VII SESSION REPORTS

Ⅶ-1　Japan

Mr. Shin TSUBOKA
Director General,
National Institute for Land and
Infrastructure Management

Adaptation to Flood Change Due to Warming in Japan

National Institute for Land and Infrastructure Management

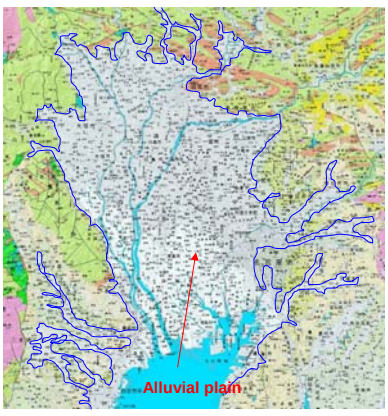
Director General : Shin Tsuboka

Geographic Features and City Formation

Most of the plains in Japan are alluvial plains and many cities are formed over these alluvial plains.

Tokyo area

（The Kanto Plain）



Chukyo area

（The Noubi plain）

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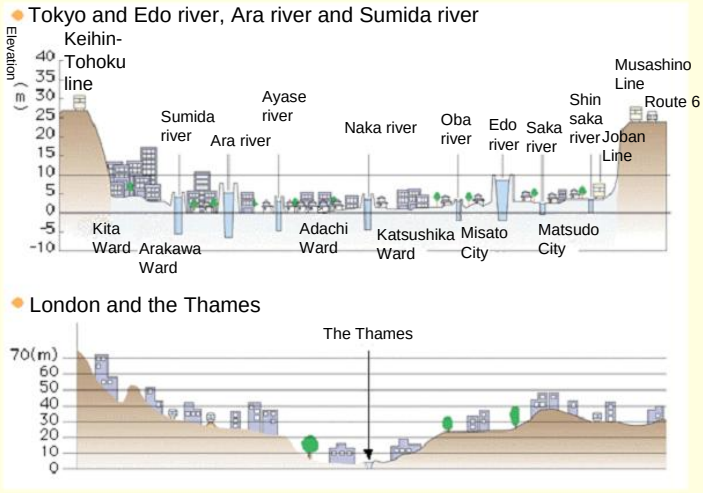
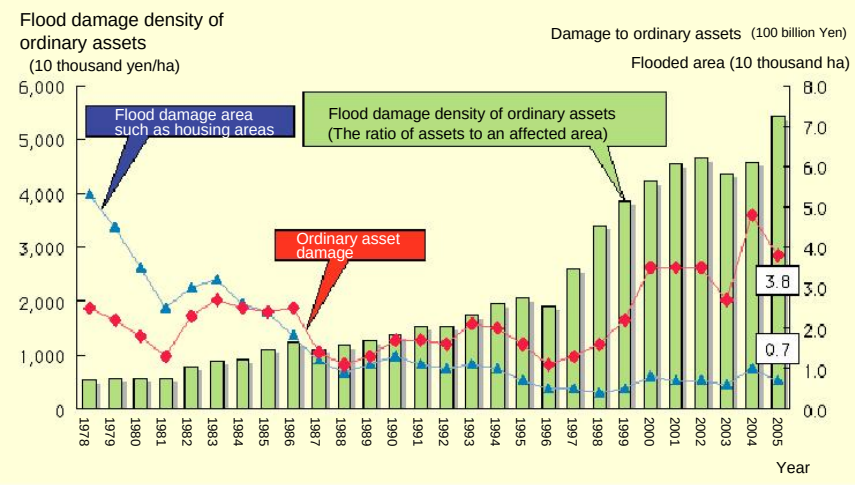
Flood Vulnerability



Information provided by MLIT

The relation of grounds and rivers level in Tokyo and London

Flood damages

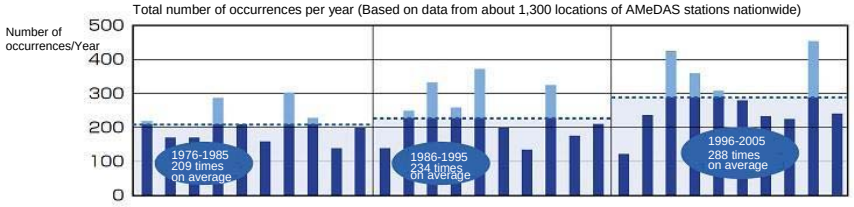


Transition of Ordinary asset damages and flooded area

Precipitation change (1)

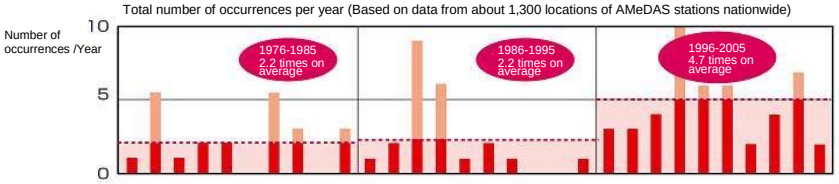
Number of downpour occurrences with 50mm rainfall per hour or larger

Total number of occurrences per year (Based on data from about 1,300 locations of AMeDAS stations nationwide)



Number of downpour occurrences with 100 mm rainfall per hour or larger

Total number of occurrences per year (Based on data from about 1,300 locations of AMeDAS stations nationwide)



Prepared by MLIT based on data by Japan Meteorological Agency

Recent changes in heavy rain frequency based on AMeDAS data by Japan Meteorological Agency

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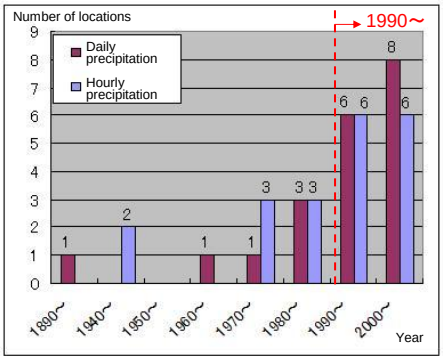
Precipitation change (2)

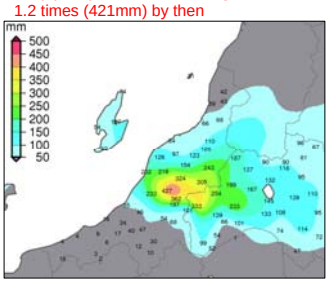
Recorded decade distribution of top 20 largest precipitation
(Observatories of Japan Meteorological Agency)



Most of the largest precipitation events in various areas in Japan were recorded after 1990.

2004 Niigata and Fukushima Heavy Rainfall

Daily precipitation was the largest amount of 1.2 times (421mm) by then

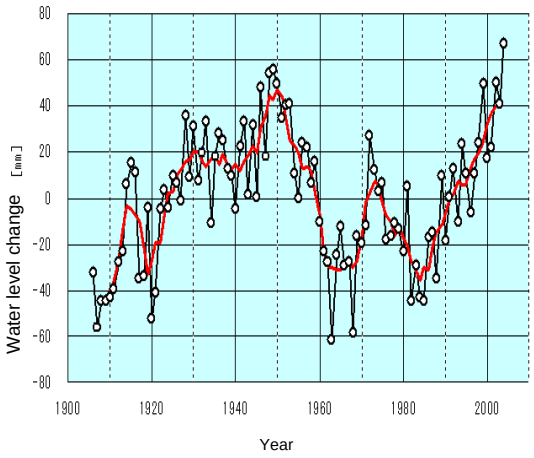


Precipitation distribution map

Levee breach (Kariyata River)

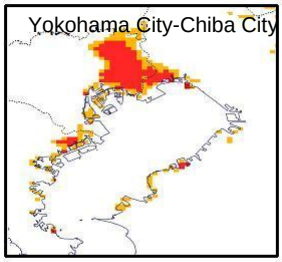
5

Changes in Sea Surface Level and their influences



Changes in sea surface in Japan's coastal areas

Tokyo Bay



1.76 million people (Currently) ⇨ 2.7 million people (After sea level rise)

Change in the under sea surface area in Tokyo Bay in the case of rise of 0.59m

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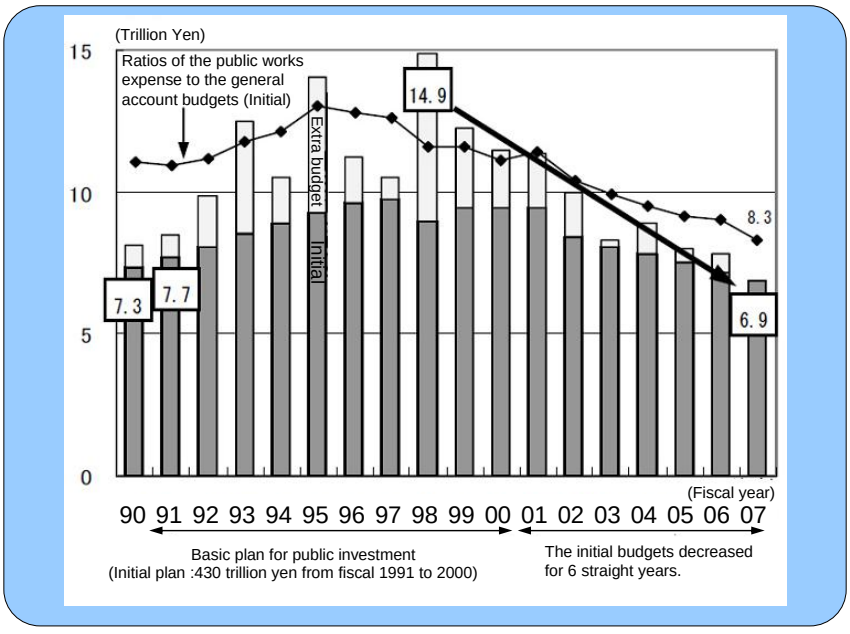
Transition national budget concerning public works



Data:Road-related budget for fiscal 2007【MLIT Press Release (January, 2007)】

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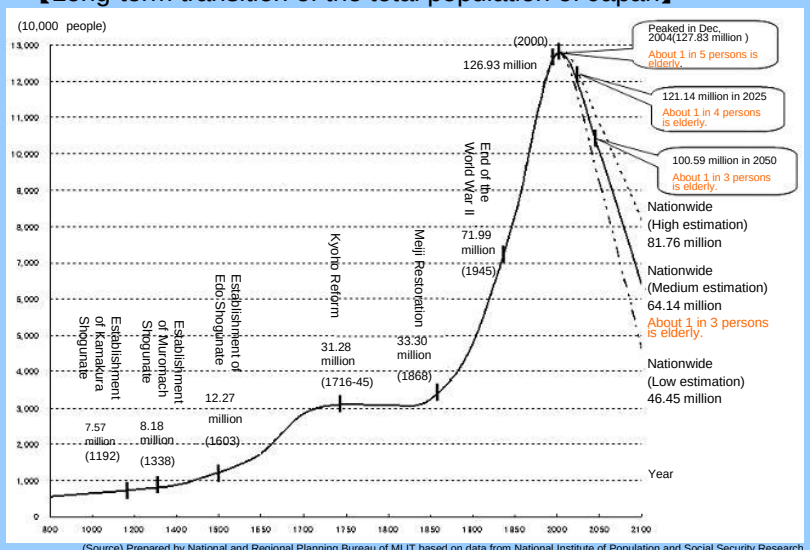
Coming of Depopulating Society

【Long-term transition of the total population of Japan】

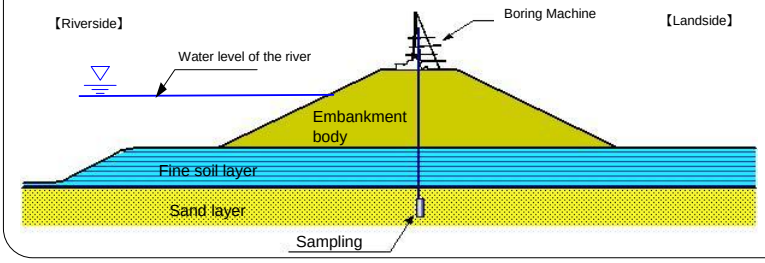


(Source) Prepared by National and Regional Planning Bureau of MLIT based on data from National Institute of Population and Social Security Research

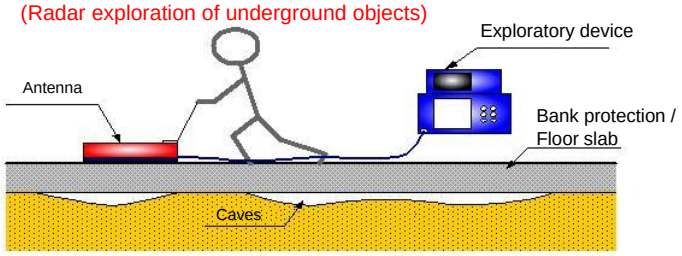
Worry・Uncertainty about the future is growing in minds of Japanese peoples

Adaptation Measures in Terms of Structure (1)

Understanding of soil mechanics of embankment body by boring



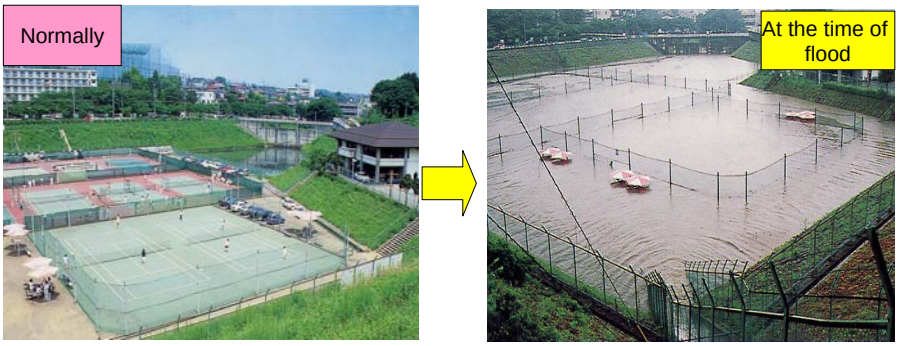
Investigation of caves in storm surge barriers
(Radar exploration of underground objects)



Implementation of dike inspections

Adaptation Measures in Terms of Structure(2)

Kirigaoka retarding basin (Tsurumi River)



Utilization of multipurpose storage facilities

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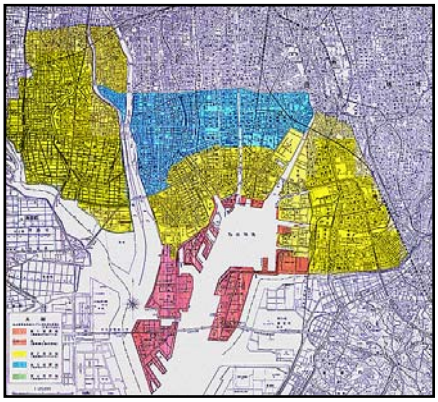
Adaptation Measures in Terms of Land Use Revision



	Floor height of 1st story	Structural limitation	Diagram
	N・P (+) 4 m or more	Wooden buildings are prohibited	
	N・P (+)1m or more	Rooms for human occupation must be on the 2nd or higher stories.	
	N・P (+)1m or more	–	

Example of Restrictions under Ordinance (Nagoya City)

－Hazardous areas designation based on Building Standard Law －

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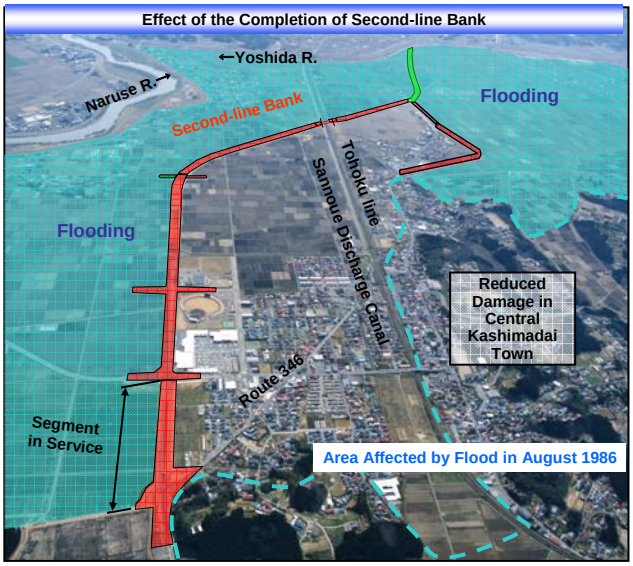
Adaptation Measures in Terms of Damage Reduction Measures (1)



The construction of second-line bank in this district is promoted combined with a road project (bypass construction).

Flood Flow Control Using Second-line Banks

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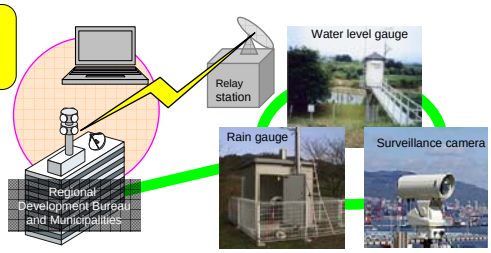
Adaptation Measures in Terms of Damage Reduction Measures (2)

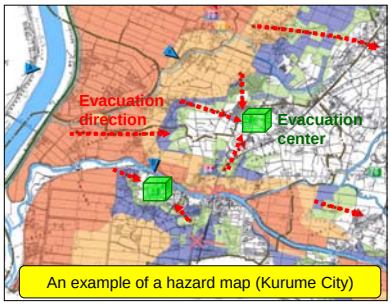
Improvement and Maintenance of Information offer System

Improvement and maintenance of observation equipment such as rain gauges, surveillance cameras, etc.



Preparation of Flood Hazard Map

Preparation and publication of flood hazard maps based on the area where flood is expected.



Implementation of required information offer for safe evacuation such as preparation and publication of hazard maps

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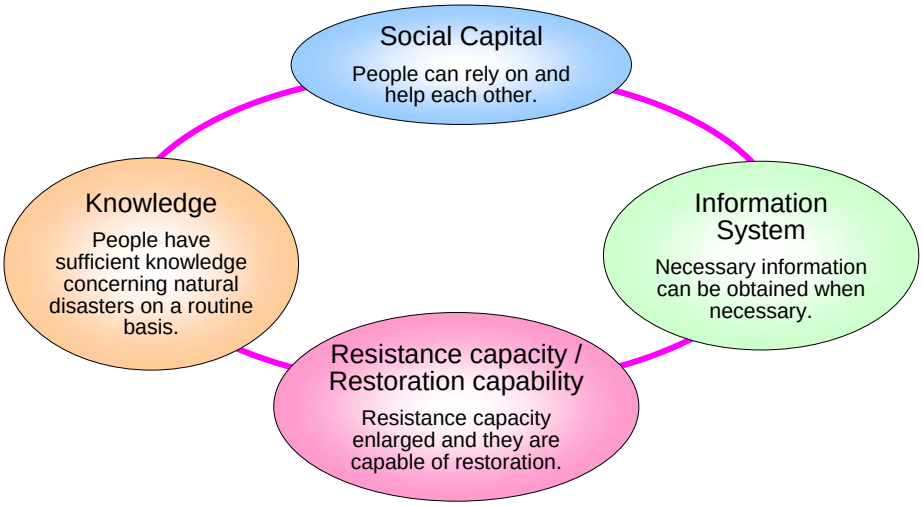
For Safe and Secure Local Communities against Natural Disasters



Four basic elements for safe and secure local communities

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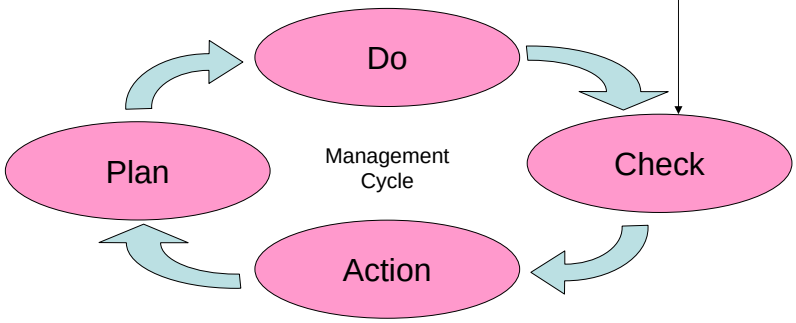
Management Cycle of Activities of Disaster Prevention Organizations

Knowledge・・・People should have sufficient knowledge about natural disasters.

Understanding and Indexing of Achievement Status for Safe and Secure Local Community



PDCA Management Cycle related to Activities of Disaster Prevention Organizations

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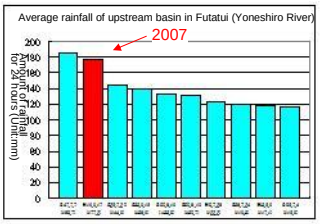
Local Disaster Prevention Capability and Disaster Damage Occurrences

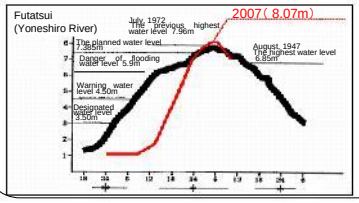
September 17, 2007　Frontal heavy rain (Yoneshiro River)

The previous second largest rainfall



Those houses were located outside the flooded area and suffered no damage.

The previous highest water level



Most of the flooded Area is arable land.

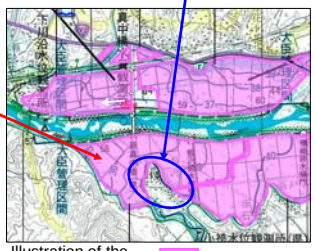


Illustration of the flooded areas　（ ：Flooded area）

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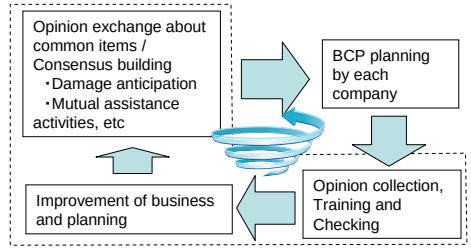
Examples of Support Activities by NILIM for Improvement of Disaster Prevention Capabilities of Local Communities (1)

Support for planning Small and Medium-Sized Companies BCP（Business Continuity Plan）



:Exchange of opinions and their review at skull sessions

【 **Members of the skull session** 】
Chamber of Commerce, Representative Company, Offices of municipalities and prefectures, Regional work offices of MLIT, NILIM, etc

Procedure of BCP preparation support

A scene from a planning meeting

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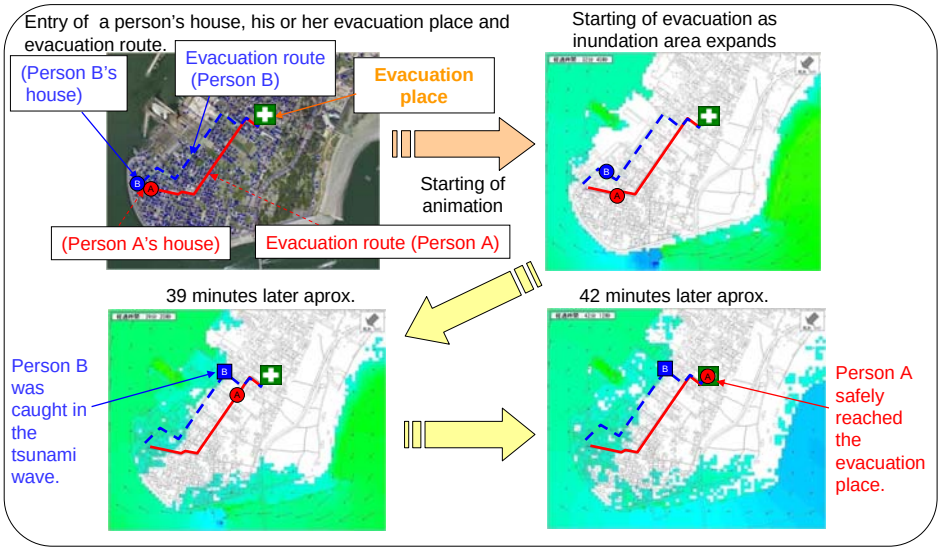
Examples of Support Activities by NILIM for Improvement of Disaster Prevention Capabilities of Local Communities (2)

Development of the animated hazard map and cooperation with local communities



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Conclusion

1) Japan has many cities over alluvial plains and vulnerable structure to flooding.

2) Because of global warming, extreme precipitation in Japan is expected to increase.

3) As adaptation measures, improvement and development of structures are important but have limitations. So it is necessary to improve damage reduction capability of local communities against flooding.

4) National Institute for Land and Infrastructure Management has implemented researches for various technical tasks. We take it important for local communities to make efforts especially to improve their damage reduction capabilities from now on.

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ANNEX-I

COUNTRY REPORT OF INDIA

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

JICA ECXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
JFY 2007

Prepared by

M. Dhinadhayalan
Assistant Adviser(PHE)
Central Public Health & Environmental Engineering Organization (CPHEEO),
Ministry of Urban Development
Government of India
New Delhi

COUNTRY REPORT OF INDIA

INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

Executive Summary

Urbanization in India is taking place in a rapid manner. Out of the total population of 1027 million as per 2001 census, the urban population was about 285 million, or 27.8% of the total population living in 5161 towns.

The most difficult challenges will be faced by the developing countries, particularly in the field of water. Development and management is needed in view of mismatch between natural availability and demand. This is especially important for countries of the south in view of the climatic-hydrologic considerations. Water resources development has, therefore, been given importance in India from times immemorial. However, very serious challenges emerge in the context of massive development needed in the context of increasing population and high economic growth required for development.

Far reaching and rapid socio-economic and environmental changes will take place as India commits to come in the mainstream of human endeavor, as postulated in the Tenth Five Year Plan. Focusing on water, a revolution will be required in the concepts, policies, technology, planning, management and institutions to meet the futures challenges.

A National Program of Flood Management was launched and reasonable degree of flood protection has been provided to an area of 14.374 mha by March 1993 out of the total area of 32 mha, which is estimated to be protectable. A variety of programs for watershed management have been undertaken. Integrated land-water development has been undertaken through Canal Command Area Development. Procedures for environmental conservation have been established and several Acts have been passed in this context. An integrated development of water has been attempted and a National Water Policy (NWP) has been formulated.

There is however another side of the picture also. India has not been able to provide even drinking water facilities to the world's largest group of people, be it in terms of numbers or percentage of population. The irrigation performance is one of the poorest in the world in terms of agricultural yields or agricultural productivity. Large scale water withdrawals from rivers and polluted inflows have turned several rivers over large stretches into open gutters. There is increasing problem of ground water over exploitation and pollution in many areas. Floods and drought over large parts of the country are perennial phenomenon.

India has very for to go. With a per capita GNP of about $500, it is one of the poorest countries and home to world's largest population of the poorest of the poor. Rapid advances in all spheres have to take place, management of water being a prominent one. Drinking water and sanitary facilities have to be provided to the vast mass of rural and urban population. Reliable, timely and adequate water supply has to be provided for modernizing the agricultural activities. There is going to be a very serious pressure on resources and problem of environmental degradation as the consequent large-scale transformation of the hydrological cycle is undertaken. Serious problem of pollution from point and non-point sources will follow as economic development takes place. Conflicts are bound to arise between states and sectors as perceptions and demands very.

Yet, there is little perception of the stupendous challenge and even less capability or commitment to undertake the revolutionary changes. The socio political milieu is daunting in its impedance to the accomplishment of the task. Some of the activities of the Government to meet the futures challenge may by examined in this context.

1.Organisation data

(1) Name of Organization :- Central Public Health & Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Govt. of India

(2) Summary of Organization :-

CPHEEO is a technical wing of the Ministry of Urban Development. CPHHEO assists Ministry in formulation of policies and programmes in urban Water Supply & Sanitation Sector and advises the Ministry on technical matters. The Govt. of India has launched a reform linked programme of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for creating urban infrastructure facilities including water supply and sanitation in all 5161 towns/cities in the country with a budgetary provision of 1,00,000 crore to be implemented over period of 7 years ie., from 2005-2012.

(3) Organization Chart

Organizational chart indicating my position is enclosed at Annexure-II.

(4) Organization's Position in Government

CPHEEO is a advisory body in the Ministry of Urban Development, Govt. of India. I assist the Ministry on technical matters in the field of Water supply & Sanitation.

2.Personal Data

(1) Recent Work

I have assisted Ministry in framing the guidelines for JNNURM. I have appraised about 200 nos. of water supply, sewerage, solid waste management, and storm water management projects posed by the various State Govts. under the Centrally sponsored programme viz., Accelerated Urban Water Supply Programme, JNNURM and under the External Funding during the lat 3 years. I have monitored the schemes implemented under the Central progarmme. I have served as a member in the Expert Committee constituted for the preparation of Manual on Municipal Solid Waste Management. I advise State Govts/ULBs on technical matters time to time and frame reply to the Parliament questions, VIP references etc and attend various meetings in different Ministries.

(2) Contact Address

Office address:- CPHEEO, Ministry of Urban Development,
654- A wing, Nirman Bhawan,
New Delhi -110011

Phone number:- 91- 11-23062418 /Mobile No. 09818477087
Fax number :- 91-11-23062559
email address : mdheen@sify.com

COUNTRY REPORT OF INDIA

3. INTEGRATED WATER RESOURCE MANAGEMENT ADAPTING TO THE GLOBAL CLIMATE CHANGE

(i) Current Situation and Problem

A. Population and Urbanisation

Urbanization in India is taking place in a rapid manner. Out of the total population of 1027 million as per 2001 census, the urban population was about 285 million, or 27.8% of the total population living in 5161 towns. Of the 5161 urban agglomerations and other towns, the 35 metropolitan cities contained about 37% of the total urban population. The rate of urban population growth in the country is still very high as compared to developed countries, and the large cities in the country are becoming larger due to accretion of population to these cities. On the assumption that the urban population would continue to grow at a rate of about 3.1% per year in the next few decades, the urban population is expected to increase to an estimated 550 million by 2021 and the level of urbanization at that time will be about 41%.

B. Water Availability and Demand in India

India roughly accounts for about 2.5% of the World's land mass, 4.5% of the World's fresh water resources and 16% of the World's Population. Due to increase in population, the total annual renewable fresh water available has reduced from 5177 cubic metres per person per year in 1951 to 1820 cubic metres per person per year in 2001. It has been assessed that the per capita average annual fresh water availability may be reduced to 1341 cubic metres per person per year by 2025 and 1140 cubic metres per person per year by 2050. Any situation of water availability of less than 1000 cubic meters per person per year is considered as scarcity condition. Though India may not be water scarce country, based on the national average, but due to vagaries of rainfall and drought conditions in some parts of the country, there may be water scarcity conditions prevailing in such areas.

According to the assessment made by Ministry of Water Resources, the total water requirement of the country for various uses, such as irrigation, drinking, industry, power, navigation, ecology including evaporation losses would be :-

694 Km^3 in the year 2010,
784 Km^3 in 2025 and
973 Km^3 in the year 2050.

Against this, the total utilizable water (surface and ground water availability) will be 996 Km^3 upto the year 2050. As such, overall, in India there may not be any water shortage upto the year 2050. However, due to regional imbalances prevailing in different parts of the country, it is likely that water shortage may be felt in some regions of the country. As such, efforts should be made for effective and efficient water management so as to satisfy the various sector needs in the years to come.

Moreover, the quantum of water required for domestic needs of urban and rural areas is estimated to go up from about 42 Km^3 (5% of the total water demand for all uses) at present to 90 Km^3 in the year 2050 (9% of the total water demand for all uses). When compared to demand of water for irrigation, which is about 80% of the total demand for all uses, the requirement of water for domestic use is very small and hence as per National Water Policy adequate priority should be given for allocation of water drinking needs.

C. Current state Development of Water Resource Management in India

With the attainment of Independence in 1947, highest emphasis was laid on water resources development and impressive achievements like Bhakra Dam, just to name one, followed. Highest level of technological capability was achieved by indigenous self-sustained efforts.

The developments have slackened of late of several reasons, but even then impressive developments have taken place. Extensive surface and groundwater development has been undertaken and the irrigated area potential of 22.6 mha in 1951 ha been increased to 99.76 mha by 2001 end, making India the leader in irrigated area in the world. Many impressive large-scale dams have been constructed for multipurpose development with the storage potential of about 174 bcm, which is about 10 percent of the total water potential available in the country.

An important change from early 1960s was the development of tubewells in the north region, mainly private, as power became available with the construction of multipurpose dams in the area. Rapid development of tubewells took place and by 1997, minor irrigation, in which tubewells are predominant, covered an area of 56.60 mha against 32.96 mha irrigated by the traditional canal irrigation.

A National Program of Flood Management was launched and reasonable degree of flood protection has been provided to an area of 14.374 mha by March 1993 out of the total area of 32 mha, which is estimated to be protectable. A variety of programs for watershed management have been undertaken. Integrated land-water development has been undertaken through Canal Command Area Development. Procedures for environmental conservation have been established and several Acts have been passed in this context. An integrated development of water has been attempted and a National Water Policy (NWP) has been formulated.

There is however another side of the picture also. India has not been able to provide even drinking water facilities to the world's largest group of people, be it in terms of numbers or percentage of population. The irrigation performance is one of the poorest in the world in terms of agricultural yields or agricultural productivity. Large scale water withdrawals from rivers and polluted inflows have turned several rivers over large stretches into open gutters. There is increasing problem of ground water over exploitation and pollution in many areas. Floods and drought over large parts of the country are perennial phenomenon.

Another area of very serious concern is that of contaminated groundwater and its implications on human health and economy. Groundwater is the major source of rural water supply. However, it is well known that groundwater is seriously polluted at several locations and is a health hazard. According to the report to press by the rural development Ministry "water supplies to two lake habitations contain dangerous levels of iron, arsenic, fluoride and nitrates. Country-wide block surveys between 2000 and 2004 reveal that 31,000 habitations are fluoride-affected, 5,209 are arsenic affected, 23,495 salinity affected, 13,958 nitrate-affected 1,11,201 iron-affected".

Arsenic pollution in Bangladesh and West Bengal is well known. However, it is now feared that large areas of even the central region of the Ganga basin may be seriously contaminated with arsenic. Besides the serious and disturbing adverse health impacts, it may have serious implications for the economy..

D. Provision of Water Supply & Sanitation Facilities

At present about 90% of the urban population has got access to safe water supply and 63% has got access to sewerage and sanitation facilities respectively. The coverage figures indicate only the accessibility, whereas adequacy and equitable distribution and per-capita provision of these basic services may not be as per the prescribed norms in some cases. For instance, the poor, particularly those living in slums and squatter settlements, are generally deprived of these basic facilities.

The 2001 Census further indicates that, out of total 53.69 million urban households, 36.86 million households are having tap water source, the remaining households have water supply from other sources such as handpumps, tubewells, etc. Out of 36.86 million households, 26.67 million urban households are having tap water source within the premises, 8.08 million near the premises and 2.09 million away from the premises (i.e., the source is located at a distance of more than 100 metres from the premises).

E. Rain Water Harvesting:

Realizing the depleting ground water potential and deteriorating quality due to contamination and pollution, the Central Ground Water Board (CGWB), Ministry of Water Resources has brought out Model Ground Water Legislation and circulated to all States for preparation of similar State Ground Water Legislations and implementation. But so far, only a few States have brought out such legislation; but its implementation is not much encouraging so far. The CGWB brought out information brochures in regard to Roof Top Rainwater Harvesting and Artificial Recharge of ground water in order to increase the ground water potential in various parts of the country.

F. UNACCOUNTED FOR WATER (NON REVENUE WATER)

Several pilot studies conducted in the country have shown water losses in the distribution line to be the order of 20% to 50% of the total flow in the system and maximum leakage caused in the house service connections. In India, where water supply is by and large intermittent (supply hours ranging from 3 hours to 10 hours), during non-supply hours when the system is not under pressure, external pollution may get sucked into the system at the points of leak causing health hazards.

