Strategies for the Improvement of

Water Supply and Wastewater Management Services in Malaysia

Volume 1

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Foreword

The recently concluded United Nations Sustainable Development Summit that met in New York from 25-27 September 2015 formally announced the *Sustainable Development Goals (SDGs)* until the year 2030, endorsed by participating nations, including Malaysia. This new agenda comprising 17 SDGs sets out a "supremely ambitious and transformational vision" that envisages among many aspirations, "*a world where we reaffirm our commitments regarding the human right to safe drinking water and sanitation and where there is improved hygiene*". Sustainable Development Goal No.6 specifically focuses on ensuring "availability and sustainable management of water and sanitation for all". It reiterates the implementation of Integrated Water Resources Management (IWRM) at all levels by 2030. Universal and equitable access to safe and affordable drinking water for all, access to adequate sanitation and hygiene for all, substantial increase in water-use efficiency, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally, are some of the specific targets set for achievement by 2030.

Against the above back-drop, the Academy of Sciences Malaysia (ASM) is pleased to report that, since 2008, it has through its dedicated ASM Water Committee actively pursued the IWRM agenda and has conducted a series of in-depth studies on various water-related themes considered as sub-sets of the central IWRM theme. One of the recently concluded thematic studies is this Study Report entitled *Strategies for the Improvement of Water Supply and Wastewater Management Services in Malaysia*, which has direct relevance to the aspirations of SDG No.6 mentioned above. The Study Report has recommended some 21 strategies addressing a wide range of management attributes pertaining to the sector.

This Strategy Plan Report is yet another important deliverable of the ASM as part of its mandate to provide strategic advice to the government. We are confident that the findings, recommendations and strategies contained herein would assist the government, and *Kementerian Tenaga, Teknologi Hijau dan Air* (KeTTHA) in particular, in the exercise of its functional responsibility for the provision of water supply and sewerage services nationwide.

Congratulations to the members of the ASM Task Force on Water Supply and Wastewater Management for the timely production of this Study Report, and to the ASM Water Committee for successfully overseeing the many IWRM-related studies, including this one.

TAN SRI DR AHMAD TAJUDDIN ALI F.A.Sc.
President
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Preface

Adopting Integrated Water Resources Management (IWRM) as the central thrust, the Academy of Sciences Malaysia (ASM), has, since 2008, been conducting in-depth studies pertaining to a number of topics identified as sub-sets of the central IWRM theme. The studies also undergo a process of strategic consultations with relevant institutional, community and private sector stakeholders, culminating in the preparation of a strategy plan or advisory report for consideration and adoption by the relevant authority or agency responsible for its implementation. One of the key studies undertaken and overseen by the ASM Task Force on Water Supply and Wastewater Management completed in June 2015, is entitled *Strategies for the Improvement of Water Supply and Wastewater Management Services in Malaysia*.

In this study, *"water supply"* refers to that provided for domestic and industrial use only, and *"wastewater"* refers to effluents originating from domestic and industrial usage, also termed as sewerage.*"Water Supply and Wastewater Management (WSWWM)"* refers to the provision of utility services seen from an IWRM perspective whereby a holistic approach is pursued based on the 1992 Dublin Principles on Water and encompasses technical, economic, administrative, financial and social considerations. Hence, WSWWM aims at integrating water supply and water demand, water and wastewater, to ensure enhanced water supply security while safe guarding the sustainability of the water resource.

In leading up to the preparation of this strategic planning report, a position paper was first commissioned in June 2012 to assess the current status and needs pertaining to water supply and wastewater services in Malaysia. The outcome of this assessment study is the report entitled *Study on the current Status and Needs Assessment for Water Supply and Wastewater Management in Malaysia* completed by the study team in July 2014.

Upon completion of the position paper referred to above, the ASM Task Force proceeded to develop the strategies to chart the way forward for the improvement of water supply and wastewater management services in Malaysia. Reference was also made to parallel study reports undertaken by ASM under the IWRM agenda which were considered relevant to the topic of water supply and wastewater management services, namely:

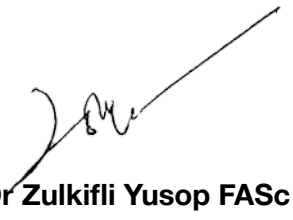
- Water and Climate Change;
- Groundwater Resource Development and Management;
- Setting a National Agenda for Integrated Water Research in Malaysia;
- Water Demand Management;
- Water-Food-Energy Nexus (Concept Note); and
- Mega Science Study on Water.

Drawing from the findings and recommendations contained in the above mentioned reports and the valuable feedback gathered from the stakeholder consultations, the Task Force completed this Study Report entitled *Strategies for the Improvement of Water Supply and Wastewater Management Services in Malaysia* in June 2015. Some 21 strategies have been recommended addressing a wide range of management attributes, namely governance, information management, planning and development, operation and maintenance, technological/ economical/financial instruments, participatory management, green technology, water for wealth creation, climate change, R&D, capacity building, water-food-energy nexus, and international cooperation.

The successful completion of this strategic planning report would not have been possible without:

- The constructive and timely guidance provided by members of the ASM Water Committee;
- The full cooperation, support and commitment of the Task Force members;
- The valuable findings and documentation by the Current Status and Needs Assessment Study Team; and
- The continuing support services provided by the ASM Secretariat.

We take this opportunity to commend them all for their invaluable contribution. Above all, we would like to place on record our deep appreciation for the strong support and cooperation of the many water-related institutional and community stakeholders from the public, private and NGO sectors that participated and provided valuable feedback at the many strategic consultations that were held.



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Executive Summary

The Academy of Sciences Malaysia (ASM), an independent think tank providing strategic advice to the government on science, technology and innovation matters since 2008 has been undertaking studies pertaining to the water sector, considered strategic for the country's economic development. One of the key studies undertaken by the Academy is entitled *Strategies for the Improvement of Water Supply and Wastewater Management Services in Malaysia*.

Growing population (including a fairly large migrant population) and urbanisation in Malaysia coupled with the fast pace of economic development has led to increased water use in all sub-sectors with resultant pollution of this finite and renewable yet vulnerable resource. The National Water Resources Study 2011 highlighted some 'water-stressed' growth regions such as Perlis, Kedah, Pulau Pinang, Selangor and Malacca were listed as water deficit states. Other water-related issues reported are increased flooding, deteriorating water quality of water sources (rivers, lakes and reservoirs, and groundwater), growing conflicts among sectors, and emerging climate change impacts.

Strategies developed under this Study for the improvement of water supply and wastewater services cover a whole range of management areas, namely governance, information management, planning and development, operation and maintenance, management instruments (technological, economic and financial), R&D, green technology, capacity building, climate change, and wealth creation. Trans-boundary issues involving the food and energy sectors have also been addressed. A summary list of the 21 recommended strategies is provided in *Appendix 1*.

With the 2012 launch of the National Water Resources Policy (NWRP), and as a matter of priority and for good governance, it is recommended that a National Water Services Policy be formulated which is consistent with the NWRP, ensures water supply security with the integration of water supply and sewerage services and fosters a cultural shift from hitherto water supply management dominance towards greater water demand management. Consequential amendments to respective legislation and review of institutional structures would also be necessary.

The integration of water supply and sewerage services offers yet another opportunity for a holistic approach towards optimal use of both raw water and wastewater through the adoption of green technology practices of "reduce, recycle and reuse". Treated effluents are not only beneficial for non-potable use but also ensure protection from pollution of the country's water sources, namely rivers and other water bodies.

The Study noted that non-revenue water reduction has been a long standing issue and The National Water Services Commission is actively pursuing to address this problem by setting initially a national target of 25% by 2020 for compliance by all operators. These efforts must be accompanied by strong water demand management measures foremost of which is to ensure that the right pricing of water is an integral part of the water services reform initiatives and as a deterrent to wastage of water. The Study noted further that the National Water Services Commission has embarked on establishing a tariff setting mechanism, for Peninsular Malaysia and F.T. Labuan that is robust, fair and transparent. Needless to say, the successful implementation of such financial

instruments requires strong political support and commitment. Technological instruments to ensure the mandatory use of water saving devices and appliances and consumer awareness campaigns and education programme are all part of the wide array of measures recommended for implementation on a sustained basis.

The Study also noted that a major impediment to achieve "operation excellence" is the dire shortage of trained operations and maintenance personnel nation-wide to manage both the water supply and sewerage systems. A strong and sustained capacity building programme is recommended together with the establishment of regional training centres. The appropriation of adequate financial resources is equally vital to ensure speedy accomplishment of this undertaking.

A continuing integrated water research programme is also vital to ensure sound and effective solutions, based on the best of science, engineering, technology and innovation, are readily available for the development and management of world class infrastructural systems.

The above mentioned recommendations together with the other strategies listed in *Appendix 1* would form a sound basis for improvement of water supply and wastewater services in the country with the ultimate goal of ensuring that good clean tap water is available and the state of the environment is safeguarded through the use of green technology befitting a nation aiming for a developed country status by 2020.

