



PENANG GREEN AGENDA 2030

Title: Water and Sanitation

Prepared by : Water and Sanitation
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EXECUTIVE SUMMARY

Efficient and effective water management is critical for Penang as 80% of its drinking water supply comes from Sungai Muda, which originates in Kedah. Penang has the lowest water tariff but also the highest domestic water consumption per capita in the country. The State Government has pledged for a “no water rationing” policy and water treatment facilities run by Penang Water Supply Corporation (Perbadanan Bekalan Air Pulau Pinang or PBAPP) are some of the best in the country. In terms of flood water management, Penang still suffers from floods several times every year although hundreds of millions of ringgit are currently being invested in flood mitigation projects. And being a urban setting, most households in Penang are connected to municipal sewage treatment systems, which are in the process of being further rationalised to improve efficiency and reduce cost.

Penang does not have a public body that oversees the issues of water in an integrated way, unlike the Public Utilities Board or PUB in Singapore. Rather, different government departments deal with the various aspects of water in Penang: a. PBAPP is in charge of supplying water for residential, commercial and industry uses; b. the Department of Drainage and Irrigation (Jabatan Pengairan dan Saliran or JPS) is in charge of stormwater and flood management; and c. Indah Water Konsortium Sdn Bhd (IWK) and other smaller companies are responsible for sewage treatment. These bodies work separately from each other and have different objectives, which results in under-utilisation of domestic water resources in Penang.

Penang faces several major challenges when it comes to its water resource. In terms of water supply, the authority predicts that Penang will face water shortage within the next few years if new water sources are not secured. Despite this, water is not seen as a strategic commodity and Penang has the highest domestic water consumption per capita, which is expected to remain so unless drastic actions are taken by the government. The main reason for high water consumption in Penang is low water tariff that does not encourage water-saving practices among consumers. Low water tariff is also making recycling of greywater or the installation of water-saving technologies less attractive. In addition, the water quality of major rivers in Penang is currently too poor to be used. All these present a grim future for Penang’s water security especially if seen against the backdrop of climate change that will bring further disruption to water supply.

In relation to stormwater management, much improvement is needed as many areas in Penang are inundated by flood water on a regular basis. JPS is currently spending a lot of money on flood mitigation, including deepening riverbeds, building barrages and retention ponds, installing pumps and building drains. Stormwater is currently channelled to the sea via drains and rivers instead of being captured and stored as an alternative water source. In terms of sewage and sanitation, IWK, a federal-level Government-Linked Company (GLC), also relies heavily on government subsidies to cover the costs of providing sanitation services to the public due to the low sewage tariff and high instances of non-payment. In Penang, IWK treatment plants have caused several river pollution incidents due to improper treatment or accidental discharges of sewage. In addition, there is currently little and inadequate demand for the by-products of sewage treatment such as bio-effluent, bio-solids and biogas.

The WAS Working Group proposes the following seven recommendations to increase water security and better management of water resources in Penang:

1. Education and Awareness on Water Saving (2020)

The cheapest way to deal with the problem of growing water demand and limited water supply in Penang is to reduce consumption of water and increase the efficient use of water. To foster water saving habits among Penang's population, the State Government needs to work closely with civil society groups (e.g. Water Watch Penang) and other stakeholders to carry out targeted and consistent education and awareness campaigns among water users. These programmes also need to increase the public's acceptance towards a change in water policy or water tariffs. More needs to be done on working closely with schools and teachers in Penang to instil the right water use habits among pupils. **Water education** should be made compulsory in all schools to highlight the precarious status of Penang's future water supply and the need to save water. In addition, all government departments including Local Governments should take the lead in addressing the issue of high water use per capita. For example, in addition to a continuous water awareness campaign among government departments, the State Government should make it **mandatory for all owners of public buildings to install water saving devices (taps fitting, toilet cisterns etc) and to have a water-saving policy** in place. The State Government and relevant government departments should also engage actively with **industrial users on promoting best practices and education on water footprint and efficiency**, with an ultimate aim of introducing targets such as water efficiency. Engagement can start with the top 100 industrial water consumers. Campaigns and training can be paid for by businesses themselves and water saving competition can be carried out to encourage businesses to adopt water-saving plans.

2. Review of Water Tariff (2020)

The low water tariff in Penang has a direct correlation with the fact that Penang has the highest water consumption per capita in Malaysia. Review of the water tariff is long overdue. Aside from reducing water subsidies paid to PBAPP, a rise in the water tariff is also needed to incentivise water saving practices among users. More importantly, as long as the water tariff remains low, adoption of water-efficient technologies or practices will not take off in Penang. This is because most users, especially businesses, will only act when it makes economic sense (meaning when the cost of adopting new technology or practices is lower than the water bill). Although a water tariff increase is seen as politically unpopular, the Government needs to stop postponing the inevitable and increase the water tariff through the **Tariff Setting Mechanism (TSM)** to prevent real water emergencies in the future that will require drastic and expensive measures. Ultimately, the water tariff should be increased to cover the operating expenditure (OPEX), capital expenditure (CAPEX), Environmental Cost and Regulated Profit according to the respective band of consumption in TSM. And to make sure that enough investments are put into enhancing water resource protection and infrastructure, the State Government needs to make sure that a green portion of the tariff or environmental surcharges are ring fenced for these purposes only. Along with the

increase in the water tariff, the Government should also ensure that the water quality and services provided to the public are excellent. Scheduled upgrades and improvements along with high quality water will improve the public's acceptance and also attract investors. The State Government needs to increase the water tariff as soon as possible to at least cover the costs (including environmental costs), with steady increases every three years.

3. Water as a Strategic Commodity (2020)

In order to increase the chances of successful water sector reform, water in Penang should first be classified as a State Strategic Commodity. By classifying water as a strategic commodity, it will create a **strong mandate and consensus for all government agencies** at both the state and local levels to work towards a common goal - improved water security and resilience. New approaches to town planning and utility networks should be introduced to align with the new strategies to enable both new developments and existing areas to be more water resilient and sustainable. Meanwhile, all aspects of enforcement should also be strengthened, starting with: the protection and management of the catchment areas; the 15-meter buffer zone for rivers and river reserved land; and point source and nonpoint source discharge into rivers and drains.

4. Climate Adaptation and Resilience Plan for Penang's Water Sector (2020)

Penang is already suffering from the impacts of climate change such as more intense rainfall and sea-level rise. Climate change threats will continue to worsen, and the current plans that address floods and drought may not be adequate with "once-in-a-lifetime" events occurring more frequently than expected. The State Government must adopt a Climate Adaptation and Resilience Plan for the Water Sector that introduces measures to **strengthen water security and supply, and manage flood as well as drought**. In particular, severe drought will put an intense pressure on Penang's water supply as 80% of the water is sourced from outside Penang (where in the event of drought, water allocation to Penang may be reduced). Penang also does not have adequate water storage facilities. The costs of building and maintaining additional water infrastructure need to be measured against the benefits Penang will experience in being prepared against the impact of climate change.