There is need for systematic approach for reduction of wastage of water through leaks and hence preventive maintenance should form an integral part of O&M on a regular basis. If such measures are taken by the water supply agencies, then there may not be any immediate need to take up augmentation scheme and it will also help increase revenue to make the system self-sufficient.

G. REUSE OF MUNICIPAL WASTEWATER

A major catalyst for the evolution of wastewater reclamation, recycling and reuse has been the need to provide alternative water sources to satisfy water requirements for irrigation, industry and non-potable applications due to unprecedented urban growth. Water shortages, particularly during the periods of droughts, have necessitated stricter control measures on per-capita water consumption and development of alternative water sources. Such an attempt would result in waste reduction and reduction in pollution load, which eventually helps maintain a healthy and eco-friendly environment for better quality of life in the cities and towns.

It should be made mandatory in a phased manner so that large industries and commercial establishments may meet at least 50 percent of their non-potable water requirements from the reclaimed water. Similarly, for irrigating crops, horticulture, watering public lawns/gardens, flushing of sewers, fire-fighting etc. reclaimed water should only be used and to this effect, there is a need for legislation or amendment in the municipal bye-laws.

H. Natural disaster scene in the world

Between 1970 and 2000, natural disasters in the world killed at least three million people and affected millions more. The average annual economic losses due to disasters were eight times more than in previous decades. The losses in the 1990s were more than US$ 400 billion.

Ninety percent of natural disasters and 95 percent of all deaths in such disasters occur in developing countries. The average annual population affected is highest in China (90 million), followed by India (56.6 million) and Bangladesh (18.5 million). In November 1970, a cyclone claimed 500,000 lives in Bangladesh.

I. Why is India classified as a disaster prone country?

India's size, geographical position, and the behaviour of the monsoon make it one of the most disaster-prone countries in the world. The subcontinent is highly vulnerable to droughts, floods, cyclones, and earthquakes, In addition, the Himalayan region experiences landslides, avalanches, and bush fires. However, volcanoes are uncommon in India, with just two active ones in the Andamans.

The number of people affected in earthquakes, cyclones, and floods is the highest, followed by those affected by droughts. The areas prone to different types of natural disasters are as follows:

- Cyclones: The eastern coastline and the islands of Lakshadweep, Andaman and Nicobar.
- Floods: The major river valleys such as those of the Ganga and the Brahmaputra.
- Earthquakes: Fifty six percent of the land area.
- Droughts: Sixteen percent of land area spread over 16 states.
- Landslides: The Himalayan region and Western Ghats.
- Fires: Bihar, West Bengal, Orissa, and the North East.

Cyclones occur mainly in the Indian Ocean. They are violent tropical storms in which strong winds move in a circular fashion. Hurricanes and typhoons are violent storms with very strong winds experienced mainly in the western Atlantic Ocean.

J. How do floods occur in India?

Floods are the result of the peculiar rainfall pattern in most of the country. Of the total annual rainfall, 75 percent occurs over three to four months. This leads to a very heavey discharge from the rivers, which floods large areas.

Off all the natural disasters that occur in India, the most frequent and devastating are river floods. The Ganga-Brahmaputra-Meghna basin, which carries 60 percent of the total river flow in India, is most susceptible to floods. The rivers Brahamputra, Ganga, and their tributaries carry tons of debris and water throughout the year, and during the monsoon the water flow exceeds the capacity of the rivers, breaks the man-made ridges, and floods whole areas. Hectares of land in the country are flood-prone. Every year, an average of 19 million hectares of land becomes flooded.

K. What is the impact of earthquakes in India?

The primary effect of an earthquake is the shaking and possible displacement of the ground. This results in damage to buildings, roads, dams, pipelines, etc., and causes loss of life and property. The secondary effects include flooding caused by subsidence of land, fires, epidemics, etc. Coastal areas could be hit by earthquake-generated waves called tsunamis (see the section on tsunamis).

On an average, about 15,000 people are killed every year in earthquakes. They destroy property and cause fires and floods. Earthquakes in the ocean create giant waves and cause coastal or underwater landslides.

A severe earthquake with a magnitude of 6.9 on the Richter scale had hit Gujarat with its epicenter 20km northeast of the town of Bhuj in Kutch. The shock was felt in most parts of the country. The districts of Kutch, Bhavnagar, Surendranagar, Rajkot, and the Ahmedabad districts were devastated.

It was the most severe earthquake in the last 50 years in India, with 20,000-30,000 dead, 150,000 inured, and 15.9 million affected. The total economic loss was estimated at Rs. 225 billion.

Bhuj was the worst affected town with about 10,000 people killed. Almost half of its structures has been leveled. Amazingly, its historic tower was still standing. This was the case in other places too, with many old buildings remaining intact, while new buildings had collapsed.

L. Tsunamis in India

Tsunami is a Japanese word meaning 'harbour wave'. A tsunami is not a tidal wave and is not caused by winds or the gravitational pull of the Moon or the Sun. Most tsunamis are caused by undersea earthquakes that set off waves in water. A tsunami moves silently but rapidly across the ocean and when it hits the coast, it unexpectedly rises as destructive high waves. These waves many last just minutes, but can cause widespread devastation along the coast.

Most tsunamis occur in the Pacific Ocean. During the 1990s, 82 tsunamis occurred worldwide, many more than the historical average of 57 a decide. They are relatively rare in the Indian Ocean but not unprecedented.

The tsunami that hit south East and South Asia on December 26, 2004, was the biggest ever in history. It was triggered by a massive undersea earthquake measuring nearly 9.0 on the Richter scale that occurred in Sumatra. It moved with a speed of about 900 kmph and hit the Andaman and Nicobar Islands barely an hour after the quake occurred.

Nearly 300,000 people died in this disaster and entire coastal villages were wiped out in Thailand, Sri Lanka, and India. Car Nicobar, Cuddalore, and Nagapattinam were the worst affected places in India. Thousands of people, particularly fisherfolk, lost their homes and livelihoods. It is noteworthy that the damage was less in those parts of the coast that had natural barriers like mangroves and casuarinas trees.

2. Research and Study

A. Interlinking of Rivers in India

Of late, considerable emphasis has been laid on the subject. The Ministry of Water Resources formulated a National Perspective Plan for water resources development with the objective of transferring water from surplus basins to water deficient basins/regions by Interlinking of Rivers, as early as 1980. The National Perspective Plan has two main components, i.e. the Himalayan Rivers Development and Peninsular Rivers Development. Subsequently, a National Water development Agency (NWDA) was set up as a society in 1982 to carry out surveys and investigations and to prepare feasibility reports of the links under the National Perspective Plan.

The studies revealed that the work is seriously deficient in engineering-economic terms, more in the neglect of the environmental and political aspects. It is unfortunate that even some basic engineering principles have been violated while making the proposals and estimates. For example, the proposed transfer from Brahmputra will raise serious problems of water logging and flooding in view of interference with drainage in that area of heavy floods. Second, interbasin transfer in Himalyan region is going to be very expensive, which was the basis of classical Cotton-Cautley controversy about location of the Upper Ganges Canal. It was found to be vastly true as the Ramganga-Ganga link was designed by the author, which was accordingly proposed to be shifted as far downstream as possible, though it could not be implemented fro certain reasons.

Third, large canals in Himalayan foothills suffer from the serious danger of natural disasters on account of land slides and possibility of complete silting, as was the experience of the Upper Ganges canal recently. Fourth, all interbasin canals will have to be developed in full cutting and not in balanced filling and cutting, as is the usual practice and as proposed currently. Thereby the costs will be further increased substantially. It can be argued that technology can deal with all these problems but it has to be noted that, then the proposals will become economically infeasible.

The group recommended that the proposed interlinking was not warranted. It can be said that the river linking project is "a big dream of little logic". The Parliamentary Agriculture Committee invited the views of the author on the subject and it had to be stated that the subject has not been scientifically studied and some of the proposals are preposterous. As per latest media reports, the matter is being pursued (even through there may be second thoughts by some influential members of the Government).

3. Policy & Practices

A. National Water Policy, 2002

The National Water Policy, 2002 has assigned overriding priority for drinking water allocation in the planning and operation of systems. The National Water Policy, inter alia, suggests the following:-

- There should be a periodical reassessment of the ground water potential on a scientific basis, taking into consideration the quality of the water available and economic viability of its extraction.

- Exploitation of ground water resources should be so regulated as not to exceed the recharging possibilities, as also to ensure social equity. The detrimental environmental consequences of over-exploitation of ground water need to be effectively prevented by the Central and State Governments. Ground water recharge projects should be developed and implemented for improving both the quality and availability of ground water resource.

- Integrated and coordinated development of surface water and ground water resources and their conjunctive use should be envisaged right from the project planning stage and should form an integral part of the project implementation.

- Over exploitation of ground water should be avoided especially near the coast to prevent ingress of seawater into sweet water aquifers.

B. General policy on disaster management in India

In recent years, there has been a shift of focus from post-disaster management to preparedness and mitigation. Forecasting and monitoring systems are now in place for earthquakes, droughts, floods, and cyclones.

The draft National Policy on Disaster Management released in 2003, proposes the following:

- A holistic, and proactive approach towards prevention, mitigation, and preparedness.

- Each ministry and department of the central and state governments should set apart adequate funds for vulnerability reduction and preparedness.
- Mitigation measures should be built into ongoing schemes and programmes.
- Each project in a hazard-prone area should include mitigation measures and vulnerability reduction.
- A national disaster management law should be enacted covering all the existing mechanisms.

C. National Lake Conservation Plan (NLCP)

The National Lake Conservation Plan was initiated in 1994 for cleaning important lakes with high levels of silting and pollution.

The 10th National Fiver-year plan has appreciated the importance of the National Lake Conservation Plan (NLCP) undertaken by Ministry of Environment and Forest, GoI.

The objective of NLCP is to develop national level policies and actions with focus on urban lakes. It envisages a comprehensive and holistic approach for Lake Conservation. The socio-economic development of the people dependent on the lake ecology shall also be fully integrated.

The programme includes the following:

- Prevention of pollution from point and non-point sources
- Catchment area treatment
- Desilting and weed control
- Research & Development studies on flora and fauna
- Other lake specific activities such as integrated development approach, including interface with human populations

Under NLCP, the Central and State Governments share the capital costs in the ratio of 70:30.The scope of NLCP has been enlarged during the 10th Plan by including the rural lakes in the programme, with corresponding increase in plan outlay.

Initially ten lakes were identified for conservation under the NLCP – Ooty (Karnataka), Kodikanal (Tamil Nadu), Powai (Mumbai), Dal (Jammu and Kashmir), Sukhna (Chandigarh), Man Sagar (Rajasthan), Nainital (Uttaranchal), Udaipur (Rajasthan, Rabindra Sagar (Thane, Maharashtra) and Hussain Sagar (Hyderabad, Andhra Pradesh). Out of these 10 lakes work has been completed on Powai Lake in Mumbai and Rabindra Sagar in Thane and work has started on two lakes, namely, Ooty and Kodikanal. The progress regarding other lakes is extremely slow because of delays in the finalization of detailed projects reports (DPRs), tender procedure and award of contract. The progress of the work on Dal Lake has been hampered by the delay in approval of the DPR by the State Government.

D. TENTH FIVE YEAR PLAN TARGETS IN WATER SUPPLY & SANIATAION :

For achieving 100%population coverage with drinking water supply facilities and 75% with sewerage & sanitation facilities in the urban areas and solid waste management facilities in 300 Class-I cities, the 10th Plan document has indicated the following requirements of funds:

Water supply	- Rs.28, 240 crore
Sanitation	- Rs.23, 157 crore
Solid Waste management	- Rs.2, 322 crore
Total	-Rs.53, 719 crore

In this background, there is an estimated deficit of Rs.33, 960 crore for the urban water supply and sanitation sector during the 10th Plan period.

E. Govt. of India Initiatives on Water Supply & sanitation

The Govt. of India stands committed to achieve the target of Millennium Development and Johannesburg Summit Goals which requires India to half by 2015 the proportion of the people who had no access to safe drinking water and basic sanitation services.

Government of India frames broad policies in line with the international decisions and its obligations viz. Millennium Development Goal (MDG) and formulates various programmes to provide Central funding for augmenting water supply sanitation services.

Govt. of India attaches top priority to sector reforms viz, institutional and financial reforms including capacity building at water utility level to ensure efficient management of water supply system in urban areas as per 2001 Census

Recognizing the need for financial handholding and radical reform in urban infrastructural sector, particularly water supply & sanitation sector, Government of India has launched two new programmes viz. Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and the Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT) to implement reform oriented schemes to augment drinking water supply and sanitation facilities in all the 5161 towns in the country.

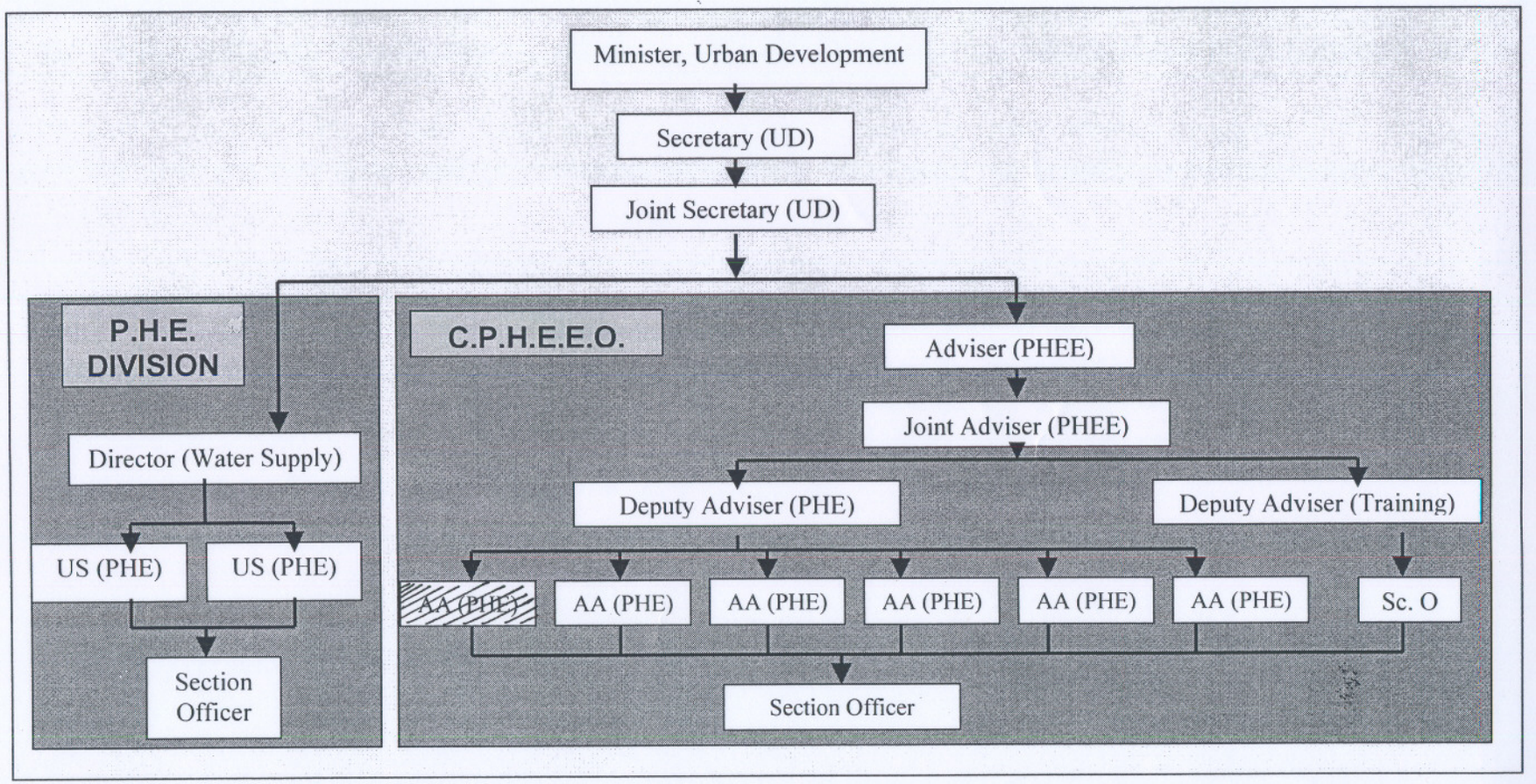
F. Future Challenge

There are two concurrent dimensions of development, which have particular relevance for the developing countries. While in the first instance, immediate issues of water supply and sanitation, irrigation, hydroelectric development and flood mitigation, and environmental conservation have to be attended to and can be met, there is the very serious long term challenge, which must also be conjunctively kept in view. This will require constant study as sustainable development is a journey rather than an end.

India has very for to go. With a per capita GNP of about $500, it is one of the poorest countries and home to world's largest population of the poorest of the poor. Rapid advances in all spheres have to take place, management of water being a prominent one. Drinking water and sanitary facilities have to be provided to the vast mass of rural and urban population. Reliable, timely and adequate water supply has to be provided for modernizing the agricultural activities. There is going to be a very serious pressure on resources and problem of environmental degradation as the consequent large-scale transformation of the hydrological cycle is undertaken. Serious problem of pollution from point and non-point sources will follow as economic development takes place. Conflicts are bound to arise between states and sectors as perceptions and demands very.

Yet, there is little perception of the stupendous challenge and even less capability or commitment to undertake the revolutionary changes. The socio political milieu is daunting in its impedance to the accomplishment of the task. Some of the activities of the Government to meet the futures challenge may by examined in this context.

ANNEX-II


Minister, Urban Development
Secretary (UD)
Joint Secretary (UD)
P.H.E. DIVISION
Director (Water Supply)
US (PHE)
US (PHE)
Section Officer
C.P.H.E.E.O.
Adviser (PHEE)
Joint Adviser (PHEE)
Deputy Adviser (PHE)
Deputy Adviser (Training)
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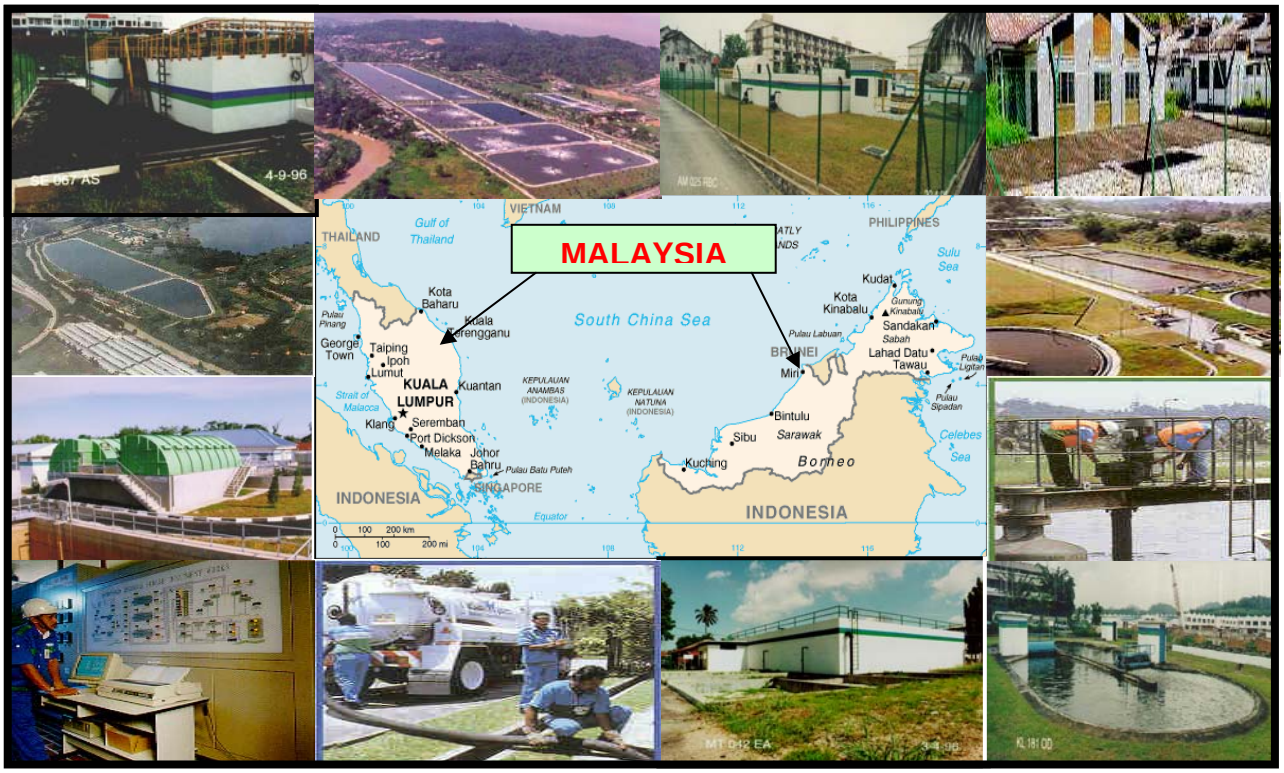
Section Officer

EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT (J-07-00762)

Country Report



Country : **MALAYSIA**

Organization : **SEWERAGE SERVICES DEPARTMENT MINISTRY OF ENERGY, WATER AND COMMUNICATIONS, MALAYSIA.**

OCTOBER 2007

EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT
(J-07-00762)

Executive summary a presentation about Country Report (MALAYSIA)
"Integrated Water Resource Management Adapting to the Global Climate Change"

1. Name, Roles and Responsibilities of Organization

   Sewerage Services Department, Ministry of Energy, Water and Communication Malaysia.

   Roles :

   i. To plan, regulate and enforce all rules and regulations
   ii. To facilitate the implementation of a suitable and modern sewerage system
   iii. To nurture the development of local sewerage in terms of competitiveness, technology innovation and application
   iv. To protect the consumers interest by ensuring excellent services at and affordable cost
   v. To ensure that the privatization project is implemented successfully and satisfactorily
   vi. To assist in the growth of the national economy through the development of a modern sewerage sector that protects the water resources and the environment.

   Responsibilities :

   i. Physical development programme
   ii. Approval of plans and certified of fitness
   iii. Licensing and enforcement
   iv. Monitoring the privatised sewerage services
   v. Development of sewerage standard and guidelines
   vi. Registration of sewerage system and product

2. Background and Overview of Sewerage Issues Over Last 10 years
   - sewerage services Act 1993
   - sewerage services Department as a Regulatory Body took place 1994
   - federalization of sewerage services and concession agreement with IWK
   - Tariff OPEX and CAPEX

3. Federal Development Fund for Sewerage Sector and Capex Investment
   - Long Term Sewerage Development Plan

4. Conflicts Resolution - Social, Economic and Enviroment.
   - create awareness and campaign to the public
   - tariff, affordability and willingness to pay
   - enforcement of the current /exisiting Enviroment Regulation

5. Profile of Sewerage Coverage in Peninsular Malaysia, Status of Public Sewage Treatment Plant and Status of Rivers in the Country.

6. Evolution of Sewerage Technology, Market Analysis and Local R & D.
    - evolution of sewerage treatment technology over the years in Malaysia
    - control of equipment and products ~ process equipments & non-process product
    - equipment asset statistics
    - R & D ~ long term planning, competitiveness market driven ..

7. Sewerage Development Quality System
    - establishing monitoring indicators
    - key performance indicators (KPI)
    - set policies
    - guidelines and standardization
    - enforcement

8. The Way Forward in Managing the Water Demand and Sewage Generation
    - a holistic approach to manage water demand and sewage generation.

9. Integrated River Basin Management
    - river corridor management plan
    - flood mitigation plan
    - environment management plan
    - water resources management plan

10. The Way Forward in Managing the Urban Water Cycle
    ~ Water Supply and Sewerage Integration
    - legislative reforms
    - regulalatory reforms
    - sectorial regulatory reforms

11. The Way Forward – Possible Solution
    - Government and Private Sector jointly delivering infrastructure or services

WAN ABD RAHIM <u>WAN ABDULLAH</u>
DIRECTOR
REGULATORY DIVISION
SEWERAGE SERVICES DEPARTMENT
MINISTRY OF ENERGY, WATER AND CUMMUNICATIONS
MALAYSIA.

1. NAME OF APPLICANT/COUNTRY

I.	Name of Applicant Country Designation Organization	: : : :	**WAN ABD. RAHIM WAN ABDULLAH** **MALAYSIA** **DIRECTOR** **SEWERAGE SERVICES DEPARTMENT, MALAYSIA**

2. NAME, ROLES AND RESPONSIBILITIES OF ORGANIZATION

Sewerage Services Department, Ministry of Energy, Water and Communication , Malaysia

2.1 Roles of Organization

1) To plan, regulate and enforce all rules and regulations related to sewerage in accordance with the provisions given in the Sewerage Services Act 1993.

2) To facilitate the implementation of a suitable and modern sewerage system for the whole country in compliance to established standards.

3) To nurture the development of local sewerage industry in terms of competitiveness, technology innovation and application as well as human resources.

4) To protect the consumer's interest by ensuring excellent services at an affordable cost.

5) To ensure that the privatisation project is implemented successfully and satisfactorily.

6) To assist in the growth of the national economy through the development of a modern sewerage sector that protects the water resources and the environment.

2.2 Responsibilities of Organization

1) Physical Development Programme

The Government has taken over the responsibility of funding and implementing public sewerage projects after it has taken control of the full equity in IWK in the year 2000. Through SSD, Government has implemented a number of new sewerage projects and works relating to refurbishment and upgrading of sewerage facility by utilizing the development funding.

2) Approval of Plans and Certificate of Fitness

The SSD also responsible for the approval of new sewerage system development and provides technical input to the Local Authorities in the process of issuing the Certificate of Fitness for Occupation for buildings by the Local Authorities.

3) Licensing and Enforcement

SSD is responsible for the supervision of all tasks related to the provision of sewerage services, issuing of sewerage services licenses and reviewing sewerage tariff.

4) Monitoring the Privatised Sewerage Services

The SSD has been entrusted by the Malaysian Government to regulate the provision of sewerage services by IWK under the privatization Concession awarded in the year 1993.

5) Development of Sewerage Standards and Guidelines

SSD is a SIRIM's Standard Writing Organisation (SWO) on sewerage matters. With the regards, SSD has initiated the review of the Malaysian Code of Practice for the Planning, Design, Installation, Operation and Maintenance of Sewerage System (MS 1228: 1991) and development of a number of standards and guidelines for sewerage works as follows:

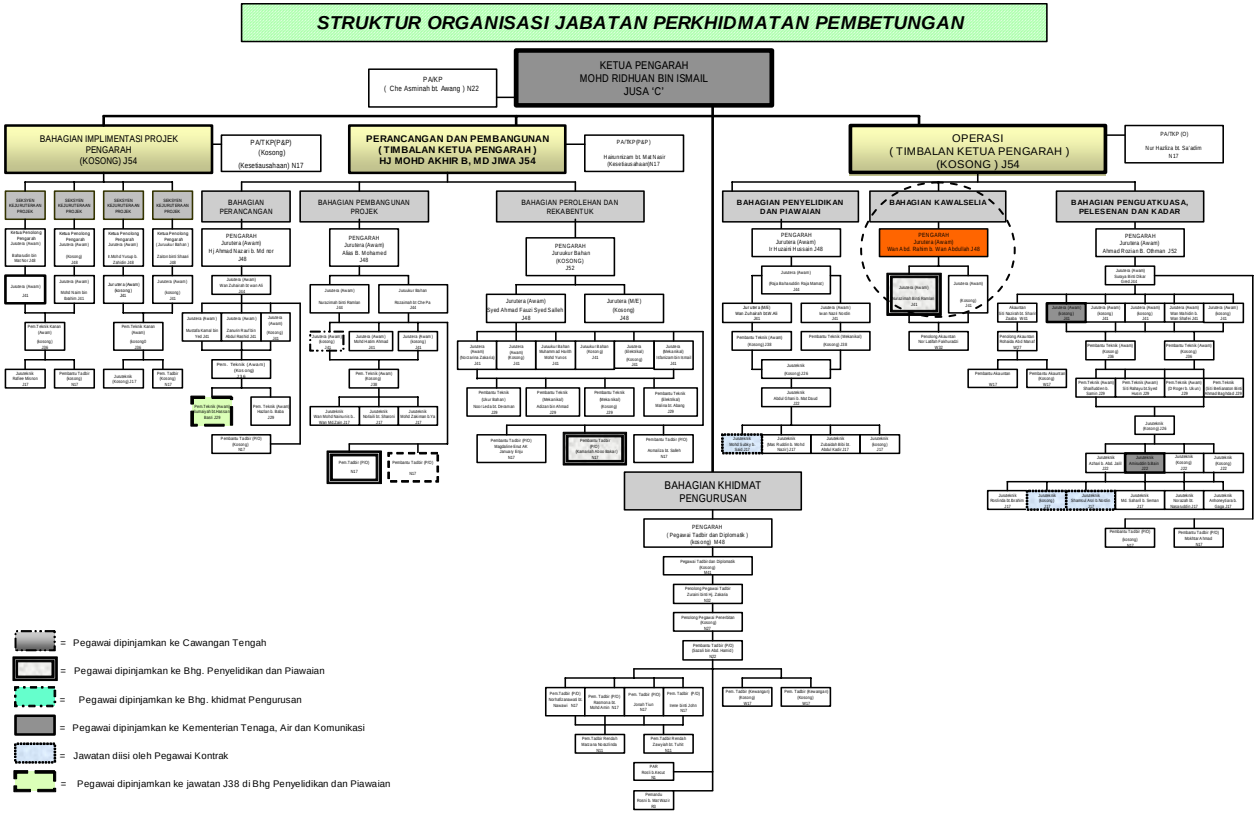
a. Restructuring of MS 1228 : 1991 into four sections – Part 1: Planning for Sewerage Infrastructure, Part 2: Design, Part 3: Material, Construction and Installation & Part 4: Operation and Maintenance.

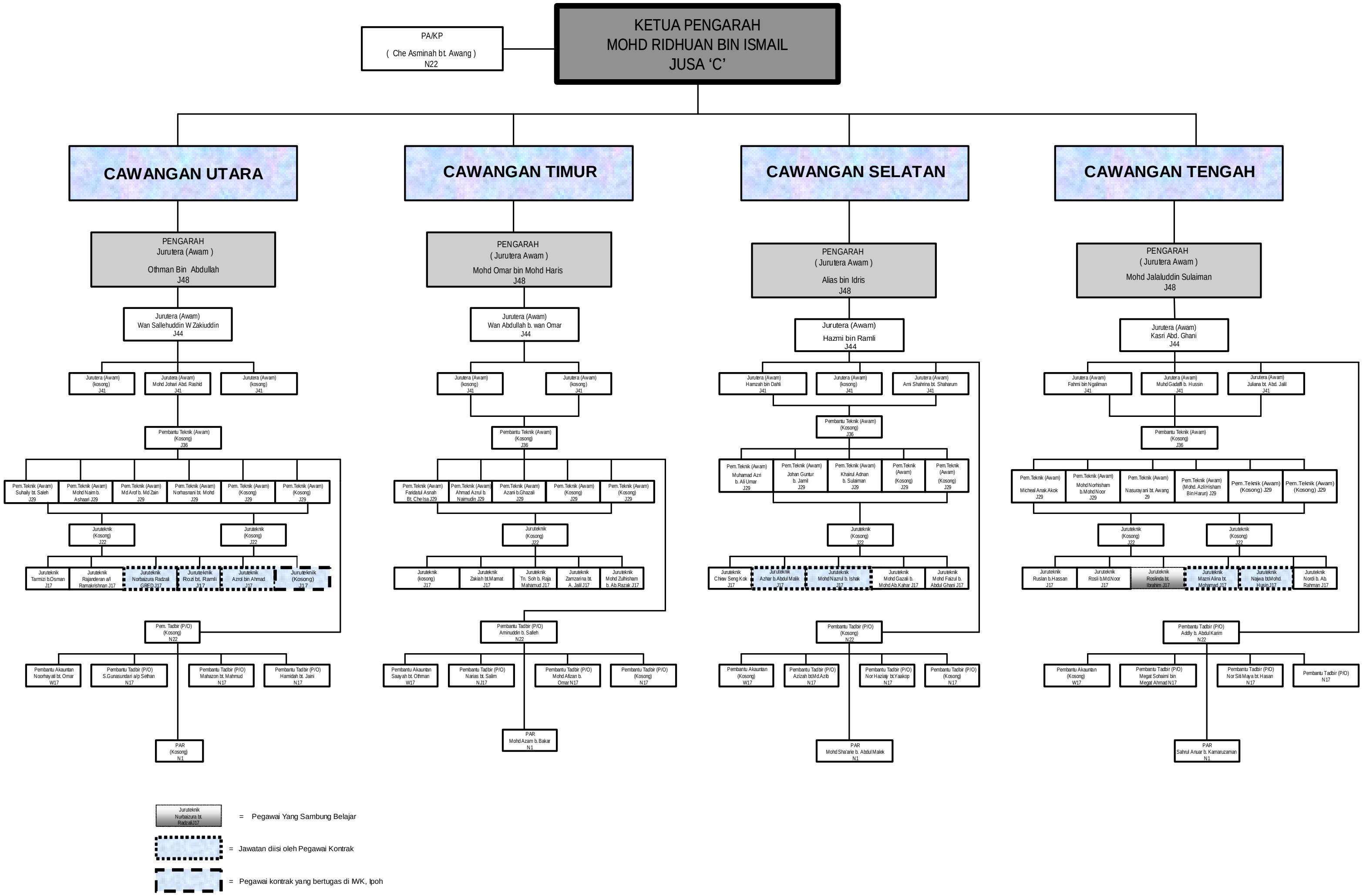
b. New Standards – Malaysian Standard (Manhole Tops)
c. Guidelines for Developers – Volume I: Sewerage Policy for New Development, Volume II: Sewerage Works Procedure, Volume III: Sewer Networks and Pump Stations, Volume IV: Sewage Treatment Plant and Volume V: Septic Tanks.

6) Registration of Sewerage Systems and Products

Under Part III Section 9 (c) of Sewerage Services Act 1993, all sewerage systems and products to be used in the country must be registered with Sewerage Services Department (SSD). All applications for the registration are processed by SSD and evaluated by Products Evaluation Committee to make decision on the application. Members of the committee comprises of SSD and IWK (the concessionaire contractor for sewerage system in Malaysia). The registration is valid for a period of 3 years and must be applied for renewal six months before the expiry date.

