SUNGAI SELANGOR

STATE OF THE RIVER REPORT 2015

Water Supply

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ACRONYMS

ABASS	Konsortium Aliran Bekalan Air Selangor Selatan Sdn. Bhd.
APMM	Agensi Penguatkuasaan Maritim Malaysia / Maritime Enforcement Agency Malaysia
ASEAN	Association of South East Asian Nations
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
DAF	Dissolved air flotation
DO	Dissolved oxygen
DOA	Jabatan Pertanian / Department of Agriculture
DOF	Jabatan Perikanan / Department of Fisheries
EIA	Environmental Impact Assessment
EPU	Economic Planning Unit
FRIM	Forest Research Institute Malaysia
GPT	Gross pollutant trap
GRT	Gross rate tonnage
HORAS	Hybrid Off-River Augmentation Storage
IADA	Integrated Agricultural Development Area
ISO	International Standard Organisation
IWK	Indah Water Konsortium Sdn. Bhd.
JAS	Jabatan Alam Sekitar / Department of Environment
JKNS	Jabatan Kesihatan Negeri Selangor / Selangor State Department of Health
JKT	Jabatan Kerajaan Tempatan / Department of Local Government
JKPTG	Jabatan Ketua Pengarah Tanah dan Galian/ Department of Director General of Lands and Mines
JKR	Jabatan Kerja Raya / Public Works Department
JLM	Jabatan Laut Malaysia / Marine Department Malaysia
JMG	Jabatan Mineral dan Geosains / Department of Mineral and Geoscience
JPBD	Jabatan Perancangan Bandar dan Desa / Department of Town and Country Planning
JPNS	Jabatan Perhutanan Negeri Selangor / Selangor Forestry Department
JPP	Jabatan Perkhidmatan Pembetungan/ Sewerage Services Department
JPS	Jabatan Pengairan dan Saliran / Department of Irrigation and Drainage
JPSPN	Jabatan Pengurusan Sisa Pepejal Negara / Department of National Solid Waste Management
JPV	Jabatan Perkhidmatan Veterinar / Department of Veterinary Services
JUPEM	Jabatan Ukur dan Pemetaan Malaysia / Department of Measurement and Maps Malaysia
KKM	Kementerian Kesihatan Negara / Ministry of Health
KeTTHA	Kementerian Tenaga, Teknologi Hijau dan Air / Ministry of Energy, Green Technology and Water
KISDAR	Kolej Islam Selangor Darul Ehsan

KPI	Key performance index
KSSB	Kumpulan Semesta Sdn. Bhd.
KUIS	Kolej Universiti Islam Antarabangsa Selangor
LiSS	LUAS Intelligent Support System
LKIM	Lembaga Kemajuan Ikan Malaysia / Malaysian Fisheries Development Authority
LLM	Lembaga Lebuhraya Malaysia / Malaysian Highway Authority
LUAS	Lembaga Urus Air Selangor/Selangor Water Management Authority
MARDI	Institut Penyelidikan Dan Kemajuan Pertanian Malaysia / Malaysian Agricultural Research Development Institute
MCM	Million cubic metre
MLD	Million litres per day
MNS	Malaysian Nature Society
MOA	Kementerian Pertanian dan Industri Asas Tani Malaysia / Ministry of Agriculture and Agro-Based Industries
MyGAP	Malaysian Good Agricultural Practices
NAHRIM	National Hydraulic Research Institute Malaysia
NGO	Non-governmental organisation
NH_3-N	Ammoniacal nitrogen
NTU	Nephelometric turbidity unit
OPAK	Operasi Pengepaman Air Kolam
PAAB	Pengurusan Aset Air Berhad
PAMPS	Penyaluran Air Mentah Pahang Selangor
PDTG	Pejabat Daerah dan Tanah Gombak / Gombak Land and District Office
PE	Population equivalent
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara/ Department of Wildlife and National Parks
PNSB	Puncak Niaga (M) Sdn. Bhd.
RDF	Refuse derived fuel
RPS	Reverse Pumping Scheme
SAAB	Sijil Amalan Akuakultur Baik / Good Aquaculture Practice Scheme
SPAN	Suruhanjaya Perkhidmatan Air Negara / National Water Services Commission
SPLAM	Skim Pensijilan Ladang Akuakultur Malaysia / Malaysian Aquaculture Farm Certification Scheme
SPLASH	Syarikat Pengeluar Air Sungai Selangor Sdn. Bhd.
SS	Suspended solids
SSP1	Loji Pembersihan Air Fasa 1 / Sungai Selangor Phase 1 Water Treatment Plant
SSP2	Loji Pembersihan Air Fasa 2 / Sungai Selangor Phase 2 Water Treatment Plant
SSP3	Loji Pembersihan Air Fasa 3 / Sungai Selangor Phase 3 Water Treatment Plant
STATS	Jabatan Perangkaan / Department of Statistics
STP	Sewage treatment plant
SYABAS	Syarikat Bekalan Air Selangor Sdn. Bhd.
TN	Total nitrogen
TOL	Temporary occupation license
TP	Total phosphorus
TSS	Total suspended solids
UKM	Universiti Kebangsaan Malaysia
UNISEL	Universiti Selangor
UPEN	Unit Perancangan Ekonomi Negeri / State Economic Planning Unit
VFS	Vegetative filter strips
WQ	Water quality
WQI	Water quality index
WSIA	Water Services Industry Act
WSP	Water Safety Plan
WTP	Water treatment plant

WHAT IS THE STATE OF THE RIVER REPORT?

This is the fourth edition of the State of the River Report produced by Lembaga Urus Air Selangor (LUAS). Starting with the first edition in 2006, the reports have been providing a snapshot of the river's health in five-year intervals. This latest report covers the period from 2012 to 2015.

The river's health is reported and assessed from various perspectives, including water quality, water availability, level of water stress in the river basin, and river ecology. The report also looks at human activities within the river basin that may contribute as sources of pollution and degradation of the riverine ecosystem and the impacts that they have on humans and the environment.

The role of the State of the River Report is to highlight issues and inform its readers on the status of the various facets of the river basin. As such, this report will be divided into several parts:

About the River Basin provides an overall overview of the river basin.

State of the River 2012-2015 gives an indicator of the health of the river and highlights issues or matters of significance that should be considered and addressed by river basin managers and relevant government agencies for future planning and action.

Resources in the River Basin is a handbook that presents some facts and figures on the availability of the water resources and various activities within the basin.

River Related Activities and Sources of Pollution present the various human activities in the river basin and how they generate pollution.

Impacts of Pollution and Human Activities presents the downside of human activities and how it affects humans as well as the ecosystems around them.

Interspersed throughout the sections are issues and challenges as well as suggestions made by various stakeholders in addressing these problems.

In the spirit of Integrated River Basin Management, which requires participation and coordination by all agencies related in some way to the rivers' waters—either in water resources management, water abstraction, consumption, monitoring or any other use—the State of the River Report serves to inform and unify all agencies towards better stewardship of our ever-increasingly precious resource, our river water.

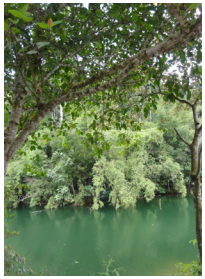
Why Should We Care?

Simply put, water is life. As stated in Malaysia's water vision for the 21st century, water sustains all aspects of human livelihood. To continue growing as a nation in a sustainable manner, we must consider:

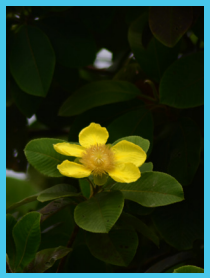
- **Water for people:** universal access to safe, adequate and affordable water supply, hygiene and sanitation
- **Water for food and rural development:** provision of sufficient water that will ensure national food security and promote rural development
- **Water for economic development:** provision of sufficient water to spur and sustain economic growth within the context of a knowledge-based economy and e-commerce
- **Water for the environment:** protection of the water environment to preserve water resources (both surface water and groundwater) and natural flow regimes, bio-diversity and the cultural heritage, along with mitigation of water-related hazards

But at the same time that we are growing dependent on access to more water, the amount of water available to us to is diminishing. While the demand for water is increasing, irregularities in seasonal weather patterns divert rainfall from critical catchment areas or result in a deluge of torrential rainfall or floods that flow water out towards the sea. However, water shortages and other river related problems are not caused only by acts of nature; human oversights in proper water resource management make the situation even more critical.

Thus, proper water resource management at the state and federal levels is key to safeguarding and ensuring the sustainability of our river basins. Through this report, LUAS aims to create a platform for future discussion and joint problem-solving among agencies towards a future where the coming generations can continue to enjoy the beauty and bounty of our rivers.



The pristine waters of upper Sungai Selangor basin



Flora found along the river banks of Sungai Selangor

Contributors to this Book

The State of the River Report 2015 was commissioned by LUAS, the water resources management board for the state of Selangor. Its functions involve managing the state's water resources to ensure good quality water in sufficient amounts to meet the state's economic and social needs.

However, as a report of the river includes perspectives from various sectors, other agencies contributed to the contents of this report. Thus, the contents presented within this report came from comments, feedback, and input from various agencies and organisations within the state of Selangor.

LUAS wishes to thank all agencies that contributed to the content of this report and aspires for the book to initiate further collaboration and coordination in an integrated approach to river management. A list of all the contributors is can be found in Appendix E of this report.

RIVER HERITAGE

How Sungai Selangor Got Its Name

A name that originated in the 14th century, there are many oral accounts of how Selangor got its name.

A weary warrior, heading north after Melaka fell to the Portuguese in 1511, stopped to rest under a tree. A blowfly (a green insect that looks like a fly) buzzed around the warrior's head, irritating the warrior who tried to slap it. After several attempts, the blowfly finally settled on the warrior's nose and the warrior decided to kill it once and for all. He slapped with all his might, but the blowfly merely flew away, leaving the defeated warrior with a very sore nose. It occurred to the warrior that he, who slew many men in battle, was defeated by a lowly blowfly. He decided to stop his travels and explore the area further. The place was named se (satu) langau (blowfly)—selangau.

Text source: Majlis Daerah Kuala Selangor

ABOUT THE **RIVER BASIN**

Location

The Sungai Selangor basin is situated in the upper part of the state. Sungai Selangor starts from Fraser's Hill and stretches for 110 kilometres to the coast of Kuala Selangor. The basin covers an area of 2,200 square kilometres, which is about 28% of the state, and contains ten sub-basins, which are Hulu Selangor, Kerling, Kuala Kubu, Hulu Rening, Sungai Tinggi, Rantau Panjang, Batang Kali, Tanjung Karang, Rawang, and Kuala Selangor. It is the third largest river basin in Selangor after the Sungai Langat and Sungai Bernam basins.

Tributaries

The river has 13 main tributaries, which are Sungai Kanching, Sungai Kerling, Sungai Sembah, Sungai Batang Kali, Sungai Rening, Sungai Luit, Sungai Kul, Sungai Gumut, Sungai Darah, Sungai Kubu, Sungai Gerachi, Sungai Peretak, and Sungai Tinggi. There

are another eight lesser tributaries for the river, which are Sungai Beletak, Sungai Buloh, Sungai Liam, Sungai Serendah, Sungai Rawang, Sungai Garing, Sungai Kundang, and Sungai Ayer Hitam.