5. Surface Water Runoff and Flood Management Plan (2020)

The State and Local Governments should adopt an integrated **water and flood management plan** to deliver a holistic approach in controlling and utilising water resources. For example, the Government should actively promote the capture of onsite surface water runoff through **rainwater harvesting and onsite water storage** (in ponds or underground tanks). Stormwater capture and reuse can provide an alternative source of water as well as reduce flooding incidents. On rainwater harvesting, on top of the distributed rainwater harvesting system, the Government can also push for **centralised rainwater harvesting** that can be built and maintained more efficiently. For example, planning laws should require developers to create an artificial pond or wetland for each development project. Open drainage pipes

can be connected directly to the ponds instead of to the conventional drains. These ponds or wetlands can be included in the 10% “public space” to be set aside by developers. Once the wetlands or ponds are built, their **maintenance can be contracted out** to private or public-private bodies so that Local Governments do not have to bear the maintenance cost alone. For industrial and commercial properties, incentives can be given to landowners or tenants to build rainwater harvesting facilities. Lastly, the Government should also enhance river management in Penang to reduce the occurrence of flood by adopting **Integrated River Basin Management (IRBM)**.

6. Empowerment of Bahagian Kawal Selia Air (2020-2023)

To improve water security and better utilisation of Penang’s water resources, Penang needs an **Integrated Water Management Regime** that oversees all matters related to water, including drinking water, sewage treatment and flood management. This can be modelled after the Public Utilities Board (PUB) of Singapore that regulates and oversees the country’s entire water supply system comprising the water catchment systems, drainage systems, water works, water reclamation plants and sewage systems. Under this system, every drop of water that falls within the country is managed by one authority. Instead of combining all agencies into one body that would require a total overhaul of the current system, Penang should aim to create at least a management regime headed by the revamped Bahagian Kawal Selia Air (BKSA) that can coordinate planning and programmes of all water-related issues in Penang. **BKSA can be upgraded into a Lembaga** body supported by an independent Enactment with powers to manage and plan as well as the necessary enforcement power for all water resources in Penang (like Lembaga Urus Air Selangor or LUAS). As part of the upgrade, BKSA needs to be equipped with the necessary capacity through staff training and increment, as well as a clear mandate. At the Federal Level, a new water enactment (Rang Undang-Undang Sumber Air or RUU) is being tabled before the Parliament and is expected to be adopted next year (2020). The RUU is an overarching Act that consolidates all laws governing water supply in Malaysia. The RUU will mandate the setting up of Majlis Sumber Air Negeri in each state; the new Majlis Sumber Air Negeri in Penang can propose and sanction the further empowerment of BKSA. The revamped BKSA can also represent Penang in presenting a unified voice and authority in dealing with other water bodies within a **regional context**, especially in pushing for a Regional Water Commission for the Northern Economic Corridor Region to facilitate better collaboration between Northern States on issues such as water supply.

The new Integrated Water Management Regime and RUU present opportunities for Penang to further tighten up water management in Penang. For example, The RUU will also update fines, water quality and standards. In terms of effluent discharge, the State Government should push for a law that regulates discharge based on **total maximum daily load (TMDL)** instead of the current regulation focusing on concentration of pollutants at each discharge point. This would require the State Government to specify the carrying capacity of each river and the total maximum discharge load allowed for each river, which is then distributed among the different users. Penang should also have a **Water Security Plan for the Agriculture Sector** that focuses on promoting the adoption of best practices and efficient

use of water through education, capacity building, and technical assistance among agriculture users.

7. Land Use Planning and Blue-Green Infrastructure (2025)

To further strengthen Penang's Integrated Water Management Regime, it needs to be incorporated into **land use planning**. Existing and new water catchment areas (especially in urban areas), water storage areas, centralised sewage treatment plants etc need to be clearly identified and protected by the Structure, Local and Special Area Plans. This is particularly true if Penang wants to adopt a 'sponge city' approach to tackling flood management. Penang's land use planning should also set out and prioritise the **use of blue-green infrastructure in managing water resources and flood**. Such infrastructure is designed to accommodate the natural flow of water as well as additional water based on flood predictions. Combining water management and natural spaces like parks to reduce flooding, it increases both the liveability of our city and the ability to adapt to climate change. Some examples are turning suitable existing and new parks / squares into dual-purpose use i.e. retention ponds, and promoting the use of vegetated swales, bioswales and bioretention swales in the design of landscapes, drainage and development. Blue-green infrastructure can also include the construction of green roofs and vertical gardens to help slow down and reduce the volume of runoff. The State Government should produce a **Blue-Green Infrastructure Plan for Flood Management** and adopt regulations to mandate the building of blue-green infrastructure in existing and new development that takes into account the average recurrence interval (ARI) of rainfall.

1. Background

1.1 Penang Green Agenda 2030 and Water and Sanitation

Water and Sanitation is one of the ten key focus areas that can be utilized as a tool in order for Penang to achieve its sustainable development goals by 2030. As a small state, Penang is highly reliant on cross-border water supply – 80% of its drinking water currently comes from Sungai Muda, which originates from the State of Kedah.¹ Sungai Muda is also the main source of water for the agriculture sector in Penang, especially the paddy production based in the Mainland. Despite this, water consumption in Penang is notoriously high. Its domestic per capita consumption is the highest in Malaysia, amounting to 290 litres per capita per day (l/cap/d)², compared to a mere 143 l/cap/d in Singapore (which has a target of reducing it to 130 l/cap/d by 2030).³

One of the reasons for the high water consumption in Penang is the low water tariffs for both domestic and commercial uses. At RM0.32 per 1,000 litres for the first 35,000 litres, Penang's water tariff is the lowest in Malaysia.⁴ Penang Water Supply Corporation (PBAPP) spent RM163.2 million on domestic water subsidies in 2017 and 2018 alone.⁵ With the predicted increase in water demand and the impact of climate change, water stresses will continue to worsen in Penang – it could even face water shortage in less than five years' time if no drastic action is taken.

In 2012, the Federal Government adopted a National Water Resource Policy (NWRP), and subsequently introduced the National Water Balance System (NAWABS) as a comprehensive river basin management instrument, which is being implemented at the Sungai Muda Basin. Penang has also been in discussion with the State of Perak on the purchase of raw water from Perak River as an alternative source of water supply. What is lacking is an integrated water resource management approach where every drop of water counts, meaning utilising all water resources including stormwater and treated wastewater as potential sources of water supply to increase water security and achieve additional co-benefits.

As more than 90% of Penang's population reside in urban areas, most people are connected to the public sewerage system.⁶ However, pockets of population, even in the George Town Heritage area, have yet to be provided with proper sewage treatment including the desludging services for some on-site treatment systems. Significant effort and adequate financial resources have been put in place for the rationalization and regionalization of the sewerage system in Penang. However, there are still certain aspects that need to be

¹ "Check entire Sungai Muda for more illegal dump sites, says Penang water company". *Free Malaysia Today*, 30th July 2019. <<https://www.freemalaysiatoday.com/category/nation/2019/07/30/check-entire-sungai-muda-for-more-illegal-dump-sites-says-penang-water-company/>>

² "Water usage highest in Penang and Selangor". *New Straits Time*, 12th April 2018. <<https://www.nst.com.my/news/nation/2018/04/356563/water-usage-highest-penang-and-selangor>>

³ PUB, *Singapore Water Story*. <<https://www.pub.gov.sg/watersupply/singaporewaterstory>>

⁴ PBA, "Penang's Average Domestic Water Tariff is 116% Below the National Average". Press Statement, 15th January 2019.

<http://www.pba.com.my/pdf/news/2019/20190115_PBAPP_Tariffs_116_Below_National_Average_v2.pdf>

⁵ Ibid.

⁶ Somasundram, Sotheeswari, 'Ranking the Challenges of the Urban Community in Malaysia' (2018). *Institutions and Economies*. 10. 69-89.

improved such as the release of sullage (grey water) into the drain especially from the residential and domestic (hawker centres and F&B outlets) sectors. Wastewater treatment in Penang's industrial zones is also less than satisfactory as discharges sometimes exceed the carrying capacity of the rivers and the enforcement regime relies disproportionately on self-regulation. The idea of developing a charging mechanism based on the load of pollutant released in the river should also be properly explored and utilized. Although IWK or Indah Water Konsortium Sdn Bhd continues to upgrade sewage treatments in Penang, wastewater and biosolids reuse are still underdeveloped.