3. ORGANISATION STRUCTURE





PA/KP
(Che Asminah bt. Awang)
N22
KETUA PENGARAH
MOHD RIDHUAN BIN ISMAIL
JUSA 'C'
CAWANGAN UTARA
CAWANGAN TIMUR
CAWANGAN SELATAN
CAWANGAN TENGAH
PENGARAH Jurutera (Awam) Othman Bin Abdullah J48
Jurutera (Awam) Wan Sallehuddin W Zakiuddin J44
Jurutera (Awam) (kosong) J41
Jurutera (Awam) Mohd Johari Abd. Rashid J41
Jurutera (Awam) (kosong) J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Suhaily bt. Saleh J29
Pem.Teknik (Awam) Mohd Naim b. Ashaari J29
Pem.Teknik (Awam) Md Arof b. Md Zain J29
Pem.Teknik (Awam) Norhasnani bt. Mohd J29
Pem. Teknik (Awam) (Kosong) J29
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Juruteknik (Kosong) J22
Juruteknik (Kosong) J22
Juruteknik Tarmizi b.Osman J17
Juruteknik Rajanderan a/l Ramakrishnan J17
Juruteknik Norbaizura Radzali GRED J17
Juruteknik Rozi bt. Ramli J17
Juruteknik Azrol bin Ahmad J17
Juruteknik (Kosong) J17
Pem. Tadbir (P/O) (Kosong) N22
Pembantu Akauntan Noorhayati bt. Omar W17
Pembantu Tadbir (P/O) S.Gunasundari a/p Sethan N17
Pembantu Tadbir (P/O) Mahazon bt. Mahmud N17
Pembantu Tadbir (P/O) Hamidah bt. Jaini N17
PAR (Kosong) N1
PENGARAH (Jurutera Awam) Mohd Omar bin Mohd Haris J48
Jurutera (Awam) Wan Abdullah b. wan Omar J44
Jurutera (Awam) (kosong) J41
Jurutera (Awam) (kosong) J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Faridatul Asnah Bt. Che Isa J29
Pem.Teknik (Awam) Ahmad Azrul b. Naimudin J29
Pem.Teknik (Awam) Azani b.Ghazali J29
Pem.Teknik (Awam) (Kosong) J29
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Juruteknik Tn. Soh b. Raja Mahamud J17
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Pembantu Tadbir (P/O) Aminuddin b. Salleh N22
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PENGARAH (Jurutera Awam) Alias bin Idris J48
Jurutera (Awam) Hazmi bin Ramli J44
Jurutera (Awam) Hamzah bin Dahli J41
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Jurutera (Awam) Arni Shahrina bt. Shaharum J41
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Pem.Teknik (Awam) Muhamad Azri b. Ali Umar J29
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Juruteknik Chiew Seng Kok J17
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Juruteknik Mohd Nazrul b. Ishak J17
Juruteknik Mohd Gazali b. Mohd Ab.Kahar J17
Juruteknik Mohd Faizul b. Abdul Ghani J17
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Pembantu Tadbir (P/O) Azizah bt.Md.Azib N17
Pembantu Tadbir (P/O) Nor Haziaty bt.Yaakop N17
Pembantu Tadbir (P/O) (Kosong) N17
PAR Mohd Sha'arie b. Abdul Malek N1
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Jurutera (Awam) Fahmi bin Ngaliman J41
Jurutera (Awam) Muhd Gadaffi b. Hussin J41
Jurutera (Awam) Juliana bt. Abd. Jalil J41
Pembantu Teknik (Awam) (Kosong) J36
Pem.Teknik (Awam) Micheal Anak Akok J29
Pem.Teknik (Awam) Mohd Norhisham b.Mohd Noor J29
Pem.Teknik (Awam) Nasurayani bt. Awang 29
Pem.Teknik (Awam) (Mohd. Azli Hisham Bin Harun) J29
Pem.Teknik (Awam) (Kosong) J29
Pem.Teknik (Awam) (Kosong) J29
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Juruteknik Rosli b.Md.Noor J17
Juruteknik Roslinda bt. Ibrahim J17
Juruteknik Mazni Alina bt. Mohamad J17
Juruteknik Najwa bt.Mohd. Husin J17
Juruteknik Nordi b. Ab. Rahman J17
Pembantu Tadbir (P/O) Addly b. Abdul Karim N22
Pembantu Akauntan (Kosong) W17
Pembantu Tadbir (P/O) Megat Sohaimi bin Megat Ahmad N17
Pembantu Tadbir (P/O) Nor Siti Maya bt. Hasan N17
Pembantu Tadbir (P/O) N17
PAR Sahrul Anuar b. Kamaruzaman N1
Juruteknik Nurbaizura bt. RadzaliJ17
= Pegawai Yang Sambung Belajar
= Jawatan diisi oleh Pegawai Kontrak
= Pegawai kontrak yang bertugas di IWK, Ipoh

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e-mail : wanabdulrahim@ktak.gov.my

5. SEWERAGE STATUS OF THE COUNTRY

5.1 a) Total Population Equivalent in the Country :26,000,000 PE

5.1 b) Estimated Population with sewers :12,000,000 PE

5.1 c) Total population and estimated population with sewers of the six(6) large cities is shown below:

6 Major Cities in Malaysia	Population Equivalent	Connected Public Services		IST		Pour Flush		Private Plant		Outside operating Area	
		PE	%	PE	%	PE	%	PE	%	PE	%
Langkawi	103,502	18,721	18	18,000	17	6,280	6	10,740	10	49,761	48
Melaka Town	599,458	342,301	50	171,115	25	38,310	6	131,509	19	0	0
Kuantan Town	358,449	126,798	24	198,530	37	173,680	32	40,381	7	0	0
Penang	898,800	888,261	91	31,425	3	30,000	3	22,486	2	0	0
Shah Alam	1,095,776	790,106	99	4,860	1	500	0	1,115	0	0	0
Kuala Lumpur	2,296,875	1,503,383	65	286,640	12	25,000	1	10,355	0	471,497	21
TOTAL	**23,931,395**	**4,584,439**	66	**1,041,525**	15	**359,770**	5	**235,833**	3	**718,694**	10

Note: IST – Individual septic tank
PE – Population Equivalent

5.2 SOURCES OF POLLUTION IN RIVERS

In general, the sources and main pollutants of concern in rivers in Malaysia identified as sediment, nutrients, pathogens, organic materials, heavy metal and other toxic chemicals. The relative importance of each pollutant depends on particular circumstances in each river system.

Most sources of pollution have been caused by human activity, although natural sources of pollution such as organic matters from forest and rural areas and also natural minerals from existing soils. The solid waste issues also the contributor to the floatable materials that result in unsightly scene in the river especially in urban areas.

The sources of pollution can be categorised in two category :-

a) Point Pollution

Where the point source of pollution or pollution generated can easily identified which are as follows:-

i) Manufacturing Industries

1. Industrial Wastewater from big, medium and small industries

ii) Sewage Treatment Plant

Domestic wastes have been identified as one of dominant source of pollution which contribute significant amount of pollution loading in the river system and in many places either in rural or urban areas. As the source of treated or partially treated domestic waste water contains organic pollutants, pathogens and suspended solid especially where waste is discharged directly to the river. Listed below list of source of possible pollution from sewage treatment plants :-

1. Effluent from public Sewage Treatment Plants
2. Effluent from private Sewage treatment Plants
3. Effluent from Individual Septic Tanks
4. Sullage (from households)
5. Discharge of raw sewage(squatters & rural areas)
6. Sewage from primitive systems

iii) Livestock and Aquaculture Farms

1. All type including poultry, cow, goat, pigs, fish and prawns

iv) Miscellaneous Pollution Sources

1. Wet markets/Eateries
2. Institutional including office buildings, hospital, educational institution.
3. Trade/commercial e.g. vehicle service workshop, petrol stations, laundry, water treatment plant etc.
4. Sand mining area, quarry

b) Non -Point Pollution

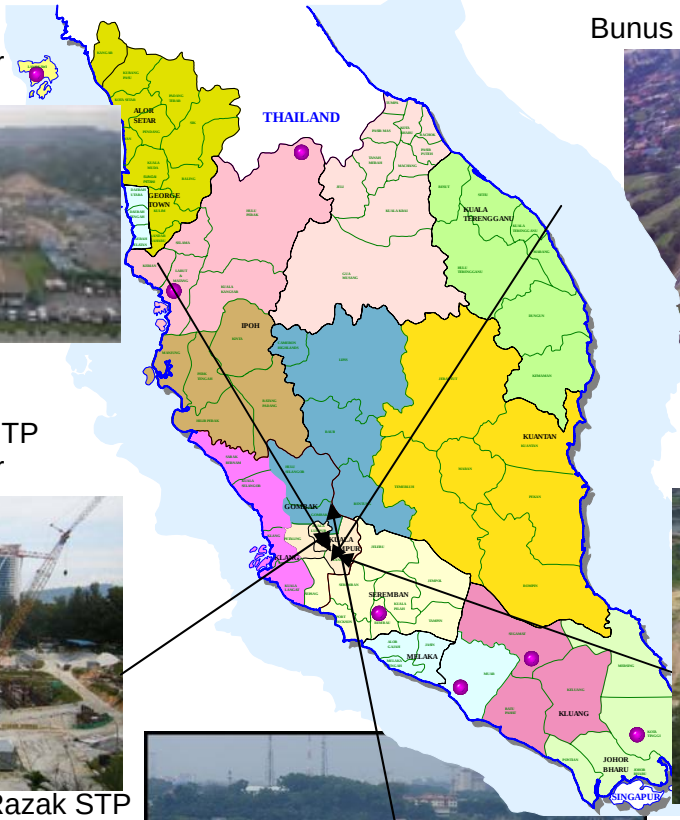
Where the point source of pollution or pollution originating from diffused sources and generated as wash-off by stormwater runoff which are as follows:-

1. Fertilizers from Farmland and Golf Courses
2. Agricultural areas e.g. plantation estates, orchards etc;
3. Earthworks from construction sites
4. Developed urban areas.
5. Forest clearing and Forest reserve
6. other type of vacant or barren lands.

5.3 FIVE (5) LARGEST EXISTING TREATMENT PLANT IN THE CAPITAL CITY

a) Name and Location of the plants

Pantai STP ,
Kuala Lumpur



Bunus STP, Kuala Lumpur

Damansara STP
Kuala Lumpur

Puchong STP, Selangor

Bandar Tun Razak STP
Kuala Lumpur

Figure 1 above shows the location of the five largest STPs in the capital city (Kuala Lumpur).

b) Size and Capacity of the Plants

Table 1 below shows the capacity of 5 large plants in the country

Plant	Plant Type	Existing Population Equivalent	Average Domestic Wastewater Flow (m3/day)	Industrial Wastewater Flow (m3/day)	To be upgraded. #
Damansara STP	Extended Aeration	50,000 PE	11,250m3/day	-	150,000
Pantai STP	Aerated Lagoon	636,000 PE	143,100m3/day	-	1,000,000
Bunus STP	Axtended Aeration	437,000 PE	98,325m3/day	-	
Puchong STP	Axtended Aeration	300,000 PE	67,500m3/day	-	
Bandar Tun Razak STP	SBR	100,000 PE	22,500m3/day	-	

Note : # Part of the existing Module will be maintain and part of it will be converted to mechanised Sewage Treatment Plant under Japan Bank for International Cooperation (JBIC) loan.

c) Efficient Quality criteria implemented, parameter control limits

For the rivers in Malaysia, the water quality standards are monitored based on the Interim National River Water Quality. To control the level of pollution in the waterways, 2 effluent discharge standards are enforced:

- Standard A – for upstream of water catchments areas.
- Standard B – for downstream of water catchments areas.

The effluent standards set as Absolute Standards. In design, Average Standards much lower than the limits should be used to have 95% level of confidence of maintaining the effluent below the set Absolute Standards. Table 2 illustrates the Absolute Standards and the respective Average Standards to be adopted in design.

Table 2: Malaysian's Effluent Standards

Parameter		Standards A		Standards B	
		Absolute	Design	Absolute	Design
BOD_5	mg/L	20	10	50	20
SS	mg/L	50	20	100	40

d) The effluent of all 5 regional plants mentioned above is discharged into Klang River, main river that cut cross the city of Kuala Lumpur and eventually leads to the Straits of Malacca

e) Types of Sludge Stabilisation and dewatering

For Aerated Lagoons, sludge is allowed to settle and it is desilted once in 10 to 15 years.
For Mechanised Sewage Treatment Plant, sludge facilities comes along with Sludge Treatment Facilities.

f) Is treated effluent reclaimed and reused?

No. Treated Effluent is not reclaimed and is discharged into the river.

6. SEWERAGE FACILITIES

6.0 Brief description of the Geography

- Location: South-eastern Asia, peninsula and northern one-third of the island of Borneo, bordering Indonesia and the South China Sea, south of Vietnam
- Geographic coordinates: 2 30 N, 112 30 E
- Map references: Southeast Asia
- Area: total: 329,750 sq km land: 328,550 sq km water: 1,200 sq km
- Area - comparative: slightly larger than New Mexico
- Land boundaries: total: 2,669 km border countries: Brunei 381 km, Indonesia 1,782 km, Thailand 506 km
- Coastline: 4,675 km (Peninsular Malaysia 2,068 km, East Malaysia 2,607 km)

- Maritime claims: continental shelf: 200-m depth or to the depth of exploitation; specified boundary in the South China Sea exclusive economic zone: 200 nm territorial sea: 12 nm
- Climate: tropical; annual southwest (April to October) and northeast (October to February) monsoons
- Terrain: coastal plains rising to hills and mountains
- Elevation extremes: lowest point: Indian Ocean 0 m highest point: Gunung Kinabalu 4,100 m
- Natural resources: tin, petroleum, timber, copper, iron ore, natural gas, bauxite
- Land use: arable land: 3% permanent crops: 12% permanent pastures: 0% forests and woodland: 68% other: 17% (1993 est.)
- Irrigated land: 2,941 sq km (1998 est.)
- Natural hazards: flooding, landslides
- Environment - current issues: air pollution from industrial and vehicular emissions; water pollution from raw sewage; deforestation; smoke/haze from Indonesian forest fires
- Environment - international agreements: party to: Biodiversity, Climate Change, Desertification, Endangered Species, Hazardous Wastes, Law of the Sea, Marine Life Conservation, Nuclear Test Ban, Ozone Layer Protection, Ship Pollution, Tropical Timber 83, Tropical Timber 94, Wetlands signed, but not ratified: Climate Change-Kyoto Protocol
- Geography - note: strategic location along Strait of Malacca and southern South China Sea

6.1 Sewerage Status Of The Country

Malaysia has seen the evolution of its sewerage industry over the last half a century. Prior to the country's independence in 1957, there were no proper sewerage systems in Malaya. At that time, there wasn't a need for proper sewage treatment due to the low population densities and very limited urbanised developments. Sewage treatment was mainly by way of primitive methods such as pit and bucket latrines, over-hanging latrines and direct discharge to rivers and seas. When Malaya begun to develop itself and move from an agricultural base to an industry base country, the needs for proper sanitation arose.

In the 1960s, sewage treatment systems in the form of individual septic tanks and pour flush systems were introduced. Small communal systems engaging mainly primary treatment, such as the Communal Septic Tanks and Imhoff Tanks also started developing. In the 1970's, the technology engaged expanded to biological treatment processes in the form of oxidation pond systems utilising natural means of treatment. Then in the 1980s, mechanised systems started to be introduced in Malaysia and oxidation ponds were being converted to aerated lagoon systems. The late 1980's and the 1990s, saw the accelerated development of fully mechanised systems in the form of Biological Filters and Activated Sludge Systems.

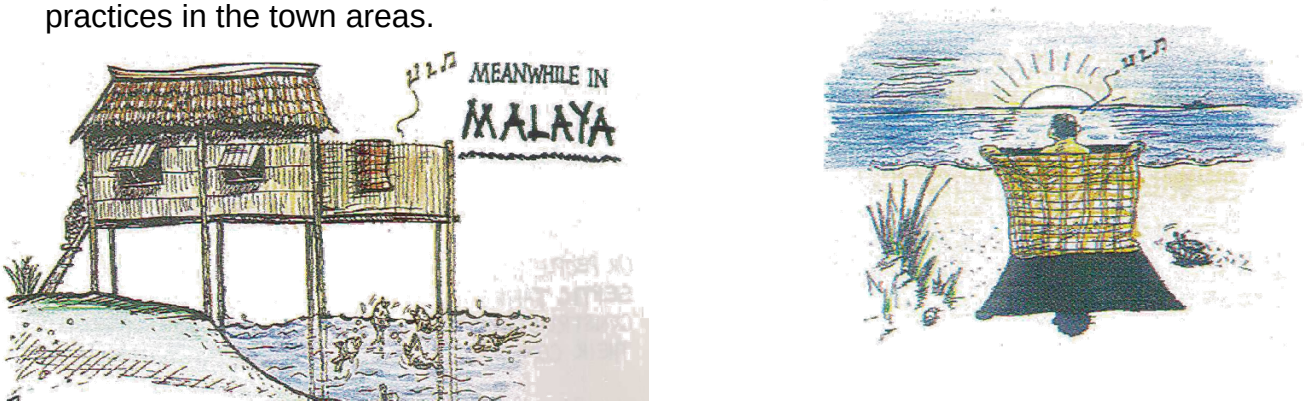
Later part of the 1990's saw efforts concentrated on the control of mechanised systems, which allows for process optimisation of new systems. This evolution of treatment processes from primitive to primary and then to secondary systems was

mainly due to development of technologies in the sewerage industry. The evolution has also seen the movement from non-mechanical systems to a more mechanical and automated system. New and improved equipment were also continuously being introduced due to technological advancements. This with time has also increased the expectation on environmental standards and the skill level in the design, construction and operations of new sewerage works.

The advancement in technological development in the local sewerage industry has mainly been dependent upon foreign development, especially from the developed nations i.e. the import of technologies from abroad. Most treatment systems and equipment were being developed in the western countries. Even the design parameters were derived from studies conducted in the developed nations.

6.1.1 Pre-Independence Sanitation in Malaya

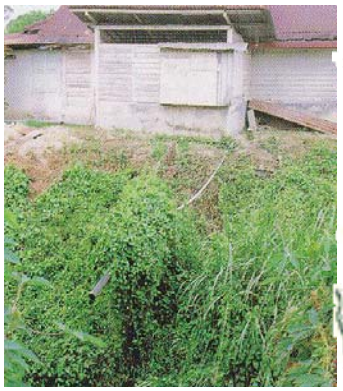
Meanwhile, during the pre-independence period in Malaya, the development of sanitation facilities was very limited as the need for sanitation was not critical. Figure 4 illustrates sanitation practices in the rural areas, and Figure 5 illustrates sanitation practices in the town areas.

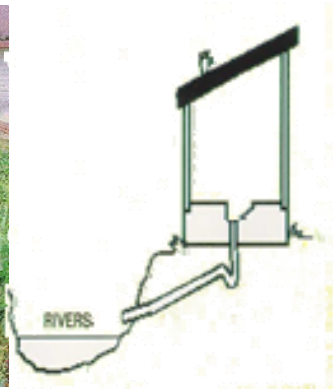


THE RIVER' **'THE BEACH'**

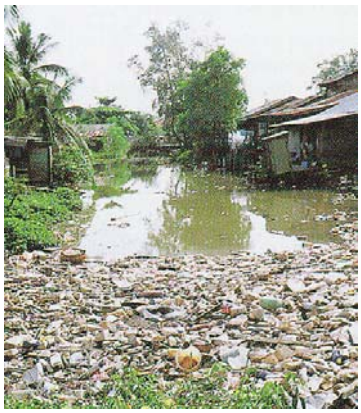
Figure 4: Rural Sanitation – Direct Discharges

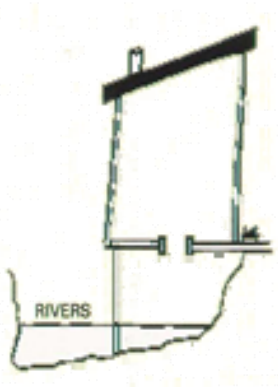
Figure 5: Town Sanitation – Night Soil Systems



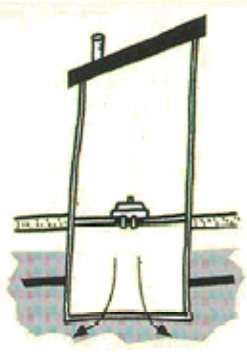


Pour Flush

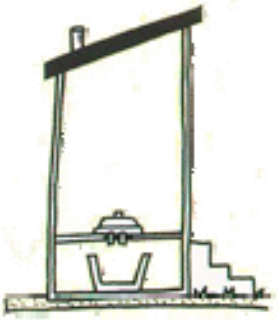




Hanging Latrines



Pit Latrines



Bucket Latrines

Figure 6 – Technologies in the early days in Malaya

6.1.2 Technology of the 1950s

In the 1950s, towns started to develop and population densities began to grow. There was an increased need for improvement in the sanitation sector. Technological advancement at the time was the use of primary systems, which utilised sedimentation processes. Individual septic tanks utilised this treatment concept. Figures 7 and 8 illustrate the Individual Septic Tank (IST) Systems. This primary system is only capable of providing basic primary treatment via sedimentation and digestion. The expected performance of such systems is as shown in Figure 9.

In the towns, individual septic tanks started to be used to replace primitive systems. This formed the early evolution of technological advancement, where primary systems replaced the primitive systems. This evolution reduced the direct pollution levels to the environment. For example, BOD is reduced from 200-400 mg/l to 150-200 mg/l (as shown in Figure 9).

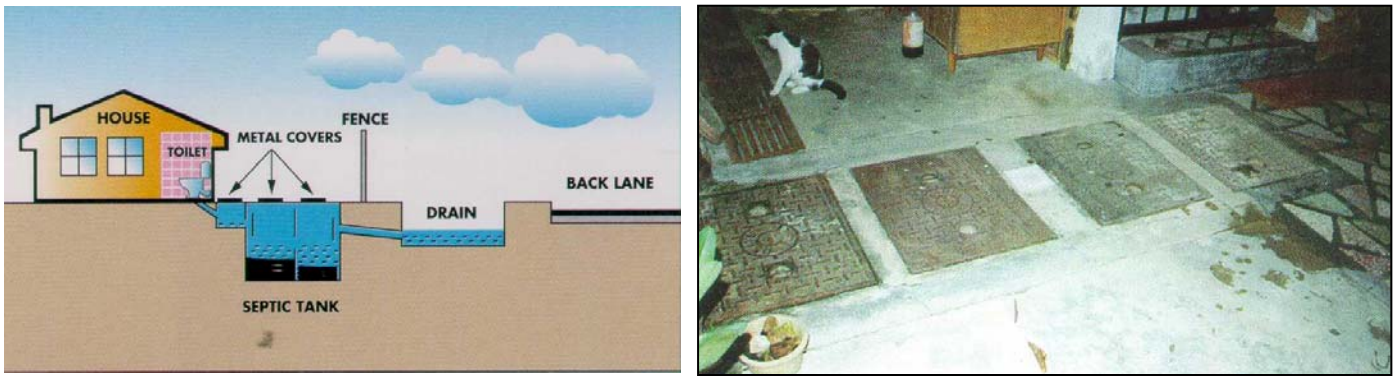
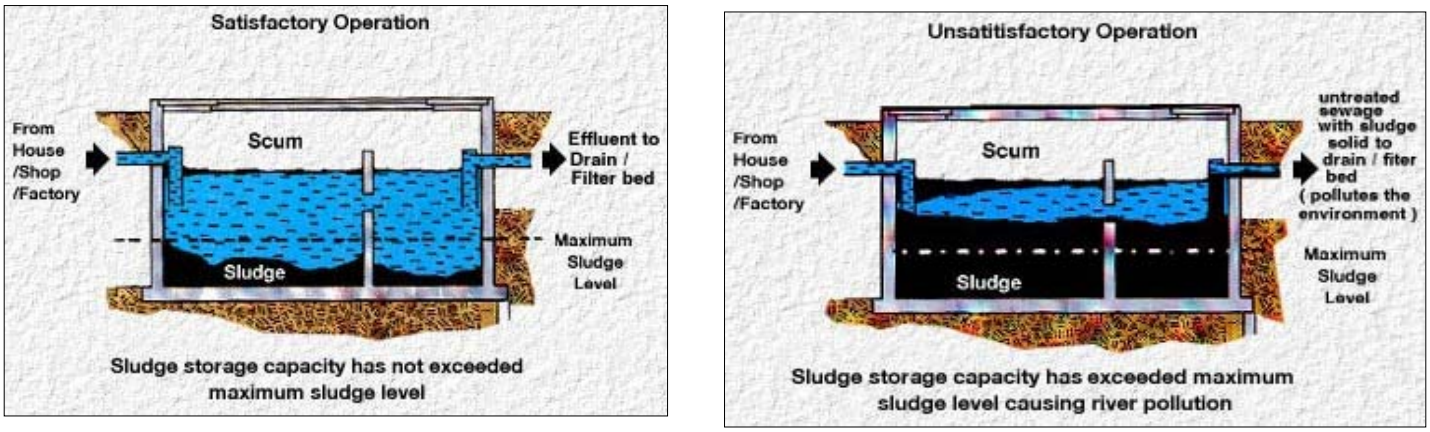


Figure 7: Individual Septic Tank



6.1.3 Technology in the 1960s

After the independence in 1957, Malaya at the time started to develop. More towns were established and more people occupied these towns. The need for improved sanitation expanded to community based sanitation. Communal Septic Tanks were introduced and utilised to improve the community sewerage systems. Figure 10 illustrates examples of Communal Septic Tanks (CST) systems. In terms of performance, Communal Septic Tanks are similar to Individual Septic Tanks but the CST, serve a bigger population via a series of pipes connecting a row of tanks.

Imhoff Tanks (IT) systems, which is another improved version of primary treatment system, were later introduced for the community sewerage systems. Figure 11 illustrates

examples of Imhoff Tanks. Imhoff Tanks further helped in improved treatment performances. For example, BOD is reduced from 200-400 mg/l to 50-175 mg/l (as shown in Figure 12).

Figure 10: Communal Septic Tanks

improved sewerage systems was further enforced via the enactment of the Act. Partial secondary treatment systems such as Oxidation Ponds were introduced in Malaysia in the 1970s. Figure 13 illustrates examples of Oxidation Ponds.

Oxidation ponds were capable of providing partial secondary treatment, mainly in the form of biological treatment. The treatment performance improved as BOD could be reduced from 200-400 mg/l to 20-100 mg/l (as shown in Figure 14).

Figure 13: Oxidation Ponds

In late 1970s, Aerated Lagoons were introduced where there was a need to serve a larger population within a limited land area reserved for oxidation ponds. This was done (by introducing aerators to the systems). This technological advancement allowed for enhancement of oxidation ponds capacities up to more than 5 times the original capacities. Figure 15 illustrates typical performance of Aerated Lagoons systems.

6.1.5 Technology in the 1980s and 1990s

The needs for improvement in the sewerage systems became more prevalent in 1980s. When the (The Environmental Quality Regulations were enacted in 1979). The technological advancement in the 1980s includes the introduction of full secondary treatment via mechanised sewage treatment plants. There are various types of mechanised sewage treatment plants. Examples include Conventional Activated Sludge, Extended Aeration, Rotating Biological Contactors and Trickling Filters. Figure 16 shows example of an Extended Aeration Activated Sludge System.

Mechanised sewage treatment plants are capable of providing full secondary treatment and the treatment performance is more superior than the other systems discussed earlier. Figure 17 illustrates typical unit processess of mechanised sewage treatment plants.

Figure 16: Mechanised Sewage Treatment Plant

6.2.6 Overview of the Sewerage Industry Evolution

In Malaysia, the sewerage technology has evolved from pre-independence era of no treatment to the primary treatment by individual septic tanks in the 1950s. This has improved the level of sanitation by providing partial treatment of sewage. In the 1960s, introduction of Communal Septic Tanks and Imhoff Tanks, further improved the effluent quality. In the 1970s, introduction of partial secondary systems like

Oxidation Ponds which is capable of producing better effluent quality. Fully mechanised systems were introduced in the 1980s, which provide full secondary treatment, which is capable of meeting DOE effluent standards consistently.

PROGRESSES IN SEWERAGE SECTOR

Privatisation of National Sewerage Services

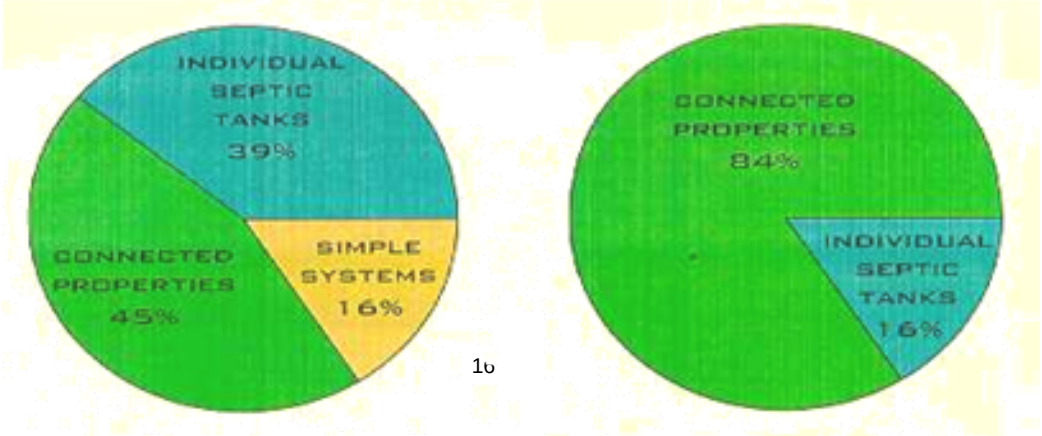
Prior to 1993, sewerage management in Malaysia fell under the jurisdiction of local authorities. The local authorities already has too many responsibilities such roads, drainage, buildings, planning, etc. Furthermore, there were 144 local authorities and the level of expertise and financial capabilities between these local authorities widely varied. Thus, the standard of sewerage services was not consistent throughout the country.

In realising the needs to upgrade the sanitation level in the country, in 1993, the Malaysian government took a bold step in privatising the management of the sewerage systems to the National Concession Company. The Sewerage Services Act was enacted in 1993 to empower the Federal Government to regulate the sewerage industry. The Department of Sewerage Services was formed under the Ministry of Housing and Local Government, as the regulator of the sewerage industry. A National Concession Company by the name **of Indah Water Konsortium Sdn Bhd (IWK)** was formed in April 1994 to undertake the management of the sewerage services of the country.

To date, IWK has taken over the management of sewerage services in the local authorities operational areas of Peninsular Malaysia (except Majlis Bandaraya Johor Bahru, Johor and Kelantan), and Federal Territory of Labuan. IWK is responsible to operate and maintain public sewerage systems in these areas, as well as planning and manage the implementation of national sewerage projects by assist the government in controlling sewerage systems built by developers.

Concession Targets

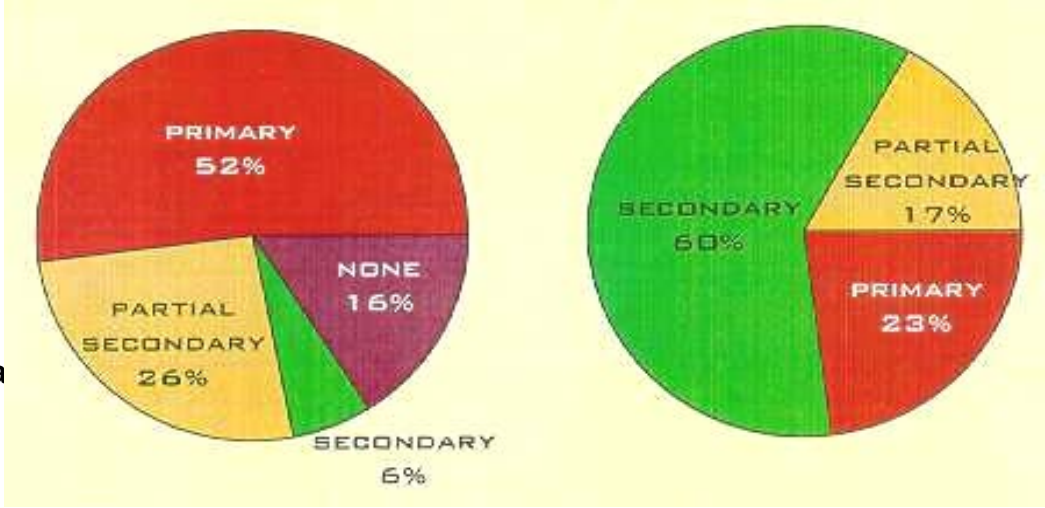
The targets of the concession are to achieve total coverage of sewerage services by the end of the concession period. Figure 22 shows the targets for major local authorities and Figure 23 shows the target for smaller local authorities.