Acknowledgement

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Appendix 1

List of Strategies for Improved Management of Water Supply and Wastewater Management Services in Malaysia

Management category	Strategy
a) Governance	**Strategy 1 -** Formulation of a National Water Services Policy (NSWP). **Strategy 2 -** Review all relevant legislations at both Federal and State levels to be consistent with the proposed NWSP. **Strategy 3 -** Review institutional structures at all hierarchical levels following the integration of the water supply and sewerage sectors. **Strategy 4 -** Expedite migration to Water/Services Industry Act.
b) Information Management	**Strategy 5 -** Implement Management Information System to cover both water supply and sewerage services at the national level.
c) Planning and Development	**Strategy 6 -** Develop alternative sources of water supply for use singly or conjunctively with surface water. **Strategy 7 -** Seeking exemption of aluminium sludge as a scheduled waste. **Strategy 8 -** Centralised versus decentralised wastewater treatment system. **Strategy 9 -** Review scope and coverage of sewerage services to ensure proper management of sewarage treatment plant effluent.
d) Operation and Maintenance	**Strategy 10 -** Reduction in non-revenue water. **Strategy 11 -** Water Safety Plans.
e) Technological, Economic and Financial Instruments	**Strategy 12 -** Application of innovative technologies for water supply and wastewater sectors **Strategy 13 -** Water tariff adjustment and appropriate tariff structure to reduce wasteful consumption.
f) Participatory Management	**Strategy 14 -** Engaging the consumers and the public in water conservation initiatives and the role of water forum.
g) Green Technology	**Strategy 15 -** Reduce, reuse, recycle.

h)	Water for Wealth Creation	**Strategy 16 -** Implement projects and services for wealth creation.
i)	Climate Change	**Strategy 17 -** Implement adaptation and mitigation strategies in response to the impacts of climate change.
j)	Research and Development	**Strategy 18 -** Pursue continuing integrated research on water supply and sewerage systems, products and services.
k)	Capacity Building	**Strategy 19 -** Training of operations and maintenance personnel towards achieving “operation excellence”.
l)	Water-Food-Energy Nexus	**Strategy 20 -** Develop together with the food and energy sectors a common Water-Food-Energy Nexus framework.
m)	International Cooperation	**Strategy 21 -** Enhancing networking and international cooperation.

List of Abbreviations

ASM	Academy of Sciences Malaysia
BCM	Billion Cubic Metres
DMA	District Metering Areas
DOE	Department of Environment
FOMCA	Federation of Malaysian Consumers Association
ICWE	Conference on Water and the Environment
IRBM	Integrated River Basin Management
IST	Individual Septic Tanks
IWA	International Water Association
IWK	Indah Water Konsortium
IWRM	Integrated Water Resources Management
KeTTHA	Ministry of Energy, Green Technology and Water
JBA	*Jabatan Bekalan Air*
MHR	Ministry of Human Resources
MLD	Million Litres per Day
MOH	Ministry of Health
MWA	Malaysian Water Association
MWIG	Malaysia Water Industry Guide
NRW	Non-revenue Water
NWRS	National Water Resources Study
OPEX	Operating Expense
PAAB	*Pengurusan Aset Air Berhad*
PWSA	Penang Water Services Academy
RBM	River Basin Management
R&D	Research and Development
SPAN	*Suruhanjaya Perkhidmatan Air Negara*
SPPCA	*Skim Pelabelan Produk Cekap Air*
SSD	Sewerage Services Department
STI	Science, Technology and Innovation
STP	Sewerage Treatment Plant
SW	Scheduled Waste
TMDL	Total Maximum Daily Load
TTLC	Total Threshold Limit Concentration
UN	United Nations
WDM	Water Demand Management
W-F-E Nexus	Water-Food-Energy Nexus
WHO	World Health Organisation
WSIA	Water Services Industry Act
WSP	Water Safety Plans

Chapter One : Introduction

Introduction

Malaysia is committed to implementing Integrated Water Resources Management (IWRM) for the sustainable management of the country's water resources since the late 1990s. The National Water Resources Policy formally launched in March 2012 further re-affirms the adoption of IWRM which calls for the balanced development and management of "**water as a resource**" and **"water for livelihood**". Implementation of it involves the integration of both natural and human systems set within an overall framework that provides the enabling environment with effective institutional arrangements and supported by necessary management instruments. Implementation of IWRM across all sub-sectors and levels of hierarchy are guided by the internationally endorsed 1992 ICWE Dublin Principles.

The Academy of Sciences Malaysia (ASM), an independent think-tank providing strategic advice to the Government on STI matters, has since 2008, been undertaking studies pertaining to the water sector which is considered strategic for the country's economic development. The studies have been overseen by a dedicated ASM Water Committee. Adopting IWRM as the central thrust and noting that IWRM *per se* is a rather abstract concept, the Committee has for practical application in the Malaysian context, broken down IWRM into discrete sub-sets or sub-themes. Each of these sub-sets or sub-themes is then subjected to in-depth studies culminating in the preparation of a strategy plan or advisory report for consideration and adoption by the relevant authority or agency responsible for its implementation. The studies also undergo a process of strategic consultations with relevant institutional, community and private sector stakeholders.

One of the studies undertaken by the Academy is entitled *Study on the Current Issues and Needs for Water Supply and Wastewater Management in Malaysia*. This study was initiated by ASM to review the current status and adopting a holistic approach to identify the shortcomings and develop strategies to improve the services provided.

The Dublin Principles on Water (ICWE 1992)

Principle No. 1 - Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle No. 2 - Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle No. 3 - Women play a central part in the provision, management and safeguarding of water.

Principle No. 4 - Water has an economic value in all its competing uses and should be recognised as an economic good.

Chapter Two:
Malaysian Water Scenario - Brief Overview of Issues and Challenges

Malaysian Water Scenario - Brief Overview of Issues and Challenges

Growing population (including the fairly large migrant population) and urbanisation in Malaysia coupled with the fast pace of economic development has led to increased water use in all sub-sectors with resultant pollution of this finite and renewable yet vulnerable resource. Fragmented management, a legacy from the past, still prevails leading to competition and conflicts in water use in some river basins.

The **National Water Resources Study (NWRS)** commissioned by the Ministry of Natural Resources and Environment which was completed in 2011 reported that the annual rainfall recorded in Malaysia was around 973 billion cubic metres (BCM), of which 414 BCM was lost to the atmosphere as evapotranspiration, 496 BCM formed surface runoff and some 63 BCM contributed towards groundwater recharge. Consumptive demand was assessed to be 14.8 BCM in 2010 and predicted to rise to 17.2 BCM in 2020 and to 18.2 BCM in 2050. With the total effective rainfall estimated at around 74 BCM sets the available resource some four times above the projected need!

The NWRS highlighted some 'water-stressed' growth regions and states such as Perlis, Kedah, Pulau Pinang, Selangor and Malacca are reported as water deficit states. Back in 1998, water was rationed for nearly 150 days for 3.2 million residents as the "national water crisis" was triggered by a protracted dry spell in the Klang Valley and parts of Negeri Sembilan, Malacca, Penang, Kedah and Perlis. More recently, a similar prolonged drought which began in February 2014 affected many regions in the country with the Klang valley experiencing the worst, also resulting in water rationing. Temporal and spatial variability of the rainfall, coupled with high population densities and/or extensive agricultural activities in these regions led to water demands exceeding the carrying capacity of the respective river basins. The situation was further exacerbated by river pollution associated with both point and non-point source pollution that was already affecting the ecology and the functional capacity of the aquatic ecosystems.

The NWRS also highlighted other water-related issues, namely increased flooding, deteriorating water quality of water sources (rivers, lakes and reservoirs, and groundwater), emerging climate change impacts, fragmented management and growing conflicts among sectors.

For a country that is envisioned to be a developed nation by year 2020, the support of a vibrant water sector with a host of expectations of which a strong and sustained water supply and wastewater development and management programme are vital components.

Chapter Three: Current Status and Review of Malaysia's Water Supply and Wastewater Management Services

Current Status and Review of Malaysia's Water Supply and Wastewater Management Services

Before attempting to chart a strategic direction for the water supply and wastewater management in Malaysia over the medium-term to year 2020, ASM undertook a **Study on the Current Status and Needs Assessment for Water Supply and Wastewater Management in Malaysia**. This Study, commissioned in June 2012 was completed in July 2014.

The objectives of the Study were six-fold, namely:

(i) A compilation of on-going policies and strategies decided by the Government related to the water and wastewater industry;

(ii) Undertake evaluation of the achievement of the policies and strategies, review and making necessary recommendations for improvement;

(iii) Undertake study on the water safety and security countrywide with reference to the previous studies particularly the National Water Resources Study;

(iv) Recommendations of practical solutions for sustainability of industry on issues related to operations of water and wastewater facilities;

(v) To ensure comprehensiveness, all data and information compiled under items (i), to (iv) above was obtained through desk studies, from responses to suitably framed questionnaires, and through interviews with responsible personnel of relevant public and private stakeholder agencies and organisations. Prior to their adoption, all information was duly validated with their respective sources; and

(vi) To submit a report to ASM addressing items (i) - (v) above.

A copy of the Study Report appears as **Volume 2.** The main findings of the Study are summarised hereunder and comprise two parts:

3.1 Current Status, Issues and Challenges

The Study highlighted a number of issues and challenges facing the water supply and sewerage services sector as follows:

(a) Policies, Strategies and Issues on Water Supply and Wastewater Sectors

The water supply and wastewater industries are governed by two Acts, the *Suruhanjaya Perkhidmatan Air Negara* Act 2006 (Act 654) and the Water Services Industry Act 2006 (Act 655). Act 654 empowers a Commission to regulate both the water supply and wastewater industries in Peninsular Malaysia, and the Federal Territories of Putrajaya and Labuan. Act 655, on the other hand, was promulgated for the purpose of ensuring uniformity of law and policy for the proper control and regulation of water supply services throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan whereas for sewerage services and systems, it covers the whole of Malaysia.

There has not been a clear policy pertaining to sewerage services to guide the industry although Section 15(a) of The National Water Services Commission

Act mentioned a national policy objective for the sewerage industry. A National Sewerage Policy draft was prepared in 2010 but is yet to be approved by the relevant authorities for implementation. The *Jabatan Bekalan Air* (JBA) had drafted a water supply policy for the water supply sector in 2012 but this draft has also yet to be approved for implementation by the authorities.