The Working Group on Water and Sanitation (WAS) explores what can be done to increase Penang's water security and improve water sanitation. In particular, it aims to identify the priority areas and issues for Penang as well as the measures that need to be adopted to achieve the objectives of NWRP. It will also explore the use of innovative mechanisms (technology, governance and financing) to make sure Penang is ready to face the increasing threat of water insecurity.

1.2 Current State of Affairs

Despite its over reliance on cross-border water supply, Penang has the highest domestic water consumption per capita in the whole of Malaysia. In 2018, Penang's domestic water consumption per capita per day was 278 litres⁷ compared to the national average of 210 litres per capita per day.⁸ Despite the introduction of water surcharges and continuous efforts by the PBAPP and civil society organisations on water education, water consumption per capita per day had increased by 2 litres in 2018 compared to 2017, after a couple of years of steady decline.⁹ The Penang State Government has a target of reducing water per capita consumption in Penang by 20% by 2030 as part of the effort to achieve the Penang2030 vision.¹⁰

The high water consumption per capita in Penang is mainly due to the low water tariff. Penang has the lowest domestic water tariff in Malaysia at RM0.32 per 1,000 litres (for the first 35,000 litres per month) of water, compared to RM1.31 per 1,000 litres in Johor (and national average of RM0.69 per 1,000 litres).¹¹ Penang State Government, PBAPP and the National Water Services Commission (SPAN) have recognised and agreed on the need to increase the water tariff but a new water tariff has not been announced due to political concerns. The water tariff should at least reflect the cost of production including its operational and maintenance costs. The current water tariff however, does not only discourage water saving, it also means that the State Government, through PBAPP, is

⁷ PBA, "Penang has to Tackle 3 Key Water Supply Issues". Press Statement, 30th May 2019.

<http://www.pba.com.my/pdf/news/2019/30052019_PBAHB_AGM_PR3A.pdf>

⁸ "Low Priority for Saving Water". *The Star*, 3rd May 2016.

<<https://www.thestar.com.my/opinion/letters/2016/05/03/low-priority-for-saving-water>>

⁹ PBA, "Penang has to Tackle 3 Key Water Supply Issues". Press Statement, 30th May 2019.

<http://www.pba.com.my/pdf/news/2019/30052019_PBAHB_AGM_PR3A.pdf>

¹⁰ "Penang sets up Climate Change Plan". *The Star*, 28th April 2019.

<<https://www.thestar.com.my/news/nation/2019/04/28/penang-sets-up-climate-change-plan>>

¹¹ "Penang also plans to reduce water subsidies- Chief Minister". *Malaysia Kini*, 15th January 2019.

<http://www.pba.com.my/pdf/media/150119/15-1-2019_MALAYSIAKINI_ENG.pdf>

subsidising domestic water to the tune of around RM83 million in 2018.¹² The large subsidies for domestic water consumption mean that PBAPP has less funds to carry out water engineering projects such as treatment plant upgrades, laying down new pipes, and major water supply initiatives such as the Sungai Perak Raw Water Transfer Scheme (SPRWTS). This will threaten the future water security of Penang.

Penang is ranked among the lowest in Malaysia for non-revenue water, which is water that has been produced and is "lost" before it reaches the customer. PBAPP has a plan to further reduce non-revenue water but needs funds to invest in a management plan.

1.2.1 Water Supply

In 2018, PBAPP produced 1,073 million litres per day (MLD) of treated water by abstracting raw water from Sungai Muda and other smaller raw water resources in Penang.¹³ Penang has 100% urban and 99.8% rural supply coverage in 2018.¹⁴ Water demand projection done by PBAPP shows that demand is going to reach 1,483 MLD by 2030, 1,696 MLD by 2040 and 1,884 MLD by 2050.¹⁵ Sungai Muda, the primary raw water resource for Kedah, Perlis and Penang, may only be able to meet each states' raw water needs by 2025.¹⁶ This is because water demand is expected to increase in all three states. Moreover, Kedah is undertaking the 2,592 MLD Jeniang Water Transfer Project, which is upstream of PBAPP's Lahar Tiang Intake in Penang, to abstract more water from Sungai Muda in the near future.¹⁷ This may mean the volume of water available for extraction for Penang may reduce. In addition, the turbidity of raw water in Sungai Muda is increasing yearly because of logging activities, while the existence of illegal dump sites along the River contributes to the depletion of raw water resources.

Penang currently does not pay Kedah for the water extracted from the stretch of Sungai Muda that falls within the boundary of Penang. However, Penang has been urging the Federal Government to at least compensate Kedah for the loss of income from logging through the gazetting of Ulu Muda forests as water catchment areas. Currently, PBAPP is also undertaking the Third Penang Submarine Pipeline Project where it plans to replace 2 of the 4 pipelines that deliver treated water from the Mainland to the Island.¹⁸

The potential water shortage in 2025 is the reason why Penang needs to tap into a second major raw water resource urgently. The SPRWTS, if implemented in time, can help avert a water shortage crisis in Penang in a few years' time. The Perak River is currently seen as

¹² PBA, "Penang's Average Domestic Water Tariff is 116% Below the National Average". Press Statement, 15th January 2019.

<http://www.pba.com.my/pdf/news/2019/20190115_PBAPP_Tariffs_116_Below_National_Average_v2.pdf>

¹³ PBA, "Penang is Working Towards Achieving Water Supply Security Until Year 2050". Press Statement, 1st January 2019. <http://www.pba.com.my/pdf/news/2019/01042019_PBAPP_MasterPlan2050_ENG.pdf>

¹⁴ PBA, "PBAPP Achieves High Benchmarks in Penang Water Supply Engineering". Press Statement, 30th May 2019. <http://www.pba.com.my/pdf/news/2019/30052019_PBAHB_AGM_PR2.pdf>

¹⁵ "Penang needs to source raw water from Sungai Perak by 2025". *New Straits Times*, 28th August 2019. <<https://www.nst.com.my/news/nation/2019/08/516736/penang-needs-source-raw-water-sungai-perak-2025>>

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ PBA, "PBAPP Water Success Story". Press Release, 19th March 2019.

<http://www.pba.com.my/pdf/news/2018/19032018_NEW_SUB_PIPELINE_2018_ENG.pdf>

being underutilised as a source of raw water and the water transfer scheme is expected to enhance water security for Penang and Northern Perak until 2050.¹⁹ Negotiations between the Governments of Penang and Perak have been going on for a few years now but no agreement has yet been achieved. The disagreement lies with the fact that Penang wants to buy raw water while Perak wants to sell treated water that will fetch a higher price. The price of treated water from Perak is going to be higher than the current water tariff in Penang, hence the resistance by PBAPP.

Another potential source of raw water for Penang is Sungai Prai, which is less polluted than Sungai Kulim. Sungai Prai can potentially provide 136 million litres of raw water a day, which meets around 10% of Penang's water demand.²⁰ However, a lot of issues need to be resolved before Sungai Prai's water can be extracted, mainly related to river pollution and cultural sensitivity as some waste discharged into the river comes from pig farms. These pig farms will need to be moved and water pollution needs to be substantially reduced to make it viable for Sungai Prai water to be used. In addition, Sg Prai is also facing the threat of seawater intrusion which will further increase the cost of treatment.