Major Towns and Administrative Bodies

The river stretch passes through six major towns namely Kuala Kubu Baru, Rawang, Serendah, Rasa, Bestari Jaya (Batang Berjuntai) and Kuala Selangor. The river basin includes the districts of Hulu Selangor, Gombak and Kuala Selangor, which are administered by Majlis Daerah Hulu Selangor, Majlis Perbandaran Selayang, and Majlis Daerah Kuala Selangor. There are 19 mukim among the three districts.

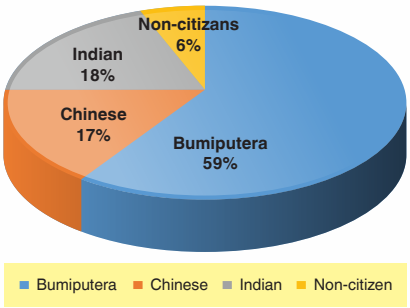
Jabatan Perangkaan
MALAYSIA

***DOSM** is an agency that provides statistical services and conducts census of the population*

DISTRICT	MUNICIPALITY
Hulu Selangor	Majlis Daerah Hulu Selangor
Gombak	Majlis Perbandaran Selayang
Kuala Selangor	Majlis Daerah Kuala Selangor

Population

The population of the Sungai Selangor basin for 2015 is based on the 2010 census taken by Jabatan Perangkaan Malaysia (DOSM). The 2015 population for the basin is approximately 451,219. Bumiputeras make up the majority at 266,219 (59%) while the Chinese number at 76,707 (17%) and Indians at 81,220 (18%). Non-citizens make up the balance at 27,073 (6%).



Breakdown of the Sungai Selangor basin population

Main Uses of the River

The river is one of the most important natural resources in the basin, supporting many economic activities in the state.

The Sungai Selangor Water Supply Scheme supplies about 2,950 MLD, which is about 60% of the total requirement for Kuala Lumpur and Selangor. As a major supplier of potable water to various parts of Selangor, including the Klang Valley, ensuring water supply is one of the priorities for the Sungai Selangor basin.

In terms of economic value-added, sand mining is an economy activity that dates back 50 years in the country. There are about 19 sand mining locations, and the estimated sand yield is 1.4 million tonnes per year.

In the Sungai Selangor Basin Management Plan 2007-2012, the main uses of the river were listed as water supply, ecosystem, tourism and recreation, sand mining, aquaculture, and inland navigation. The river is also famous for tourist attractions such as the firefly sanctuary at Kampung Kuantan.

To ensure that these uses can be sustained, the Plan unveiled four main policies, which comprised (1) ensuring sufficient water, (2) ensuring clean water, (3) protection against floods, and (4) conservation of fireflies.

Water Supply
Public consumption and irrigation

Sand Mining
Viable economic activity in the river basin

Ecosystem
Rich aquatic and terrestrial life in the basin, notably at the Kampung Kuantan Firefly Reserve and the lower basin areas for migratory birds, peat swamp forests and mangroves

Tourism/Recreation
Attractions at the rivers within the basin include fishing, water sports, and river cruises

Aquaculture
Aquaculture are present in the basin: brackish water, fresh water and ornamental fish culture

Navigation
Inland navigation includes river crossing, sand barging, and recreational fishing

Distinctive Features of the Basin

Tourism map of the Sungai Selangor basin
Source: Tourism Selangor 2015

In the upstream reaches of the Sungai Selangor basin, there are cool refuges for recreational activities at **Sungai Chilling Sanctuary, Sungai Luit Falls, and Kuala Kubu Waterfall**. Picnicking families and sports enthusiasts of white water rafting, kayaking, and trekking can be found there.

In the midsection of the basin, there is the **Kampung Kuantan Firefly Park**, which is a tourist spot and protected zone, valued for its ecological significance and its tourist draw.

Downstream is **Kuala Selangor**, which was the administrative center and stronghold of the Selangor Sultanate in the late 18th and early 19th century. A heavily fortified fort once stood on the summit, now known as Bukit Melawati. It was built during the reign of Sultan Ibrahim from 1782 to 1826 to fight the Dutch when Selangor was drawn into the struggle between the Dutch and the ruler of Johor and Riau.

At **Bukit Melawati**, relics of the past were found, including the protective walls of the fort, the palace ground, a lighthouse, royal graves, seven walls, a flat stone used for beheading offenders, a 100-step ladder, a poisonous well and several cannons pointed at the mouth of Sungai Selangor. In 1977 Bukit Melawati was designated a historical monument and historical site under the Antiquities Act 1976.

Tourism SELANGOR

Tourism Selangor *is a state government agency that attracts local and international tourists to Selangor by increasing the profile of the state*

***JPBD** is a town planning agency that plans, controls, and coordinates development, land use, and land conservation*

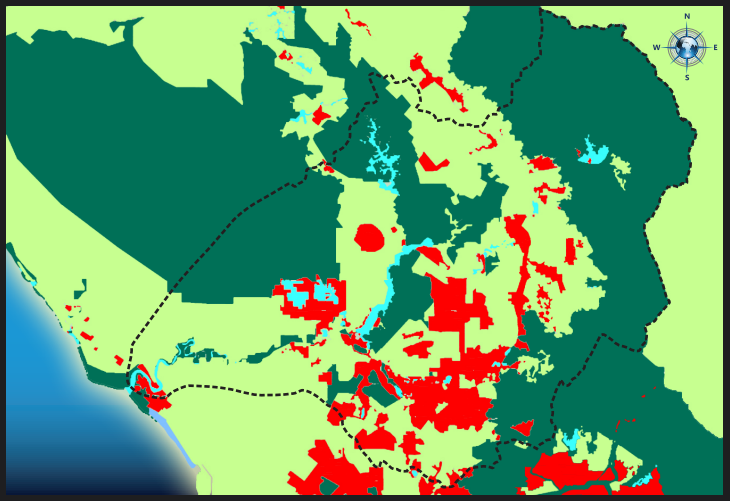
Land Use

Land use in the Sungai Selangor basin consists of four distinct zones, which are forests; agriculture (including animal husbandry, aquaculture, oil palm and rubber cultivation); built-up areas (residential, commercial, industrial, mixed development, institutions, mining, sand mining, and quarries); and water bodies comprising rivers, lakes and ponds.

In the **district of Hulu Selangor,** 53.50% of the area is covered by forest, the largest among all the districts. The area features many tourist attractions, such as the Sungai Perentak Recreation Forest and Sungai Chilling Waterfall. The agricultural area, taking up 33.40% of the basin area, is located near the mountainous region, around Batang Kali and Kalumpang. The remaining 10.40% and 2.70% is taken up by built-up areas and water bodies respectively.

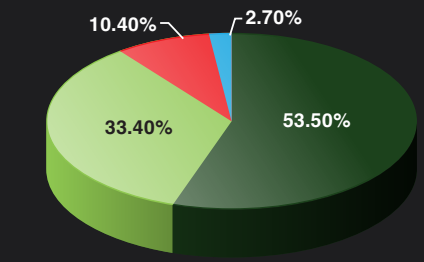
The **district of Gombak** has 43% forest cover in the upper reaches of the river basin. The built-up area, including the town of Rawang, comprises 36.40% of the district's land use and has the highest population in the state. Agricultural land makes up 18.80% while water bodies occupy 1.80%.

At 48.20%, agriculture comprises the highest land use in the **district of Kuala Selangor**, which is mainly made up of oil palm plantations. This is followed by forest area at 33.50%, while built-up land and water bodies claim 15.80% and 2.50% of the land respectively.



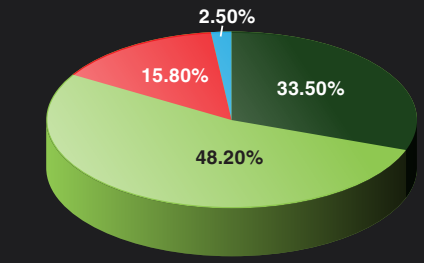
Land use within the Sungai Selangor basin
Source: Structure Plan, Jabatan Perancang Bandar dan Desa

Map of the Sungai Selangor basin
Source: JPBD 2015



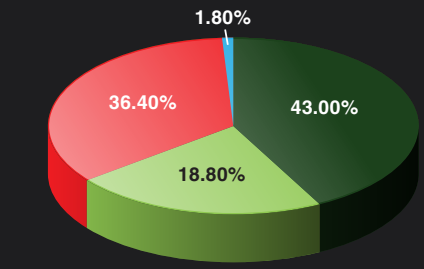
LAND USE FOR DISTRICT OF HULU SELANGOR

Forest | Agriculture | Built up Area | Water Bodies



LAND USE FOR DISTRICT OF KUALA SELANGOR

Forest | Agriculture | Built up Area | Water Bodies



LAND USE FOR DISTRICT OF GOMBAK

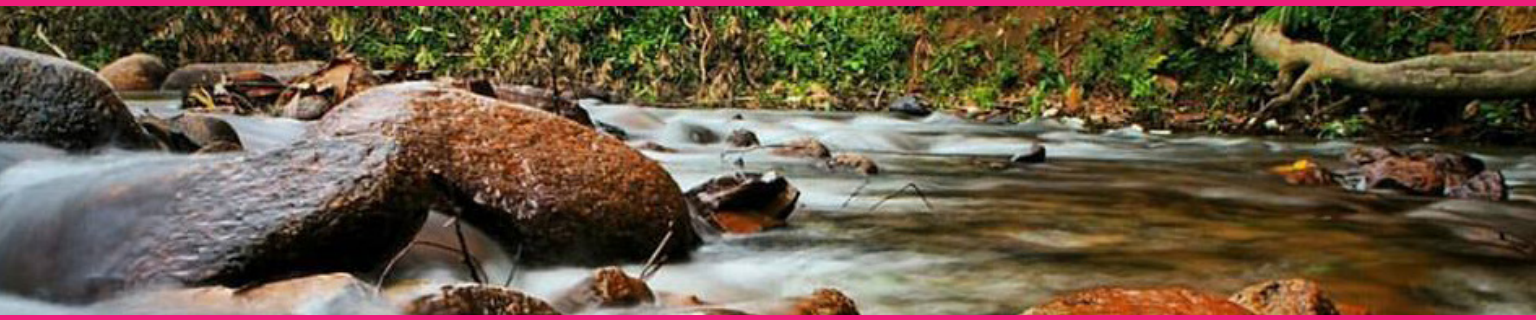
Forest | Agriculture | Built up Area | Water Bodies

MAP OF SUNGAI SELANGOR BASIN

Source: SYABAS EIS 2011 and LUAS

STATE OF **SUNGAI SELANGOR 2012-2015**

How Is Our River Doing?



The indicator used to measure river health is the water quality index (WQI). WQI summarises and presents water-quality data in an easily understandable format. It is a number ranging from 1 to 100; a higher number indicates better water quality. In general, stations scoring 80 and above met expectations for water quality and are of 'lowest concern', scores 40 to 80 indicate 'moderate concern', and water quality at stations with scores below 40 do not meet expectations and are of 'highest concern'.