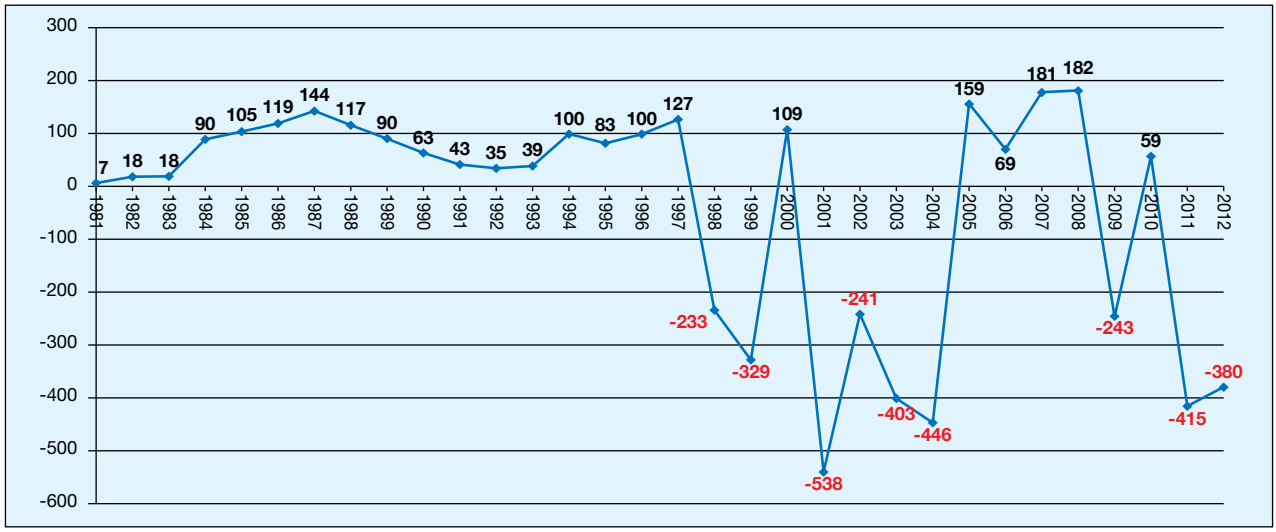
(b) Tariff Setting

Water operators are not able to implement proper water supply management initiatives due to inadequate revenue from the low tariff scheme in place now and thus are not able to implement good business practices because of their small earnings.

In the wastewater sector, the current tariff rate is also low for an efficient and sustainable sewerage services industry. Operating at an annual loss of more than RM75 million proved that the tariff mechanism is not possible for the operators to recover full costs. Comparing the size of the industry to others, sewerage is just 10% of the water industry, too small to compare to energy and communications companies.

The current practice of tariff review is seen to be as not inadequately facilitated. The negative impacts of low tariff on water industry are as follows:

(i) The low tariff had resulted in deficit in the revenue to cover the expenditure (Figure 1). This is not sustainable and has resulted in poor services and system inefficiencies;



Negative figure shows deficit in operational expenditures

(Source: MWIG 1998/1999 & MWIG 2013)

Figure 1: Revenue minus expenditure of water supply industry in Malaysia between 1981 and 2012.

(ii) The trend of losses was evident from 1998, possibly due to the cost incurred in paying for water production concessions in a number of states. Hence, the effort for restructuring and regulating water industry in a holistic manner is inevitable;

(iii) Some states had their last tariffs reviewed in the 1980s. In the past, this was attributed to the lack of political determination at state level to raise the tariffs. The political unwillingness was expected for fear of losing political support in future elections. This is unhealthy and tariff setting should be based on economic and performance considerations and free from political agenda;

(iv) Repairing pipe leaks is more costly than the losses incurred by letting water to leak; and

(v) Initiatives to use alternative sources, such as rainwater harvesting or efforts to recycle, reuse and reduce water, are not economically feasible since the savings anticipated from these initiatives do not justify implementing these initiatives.

(c) Role of *Forum Air*

Forum Air Malaysia was formed under Sections 69 and 70 of the Water Supply Industry Act and entrusted to assist National Water Services Commission (*Suruhanjaya Perkhidmatan Air Negara* — SPAN) in carrying out public water fora as stipulated under the WSIA 2006.

However, there had apparently been not much interaction between *Forum Air* and the industry. This is particularly important since *Forum Air* does not only address issues around consumerism but also acts as a conveyor of information pertaining to services and works of the industry players. The present act is limited to interaction with consumers. It is crucial to ensure that the water supply and sewerage services companies are aware of, and responsive to concerns about their services.

(d) High Non-revenue Water (NRW)

NRW in Malaysia is still high with the national average of 36.4% with four states, Pahang, Kelantan, Sabah and Perlis having NRW levels exceeding 50%.

(e) Water Safety Plans (WSPs)

The NWRP 2012 embodies water safety and security in its vision and objectives and takes into cognizance the IWRM principles in water resources management. WSIA also requires all its licensees "to maintain at all times the security, integrity and safety of its water supply system and sewerage system and all other assets in relation to the systems". However, WSPs has not been implemented yet by the water operators. In line with the World Health Organisation-International Water Association (WHO-IWA) requirements for WSPs, which it has been promoting since 2005, the Ministry of Health Malaysia is currently championing the development of WSP and is planning to include WSP in the proposed Safe Drinking Water Act. At the national level, an action plan is being implemented to initiate the development of WSP. Each water operator has been assigned to develop a pilot project.

Factors that could affect water quality are addressed in the Water Services Industry Act 2006 (Act 655), among them being the following sections: *Section 34 — Security, integrity and safety of water*

supply and sewerage system; Section 35 — Duty of facilities licensee in respect of water supply and sewerage system; Section 41 — Water quality; Section 61 — Prohibited effluent or noxious matter not to be discharged into public sewer, etc.; Section 121 — Offence of contamination of water; Section 122 — Wrongful acts.

It is further noted that the Act had a clause relating to the development of WSP, viz. *Clause180. The Commission may make such rules for all or any of the following matters: (k) All matters relating to the safety and security of water supply and sewerage systems; (l) All matters relating to the formulation and implementation of water and sewerage safety plan.*

Currently, there are only 27 WSPs developed, or 6% of the total 458 water systems. The water operators that have developed WSP are Syarikat Air Johor (SAJ) — 1 system, Lembaga Air Perak (LAP) — 7 systems, SYABAS — 1 system and SATU — 1 system. In addition the Ministry of Health (MOH) has developed 28 WSPs under the rural water supply scheme. WSP for sewerage systems has yet to be explored.

The current constraints facing the water supply and sewerage industry on WSP are as follows:

(i) No incentive for water operator to provide good quality potable water;
(ii) Low priority by regulator to enforce the development of WSP;
(iii) Lack of facilitators to assist operators in WSP development;
(iv) Insufficient funding to develop WSP;
(v) Legislative and jurisdictional uncertainties on catchment pollution especially on non-point source pollution, sullage and septage; and
(vi) Very poor awareness and response to WSP development.

(f) Aluminium Sludge as a Scheduled Waste (SW)

The Environmental Quality Act's (EQA) Regulations 2005 had included metals such as *chromium, nickel, zinc, lead, cadmium, aluminium, tin, vanadium and beryllium* as scheduled wastes (SW204). As most of the plants use alum, polyaluminium chloride or other aluminium-based coagulants, aluminium concentrations are expected to be high. A study in 2007/2008 of the sludge in Water Treatment Plants showed that the values of aluminium concentrations ranged from 1,100 mg/kg to 79,200 mg/kg with an average of 29,677 mg/kg. However, it is interesting to note that there is no aluminium threshold limits specified in the total threshold limit concentration as specified in the Department of Environment, Malaysia Guidelines for the application of special management of scheduled waste.

A study by Malaysian Water Association (MWA) recommended that the sludge should not be considered as a scheduled waste but as ordinary wastes which are subjected to other existing regulations, such as effluent standards for direct discharge or threshold limits for landfill and land applications.

There was also a suggestion made earlier to DOE that the sludge from aluminium be given similar treatment as —*spent activated carbon excluding carbon from potable water and processes of the food and vitamin production (SW411).* This was not agreed by DOE

and the status of aluminium as SW remains unchanged.

The classification of aluminium waste as a SW requires the treated sludge to be transported to designated landfills which would raise the cost to the operators to bear. It was estimated that the cost of disposal of aluminium sludge at municipal landfills and *Kualiti Alam* is RM0.06 and RM1.58, respectively per cu.m.of water produced. Hence, the annual cost for the whole country may exceed RM10 billion a year if all the sludge is to be stored in drums and sent to *Kualiti Alam*, double the annual revenue which is currently about RM5 billion.

(g) Integration of Water Supply and Wastewater Services

There has been much discussion on the subject of integration of water supply and wastewater services but there has not been any progress. The issue needs to be addressed in a holistic manner taking cognition of the difficulties of collecting revenue for sewerage if it continues to be operated as a separate entity. Water companies are not keen to share their profit and taking sewerage as part of their responsibilities without seeing the profitability of sewerage services. Hence, integration efforts should look at the tariffs in the sewerage services as well as on considering a combined billing for water supply and wastewater services. This was done before but did not succeed. If integration of the billing is difficult to be carried out, it is envisaged that integration of the two services will even be more difficult.

(h) Reduce, Reuse, Recycle

Another finding of the Study pertains to reusing and recycling of the water supply and wastewater. Water used by large consumers is not lucrative to be recycled as the price of water is cheap. Similarly, in the wastewater sector, as quality of sewerage treatment plant (STP) effluent increases, there is a need to look at how the effluent can be reused for purposes other than for potable use. The possible reuse and recycle of treated effluents may be considered for non-potable purposes and industrial usage could be relieved from current water demand burden. With the limited source of fresh, clean water anticipated in future, recycling and reusing effluents is one option. This will also contribute significantly to reinforce the green initiative of the government.

(i) Sewerage Services Coverage

Currently, sewerage-related issues are dealt with by different authorities, namely:

(i) Ministry of Energy, Green Technologies and Water for urban areas;
(ii) Ministry of Health for the rural areas;
(iii) Ministry of Local Government and Housing; and
(iv) Local governments for internal sanitary plumbing.

Sullage is not currently part of domestic wastes and is allowed to flow into the drains which pollutes rivers, the main source of raw water for drinking purposes. Although the management of sullage would be under the prerogative of local Governments, it is viewed that it will not work well as these institutions do not have sufficient, and the personnel with the necessary technical expertise. About a third of the sewerage system is still using individual septic tanks and pour-flush systems.

(j) Capacity Building

Three years have passed since the formation of the national training Malaysian Water Academy (MyWA), which is tasked to consolidate and standardise various training programme especially related to competency. MyWA would also address the current obstacles facing the water supply and sewerage industries on capacity building. However, the following issues need to be resolved first:

- The regulator has yet to enforce the competency requirement on the state operators in operating the water systems;
- Lack of financial support for developing water competency modules as well as acquiring training equipment facilities;
- No government funding to support the capacity building programme for water supply and sewerage industries as the state water operators have financial difficulty to participate in; and
- Very poor response from the state water operators to take up the competency assessment and knowledge-based training programme provided under MyWA.