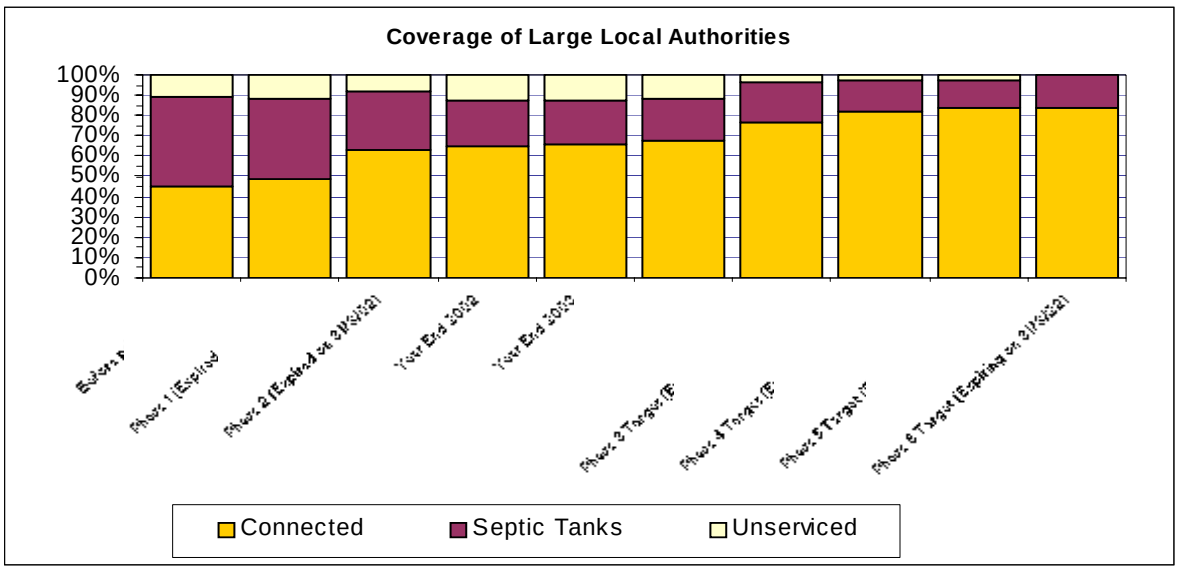
(a) At start of Concession **(b) At end of Concession**

Figure 22: Concession Targets for 48 Major Towns

(a



The original privatization of the national sewerage service aims to achieve full coverage throughout Malaysia, as shown in the following graphs:

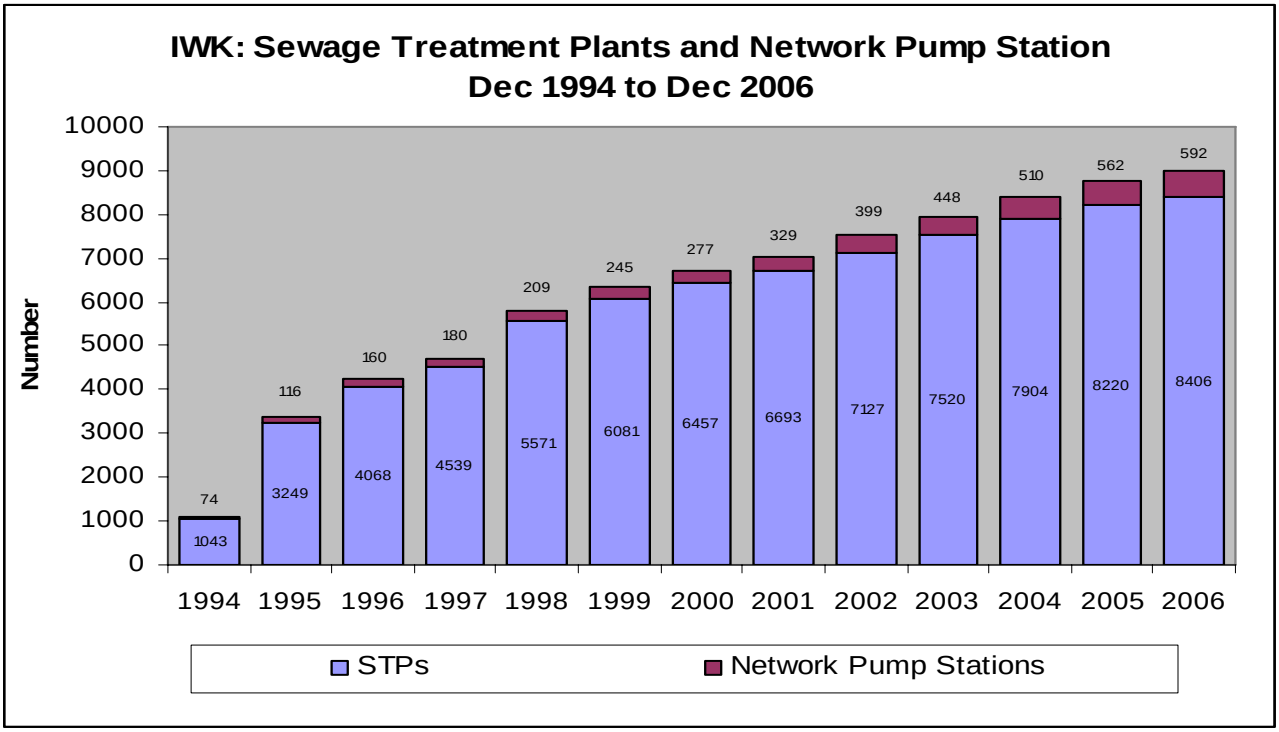


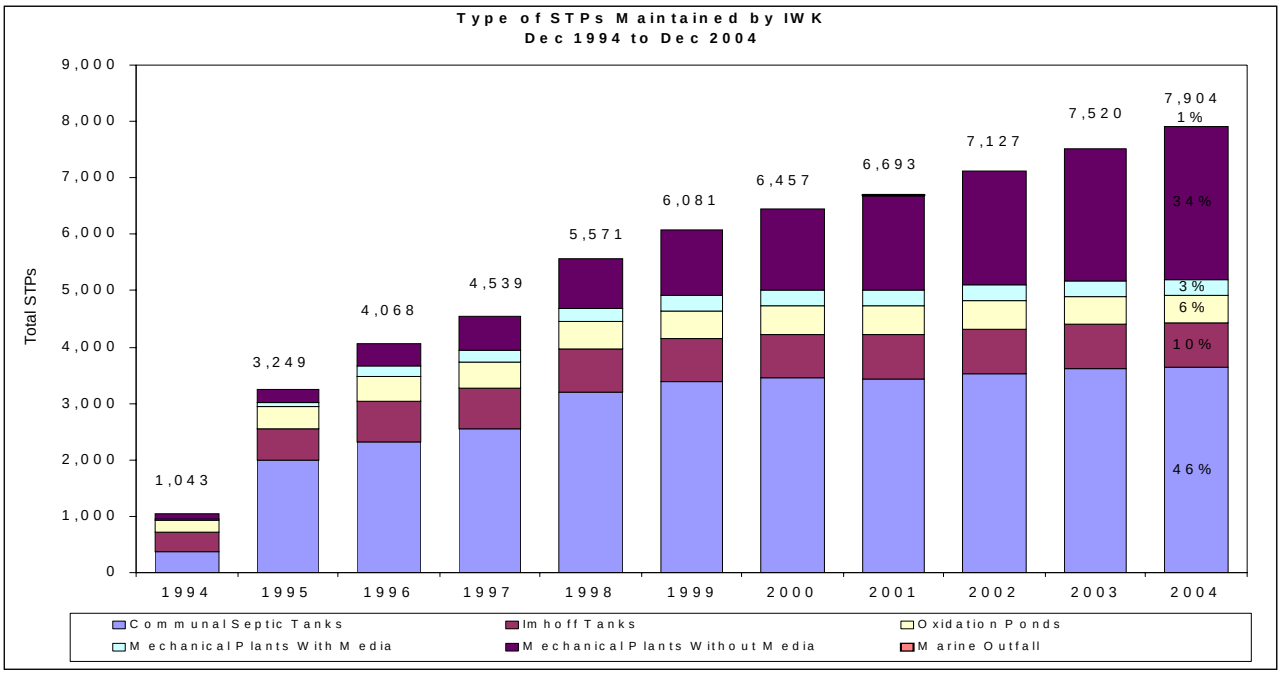
Sewerage Systems in Malaysia

Currently, there are approximately 7,600 public sewage treatment plants and more than 14,000 km of sewers managed by IWK in Malaysia. Most of the sewage treatment plants are constructed using 1960s technology, such as Communal Septic Tanks and Imhoff Tanks, which utilised primary treatment systems. There is also substantial portion of Oxidation Ponds and Aerated Lagoons, which utilised partial secondary treatment systems.

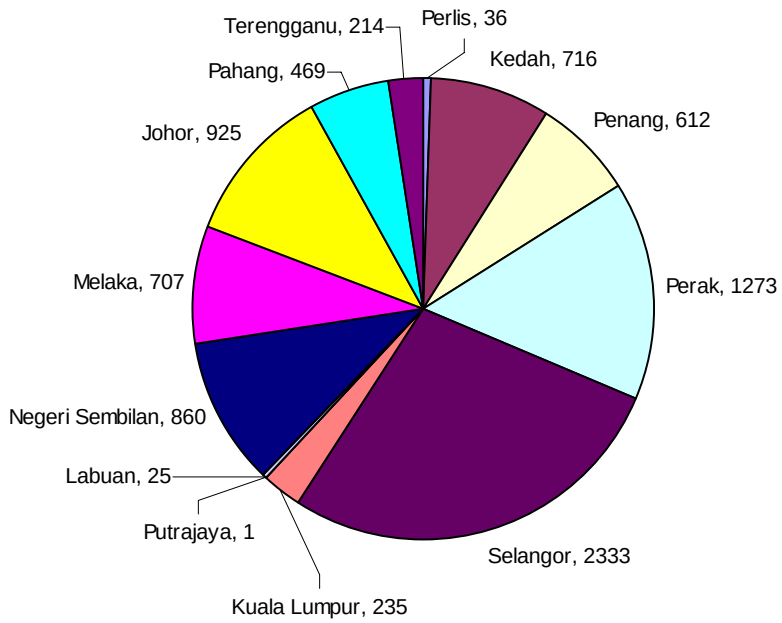
Asset Profile of Treatment Plants in Malaysia are as Follows

- Aerated Lagoon - 2% of total STPs (15% of Population Served)
- Mechanical Plant - 31% of total STPs (55% of Population Served)
- Oxidation Pond - 7% of total STPs (18% of Population Served)
- Communal Septic Tank & Imhoff Tank - 60% of total STPs (9% of Population Served)

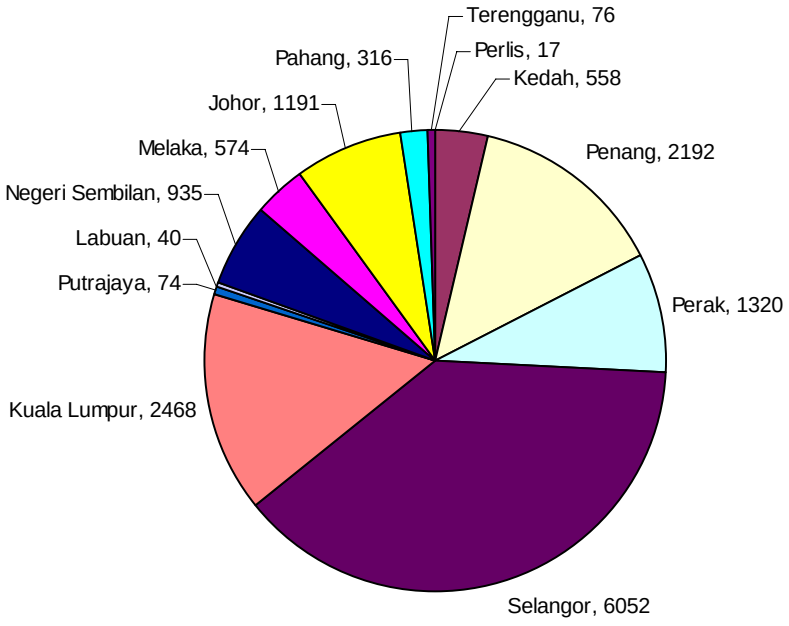

IWK: Sewage Treatment Plants and Network Pump Station
Dec 1994 to Dec 2006
Number
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
74
116
160
180
209
245
277
329
399
448
510
562
592
1043
3249
4068
4539
5571
6081
6457
6693
7127
7520
7904
8220
8406
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
STPs
Network Pump Stations

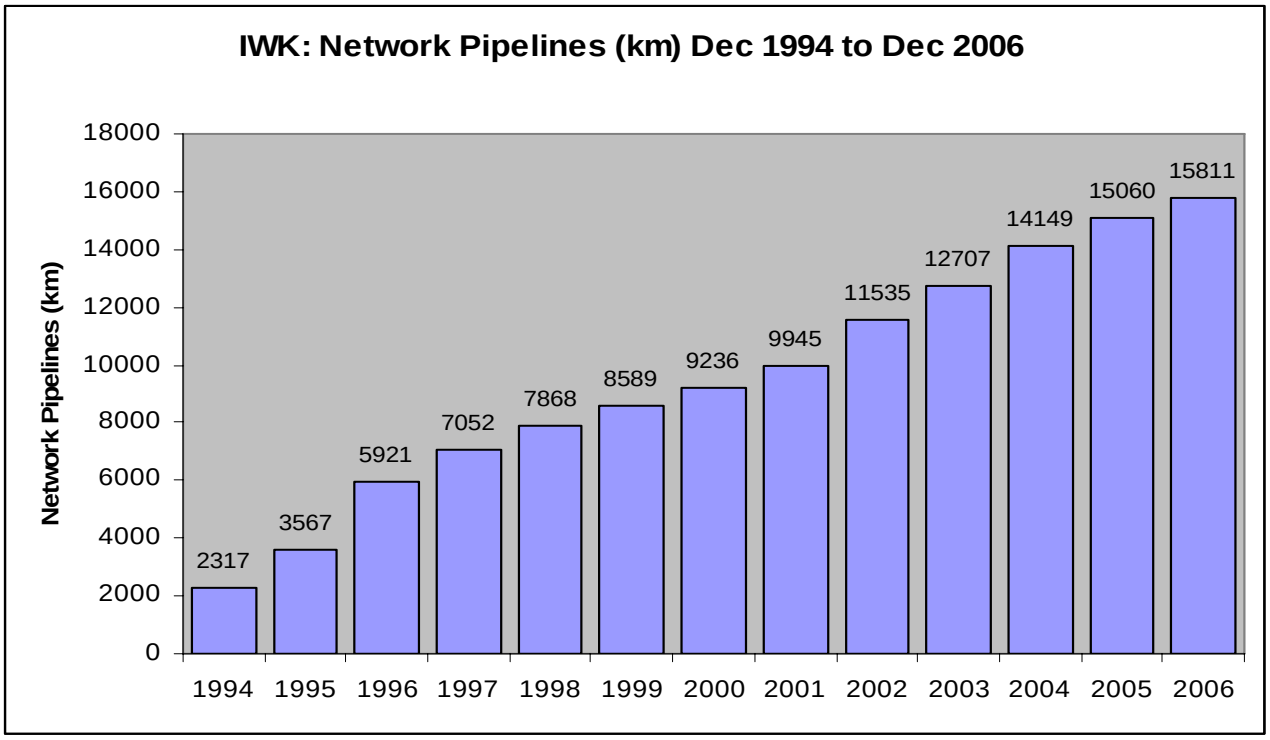

Type of STPs Maintained by IWK
Dec 1994 to Dec 2004
Total STPs
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1,043
3,249
4,068
4,539
5,571
6,081
6,457
6,693
7,127
7,520
7,904
1%
34%
3%
6%
10%
46%
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Communal Septic Tanks
Imhoff Tanks
Oxidation Ponds
Mechanical Plants With Media
Mechanical Plants Without Media
Marine Outfall

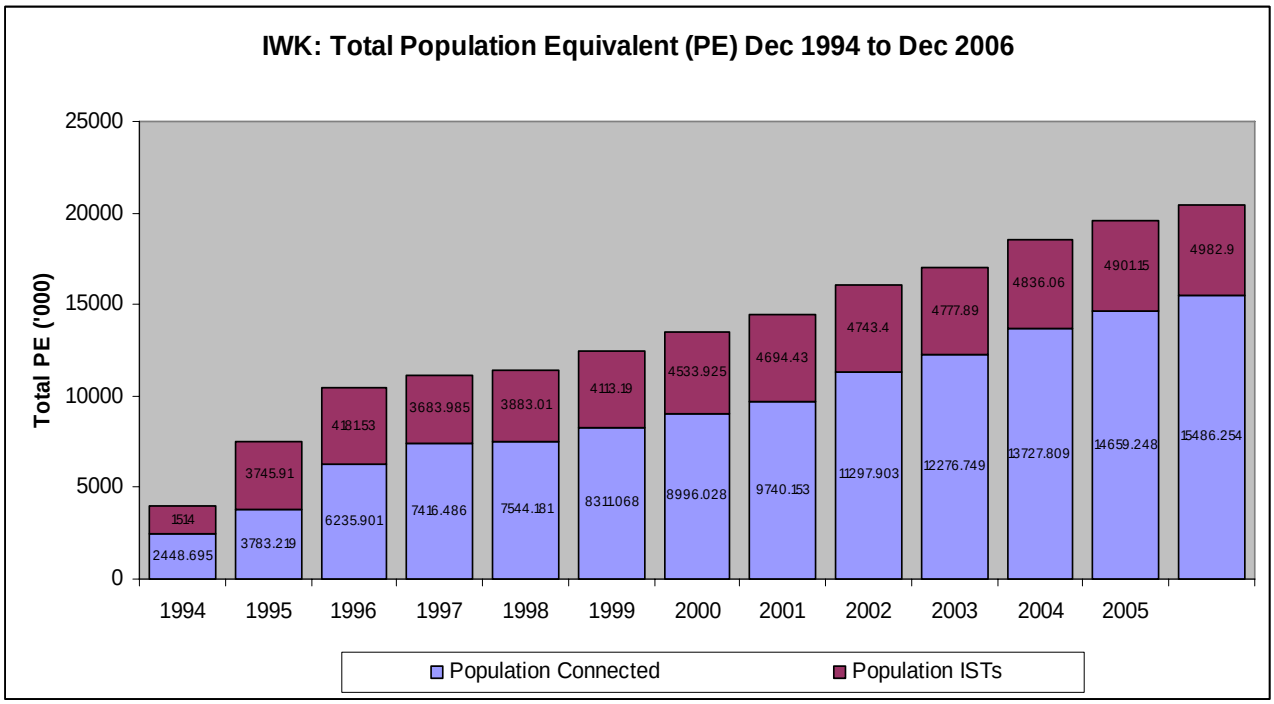
Number Of STPs and NPSs as at Dec 2006



Length of Network Pipelines (km) as at Dec 2006




IWK: Network Pipelines (km) Dec 1994 to Dec 2006
Network Pipelines (km)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2317
3567
5921
7052
7868
8589
9236
9945
11535
12707
14149
15060
15811
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006


IWK: Total Population Equivalent (PE) Dec 1994 to Dec 2006
Total PE ('000)
25000
20000
15000
10000
5000
0
1514
2448.695
3745.91
3783.219
4181.53
6235.901
3683.985
7416.486
3883.01
7544.181
4113.19
8311.068
4533.925
8996.028
4694.43
9740.153
4743.4
11297.903
4777.89
12276.749
4836.06
13727.809
4901.15
14659.248
4982.9
15486.254
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Population Connected
Population ISTs

Standards

For the rivers in Malaysia, the water quality standards is monitored based on the Interim National River Water Quality. To control the level of pollution in the waterways, 2 effluent discharge standards are enforced:

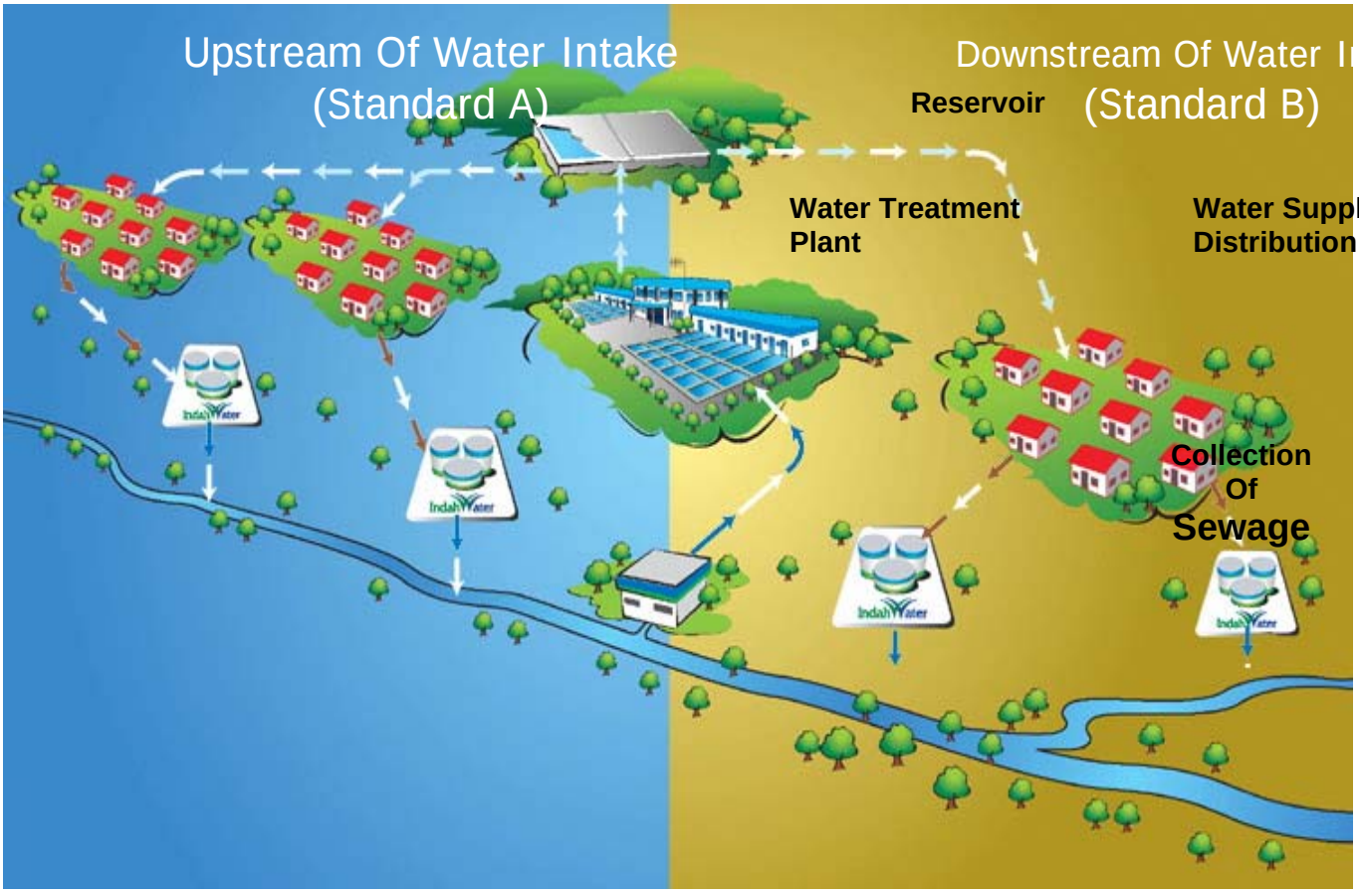
- Standard A – for upstream of water catchments areas.
- Standard B – for downstream of water catchments areas.

The effluent standards set as Absolute Standards. In design, Average Standards much lower than the limits should be used to have 95% level of confidence of maintaining the effluent below the set Absolute Standards. Table 3.2 illustrates the Absolute Standards and the respective Average Standards to be adopted in design.

Table 3.2: Effluent Standards

Parameter		Standards A		Standards B	
		Absolute	Design	Absolute	Design
BOD_5	mg/L	20	10	50	20
SS	mg/L	50	20	100	40

In the past, the Absolute Standards have been misinterpreted as the value to be adopted in design. Thus, most plants designed prior to 1994 have been designed to give average effluent of 50 mg/l BOD and 100 mg/l SS for Standard B areas. Most biological systems' performance will fluctuate depending upon the incoming flow ..quality, thus most plants designed prior to 1994 will fail at least 50% of the time due to misinterpretation of the effluent standards.



6.1.6.5 Controls

In order to ensure all new sewerage developments are designed according to correct interpretation of the effluent standards, and also to ensure consistent quality in the sewerage development, Sewerage Services Department prepared Guidelines for developers to follow the requirements. In 1994, the first edition of the Guidelines was published in 2 volumes. In 1998, revisions were initiated and the second edition was published in stages of volume by volume. There are 5 volumes of the Guidelines:

Volume 1 – Sewerage Policy for New Developments
Volume 2 – Sewerage Works Procedures
Volume 3 – Sewer Networks and Pump Stations
Volume 4 – Sewage Treatment Plants
Volume 5 – Septic Tanks

In line with the drive towards improved sewerage standards in Malaysia, Sewerage Services Department became a Standards Writing Organisation (SWO). In 1998, revision of the Malaysian Standards for Sewerage (MS 1228:1991) was initiated. Other Malaysian Standards such as Standards for Manhole Tops, Standards for FRP Tanks, and Standards for Septic Tanks were also initiated. Design Manuals were also developed to assist designers in design of sewerage systems. Design Manuals include STP Design Manual, Hydraulics Manual, Pumping Station Design Manual, M&E Design Manual, Drafting Manual, Guides to Sewer Selection & Installation, Engineering Specifications, Products Specifications and Typical Drawings. All these standards and manuals will assist in assuring the consistency and enhancement of standards of sewerage systems in Malaysia.

6.1.6.6 The Management of Sludge in the country

The annual sludge volume produced currently is estimated to be 3 million cubic metres. This equates to filling the twin-tower at KLCC to the 78th floor in the first year and requires some 600,000 tanker trips to transport the sludge to designated treatment and disposal sites. By the year 2020, the volume is estimated to increase to 7 million cubic metres which will require about double the KLCC twin-tower to fill, or almost 1.4 million tanker trips to manage. Figure 4 shows the annual sludge production rate in Malaysia.

The increase in volume is mainly due to the population growth, intensive developments and improvements on wastewater treatment efficiencies. To manage these volume of sludge in order to minimise the impact onto the surrounding environment, IWK has been directed to desludge all septic tanks within local authority operational areas on a periodic basis once every two years. All existing plants also will be desludged regularly while all new plants will require proper on-site sludge handling facilities. IWK is also required to have the correct size of manpower, tanker and appropriate equipment to cope with the volume of sludge to be handled. They are also required to construct proper sludge handling facilities at strategic locations. Land needs to be leased, purchased, acquired or alienated in order to construct

these facilities. Co-operations from state governments are urgently required. Remember that this is a government project and IWK is merely a contractor who has been appointed to serve the Federal Government for 28 years. All land will remain as the property of the Federal Government.

6.1.6.7 Annual Sewage Sludge Production

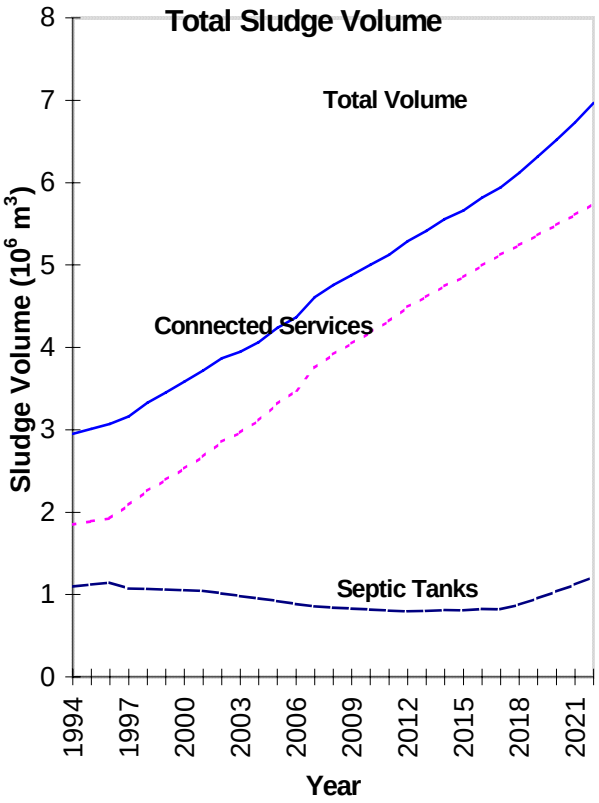


Figure 19 above shows the Sludge Volume Projection

6.1.6.8 Planned Strategy

In order to properly manage and treat the existing and future sludge volume, a three (3) stage strategy has been planned by the government and IWK as follows :-

Stage I

The *Immediate Strategy* which deals with the existing sludge problems effective from the date of takeover of a particular local authority. At this stage, responsive and

scheduled desludging will be the main sludge concerns. The privately operated plants will not be included in this case. Existing sewage treatment facilities such as the oxidation ponds and aerated lagoons are being used for receiving sludge from individual and communal septic tanks. This will facilitate IWK's desludging requirements under the Concession Agreement and allows sufficient time for the establishment of the short terms solutions.

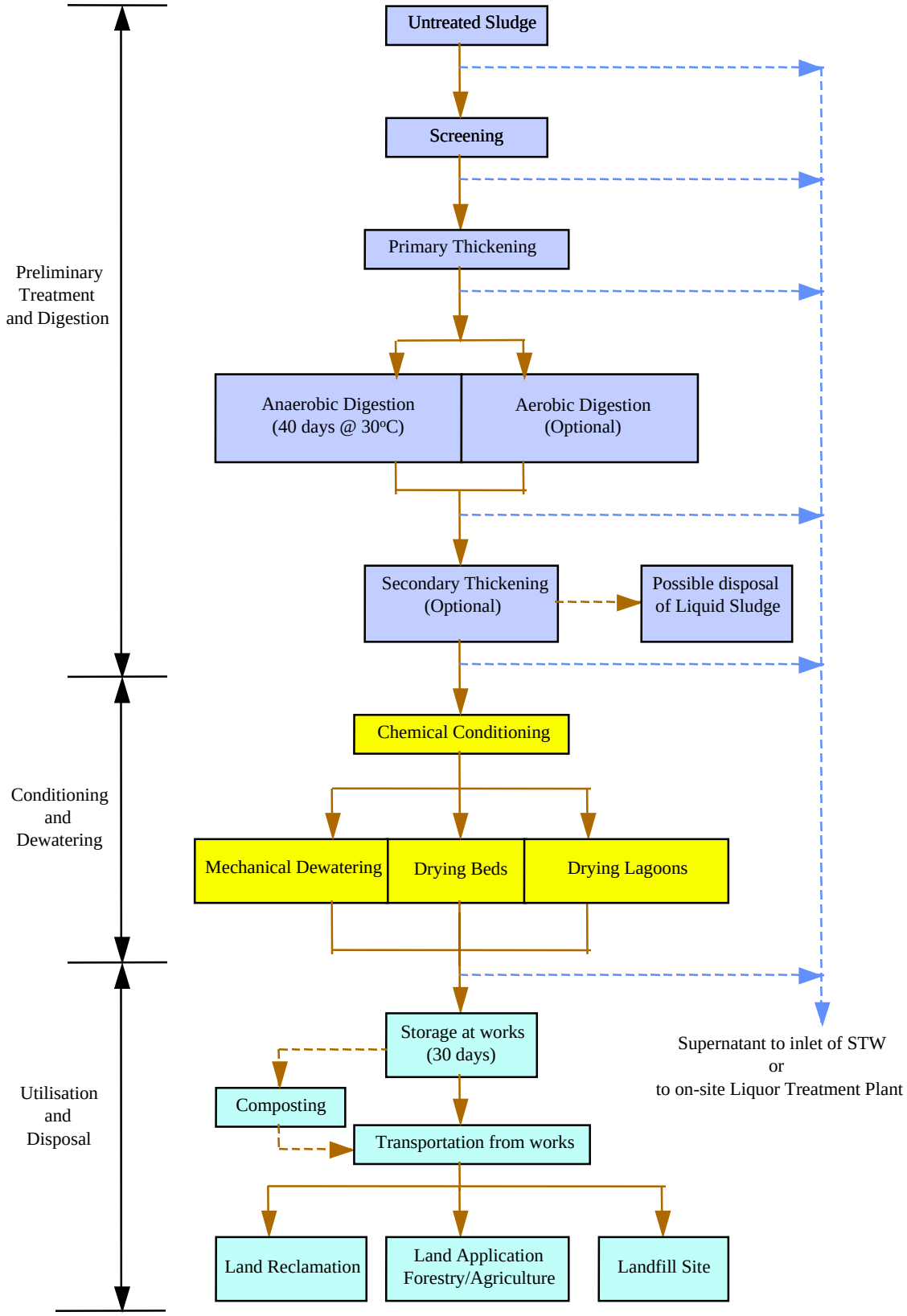
Stage II

The *Short Term Strategy* will involve acquiring land and constructing sludge lagoons and sludge transfer stations for a period of approximately 5 years until the selected centralised sludge treatment facility is commissioned. It is proposed that each local authority will have at least one treatment/disposal outlet for sludge generated in that particular area. Sludge lagoons and drying beds are selected for the short term because they provide standard methods of design, simple to construct and can be commissioned within a short period of time. An estimated budget of RM250 millions will be spent over the next 5 years to establish the short term solutions.

Stage III

The *Long Term Strategy* will involve the acquiring of lands and constructing modern centralised sludge treatment plants at selected locations with digestion and mechanical dewatering facilities to achieve at least 25% dry solids content of sludge cake. About 40 large scale mechanised plants will be constructed under this strategy which will involve an estimated budget of RM750 millions over a 15 years expenditure period.

Figure 20 : Sludge Treatment Flow Chart



For the *Short Term* solution - trenching, lagooning, drying beds and sludge transfer stations are the selected treatment technologies because they offer simple solutions within a reasonable short period of time.

a) Trenching is the simplest and fastest method of sludge disposal on land where stabilised or unstabilised sludge maybe disposed of to the ground in liquid form and covered with soil. Sludge trenching is usually carried out in forest areas or plantations where narrow trenches are placed in between trees. It can also be used in abused land sites or near landfill areas.

b) Sludge lagoons provide a safe and economical way of treating sludge. They can be easily built and provide both short and long term solutions to sludge management. Sludge lagoons are sized to receive sludge for up to 12 months. The filling of a lagoon will start at the first lagoon and will move to the second lagoon as soon as the first lagoon is filled. While filling the second lagoon, the sludge inside the first lagoon will undergo anaerobic digestion and dewatering under natural conditions by evaporation and draining of supernatant. An anaerobic liquor treatment plant is provided to handle supernatant. Picture 2 shows a typical view of sludge lagoons.

c) Sludge drying beds are shallow tanks with a system of under drainage overlaid with filtering media. Liquid sludge is discharged onto the surface of the media and dewatering occurs as a result of water entering the under drainage system. Water is also removed from the surface by decantation and evaporation. The drained liquor is normally returned to the supernatant treatment plant for further treatment.

d) Sludge transfer stations are collection points where smaller tanker transfers sludge into a central tank from where a bigger size tanker is used to transfer sludge to the centralised sludge treatment facility, sludge lagoons or drying beds for further treatment and disposal. The main reason for using sludge transfer stations is to reduce sludge tankers travelling distance and hence reducing the tankerage costs. It will also reduce the number of small capacity tankers. Whether sludge transfer stations are provided or not is purely a matter of economics.

   As for the *Long Term* solutions, sludge lagoons will continue to be used in remote, less urbanised areas while proper mechanised plants will be constructed at urbanised centres. These facilities offer the benefits of occupying a relatively smaller area of land, offers control over the treatment processes and minimises the impute of sludge treatment on neighbouring communities. The treatment process for a fully mechanised sludge treatment facility comprises the following basic processes: -

   a) Raw sludge reception well with transfer pump
   b) Mechanical drum screen (including screening, washing and dewatering systems)

c) Screened sludge holding tanks for 3 days storage
d) Rotary drum thickeners/centrifuge or equivalent up to 6% DS
e) Single stage anaerobic digester with 40 days holding capacity (unheated)
f) Digested sludge holding tank with 5 days capacity
g) Mechanical dewatering using Filter Press to achieve 30% DS
h) Dried sludge storage facility for 1 month storage
i) Liquor treatment plant
j) Ancillary works

6.1.6.9 Ultimate Disposal

There are various methods of ultimate sludge disposal which can be carried out in the form of liquid or dried sludge. The methods that will be employed here in Malaysia are:

- Agriculture /Forestry Land Improvement
- Land Reclamation
- Land fill
- Composting

a) Sludge utilisation on agricultural and forestry land has proven to be most resourceful. Sludge contains most of the organic loads from the sewage, which can help farmers reduce their fertiliser requirements and improve soil fertility. Sewage sludge contains significant proportion of nitrogen and phosphorus and can supply a large part of the requirements of most crops. The organic content of sludge can also improve the water retaining capability and the structure of certain soils. It is also a very useful product for reforestation.

b) Sludge cake can be very effective in improving disturbed soils or providing a growing media where no soil exists. For example, soil is normally stripped and stockpiled prior to mineral extraction for reinstatement on completion of the operation. When reinstatement takes place, the stockpiled soil is generally structurally damaged and the addition of sludge cake provides extra organic matter, improving both the physical and hydraulic properties of soil. In areas where no topsoil exists, sludge cake can be used as a soil forming material providing a cheap alternative as topsoil. In Malaysia, land reclamation techniques will be most suited to ex-mining lands.

c) Land filling of sewage sludge with domestic refuse is the most common method of sludge disposal. The basic procedure is to construct a series of clay sided cells or lagoons, which are capable of being filled to an average depth of 3 metres with sewage sludge. Thickened sludge is pumped into the lagoons and allowed to stand for a period of time after which any surface water can be decanted of and additional sludge pumped in. Once the maximum volume of sludge has been passed into the lagoon it is again allowed to stand for a period of time to remove water. At this point dry solid wastes are tipped into the lagoon and this absorbs most of the remaining moisture of the sludge. Additional solid waste are then

deposited on top of this, up to the final and agreed contour levels. Ground compaction is done and final restoration of the site takes place.

d) Composting of sewage sludge is new to Malaysia and maybe considered in the future if the economies are favorable. Liquid or dewatered sewage sludge can be stabilised by mixing it with a bulking agent such as wood chip, straw or municipal waste, provided that non-degradable materials such as metal, plastic and glass is removed.

An overview of sludge management in Malaysia has been presented. Municipal sludge has not been given due respect prior to 1994. As a result, over 70 percent of our river systems throughout the country has been reported to be polluted by human wastes. A strategy has been put forward to tackle this massive issue in stages over a 15 years timeframe. The total cost of the project is estimated at RM 1 billion (inclusive of land costs). Cooperations from state governments are required to release reasonable land sites for construction of dedicated sludge treatment facilities at their respective states. Consumers are being enlightened to understand the seriousness of the municipal sludge problems in Malaysia and do their bit in helping manage this massive tasks. Efforts by all of us today will ensure good health, safety and prosperity of our future generation in Malaysia.