RIVER BASIN	STATE	WQI				
		2011	2012	2013	2014	2015
Selangor	Selangor	85	84	83	87	87

Conclusion Sungai Selangor is a relatively clean river, with an overall water quality index of 85.2, which ranks it as a Class II river.

KEY FOR INDICATORS

The key for the indicators is shown below. The direction of the triangles show whether the trend is increasing, decreasing, or no change. The colour of the triangle indicates whether the trend is positive, negative, or neutral (neither good nor bad).

TREND

▲ Increasing ◆ No Significant Change ▼ Decreasing

IMPACT/EFFECT

■ Positive ■ Neutral ■ Negative

Main Issues in 2012-2015

The following section covers key issues and suggestions highlighted by stakeholders for joint problem resolution because issues usually require the actions of more than one department or agency. There are more issues and challenges raised in various chapters and sections throughout this report, but some issues that were common to all and highlighted by numerous stakeholder agencies are consolidated in this section.

Sufficient Water to Meet Population Needs

Over the past two decades, the Greater Klang Valley has become a water-stressed conurbation. Faced with erratic rainfall patterns, growth in urban population as well as greater industrial needs, water treatment plants in the Sungai Selangor basin are running over capacity to supply adequate water to meet the needs. After enduring water disruptions year after year, the Selangor State Government set up alternative water supply schemes to augment its existing supply capacity.

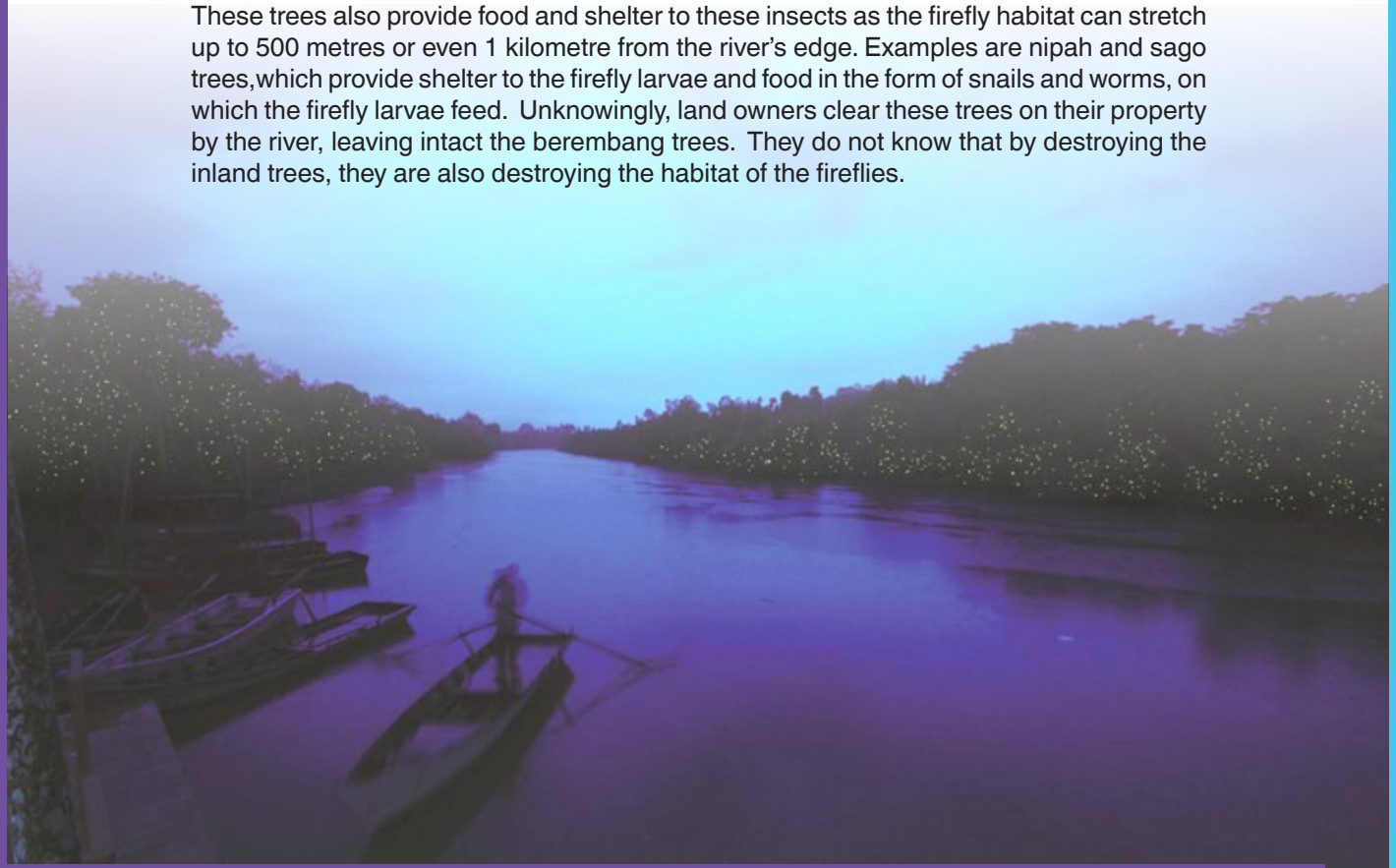
Operasi Pengepaman Air Kolam (OPAK) is an alternative source of water supply within the Sungai Selangor basin. This alternative water supply scheme, which involves pumping water from large-capacity ponds into Sungai Selangor, was started in July 2014 after Selangor and the rest of the country suffered a particularly bad drought. There are ten ponds that are involved in the OPAK scheme (Kolam KL Larut, Hang Tuah 5, HORAS 600, MBI, Taman Ilmu, Kambing Susu A, B, C, Hang Tuah 6 and Tan Chong). There are 33 pumps (10 pumps under JPS and 23 pumps under KSSB) with 1,000 MLD storage capacity that have been specified by LUAS to comply with plant requirements of SSP1, SSP2, and SSP3. The ponds are recharged with river water whenever there is excess flowing from upstream of the basin.

The **HORAS** project was initiated by the State Government to provide additional sustainable raw water source for treatment plants at Bestari Jaya. The storage pond in the project was designed to harness excess river water as well as groundwater. The acronym HORAS is derived from the project name Hybrid Off-River Augmentation Storage. The aim of the project is to ensure raw water supply during droughts. At the same time, the government is also working towards providing additional yield of 10% or 300 MLD to increase the output of the existing water treatment plants at Bestari Jaya. HORAS 600 is the first HORAS project undertaken by the government, and it is located at Kampung Sungai Darah, Bestari Jaya. The project is under construction and expected to be completed in 2017.

Degradation of Firefly Habitat

Part of the decline in the firefly population at Kampung Kuantan has been attributed to habitat degradation caused by the clearing of the Zone of Protection, which stipulates 400 metres from the riverbank to inland. The degradation stems from not only clearing the riverbanks of vegetation, but also the vegetation within the Zone of Protection.

Many observers have attributed the disappearance of the berembang trees (on whose nectar, and not the leaves, that the fireflies feed) to the decline in the firefly population. Not many among the public are aware that the decline is also caused by the cutting of other types of trees in the surrounding forest behind the frontline of the berembang trees. These trees also provide food and shelter to these insects as the firefly habitat can stretch up to 500 metres or even 1 kilometre from the river's edge. Examples are nipah and sago trees,which provide shelter to the firefly larvae and food in the form of snails and worms, on which the firefly larvae feed. Unknowingly, land owners clear these trees on their property by the river, leaving intact the berembang trees. They do not know that by destroying the inland trees, they are also destroying the habitat of the fireflies.



Water Quality at Kampung Kuantan

The Forest Research Institute Malaysia carries out biweekly water quality monitoring along the stretch between Kampung Kuantan and another point upstream along the river. It has two stations at the Kampung Kuantan jetty and another at the Bukit Belimbing jetty. Along with several parameters, the institute also checks for salinity. Overall, it found the river water there slightly polluted. Although the lower section of the basin comprises light industries, according to some sources the water quality is low from Batang Berjuntai to the river mouth.

Along this stretch of river, there are palm oil mills, chicken farms, a rubber glove factory and palm oil estates. At Kampung Telok Penyamun, there have been incidents of drainage from the palm oil mills. At Kampung Kuantan, farmers use sagu leaves for roofing, from which the discarded cuttings are thrown into the river. At Bagan Sungai Buloh, there are fish and cockle breeding as well as landings of herons that are affected by large volumes of solid waste thrown into the river. Water concessionaires also complain about the trash that disrupt operations at the intake points.

Rainfall Patterns Have Shifted To More Extreme Weather Events

Droughts and tropical storms are projected to get stronger due to global climate change. Dry seasons hamper dilution effects, which increases ammonia and other chemical concentrations. Wet seasons increase turbidity in the river water as well as wash off chemicals from impermeable land surfaces into the river (first flush).

RESOURCES IN THE RIVER BASIN

NRE is responsible for natural resources management, conservation and management of environment and shelters, and management of land survey and mapping administration

Puncak Niaga Sdn Bhd is one of water treatment operators in the state. It has 29 plants and 49% of treated water to five million agricultural and industrial end-users

Water Resources in the River Basin

River Basin Planning and Management

Activities, resources and assets within the river basin are managed by a number of government bodies at both state and federal levels.

Changes to the Environmental Quality Act 1974

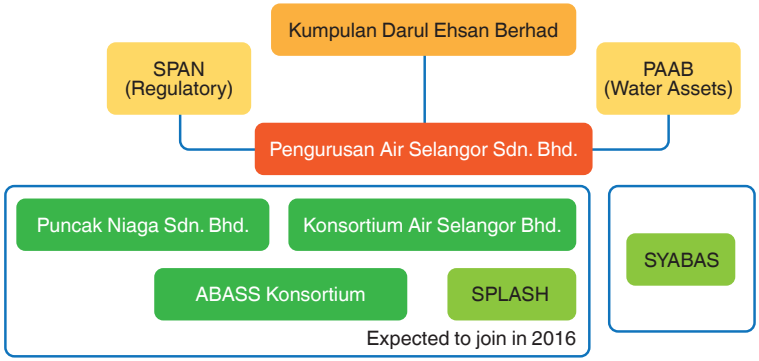
In 2015, amendments to the Environmental Quality Act 1974 were initiated and tabled by Kementerian Sumber Asli dan Alam Sekitar (NRE). These amendments introduced a new order called the 'Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015' as part of the government's preventive strategy in ensuring that all development projects would consider environmental factors in all stages of planning, construction, and operations based on environmental impact assessment (EIA) procedures.

The EIAs mandated in the new order is expected to help the authorities make informed decisions on development projects by considering its impact on the environment, as well as control measures that need to be done. When the new order is gazetted and comes into force in 2016, it will reduce among other things, the area of development projects requiring EIA from 50 hectares to 20 hectares. These changes shall have an impact on all activities within the river basins, from agriculture to fisheries to forestry, industries, mining and other activities in other industries and sectors.

Changes in the State Water Supply Structure

The Selangor State Government acquired control over most of the water abstraction and distribution operators in the state in 2015. Under the new water supply structure, all water concessionaires—Puncak Niaga Sdn. Bhd, ABASS Konsortium Sdn. Bhd., Konsortium Air Selangor Berhad, and potentially SPLASH Sdn. Bhd.—as well as water supplier SYABAS Sdn. Bhd. fall under the umbrella of Pengurusan Air Selangor Sdn. Bhd., which in turn is overseen by state-run company Kumpulan Darul Ehsan Berhad.