To increase water supply security, PBAPP is first and foremost focusing on the conventional river water treatment system. This is because operating such a system is more cost efficient than recycling or desalinating water. Large-scale desalination and reverse osmosis (or ultra-filtration) processes are also more energy-intensive and cost-intensive. In addition, water recycling and rainwater harvesting require additional specialised infrastructure, including separate pipeline networks for channelling the raw water and / or distributing the processed water. Given the low water tariff, conventional river water treatment is also the most commercially viable for PBAPP.

Nevertheless, PBAPP is still exploring other alternative sources of water. For example, it has proposed to the State Government to supply recycled water to factories and the discussion is still ongoing. The proposal will offset the demand for drinking water from industrial players to domestic users. Penang's Local Governments have also been promoting rainwater harvesting. Installation of rainwater harvesting systems has been included in the local building guidelines although their effectiveness is questionable – there is no incentive for developers or households to install them (due to the low water price) and enforcement is lacking and even unattainable (enforcement officers are not legally allowed to go into premises to carry out inspections). Nevertheless, there is a recognition of the potential of rainwater harvesting as an alternative source of water supply, which can be used for toilet flushing or landscaping purposes. Current successful cases of rainwater harvesting at blocks of flats involve external funding.

Another potential source of non-potable water is greywater. Greywater refers to used water from bathroom sinks and does not contain faecal matter. 43% of total water use in Malaysia currently ends up as greywater.²¹ Greywater can be reused to water plants – for example,

¹⁹ "Sungai Perak: The best future raw water resource for Penang and North Perak". Press Statement, 3rd April 2019. <http://www.pba.com.my/pdf/news/2019/03042019_PBAPP_SPRWTS_Rationale.pdf>

²⁰ 1st Water and Sanitation Working Group Meeting on 9th August 2019.

²¹ Oh, Kai Siang & Leong, Janet & Poh, Phaik Eong & Chong, Meng Nan & Lau, Ee. (2017). A review of greywater recycling related issues: Challenges and future prospects in Malaysia. *Journal of Cleaner Production*. 171.

MBPP uses bio-effluent water for landscaping purposes. The challenge lies in persuading people to use greywater. The process around implementing greywater recycling is very involved as it needs new pipe systems, water safety consideration and so on. Not all plumbers are familiar with the new system which makes maintenance more challenging. There is currently no strong push from the Government or industry to invest in greywater recycling. SPAN had been working on a national resource recovery policy paper from a few years ago focusing on use of recycled water although there has been no further development.

In terms of regulating water resources, the Bahagian Kawal Selia Air (BKSA) is in charge of gazetting water catchment areas and controlling Penang's water level. The Economic Planning Division (BPEN) plays the coordinating role in getting consensus from all related stakeholders in the event of inadequate water supply. The consensus will be proposed during the EXCO meeting and a decision on water distribution will be made by the EXCO members. As the State Government has promised not to ration water for domestic uses, water restriction is usually imposed on agriculture during drought season, as happened a few years ago.

At the Federal Level, a new water enactment (Rang Undang-Undang Sumber Air or RUU) is being tabled before the Parliament and is expected to be adopted next year (2020). The RUU is an overarching Act that consolidates all laws governing water resources in Malaysia. Under the RUU, a Majlis Sumber Air Negara or National Water Resource Council will be set up, which will be assisted by the State Water Resource Councils.

1.2.2 Flood mitigation

Flood mitigation is one of the main priorities of the Penang State Government as Penang has suffered incidents of severe flooding in the past few years. Floods in Penang happen during heavy storms and high tides, and there are various flooding hotspots across Penang especially on the Mainland. Penang's vulnerability to flood is mainly due to urbanisation, irrational land use and lack of effective drainage systems. Currently, Penang's large flood mitigation project focuses on Sungai Pinang, which involves deepening and widening the river, installation of tidal gates to prevent backflow of water from the sea and improving overall water quality.²² The Drainage and Irrigation Department (JPS) is in charge of monitoring and managing the flood risks of Penang's rivers. According to the policy of the Federal Government, State-level JPS has to gazette rivers to be under their purview in accordance with the National Land Code 1965 (Kanun Tanah Negara 1965). This is to enable rivers to be better monitored and maintained; for example, any development along the riverbank needs to be approved by JPS and the conditions imposed are more stringent than the ones currently imposed by local councils. Currently in Penang, only Sungai Batu Feringghi is gazetted and the next river to be gazetted is Sungai Kerian. The process to gazette the rivers depends on the land ownership around the river, current development

10.1016/j.jclepro.2017.09.267.

<https://www.researchgate.net/publication/320123341_A_review_of_greywater_recycling_related_issues_Challenges_and_future_prospects_in_Malaysia>

²² "Finally, Penang gets RM150 million for flood mitigation project". *Free Malaysia Today*, 31st July 2018.

<<https://www.freemalaysiatoday.com/category/nation/2018/07/31/finally-penang-gets-rm150-million-for-flood-mitigation-project/>>

along the river and whether or not the State Government is interested in gazetting them.

The State Government is also planning to increase the capture of stormwater, which can minimise the risk of flooding. For example, JPS changed its approach from open drain to storage at source. Another example is the system used by USM's Engineering Campus where rainwater is absorbed into the ground for 1 to 2 hours before being discharged back into the river; the water quality is much better due to natural filtration. Treated differently (through the capture of surface runoff as well as rainwater harvesting), rainfall that might previously have caused flooding can now be used as an alternative source of water supply especially for non-potable use. In-situ capture and storage of water is also safer and will reduce the instances of drains being clogged with rubbish.

At the regional level, NAWABS is a tool used to regulate release of water from dams. It is a prediction tool and is used to recommend action to be taken in response to drought or monsoon three months in advance. Any action that needs to be taken will depend on the State Government. The first project under NAWABS is the Projek Lembangan Sungai Muda (PLSM), which has prevented flooding in Seberang Perai Utara.

1.2.3 Water Quality

The role of the Health Department (JKN) is to control the quality of drinking water in accordance with the national water standard. Under the National Drinking Water Quality Control Programme (KMAM), JKN is tasked with collecting and analysing water samples from basic stations, treatment plant outlets (TPOs) and service reservoir outlets (SROs). Water is tested for 4 different pollutant groups: bacteria, aluminium, heavy metal and pesticide. Tests at TPOs and SROs are done weekly while tests at the auxiliary ponds are carried out monthly. JKN also produces the "Cleanliness Survey" (Kajian Kebersihan) reports once a year where water samples from the treatment plants, water catchment areas and reticulation areas are tested. PBAPP is responsible for making sure that drinking water is treated to an acceptable standard. In 2018 alone, PBAPP and the Health Department collected a total of 3,182 samples of treated water in Penang for physical and microbiological analysis. So far, PBAPP has a good record of attaining and even exceeding the national standard for drinking water quality.²³

In contrast, the role of the Department of Environment (JAS) is to check and monitor the water quality in the rivers. River water quality is checked against a total of 7 parameters (water quality index). JAS has a total of 58 manual water monitoring stations and covers 7 river basins²⁴; it also has one auto station in Sungai Muda. Industrial discharges into rivers is largely self-regulatory – each factory is required to collect a discharge sample on a monthly to trimonthly basis depending on the requirement set by JAS and report back to JAS. JAS carries out spot checks to make sure factory discharges are within the law and if there are complaints from the public JAS will have a visit to collect related samples. The power of JAS also includes monitoring, imposing compounds; issuing warning notices and taking court action against perpetrators.