To operate the water supply and sewerage systems, the competency requirement is duly addressed in the Water Services Industry Act 2006 (Act 655), Sections 49 (1) and (2) and the critical findings of this study are given below:

- Three competency programme for the sewerage sector are fairly well established with major participation from the private sector, such as the contractors and private-run STPs. This is due to the fact that the Department of Environment had enforced the requirement;
- The refresher course for Confined Space with a 3-year cycle has also attracted a large number of participants as it is compulsory for their license renewal;
- Other competency and knowledge-based programme has not really taken off. It is also noted that Indah Water Konsortium Sdn Bhd (IWK), being the largest sewerage operator, has not enforced its staff to undergo the same programmeas imposed on to the other parties; and
- For the water supply sector, MWA is currently pursuing with KeTTHA to obtain a grant to assist MyWA in developing competency modules and to acquire laboratory equipment and other facilities for competency training and practical examination.

3.2 Study Recommendations

In addressing the issues and challenges highlighted above, the Study made the following recommendations:

a) Policies, Strategies and Issues on Water Supply and Wastewater Sectors

Since both water supply and wastewater sectors do not as yet have a national policy, it is timely that a National Water Services Policy be developed to complement the NWRP 2012 by the Ministry of Natural Resources and Environment, as well as the National Green Technology Policy, which was launched in 2009 by the Ministry of Energy, Green Technology and Water

(KeTTHA). KeTTHA could provide the necessary clarification on the policy for different states. The policy should be reviewed from time to time.

The national policy objectives pertaining to sewerage services must be well defined to ensure that sewerage industry will progress on the right track. The national policy should provide solutions through a national sewerage development plan focussing on issues related to sewerage catchment and local sewerage plans, facilities and infrastructure together with the operations and management of the industry.

In the issue of states not having migrated to WSIA, the Study recommended that the Federal Government facilitates deficit water entities by providing grants until the new tariffs are able to recover operational expenses, provide more leniency in restructuring of debt by taking into account the high cost of these entities providing the necessary infrastructure in rural areas as well as set a new target date, probably, by end of 2016, for all state water entities to migrate. The Study further recommended that companies should not be burdened with the debts of previous entities as it will only burden the people in the end. This is where Government assistance would be needed. PAAB would need to consider allowing more 'reasons' for new operators to migrate.

b) Establishment of a Fair and Efficient Tariff Mechanism

Water tariffs should be reviewed at regular intervals until they reach full-cost recovery before 2030. Any increase in electricity tariff should automatically lead to an upward revision of water tariffs. A strategy of full-cost recovery should be targeted for sustainability of the water supply industry. The current water tariff setting mechanism must incorporate these objectives. An independent party, such as SPAN, should take the responsibility of setting the tariff, as is practised in Australia. The tariff rates adjustment is to be done in a transparent and holistic manner and subsequent announcement on tariff reviews is to be conducted by SPAN. SPAN, upon concurrence of the state governments, should announce the new tariff.

c) Role of *Forum Air*

The role of Water Forum in the need for the public to understand the tariff situation in the country must be further explored with more dissemination of information and discussions held. SPAN, as the custodian of the information, should allow access to this information. *Jabatan Bekalan Air* (JBA), assisted by the MWA, could organise discussions on the assessment of the value of water.

Forum Air should be strengthened by getting industry players involved and not just limited to consumer enthusiasts. *Forum Air* would also need to engage organisations, such as MWA/SWAn. In this way, dialogues between all parties can be enhanced.

d) Non-revenue Water (NRW)

The implementation of NRW must adopt a holistic approach with the following steps:

- Accurate measure of water balance components;
- Immediately attend to all complaints on visible leaks;

- Metering of production;
- District Metering Areas (DMA) and pressure management; and
- Selective pipe change.

This process should be addressed in the order of priority as given above as close as possible so as to follow a more systematic approach. As an example, there are operators who opted for pipe change as one way towards reducing NRW. However, it is quite difficult to assess the effectiveness of this NRW approach since there is no means to measure the baseline NRW for the area in which the pipes have been changed.

In managing NRW, the Study proposed a number of mechanisms, as follows:

(i) **Establishment of Water Balance**

Water Balance is a tool developed by the International Water Association (IWA). It enables the evaluation of the magnitude of every component of NRW (Table 1):

Table 1: Water Balance components for Non-revenue Water Assessment

System Input Volume	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption	REVENUE WATER
			Billed Non-metered Consumption	
		Unbilled Authorised Consumption	Unbilled Metered Consumption	NON-REVENUE WATER
			Unbilled Non-metered Consumption	
	Water Losses	Apparent Losses	Unauthorised Consumption	
			Metering Inaccuracies	
		Real Losses	Leaking Transmission/Distribution	
			Leaking/Overflows from Tanks	
			Leakage on Service Connection	

It is necessary that the application of Water Balance as an NRW management tool be actively adhered to. Accurate and reliable data is essential to obtain useful Water Balance. In doing so, the following fundamentals need to be addressed:

- Standardisation of Terms and Measurements; and
- Specific approach according to NRW situation.

a. Standardisation of Terms and Measurements

This definition has to be standardised throughout the nation and the person responsible for the collection and analysing the data needs to have the same understanding of the terms used. Even though IWA has developed the formula for every component of the Water Balance, the methods

of measurement, data collection and reporting format and frequency have to be standardised.

SPAN will be the best agency to regulate the water companies in Peninsular Malaysia and Labuan with the respective state regulatory agencies in Sabah and Sarawak regulating their water companies.

It is essential that data and records submitted to SPAN be gathered correctly since the information will be used in decision making including determining tariff rates. The aspects lacking in the NRW implementation are:

- Training; and
- Auditing.

Some states, such as Selangor, Johor, Malacca, Perak and Penang, have already established their own standard operation procedures in producing the Water Balance tool, thus can be emulated by other states after standardisation is achieved at the national level.

b. Specific Approach According to NRW Situation

As mentioned earlier, there are several approaches in addressing NRW. The NRW *Leadership Workshop*, held in New Delhi in 2010, agreed that in adopting a holistic approach in NRW management, the solution for each state is different and need to suit their respective problems.

In brief, the approach can be simplified as follows:

(i) Prompt repair of visible leaks;
(ii) Ensure accurate production meters;
(iii) Establish district metering zones;
(iv) Undertake pressure management; and
(v) Implement selective pipe replacement.

The approaches should be implemented in the range of priority as listed above but there is no restriction to implement them simultaneously, rather to vary according to each state's NRW situation.

NRW must be taken seriously and due attention must be given as there had not been much change since the *Water Loss Asia (WLA) 2010* event except for the formation of the NRW Task Force at SPAN. The focus has been more on technical issues whereas inadequate funding to undertake NRW programmes has long been the main barrier to a holistic approach.

The Study felt that the role of PAAB is indeed crucial to sort out the high NRW in most states. The success evidence in Malacca and Penang was very much attributed to the high management commitment in reducing NRW. Hence NRW reduction should be an important component of the business plan that PAAB would need to look into to assist the water operators.

The Study suggested that a good practice that PAAB could adopt is to tie conventional project

loans to NRW projects. This was done in the past where international funders, such as the World Bank and the Asia Development Bank, included a condition that borrowers appoint consultants and carry out proper auditing, policy evaluation or/and implementation of the NRW programme planned by the operators. Having a clear policy and direction, coupled with proper planning, will be important to ensure NRW is always a top priority to the management. It must be realised that putting NRW programme on hold while waiting for funds will waste much of the improvement efforts previously achieved. Continuity of NRW implementation is a must and in need of adequate funding.

c. Develop Comprehensive Asset Management Plan

Asset management plan is part of the NRW reduction programme. Funding is required for the implementation of NRW reduction and in sustaining it. A rough estimate of RM250/- per metre of pipe replacement will total some RM10.97 billion to change the length of AC pipes and communication pipes.

This programme could take 20 years to complete if the required annual budget of about RM550 million is allocated. This amount does not include the funds needed for the NRW programme.

d. Tariff Review Strategies

The following strategies for tariff reviews are proposed:

(i) The review should allow for inflation, increase in fuel costs and power costs;
(ii) The review should be gradual and implemented on a yearly basis; and
(iii) Effective role to be played by *Forum Air* together with SPAN.

e. Asset Management Strategies

The following strategies are proposed for Asset Management:

(i) Asset tagging and mapping;
(ii) Proactive pipe replacement system;
(iii) GIS for distribution system; and
(iv) DMA establishment.

f. Public Engagement Strategies

As NRW affects the general public over the long run, the following strategies are proposed for public engagement:

(i) Media and public support for awareness on the value of water and NRW reduction
(ii) Continuous campaigns on the importance and true/right values of water
(iii) Reward and appreciation platform to consumers; and
(iv) Indicate actual cost of water in bills.

g. Role of SPAN

The Study proposed the following strategies for SPAN:

(i) Obtain accurate baseline data;
(ii) Baseline prepared by vendors independently;
(iii) Baseline cannot be changed during contract commencement;
(iv) Determining of target level for each component;
(v) Realistic targets; and
(vi) Proper specification and project management.

h. Water Safety Plans (WSPs)

The Study recommended that SPAN enforce the mandated WSP formulation and implementation. The Study Team also felt that there was a need for a minimum yearly review of WSPs to be made. The following targets could be set to be achieved by the industry:

(i) Enforcing the development of WSP for all water and sewerage systems;
(ii) Utilising WSP in improving operation and maintenance;
(iii) Utilising WSP in the budget for improvement works to reduce risk and enhance reliability and efficiency; and
(iv) All water operators to adopt WSP which covers from source to tap.

The Study further suggested that water NGOs, such as the Malaysian Water Association, play a role in promoting WSP even at Ministry level to get support from water agencies such as JBA Malaysia and SPAN.