With this move, the water supply structure no longer has any federal links; it is all owned and run by the State of Selangor. Only the regulatory body, Suruhanjaya Perkhidmatan Air Negara (SPAN), and the asset owner Pengurusan Aset Air Berhad (PAAB) would remain as federal links to the Selangor water structure. However, all water sector bodies in the state are still bound by the terms of the Water Service Industry Act (WSIA) 2006, a federal enactment.



2015 State Water Industry Structure

Under this framework, the Sungai Klang and Sungai Langat river basins are covered by Puncak Niaga while Sungai Selangor is covered by SPLASH. SPLASH is slated to come under the umbrella of Air Selangor within the next year.

Regulation of Water Services

Suruhanjaya Perkhidmatan Air Negara (SPAN) is the regulator and enforcement agency of water and sewerage services. It conducts investigation and brings those who breach the law to court. It enforces the Water Services Industry Act (WSIA) 2006, which dictates the water industry and tariff structure and gives SPAN the authority to prosecute illegal tappers and unlicensed contractors. With WSIA, SPAN can register and regulate a

Konsortium ABASS Sdn Bhd *operates and maintains the Sungai Semenyih Scheme*

Konsortium Air Selangor Berhad *operates and maintains the Sungai Labu water treatment plant*

Syarikat Pengeluar Air Sungai Selangor *operates and maintains SSP1 and SSP3 water intake and treatment plants along Sungai Selangor*

***SPAN** is a government commission that regulates water supply and sewerage services*

Pengurusan Aset Air

***PAAB** is the water asset management company for the nation's water industry*

wide range of service providers such as water concessionaires, developers, plant and parts suppliers and any other registered suppliers, as well as pipe work companies, including plumbers. This means that any activities between raw water source to consumer water meters need to go through SPAN, which in effect is the regulator and enforcer of water supply and sewerage services. To maintain the license from SPAN, service providers must submit three years of performance records and meet key performance indices for ten years. There is a distinction in that the term 'authorisation to operate' is not the same as a full-fledged license.

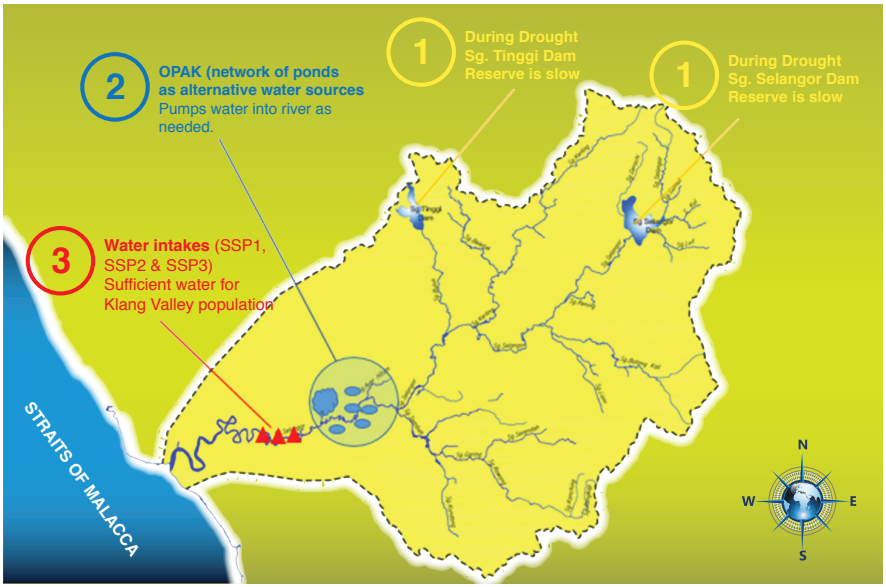
SPAN also enforces the EQA (Environmental Quality Act) for treatment of raw water, distribution, collection, treatment of wastewater and discharge into waterways.

Water-related assets such as pipes and plants fall under the purview of a federal agency called Pengurusan Aset Air Berhad (PAAB). PAAB assists new service companies in getting started up by renting assets to these companies until they can self-sustain the operating costs of the assets. The assets are owned by PAAB. After 45 years, the assets can be owned by the state. The main difference between SPAN and PAAB is that water services are managed by SPAN, while physical assets, facilities, and works are managed by PAAB. As such, PAAB oversees agencies such as Jabatan Perkhidmatan Pembetungan and Jabatan Bekalan Air, which manage and carry out the physical water projects.

Regulation of Sewage Services

The structure of the sewerage industry remains the same as before, although it will eventually likewise undergo a similar restructuring like the water services industry.

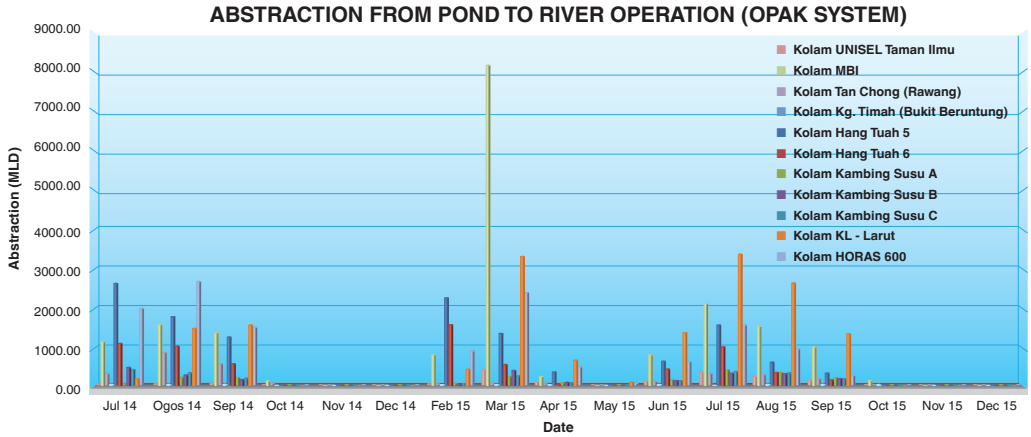
Infrastructure Schemes to Ensure Water Supply and Prevent Water Wastage



Operasi Pengepaman Air Kolam Alternatif (OPAK)

Water Security. With uncertainties in rainfall volume during monsoon seasons or vagaries of weather patterns such that rain does fall but not in the catchments where it is needed to recharge the dams, there is always the spectre of water shortage. Not leaving matters to chance, the State of Selangor, through LUAS, has invested in an alternative water resource scheme called **Operasi Pengepaman Air Kolam Alternatif (OPAK)**.

Located in Bestari Jaya upstream of the intake points, these ponds that serve as alternative water resources have a huge capacity of water available for pumping into the river when drought conditions arise. With a combined volume of 84 million cubic metres, it provides uninterrupted water supply to the Klang Valley while the dams in the river basin recharge. The short-term supply is currently expected to be around 1,000 to 2,000 MLD. Once recharged, any excess water released from the dams are then pumped back into the ponds through a Reverse Pumping Scheme (RPS).



Abstraction from pond to river within the Sungai Selangor basin
Source: LUAS

LUAS Intelligent Support System

Preventing Water Wastage. While LUAS is trying to provide sufficient water to meet the population's demands, it is also trying to prevent excess water from flowing out to the sea. Each day, a significant amount of river water—2,934 MLD—in Sungai Selangor flows out to the sea. This is water that is wasted and becomes precious during droughts.

Thus, an intelligent decision support system was developed by LUAS to model the catchment's water balance of daily dam releases, current and forecasted rainfall, river water level and water abstraction volume so that releases from the dams can be adjusted to allow just the right amount of river water to flow out to the sea. Called the **LUAS Intelligent Support System (LiSS)**, the system allows LUAS to regulate river flow and reduce the amount of river water wastage.

River Basin Monitoring

The Selangor State Government maintains close surveillance on the state of the river basins by calling for a meeting on river basins (Mesyuarat Jawatankuasa Pengurusan Lembangan Sungai dan Pantai) once a month or every two to three months. Starting in 2014, LUAS, local authorities, district offices, and other relevant stakeholders meet to report on incidents and cases within their jurisdictional area and update on happenings. The meeting is chaired by the State Secretary.

Dedicated Water Management Authority

Lembaga Urus Air Selangor (LUAS) is the water resources management body that monitors and enforces control over all human activities for the management of water resources, river basins, water bodies, groundwater, and coastal waters in the state of Selangor. Water quality of rivers is also monitored by other agencies and organisations such as water concessionaires, water distributors, Jabatan Alam Sekitar Selangor, and Jabatan Kesihatan Negeri Selangor. Through LUAS, information is shared so that any issues or problems arising can be handled effectively and expeditiously.

Currently, LUAS addresses violations mainly based on incoming complaints or reports. To become more proactive through widening its scope of responsibilities, the enactment **Emission or Discharge of Pollutants (State of Selangor) 2012** was gazetted in 2012. A list of activities that were expanded is shown below. With an expanded scope, LUAS can better regulate errant end-users of water resources.

Subsidiary Legislation

The State of Selangor has passed several laws between 2009 and 2011 relating to the management of the river basin.

In 2009, the **Port Klang Coastal Strategy Implementation Plan** was gazetted for implementation. The Plan, which was prepared by LUAS and approved by the

***LUAS** is a state agency for regulating and managing all water resources in Selangor*

ACTIVITY	LUAS' EXPANDED SCOPE
Freshwater aquaculture in ponds or cages	Operating breeding area of 50 hectares or above
Marine shrimp aquaculture in ponds	Operating breeding area of 10 hectares
Development and earthworks	For areas less than 50 hectares
Livestock other than pigs	Chicken, ducks, geese, turkeys, guinea fowl, guinea, pigeon, ostrich, emu, cows, goats, and other livestock in number of 20,000 or more
Swine livestock	All farms regardless of the number
Pets	Activities involving 20 cats or dogs
Mining-related activities	Any type of sand mining, soil and other irrespective of the quantity of mining or quarry in areas less than 200 hectares

Source: LUAS 2011

State of Selangor in 2007, delineates actions to address water pollution, destruction of habitat, solid waste, health, over-exploitation of natural resources, erosion, and sedimentation.

In 2010, the **Notification of Charges for Diversion of Water from Any Water Source 2010** was ratified, allowing LUAS to prescribe a rate for the diversion of water for electricity generation.

In the same year, a regulation called the **Zone of Protection (Declared Area and Restriction) Notification 2010** was gazetted to protect part of the wetland area, river reserve, and environmentally sensitive coastal area at Mukim Kapar in the district of Klang. The regulation places restrictions on building structures and carrying out works, application or storage of chemicals, alteration of existing land contours, clearing or harvesting of vegetation, and discharges of any effluent or waste.

Another 2010 regulation, **Zone of Protection (Declared Area and Restriction) (No. 2) Notification 2010** protects and reserves water resources and their environment in the catchment area for dams within the State of Selangor. It protects Klang Gates Dam, Batu Dam, Sungai Langat Dam, Sungai Selangor Dam, Sungai Semenyih Dam, Sungai Tinggi Dam, and Tasik Subang Dam.