²³ PBA, "PBAPP Achieves High Benchmarks in Penang Water Supply Engineering". Press Statement, 30th May 2019. <http://www.pba.com.my/pdf/news/2019/30052019_PBAHB_AGM_PR2.pdf>

²⁴ JAS Pulau Pinang, Laporan Kualiti Air Sungai Di Pulau Pinang 2018.

Year	River Basin	River	No of Stations	Water Quality Index	Class	Category
2015	Pinang	Air Terjun	1	87	II	C
		Air Itam	5	67	III	SP
		Dondang	1	66	III	SP
		Jelutong	1	49	IV	P
		Pinang	1	54	III	P
	Kluang	Ara	2	87	II	C
		Relau	1	79	II	SP
	Perai	Kulim	2	82	II	C
		Jarak	3	77	II	SP
		Keladi	1	81	II	C
		Kereh	2	56	III	P
		Perai	2	63	III	SP
		Pertama	1	50	IV	P
	Jawi	Junjong	1	90	II	C
		Machang Bubok	1	78	II	SP
		Jawi	1	50	IV	P
	Juru	Kilang Ubi	4	71	III	SP
		Juru	2	63	III	SP
		Pasir	1	70	III	SP
		Rambai	1	52	III	P
	Bayan Lepas	Bayan Lepas	1	68	III	SP
		Tiram	2	75	III	SP

I. Average water quality (river)

IQA - Water Quality Index
IQA 81-100 : Good
IQA 60-80 : Moderate
IQA 0-59 : Unhealthy

Figure 1: Water Quality Status of Rivers in Penang, 2015 ²⁵

1.2.4 Sewage treatment by IWK

Indah Water Konsortium Sdn Bhd (IWK) is a government-owned company, under the Ministry of Finance Incorporated, entrusted to build, operate and maintain an efficient and modern sewage system for several states in West Malaysia including Penang. Similar to the water tariff, the sewage tariff is also set at a very low rate – IWK charges domestic users a fixed fee of RM8 per month. Hence, IWK is heavily subsidised by the MOF; domestic users are also cross-subsidised by commercial users which are charged based on volume. The sewage tariff is set by SPAN with the approval of the Ministry of Water, Land and Natural Resources (KATS). Going forward, IWK has proposed to SPAN to set the price using a ‘volumetric tariff’ instead of a fixed fee.

Apart from the low sewage tariff, IWK also faces the problem of widespread non-payment. This is because for public health reasons, IWK is reluctant to cut off sewage treatment services in the event of non-payment, therefore emboldening some users to ignore the requirement to pay. The cost of sewage treatment itself has also gone up due to upgrade programmes and the increase in the electricity tariff.

In the future, IWK plans to carry out ‘rationalisation’ of sewage treatment plants – a networked system where small multi-point plants are ‘rationalised’ and connected to a major regional plant. By 2030, it aims to build three regional plants on Penang Island (Batu Ferringhi, Bayan Baru and Jelutong) and eight regional plants on the mainland. The purpose of the rationalisation exercise is to cut down costs and increase efficiency.

²⁵ PGC, Penang in Numbers: Green Data. <<https://www.pgc.com.my/images/pga/green-data-goal-6-water.pdf>>

At the moment, IWK discharges most of the treated water into the river as there is not yet any other mandated use for the water. However, IWK has plans to further expand the use of its treated water and biosolids. For example, IWK is already using bio-effluent generated from public sewage treatment plants for landscaping purposes, and sludge cakes are used as fertilizers. IWK is also giving MBPP some of its treated water for free to water plants. Furthermore, IWK is also building large tanks to store the bio-effluent so that interested industrial players can collect the treated water from the tanks. In addition, IWK plans to recycle biogas to produce electricity in the Jelutong treatment plant, which can be used to power street lights. Despite these plans, there is not yet a clear policy or incentive scheme from the Federal Government to promote commercial uses of the by-products of IWK's sewage treatment, namely bio-effluent, bio-solids and biogas.

IWK treatment plants in Penang are generally well-run although some incidents of pollution from the plants do occur from time to time. One of the problems IWK faces regarding sewage treatment in Penang is blockage due to rubbish that causes sudden overflow. A fixed tariff also does not encourage water-saving practices, which subsequently increases the treatment cost.

However, the performance of private sewerage systems is unknown and has not been reported by Suruhanjaya Perkhidmatan Air Negara (SPAN). Malaysian Water Industry Guide (MWIG) 2018 reported Penang has 174 private sewage treatment plants serving 172,947 PE as of 2017.²⁶ In addition, as per 2017 records, the conditions of 83 communal septic tanks, 13,781 individual septic tanks and 60,933 primitive systems such as pour flush are also unknown and whether optimal desludging services had been provided.²⁷

2. Long-Term Goals

In order to increase water security and better flood management, the Water and Sanitation Working Group recommends that the State Government adopt the following targets:

- a. 30% of the water used for landscaping at public places to come from surface runoff water by 2030.
- b. Increase the use of treated effluent by the industry sector by 2030 [with the view of introducing a specific target once the baseline value is established].
- c. All new development projects to have a centralised rainwater harvesting system by 2020.
- d. Reduce the water footprint of the top 100 industrial water users in Penang by 2030 [with the view of introducing a specific target once the baseline values are established].

²⁶ SPAN, Sewerage Facilities by States. <<https://www.span.gov.my/article/view/sewerage-facilities-by-states-2015-2016>>

²⁷ Ibid.

- e. Reduce water consumption per capita per day by between 20%-35% by 2030.

3. Main Challenges and Gaps

3.1 Water supply

3.1.1 Penang has an unsustainably **high domestic water consumption per capita**. Although water consumption dropped briefly in 2016 and 2017, it has crept up again in 2018 once users acclimatised to the new environment surcharge.²⁸

3.1.2 **Low water tariff** means PBAPP needs to be heavily subsidised by the State Government and has less money to invest in other things such as pipe upgrades and investment in new water sources. The low water tariff also deters the adoption of water saving practices and technologies among water users.

3.1.3 Current water supply sources (especially Sungai Muda) can **only meet Penang's water demand until 2025**.²⁹ Unless Penang finds a new secure water source or significantly reduces water consumption, there will be water shortages in the near future.

3.1.4 The State Government has not paid enough attention to nor invested enough in **water education as well as awareness**. There are also inadequate resources among NGOs to carry out extensive outreach programmes on water education.

3.1.5 There is currently no one agency that has an overarching responsibility towards river management protection: JPS is in charge of drainage and irrigation; JAS is in charge of water quality; the Department of Fisheries is in charge of inland fisheries. Penang also does not have an **integrated river management regime**, which means no one takes responsibility for rehabilitating rivers and ensuring that rivers are used sustainably.

3.1.6 **Water catchment areas** in Penang are confined to a few forested areas. There is no plan yet to turn urban areas into catchment areas where all water flows to dams that store water (as in Singapore). Furthermore, turning urban areas into water catchments may require relocation of businesses and industries which might be considered too disruptive.

3.1.7 **Agriculture water use** in Penang is also not sustainable. Paddy fields require a lot of water and due to the fact that much of the time irrigation water is drawn directly from the river or the water canal infrastructure (not through metered pipe networks), farmers do not adopt water-saving practices or technologies. Paddy fields are saturated unnecessarily to prevent weed growth and water flows out of paddy fields as the outlets are not closed. The small plot size discourages the use of water saving technologies such as water recycling irrigation systems.