The Study recommended that the importance of WSP needs to be highlighted and adequate funding to be provided to water operators to develop and implement WSP. Towards achieving this end, it was suggested that SPAN/Ministry of Health (MOH) should set targets as the Team considered WSP as the tool to assess the reliability of facilities.

It is also crucial for a national steering committee on WSP be established to deal with legislative and judicial uncertainties, and the implementation of programme. The steering committee could be jointly managed by both KeTTHA and MOH whose task was to develop a master plan and implement it accordingly. The Study also suggested that SPAN enact the regulations under WSIA for implementation by the operators.

i. Aluminium Sludge as a Scheduled Waste (SW)

Specific exemption is recommended for the potable water treatment sludge residues, based on findings on the characteristics and also based on practices in other countries, where these residues are not considered hazardous wastes. As such, the Study recommended for aluminium residues from Water Treatment Plants to be omitted from the list of scheduled wastes under SW204. In moving this recommendation forward, the Study recommended that KeTTHA/JBA prepare a Cabinet Paper to resolve the issue.

j. Integration of Water Supply and Wastewater Services

On the issue of integration of the water supply and wastewater services, the Study recommended that KeTTHA prepare a National Water Services Policy (NWSP) that will include proposing initiatives towards integration of both the water services and wastewater sectors. Towards achieving this end, KeTTHA could mobilise both industries and the relevant stakeholders to prepare the NWSP.

The Study recommended that an integrated management system could also chart the national development goals of the sewerage services to ensure that all sewerage-related issues are well addressed with uniformity. The integration would be able to look at every party's interests, both in the rural and developed regions, while continuing to protect the environment for long-term sustainability.

k. Sewerage Services Coverage — Management of Pollution from STP

There are nearly 6,000 public sewage treatment plants and nearly 2,400 private plants. The national coverage policies should also address issues pertaining to the operations and management of all the private and public STPs as poor management could result in pollution. Some of the methods to control pollution that could be incorporated in the national policy objectives are:

(i) All sources of sewage discharge be identified and quantified;
(ii) Possibility of the provision of interceptor sewers as was done for the Sungai Malacca rehabilitation programme;
(iii) The concept of River Basin Management (RBM) be implemented which includes the issue of storm water and industrial discharges to be part of the sewerage services which should be best to deal with; and
(iv) Advocate the implementation of total maximum daily load (TMDL) to support the RBM approach by considering the river capacity to assimilate pollutant. This requires polluters to meet specific effluent discharge standards.

The Study recommended that sullage be part of the sewage to be treated in the existing STPs. However, the preliminary treatment before entering into the sewerage system should be provided and monitored. The management of all aspects of sewerage services and other related issues should be under the purview of SPAN as the regulator. SPAN should regulate all types of sewerage systems, including the primitive pit toilets, pour flush, and direct discharges and upgrading of conventional and decentralised sewerage systems.

The Study suggested for standards of sewage treatment plant effluents to be improved to enable reuse while reducing pollution loading to rivers. In achieving this goal, it's recommended

that SPAN/Sewerage Services Department work with IWK to undertake plant evaluation towards proposing effective refurbishment works.

I. Capacity Building

To overcome the issue of inadequate capacity building among the operators, the Team proposed the following strategies:

(i) Development of competency modules through funding by the government;
(ii) Procurement of training equipment and facilities;
(iii) Enforcing the participation of all water supply and sewerage operators in competency programme over an agreed period by the industry players;
(iv) Enforcing Section 49 WSIA to ensure water supply and sewerage systems are handled by competent staff; and
(v) Enforcing all staff in both industries to attend knowledge-based courses for a designated number of days annually.

To ensure the success of these strategies, the following recommendations were proposed:

(i) Government to establish a centralised training centre for water supply and wastewater services with KeTTHA being tasked to plan and budget for building the training centre;
(ii) Government to provide funding for conducting competency and knowledge-based programme; and
(iii) All water operators must enroll in competency and training programme currently carried out by training centres and institutions endorsed by SPAN and with SPAN/PAAB to ensure that all stakeholders allocate the necessary funds for training.

Chapter Four: Strategies for the Improvement of Water Supply and Wastewater (Sewerage) Management Services in Malaysia

Strategies for the Improvement of Water Supply and Wastewater (Sewerage) Management Services in Malaysia

The current status study highlighted in Section 3 above has clearly exposed weaknesses in the existing water supply and wastewater (sewerage) management services governance structure, gross inadequacies in resource allocation, but more importantly, inadequate sectoral capacity building to support the sustainable development and management of both the water services sectors.

Based on updated information and after further scrutiny, it was noted that the following pertinent matters were not addressed by the Study but which merit consideration:

- **Incorporation of IWRM Principles and Practices**: In reviewing the two Acts, the *Suruhanjaya Perkhidmatan Air Negara (SPAN)* Act 2006 (Act 654) and the Water Services Industry Act (WSIA) 2006 (Act 655) it is clear that there is no sufficient infusion of IWRM principles and practices, an essential prerequisite under the NWRP 2012 and for the achievement of the Millennium Development Goals and the soon to be launched post-2015 Sustainable Development Goals. IWRM compliance calls for the integration of both natural and human systems as illustrated in **Figure 2**.

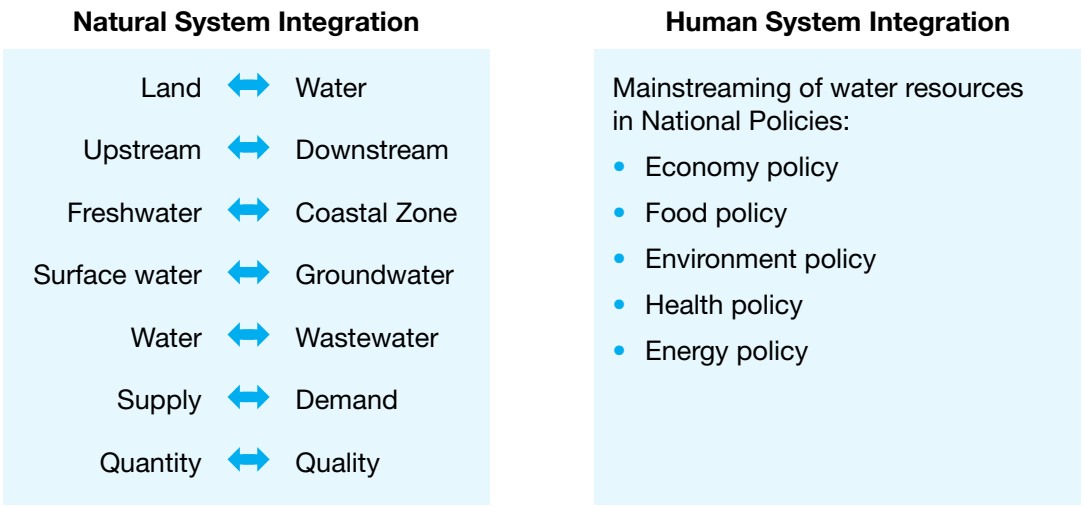


Figure 2: Integration of Natural and Human Systems in Integrated Water Resources Management

IWRM aims for a balanced development of "water as a resource" and "water for livelihood" and implementing agencies entrusted with functional responsibilities as resource managers or utility providers need to move away from hitherto fragmented management practices and adopt a more holistic approach in providing effective and efficient services that does not unduly compromise on the sustainability of the water resource. Hence, policies, legislation and strategies related to water supply and wastewater management services at all hierarchical levels must reflect not only the need for integration of supply and demand;

quantity and quality; surface water and groundwater; water and wastewater, but also consider the impacts and links to related policies pertaining to energy, food, health and the environment.

- **Water Shortages during Prolonged Dry Spells**: Though Malaysia is blessed with abundant rainfall; there are occasional long dry spells that have led to potable water shortages in some regions. The most recent occurrence was in 2014 and 2015 where several states including Selangor, Negeri Sembilan, Johor, Perak and the Federal Territory of Kuala Lumpur were affected leading to water rationing. The cause of the water shortage in the Klang Valley was attributed to insufficient water resources in the Sgf. Selangor Reservoir which is the raw water source for the potable water supply for more than 60% of the populated areas in Selangor, KL and Putrajaya.

- **Restructuring of Selangor Water**: The recent impasse between the Federal and Selangor Governments over the restructuring exercise of Selangor water has had a negative impact on the security of water supply to the Klang valley causing undue delays to the completion of planned Langat 2 water supply infrastructural works and resultant hardship to consumers due to frequent water rationing measures by the utility providers.

Reference was also made to parallel study reports undertaken by ASM under the IWRM agenda that are relevant to this topic of water supply and wastewater management. They are the following:

- Water and Climate Change;
- Groundwater Resource Development and Management;
- Setting a national agenda for integrated water research in Malaysia;
- Water Demand Management;
- Water-Food-Energy Nexus; and
- Mega Science Study on Water.

The above considerations and the valuable feedback gathered from wide stakeholder consultations conducted by the Task Force provided a sound basis in recommending strategies for the consideration and implementation by the government, and especially KeTTHA, the ministry vested with the functional responsibility for water supply and sewerage services. The strategies developed are based on a holistic approach involving the integration of water supply and water demand; and water and wastewater so as to ensure enhanced water supply security while also safeguarding the sustainability of the water resource. The recommended strategies have been categorised under discrete headers as follows:

4.1 Governance

(i) Policy

Strategy 1 — Formulation of a National Water Services Policy

Since both water supply and wastewater (sewerage) sectors do not as yet have a policy, it is timely that a NWSP, integrating both these sectors, be formulated that is consistent with the NWRP 2012 and complementing the National Agro-Food Policy 2011, National Green Technology Policy 2009 and the New Energy Policy (2010).

The NWRP is underpinned by the three Principles of Water Security, Water Sustainability and Collaborative Governance. Water must be regarded as a 'metaphor for peace and sustainability' and hence in the spirit of good

collaborative governance, the proposed policy must emphasize and promote inter-sector and Federal-State harmonisation, smart partnerships, and perseverance at all times to seek peaceful solutions in resolving conflicts that may arise. The proposed NWSP must adopt a holistic approach guided by IWRM principles and practices in the management of water supply and wastewater (sewerage) services that emphasizes not only the need for integration of water supply and water demand; quantity and quality; surface water and groundwater; water and wastewater, but also considers the impacts and links to externalities especially with regard to parallel national policies pertaining to energy, food, health and the environment. In providing effective and efficient services there should also be an inherent concern to ensuring the sustainability of the water resource.