Enforcement on Government Land

Land and district offices have the authority to ensure proper compliance for all government land. Any enforcement on violations on government land falls under the land and district offices. Privately-owned structures on government land, such as river reserves, are demolished or acquired through buy-back. Buy-back occurs on land under old grants, when rivers were part of the private owners' land. Under the new grant, rivers are not included in private grants, and reserve land by the rivers belong to Jabatan Pengairan dan Saliran.

ISSUE 01

GETTING STATES TO MIGRATE TO PAAB

Some states such as Terengganu and Pahang are still not under the PAAB scheme. The physical works of water industry such as pipe system upgrading or water facility building are costly, and the advantages of being under PAAB is the provision of funds to engage in these costly works. There are regulatory meetings to ensure that certain conditions are met and KPIs are attained such as production, quality, and compliance.

ISSUE 02

LACK OF STANDARDISATION OF TREATMENT PLANTS AMONG DEVELOPMENT PROJECTS

Not all treatment plants follow uniform design specifications. There are requirements and guidelines, such as the requirement of a treatment plant if a development is more than 30 population equivalent (PE). Moreover, the plants that are constructed do not always follow standardised design plans.

ISSUE 03

DISCOURAGE DEVELOPERS FROM BUILDING THEIR OWN PLANTS

As there is a trend for centralisation of sewage treatment plants (STPs), developers are encouraged not to build their own, stand-alone plants on their development lot. Instead, they are encouraged to pay a contribution levy towards the construction and maintenance of a centralised STP which is shared by several parcel owners on a larger scale.

JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

JPS is the government agency responsible for river basin management and costal zones, water resource management and hydrology, and flood management

Water Resources and Supply

Surface Water

Sungai Selangor is a major source of surface water supply for the State of Selangor, supplying approximately 67% of Klang Valley's water demand. The Sungai Selangor and Sungai Tinggi dams supply potable water to the northern Selangor region. The Sungai Selangor Scheme, which provides the water supply, was developed in three phases.

Phase 1 (SSP1) comprises the Sungai Tinggi Dam to secure a yield of 1,900 MLD at the intake at Bestari Jaya, formerly known as Batang Berjuntai, for water treatment at Bukit Badong.

Phase 2 (SSP2) involves another river intake at Bestari Jaya and upgrading of the water treatment. Both Phase 1 and 2 treatment plants have a design capacity of 950 MLD each, with a total output of 1,900 MLD.

Phase 3 (SSP3) covers the Selangor Dam to secure an additional yield of 1,100 MLD. The combined storage capacity of both Sungai Tinggi and Sungai Selangor reservoirs increased the total yield to 3,000 MLD. The scheme also includes a treatment plant at Rasa of 250 MLD capacity to supply the northeastern area of Selangor towards Perak. The Bukit Badong water treatment plant, which supplies to Kuala Lumpur and other part of Selangor, was expanded by 800 MLD.

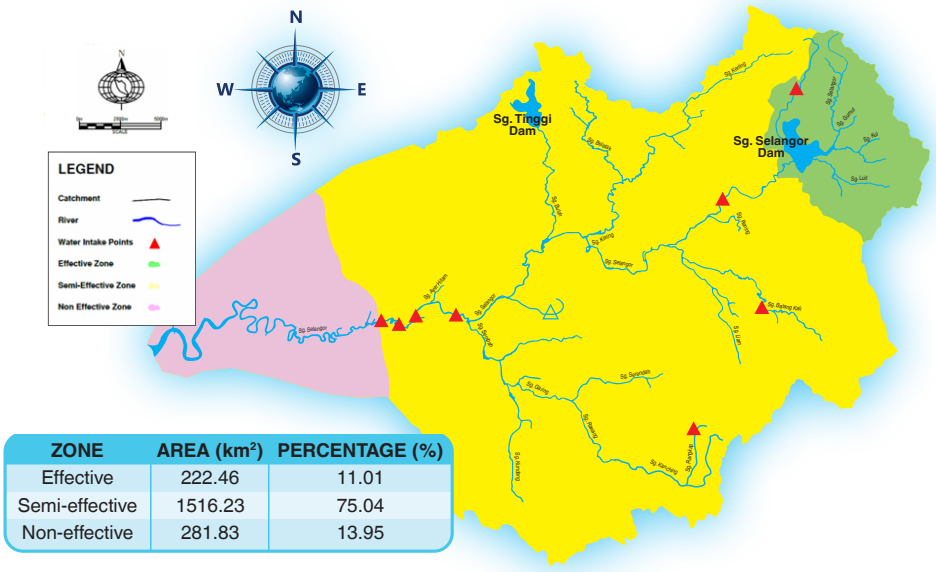
There are nine water treatment plants (WTPs) in the basin—three of which are operated by Syarikat Pengeluar Air Sungai Selangor Sdn. Bhd. (SPLASH) and the rest by Puncak Niaga Sdn. Bhd. (PNSB).

NO	INTAKE	OPERATOR	RAW WATER SOURCE	DESIGN CAPACITY (MLD)
1	Kuala Kubu Baru	PNSB	Sg. Gerachi	6.7
2	Batang Kali	PNSB	Sg. Batang Kali	20.3
3	Sg. Buaya	PNSB	Sg. Darah	0.9
4	Sg. Rangkap	PNSB	Sg. Rangkap	9.0
5	Rantau Panjang	PNSB	Sg. Selangor	31.5
6	Sg. Selangor (SSP1)	SPLASH	Sg. Selangor	950
7	Sg. Selangor (SSP2)	PNSB	Sg. Selangor	950
8	Sg. Selangor (SSP3) - Badong	SPLASH	Sg. Selangor	250
9	Sg. Selangor (SSP3) - Sg. Rasa	SPLASH	Sg. Selangor	800

Water intakes within the Sungai Selangor basin
Source: PNSB 2016

Zones of Contribution of Surface Water

It is important to look at surface water resources contribution by zones. Through zonation, water resources managers can see where the water consumption and storage is concentrated within the river basin and can plan for mitigation measures when unexpected occurrences, such as drought conditions or widespread pollution, arise.



ZONE	AREA (km²)	PERCENTAGE (%)
Effective	222.46	11.01
Semi-effective	1516.23	75.04
Non-effective	281.83	13.95

The **effective zone** (shown as the green area on the map) is where water from rainfall is fully captured and stored in the dam reservoirs up to the reservoir capacity. There are two dams in the upper reaches of the Sungai Selangor basin—Sungai Tinggi Dam and Sungai Selangor Dam. The capacity of the effective zone is 222.46 square kilometres, or 11.01% of the total basin area.

The **semi-effective zone** (shown as yellow) is where surface water from rainfall contributes to the river flow without any benefit of major storage. This zone contributes to the abstraction for public water supply and other uses. Without storage, part of the river flow discharges to the sea even after abstraction. The capacity of the semi-effective zone in the Sungai Selangor basin is the largest among the other zone; at 1,516.23 square kilometres, it comprises 75.04% of the total area of the basin.

The third zone is the **non-effective zone** (shown as purple), which covers catchment that is not contributing to any abstraction for public water supply or major irrigation. Any flow contribution from this zone is mostly discharged to the sea. The capacity area of the non-effective zone is slightly larger compared to the effective zone, at 13.95% or 281.83 square kilometres of the total basin area.

Sungai Tinggi Dam

Water Reservoir

The two dams, Sungai Tinggi and Sungai Selangor Dam, are managed by SPLASH.

The **Sungai Tinggi Dam** is located in the Bukit Tarek forest reserve and constructed at the riverheads of Sungai Buloh, the first order tributary of Sungai Selangor near Ladang. It has a catchment area of 40 square kilometres and was commissioned in 1996 under the Sungai Selangor Phase 1 (Stage 2) to regulate the flow at the existing water intake at Batang Berjuntai, which is located about 30 kilometres downstream. A pumping station with capacity of 150 MLD has been constructed to assist with the refilling of the Sungai Tinggi reservoir during high flow seasons from the main stream of Sungai Selangor.

SUNGAI TINGGI DAM

Catchment:
3,692 hectares

Dam area:
805 hectares

Capacity:
51,694 MLD

Yield:
1,100 MLD

SUNGAI SELANGOR DAM

Catchment:
20,219 hectares

Dam area:
509 hectares

Capacity:
26,247 ML

Yield:
1,200 MLD

Type:
Rockfill

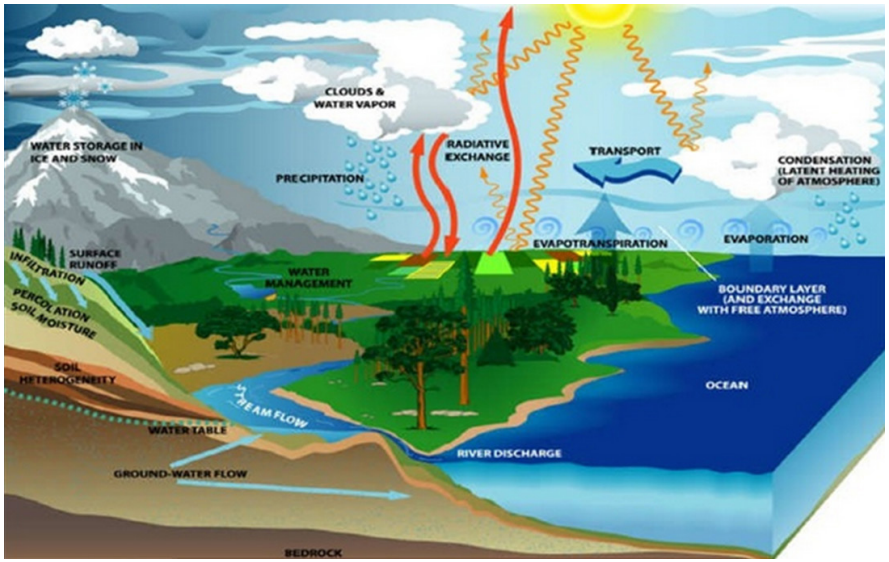
The pumping station is located downstream of the North-South Expressway crossing over Sungai Selangor. The height of Sungai Tinggi Dam has been raised to increase its active storage capacity to 114.5 MCM.

Sungai Selangor Dam

The **Sungai Selangor Dam** is the newest dam in Selangor, with operations starting in 2003 under the Sungai Selangor Phase 3. The dam is in the forest reserve of Kuala Kubu Baru and has a catchment area of 197 square kilometres. The dam was constructed to provide an additional 1,100 MLD (12.7 m^3/s) and enables the abstraction capacity from Sungai Selangor to be increased from 1,900 MLD (22 m^3/s) to 3,000 MLD (34.7 m^3/s).

Groundwater

Groundwater is defined as 'water under the ground surface that fills spaces between sand grains, in rock crevices and in solution openings'. LUAS refers to groundwater as 'subsurface water that occurs beneath the water table in soils and geologic formations'. It is abstracted via wells, boreholes, or any similar work sunk into underground strata, excavation into underground strata, or designated groundwater.



Hydrological cycle showing groundwater flow

All groundwater abstraction in Selangor is regulated by LUAS. Users must get a license from LUAS pending technical comments from Jabatan Mineral dan Geosains (JMG), which serves as a technical advisor. It is LUAS role to ensure that abstraction is properly managed, while JMG advises on the volume and method the abstraction is done.