²⁸ PBA, Annual Report 2018. <<http://www.pbahb.com.my/pdf/annual-report/PBAHB-AR2018.pdf>>

²⁹ "Penang needs to source raw water from Sungai Perak by 2025". *New Straits Times*, 28th August 2019. <<https://www.nst.com.my/news/nation/2019/08/516736/penang-needs-source-raw-water-sungai-perak-2025>>

3.2 Flood Management

3.2.1 Penang's **drainage system** gets clogged with rubbish which increases the chance of flooding and stormwater overflow. In addition, the current drainage system channels stormwater into the sea so its potential as a water source is wasted.

3.2.2 Flood mitigation measures like the one currently implemented at Sungai Pinang are very costly (the Sungai Pinang project costs RM150 million³⁰), and requires funding the State Government does not have.

3.2.3 **Penang's Water Catchments** are always half full and are filled after heavy rain; there is limited capacity to hold more water as a result of more rainfall in the future. Penang is not properly equipped for one impact of climate change which is further expected heavy storms and rainfall.

3.3 Wastewater Treatment

3.3.1 Due to the low tariff and high incidents of non-payment, IWK needs a lot of **subsidies** especially as operational costs continue to increase due to plant upgrade and increased electricity costs.

3.3.2 **No market yet for by-products** of sewage treatment e.g. bio-effluent, bio-solids and biogas. Penang's farmers do not currently use bio-effluent for irrigation due to concerns about safety especially for food crops.

3.3.3 **Improper treatment or accidental discharges of sewage** and industrial effluent pollute Penang's rivers and sea. In relation to industrial effluents, the law currently governs the concentration of pollutants at each discharge point and not on the total maximum daily load (TMDL). This means effluent discharges may exceed the carrying capacity of a particular river. Also, the JAS relies on factories to report on their own effluent discharges, which creates room for fraud and misreporting.

3.4 Limited Enforcement

3.4.1 There is **limited enforcement capacity by JAS** on water pollution – severe staff shortage (only 3 staff per district), limited scope for automated enforcement due to lack of technologies like sensors, and a culture of being overly forgiving. This is compounded by the fact that JAS is the only environmental regulator that can issue fines without having to bring a case to court.

³⁰ "Penang happy with RM150 million for Sg Pinang flood project". *Star Online*, 8th November 2016.
<<https://www.freemalaysiatoday.com/category/nation/2016/11/08/penang-happy-with-rm150-million-for-sg-pinang-flood-project/>>

4. Solutions

4.1 Water Supply Enhancement

4.1.1 State Government to recognise and **treat water as a strategic commodity**.

- This would entail giving it the highest priority when it comes to decision making including **aligning development needs** and pace with the need to protect water security.
- To formulate and implement necessary plans to have **climate resilient water supply**.
- This will also require the Government to **guarantee the sustainability of water consumption** in Penang e.g. by making sure that water charges reflect the true value of water resources in Penang.
- To establish an **Integrated River Basin Management Plan** for Penang.

4.1.2 **Increase water tariff** to at least cover the cost and incorporate environmental cost as a green tariff.

- A higher water tariff is necessary to incentivize **behavioural change** especially in tackling wasteful consumption in all sectors.
- A higher water tariff is also the **prerequisite to the adoption of effective supply and demand enhancement measures** e.g. a low water tariff discourages adoption of water-saving technology.
- The **green tariff** portion to be allocated for strategic initiatives related to protection of water resources and building water infrastructure.

4.1.3 Actively promote the application of **rainwater harvesting** and other methods to **capture onsite surface water runoff** in Penang to reduce pressure on conventional water supply as well as to reduce stormwater runoff.

- **Centralised rainwater harvesting** at local or development (e.g. “taman”) level through the construction of artificial ponds or localised water catchments.
- Encourage private sector participation through **public-private partnership for the management of localised catchments or ponds** in order to reduce burden on local authorities.
- Incentives should also be given to industrial and commercial properties that adopt rainwater harvesting.

4.1.4 Establish a **Centre of Excellence for Water Research** in Penang.

- The Centre can be hosted by a renowned university or research centre with close collaboration between government entities and researchers to achieve strategic goals in terms of technology, feasibility and practicality.
- The Centre can carry out research in fields that will have an impact on Penang’s water security, including wastewater recycling.

4.1.5 Incorporate water management into **land use planning** e.g. a comprehensive land use plan that identifies the existing and new catchment areas, water storage areas, centralised sewage treatment plants etc.

- A land use plan that reflects an **integrated water management plan** for Penang.
- This is needed to enable the State to have a “every drop counts” policy which will ensure that ‘every single drop’ belongs to the state.
- Promote land use planning that adopts the “**sponge city**” concept.

4.1.6 Greater effort to **rehabilitate and clean rivers** in Penang (e.g. through a multi-agency river taskforce) to expand water supply sources and increase water security.

- This will require a comprehensive **river rehabilitation plan** with effective measures and short and long-term goals, which can be included in the Integrated River Basin Management Plan.

4.1.7 Further expanded **use of treated sewage water** for non-potable water uses including in industry and agriculture sectors.

- Existing regulations governing crop safety may need to be reviewed to allow more widespread use of treated sewage water.
- Also needs more awareness and education among farmers to alter perception of treated water.

4.1.8 **Increase tariff for sewage treatment** to at least cover the cost.

- New charges for domestic use can be based on volume instead of a fixed rate.
- A higher sewage treatment tariff is necessary to induce behavioural change especially in tackling wasteful consumption of water.

4.2. Water Demand Management

4.2.1. Increase **water efficiency standards** for all sectors in Penang.

- Incentive scheme for the adoption of water consumption best practices among industries.

4.2.2 **Rationalise agriculture water use** to increase water efficiency in the sector.

- Need to have good data showing actual water demand and use in the agriculture sector in Penang e.g. water metering.
- Promote adoption of best practices and efficient use of water through education, capacity building, technical assistance etc.
- Adopt a **Water Security Plan** for the agriculture sector in Penang.

4.2.3 Increase **education and awareness** on water saving.

- Inclusion of water education at every school in Penang.

- Annual campaigns by all government departments to promote water efficiency.
- Encourage participation in the Green Office award especially among government offices to incentivise behavioural change.
- Water bills that provide comparison between a user and their neighbours would create awareness about their water usage.

4.2.4 Encourage **water rating** of greater number of appliances and the purchase of water efficient appliances through education, incentive schemes and green public procurement.

- Encourage factories to include information on their **water footprint** in their products.

4.3 Stormwater and Flood Management

4.3.1 Adopt integrated **water and flood management plan** to deliver a holistic approach in controlling and utilising water resources.

- **Stormwater capture and reuse** e.g. through creating water catchment areas to coincide with flood management, and the construction of underground tanks to store stormwater.
- In order to maximize the collection of water, the State Government can consider shifting from open drain system to **storage at source system**.

4.3.2 Penang Government should look into the use of **blue-green infrastructure** that combines water management and natural spaces like parks to reduce flooding, to increase liveability of our city as well as increasing its ability to adapt to climate change. Blue-green infrastructure is designed to accommodate the natural flow of water as well as additional water based on flood predictions.

- Turn suitable existing and new parks or squares into dual-purpose use i.e. **retention ponds** when it rains and recreational areas when it is dry. This should be identified and included in Local Plans.
- Connect downpipes from buildings to suitable green areas / parks / squares instead of into the drains.
- Promote the use of **vegetated swales, bioswales and bioretention swales** in the design of our landscapes, drainage and development.
- Promote the construction of **green roofs and vertical gardens** to help slow down and reduce the volume runoff.
- Penang Government should produce a **Blue-Green Infrastructure Plan for Flood Management** to promote a steady and systematic construction of blue-green infrastructure.
- Adoption of **regulations** to mandate the building of blue-green infrastructure in existing and new development that takes into account the average recurrence interval (ARI) of rainfall.

