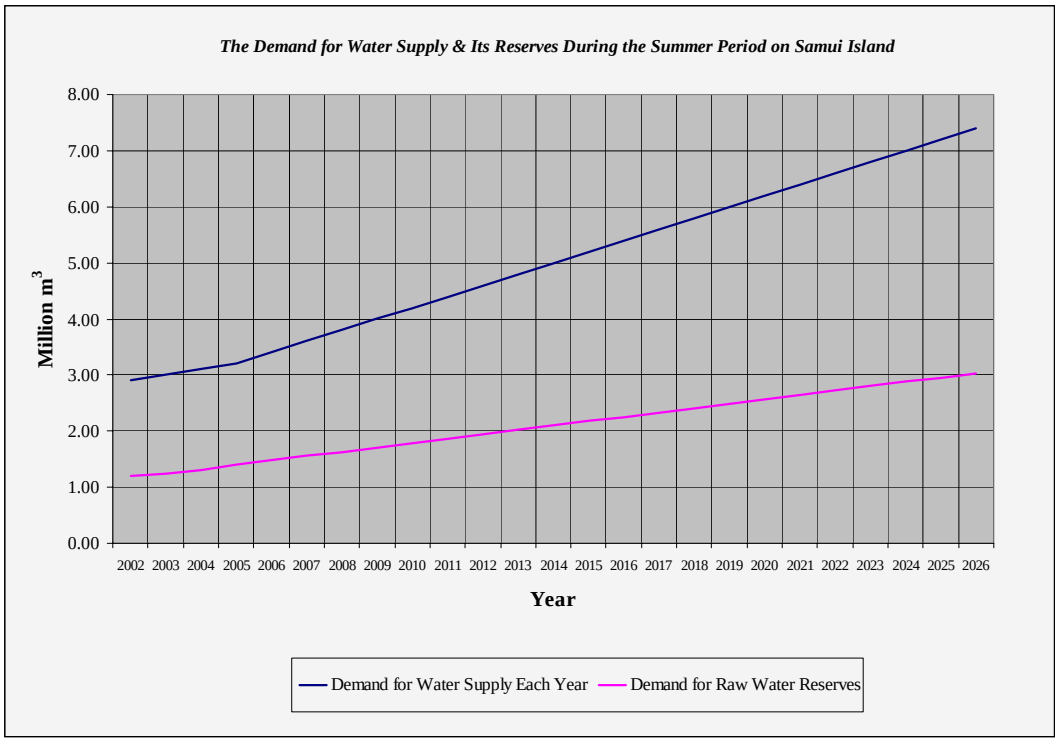

Figure 11. The Demand for water supply forecasting

This Figure shows that the rate of demand for the water supply stands at 3,400,000 cubic meters per year or 9,300 cubic meters per day in 2005. This demand has increased by 200,000 cubic meters each year since 2004. Therefore, if the demand for water continues to rise at this ratio, then it could be predicted that the rate of water demand will be at approximately 7,200,000 cubic meters per year or the daily rate of 19,700 cubic meters per day by the year 2025.

The PWA forecasted that the raw water stored in the reservoirs during the summer period could hold up to 5 months of water demand without rainfall. This is the same amount of time of water drought that occurred back in 2002 when there was no provincial rain. According to the prediction figure above, the demand of the reserve raw water in 2005 would be at around 1.50 million cubic meters. At present, there are two reservoirs, Na Muang and Krajud, which are essential to the production of clean water supply. The combined capacity for both reservoirs is approximately 1,150,000 cubic meters. This amount of water can supply up to 4 months on its own which is less than what was desired. However, since 2002, there have not been long intervals of scarcity of rain, so there was no significant impact on water shortage during summer period on Samui Island in the past couple years. From these data, it could be predicted that the demand for the raw water reserves will be at approximately 2.955 million cubic meters per year in the year 2025.