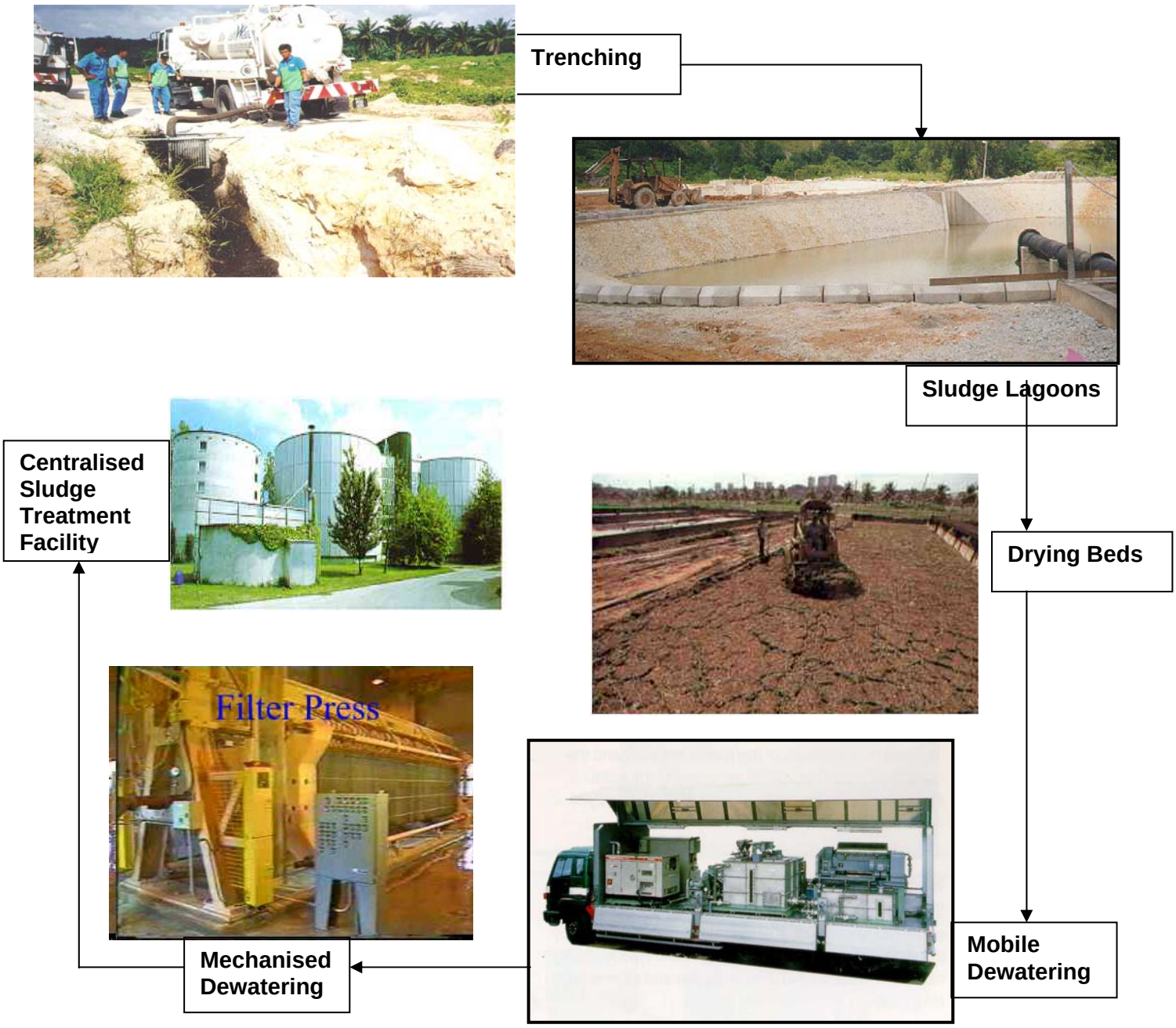


Figure 21: Progress Improvements of Sludge Management

The above figure demonstrates the technology developments of sewage treatment over the years. One very interesting fact can be observed from the figure is that with advancement in treatment technology , the user of mechanical and electrical equipment shows a steep increasing trend.

6.2 Master Plan For Sewerage Work.

A comprehensive Malaysian National Sewerage Development Plan where sewerage facilities for the nation, outlining the strategic investments in the development of

sewerage infrastructure, in order to sustain continued public health protection, preserve our national water resources and enhance environmental quality has been drawn up to address the above issues. The plan will have components to address the various issues highlighted earlier. It is estimated that a total of RM 33 billion will be required for the National Sewerage Development Plan over the next 30 years.

The main objectives of the comprehensive National Sewerage Development Plan to provide better management of sewerage systems for: -

1. Safeguarding public health
2. Protection of water resources from sewage related pollution
3. Preservation of the environment from detrimental effect of sewage.

These are the target of National Sewerage Development Plan:-

- Priory Need (2005-2020) : To improve asset condition and meet regulatory Standard
- Long Term Needs (2021-2035) : Enhance Environmental Efficiencies through Regionalisation

These are the issues and components need to be address in National Sewerage Development Plan:-

- Refurbishment works
  - Upgrading and consolidation of 4,632 STPs to meet DOE Effluent Standards within set timeframes
  - located within 12 states.
  - STPs having operational problems and public issues.
  - STPs located in water catchment areas or within catchments of critically polluted rivers and areas of tourism importance will be given priority
  - includes network rehabilitation for approximately 1,300 km of critical sewer networks.
  - rehabilitate sewer networks experiencing poor structural , hydraulic or operational conditions.
- Sludge
  - Provision of a total of sludge facilities for all priority Local Authority areas.
  - to handle sludge from desludging of ISTs and multipoint plants.
  - to serve an eventual PE of 22.5 million after discounting PE served by Regionalised systems
  - will enable desludging program of IST and multipoint STPs to be carried out in a systematic manner.
- Regionalisation
  - expansion of sewer networks. construction of new STPs and networks to enable regionalisation of all key urban areas.
  - to provide efficient sewerage management.
  - Estimated of about 42% of the total PE of 44 million will be regionalised by the end of the plan period.
  - Sub-components include acquisition of land for siting of facilities.

- Property connection
  - maximise benefits of new projects.
  - minimise impact of IST effluents
  - a total of 550,000 properties in water catchments and other sensitive areas.
- Pour flush system conversion
  - estimated 850,000 pour flush systems.
  - major source of sewage pollution.
  - convert all of pour flush to a basic septic tank system.
- Sullage connection
  - major source of sewage pollution in many critical areas.
  - program of replumbing of such properties to intercept sullage wastes into sewerage systems.
  - involve an estimated 250,000 premises in high priority areas

PROJECT DESCRIPTION	***QTY***	***TARGET COMPLETION DATE***
❖ *Refurbish / Upgrade of Sewage Treatment Plants (STP) and Sewers to Meet Proposed Effluent Standards* *A)Standard A (in water catchment areas)* *B)Standard B (non-water catchment areas)* *C)Sewer Rehabilitation*	*884 STPs* *3,748 STPs* *1,300 km*	*2015* *2020* *2010*
❖ *Sludge Treatment Facility Development*	*22.5 Mil PE*	*2015*
❖ *Regional Sewerage System Development*	*17.4 Mil PE*	*2035*
❖ *Financing Property Connection Up To Private Property Boundary*	*550,000 Properties*	*2035*
❖ *Financing Property Connection Within Private Property Boundary*	*550,000 Properties*	*2035*
❖ *Pour Flush System Conversion*	*850,000 Properties*	*2035*
❖ *Re-plumbing for Sullage Collection*	*250,000 Properties*	*2035*

This comprehensive National Sewerage Development Plan is considered to be the required Capital Investment Plan for the sewerage sector. The plan must have supported by adequate non-structural components including legal and institutional frameworks, policy support and enforcements. A matching operational plan is also required to complement the Sewerage Development Plan for effective and sustainable development.

6.3 Industrial Wastes that produce water pollution.

Industrial waste control is not covered under Sewerage Services Department . It is under jurisdictions of Department of Environment, Malaysia.

6.4 Current Technical Problems

In implementing the sewerage projects, some issues and challenges has been identified and need to be overcome in an orderly manner so that the strategies can be smoothly implemented:

(a) Co-ordination of planning concept with different developers
(b) High capital cost for installation of sewerage infrastructures
(c) Lack of reliable database on trunk sewers and treatment works resulting in the delay of the response to developers regarding their new developments.
(d) Unavailability of strategic lands especially downstream of major rivers where lands are fully developed. Sufficient lands at these areas are not available or have not been allocated for sewerage infrastructures. Apart from land being expensive, residents mostly do not agree with the location of sewerage infrastructures within their neighbourhood. This has opted for the construction of sewage treatment plants to move upstream or to some other locations further from the actual development and thus resulting in high capital, operations and maintenance costs.
(e) Providing for sufficient land bank for multi-point projects.

(f) Identifying suitable treatment locations and plans so that upgrading made possible as required at proposed development.
(g) Developers need to understand that long term planning for sewerage is a must and up-front capital funding for utility must be considered for ultimate development.
(h) High Capital Cost creates pinch for the Government to implement several projects large projects at one time.
(i) Plant operability - Although most newer design require approvals from Sewerage Services department, operability still remain an issue since it is often difficult to conceptualized operability issues based on drawings alone. For IWK internal project, IWK has established its own HAZOP (hazards and operability) committee review requirements. However, there is no HAZOP requirement for privately developed STP. When IWK take over significant numbers of Sewage treatment plant, a large no of STP are difficult to operate.

(j) Staff retention presents IWK's one of the greatest challenges in human resources management. With the negative publicity that the company is facing, it has been difficult to maintain staffs for a long period of time. In addition, as the overall Malaysian Industry places high importance on environmental compliance and requirements, demand for highly trained professionals has increased. This has indirect affect IWK's ability to operate and maintain it's STP as many of it's trained professional opted for lucrative offers in the market. IWK expenditure on training and staff development will increase as more and more replacements are needed to fill up the void created due to the high staff turnover.

(k) Some of STPs constructed before year 1994 are under-designed (designed to absolute standard without any margin).

(l) Many STPs do not have Oil & Grease trap.

(m) Inadequate Operation and maintenances - many Individual Septic Tank, Oxidation Ponds, imfoff tank, Communal Septic tank have not desludged (especially private operated) while most IST never desludged, damaged component remains un-repaired inadequate scheduled maintenance, lack of operating manual and as-built drawings.

(n) Vandalism – parts are stolen or damaged by irresponsible people.

(o) Inadequate enforcement and monitoring especially private plants.

There are many factors that presents challenges in operation and performance of treatment plants. The key decision factors affected by the challenges are as stated below.

- Human resource
- Location and Logistics
- STP Maintenance, scheduling, inventory and performance
- Quality and Service

Another factor that can influence key decision factors mentioned above id financial strength. It is the utmost quintessential factor that can dictate how IWK should operate it's business and at the same time meet STP performance target that is expected by it's regulators and the general public.

7.0 PLEASE DESCRIBE WHAT YOU WANT TO LEARN INTENSIVELY THROUGH THIS SEMINAR.

From this seminar do expect that we want to learn the implementation of sewerage work as following:

1. Based on the lessons learned from the past experience in your country what are the strategies to put in place for better plan and implementation of sewerage system that could be applied in Malaysia.

2. What are the policies that to be formulated to achieve the above goals and objectives in managing sewerage services industry in Malaysia.

3. In an ideal case, the cost of implementing good planned and high quality effluent, the cost will be very high. What is the best way forward for Malaysia in planning and implementing well planned and designed sewerage systems in our country.

4. Is high technically design sewerage treatment system required in Malaysia? If yes, what is eventual cost to the layman in street?

5. The implementation, monitoring and enforcement of the regulation in sewerage industry In Japan?

6. Best technology and latest invention used in sewage treatment system and managing sewerage services in Japan which are can be introduced or implemented in Malaysia?
7. The application of advanced IT system and other ICT technology developed in sewage treatment system and managing sewerage services in Japan ?

7. Implementation of sewerage development project in Japan including planning, tendering & procurement processes, engineering & design, construction & refurbishment, operation and maintenance.

Prepared by:

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OKTOBER 2007

COUNTRY REPORT OF THE PHILIPPINES

On

Integrated Water Resource Management Adapting to the Global Climate Change

JICA EXECUTIVES' SEMINAR
ON
PUBLIC WORKS AND MANAGEMENT
JFY 2007

Prepared by:

DR. JUDY F. SESE
Director III
Bureau of Research and Standards
Department of Public Works and Highways
PHILIPPINES

SUMMARY

The Department of Public Works and Highways (DPWH) being the country's engineering and construction arm, is responsible for the planning, design, construction and maintenance of infrastructure such as roads and bridges, flood control systems, water resource development projects and other public works in accordance with national objectives.

The DPWH is likewise responsible in the monitoring of National Water Data Collection Program and recognizes the importance of the Integrated Water Resources Management (IWRM) to ensure and secure sustainable water for all. This mechanism is also accepted as a way of adapting to the effects of global climate unpredictability.

In January 2006, the Philippines started the implementation of the United Nation Environmental Program (UNEP) - Assisted IWRM project to come out with a plan in implementing the IWRM. Preparation of the plan was undertaken by Multi-Sectoral Task Force of water related key government agencies and Non-Governmental Organizations (NGOs). A series of activities were conducted in preparation of the IWRM Plan Framework. These include workshops, conferences and consultations with all sectors of the society. The Philippine planners also attended meeting with Southeast Asian neighbors where the Philippine Plan Framework was presented.

The Philippines archipelago is abundant in water resources. It has 421 principal river basins, 20 of which is considered major river basins. The country receives an annual rainfall of about 2,400 mm of which 1000 mm to 2000 mm goes to run-off. Despite having a relatively rich water resources; the Philippines is facing an imminent water shortage due to over population, urbanization and industrialization, which created problems of water resources management. Control in water utilization poses a great problem due to unregistered/illegal water users.

Other concerns and issues dominating the water sectors are the deteriorating water quality, declining access to safe drinking water, inadequate sanitation and sewerage facilities and degradation of major ecosystem. These concerns were aggravated by the increasing frequency and intensity of extreme climate event and variability. Likewise, there is also a problem with respect to sectoral water governance and regulation with 30 government agencies and offices dealing with water.

In view of the above issues and concerns, the DPWH, who is responsible with flood control and water development systems and being aware of the role of the IWRM, has embarked on water-related researches and studies. Currently, it conduct studies on "Nationwide Flood Risk Assessment and Flood Mitigation Plan" in selected areas of the country and the "Project for Enhancement Capabilities in Flood Control and Sabo Engineering of the DPWH" which is a JICA-Assisted Project.

I. Organization Data

(1) Name of Organization: **Bureau of Research & Standards (BRS)**
Department of Public Works and Highways (DPWH)

(2) Summary of Organization

2.1 The BRS was created under Executive Order No. 124, dated January 30, 1987 and mandated to develop and set effective standards and reasonable guidelines to ensure the safety of all infrastructure facilities in the country and to assume efficiency and proper quality in the construction of government public works.

The following are the specific functions of the Bureau:

(a) Study, on a continuing basis, and formulate and recommend guidelines, standards, criteria and system for the survey and design, construction, rehabilitation, maintenance, and improvement of all public works and highways;
(b) Conduct or sponsor research on construction materials and formulate and recommend policies, standards, and guidelines on materials and quality control;
(c) Undertake or cause to undertaken specialized technical studies to advance the in-house technology of the Department and secure the most complete information for project development and implementation;
(d) Formulate technical training programs for Department technical personnel, including the identification of appropriate local and foreign training program, and recommend the selection of Department personnel for such programs;
(e) Review and study, for the purpose of recognizing new technologies especially those utilizing indigenous resources, current national building and construction standards and procedures, and make appropriate recommendations thereon;
(f) Promote, publish, and disseminate technical publications;
(g) Provide technical assistance to the Department Proper, other Bureaus, Regional Offices and other agencies on matters within its competence, including technical assistance in the upgrading or updating of the building code, and other services;
(h) Cooperate or coordinate with other established research, development, and engineering centers in area of common or national interest;

2.2 The BRS has six (6) technical divisions and has an administrative unit. It has a total of 175 personnel and staff. See Figure 1 for the Organization Chart of BRS.

2.3 The BRS has no fixed budget. For the Fiscal Year 2007, a total of P97,882,000.00 was allotted, as summarized below:

2007 Fiscal Year Budget of BRS

ACTIVITY	PERSONAL SERVICES (PS)	MOOE	TOTAL
Infrastructure Research, Quality Control and Management, Production and Processing of Construction Materials and Ancillary Facilities	P 40,174,000	P 8,767,000	P 48,941,000
Formulation and development of guidelines, standards, systems and procedures for areas of infrastructure, including quality control and management of materials and ancillary facilities for the production and processing of construction materials	P 2,752,000	P 321,000	P 3,073,000
Conduct of research on construction materials for infrastructure projects and evaluation of feasibility studies of potential material supply sites	P 30,802,000	P 5,852,000	P 36,654,000
Conduct of hydrologic surveys and establishment, operation and maintenance of a national water resources data collection network	P 6,620,000	P 2,594,000	P 9,214,000
TOTAL	**P 80,348,000.00**	**P 17,534,000.00**	**P 97,882,000.00**

(2) Organization Chart

Refer to Figure 1 – Annex A

(3) Organization's Position in Government

The BRS is one of the Staff Bureau of DPWH. The DPWH is the country's engineering and construction arm, and responsible for the planning, design, construction and maintenance of infrastructure such as roads and bridges, flood control systems, water resource development projects and other public works in accordance with national objectives. See Figure 2- Annex A (Organizational Chart of DPWH).

In pursuit of the above tasks, the BRS shall engage in research and development on all major areas pertinent to infrastructure development. The BRS is looking forward to be the center of excellence in research, standards formulation and materials testing, and a leading advocate of quality assurance practices. It shall also promote innovation by providing DPWH and its stakeholders with improved access to engineering developments and advances through publications and the use of state-of-the-art technology. Finally, BRS shall be a respected DPWH institution providing technical advice and services to the Philippine Construction Industry in the age of Technology.

2. Personal Data

(1)Recent Works

As Director III of BRS, I am responsible to assist the Director IV in the macro-planning of research, standards formulation, materials testing, quality assurance, technical services and technical training and publication including administrative and financial management functions.

I am also responsible in monitoring and control of the planned activities and targets of each Division to ensure quality outputs. Provide assistance in the management of the physical and financial resources of the Bureau; introduce innovation for more effective implementation of the BRS goals and plans and to recommend policies and actions to top management of DPWH to further improve the research and development and quality assurance programs of the Department.

The Hydrology Section under the Research and Development Division of BRS, undertakes the evaluation and processing of streamflow data whose outputs are used in the design of water-related infrastructure projects. In these activities, I monitor the hydrologic activities of the said section including 16 DPWH Regional Offices in terms of targets and accomplishments of water level, river discharge measurement, collection of surface water sample, conduct of river-cross section survey, establishment, rehabilitation and maintenance of gaging stations and review of processed streamflow data, water quality results and sediment load analysis of water samples.

For water-related activities, I provided technical assistance to some water-related agencies specifically in the implementation of National Hydrologic Data Collection Program and the National Water Information Network (NWIN) under the Water Resources Development Project funded by the World Bank. Also, I actively participated in the annual meeting of the Philippine Water Partnership which was attended by institutional foreign and local members and offi/cers.

I actively participated and provide technical advice to the on-going study on Nationwide Flood Risk Assessment and Flood Mitigation Plan and the Project for Enhancement of Capabilities in Flood Control and Sabo Engineering of DPWH. I was been the resource speaker in seminar/training conducted by JICA and DPWH relative to implementation of the above-mentioned studies.

At present, I was designated Project Manager of the JICA-Assisted Technical Cooperation Project (TCP) on the "Improvement of Quality Management Systems for Highway and Bridge Construction and Maintenance."

(2) Contact Address:

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1. Integrated Water Resource Management Adapting to the Global Climate Change

(1) Current Situation and Problems

1.1 The Philippine IWRM Plan Formulation Process

In January 2006, the United Nation Environmental Program-assisted IWRM 2005 South East Asia Project commenced implementation in the Philippines. The project intended to accelerate IWRM implementation in the country through the development of a National IWRM and Water Efficiency Improvement Plan.

A series of key activities were conducted relative to the preparation of the IWRM Plan Framework. These included the following:

a. Multi-Sectoral Task Force (MSTF) workshops and conferences. The MSTF conducted a series of activities for the formulation of the plan including an organizational meeting, a leveling workshop, an IWRM Orientation, IWRM Strategic Framework meeting, institutional mapping workshops and thematic group consultative meetings among the MSTF.

b. Consultation-Workshop with Non-Government Organizations and Civil Society Organizations. The workshop, entitled "Building Partnerships and Enhancing Synergies for IWRM", oriented the representatives from various NGOs and CSOs on the commitment and initiatives of the Philippine government on IWRM. It also generated feedback on the IWRM Plan Framework. Key water-related issues of the NGO/CSO sector were articulated and suggestions and recommendations on the process and content (both form and substance) were discussed.

c. Multi-sectoral Consultation-Workshops on the proposed National IWRM and Water Efficiency Improvement Plans in Visayas and Mindanao. With the theme "Working Together to Secure Sustainable Water for All," the consultations generated feedback on the IWRM plan framework from a wider stakeholder base. The scope covers both sectoral and regional concerns since the participants were from different sectors and based in different regions in Visayas and Mindanao.

d. IWRM-SEA Project Meeting (Rayong, Thailand). The meeting brought together different Southeast asian countries to assess the status of IWRM implementation. The draft Philippine Plan framework was presented and generated positive feedback in terms of its scope, planning process and its multi-stakeholding approach.

e. IWRM Plan Framework Launching and Partners' Forum. The IWRM Plan Framework was presented to key stakeholders and said stakeholders adopted a platform for action to implement IWRM.

1.2 Purpose of Philippine IWRM Plan Framework

The IWRM Plan Framework is a directional plan. It is intended to guide the different stakeholders involved in water resources management, at different levels, to either prepare their respective IWRM plans, update/enhance their existing IWRM related plans or make IWRM an integral part of their development plans/programs.

It provides a clear roadmap and a collaborative platform for all stakeholders and water-related agencies to effectively work together to achieve water for all in a sustainable, equitable and ecologically balanced manner.

1.3 Philippine Water Resources Situation

(a). Land and Water Systems

The Philippines is an archipelago consisting of 7,100 islands and islets with a land area of about 300,000 km^2. The country is rich in water resources. It has 421 principal river basins with drainage area varying from 41 to 27,280 km^2. Out of these 421 principal river basins, 20 are considered as major river basins, with each one having at least 990 km^2 basin area. These major river basins cover a total area of 111,269 km^2 equivalent to 37.1% of the total land area of the Philippines.

In addition, the Philippines has 15 major lakes, covering 400 hectares and above. Its coastal bays and coastal waters covers an area of 266,000 sq. km.; while its oceanic waters cover 1,934,000 sq. km. It is considered the center of marine biodiversity in the world, characterized by extensive coral reefs, sea grass beds, dense mangrove forests, and pristine and beautiful beaches. The country's total coastline is one of the longest in the world and stretches over 36,289 kilometers. Average annual rainfall is about 2,400 mm of which 1,000 mm to 2,000 mm are collected as run-off by a natural topography of river basins, natural lakes and numerous small streams.

(b). Availability of Water Resources - Increasing Water Stress and Potential Water Scarcity

The country is now facing the prospects of an emerging water crisis. Rapid population growth, indiscriminate urban sprawl, industrialization and economic growth are creating serious problems for water resources management, water security and sustainability.

Over the years, per capita water availability has been declining. The Philippines has reported 1,907 cubic meters availability per capita as the second

lowest among the South east Asian Countries. The increasing demand for water has resulted in a number of regions and at least 9 key urban centers experiencing water stress. Some areas are subject to devastating floods during the wet season while many areas experience water shortages during the dry season.

Total area provided by DPWH with river control and drainage facilities reached about 305,725 hectares, representing only 15.69 percent of the total potential coverage of 1,947,950 hectares.

(c.) Water Production and Use

As of December 2006, there are 19,247 water rights grantees for domestic (municipal), agriculture, power, and commercial users of water. These represent only the legal water users and do not include unregistered and illegal water appropriators.

Agriculture water use covers irrigation, livestock and fisheries. More than half of the water rights grants are for irrigation purposes, followed by domestic use. Currently, the total area with irrigation facilities is 1,515,347, representing only 48.47% of the total irrigable area. Considering that over the next 25 years, food will be required for another 25-26 million Filipinos, this is cause by concern.

The country's total water resources production is 5,792,857 liters per second (lps). Surface water contributes 98.4 percent of production and the remaining 1.6 percent is produced from groundwater.

The increasing demand for potable water especially in urbanized areas has resulted in over-extraction and the unabated exploration of groundwater resources. These in turn have resulted to saline water intrusion in some coastal areas and ground subsidence. Groundwater pollution is yet another growing problem.

(d.) Deteriorating Water Quality

Water quality standards for environmental water bodies are regulated by the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR) while standards for drinking water are set by the Department of Health (DOH).

Ideally, the bulk of our potable water should be sourced from surface water, as it is much more abundant than groundwater. However, the results of the Water Quality Scorecard (as reported in the 2003 Philippines Environmental Monitor) indicate that only a little over one third (36%) of our river systems/surface water areas are potential sources for drinking water. Of this, only one percent falls under Class AA, or those that require only disinfection to meet the Philippine National Standards for drinking Water. The rest of the sampling points (35%) fall

under Class A which require complete treatment to pass drinking water standards. The remaining 2/3 (64%) are not fit for drinking.

Likewise, preliminary data from the National Water Resources Board (NWRB) - NWIN project and Local Water Utilities Administration (LWUA) indicate that up to 58 percent of groundwater intended for drinking water supplies are contaminated with total coliform and would need treatment.

The poor quality of water affects the health status of the population. Data from the National Epidemiology Center of DOH indicates that almost 1/3 (31%) of the reported illnesses from 1996 to 2000 are water-related diseases. Contaminated drinking water is one of the most prevalent causes of health decline among the population. On the average, DOH estimates a total of P 3.3 billion direct income losses and medical hospitalization costs, annually.

Aquatic ecosystems depend on water flows, seasonality and water-table fluctuations and are similarly threatened by poor water quality.

(e.) Water Supply - Equity and Sustainability Issues

Domestic water systems delivery is classified into three main types of facilities:
Level I or point source system without distribution facilities,
Level II or communal faucet system,
Level III or individual household connection system.

Individual piped supplies (Level III) are provided by water districts, private operators, LGUs and Community-Based Organizations (CBOs). Shared water supplies are provided by LGUs and CBOs through Barangay Waterworks and Sanitation Associations (BWSAs) for point sources (Level I), and Rural Waterworks and Sanitation Associations (RWSAs) for communal faucet systems (Level II).

The Annual Poverty Indicators Survey (APIS) shows that access of the population to safe drinking water deteriorated from 81.4 percent in 1999 to 80 percent in 2002. This decline in coverage is largely due to the increasing demand of potable water brought about by a growing population.

(f.) Inadequate Sanitation and Sewerage Services

The proportion of the population with access to adequate sanitation in 2000 was estimated to be at 74.2 percent. This is a slight decrease from the 1991 coverage rate of 74.9 percent. The quality of sanitation services leaves much to be desired. Non-poor urban households rely mostly on septic tanks, which have been found to be poorly constructed and maintained, without provisions for desludging; thus, affecting their efficacy for primary treatment of wastewater.

Sewerage coverage is very low. Less than 8% of households in Metro Manila have access to sewerage, while the over-all urban sewerage coverage is a measly 4 percent (six cities.) The few sewerage systems that exist at present cater mostly to commercial establishments and affluent residential communities. In other parts of the country, coverage is much lower (estimated to be 1 percent).In the last 30 years, investment in urban sanitation totaled only 15% of amount spent on urban water supply.

(g.) Degradation of Major Ecosystems

The present status of coastal ecosystems in the country is a cause for alarm. Almost all Philippine coral reefs are at risk due to the impact of human activities; only 4 to 5 percent remain in excellent condition. More than 70 percent of the nation's mangrove forests have been covered to aquaculture, logged, or reclaimed for other uses. Half of the seagrass beds have either been lost or severely degraded, and the rate of degradation is increasing.

Beaches and foreshore areas are under increasing pressures from rapid population growth and uncontrolled development, which in turn leads to erosion, sedimentation and water quality problems.

Watersheds supply water according to the requirements of various domestic and industrial water and irrigation systems, as well as hydroelectric dams. About 140 priority watersheds with a total area of 4.5 million hectares nationwide need to be protected and/or rehabilitated.

One of the most formidable environmental challenges the Philippines faces today is diminishing forest cover. Of the country's total forestland areas of 15.88M hectares, only 5.4M hectares re covered with forests and fewer than a million hectares of these are left with old growth forests. Over exploitation of the forest resources and inappropriate land use practices have disrupted the hydrological condition of watersheds, resulting in accelerated soil erosion, siltation rivers and valuable reservoirs, increased incidence and severity of flooding and decreasing supply of water.

(h.) Increasing Frequency and Intensity of Extreme Climate Events and Variability

The Third Assessment Report of Intergovernmental Panel on Climate Change (as cited by Greenpeace, 2005) indicated that extreme climate events/availability, such as, floods, droughts, forest fires, and tropical cyclones have increased in temperate and tropical Asia. The warm episodes of the El Niño-Southern Oscillation (ENSO) phenomena have been more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years. This IPCC finding has manifested itself in the Philippines through the more frequent occurrence of

severe El Niño and La Niña events, as well as, deadly and damaging typhoons and other severe storms; floods, landslides, drought, forest fires, etc.

There were 5 La Niña episodes and 7 El Niño episodes from 1970 to 2000 compared to only 3 La Niña episodes and 2 El Niño episodes from 1950 to 1970, The strong warm (El Niño) events were in 1972-73, 1982-83, 1997-98, while the strong cold (El Niña) events were in 1974-74, 1988-89 and 1998-99. The most common extreme climate events with significant economic and social impacts in the Philippines are tropical cyclone occurrences of which typhoons are the strongest and most destructive. Several typhoon extremes were observed from 1990 to 2004. The highest and lowest frequency of tropical cyclone occurrence, the strongest typhoon, the 2 most destructive typhoons, deadliest storm and the typhoon that registered the highest 24-hour record rainfall occurred during this period. There were seven (&) extreme tropical cyclone/southwest monsoon induced extreme events from 1991 to late 2004, namely, the Ormoc Catastrophe, 1991; Cherry Hill Tragedy, 1999; Payatas Garbage-slide, 2000; Baguio-La Trinidad landslides, 2001; Camiguin flashfloods, 2001; Southern Leyte-Surigao disaster, 2003; and the Aurora floods, 2004.

The sector most affected by climate change, so far, is agriculture and food security. The sharpest fall in agricultural productions are experienced during strong El Niño events and after the occurrence of severe tropical cyclones. However, increases in rice and corn productions are attributed to favorable rainfall conditions during La Niña years. The highest typhoon damage was 1.17% of GDP and and 4.21% of agriculture. In the health sector, many of the biological organisms linked to the spread of infectious diseases are especially influenced by the fluctuations in climate variables. Among other factors, dengue fever and malaria are sensitive to such climate parameters as temperature, relative humidity and rainfall. Other-related diseases like cholera have been associated with extremes of precipitation, droughts and floods.

The climate change impacts on coastal zones and marine ecosystems observed in 1998 were massive coral bleaching in various reefs throughout the Philippines caused by the elevated sea temperature during the severe 1997-98 ENSO episode. Fish kills and high mortality of cultured after the strong El Niñ0 periods. The worst incidence of red tide in Manila Bay occurred in 1992, another El Niño period.

(i.) Water Governance and Regulation: Sectoral Approach

Water resource governance is the responsibility of multiple national agencies in varying capacities. LGUs and local water districts also exercise certain powers but subject to national government decisions. NGO intervention has also been emerging. The current institutional and regulatory framework in the water resources sector is the product of incremental developments over many years, each in response to particular challenges of the time. This has led to the absence

of an integrated water resources management system that adopts a holistic approach to sector demands.

There are some 30 government agencies and offices concerned with water resources development and management responsible with their own sectoral concerns. These agencies deal with water supply, irrigation, hydropower, flood control, water management, and other water-related concerns. For administrative supervision, these agencies are distributed among executive departments of the national government.

The DOH is responsible for overseeing the implementation and enforcement Sanitation Code of the Philippines. As part of its mandate to protect public health, DOH monitors the quality of drinking water and regulates premises with sanitation installation.

Based on the Local Government Code (LGC), the LGUs can also perform watershed management functions but are subject to DENR supervision and control. Provinces and municipalities implement community base forest management, social forestry, and watershed projects, but the barangay's role depends on the discretion of LGU executives. LGUs are likewise empowered to implement Level I to Level III water supply subsystems, communal irrigation systems and local flood control projects.

Unfortunately, there are no cross-sectional water resources plans and policies that will enable and ensure integration of various water and land use activities, water quantity and quality management, conjunctive use of surface and groundwater, upstream and downstream uses, with due consideration for the full hydrologic cycle.

(2.) Current Researches and Studies of the DPWH

(a.) The Study on The Nationwide Flood Risk Assessment and Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines

In response to the request, GOJ dispatched the preparatory study team, headed by Mr. Hiroyasu Tonokawa (herein after referred to as "the Team") to the Republic of the Philippines from 26 February to 17 March 2006, through the Japan International Cooperation Agency (hereinafter refer to as "JICA") to discuss the Implementing Arrangement (I/A) on the Study. I/A was finally agreed upon between the GOP and the Team, as spelled out in the Minutes of Meeting prepared as attached in Annex-1.

The objectives of the study are to select prioritized areas based on the flood risk assessment and to prepare flood mitigation plans for these selected

areas, and to conduct technical transfer to DPWH counterpart personnel during the course of the study.

The study area shall cover the 954 flood-prone cities/municipalities identified by the National Disaster Coordinating Council (NDCC). **The study schedule** was started in the beginning of September 2006 in a manner of Home Work. In the middle of September, the Field Survey Work will start and continue until the middle of March 2008.

(b). The Project for Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH

Enhancing the capability of the DPWH in the planning and design of flood control and sabo structure properly addressed to the water induced disaster in the country is the main focus of the Project ENCA. However, lower priority is given to flood control, hence, most of engineers had been shifted to road engineering. Consequently, the engineers don't have enough occasions to plan and design flood control structures, and it makes the vicious circle of few flood control projects. The Implementation of the Project-Type Technical Cooperation of Japan International Cooperation Agency (JICA) for the Project for the Enhancement of Capabilities in Flood Control and Sabo Engineering of the DPWH Stage I (Project ENCA) started on January 2000. The DPWH established the PMO-FCSEC (Flood Control and Sabo Engineering Center) as the implementing body of Project JICA.

As the implementing body of Project ENCA, the Flood Control and Sabo Engineering Center (FCSEC) undertook a number of activities in order to achieve the project goal. These include the following:

1. Investigate damaged structures/insufficiently functioning structures and/or flood prone/bank erosion areas, and undertake problem analysis for each structures.
2. Formulate Damaged Structure Information System
3. Analyze the problem of planning and design of flood control projects.
4. Identify solutions of the problem and conducts training.
5. Formulate/Update the DPWH Technical Standards and Guidelines
6. Establish the Research System of FCSEC

(3.) Policy and Practices

a. Integrated Water Resources Management Plan Framework

The National IWRM Plan Framework is not just another water plan. There are key differences between the IWRM Plan Framework and a traditional water plan. The IWRM Plan Framework has the following distinctive features.

A Broader focus: It looks at water in relation to other dimensions needed to achieve larger development goals and meet strategic water related challenges

Dynamic and adaptive: It provides framework for a continuing and adaptive process of strategic, integrated and coordinated action in all levels.

Integrated and holistic: All the different uses of water are considered together. Water allocation and management decisions consider the interrelationships and effects of these various uses. They are not viewed purely from a sectoral or project focus.

Multi stakeholder engagement and environment in all stages and key processes: Includes government agencies, non government organizations, private/business sector, academe and civil society organizations working in the areas of health, environment, energy, finance, agriculture, education, tourism and disaster management.