4.4 Wastewater Treatment

4.4.1 Higher wastewater treatment standards especially for industries in Penang.

- Currently, the Environmental Quality Act 1974, Environment Quality (Clean Air) Regulations 2014 requires existing factories to upgrade the quality of their emission and imposes higher standards for the emission of pollutants into the air. It also requires tighter enforcement. There is, however, no equivalent legislation to tighten emission of pollutants into water.
- The Penang State Government can introduce more stringent standards for water discharges as part of its River Rehabilitation Plan.

4.4.2 Wider use of technology/sensors to detect effluent water quality to enhance enforcement. Currently, sensors and automated data collection at industrial premises only exist for monitoring air quality.

4.4.3 Create a new market for the use of biosolids from sewage treatment.

- Explore the market for bio-solids to be used as a source of renewable energy. A **Penang Renewable Energy Policy** can help to promote new energy sources.
- Explore with the Department of Agriculture the potential of using bio-solid as a source of **low cost fertiliser**.

4.4.4 Improve and tighten law on effluent discharge.

- Regulations governing discharge of treated water into the river should specify not only the concentration of pollutants in the discharge but should be based on **total maximum daily load (TMDL)**. It should require the State Government to specify the carrying capacity of each river and the total maximum discharge load allowed, the allowable load is then distributed among the different users.
- The allowable quantity has to meet the discharge standard and this will also eliminate the probability of the factory diluting their effluent before release.

4.5 Governance and Regulations

4.5.1 Empower State's Bahagian Kawal Selia Air (BKSA) to become an overarching authority over all water resources in Penang.

- In order to give more power as well as increase the capacity of Bahagian Kawal Selia Air, it should be reconstituted as a **Lembaga supported by an independent Enactment** with the power to manage and plan for all water resources in Penang (like Lembaga Urus Air Selangor or LUAS).
- The new body can produce a comprehensive **water management plan** for Penang that includes water supply, sewage as well as flood management, which are currently governed by different bodies.
- It can also be the **coordinating body** to make sure that Penang's water resources are managed efficiently and all viable water supply sources are tapped into.

- The new body should also be in charge of the **Integrated River Basin Management Plan (including river rehabilitation)** to improve water security in Penang.
- It will also be the agency to implement the “every drop counts” policy.
- The new Lembaga can also represent Penang in **regional cooperation** on water resources.

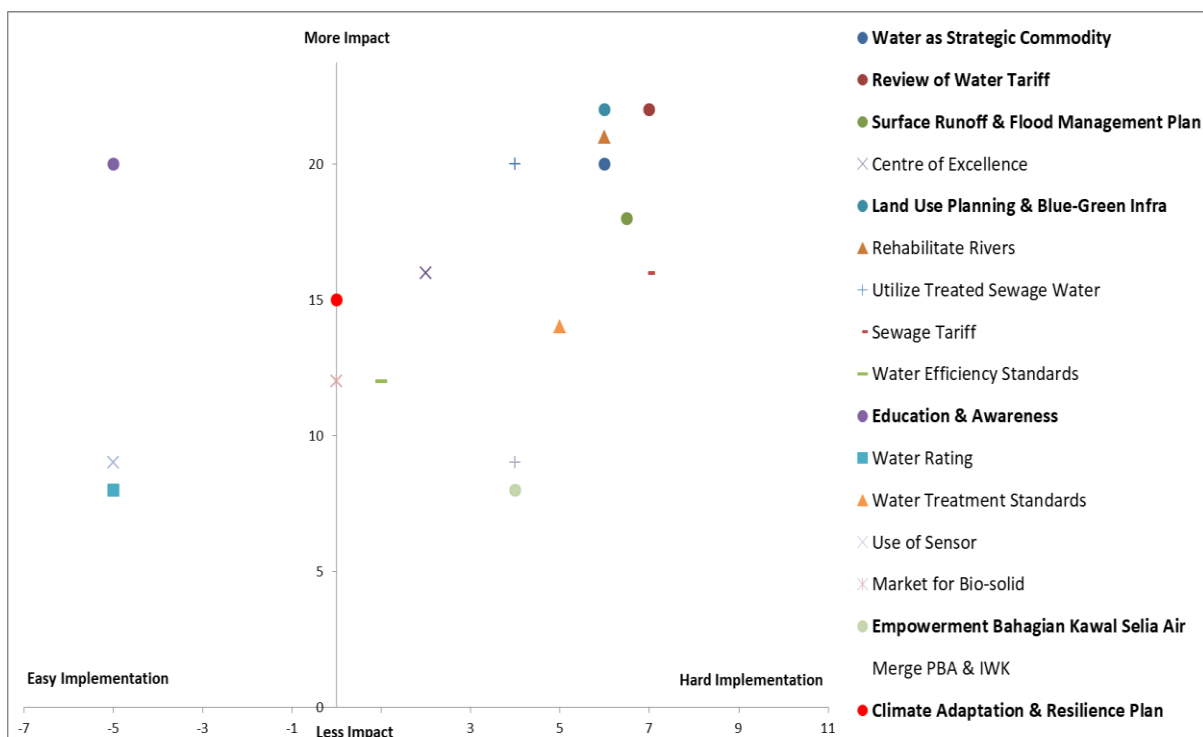
4.5.2 A **new Water Enactment** to reaffirm the State’s ownership of and responsibility for all water resources within the state, and set up an integrated governance and monitoring system.

4.5.3 **Merge PBA and IWK** to create an integrated water services company.

- The Federal Government needs to provide a conducive environment to allow the merge to take place i.e. debt cancellation or guarantee facilities etc.
- The integration of companies will also enable better use of treated effluent as a resource.

4.5.4 **Regional Water Commission** for the Northern Region to facilitate better collaboration and closer cooperation on issues such as water supply (e.g. river basin management), sewage treatment and flood management.

5. Major Policy Recommendations and Milestones



1. Education and Awareness on Water Saving (2020)

The cheapest way to deal with the problem of growing water demand and limited water supply in Penang is to reduce the consumption of water and increase efficient use of water. To foster water saving habits among Penang's population, the State Government needs to work closely with civil society groups (e.g. Water Watch Penang) and other stakeholders to carry out targeted and consistent education and awareness campaigns among water users. These programmes also need to increase the public's acceptance towards a change in water policy or water tariffs. More needs to be done on working closely with schools and teachers in Penang to instil the right water use habits among pupils. **Water education** should be made compulsory in all schools to highlight the precarious status of Penang's future water supply and the need to save water. In addition, all government departments including Local Governments should take the lead in addressing the issue of high water use per capita. For example, in addition to a continuous water awareness campaign among government departments, the State Government should make it **mandatory for all owners of public buildings to install water saving devices (taps fitting, toilet cisterns etc) and to have a water-saving policy** in place. The State Government and relevant government departments should also engage actively with **industrial users on promoting best practices and education on water footprint and efficiency**, with an ultimate aim of introducing targets such as water efficiency. Engagement can start with the top 100 industrial water consumers. Campaigns and training can be paid for by businesses themselves and water saving competition can be carried out to encourage businesses to adopt water-saving plans.