If the volume of abstraction exceeds 1 MGD (million gallons per day or 4.5 MLD), an EIA is required and reviewed by JMG for groundwater modelling. This is necessary as there are four wells in Selangor, two wells for Spritzer in the Sungai Selangor basin and two wells for Champs Water in the Klang River basin. Groundwater abstraction for groundwater is 5 sen/m^3 for industry and 1 sen/m^3 for public utility. For personal consumption, water users are given a free allocation of water in accordance to section 45 of the LUAS Enactment.

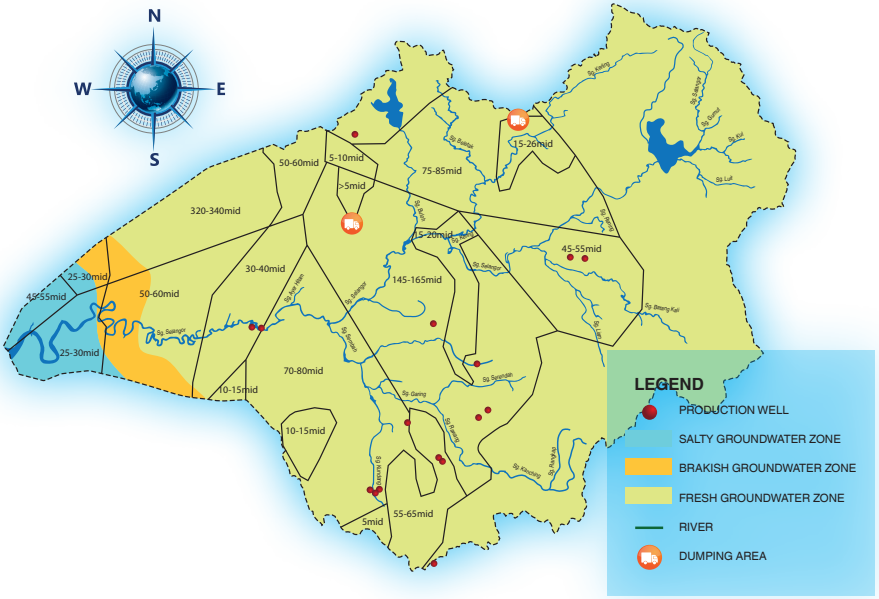
JABATAN MINERAL & GEOSAINS MALAYSIA

***JMG** is an agency that provides technical advisory services and expertise in minerals, geosciences, mining and quarries*

Available Groundwater Resources

The Sungai Selangor basin has three groundwater zones, which are fresh, brackish, and salty. A total of 93.64% from a catchment of groundwater zone is freshwater located upstream, followed by the brackish and salty zone at 3.11% and 3.25% respectively. The freshwater zone is at risk of becoming contaminated due to two existing landfill located at Bukit Tagar and Bukit Beruntung. Based on the available groundwater resources, the maximum rate available is 320–340 MLD, which is located downstream of Sungai Selangor near Kampung Raja Musa in Kuala Selangor, while the range for the other zones is 5-165 MLD.

Groundwater zone and availability within the Sungai Selangor basin
Source: Laporan Kajian Kebolehdapatan Sumber Air Bumi Negeri Selangor untuk LUAS



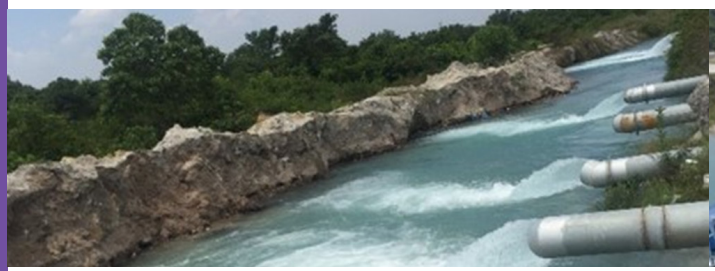
Lakes and Ex-Mining Ponds

There are 15 natural ponds, lakes, and ex-mining ponds that have been classified as alternative water resources. Nine are in the Hulu Selangor district, four are in Kuala Selangor, and two in Gombak. Some of the lakes are large and quite deep, some are over 20 metres, and all have been identified as alternative water supply resources, especially for periods during the dry seasons.

DISTRICT	LOCATION
Hulu Selangor	KT Batu 31, Jln. Rawang-Batang Berjuntai near Sg. Sembah
	KT Sg. Rawang-Sg. Serendah (near PLUS highway), Sg. Rawang
	KT Tasik Teratai, Serendah (near Sg. Punggor)
	KT Rasa near Sg. Selangor
	KT Kg. Timah, Hulu Yam (near Sg. Selangor)
	Kuala Garing
Kuala Selangor	Lombong Berjuntai Tin 1 and 2 (Batang Berjuntai), Sg. Selangor
	Kolam PNSB Batang Berjuntai, Kg. Sg. Darah, Sg. Selangor

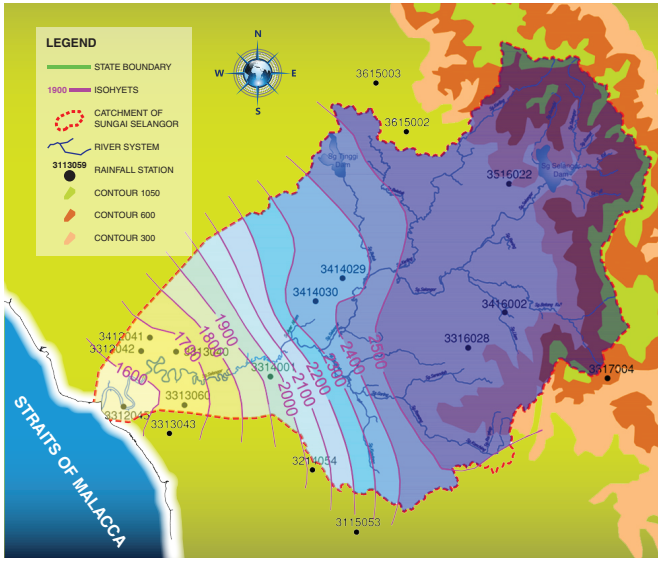
Ponds within the Sungai Selangor basin
Source: LUAS

OPAK, the alternative water source to Sungai Selangor, has a total of ten ponds that are used as water storage.



The HORAS pond, which is located at Kampung Sungai Darah, Bestari Jaya, is currently under construction and expected to be completed in 2017.

HORAS pond
Source: Unit Perancang Ekonomi Negeri (UPEN) Selangor

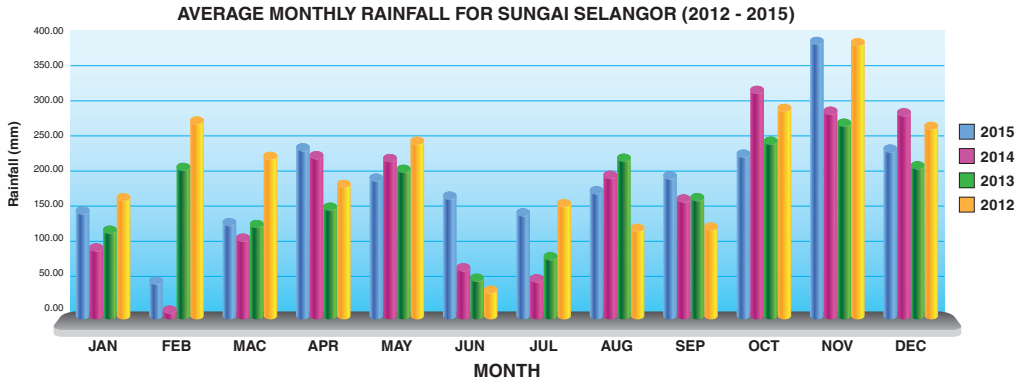


Isohyet map within the Sungai Selangor basin

Rainfall Patterns

There are ten rainfall stations in the Sungai Selangor basin that are monitored by Bahagian Saliran dan Air Hujan, JPS for analysis. From 1971 to 2015, the average annual rainfall in the basin fell within the range of 1,600–2,500 millimetres whereby the water level upstream is higher than the level downstream.

An analysis of the average monthly rainfall from 2012–2015 shows that the rainfall depth was higher at the end of the year compared to the beginning of the year. The highest annual rainfall was 378.78 millimetres during November 2012, with the next highest in November 2015 at 378.48 millimetres. During February 2014, 10.37 millimetres was recorded as the lowest annual rainfall depth because of the El Nino phenomenon.

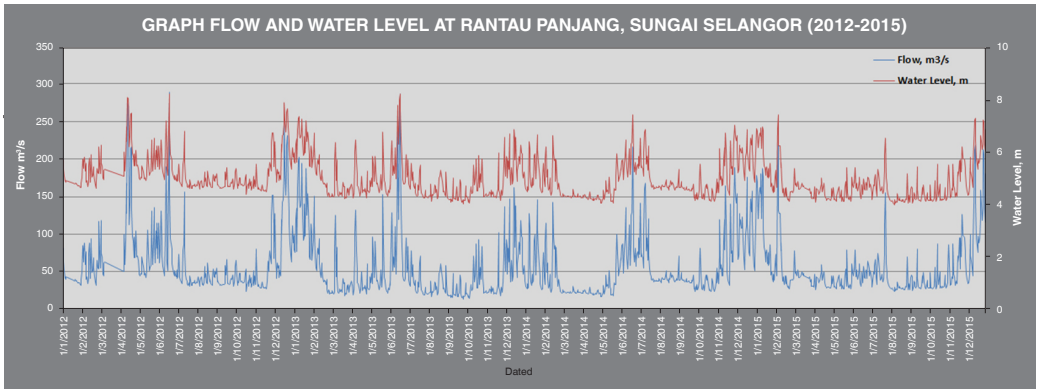


Average monthly rainfall within the Sungai Selangor basin
Source: JPS 2015

The El Nino phenomenon has had a negative impact throughout the state of Selangor. The lack of rainfall and increase in average air temperature caused the water level in the dam to drop. The most significant impact of the phenomenon was the burning of the peat swamp forests, which occurred mostly in the neighbouring catchment of Kuala Langat due to lack of water content in the peat soil. Because of the low volume of rainfall, there was no dilution in the river, causing the ammonia level to increase. This affected the operation of WTPs at Batu 11 and Bukit Tampoi, which had to be shut down every year, especially during drought periods.

Water Level and Flow

For the period 2012 to 2025, the water level and flow patterns for Sungai Selangor were higher during the monsoon season (November to February) than other times of the year.



Water flow and water level pattern for Sungai Bernam from 2012 to 2015
Source: JPS 2015

Water Abstraction

Abstraction from Surface Water

Water Abstraction by Water Intake Point

In Selangor, approval from LUAS is required before water can be abstracted. LUAS carries out monitoring and enforcement to ensure that premises and factories that abstract ground and surface water resources are registered with LUAS. This is to ensure that all the conditions stipulated in the license are complied with by the water abstractor. The ultimate goal is to control the use of water in a holistic and integrated manner.