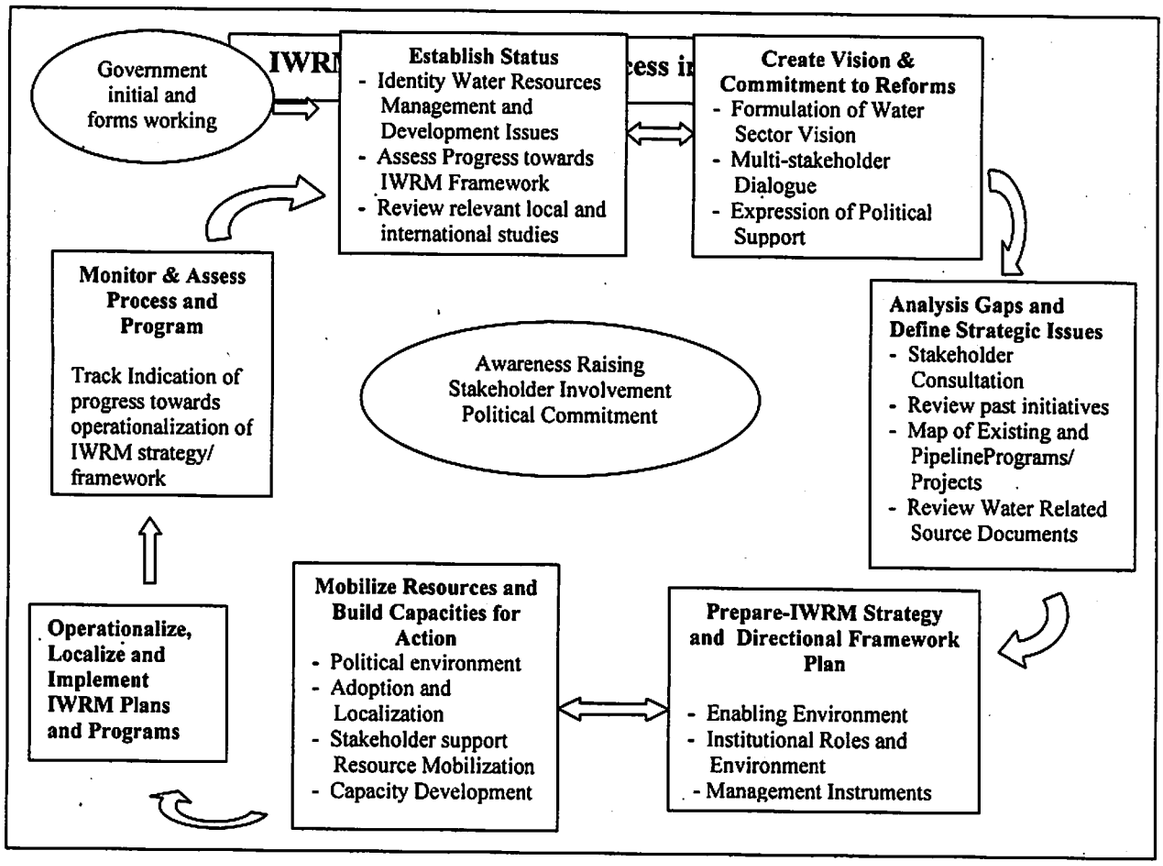


Figure 3 : The Structure of the Integrated Water Resources Management Plan Framework

The plan framework was developed based on the hierarchy of initiatives consistent with the challenges and issues confronting water resources management in the Philippines.

SUSTAINABLE OUTCOMES

Four (4) Sustainable Outcomes were identified. These are the medium to long-term goals that we aspire for our resources management system. These outcomes reflect our development aspirations for IWRM, and would ensure sustainability for our water resources. These include the following:

1. Effective Protection and regulation for Water Security and Ecosystem Health
2. Sustainable Water Resources and Responsive Services for Present and Future Needs
3. Improved Effectiveness, Accountability, and Synergy among Water Related Institutions and Stakeholders
4. Adaptive and Proactive Response to Emerging/Future Challenges

STRATEGIC THEMES

Each of these sustainable outcomes is supported by Strategic Themes. A strategic theme is either a sectoral or cross cutting imperative that are necessary to achieve the desired outcomes. The strategic themes under a particular outcome are mutually reinforcing and are inter-dependent. Nine (9) strategic themes were identified to support the four (4) sustainable outcomes. These are:

a. *For Effective Protection and Regulation for Water Security and Ecosystem Health*
   1. Ensuring Rational, Efficient and Ecologically Sustainable Allocation of Water
   2. Enhancing Effectiveness in Groundwater Management and Aquifer Protection
   3. Achieving Clean and Healthy Water
   4. Managing and Mitigating Risks from Climate Change Events and Water Related Disasters

b. *For Sustainable Water Resources and Responsive Services for Present and Future Needs*
   1. Promoting Water Conservation/Stewardship and Improving Water Use Efficiency
   2. Expanding Access and Ensuring Availability of Affordable and Responsive Water Supply and Sanitation Services

c. *For Improved Effectiveness, Accountability, and Synergy among Water Related Institutions and Stakeholders*
   1. Promoting Participatory Water Governance and Supportive Enabling Environment
   2. Strengthening Knowledge Management and Building Capacity for IWRM

d. *For Adaptive and Proactive Response to future Challenges*
   1. Exploring New Pathways to Water Resources Management: Water Sensitive Design and Water Rights Trading

Each strategic theme is supported by several Strategic Objectives and each strategic objective is supported by several Key Actions. These key actions are major steps or initiatives required to accomplish the said strategic objectives. Note that the specific activities and their respective timeframes are not indicated. This will be defined through the different operational plans to be prepared by different government agencies and stakeholder groups, at different levels.

1. Integrated Water Quality Management Framework

A. Requirements of the Clean Water Act

Republic Act 9275, otherwise known as the Philippine Clean Water Act of 2004 (CWA), declares that the State shall pursue a policy of economic growth in a manner consistent with the protection, preservation, and revival of the quality of our fresh, brackish, and marine waters. As such and following the principle of sustainable development, the State shall "formulate an integrated water quality management framework through proper delegation and effective coordination of functions and activities."

Article 2, Section 4 of RA 9275 defines Integrated Water Quality Management Framework (IWQMF) as "the policy guideline integrating all the existing frameworks prepared by all government agencies on water quality involving pollution from all sources". Specifically, the framework shall contain the following:

1. Water quality goals and targets
2. Period of compliance
3. Water pollution control strategies and techniques
4. Water quality information and education program
5. Human resources development program

Furthermore, Chapter 3, Section 19 of RA 9275 and Rule 19 of its Implementing Rules and regulations (IRR), states that it is the responsibility of the Department of Environment and Natural Resources (DENR) as the lead agency to prepare an integrated water quality management framework, and to evaluate the same at the end of every five (5) years or as the need arises. The framework may contain, but not limited to: (a) assessment of policies and institutional arrangements and capacities relevant to water quality management including strategy for devolution to local government units (LGUs); (b) management strategies; (c) sustainable financing strategies; and (d) performance monitoring.

B. Coverage of the Framework

This Framework applies to all natural and man-made bodies of fresh, brackish, and saline waters, and includes, but is not limited to, aquifers, groundwater, springs,

creeks, streams, rivers, ponds, lagoons, water reservoirs, lakes, bays, estuarine, coastal, and marine waters.

It supports the Integrated Water Resources Management Framework (IWRMF) which calls for a systematic, adaptive process conducted in collaboration with stakeholders for the sustainable development and management of water and related resources in the context of equity, social, economic and environmental objectives.

IWQMF integrates all existing frameworks in so far as these frameworks cover water quality involving pollution from various sources. Major frameworks that were integrated or referred to in this document are:

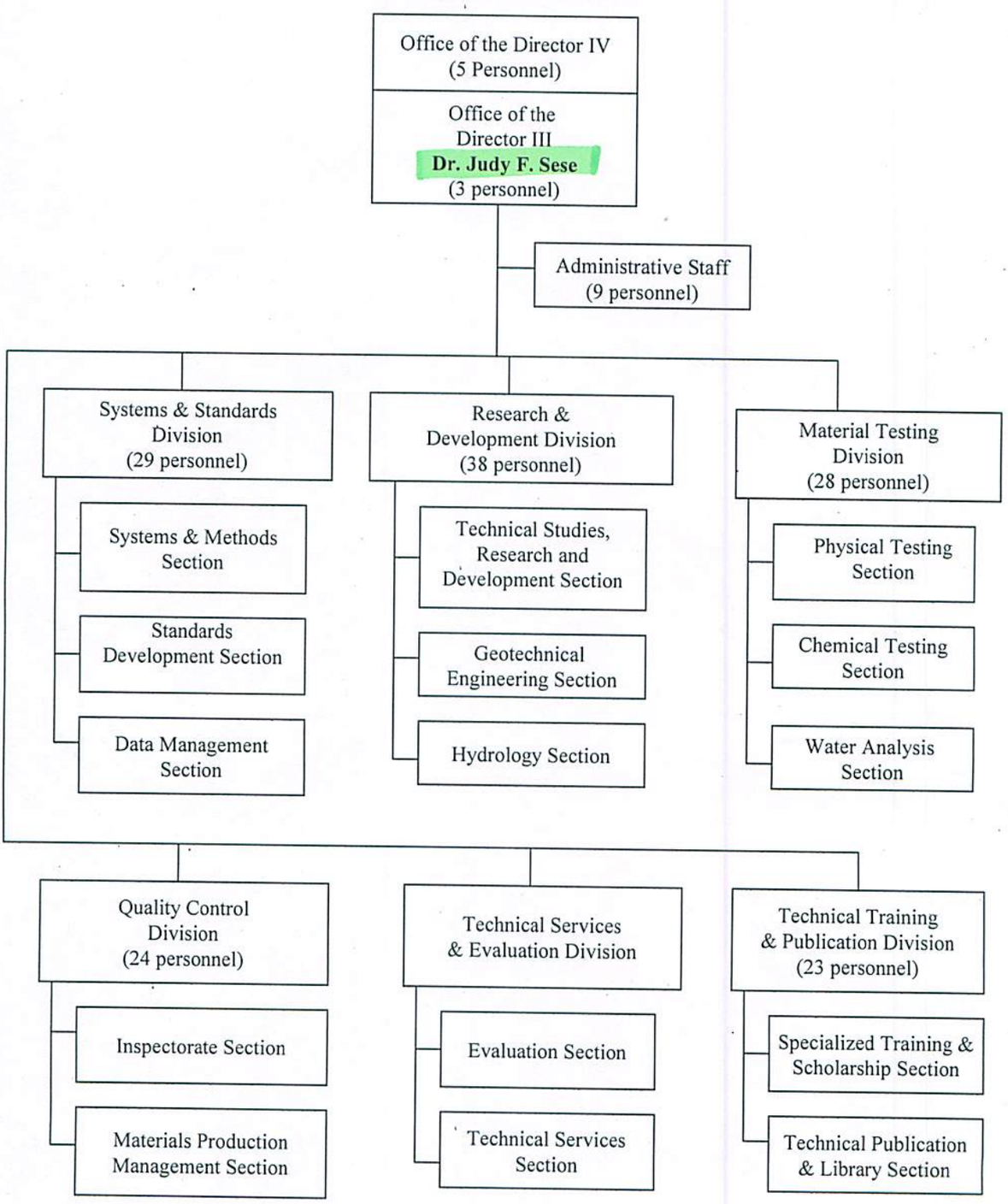
1. Philippine Strategy for Sustainable Development (PSSD) – which aims to achieve economic growth with adequate protection of the country's biological resources and its diversity, vital ecosystem functions, and overall environmental quality.
2. Framework for Sustainable Philippine Archipelagic Development (ArcDev) – which (a) calls for functional cooperation between government and relevant stakeholders to strengthen the existing terrestrial focused, national planning and policy framework; (b) recognizes that the people's welfare relied on management bodies incorporating institutional mechanisms which account for both the vast potential and sustainable use of the country's predominant maritime resources, environment and heritage; and (c) promotes integrated archipelago that recognizes the interaction of land, sea, air and people within the archipelagic setting.
3. Integrated Coastal Management (ICM) – an Executive Order No. 533 which aims to ensure the sustainable development of the country's coastal and marine environment and resources.

The Medium-Term Philippine Development Plan (MTPDP) for 2004-2010 was likewise considered in this framework, and on an international scale, the United Nations Millennium Development Goals, which aims to ensure environmental sustainability, was also taken into account.

ANNEX A

FIGURE 1
Organizational Chart of the Bureau of Research and Standards (BRS)

Organizational Chart



Total Number of Personnel/Staff = 175

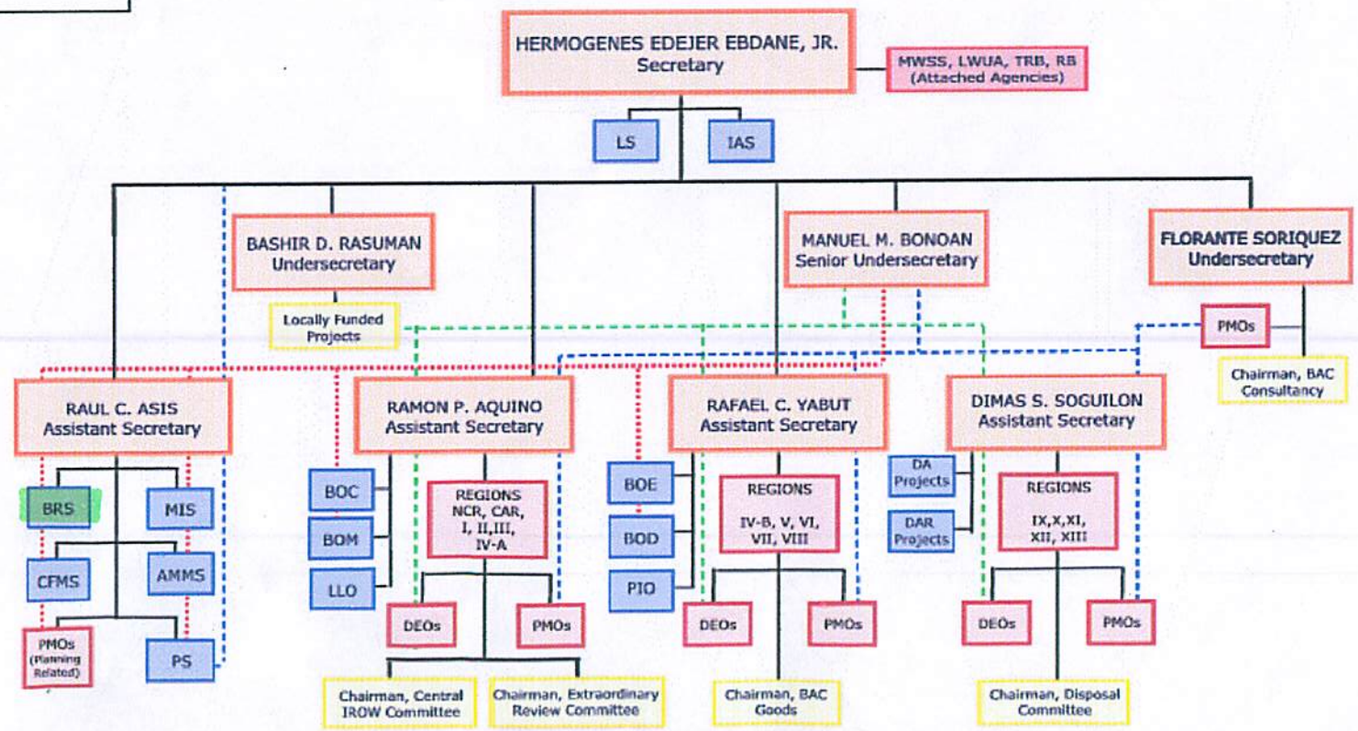
Department of Public Works and Highways

About Us

Organizational Chart

Figure 2

The Department of Public Works and Highways is pursuant to Executive Order No. 124 dated 30 January 1987.



AMMS - Administrative & Manpower Management Service
BAC - Bidding and Awards Committee
BOC - Bureau of Construction
BOD - Bureau of Design
BOE - Bureau of Equipment
BOM - Bureau of Maintenance
BRS - Bureau of Research and Standards
CFMS - Comptrollership & Financial Management Service
IAS - Internal Audit Service
LS - Legal Service
MIS - Monitoring and Information Service
PS - Planning Service

CAR - Cordillera Administrative Region
DEOs - District Engineering Office
IROW - Infrastructure Right-of-Way
LLO - Legislative Liaison Office
LWUA - Local Water Utility Administration
MWSS - Metropolitan Waterworks and Sewage System
NCR - National Capital Region
PIO - Public Information Office
PMO's - Project Management Office
PPP - Pump Priming Projects
RB - Road Board
TRB - Toll Regulatory Board

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COUNTRY REPORT OF SRI LANKA

Integrated Water Resource Management

Adapting to the Global Climate Change

JICA EXECUTIVES' SEMINAR ON PUBLIC WORKS AND MANAGEMENT

JFY 2007

Prepared by

ENG. (MRS.) P.N.S YAPA

DEPUTY GENERAL MANAGER, NATIONAL WATER SUPPLY & DRAINAGE BOARD

SRI LANKA

TABLE OF CONTENT

Summary

The world's climatologists agree that climate change is underway. The "Global Climate Change" has a strong probability of an increase in frequency and severity of rainfall extremes, which may cause unexpected floods and droughts and rise in sea level, which will affect the low-lying islands and deltas.
The change in climate, which is induced by the influence of the increasing atmospheric concentrations of greenhouse gases and aerosols and the projected human induced changes in climate, regionally or globally, has resulted in;

- The frequency and magnitude of climate fluctuations
- The duration, location, frequency and intensity of extreme events such as heat waves, droughts, floods, heavy precipitation, avalanches, storms, tornados, and tropical cyclones.
- The risk in abrupt or non-linear changes in ecological systems.

The projected changes during the 21st century in extreme climate phenomena, due to the above, and their likelihood are;

- Higher maximum temperatures, more hot days and heat waves over nearly all island areas
- Higher (increasing) minimum temperatures, fewer cold days, frost days and cold waves over nearly all land areas (*very likely*)
- More intense precipitation events (*very likely* over many areas)
- Increased summer drying over most mid latitude continental interiors and associated risk of droughts (*likely*)
- Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities
- Intensified droughts and floods
- Increased Asian summer monsoon precipitation variability
- Increased variability of mid-latitude storms

As such, the impact of this increasing variability will seriously affect livelihoods, societies, economies and ecosystems across the world. Especially the poor in the developing countries will be the mostly affected and will find it most difficult to recuperate.

Hence, in addition to the mitigation, it is important to adapt integrated water systems to the impacts of climate change, within their development agendas for water and other sectors. Adaptation has the potential to reduce adverse effects of climate change and can often produce immediate ancillary benefits, but will not prevent all damages.

Sri Lanka, being an island and a developing country, is most vulnerable to such impacts. Empirical evidence indicates that climate variability in the recent past had adversely affected environment, food, health, and all other dimensions of human security in Sri Lanka. The most vulnerable are the communities in coastal, drought-prone, flood-prone, and landslide high-risk areas, whose livelihoods depend directly on rainfall, bio-diversity

and other natural resources. Although Sri Lanka was able to achieve its Millennium Development Goals, anticipated changes in climate, such as the decline in rainfall in the dry zone, the increase in temperature and the intensity and frequency of extreme weather events like prolonged droughts, heavy rainfalls, floods and landslides and sea level rise, will undoubtedly undermine the efforts for poverty alleviation, reduction of food and health insecurities and inter and intra-regional inequities. There is a likelihood that conflicts among the farmers for the use of scarce irrigation water, between the villagers and State on the utilization of forests, river sand and other resources, and between the state-environmentalists and general public regarding the development projects that could impact adversely on the environment may occur more frequently.

This report focuses on the degree, to which natural and human systems in the country are sensitive and vulnerable to existing climate variability. Special emphasis is placed on its impact, need for mitigation and adaptation to cope with longer-term climate change and its associated insecurities.

1.0 ORGANIZATION DATA

1.1 Name and Summary of Organization

NATIONAL WATER SUPPLY & DRAINAGE BOARD

The National Water Supply & Drainage Board (NWSDB) presently functions under the Ministry of Water Supply and Drainage. It is the principal authority providing safe drinking water and facilitating the provision of sanitation in Sri Lanka. The NWSDB was established in 1975 by an act of parliament.

During the past 30 years, the organization has considerably expanded its scope of activities. The NWSDB is presently operating 291 Water Supply Schemes, which covers 30% of the total population with pipe borne water supply. In addition, Rural Water Supply and Sanitation Programmes, including deep well programmes, are also being implemented by the NWSDB. Further, 8 % of the population is served with hand pump tube well.

In its Corporate Plan for the period 2007-2011, NWSDB has planned to provide additional pipe borne drinking water coverage to facilitate achievement of government goals, set in accordance with the United Nations' Millennium Development Goals. With this view, NWSDB expects to implement many more capital projects, in addition to the capital projects that are being undertaken at present. It is expected to achieve 40% pipe borne coverage by the year 2011, if required level of capital investment is made available.

Meanwhile projects were implemented to reduce non-revenue water and to improve sewerage system. Several research and development activities relevant to the NWSDB activities were undertaken in the newly established Research & Development Unit. The staff per 1,000 water connection ratio improved steadily from 27.6 in 1995 to 8.7 in 2005. Emphasis on reducing wastage, cutting down inventory costs and controlling establishment expenses continued. Training programmes and institutional development efforts were undertaken to improve productivity.

As a commercially oriented organization, NWSDB commenced consumer metering and billing in 1982. However, the National Water Supply & Drainage has to operate as a service organization in certain respects. Water had to be supplied through public stand posts to tenement gardens, public toilets and public bathing areas. This activity, in most cases did not generate revenue. The NWSDB is also compelled to maintain hand pumps installed in dry zone areas. Rain water Harvesting is becoming popular and the NWSDB is actively pursing the construction of these tanks island-wide. The NWSDB is also in charge of the sewerage system in Colombo and suburbs.

Water supply facilities to people, affected by the Tsunami disaster, were another activity undertaken by the NWSDB with the assistance of several donors.

The water tariff levied at present is just sufficient to meet the operational cost and debt service. Ideally the traffic should generate revenue for the NWSDB to be able to meet all O&M expenditure, debt service and make available additional revenue to undertake the smaller scale development works.

In addition, the Regional Support Centers of the NWSDB provide technical assistant to rural communities to develop their water supply and sanitation needs, on a regular basis. To meet this requirement, a large number of non-governmental organization, both national and international, are working with the NWSDB to provide technical support and, when need arises, to support the construction of ground water wells.

NWSDB hopes to increase the pipe borne water coverage to 45% by the year 2015 to facilitate the achievement of the United Nations' Millennium Development Goal of 85% safe drinking water coverage by that year.

1.2 Budget of Organization

NATIONAL WATER SUPPLY & DRAINAGE BOARD

Project Balance Sheet

as at 31.12.2007

(Rs. 000's)

	2006	2007
ASSETS		
Non-Current Assets		
Property, Plant & Equipment, Net - At cost	36,766,248	35,712,400
Capital Work in Progress	40,449,015	69,402,915
Intangible Assets	83,098	83,098
Investments	143,718	143,718
	77,442,079	**105,342,131**
Current Assets		
Research & Development	-	71,000
Inventories	2,144,401	2,144,401
Trade & Other Receivables	4,993,595	4,919,178
Deposits & Advances	3,170,504	3,170,504
Investments	672,617	672,617
Cash & Cash Equivalents	693,564	704,992
	11,674,681	**11,682,692**
TOTAL ASSETS	**89,116,760**	**117,024,823**
EQUITY AND LIABILITIES		
Capital and Reserves		
Assets taken over from Government Dept.	185,480	185,480
Capital Grants	73,032,153	100,518,791
Capital Recovery Fund	1,059,641	1,059,641
Staff Welfare Fund	11,571	11,571
Revaluation Reserve	309,763	309,763
Accumulated Losses	(2,613,386)	(2,329,536)
	71,985,222	**99,755,710**
Non-Current Liabilities		
Interest bearing Loans	13,551,949	13,251,949
Other Deferred Liabilities	1,482,653	1,482,653
	15,034,602	**14,734,602**
Current Liabilities		
Creditors	1,202,787	1,640,362
Interest bearing Loans	486,077	486,077
Other Payables	408,072	408,072
	2,096,936	**2,534,511**
TOTAL EQUITY AND LIABILITIES	**89,116,760**	**117,024,823**

NATIONAL WATER SUPPLY & DRAINAGE BOARD
OPERATION AND MAINTENANCE BUDGET 2007
Project Income and Expenditure Statement for the Year ending 31st December 2007

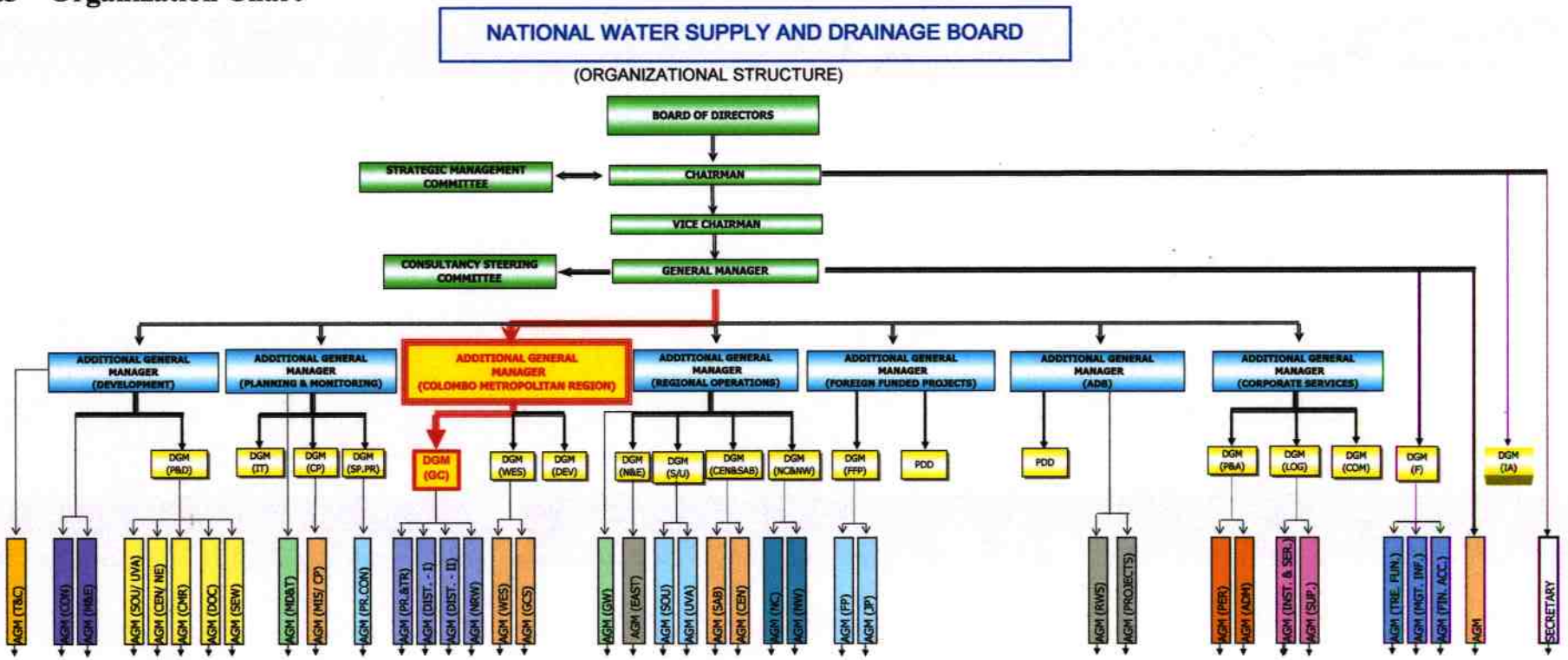
	Rs. "000"			
	2005 Actual	2006 1st six month Actual	2006 Budget	2007 Estimated
Income				
Sale of Water	5,446,264	2,811,160	6,544,232	7,441,768
Sewerage Income	-	-	-	288,000
Capital recovery	178,885	91,243	197,092	271,284
New connection Net	218,850	113,387	233,826	376,138
Other income	416,722	211,191	250,240	344,026
Income from Investments	32,634	31,099	100,000	120,000
Total Income	***6,293,355***	***3,258,080***	***7,325,390***	***8,841,216***
Less operating Expenses				
Personal Cost	2,291,198	1,185,310	2,769,834	3,159,077
Electricity	1,217,702	589,622	1,454,786	1,618,557
Chemicals	301,387	156,365	318,569	329,823
Repairs & Maintenance / Defective Meter Cost	285,379	157,166	449,186	627,434
Establishment Expenses	281,437	148,514	320,518	383,218
Rents Rates & Finance charges	226,195	119,913	297,053	348,510
Retiring Gratuity Provision	75,353	37,676	150,000	75,000
Bad Debts and Irrecoverable	102,058	72,573	66,108	148,835
Total Operating Expenses	***4,780,709***	***2,467,139***	***5,826,054***	***6,690,454***
Surplus before Depreciation and Interest	***1,512,646***	***790,941***	***1,499,336***	***2,150,762***
Less Depreciation	1,043,414	616,923	1,007,527	1,053,848
Interest in Loans	491,504	253,570	461,173	819,000
Net Profit/ Loss Before Tax	(22,272)	(79,552)	30,636	277,914
Less Tax to be Paid	69,629	12,500	9,000	78,263
Net Profit/ Loss After Tax	***(91,901)***	***(92,052)***	***21,636***	***199,651***

NATIONAL WATER SUPPLY & DRAINAGE BOARD
OPERATION AND MAINTENANCE & CAPITAL BUDGET 2007

Project Cash flow Statement for the Year ending 31st December 2007 Rs.'000

	2006 BUDGET	2007 ESTIMATED
Inflow of Funds		
Total Operation Inflow	**9,322,846**	**11,177,512**
Capital Budget Treasure Grant		27,580,000
Total Inflow		**38,757,512**
Less Outflow of Funds		
Total Personnel Emoluments	3,450,533	3,852,877
Total Power & Electricity	1,265,031	1,668,557
Total Chemicals	277,539	329,823
Total of New Connection Extension Expenditure	378,534	490,622
Total Materials	98,115	152,840
Total Repairs	351,071	499,594
Total Establishment	320,818	483,218
Total Rent, Security	277,075	342,565
Total Finance Charges	494,995	639,288
Total Expenditure Budget	**6,913,711**	**8,459,384**
Debt Service and Capital Expenses		
Capital Budget Construction Works		27,580,000
Board Fixed Assets and Rehabilitation Expenses	320,000	470,000
Debt Service to Treasury (Principal)	301,700	300,000
Debt Service to Treasury (Interest)	1,236,828	1,323,000
Rechargeable outflows	44,000	145,000
Research & Development Expenditure	63,527	71,000
Urgent Important Development fund	300,000	400,000
Total Debt Service and Capital Expenses	**2,266,055**	**2,709,000**
Total Outflow	**9,179,766**	**38,748,384**
Net Surplus	**143,080**	**9,128**

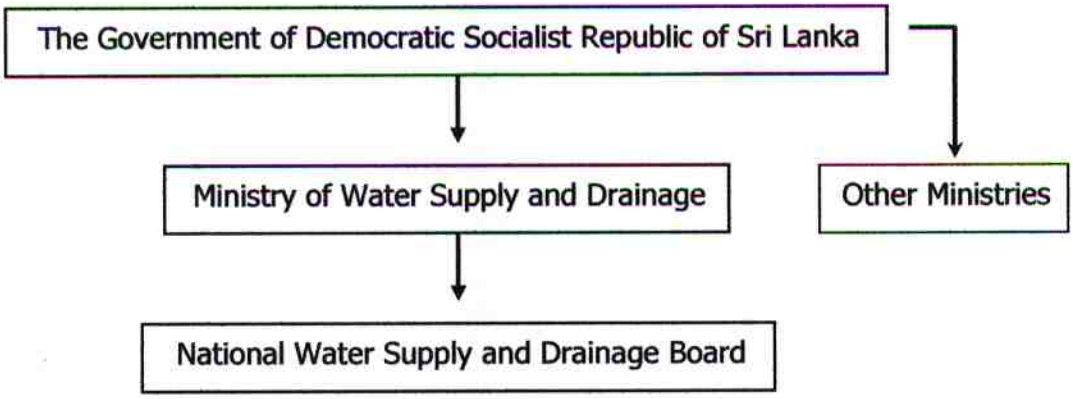
1.3 Organization Chart



Number of Employees as at August 2007:

Greater Colombo	:	2,100
Southern / Uwa	:	2,050
Central / Sabaragamuwa	:	1,200
North Central	:	710
Western	:	837
North / East	:	510
Head Office and Other	:	1,081
Total	:	**8,488**

1.4 Organization's Position in Government



The National Water Supply & Drainage Board (NWSDB) presently functions under the Ministry of Water Supply & Drainage. Being the principal and key authority of providing safe drinking water and facilitator for the provision of sanitation in Sri Lanka, National Water Supply & Drainage Board holds itself responsible for the research and development of drinking water resources and its timely management. A Research and Development Section has been set up, within the NWSDB's organization structure to the above effect. The Research and Development Section, which is under an Assistant General Manager, welcomes the ideas, researches and proposals by the Board's employees for its action plan, which in turn facilitate the implementation of them. This may be through its' own funds or donor agents' funds.

2.0 Personal Data

Work which I have done for the past three years

May 2005 Up-to-date

Deputy General Manager
Regional Support Centre – Greater Colombo

Since I assumed duties as the Deputy General Manager of the Greater Colombo Regional Support Centre in May 2005, my main function has been to monitor the Operation and Maintenance of the process to provide safe drinking water to about 460,000 consumers in the region. This monitoring covers the process of extracting water from the *Kelani* River, its purification and distribution, which caters about 140 million gallons per day to meet the water demand. Greater Colombo Regional Support Centre employs the service of 2100 personnel at different levels, which includes 06 Managers and 04 Assistant General Managers.
The regional revenue of the water sale accounts for 70% of the total revenue of the NWSDB, which requires high level of supervisory mechanism on commercial activities, such as meter reading, billing, revenue collection and control of expenses.
Region experience a major set back in its water distribution system as the Non-revenue water (NRW) percentage exceeds 53% in the Colombo city. I have been responsible for drafting and implementing a 05 year action plan to reduce the NRW from its 53% to 30% by the year 2012, which has paid special attention to reduce leakages, water theft, free water supply and administrative losses.
I was also involved in the development study of the transmission model for transmission mains in the region and in the proposed construction of the salinity barrier, across *Kelani* River to prevent the salinity intrusion, during drought season, to the main treatment plant at *Ambatale*.
Also the following projects are being implemented under my supervision and assistance;

- Towns North of Colombo (TNC) Water Supply Project
- *Kluganga* River Water Supply Project (Phase I of Stage I)
- Sri Lanka Tsunami Affected Areas Recovering and Take Off Project (STARRT)
- Enterprise Wide IT Solution Project
- *Labugama-Kalatuwawa* Rehabilitation Project
- *"Pavithra Ganga"* (Clean Rivers) Programme

July 2004 to May 2005

Deputy General Manager
Regional Support Centre – Southern/Uva

My responsibility as the Deputy General Manager (Southern/Uva Regions), from January 2002 to May 2005, involved the comprehensive supervision of water supply and sewerage in the regions, which included planning and monitoring of the operation and maintenance activities. There were about 1960 employees for the above work, which included different processes at intakes, treatment plants, transmission system, reservoirs and the distribution systems. I had the assistance from Two Assistant General Managers and 04 Managers in implementing the above duties and they helped me in planning and construction work of the following major projects to meet the forecasted future demands, and to deliver the results on time.