2. Review of Water Tariff (2020)

The low water tariff in Penang has a direct correlation with the fact that Penang has the highest water consumption per capita in Malaysia. Review of the water tariff is long overdue. Aside from reducing water subsidies paid to PBAPP, a rise in the water tariff is also needed to incentivise water saving practices among users. More importantly, as long as the water tariff remains low, adoption of water-efficient technologies or practices will not take off in Penang. This is because most users, especially businesses, will only act when it makes economic sense (meaning when the cost of adopting new technology or practices is lower than the water bill). Although a water tariff increase is seen as politically unpopular, the Government needs to stop postponing the inevitable and increase the water tariff through the **Tariff Setting Mechanism (TSM)** to prevent real water emergencies in the future that will require drastic and expensive measures. Ultimately, the water tariff should be increased to cover the operating expenditure (OPEX), capital expenditure (CAPEX), Environmental Cost and Regulated Profit according to the respective band of consumption in TSM. And to make sure that enough investments are put into enhancing water resource protection and infrastructure, the State Government needs to make sure that a green portion of the tariff or environmental surcharges are ring fenced for these purposes only. Along with the increase in the water tariff, the Government should also ensure that the water quality and services provided to the public are excellent. Scheduled upgrades and improvements along with high quality water will improve the public's acceptance and also attract investors.

3. Water as a Strategic Commodity (2020)

In order to increase the chances of successful water sector reform, water in Penang should first be classified as a State Strategic Commodity. By classifying water as a strategic commodity, it will create a **strong mandate and consensus for all government agencies** at both the state and local levels to work towards a common goal -. improved water security and resilience. New approaches to town planning and utility networks should be introduced to align with the new strategies to enable both new developments and existing areas to be more water resilient and sustainable. Meanwhile, all aspects of enforcement should also be strengthened, starting with: the protection and management of the catchment areas; the 15-meter buffer zone for rivers and river reserved land; and point source and nonpoint source discharge into rivers and drains.

4. Climate Adaptation and Resilience Plan for Penang's Water Sector (2020)

Penang is already suffering from the impacts of climate change such as more intense rainfall and sea-level rise. Climate change threats will continue to worsen, and the current plans that address floods and drought may not be adequate with "once-in-a-lifetime" events occurring more frequently than expected. The State Government must adopt a Climate Adaptation and Resilience Plan for the Water Sector that introduces measures to **strengthen water security and supply, and manage flood as well as drought**. In particular, severe drought will put an intense pressure on Penang's water supply as 80% of the water is sourced from outside Penang (where in the event of drought, water allocation to Penang may be reduced). Penang also does not have adequate water storage facilities. The costs of building and maintaining additional water infrastructure need to be measured against the benefits Penang will experience in being prepared against the impact of climate change.

5. Surface Water Runoff and Flood Management Plan (2020)

The State and Local Governments should adopt an **integrated water and flood management plan** to deliver a holistic approach in controlling and utilising water resources. For example, the Government should actively promote the capture of onsite surface water runoff through **rainwater harvesting and onsite water storage** (in ponds or underground tanks). Stormwater capture and reuse can provide an alternative source of water as well as reduce flooding incidents. On rainwater harvesting, on top of the distributed rainwater harvesting system, the Government can also push for **centralised rainwater harvesting** that can be built and maintained more efficiently. For example, planning laws should require developers to create an artificial pond or wetland for each development project. Open drainage pipes can be connected directly to the ponds instead of to the conventional drains. These ponds or wetlands can be included in the 10% "public space" to be set aside by developers. Once the wetlands or ponds are built, their **maintenance can be contracted out** to private or public-private bodies so that Local Governments do not have to bear the maintenance cost alone. For industrial and commercial properties, incentives can be given to landowners or tenants to build rainwater harvesting facilities. Lastly, the Government should also enhance river management in Penang to reduce the occurrence of flood by

adopting **Integrated River Basin Management (IRBM)**. Lastly, the Government should also enhance river management in Penang to reduce the occurrence of flood by adopting **Integrated River Basin Management (IRBM)**.

6. Empowerment of Bahagian Kawal Selia Air (2020-2023)

To improve water security and better utilisation of Penang's water resources, Penang needs an **Integrated Water Management Regime** that oversees all matters related to water, including drinking water, sewage treatment and flood management. This can be modelled after the Public Utilities Board (PUB) of Singapore that regulates and oversees the country's entire water supply system comprising the water catchment systems, drainage systems, water works, water reclamation plants and sewage systems. Under this system, every drop of water that falls within the country is managed by one authority. Instead of combining all agencies into one body that would require a total overhaul of the current system, Penang should aim to create at least a management regime headed by the revamped Bahagian Kawal Selia Air (BKSA) that can coordinate planning and programmes of all water-related issues in Penang. **BKSA can be upgraded into a Lembaga** body supported by an independent Enactment with powers to manage and plan as well as the necessary enforcement power for all water resources in Penang (like Lembaga Urus Air Selangor or LUAS). As part of the upgrade, BKSA needs to be equipped with the necessary capacity through staff training and increment, as well as a clear mandate. At the Federal Level, a new water enactment (Rang Undang-Undang Sumber Air or RUU) is being tabled before the Parliament and is expected to be adopted next year (2020). The RUU is an overarching Act that consolidates all laws governing water supply in Malaysia. The RUU will mandate the setting up of Majlis Sumber Air Negeri in each state; the new Majlis Sumber Air Negeri in Penang can propose and sanction the further empowerment of BKSA. The revamped BKSA can also represent Penang in presenting a unified voice and authority in dealing with other water bodies within a **regional context**, especially in pushing for a Regional Water Commission for the Northern Economic Corridor Region to facilitate better collaboration between Northern States on issues such as water supply.

The new Integrated Water Management Regime and RUU present opportunities for Penang to further tighten up water management in Penang. For example, The RUU will also update fines, water quality and standards. In terms of effluent discharge, the State Government should push for a law that regulates discharge based on **total maximum daily load (TMDL)** instead of the current regulation focusing on concentration of pollutants at each discharge point. This would require the State Government to specify the carrying capacity of each river and the total maximum discharge load allowed for each river, which is then distributed among the different users. Penang should also have a **Water Security Plan for the Agriculture Sector** that focuses on promoting the adoption of best practices and efficient use of water through education, capacity building, and technical assistance among agriculture users.

RUU is expected to be adopted in 2020 so the push for changes in Penang (e.g. a new Lembaga Air, effluent discharge standards, Agriculture Water Security Plan etc) can start now and be completed by 2023.

7. Land Use Planning and Blue-Green Infrastructure (2025)

To further strengthen Penang's Integrated Water Management Regime, it needs to be incorporated into **land use planning**. Existing and new water catchment areas (especially in urban areas), water storage areas, centralised sewage treatment plants etc need to be clearly identified and protected by the Structure, Local and Special Area Plans. This is particularly true if Penang wants to adopt a 'sponge city' approach to tackling flood management. Penang's land use planning should also set out and prioritise the **use of blue-green infrastructure in managing water resources and flood**. Such infrastructure is designed to accommodate the natural flow of water as well as additional water based on flood predictions. Combining water management and natural spaces like parks to reduce flooding, it increases the liveability of our city and its adaptability to climate change. Some examples are turning suitable existing and new parks/squares into dual-purpose use i.e. retention ponds, and promoting the use of vegetated swales, bioswales and bioretention swales in the design of landscapes, drainage and development. Blue-green infrastructure can also include the construction of green roofs and vertical gardens to help slow down and reduce the volume of runoff. The State Government should produce a **Blue-Green Infrastructure Plan for Flood Management** and adopt regulations to mandate the building of blue-green infrastructure in existing and new development that takes into account the average recurrence interval (ARI) of rainfall.