LUAS imposes a charge for water abstracted from all water resources. Revenues from abstraction go towards the conservation of water resources and environment. Water abstracted for commercial use is RM0.05/m^3, while water for public utility, including domestic supply, is RM0.01/m^3.

WATER ABSTRACTION	RATES
Commercial	RM 0.05/m^3
Public Utility	RM 0.01/m^3

Within the basin, there are nine water intake points to abstract surface water. SYABAS is the distributor of potable water to the consumer. Water abstraction and treatment is carried out by two water concessionaires, SPLASH and PNSB.

SPLASH is the concessionaire in charge of the Sungai Selangor Water Scheme for Phases 1 and 3, while PNSB operates the other intakes and facilities, including Phase 2. In 2012, the amount of raw water abstracted from rivers was 2,825 MLD. The amount increased to 2,827 MLD in 2013; 3,054 MLD in 2014; and 3,117 MLD in 2015.

WATER INTAKE POINT	DESIGN CAPACITY	PRODUCTION (MLD)			
		2012	2013	2014	2015
Kuala Kubu Baru	6.7	6.6	6.4	7.4	6.9
Batang Kali	20.3	13.8	7.0	11.3	10.6
Sg. Buaya	0.9	0.6	0.6	0.5	0.5
Sg. Rangkap	9.0	9.0	8.8	11.0	9.2
Rantau Panjang	31.5	34.0	30.7	35.4	39.3
Sg. Selangor (SSP1)	950.0	843.2	961.6	1017.3	1016.6
Sg. Selangor (SSP2)	950.0	1047.5	884.0	1029.3	1041.6
Sg. Selangor (SSP3) - Badong	800.0	721.4	767.3	786.2	824.1
Sg. Selangor (SSP3) - Sg. Rasa	250.0	148.8	160.9	156.0	168.5
TOTAL		**2,824.9**	**2,827.3**	**3,054.4**	**3,117.3**

Production at water intake within the Sungai Selangor basin
Source: PNSB

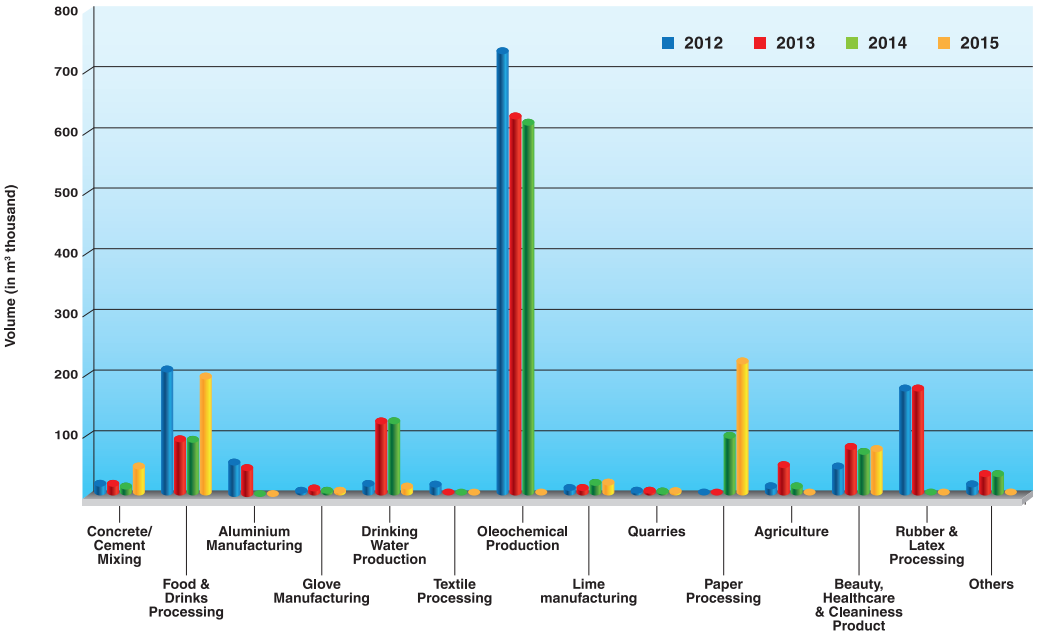
In terms of abstraction volume, the highest was at the Selangor Water Scheme Phases 1, 2 and 3 (Badong intake). The lowest abstracted volume among the nine water intake points was at the Sungai Buaya water treatment plant, due to its low design capacity.

Abstraction from Groundwater

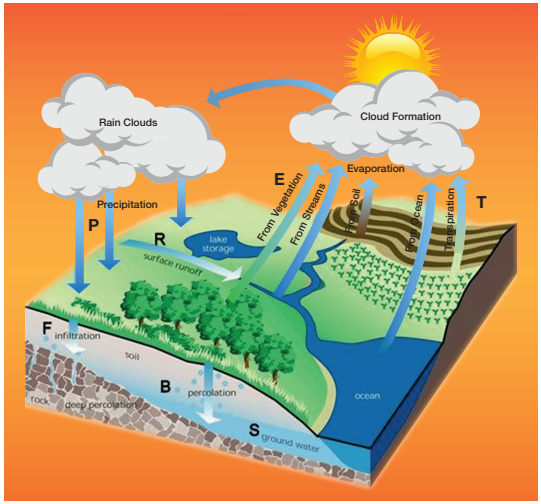
From 2012 to 2015, the production of oleo-chemical was the biggest licensed user of groundwater within the basin at 737,797 cubic metres, 632,665 cubic metres and 622,040 cubic metresfor each respective year. In contrast, the food and drinks processing industries saw a major drop in abstraction to 120,291 cubic metres during the period 2012-2013 while the amount of abstraction increased in production of drinking water increased by 107,337 cubic metres from 2014–2015. The highest volume of groundwater usage by consumers was in 2012 at 1.3 million cubic metres.

Every three months, PNSB appoints a contractor to test and monitor the water quality at the intakes for all river basins. It tests for 14 parameters. For dams, water quality will be tested every quarteryear while water treatment plants are tested every two hours.

VOLUME OF LICENCED GROUNDWATER ABSTRACTION IN THE SUNGAI SELANGOR BASIN



Groundwater abstraction within the Sungai Selangor basin
Source: LUAS



Estimated Water Balance

A water balance from the hydrological cycle perspective is defined as 'the amount of water entering and leaving a control space during a specific period of time'. In general, rainfall is the main input of the system which upon reaching the ground will undergo a process of evapotranspiration and seepage to the ground.

The remaining volume will travel overland and into the rivers in the form of surface runoff. After deducting the amount abstracted for water supply and irrigation, the balance will be discharged into the sea. The amount discharged to the sea in general can be considered as the unused potential reserve that can be capitalised provided there is adequate infrastructure to harvest the resource.

Based on long-term records, the total annual depth of rainfall and runoff at the Sungai Selangor basin are 2.44 metres and 1.01 metres respectively. The total depth of runoff is the subtraction depth of annual rainfall, evapotranspiration, and seepage to ground. Therefore, the total depth of runoff for the basin with area of 2,200 square kilometres is 2,222 MCM/year or 6,088 MLD.

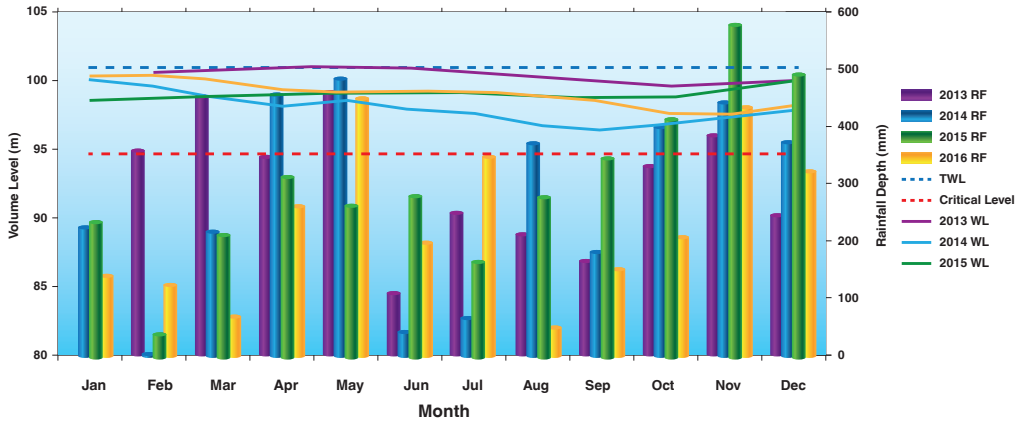
However, the river abstraction from industries and intakes needs to be counted into the remaining water balance. For the Sungai Selangor basin, the utilisation for water supply at water intakes and industries are 3,117 MLD and 43 MLD. The remaining water balance after consideration of the water utilisation for water supply is 2,928 MLD, which flows into the sea. With proper water source development, this potential reserve may be tapped for future use.

ITEM	TOTAL	TOTAL
Catchment area	2,200	km^2
Annual rainfall	2.44	m
Annual evapotranspiration	1.28	m
Annual seepage to ground	0.15	m
Annual runoff	1.01	m
Total runoff over 2,423 sq km	2,222	MCM / Year
Average runoff	6,088	MLD
Utilisation for water supply (water intake)	3,117	MLD
Utilisation for water supply (industry)	43	MLD
Balance	**2,928.0**	**MLD**

Water Level at Dams

There are two dams used for water supply, the Sungai Selangor Dam and Sungai Tinggi Dam, which are managed by SPLASH. The graph below shows the average water level for both dams. The top water level and critical level for the Sungai Selangor Dam are 220 metres and 184.63 metres respectively. The highest and lowest water level is during January 2015 at 220.07 metres and August 2014 at 186.52 metres. In 2015, the water level showed a steady drop from the month of January until October. In general, the drought season occurs from the month of February until April and continues from July until August.

AVERAGE WATER LEVEL AT SUNGAI TINGGI DAM



Water Quality

Jabatan Alam Sekitar (JAS) Selangor continuously monitors the quality of river water, marine water, and groundwater to detect and quickly address any changes in the environment that may have a negative impact on humans as well as the environment. Within the Sungai Selangor basin, there are nine JAS monitoring stations along the rivers and tributaries for water quality.

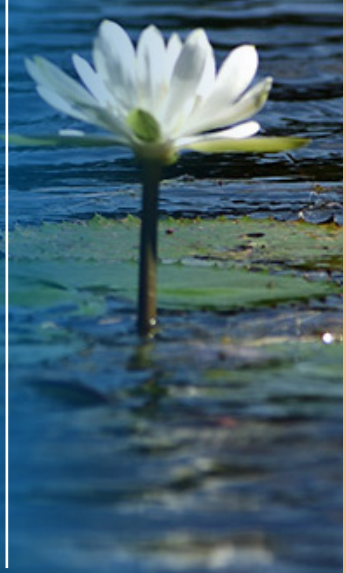
Water quality index, known as WQI, indicates how polluted is the water in a river. It is a weighted average of various pollutants, called parameters, to make it easier to classify the river according to quality levels. The quality levels fall into one of three categories, which are clean (81-100), slightly polluted (60-80), and polluted (0-59).

Every three months, PNSB appoints a contractor to test and monitor the water quality at the intakes for all river basins. It tests for 14 parameters. For dams, water quality will be tested every quarter while water treatment plants every two hours.