- Greater *Galle* Water Supply Project
- *Matara* Water Augmentation Project
- ADB 3RD Project
- ADB 4TH Project
- Salinity Barrier Studies for *Nilwala* River
- *Akmeemana* Rain Water Harvesting Project
- Tsunami Rehabilitation Project

During this period of my service, two major disasters hit the region. One was a severe flood due to a rainfall of 820 mm in Matara, in May 2003, which destroyed 9294 houses and partially destroyed another 30,360. Livelihoods of 138,973 were affected and caused death of 236 persons. Another was the Tsunami Disaster in December 2004, which killed about 60,000 in the country. On these two occasions, I was able to lead my staff to restore the water supply system within a very short period, which was a great achievement in my career.
Also, my personal intervention into the conflict among the farming community, NWSDB, Irrigation Department and Electricity Board, over the water sharing pattern, led to an amicable end.

Eng. (Mrs.) P.N.S. Yapa
Deputy General Manager,
Regional Support Centre (Greater Colombo),
National Water Supply & Drainage Board,
3rd Floor, Welikada Plaza,
Rajagiriya,
Sri Lanka.

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3.0 Introduction

3.1 Geographic Introduction

Sri Lanka is an island with a central hill country, surrounded by coastal lowlands and is located in the Indian Ocean within the latitudes of 5 55' – 9 51' N and longitudes of 79 41' – 81 53' E, with a land extent of 69,450 sq.km, which includes 1,570 sq.km of internal water surface (*see figure 01*). The island is 435 km long in the North-South direction and is 240 km wide in the East-West direction. The population is about 20 million, of which 30% is urban and 70 % is rural.

Figure 01

3.2 History of Integrated Water Management

Sri Lanka heritages a history of a culture of hydraulic civilization, which dates back to 05 th Century B.C. Much of this hydraulic civilization evolved around the Lanka's famous and major river basins named; *Mahaweli, Malwattu, Kelani, Kalu, Walawe, Menik , Deduru Oya, Kirindi Oya and Kumbukkan Oya.* Many of these rivers originate in the wet zone of the central highlands and flows down to all corners of the country, facilitating

mass-scale culture of irrigated agriculture. This geographical pattern urged the ancestors to conserve the watersheds in the highlands and to store water in a network of man-made reservoirs, along the water streams, to develop lowlands in agriculture.
This system of water management is well expressed in the popular 'Dictum' by the King Parakramabahu (1153 AD), which stated as;
"Not a single drop of water shall be allowed to flow into the sea, without being utilized for human benefit"

3.3 Introduction to Climate

Being close to the equator, the climate is "Tropical-Monsoonal", governed by two main seasonal rhythms of rainfall. Thus the climate is mainly determined by the rainfall and temperature, which is a high variable to the seasonal wind pattern and pressure developments in the sub-continent.

3.3.1 Rainfall

The rainfall has a considerable spatial variation (*See figure No 02*) and its' distribution pattern is influenced by the following factors.

- The two monsoon wind regimes
- Equatorial trough of low-pressure or Inter-Tropical Convergence Zone (ITCZ)
- Convection
- Orographic characters
- Cyclonic wind circulation

Annual rainfall spreads over four distinctive periods with wet zones receiving an annual average rainfall of 2400 mm while it is 1400mm for the dry zone.

First Inter-Monsoon period;
(March-April) Convection over the land area in the afternoon affected by convergence in ITCZ

Southwest Monsoon period;
(May-Sep.) Depressions and cyclonic wind circulations in low and mid troposphere controlled by orography. Convectional rain in Northern-Eastern part.

Second Inter-Monsoon period;
(Oct.-Nov.) Widespread convection with cyclonic wind circulation and convergence.

Northeast Monsoon period;
(Dec.-Feb.) Wind waves in the Easterly air stream, cyclonic wind circulation and convection influence the rainfall

3.3.2 Temperature

The mean temperature ranges from a low figure of 15.8 ° C in the Central highlands to a high of 29 ° C in Northeast coast where temperature may reach the highest of 37 ° C. The average yearly temperature for the country as a whole ranges from 26 ° C to 28 ° C. Day and night temperatures may vary by 4 ° C to 7 ° C. (*see figure 02*)

3.3.3 Wind:

The summer monsoon or Southwest monsoon is reckoned from May to September. The onset of the monsoon is associated with a cyclonic wind circulation in the low troposphere (1500m) or with a depression. Occasionally strong westerly winds occur, just prior to the onset of persistent rain. When the monsoon is fully established, the westerly winds extend up to the mid troposphere (6000m) and is overlain by easterly winds in the upper troposphere (9000-12000m)
In winter monsoon or Northeast monsoon, the winds up to the mid troposphere (3000-6000m) are formed in Easterly direction. The winds in upper troposphere are lighter and in southeasterly direction.

3.3.4 Pressure

The pressure distribution is fairly uniform during the months of March-April and October-November. The pressure gradient, across the country during May-September, increases Southwesterly from Northeast to Southwest. During December-February the same is in the reverse direction.
The seasonal movement of the Equator Trough of Low Pressure determines the changes in the gradient of pressure. Air from two subtropical high-pressure systems converges into this trough of low pressure. Thus the Equatorial Trough of Low Pressure is also called the Inter Tropical Convergence Zone (ITCZ). During the Northern winter (January), it is located at 10° C South and in the Northern summer (July) it is at 25 ° C North. The ITCZ moves across the country in May, in its northwards migration, which ushers in the Southwest monsoon winds.

3.3.5 Humidity

The relative humidity varies generally from 70 % during daytime to 90% at night.

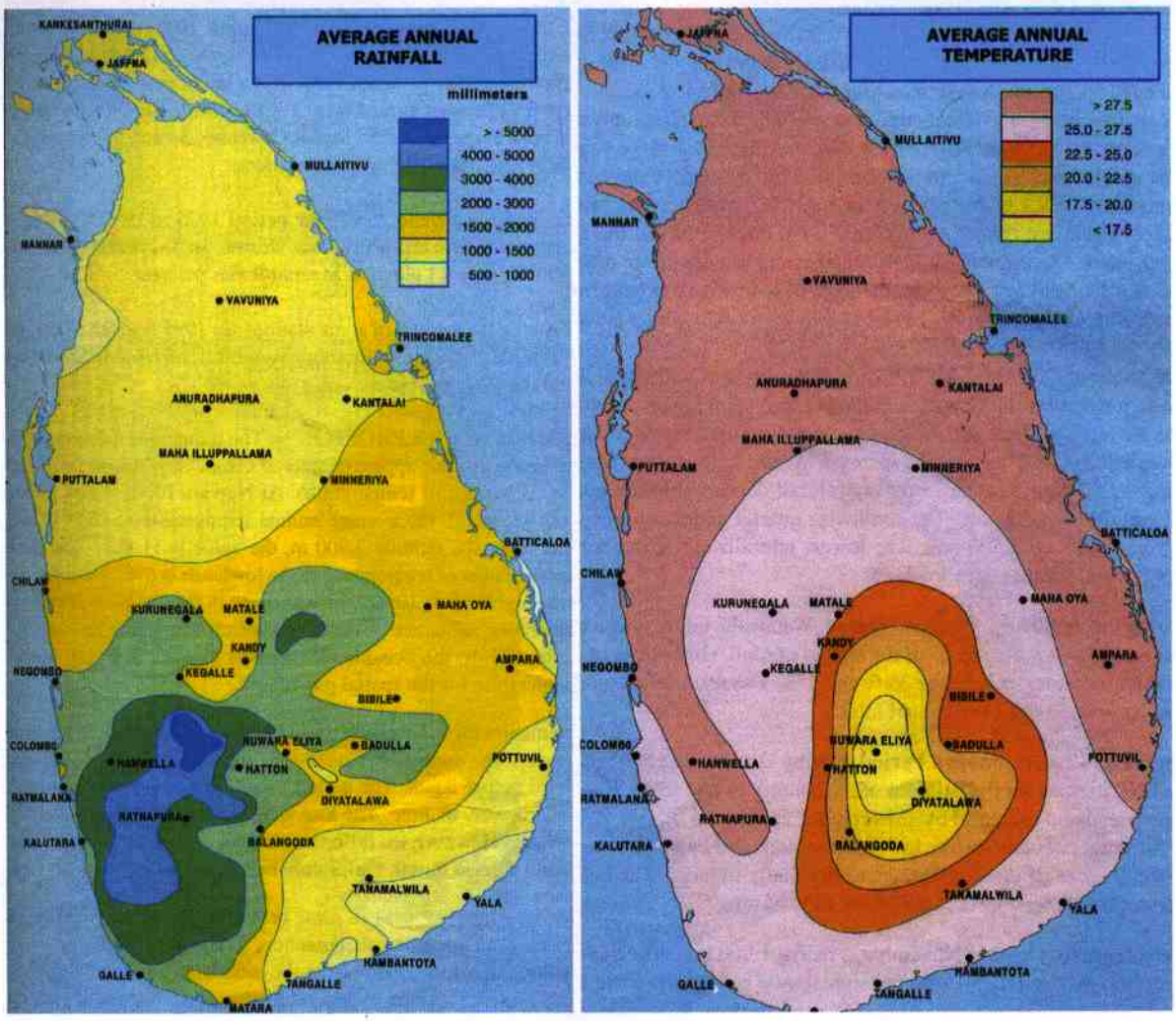


Figure 02

4.0 National Water Balance, Seepage Characteristics and Main Usage Pattern

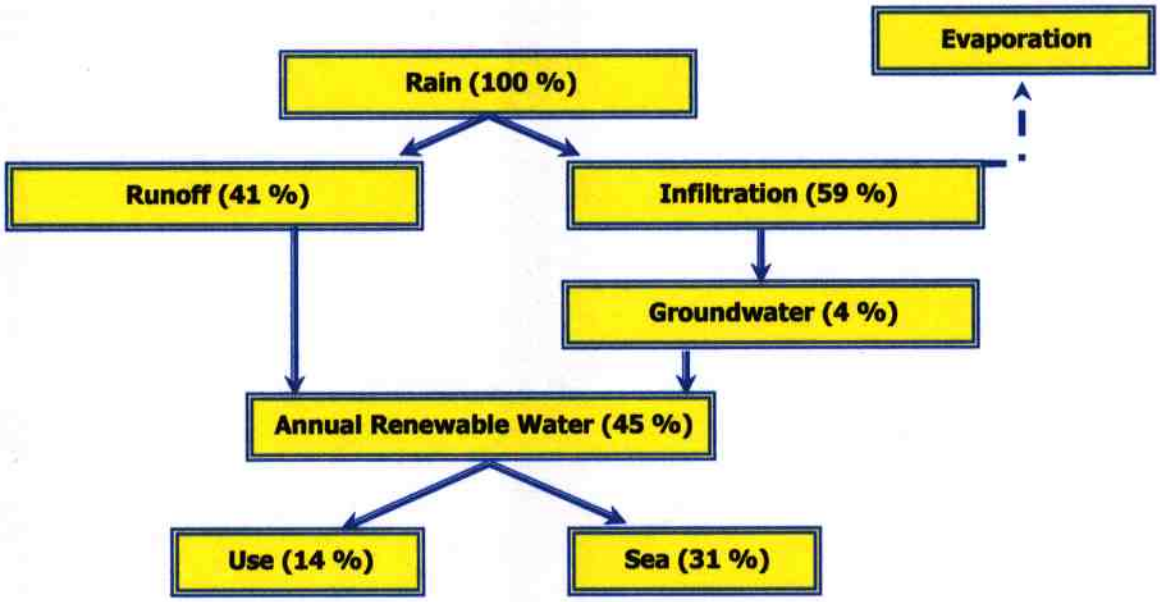
The country is endowed with about 7000 km of rivers and irrigation canals and 3500 deep tanks and reservoirs. With around 127-130 billion Cu.m of water from rainfall, Sri Lanka potentially has adequate water for all, so long as it can be properly managed.

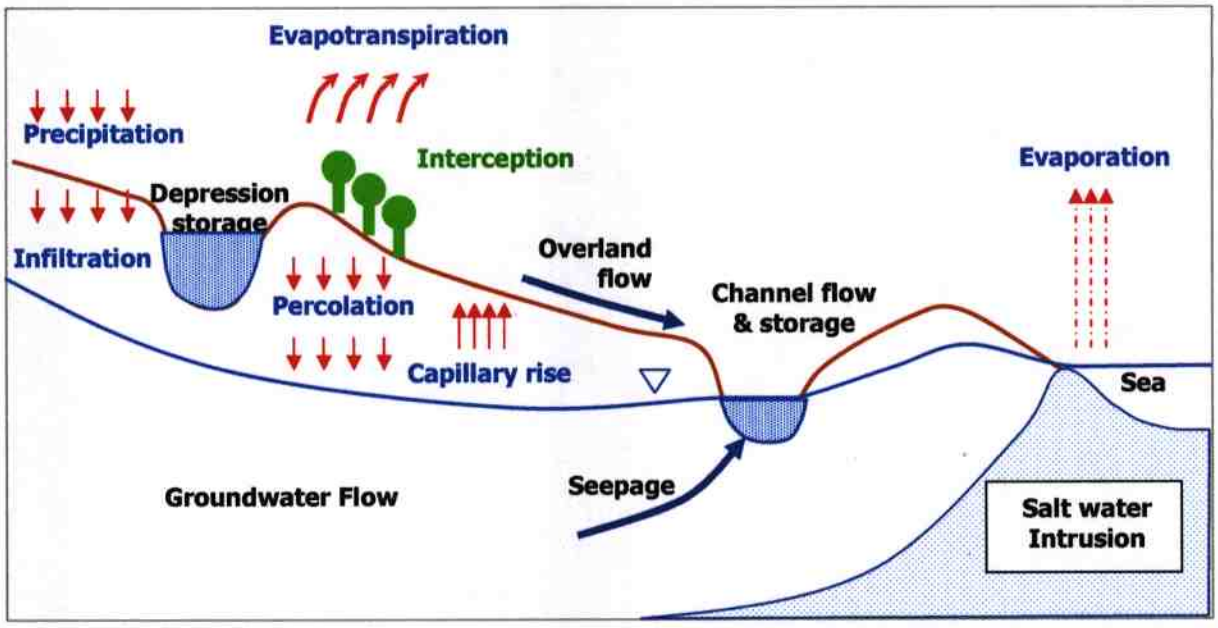
Degradation of water catchments, however, and siltation of major water bodies have been two of the main factors, threatening adequate and timely supply of water. Annual renewable freshwater resources of Sri Lanka amounted to 2134 Cu.m per capita in 2000. But with an annual population growth of 1.2-1.3 %, by 2025 it is expected that this will decline to about 1800 Cu.m per capita, only just exceeding the water scarcity threshold of 1700 Cu.m per capita.

Some 75% of the total runoff in Sri Lanka escapes to the sea; however, most of this runoff is generated in the wet season(s). In the dry season evaporation exceeds rainfall.

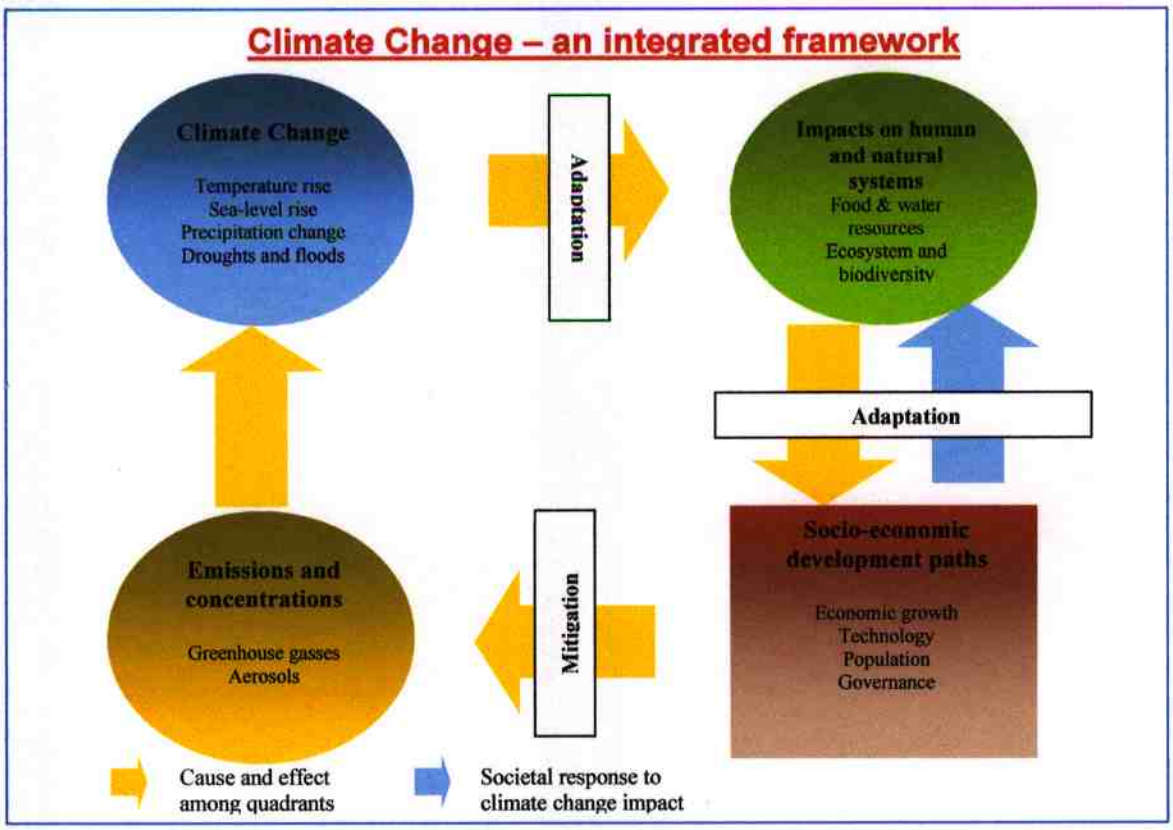
Agriculture dominates water use in Sri Lanka, accounting for 96 % of the current demand, which is in series with the production of hydro electricity. The remaining 4 % is split between the industrial and domestic sectors while about 70 % of the urban population is served with pipe borne water. Only 15 % of the rural households are served with piped water supply, the rest depend on dug wells (27 %), tube wells, streams and lakes for their domestic water requirements. This leaves a large population in the rural areas without adequate safe domestic water and it has been these people that have been most responsive to using collected rainwater as a supplementary source (Rainwater Harvesting).

National Water Balance





5.0 Integrated Framework of Climate Change



6.0 Vulnerability of Natural and Human Systems to Climate Change in Sri Lanka

An analysis of the impacts of past climate variability on water resources, bio diversity, agriculture, human settlements, health and coastal zones can provide an insight into the magnitude of the human security and issues that are climate related.

6.1 Vulnerability on Human Settlements and Health due to Change in Flood, Drought and Cyclonic Pattern

Climate change can affect human settlements in Sri Lanka directly and indirectly through impacts on the natural environment of settlements, economic activities, building and infrastructure and health of the resident and commuting population. Existing problems such as air pollution, poor waste management and inadequacy of water and sanitation facilities can be exacerbated and new problems will be created. Communities living in flood-prone areas, coastal settlements and others in resource-dependent areas are more vulnerable than others.

According to the studies by Deheragoda and Karunanayake (2004), Sri Lanka has witnessed a number of extreme rainfall events, noticeably during the last two decades of the 20th century. In the most recent past, extreme climate events such as heavy rainfall and

major floods have impacted adversely on inhabitant in settlements located in landslide prone areas in the central hill country. As many as 219,870 people from 43,000 houses had been affected by floods in 1993 while in the following year the number had increased to 353,000 from 52,900. In May 2003, heavy rain of 820 mm in three days had triggered flood and landslides which had completely destroyed 9294 houses and partially destroyed another 30,360. As a result, livelihoods of 138,973 families had been severely affected and caused death to 236 persons. The damage was estimated at US$ 27 million. In 1986, a rainfall of 299 mm intensity, in few hours time, had caused unexpected land slides in the Hill country. In 1993, during Southwest monsoon, the city of *Colombo* experienced a severe rainfall of 420mm in just 7 hours, which caused the city to be completely submerged with floods in suburbs. Towards the end of the year 2006, the persistent rainfall triggered an unforeseen landslides pattern, across the Hill country, which urged the government to shift an entire city called *Peradeniya* to a safer place.

The country also faced some severe droughts in 1992, 1997 and 2001. The drought in 1992 had reduced the country's tea production by 26 %, from the amount produced in the previous year and increased the cost of production by 19 %, thus affecting the foreign exchange earnings. The drought in 1997 affected the villages in the *Hambantota* district (southern) in the Dry zone where food insecurity and loss of income due to drought had risen to a level of 90-99%.

An unexpectedly prolonged, severe drought in 2001/2002 made water levels in major reservoirs to fall down drastically, virtually to reach their dead storage, despite intensified isolated rainfall in certain parts of the island. The government was forced to shut down the hydro-power generation which crippled the industrial sector. This led to the immediate investment-call for fossil-fuel power generation, which still remains a financial burden on national grid of power generation.

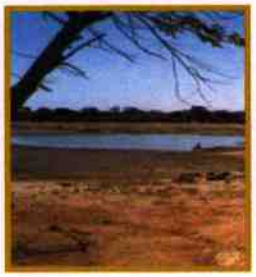
Other hazards include unexpected and abrupt heat affects. Very recently, in 2006, a 'Tornado' hit the centre of *Colombo* city, twice over a week, displacing about 1500 families. in 2002 a cyclone destroyed 77,000 houses, affecting 146,190 families. This abrupt change is very much highlighted by the heat wave which emanated from *Galle* road which reached above 40° C, making it similar to a middle-east country.

Extreme rainfall events have also affected urban squatters who live close to marshes that are liable to flooding. Squatters in unauthorized make-shift dwellings in Colombo have been exposed to *helminthic* and *protozoal* parasites (*Wanasinghe* 1995). Further, the Dengue vectors- *Aedes aegeyphi* and *Aeds albopictus* that breed in fresh water have been identified around these squatter settlements and the dengue epidemic in 2004 was attributed to heavy rains that occurred in the first six months.

A study by *De Alwis et al* (2004) on vector borne diseases in the dry Northwestern province illustrates the close relationship that exists between the incidence of diseases such as malaria, dengue and Japanese Encephalitis and climate factors. In the recent past extreme weather conditions such as heavy rainfall and prolonged drought have contributed to an increase of *anopheline* mosquitoes in the dry North-Central province which is hyper-epidemic for malaria. Suitable habitats for the vectors are created in the drying tank beds and rivers, during the long dry season and, pools on uneven land surfaces during wet weather conditions.

Dhanapala (1998) predicted that the malaria transmission within the dry zone would extend to areas that were hitherto free from malaria and that the seasonal pattern of

malaria in the endemic zone would also change. The current minor mid-year peak would be enhanced while the traditional high transmission season (November-February) during the Northeast monsoon, would be reduced. Areas bordering the non-epidemic wet zone are likely to be highly vulnerable. At present, floods caused by the heavy rain and landslides and drought in the dry zone have been responsible to the spread of water washed and water borne diseases. Studies indicate that the increasing frequency and intensity of extreme weather events in future could bring about illness and deaths as well as injuries, collapse of health infrastructure and displacement of affected persons, as well as physical and psychological trauma.



6.2 Vulnerability of the Coastal Zone due to Sea Level Rise

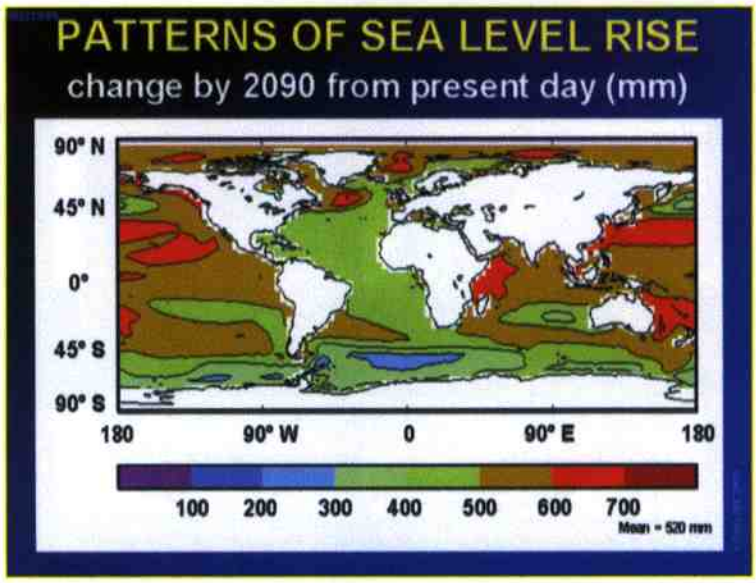
The level of the sea at the shoreline is determined by many factors in the global environment that operate on a great range of time scales, from hours (tidal) to millions of years (ocean basin changes due to tectonics and sedimentation). But more intense is the melting of glaziers in the Northern pole due to global warming. As a result, an increase of 10-20 cm in sea level was observed during 1860-2000 and the same is predicted to rise, between 9 - 88 cm during the next 100 years.

The Sri Lankan coastal zone comprises coastal habitats that include of lagoons and estuaries, beaches, barriers and spits, salt mashes and mangroves. The zone performs valuable regulation, user and productive functions. It possesses a considerable proportion of renewable and nonrenewable resources, space for residential, commercial, industrial, agricultural, administration and socio-cultural activities, infrastructure and nature conservation. This zone is the most urbanized, densely populated and economically productive (Provided 40% of the Gross Domestic Product) region in the country. As much as 62% of the total industrial units and 70% of the tourists hotels are located in this zone. The region also possesses 89 scenic and recreational sites and 253 archaeological and cultural sites of which 34 are designated as high priority sites.

The coastal ecosystems are affected by anthropogenic stresses such as the conversion of mangroves (a loss of 39% between 1986 and 2003), river sand mining (5.5 MCM in 2001), beach sand mining, coral reefs mining, inland coral mining, collection of coral from beaches and shore face, building construction and infrastructure installations close to the shoreline. The Coast Conservation Department has estimated the rate of coast erosion at 0.5 m/year with an accretion rate of 0.2m / year. Another study estimated that a sea level rise of 0.3m in the Southwest coast would lead to a land loss of 6.0 sq.km while a 1.0 m rise would cause a loss of 11.5 sq.km (*Weerakkody* 1996).
Another problem which would be accelerated by a rise in sea level is the intrusion of salt water along rivers due to river sand mining. During low flow periods, salt water extends up to 14 km along the river *Kelani* which provides portable water to Colombo Metropolitan Region. With a sea level rise in 0.3m, it is estimated that salt water intrusion in the river would extend upstream to a distance of 31km.

Thus the sea level rise will affect the country in the given extent below;

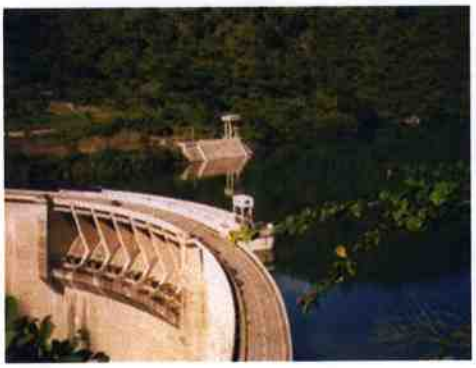
- 24 % of total land area and 32 % population
- 65 % of urbanized area
- 80 % tourism related infrastructure
- 65 % industrial outputs
- 100% commercial ports and fishery harbours and anchorages
- 80% of fish production
- Major highways and railway infrastructure
- Richest areas with biodiversity; coral reefs, lagoons, mangroves, etc. covering 160,000 hectares
- Increased coastal erosion which is 0.3-0.35 m/year at present
-



6.3 Impact on Sedimentation and Flood Vulnerability

Intensified rainfall leads to soil erosion, loss of fertility and a reduction in water holding capacity. 60 % of land slopes in Sri Lanka are vulnerable to landslide and excessive soil erosion if the intensity of a rainfall exceeds 25 mm/hour. Also the irregular urbanization, agriculture and development projects in the central hill country have contributed largely to he highland soil erosion. These eroded soils get transported by water streams and accumulates in river beds and basins, part of which, in turn gets transported down to reservoirs. This sedimentation reduces the flood carrying and retaining capacities of the rivers and reservoirs. The intensity of sedimentation is much depicted by the siltation rates and reduced storage capacities of the following reservoirs.

Polgolla reservoir : 44 % storage with 2.8 % siltation rate/year
Rantambe reservoir : 54 % storage with 4.3 % siltation rate/year
Victoria reservoir : 0.08% iltation/year
Minor tanks : 2.4 % siltation/year



7.0 Adaptation of integrated water resource management to the Global Climate Change in Sri Lanka

Mitigation is defined as an "anthropogenic intervention to reduce the sources or enhance the sinks of Greenhouse gases". As much as 95 % of the total Greenhouse gas emissions in Sri Lanka comprise carbon dioxide (CO_2.

The conversion of forest land for plantations and colonization schemes, burning of forests and scrubland for shifting cultivation and the reduction of organic matter and release of Carbon in soils are the largest sources (82%) of CO_2 emissions in future. The second important source of GHG is methane, produced mainly from waste matter in landfills followed by livestock related emissions from cattle, goats and pigs (produced by 'enteric fermentation' of food and by the decomposition of animal manure). It is likely that with intensification and extensification of paddy cultivation in the country, the amount of methane emissions would increase in future. The predominant source of nitrous oxide in Sri Lanka is agriculture due to shifting cultivation and the nitrogen found in mineral and organic fertilizers.

Adaptation to climate change means any," adjustments in ecological, social, and economic systems in response to actual or expected climate stimuli and their effects or impacts". The adaptive capacity "is the potential or ability of a system, region or a community to adapt to the effects or impacts of climate change". Enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development.

7.1 Policy and Practices:

Adjustment is necessary in both natural and human systems since the poor communities in Sri Lanka are heavily dependent (directly or indirectly) on natural resources. Action, taken so far by Sri Lanka to reduce Greenhouse gas emissions include mainstreaming of environment concerns into development decision making. The following strategies, outlined in the National Report of Sri Lanka, to the 'World Summit on Sustainable Development', the 'Initial National Communication, under the 'United Nations Framework Convention on Climate Change' (Draft 2000) and the paper on 'Multilateral Environmental Agreements (MEAs), will contribute to solving this issue to great extent with;

- Ratification of 36 Multilateral Environmental Agreements (MEAs)
- Measures undertaken to implement MEAs, which include the development of National Environment Policy, National Forestry Policy, National Policy on Wildlife Conservation and National Air Quality Management Policy,
- Development and adoption of National Environmental Action Plans (ie: Biodiversity Action Plan, National Climate Action Plan, Coastal 2000 Action Plan, Clean Air 2000 Action Plan and National Forestry Sector Master Plan.)
- Preparation of National Strategy for Clean Development Mechanism to implement the Kyoto Protocol
- Establishment of Climate Change Secretariat, Bio Diversity Secretariat and Ozone Secretariat to strengthen the capacity of implementing agencies

The environmentally friendly practices that have already benefited the country are;

- Introduction and popularization of fuel efficient stoves that reduce fuel woods
- Introduction of cleaner production technologies among polluting industries
- Installation of mini-hydro power plants as stand-alone and grid connecting system
- Facilitation of rain water harvesting in the dry zones. National Rainwater Harvesting Policy is to be adopted, making rainwater harvesting mandatory
- Identification of cost-effective utility scale wind power development (Young and Vihaure 2003)

7.2 Research & Survey

The recent 58 Nos of research studies, conducted under the auspices of Climate Change Enabling Activity Project (Phase II) of the Ministry of Environment and Natural Resources have been successful in filling some knowledge gaps on the magnitude of vulnerability of natural and human system in Sri Lanka to climate change, Greenhouse gas mitigation potential and suitable adaptation measures. A number of these research studies have focused on biological mitigation option such as;

a. Conservation of carbon pools such as forests and
b. Carbon sequestration by increasing the carbon pool size by reforestation and afforestation of degraded forests and croplands in marginal and wastelands. Forest tree species that are most suitable for carbon sequestration were screened to select species that have a higher absolute growth rate with higher level of total biomass than others and are highly responsive to elevated CO_2.

In 2004, *Nugawela, Rodrigo and Munasinghe* were able to quantify the Carbon fixing capacity of Rubber. Their research results indicate that genotype RRIC 121 was 160% superior to RRIC 100 in fixing Carbon.

Sirisena et al's (2004) study on methane emission from paddy fields showed that the lowest daily and seasonal emissions were observable in plots that did not receive any organic manure or chemical fertilizer. The most crucial period for emission of methane was 6-12 weeks after the crop was established. A further positive relationship between the number of productive tillers and the rate of methane emission was observed. Therefore, *Sirisena* et al recommended that rice varieties that produce minimum productive tillers with high yields should be introduced to reduce methane emission from paddy fields and that intermittent drying, which is commonly practiced by farmers, 7-11 weeks after transplanting 3 ½ month rice varieties shall be encouraged.

Abeywardana (2004) focused attention on selecting paddy varieties that are highly responsive to elevated CO_2 for future breeding programmes. Changes in agronomic practices, introduction of pest resistant varieties and the establishment of a surveillance and forecasting system are some of the recommendations made by their study of climatic conditions that favour the outbreaks of Brown Plant Hopper in the low country Dry Zone in order to take necessary to control pests.

The study by *Emmanual* (2004) on the Urban Heat Island (UHI) effect in Colombo discovered that the UHI has increased in recent years due to the increasing amount of energy consumed by residences, offices, institutions and other buildings and that conventional design options do not result in acceptable indoor comfort. *Emmanual* has proposed a number of strategies to ameliorate the effects of UHI, such as, the use of energy efficient designs in building construction which can reduce electricity consumption by 50%, the introduction of Guidelines for building construction and landscape control ordinances, changing of the exterior colour from dark to light, facilitation of the deeper penetration of sea breeze by discouraging construction of high rise buildings along the coast.

Senanayake (2004) has examined the possibility of reducing Greenhouse gas emissions from the Desiccated Coconut industry by improving the combustion efficient and by fuel switching. Wood gasification technologies are considered as zero GHG emission technologies, which will save foreign exchange for fuel oil, while the use of hot water boilers instead of steam boilers would ensure that there is a 40% reduction in annual GHG emissions. He recommends the introduction of industry related incentives to attract industry owners to adapt GHG mitigation actions and the dissemination of findings of researches to policy makers, equipment suppliers and academics.

Micro or mini hydropower is one of the most sustainable alternatives to the use of large scale hydroelectricity systems in Sri Lanka. The success of micro hydro projects depends on selecting suitable sites in the hill country. The study by *Pannilage* (2004) showed that water yield is affected not only by the amount of rainfall but also the land use practices in the catchments areas. Hence the anticipated change in rainfall in the hill country would have a differential impact on water yield depending on type of natural vegetation cover

and type of crops. Reforestation and forest management have been recommended by the researchers.

Rain water harvesting is an effective low cost adaptation strategy to overcome the anticipated decline of rainfall in the dry zone. Different types of tanks are being used at present, but the quality (chemical, physical and biological) of rainwater differs from tank to tank. Ariyananda (2004) compared the quality of water in the different types of tanks and has recommended on the suitable types.