(ii) Legislation

Strategy 2 — Review all relevant legislation at both Federal and State levels to be consistent with the proposed NWSP

Pursuant to the implementation of Strategy 1 above, all existing laws regarding water supply and sewerage services applicable at various hierarchical levels need review and amendments with the view of incorporating relevant provisions consistent with the proposed NWSP.

In this regard, water supply and wastewater (sewerage) services are currently regulated at the Federal level by 3 Acts, namely the Sewerage Services Act 1993 (Act 508), the National Water Services Commission Act 2006 (Act 654) and the Water Services Industry Act (WSIA) 2006 (Act 655). At the State level the list of relevant state enactments/ordinances are as follows:

(a) Terengganu Water Resources Enactment 1938;
(b) Malacca Waters Act 1920 (Revised 1989);
(c) Negeri Sembilan Water Act 1930 (Revised 1989);
(d) Kelantan Water Enactment 1935;
(e) Sarawak Water Ordinance 1994;
(f) Sabah Water Resources Enactment 1998;
(g) Sabah Water Supply Enactment 2003;
(h) Selangor Water Management Enactment 1999 (LUAS);
(i) Pahang Water Resources Enactment 2007;
(j) Perlis Waters Enactment 2011;
(k) Johor Water Enactment 2014; and
(l) Kedah Water Resources (Amendment) Enactment 2014.

(iii) Institutions

Strategy 3 — Review institutional structures at all hierarchical levels following the integration of the water supply and sewerage sectors

The integration of the water supply and sewerage sectors must be undertaken on a priority basis with a target for completion before 2020. It will also entail the reorganisation of institutional structures at national, state and district level. In the same process, the reorganisation would also cater for the implementation of enhanced water demand management programme and activities for greater effectiveness and efficiency in utility services provision.

Strategy 4 — Expedite migration to WSIA

Since only six states have migrated to WSIA, a time target should be set at 2020 for all Peninsular Malaysia states to migrate to WSIA.

4.2 Information Management

Strategy 5 — Implement MIS to cover both water supply and sewerage services at the national level

The proposed MIS will encompass the following areas:

(i) Asset management;
(ii) Water accounting, auditing and reporting;
(iii) Infrastructure systems operation (diversion works, reticulation system, treatment plants); and
(iv) Mathematical modelling (demand forecasting, water quality management).

4.3 Planning and Development

Strategy 6 — Develop alternative sources of water supply for use singly or conjunctively with surface water

Malaysia is now almost totally reliant (97%) on one source i.e. surface waters for its raw water supply, an undesirable situation over the long term from the standpoint of water security. Recent water stress events affecting a number of states have further underlined the pressing need to ensure assured water supply more so for a nation that is blessed with ample rainfall. Diversification of sources for water supply needs to be actively pursued.

(i) Conjunctive Use of Groundwater:
Current usage of groundwater is limited, estimated to contribute about 0.2 million cubic meters per day or only 1.4% of total water supply annually, the largest usage being in the state of Kelantan, the source of potable water supply since the 1930s. An earlier study undertaken by ASM in 2011 entitled *Strategic Advisory Report on Groundwater Resource Development and Management in Malaysia* recommended the following:

- That the conjunctive use of groundwater is advocated to ensure sustainability and reliability of water supply to the nation;
- That the use of groundwater is advocated to ensure the reliability of water supply during periods of long drought due to climate change;
- That the crucial role groundwater plays in ecological dynamics of river basins is widely understood and appreciated;
- That groundwater has an important and critical role to play in the Food/Water/Energy nexus in the production of high-value crops through the use of sprinkler systems and drip irrigation; and
- That, where feasible, Green Technologies be applied in groundwater development, for example, through the use of appropriate wind and solar energy technologies to drive submersibles especially in food production of high-value food crops.

(ii) Alternative Water Sources:
The NWRS 2011, in identifying other alternate water resources, had listed the following:

a) Rainwater harvesting;
b) Recycling of treated sewerage;
c) Desalination;
d) Natural lakes/ponds/wetlands; and
e) Inter-basin/State raw water transfers.

The Study cautions that factors that need to be considered when exploiting such alternative sources, among others, are economic, environmental and social.

Rainwater harvesting has been implemented in new housing development and government buildings in urban areas and has the potential of expansion on a more extensive scale. Uniform Building By-laws (Amendment) 2012 provides for Rainwater Harvesting and Utilisation system to be installed in bungalows and semi-detached houses with a roof area equivalent to or more than 100 sq.m. Case examples such as the 1 Utama New Wing building having a roof area of over 30,000 sq.m. collects adequate rainwater storage for 10 days usage of the shopping centre. The harvested rainwater usage is restricted to toilets flushing, air conditioning cooling towers, car park washing and landscape irrigation.

With the integration of the water supply and wastewater sectors, the **Recycling and Reuse of Wastewater** poses a great opportunity and challenge to sustainable economic development under conditions of water scarcity. Wastewater reclamation is an attractive option for applications involving non-potable use such as in agriculture or in industries for cooling systems, boiler feed water, process water, site irrigation, fire protection, and in municipal use for cleaning purposes.

Currently, STPs operated by IWK, generate about 4,000 Mld of treated effluent that is discharged to receiving waters. This is about 25% of the total water supply production of the country available for non-potable use, not to mention the benefits of reduced pollution from return flows entering river systems.

Strategy 7 — Seeking Exemption of Aluminium Sludge as Scheduled Waste

Aluminium sludge currently appears in the list of scheduled wastes considered hazardous under SW204. Based on the findings of the characteristics and following practices in other countries, such residues are not considered hazardous. Hence, the Study recommends that KeTTHA/JBA apply to relevant authorities to seek omission of aluminium residues in potable water treatment sludge from the list of hazardous wastes. If need be, a Cabinet Paper be tabled to resolve this issue.

Strategy 8 — Centralised versus Decentralised Wastewater Treatment System

Millions of gallons of domestic wastewater are generated every day from sinks, showers, and toilets. This wastewater contains pathogens that are dangerous to human health and thus proper treatment and management is crucial for human safety.

The current practice for wastewater has traditionally been managed through large centralised treatment facilities in urban areas and septic tanks in rural areas. However, today, there is an array of innovative decentralised wastewater systems that collect and treat domestic wastewater on-site. These systems sometimes offer benefits over conventional treatment because they reduce the need for energy and large infrastructure, provide recycled water for use on-site, and can be expanded to meet increasing demand.

The service providers had indicated eagerness to implement a new decentralised system integrated with sustainability concept (resource recovery, utilisation of natural plants, wastewater recycling) to improve Malaysia's sewerage management.

Under certain conditions, decentralised technologies may offer benefits over centralised technologies, but an array of different factors need to be considered. The Study recommends that both systems be thoroughly reviewed from the view point of

effective and efficient management in Malaysia prior to adoption.

Strategy 9 — Review Scope and Coverage of Sewerage Services to Ensure Proper Management of STP Effluent

The national coverage policies need to address issues pertaining to the operations and management of all the approximately 8,400 units private and public STPs as poor management could result in pollution of rivers and water bodies.

The Study recommends that sullage be part of the sewage to be treated in the existing STPs. However, preliminary treatment before entering into the sewerage system should be provided and monitored. The management of all aspects of sewerage services and other related issues should be under the purview of SPAN as the regulator. SPAN should regulate all types of sewerage systems, including the primitive pit toilets, pour flush, and direct discharges and upgrading of conventional and decentralised sewerage systems.

The Study suggests that standards of sewage treatment plant (SWT) effluents be improved to enable reuse while reducing pollution loading to rivers. In achieving this goal, the Study recommends that SPAN/ Sewerage Services Department work with IWK to undertake plant evaluation towards proposing effective refurbishment works.

4.4 Operation and Maintenance

Strategy 10 — Reduction in Non-Revenue Water (NRW)

A sizeable component of NRW is water leakage. Pipe replacement is an important asset replacement programme with the secondary benefit of NRW reduction. SPAN has set up a long-term NRW target over ten years commencing from 2011 for each operator towards achieving the national target of 25% by year 2020 for Peninsular Malaysia. If the target is achieved in 2020, the volume of water saved is likely to be 2336 Mld which represents a reduction of about 15.6% of total demand. If the target of 25% is equally applied in 2020 for Sabah and Sarawak, the likely volume of water saved for the states would be: Sabah—678 Mld (36.5% saved), Sarawak—140 Mld (7.9% saved).

Most states in Peninsular Malaysia are projected by SPAN to achieve 25% or less by year 2020. Currently, Pulau Pinang, Malacca, Labuan and Bintulu have already achieved this level.

The Study recommends the implementation of a holistic and systematic approach using **Water Balance**, a tool developed by the IWA which enables the evaluation of every component of NRW. Accurate and reliable data is essential to obtain a useful Water Balance. Some states, such as Selangor, Johor, Malacca, Perak and Penang, have already established their own standard operation procedures in producing the Water Balance tool, thus can be emulated by other states after standardisation is achieved at the national level. Overseen by SPAN, the step-wise measures to be taken are as follows:

- Accurate measure of water balance components;
- Immediately attend to all complaints on visible leaks;
- Metering of production;
- DMA and pressure management; and
- Selective pipe change.

The role of PAAB is indeed crucial to sort out the high NRW in most states. Success in Malacca and Penang were very much attributed to the high management

commitment in reducing NRW. Hence NRW reduction should be an important component of the business plan that PAAB would need to look into to assist the water operators. To ensure conformity, the Study recommends that PAAB consider linking conventional project loans to NRW projects.

Asset management plan is part of the NRW reduction programme. Funding is required for the implementation of NRW reduction and sustaining it. The following strategies are proposed for Asset Management:

(i) Asset tagging and mapping;
(ii) Proactive pipe replacement system;
(iii) GIS for distribution system; and
(iv) DMA establishment.