When compare the predicted data from the PWA to the actual figures, which were taken from the measurement, it is found that the rate of demand for the water supply is averaged at cubic meters per day in 2005. This is considerably higher than the predicted figure of 9,300 cubic meters per day by approximately 1,200 cubic meters per day or

13%. There are many possible reasons to explain the behaviour of water demand exceed than the predicted figure but the most likely reason may be the occurrence of the tsunami tragedy on the opposite side of the mainland at the end of 2004. Instead of going to places like Phuket and Krabi, tourists started pouring towards Samui Island which is located in the Gulf of Thailand where there is very little chance of such catastrophe occurring.

In conclusion, the predicted data that was given by the PWA conforms to the actual figure and statistics that have been collected by PWA for over long periods of time. The Action Team has decided to use these numbers to carry out an analysis and calculate the optimum capacity of the water reservoirs and the appropriate rate of water supply production.

The Expansion of the Capacity of Clean Water Supply

Samui Island was experience the 5-months water drought without a single rainfall in 2002, which caused the water supply at minimum level. In order to solve this problem, Samui Island should have a water reservoir which can supply up to five months of clean water by itself. In 2025, the prediction shows that the daily requirement for the use of clean water on Samui Island is at 19,700 cubic meters per day. In correspondence with the rate of demand, the amount of water supply is the equivalent of 2,955,000 cubic meters [(19,700 cubic meters per day) x (30 days in a month) x (5 months)].

However, the amount of needed water supply indicated above have not taken into account with the amount of water lost through insufficient piping systems, which is approximately 25%. When loss factor was integrated into the equation, the water reserve capacity in the year 2025 would be predicted at 3,693,750 cubic meters. If this value is compared to the present capacity of the reservoirs at Na Muang (800,000 cubic meters) and Krajud (350,000 cubic meters) combined, which has a total capacity of 1,150,000 cubic meters, then an additional 2,543,750 cubic meters of storage is required.

The Increase in Water Supply Capacity

The prediction for the consumption of fresh water on Samui Island in 2025 is 19,700 cubic meters per day. Hence, 1,067 cubic meters has to be generated every hour (19,700 cubic meters ÷ 24 hours x 1.30). Furthermore, as there will be 25% lost due to inefficiency in system, a total of 1,333 cubic meters has to be generated per hour.

Presently, Samui Island has improved and its water plants at Na Muang and Hid Lad waterfall, which have the combined water capacity of 700 cubic meters per hour. In addition, another 100 cubic meters per hour is generated at Bo Phut using the Reverse Osmosis (RO) treatment method, bringing the total rate of water supply generated presently to 800 cubic meters per hour, which is close to the level of water demand in 20 years time. Nevertheless, to be able to accommodate the increasing population and growing tourist industry on the Island for the next 20 years, the water supply rate should be increase to 1,300 cubic meters per hour; which is 500 cubic meters per hour more than the current rate.

Conclusion

In order to solve the water supply problems on Samui Island, the procedure involves exploring different possibilities in increasing the capacity of the reservoirs and the rate of the production of clean water, the Provincial Waterworks Authority (PWA) has proposed a development plan to the project committee on the April 7 - 9, 2003. It has been estimated by the PWA that the water demand in 2005 is at 9,300 cubic meters per day. When the

estimated figure is compared to the actual water demand in the same year, which is at 10,000 cubic meters per day, it is comprehensible that the estimation is close to the actual consumption. Therefore, the committee have decided to use the PWA's estimation as the model for further studies and research.

The water consumption on Samui Island by 2025 is estimated to be around 7,000,000 cubic meters per year or 19,700 cubic meters per day, which doubles the amount of the current water consumption. As a consequent, raw water sources and the water supply production system on the island have to be further developed so that it would be able to overcome the water demand in the future.

When comparing the current levels of water reserve and the water supply production rate to the estimated figures, it can be concluded that Samui Island should have enough water storage facilities that can supply raw water for the treatment plant by itself up to a period of 5 months. This length of time is set as a benchmark because it is the same length of time in which there was a water drought in 2002. Being able to distribute clean water to the population is essential for the overall development of the Island, which can have a dramatic effect on the tourism industry. To supply water adequately, the reservoirs should have the capacity of 3,700,000 cubic meters. In addition, the water works system has to be increased so that it can supply up to 1,300 cubic meters per hour which is 500 cubic meters per hour more than the current level.