7.3 Mitigatory and adaptative physical measures in Sri Lanka

a) Recent, following flood control, water resource development and management projects:

- *Mauara* reservoir, 75 MCM capacity to divert water to adjacent *Malalara* basin to feed water to *Meegaha Jandura* and *Badagiriya* tanks.
- *Gal-Amuna* reservoir, feeds 05 small irrigation tanks
- Proposed *Veheragala* reservoir, 75 MCM capacity to divert water to *Lunugmvehera* reservoir for drinking and irrigation water
- Proposed *DeduruOya* reservoir to control downstream flood, 75 MCM capacity storage for irrigation and hydropower. Feeds water to *Inginimitiya* reservoir and 05 minor irrigation tanks
- Proposed Urawa reservoir, 16 MCM capacity for flood control. Diverts water to *Muruthalawa* reservoir
- Proposed *Ratnapura* reservoir, 70 MCM capacity for flood control, irrigation and hydropower

b) Construction of Salinity Barrier and Dams to prevent salinity intrusion

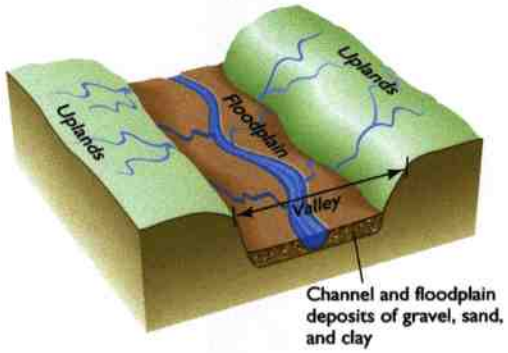
Kelani River and its tributaries are the main source of potable and industrial water to Greater Colombo area. The bed of the river is below zero MSL, to a length of 14 km along the river, up to *Hanwella*. The water treatment plant of NWSDB is located at *Ambatale* which is about 10 km from river-mouth at sea. When the flow level in the river is low, sea water propagates along the river, limiting the water extraction capacity and degrading the water quality. This leads to interruption to water supply for 6-8 hours a day. The proposed construction of a salinity barrier, downstream of *Ambatale* intake, will prevent the salinity intrusion and will double the present extraction capacity, which is 0.5 MCM per day now.

Also the proposed dams, upstream of the intake will serve the irrigation and other needs, but its main objective will be to discharge high volume of water during salinity intrusion periods, flushing out the saline water back to the sea. Presently the same is achieved with high discharge from hydro power reservoirs on requests from NWSDB, but since the salinity intrusion occurs during drought periods, unnecessary such high discharge from reservoirs affect the power generation and future irrigation capacities.

Similar attempt to construct a salinity barrier at *Nilwala* River in the southern part of the country limited only to studies, due to the objections from farming community from upstream of the intake.

c) Step-land agriculture in Hill country

The farmers in the hill country are given financial grants to develop step-land for agriculture. The construction of step-barriers in the hill country will increase the rainfall infiltration and reduce surface flow, which results in reduced soil erosion, leading to less sediment transportation. This will avoid high siltation rates in major reservoirs and deposits in rivers thus enabling to maintain flood retaining and carrying capacities.



d) **Advanced capacity building programme on integrated water resource management under '*Pavithra Ganga*' (Clean Rivers) pogramme**

Ministry of Environment and Natural Resources has implemented the " Pavithra Ganga" programme as an attempt to keep the water bodies clean and safe in Sri Lanka, in collaboration mainly with the National Water Supply & Drainage Board, Department of Local Government (Western Province), Central Environmental Authority and 13 Local Administrative Authorities along the *Kelani* River
Kelani River being a major source of drinking water and ecologically sensitive area, 13 monitoring committees have been established in the 13 Local Administrative Authorities to identify sources of pollution and take remedial action. It has enhanced the institutional and technical capacity of the major stakeholders to promote monitoring of water quality and trace the sources of pollution in the *Kelani* River, effectively.

e) Promotion of Rain Water Harvesting in Dry Zone

A cost effective system to be adapted to the anticipated declined rainfall in the dry zone. This also reduces the exploring of ground water in aquifers through tube wells, thus saving them for the future. To adapt to the climate change impact on availability of reliable water sources, the new concept of "Accessibility, reliability and timely availability of adequate safe water to satisfy basic human needs" has been defined. Most rural house holds in the dry zone and rural areas face water

insecurity. Households manage, however by lowering their consumption during seasonal shortages and by increasing their water collecting efforts and adjusting their water requirements to a minimum level. Rain water harvesting reduces water insecurity due to abrupt climatic changes by providing such households with additional source.

8.0 Mitigatory Actions in Legislation / Water Reforms

Activities of Sri Lankan Water Reforms

The following is a summary of the water 'reform' process in Sri Lanka during the last quarter century

(Nanayakkara 2003. Ariyabandu and Aheeyar 2004. L H R D : 2002, 2003, 2004, 2005)

Date	Instrument	Authority	Provisions
1980	water resources Bill	Ministry of Irrigation, Power and Mahaweli Development	Bulk water allocation to various sectoral agencies (and further allocation by those agencies) and for the establishment of a National Water Resources Council (this legislation, however, was never submitted to Parliament due to lack of cabinet support).
1983	Irrigation Ordinance (amendment)		Enable farmers to be prosecuted for non-payment of water taxes.
1984			Commencement of charging water taxes from farmers
1988	Policy of "Participatory Management of Irrigation Systems"		Substantial devolution of authority and responsibility to farmer organizations
1988	Irrigation Management Policy Support Activity (IMPSA)	International Irrigation Management Institute (IIMI)	
1992	Summary Report IMPSA	International Irrigation Management Institute (IIMI)	Recommendations on land, watershed and water resource management, and that the government should establish a high-level advisory National Water Resource Council and Secretariat.

1992			Proposal to carry out a water resources master plan was presented to external support agencies.
1993	Institutional Assessment for Comprehensive Water Resources Management (IACWRM) Project.		Assess the institutional capacity for water resources management. The action plan of the project focused mainly on the need to develop a National Water Resources Policy, to establish a permanent institutional arrangement for water sector coordination and to prepare and enact" National Water Act'
1994	Irrigation Ordinance was amended by Act No. 13 of 1994		Enable farmer organization to levy charges from the members of the organization for the operation and distribution of water through canal systems.
1995		Cabinet	The implementation of the Strategic Framework and Action Plan for the "Institutional Strengthening for Comprehensive Water Resources Management (ISCWRM) Project.
1996	IACWRM project	Government	Establishment of a Water Resources Council (WRC) and a Water Resources Secretariat (WRS).
1996 to early 2000	ISCWRM project		Production of the "National water Resources Policy and Institutional Arrangements" and the " National Water Resources Authority (NWRA) Bill"
28th March 2000		Cabinet of Ministers	Approval of the National Water resources Policy.
September 2000		Legal draftsmen's department	Release of the Draft National Water Resources Authority Bill. (Government, however, failed to push the Act through the parliament and to establish NWRA).
2001			National Policy on Rural Water Supply and Sanitation was approved.
2001	The '100 day' programme	Ministry of Irrigation and Water Management	Setting up task forces for the implementation of its water management policy at 4 levels; Village Irrigation Committee. Divisional Secretariat Irrigation Committee, District Irrigation Committee and National Irrigation Committee.

2002	PRSP	GOSL	Published the Poverty Reduction Strategy Paper (PRSP) including proposed reforms on water sector.
2002	Regaining Sri Lanka	GOSL	PRSP was incorporated into the policy document " future: Regaining Sri Lanka". Water reform policy was not taken for public discussions.
22 nd October 2003	Water Services Reform Bill	GOSL	Presented the " Water Service Reform: A Bill: to privatize pipe borne water supplies in the country in both rural and urban areas and public sewerage services. The Bill refers to drinking water and other sources of water'.
2003 to 2004	Civil action	Supreme Court	Civil Society Organizations and citizens challenged the bill before Supreme Court and a decision against the introduction of the bill was given
August 2004	Basic Policies of Usage, Conservation and Development of Local Water resources (Draft)	Agriculture Livestock, Land and Irrigation Ministry	
Septem ber 2004	water Resources Policy (Draft)	Water Resources Secretariat under the Mahaweli and River Basin Development and Rajarata Development Ministry	
22nd Novem ber 2004		The cabinet	Decided to amalgamate these two documents and come up with a common one.
24 th Novem ber 2004	National Water Resources Policy (Draft)	The special Presidential Task Force	The "common" policy document
21st Decemb er 2004		The cabinet	The document was discussed, with the versions in Sinhala and English being significantly different from each other.
January 2005		The cabinet	A four-member Cabinet sub committee was formed to come up with new proposals for a water policy.

January 2005	National Rainwater Policy And Strategies	Ministry of Urban Development and Water Supply.	In the light of increasing operational and maintenance costs to, rationalize investments, both by Government and non Government sectors, in the field of pipe borne water supply, drainage, flood control, soil conversation etc.and promote the practice on a Regional Community and family basis, in order to ensure that the 'City of tomorrow' applies Rain water harvesting broadly, by the control of water near its source, in its pursuance of becoming a 'Green city' in the future.
8th September 2005	Draft National Water Resources Management Policy	Presidential Secretariat	Attempt to reconcile the "Basic Policies of Usage, Conservation and Development of Local Water Resources (Draft)" and National Water Resources Policy (Draft)"
17th November 2005			Presidential election. At the opening of the new Parliamentary sessions, the President declares the need for National Water Policy.
2-12 December 2005	Aid-memoir on the proposed National Water Management Improvement (NAWAM) Project.	Agreement between the Cabinet and the World bank.	US$ 70 M loan from the IDA

COUNTRY REPORT OF VIETNAM

Integrated Water Resource Management Adapting to the Global Climate Change

JICA EXCUTES'S SEMINAR ON PUBLIC
WORKS AND MANAGEMENT
JFY 2007

Prepared by DANG ANH THU
Expert, the Department of Urban Infrastructure
The Ministry of Construction (MOC)

SUMMARY of

"Integrated Water Resource Management Adapting to the Global Climate Change"

The world's freshwater resources are under increasing pressure. Growth in pollution, increased economy activity and improved standards of living lead to increased competition for and conflicts over the limited fresh water resource. A combination of social inequity, economic marginalization and lack of poverty alleviation programmes which often result in negative impacts on water resources. Lack of pollution control measures further degrades water resources.

Populations under water stress: the world population has increased rapidly during the 20th century. It is estimated that currently one third of the world's population that experience medium to high water stress.

The impact of environment: pollution of water is inherently connected with human activities and climate change, flood, disaster... Variations in water flows and groundwater recharge, from climatic change or due to land mismanagement, can add to drought and flood event. Deteriorating water quality caused by pollution influences water downstream, threatens human health and the functioning of aquatic ecosystems so reducing effective availability and increasing competition for water of adequate quality.

The global climate is changing. The average temperature and sea levels are rising and with increasing confidence scientist worldwide predict an increase in extreme weather affecting people worldwide: their live hood assets, infrastructure and ecosystems. With poor people living in disaster prone areas being even more vulnerable to natural disasters if proper disaster coping mechanisms are inadequate or lacking. Vietnam is the one of the most disaster-prone countries in the world. Disaster occurring in Vietnam are mainly related to severe weather conditions. Each year typhoons, floods and droughts cause death, injury, loss of property and infrastructure damage.

Water governance crisis: weak of institutional capacity, shortcomings in the management of water, water resources management is sectoral approaches, this lead to the fragmented and uncoordinated development and management of the resource.

Although in the most countries give first priority for water supply needs, but water shortages, quality deterioration and flood impacts are among the problems that require greater attention and action. The main challenges that faced more and more countries are increasingly related to water: safe drinking water for people; security water for food production; ecosystem protection; variability of resources water in

time and space, the effect of global climate change may add further to this challenge; risks management, popular awareness and understanding; IWRM across sectors and boundaries...

By the end of February 2006, discussion papers that present the findings of literature reviews on international best practices in environmental stainability spects of IWRM and describe the current status in Vietnam were received from key ministries of Vietnam namely; Ministry of Fishery, Ministry of Agriculture and Rural Development, Government's Office, Electricity of Vietnam, and the Ministry of Natural Resources and Environment.

Integrated water resources management is a process which can assist to deal with water issues in a cost-effective and sustainable way.

1. Organization Data

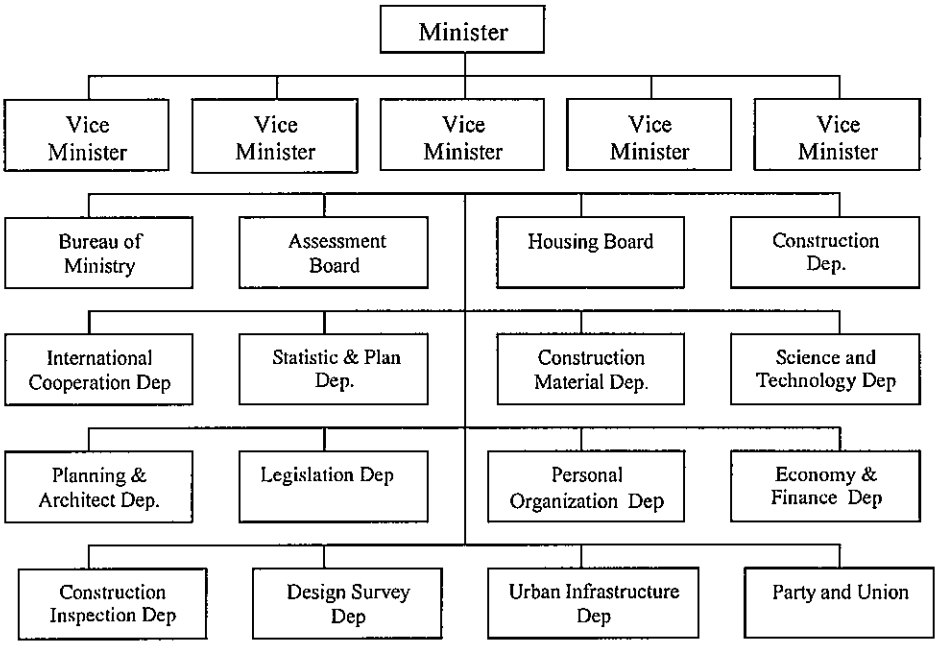
(1) Name of Organization: The Department of Urban Technical Infrastructure, Ministry of Construction (MOC),

(2) Summary of Organization

Ministry of Construction has responsible for state management related to:

- Construction;
- Urban development;
- Housing;
- Architecture;
- Urban technical Infrastructure;
- And related public services

(3) Organization Chart



(4) Organization's position in Government

The Urban technical infrastructure department (UID) is government agency help the Minister implement State management in the urban infrastructure field including: pavements, urban roads, water supply, waste water, parks and trees, urban solid waste, burial-ground, car-parking and other urban infrastructure services in accordance with law.

The UID has the following tasks and power:

- Study mechanisms and policies for submission to the Prime Minister to issue or for authorized issuance;
- Develop programs/plans in national level for submission to the Prime Minister for issuance;

and implement these programs/plans.

- Issue technical-economic regulations/standards/norms.
- Provide guidance, instruction and monitoring of activities related sectors in the urban technical infrastructure field.

2. Personal data

(1) Recent Work

I have responsible for tasks as following:

Researching, proposing, editing: policies, orientations, strategies, planning, schemes, project program, legal and instruction documents on urban infrastructure.

Appraisal mission for plan projects, construction investment projects on the urban infrastructure.

Guideline, supervising, controlling of ODA infrastructural projects: Center Urban environment improvement Project (ADB); Urban Upgrading Programe (WB), VietNam Urban Water Supply Project (WB)... are on going, Mekong deltal water supply investment program is also preparing. Examine and review construction planning projects, construction invesment projects in the field of urban infrastructure

Taking part in to execution and research on themes about infrastructure field, draft of the regulation base such as Water Supply Management Decree, Urban and Industry Sewerage System Management Decree.

Cooperate with relevant agencies and organisations and locolities to perform the state management function with regard to urban infrastructure.

(2) Contact Address

Office address: Department of the Urban Engineering Infrastructure, Ministry of Construction (MOC)
37 Le Dai Hanh str. Hai Ba Trung dist. Hanoi, Vietnam
Tel: +84 4 9760271/ext: 203
Fax: +84 4 9742132; 9742451
E-mail: danganhthu@moc.gov.com

3. Integrated Water Resource

(1) Current Situation and problems

Total area of Vietnam is 331,690 km^2 including eight special zones as Red river delta, North East, North West, North Central Coast, South Central Coast, Central Highlands, North East South, Mekong River Delta. The administrative land is divided into 64 provinces and cities. Land use for cultivation, forestry, residential area and industrial account of 57.9% total reservation land.

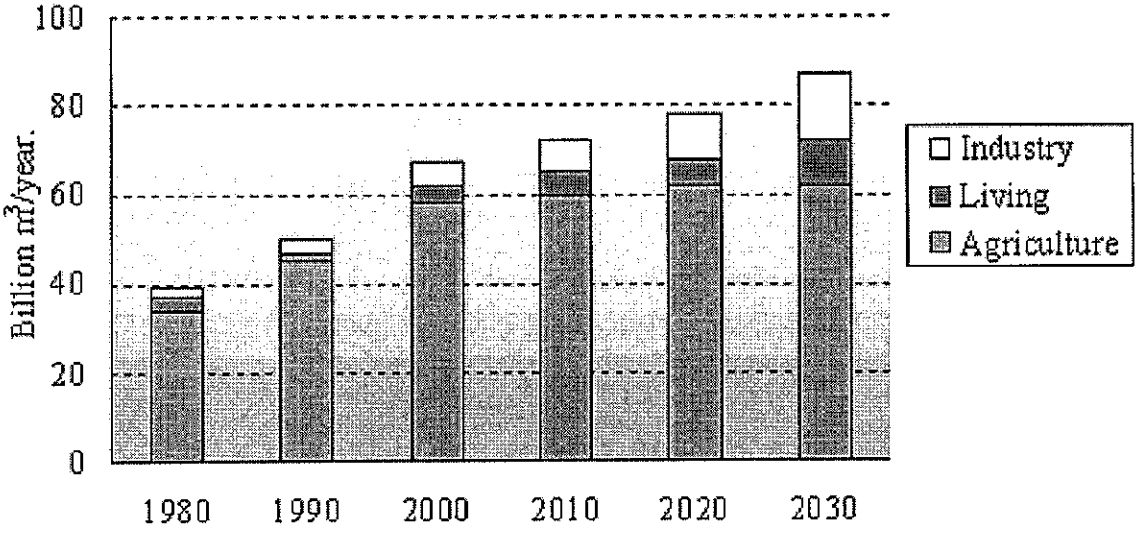
The total of urban is 718 in which 2 special capitals (over 1.5 mill. Peoples), 4 cities range in first class (over 0.5 mill. peoples), 13 cities range in second class (over 0.25 mill. peoples), 23 urban is third class (over 0.1 mill. peoples), 54 urban

range in fourth class (over 0.05 mill. peoples), 622 towns are fifth class (over 4,000 peoples). Total population is more than 83 million people (census data on 1st Apr 2005), in which 26.8% (73.2% living in rural area) is urban habitant and accounting of 22 mill peoples. Forest of Vietnam accounted of 27% total country land area with about 9.6 mill. ha. Most is secondary forest; primitive forest exists until now is not much. The average wood capacity of Vietnam forest is about 53m^2/ha. Total reservation land for cultivation in Vietnam is about 10 – 11 mill. ha.

Vietnam is located in both a tropical and a temperate zone. It is characterized by strong monsoon influences, but has a considerable amount of sun, a high rate of rainfall, and high humidity. Regions located near the tropics and in the mountainous regions are endowed with a temperate climate. The climate in Vietnam always changes in one year, between the years, or between the areas from North to South and from low to high). The climate in Vietnam is also under disadvantage of weather, such as typhoons (advantage there are 6-10 storms and tropical low atmosphere in year), floods and droughts are threaten the life and the agriculture of Vietnam.)

Every year there are 100 rainy days and the average rainfall is 1,500 to 2,000mm. The humidity ranges around 80%. The sunny hours are 1,500 to 2,000 and the average solar radiation of 100 kcal/cm^2 in a year. The monsoon climate also influences to the changes of the tropical humidity.

Design capacity for water supply in Vietnam is 4.6 million m^3/day; actual exploitation capacity is 2.9 million m^3/day.



- **Present water coverage**

The type of available water resources and those situations: 60% of total water supply capacity in Vietnam is taken form surface water source, remaining is taken form the underground water source.

- In 2002, only about half the urban residents had regular access to piped water that meets national standards.
- In 2004, 61% of urban residents had access to treated piped water that meets national standards.

The country's many canals and waterways have become dumping sites for domestic and industrial waste. In addition to an increasing population and severe water contamination, deforestation, and natural calamities like forest fires, floods and droughts affect the water supply availability

- **Severe Contamination:**
  - Natural disasters
  - Ignorance
  - Expensive to treat water waste before discharging
  - Weak policies enforcements
- **Poor Infrastructure:**

- Access to water and sanitation limited

Water resources in Vietnam:

Surface water

Surface water volume estimated for water supply is about 8 km^3 for 80 million peoples. In General, national surface water of Vietnam is good and save for many demand of economical fields and living supply. However, Water River is salinity at the estuary caused by tide. Salinity of river water goes down and up belonging to the tide regulation, changing by season. At the North delta, maximum salinity occurs in July - August. In Mekong delta on dry season, salinity water enters more 100km towards upstream in 2004. Latest news (3/2005) salinity water was penetrated to Sai Gon and Dong Nai river, far from Thu Duc water treatment plant about 10 Km. Salinity concentration of Dong Nai river is 10% and Sai Gon river is 7.7% comparing to the same value in 2003 respectively is 4.6% to 6.1%.

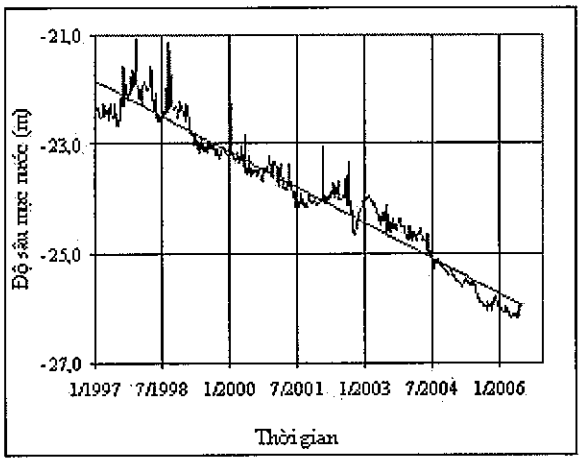
Beside of that, the reasons of irregular development for industry, agriculture, urban centralization, population growth, high water consumption demand and high wastewater those are day by day directly impact to the water environment. For instance in Ha Noi: water from To Lich river, Kim Nguu river and so on is very duty, dark water color, bad smell, dissolved oxygen (DO) is low, sometime it equals to), BOD5 is higher than 50mg/l, NH4+ is over 10mg/l, NO2- also high,

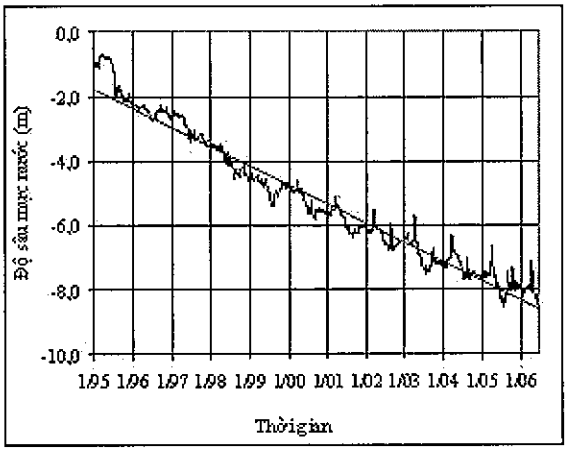
H2S is approximately 30mg/l. In Ho Chi Minh city has the same condition such as COD: 596 mg/l, BOD5: 184.5mg/l. DO equals to 0.

Underground water:

Base on the estimation of the Institute for Water Resource Research and Planning, WB, UNDP show that the existing capacity of the underground water is 48 billion m3/year (equal to 131.5 million m^3/day). However, the average usage at this time per year is 1 bill. m3 for whole the country.

The average water level is decreased year by year (see diagram below)





For instance: In Tra Vinh province, statistical date in 2001, land surface level in this area is down from 2 to 2.5m; the reason is existing of more than 42.000 wells supplying water for farm and aquatic product. In Ca Mau province, base on the UNDP's investigation, water level was down from 3m in 1995 to 11m in 2003. Same condition in Ha Noi where the water supply source is mainly underground water, water level in somewhere is more 30 m deep, and appearing sign of organic pollution, specially is arsenic (Giang Vo area, arsenic concentration is higher 50 times of permitted standard).

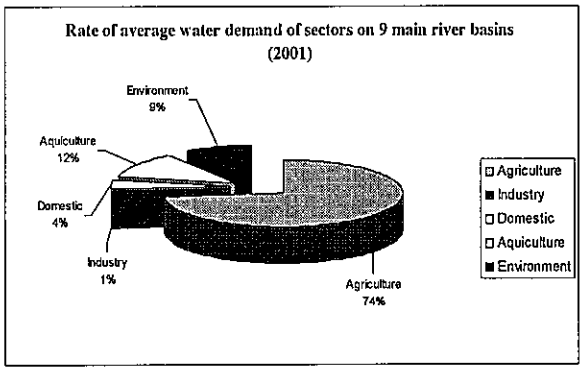
Water quality assessment for the underground water source for mountainous and midland is good, serving enough for domestic use. However, some unit are containing high ferrite concentration, hardness, carbonic erosion so that it does not convenient for some industrial sectors, necessity to treat before using. In Northern and Southern delta, water quality changes difficultly due to come between fresh water and salinity water on larger area and depth. Some cultivation land where using fertilize, pesticide and some high density of industry, water is polluted with the different level results in quality degradation.

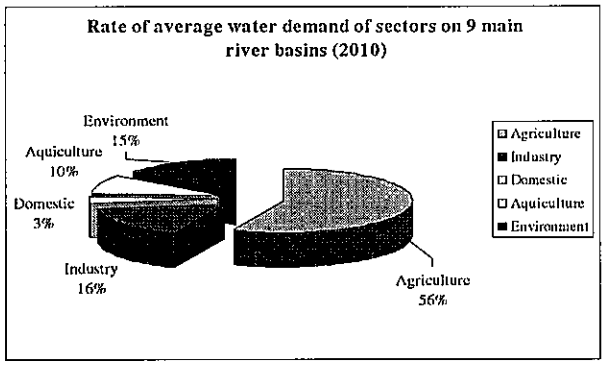
River Basins

There are bout 2,378 rivers (with length longer than 10 km) in which the main river are Mekong, Red, Dong Nai, Ma, Cau, Ky Cung, Thai Binh and Thu Bon, those rivers have basin per each is over 10,000 km^2, biggest basin is Mekong river with about 71,000 km^2.

The Mekong River's total runoff accounts for 59% of the total national runoff, followed by the Red River with 14.9%. Total water volume that the rivers can bring is about 790km^3. Quality of river water in Vietnam is soft water type (200 mg/l mineral content).

The density of Water Utilization of 9 major river basins in Viet Nam





- **Some of major issues**

Weak policies

- No consultation and coordination between agencies
- Lack of strategies on managing and protecting water environment
- Lack of manpower (overloaded with work)
- Standards of water quality not clear, not comparable to international standards
- Wastewater treatment technologies are weak and backward
- Public awareness are insufficient, given inadequate attention

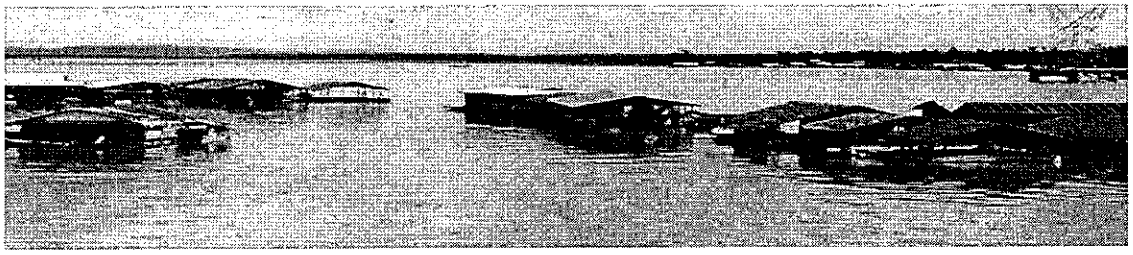
Challenges and issues

- There are still many shortcomings in terms of planning, management, utilization and protection of water resources in comparison with country development needs

- A number of water-related challenges have increased in recent times, water quality is deteriorating in many areas due to urban and industrial activities and saline water intrusion is increasing as dry season river flows are reduced, local and seasonal shortages are increasing, causing impacts on water users and environment.

- Population increasing and Industrialization

- The capacity to develop strong policy and legislation is limited.
- Some overlap of responsibilities among Government' Agencies.
- Lack of integrated river basin planning and management
- Low Institutional and capacity
- Ineffective in Inspection and enforcement and conflict resolution activities.
- Water resources data and information is still scatted, Monitoring networks are insufficient, data quality is not high
- Level of awareness, skills and technology for integrated water resources management fairly low at both the national and provincial level.
- Budget for water resources development and management is limited and has not met the demand of the sector.
- Lack of long term financial strategy including state budget, international assistance, private investment and using fees.



This isn't flooding, the houses are built over this lake.

(2) Research and survey

Case study of Tien Giang

Half of the land area of Tien Giang Province in Vietnam is exposed to annual floods and the other half to saline intrusion. Traditional sources of domestic water - rivers, canals and ponds - are naturally polluted by alluvium acidity and salinity, and also by human/animal excreta and other wastes. Water related diseases have been very serious in the Province.

Tien Giang rural residents were inspired to develop their own water sources when they saw how UNICEF supported the drilling of wells to supply fresh and clean water to communities. They followed this example and dug individual wells, but without any resources planning. The first real impact was disastrous. The water quality from the shallow wells was so bad that the water was undrinkable. The wells were abandoned and their assets lost. A more serious impact was encountered when these abandoned wells were not closed properly, resulting in aquifer deterioration that affected a widespread area. The limited national and provincial budgets prevented rehabilitation and support to these areas.

The formulation of the National RWSS Strategy (in 1998) provided a good opportunity for the Province to effect changes. Within the wider context of all

economic activities, the affected communities were made aware of methods and approaches in harvesting water and well drilling that are cost effective and sustainable in their development. After three years, Tien Giang Province manages both surface and groundwater resources, ensuring water supply for 50% of rural population (nationwide proportion access to potable water is about 35%). The Province and the communities worked through self-help, without any external support. Key components of the strategy included:

- A participatory approach, throughout project planning and implementation
- Technical support from the provincial government
- Appropriate financial policies for poor and difficult areas
- Establishment of water user groups, with the legal entity to hold, manage and operate facilities.
- Training and educating for water user groups so that they have enough ability to make plans, choose technology, manage the water resources and the environment.

Lessons learned

- RWSS is considered as a useful point of departure for poverty elimination and rural development, and achievements from RWSS help to motivate other social efforts.
- Information, education and communication (IEC) activities are very important to all levels including communities, local authorities, technical and credit agencies.
- Water resources for RWSS are of small quantity and dispersed in nature, and mainly related to groundwater, the monitoring of which is still very weak. Therefore this development must be integrated within integrated regional and basin planning, thus avoiding negative impacts to water resources and the environment.

Importance of case for IWRM

- The case shows how good planning leads to efficient use of water resources, and the integrated approach has led to a harmonious and equitable share of economic and social benefits among communities: all people have clean water for use and improved their life quality by their own contribution.
- The management of sanitation, domestic waste and rural waste production has contributed to good water quality and preservation of eco-systems.

(3) Policy and Practices

- ***Targeted Coverage***
  - Water coverage: 85% for rural population (60 liter/day) and 95% for urban population (150 liter/day) by the year 2010
  - Sanitation coverage: 70% by 2010
  - Irrigation systems upgrades: 1 billion US$ (2006-2010)
  - Introduction of water resources management into river basins integrated water

resources management in river basin

- ***Enabling condition***

Law: Vietnam's Law on Water Resources and Related Legislation for Implementation of IWRM

In January 1999, Viet Nam enacted its first national Law on Water Resources. This is a major development of existing legislation and establishes an enabling environment for managing Viet Nam's water resources. The Law is up-to-date in the issues it addresses, dynamic in its approach, and practical. In December 1999, an Implementation Decree was issued by the government which specified that River Basin Planning Management Organizations be established in the Red River and Mekong River Basins (the Dong Nai River Basin has been added to this list). The Decree also specified the functions of a national apex council to help manage water resources. The National Water Resources Council advises Government on certain issues of water governance including national and international water policies. Additionally, the National Water Resources Council is responsible for settling water disputes among national-level government agencies and among provinces and cities.

Specific issues that the Law addresses are:

- Water rights.
- Responsibilities of users to protect the water resource and to prevent and overcome any harmful effects of water.
- The right to benefit from the use of water resources.
- The development of water resources in areas with difficult socio-economic conditions.
- The development of a fee-based permit system for wastewater discharge.

The Law recognises that water is an essential element of life. The Law and Implementation Decree offer a comprehensive base for water management which reflect the numerous issues identified as crucial by both the government and international agencies. Such issues include environmental protection, management from a river basin perspective, and co-operation in international river management. These ideas are embodied in the concept of integrated water resources management (IWRM).

Strategy

- The orientation for urban water supply development until 2020 (18 March 1998): 100% of the urban population using drinking water with the consumption level from 120 to 150 lpcd; branch renovation; technological modernization; fund mobilization from every economical components.
- Comprehensive poverty reduction and growth strategy: 80% of the urban population using fresh water with 50 lpcd until 2005.

- Vietnam millennium development goals: 80% of the urban population using fresh and save water until 2005.

- Environment strategy: until 2010: 95% of the urban have drinking water.

Current policies

- Priority to use the ODA fund for water supply development
- Priority to borrow national credit fund for water supply investment projects
- Grant for training and technology development
- Capital interest assistance after investment
- Assistance for building structures located outside of the fence

Specific policy:

- Highest legal document until now is decree No 117/ND-CP dated on 17 July 2007 from State about "Urban Water Supply Management"
- Decree for guiding the implementation of the law of water resources structure exploitation and management
- Decree on administrative penalty in water resources sector
- Regulations on procedure for licensing exploitation and utilization of water resources (surface and ground water) and wastewater release water release to water resources
- Direction from Prime Minister No.04/2004/CT-TTg dated on 20 Jan 2004 mentioning about "Enhancement for water supply and consumption management".
- "Renovation program for organization model and management institutional for enterprise who participating in water supply sector" composed by MOC and Prime Minister has been approved this program.

In term of policies, according to the legal documentary programmer in every year, Ministry of Construction in general and the Urban Technical Infrastructure Department - Ministry of Construction in particular is assigned to study, draft and compose a water supply, wastewater, solid waste management and underground construction works decrees. Those decrees are policy documents that provide a solid framework to guide sub-sector management for improving urban development.

- ***Vision and concrete action***

- Developing National Strategy for Protection and Sustainable Development of Water Resources of which the National Goals for Water Resources is one of the leading component of the National Strategy.
- Inventory appraisal for Water resource
- Review and update the Law on Water Resources other By-law to create legal corridor for water resources management.
- Priority policy in the water sector
- Developing and upgrading water Resources monitoring network
- Integrated river basins planning and Management,

- Long term financial investment strategy
- Information exchange network among the water resources coordination and management agencies for international rivers.
- Water resources information system and provide timely and accurate information for the water resources users.
- Effective operation of water resources inspection.
- The type of water resources for the future

Orientation of water resource usage for the future is surface water; underground water will be kept as a national storage water source.

- ***Planned investment over next 5 years (2006-2010):***

Planning and management mechanism, technology development, human resources development, upgrading and modernizing water resources structures, multifunction reservoirs, water supply and sanitation, water resources protection, small case water resources development in mountainous area, water supply for Mekong Delta, natural disaster mitigation.