As NRW affects the general public over the long run, the following strategies are proposed for public engagement:

(i) Media and public support for awareness on the value of water and NRW reduction;
(ii) Continuous campaigns on the important and true/right value of water;
(iii) Reward and appreciation platform to consumers; and
(iv) Indicate actual cost of water in bills.

Strategy 11 — Water Safety Plans (WSPs)

WSIA requires all its licensees "to maintain at all times the security, integrity and safety of its water supply system and sewerage system and all other assets in relation to the systems". However, WSPs have not been implemented by the water operators. In line with the World Health Organisation-International Water Association requirement for WSPs, which it had been promoting since 2005, the Ministry of Health Malaysia is currently championing the development of WSP and is planning to include WSP in the proposed Safe Drinking Water Act. At the national level, an action plan is being implemented to initiate the development of WSP. Each water operator has been assigned to develop a pilot project.

Currently, there are only 28 WSPs developed, or 6% of the 458 water systems. WSP for sewerage systems has yet to be explored.

The Study recommends that SPAN enforce the mandated WSP formulation and implementation. The following targets have been suggested for achievement by the industry:

(i) Enforcing the development of WSP for all water and sewerage systems;
(ii) Utilising WSP in improving operation and maintenance;
(iii) Utilising WSP in budget for improvement works to reduce risk and enhance reliability and efficiency; and
(iv) All water operators to adopt WSP which covers from source to tap.

The Study recommended that the importance of WSP needed to be highlighted and adequate funding to be provided to water operators to develop and implement WSP.

The Study further recommends that a national steering committee be established on WSP to deal with legislative and judicial uncertainties, and the implementation programme. The steering committee is to be jointly managed by both KeTTHA and MOH whose task was to develop a master plan and implement the plan accordingly.

4.5 Technological, Economic and Financial Instruments

Strategy 12 — Application of Innovative Technologies for Water Supply and Wastewater Sectors

A number of technological innovations have been successfully implemented in the country. These technologies can be adopted, where applicable, as they have been known to be cost-effective and have been operated efficiently.

Some of the innovations which had been implemented are as follows:

- River bank infiltration — cost saving in construction as well as operations. Reference project is the Jeli WTP, Kelantan;
- Using ozone in water treatment — current development in science and technology had significantly reduced the carbon footprint of the ozone plant and its energy utilisation;
- Hybrid system to treat brackish water in Labuan (Kinabenua) and Sarawak (Daro) — it is a two-stage process where the initial stage removes suspended and colloidal particles whereas the second stage removes the salinity in water using membrane technology;
- Use of streaming current analysis in optimising floc formation and chemical consumption;
- Using other forms of chlorine to improve its optimum working pH and reduce the danger of chlorine gas leak — brine (Malacca), chlorine dioxide (Perak); and
- Expansion of reservoir capability by raising dam heights.

Technology and Incentive to Achieve More Efficient Use: Water demand management strategies include the mandatory use of efficient products or water saving devices. Legislation is required for uniform application of standards, building codes and water efficiency labelling schemes. Such products include water efficient WCs, showers, dishwashers, washing machines and efficient use of taps and restrictor valves. Efficiency labelling schemes are introduced to encourage manufacturers to produce efficient products which are recommended for use by consumers and users of water.

In Peninsular Malaysia, based on a study by FOMCA in 2007, water use in toilet facilities takes up most water which is 26% of total water consumption in a home. Through the usage of dual flush water closet, water consumption can be reduced by 20%. SPAN has enforced the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 on 1 February, 2014 with the usage of dual flush toilets. This is mandatory for new development projects and renovated buildings.

SPAN has also encouraged the use of water efficient products by labelling. The purpose of labelling is to assist consumers to opt for products that use less amount of water but still provide satisfactory performance. However, SPAN has yet to make it a mandatory requirement.

SPAN's Skim Pelabelan Produk Cekap Air (SPPCA) Implementation guidelines was launched in January 2013 for water closet, urinals and taps (basin, sinks and showers). At the end of 2013, two more appliances were added which are washing machine and showerheads. The products are assessed based on usage efficiency for which star ratings are given. The more number of stars reflects more efficient use of water. When there is no significant price difference between a water-efficient and a standard appliance, it is often more expensive to retrofit the water

appliances in an existing house than installing the same device in a new house. This is where incentives in the form of a rebate programme can be effective in persuading existing house owners to retrofit water appliances. The rebate programme subsidises the adoption of water efficient devise by refunding the cost of the appliance partially or fully. It will encourage domestic consumers to purchase water saving devices when installing or retrofitting these appliances. The rebate programme has yet to be introduced in Malaysia but is widely practiced in developed countries.

Strategy 13 — Water Tariff Adjustment and Appropriate Tariff Structure to Reduce Wasteful Consumption

Based on water supply consumption figures of the various states, the majority of Malaysians use more than 210 litres per capita per day (l/c/d). The tendency for high consumption is largely related to the prevailing low water tariff rate in the country.

There is a general consensus that the present pricing structure of treated water is low and this constraints effort for enhancing water demand management. The low water tariffs also limit the amount of resources for operators to invest in technological innovation and R&D.

To ensure water supply security over the long term, water services need to be restructured to enable the provision of affordable services on an equitable basis. Right pricing of water is an integral part of the water services reform initiatives. SPAN has embarked on establishing a tariff setting mechanism, for Peninsular Malaysia and F.T. Labuan, that is robust, fair and transparent where information on costs and performance levels will be disclosed to consumers and users of water who will know what they are paying for and what they are getting in return. In a way, relevant stakeholders will have a say in price increases which are not seen to be costly using a mechanism to capture fair and qualifying expenditure that is commensurate with the cost of providing it and the level of service being provided benefitting individuals and society.

It is understood that Sabah is now finalising a new tariff based on a 'rate structure' designed to progressively cover all costs and charges of managing water supply system.

Meanwhile, water rates in Pulau Pinang have been increased from 1 April 2015 in a move to reduce consumption and avoid rationing according to Penang Water Supply Corporation Sdn Bhd.

Consumption per capita promoted by World Health Organisation is 150 l/c/d, which would be a long-term target for Malaysia. Over the short term measure, SPAN has targeted 180 l/c/d by 2020. Should this be achieved or even surpassed, the volume of water saved in 2020 would be in the order of 2337 Mld for Peninsular Malaysia and 267 Mld for Sarawak and 208 Mld for Sabah.

The volume saved is sizeable. Based on an average operational cost per cubic metre for Malaysia estimated at around RM1.20 per cubic metre (MWIG 2014), the savings in water consumption would translate to approximately a saving in OPEX of about RM1.23 billion annually; RM1.02 billion for Peninsular Malaysia, for RM91 million Sabah and RM116 million Sarawak.

The Study supports the initiatives taken by SPAN for initiating a tariff setting mechanism that is robust, fair and transparent executed in consultation with consumers and users.

4.6 Participatory Management

Strategy 14 — Engaging the Consumers and the Public in Water Conservation Initiatives and the Role of Forum Air

The government, policy makers and public authorities have a role to play in engaging the public on water security and its implications in such issues as the prudent use of water and reduction of pollution of water resources.

Some of the issues which the public and stakeholders need to be aware of are:

- Water scarcity and the need for rationing;
- Water pricing and the need to increase the charge; and
- Water service level, such as the reason why treated water delivered at household taps is not always clean.

On the other hand, some of the issues that the government and public authorities would want the public to understand are:

- The need to pay for sewerage services charges;
- The need to conserve and save water; charges in water consumption at an individual level will be crucial to tackling water scarcity; and
- The need to reduce, reuse and recycle water, especially for non-potable purposes.

Water Forum (*Forum Air*) designated by SPAN keeps close contact with consumers and the public on water and sewerage services matters and providing feedbacks to SPAN on many issues.

In addition to engaging Water Forum which represents the interests of consumers, SPAN also continuously engages with the non-governmental organisations and the business communities to obtain proposals and feedback before the implementation or drafting of any new rules or regulations or taking any new initiative.

Some of the water conservation initiatives taken by SPAN include:

4.6.1 Requirement for water operators to develop and implement a water conservation programme on the maintenance of an efficient and economic water supply system;

4.6.2 Relevant stakeholders are encouraged to take proactive measures to constantly educate the public on conservation matters. Schools should be the target group primarily because the future generation should be made aware of the importance of conservation. In this case, SPAN itself has carried out several outreach programme in schools to educate the school children and deepen their understanding on the water cycle, the benefits of conservation and the need of a clean environment; and

4.6.3 Proposal to curb wastages by "Hose Ban Rule" during a period of crisis with deterrent penalties has been submitted to the Minister.

Other means of public engagement is through "Water Museums" or "Water Galleries" set up in major cities and towns with the sole purpose of attracting the public and especially the younger generation to visit and be interested to learn and realise the intricacies on how water is produced and made available to them and also how sewage is removed from houses, treated and subsequently disposed to receiving waters. In this way, intrinsic value of water is fully appreciated by the public as a whole. The "Water Museums" or "Water Galleries" could possibly be located at water or sewerage treatment plants.

Unmitigated wastages of water on non-important activities during crisis should be penalised. The Study supports the initiatives taken by SPAN pertaining to *Forum Air* and also regarding innovative communication packages being explored not withstanding that in cases of persistent breaches or non-compliance, imposition of penalties should be applied without fear or favour. The carrot and stick approach with continuous engagement with consumers and the public is the way forward.

4.7 Green Technology

Strategy 15 — Reduce, Reuse, Recycle

The Study has recommended water conservation, reusing and recycling of the water supply and wastewater which also appear as part of other strategies listed above. Water used by the majority of the consumers is not lucrative to be recycled as the price of water is cheap. Similarly, in the wastewater sector, as the quality of STP effluent improves, there are opportunities for reuse for non-potable purposes and for industrial use by way of trade-off thereby providing some relief to the current water demand burden. Growing limitations in fresh water availability in the future would render the recycling and reusing effluents a viable option. This is very much in line with the green initiatives currently being pursued by the government.

4.8 Water for Wealth Creation

Strategy 16 — Implement Projects and Services for Wealth Creation

In 2010, the Academy produced a report entitled *Mega Science Framework Study for Sustained National Development 2011 - 2050 on the Water Sector*. This Report prioritised ten highest rating STI opportunities for 'creating new wealth' and rated according to highest returns and lowest risks. These are:

a) Eco-tourism around high ecological value sites;
b) Urban water-based tourism;
c) Market and export high-quality water;
d) Clean water for aquaculture industry;
e) Malaysian brand for domestic water purification unit;
f) World-leading tropical aquatic research and education;
g) Knowledge export;
h) Downstream water tapping;
i) Rainwater harvesting; and
j) Zero pollutant discharge.

4.9 Climate Change

Strategy 17 — Implement Adaptation and Mitigation Strategies in Response to the Impacts of Climate Change

In 2014, the Academy produced an Advisory Report entitled *Strategic Plan for Addressing the Impacts of Climate Change on Water-related Issues in Malaysia*. The Strategies were clustered around three main sectors, which are, "Water Bodies Management Capacity", "Water Services Management Capacity" and "Water-related Hazards Management Capacity". The strategies listed in Water Services Management Capacity" specific to potable water supply are as follows:

(a) Water Services Management Capacity

For "Potable Water Supply (Water Resources Management)", the following strategies were proposed:

- Protecting the catchments in order to provide potable water supplies through the adoption of the IWRM and IRBM principles and approach in land use planning;

- Need to develop a long-term strategy for water resources management to achieve water security; and
- Need for water-resources-rich states to protect their water catchments and develop them for export to water-stressed states.

For "Potable Water Supply (Water Demand Management)", the following strategies were proposed:

(a) Setting-up national and state-level IWRM secretariats to develop strategies, implement, monitor and report regularly on the progress in the implementation of IWRM principles, including integrated thematic sector-based approaches based on IWRM principles, such as IRBM, integrated flood management, etc.;

(b) Reviewing the existing and future water supply infrastructure development plans recommended in the NWRS (2011), to anchor the plans on a targeted, sustainable per capita water consumption figure that is benchmarked with the contemporary figures achieved by other countries;

(c) Adopting a policy of water supply capacity planning based on a targeted, sustainable per capita water demand figure, and making water supply planners, operators and consultants aware of such a policy so that the planning and operations of water supply infrastructures will be based on a constrained demand;

(d) SPAN to impose requirements on water supply providers to develop and implement Water Safety Plans to address the loss in confidence of the consumers in the drinking quality of our potable water supply;

(e) SPAN to setup a Water Demand Management Taskforce to develop strategies, implement, monitor and report on the country's progress towards achieving the targeted, sustainable per capita water demand figures;

(f) SPAN to develop financial incentive structures to make water supply providers earn their revenue from delivering water supply efficiently; and

(g) Developing strategies to increase the resiliency of our water supply system to cope with the projected increased in variability of river runoff arising from climate change.

4.10 Research and Development

Strategy 18 — Pursue Continuing Integrated Research on Water Supply and Sewerage Systems, Products and Services

In a recent ASM Study Report entitled *National Agenda on Water Research and Development*, water supply and sewerage services fall under the "Water for Livelihood and Wealth Creation" category. Two research themes applicable to both services are:

i) Sustainable Water Supply Development and Management for Multi-purpose Use; and

ii) Wastewater Management and Reuse.

The first research theme on "Sustainable Water Supply Development and Management for Multi-purpose Use" has four research fields, of which three are applicable as follows:

(a) Advanced dam technology;

(b) Water-use efficiency; and

(c) Balancing water supply versus demand.

Under each research field, three related research topics have been listed, details of which are available from the ASM R&D Study report.

Similarly, the second research theme on "Wastewater Management and Reuse" has six research fields as follows:

(a) Quality water and wastewater reuse for irrigation;
(b) Integrated urban water management;
(c) Environmental and social impacts;
(d) Advanced and innovative technology for industrial wastewater treatment;
(e) Low carbon and energy efficient treatment system; and
(f) Zero discharge technology.

Each research field has three related research topics listed, details of which can be seen in the ASM R&D Study Report.

4.11 Capacity Building

Strategy 19 — Training of O&M Personnel towards Achieving "Operation Excellence"

All water supply and sewerage operators in Peninsular Malaysia are licensed under the Act. There are two categories of licensees or operators in the water supply and sewerage services industries. The main challenge to achieve "Operation Excellence" in the water supply and sewerage services sector is the lack of trained manpower at all hierarchical levels to operate and maintain water supply and sewerage systems.

Based on information from *Water Services Industry Performance Report 2013* by SPAN and Malaysia Water Industry Guide 2014 by MWA-KeTTHA and SPAN and discussions with SPAN and several water supply operators, the ratio of trained manpower to consumer connections should be in the order of 1 to 450 - 500, largely depending on the size and status of development of the area and that is whether the area is mainly urbanised (densely populated) or for all or most part still rural in nature. The trained personnel are mainly involved in plant processing, distribution pipeline and reservoir inspections and pump operation. Extra duties may be required to inspect work done by contractors, such as pipe connections. Variation to this would include expected level of service, level on outsourcing services by water operators and also level of automation of the facilities. The above ratio assumes level of service to be mainly provided by in-house manpower and some automation of facilities.

The trained personnel should be subjected to continuous training to upgrade skills and knowledge. Their service conditions should be conducive enough for the experienced personnel to be retained in operational services. There must also be management commitment in WDM and in particular NRW investments in order to maintain achieved levels of NRW at all times and reduction in per capita consumption.

For sewerage systems, operations include sewer maintenance, sewage treatment plant operations, and septage services. IWK as the national sewerage company provides services to 21 million population equivalent in most parts of Peninsula Malaysia excluding Kelantan, Johor Bahru and Pasir Gudang. In non-IWK operational areas, the responsibility of operations is either taken up by the local government or private parties. IWK manages over six thousand sewage treatment plants which are connected via over 18,000 kilometer of sewers.

The current skilled manpower ratio of IWK is approximately 1 per 1000 connected accounts. However, the ideal range is envisaged to be in the order of 1 per 500 to 600 customers for now and this ratio should be decreasing over time to get better customer care and attention.

Staff training in water supply and sewerage services has mostly been operationally related in nature or in other words, subjected to in-

house training. This method of training is time consuming and inadequate to meet challenges to ultimately scale up the system to "Operation Excellence" level.

Penang is known to have a well-structured training programme under the Penang Water Services Academy which was established in 2007, accredited by SPAN and the Ministry of Human Resources. It has taken a step further by offering their training to school leavers and operators from neighbouring countries. Building on this example, and as a matter of urgency, the Study recommends that government under the auspices of KeTTHA establishes centralised or regional training institutions in Peninsular Malaysia, Sabah and Sarawak.

All water operators need to enrol in competency and training programme currently carried out by training centres and institutions endorsed by SPAN and with SPAN/PAAB ensuring that all stakeholders allocate the necessary funds for training.

The Study also noted Malaysian Water Association's interest in providing training facilities for the whole country by working closely with water supply operators and sewerage services providers

4.12 Water-Food-Energy Nexus

Strategy 20 — Develop Together with the Food and Energy Sectors a Common Water-Food-Energy Nexus Framework

The Study recommends the formulation of a Water-Food-Energy Nexus policy framework that would ensure a more balanced approach in determining the needs of the three inextricably linked components of water security, energy security and food security. All the three components are dependent on the availability of water resources.

4.13 International Collaboration

Strategy 21 — Enhancing Networking and International Cooperation

The problems that beset water supply and wastewater management in Malaysia are not new. Globally, with dwindling fresh water supplies and poorly managed wastewater, the sustainable management of both water supply and wastewater has taken on a crucial profile. Networking with regional and international organisations, such as UN Water and IWA, would enable the country to learn from experiences of other countries as well as share our own with them. Strategic alliances with renowned regional and international water supply and sanitation research centres need to be nurtured for mutual benefit.

Conclusion

Conclusion

The ASM-commissioned Study Report (**Volume 2**) on the current status of the nation's water supply and wastewater sectors serves as a good reference document to understand where the country stands with regard to the water supply and wastewater industries, and in identifying issues, challenges and gaps that need to be addressed. Parallel studies undertaken by ASM on issues pertaining to water demand management, water R&D, water and climate change, groundwater, and the mega science study on water have provided useful references in the development of this Strategy Plan.

Strategies developed for the improvement of water supply and wastewater services cover a whole range of management areas, namely governance, information management, planning and development, O&M, management instruments (technological, economic andfinancial), R&D, Green Technology, Capacity Building, climate change, and wealth creation. Trans-boundary issues involving the food and energy sectors have also been addressed.

With the 2012 launch of the National Water Resources Policy (NWRP), and as a matter of priority and for good governance, it is recommended that a National Water Services Policy (NWSP) is formulated which is consistent with the NWRP, ensures water supply security with the integration of water supply and sewerage services as well as fosters a cultural shift from hitherto water supply management dominance towards greater water demand management. Consequential amendments to respective legislation and review of institutional structures would also be necessary.

The integration of water supply and sewerage offers yet another opportunity for a holistic approach for optimal use of both raw water and wastewater with the adoption of green technology practices of "reduce, recycle and reuse". Treatment of effluents is not only beneficial for non-potable use but also ensures protection from pollution of the country's water sources, namely rivers and water bodies.

The Study noted that NRW reduction has been a long standing issue and SPAN is actively pursuing to address this problem by setting initially a national target of 25% by 2020 for compliance by all operators. These efforts must be accompanied by strong water demand management measures foremost of which is to ensure that the right pricing of water is an integral part of the water services reform initiatives and as a deterrent to wastage of water. The Study noted further that SPAN has embarked on establishing a tariff setting mechanism, for Peninsular Malaysia and F.T. Labuan that is robust, fair and transparent. Needless to say, the successful implementation of such financial instruments requires strong political support and commitment. Technological instruments to ensure the mandatory use of water saving devices and appliances, consumer awareness campaigns as well as education programme are all part of the wide array of measures recommended for implementation on a sustained basis.

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