New Function within SYABAS: River Surveillance and Investigation

In light of recent water disruptions due to indiscriminate and severe river water pollution, Selangor's treated water distributor SYABAS has revamped its former environmental monitoring function to a more active water quality sampling and monitoring unit, which now includes river surveillance. It monitors two groupings of major catchments, which are Sungai Selangor/Sungai Bernam and Sungai Langat/Sungai Klang. In addition to its role of monitoring, it now has added investigation and facilitates towards enforcement of infractions by offending parties. These new roles were added during the restructuring of the water services sector in Selangor in 2014 and 2015.

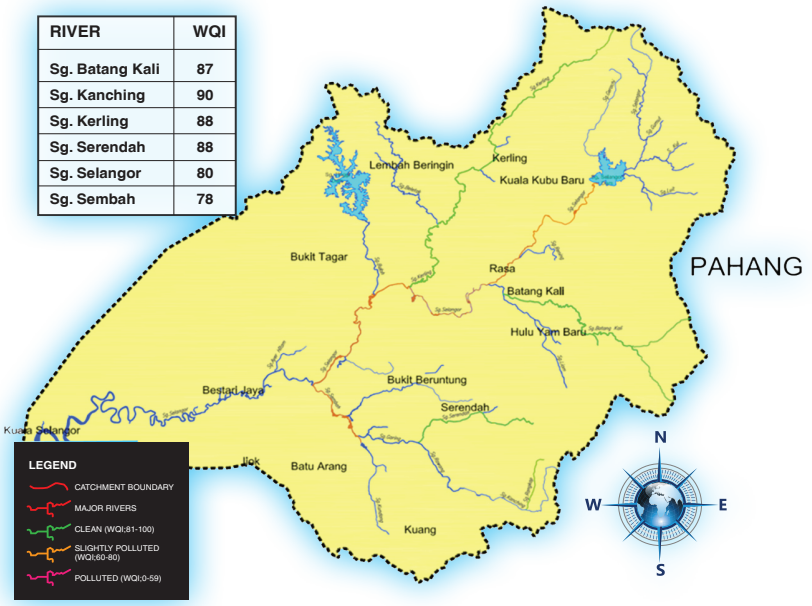
***JAS** is an environmental protection agency that monitors and regulates air quality, river, groundwater and marine water quality, noise pollution and climate change*



Review of Existing Effluent Discharge Regulations

LUAS is currently in the process of reviewing the existing Emissions or Discharge of Pollutants (Selangor) 2012. It would review the limits of parameters for seven activities covered in this regulation. The seven activities are sand mining and quarry, earthwork, pig farming, animal husbandry excluding swine, freshwater aquaculture, marine prawn aquaculture, and pets.

In map below, the main and tributary rivers are coloured according to their classes. Sungai Batang Kali, Sungai Kanching, Sungai Serendah, and Sungai Kerling are classified as clean rivers. For slightly polluted rivers, there two: Sungai Selangor and Sungai Sembah. There are no rivers or tributaries that are classified as polluted rivers in the basin.



River water quality within the Sungai Selangor basin
Source: JAS 2016

Although the lower section of the basin comprises light industries, according to some sources the water quality is low from Batang Berjuntai to the river mouth. Along this stretch of river, there are palm oil mills, chicken farms, a rubber glove factory, and palm oil estates. At Kampung Telok Penyamun, there have been incidents of drainage from the palm oil mills. At Kampung Kuantan, farmers use sagu leaves for roofing, from which the discarded cuttings are thrown into the river. At Bagan Sungai Buloh, there are fish and cockle breeding as well as landings of herons that are affected by large amounts of solid waste thrown into the river. Water concessionaires also complain about the trash that disrupt operations at the intake points.

In one case in Sungai Selangor, there was discharge of recycled diesel oil. LUAS brought the owner to court, where it was discovered that the owner had been operating a factory for ten years without a license. This points to a need for more monitoring by the district and land offices.

Water Quality at Kampung Kuantan

The Forest Research Institute Malaysia (FRIM) carries out bimonthly water quality monitoring along the stretch between Kampung Kuantan and another point upstream in the river. It has two stations at the Kampung Kuantan jetty and another at the Bukit Belimbing jetty. Along with several parameters, FRIM also checks for salinity. Overall, FRIM finds the river water there slightly polluted.

Is the Diesel from Firefly Tourism Boats Causing Water Quality Degradation?

Many observers in Kampung Kuantan blame the tourist-carrying boats as a negative contributing factor to the firefly population. FRIM refutes this, saying that many of the boat operators use paddles and the boats at Bukit Belimbing use battery operated motor boats. The sources of pollution in the river could be attributed more to spillage from upstream factories. There has been a report of blackish water appearing in the upstream vicinity of Kampung Kuantan, although the source was not confirmed. In terms of tourism boats, they are not a threat ecologically, and any diesel engines used on boats are by fishermen who engage in subsistence fishing.

ISSUE 01

FLUORIDE LEVEL SPIKES IN THE RIVER GETTING MORE FREQUENT, HENCE DISRUPTING INTAKE PLANTS

As intake plants are not designed to remove fluoride, consistency of raw water quality cannot be maintained as SPLASH does not have the proper tools to maintain national raw water quality standards based on fluoride level spikes. (This applies to oil as well)

* *Trend of water pollution shifted from physical pollution (turbidity issues in the 1990s) to chemical pollution. One can speculate that clearing of forests in the '90s caused increased surface erosion and runoff, thus contributing to the increased turbidity while today's chemical pollution is due to the industrial areas that are built in the cleared areas and hence contributing to chemical pollution in the river.*

■ **Action:** LUAS is developing plans for 24-hour monitoring of river quality in an effort to find the culprits behind the pollution.

ISSUE 02

RAINFALL PATTERNS HAS SHIFTED FROM CONSTANT RAINFALL TO MORE EXTREME WEATHER EVENTS

Droughts and tropical storms are getting stronger. Dry seasons dampen dilution effects which increases ammonia and other chemical concentrations, while wet seasons increase turbidity and potentially washes other chemicals from the riverbanks into the river.

ISSUE 03

CLEANING OF LOG BOOMS ARE QUESTIONABLE AS CONTRACTORS DO NOT DISPOSE THE TRASH COLLECTED FROM LOG BOOMS ADEQUATELY

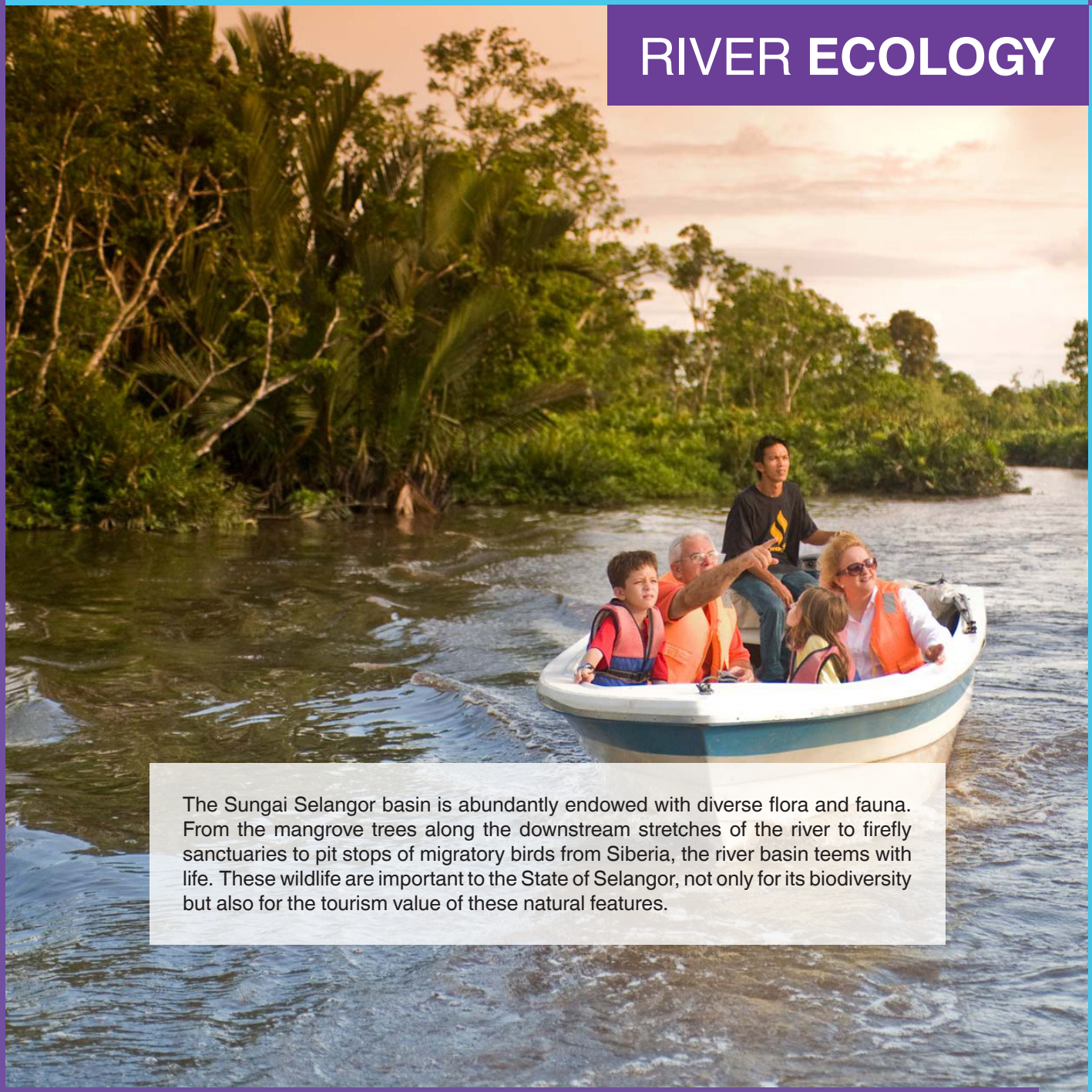
With improper disposal methods, trash ultimately ends up back into the river. More supervision of the work by contractors is needed.

ISSUE 02

WATER HYACINTH BLOOMS FREQUENTLY CLOG WATER INTAKE POINTS

Some clusters of blooms are the size of small islands. The source of hyacinth growth is crucial as overgrowth of these plants would mean more water is lost due to high evapotranspiration rates of the plant and deoxygenising effect on the water body as it inhibits green algae growth beneath the water column it is growing on.

RIVER **ECOLOGY**



The Sungai Selangor basin is abundantly endowed with diverse flora and fauna. From the mangrove trees along the downstream stretches of the river to firefly sanctuaries to pit stops of migratory birds from Siberia, the river basin teems with life. These wildlife are important to the State of Selangor, not only for its biodiversity but also for the tourism value of these natural features.

Fireflies of Kampung Kuantan

The Fireflies of Kampung Kuantan have been nicknamed “Nature of Wonders” and “Christmas in Summer”. With thousands of twinkling lights illuminating the dark stillness along Sungai Selangor, the scenery is a fairytale wonderland that attracts local and foreign tourists alike. The fireflies are special not only in the beauty they produce, but this species—*Pteroptyx Tener*—is found in only two places in the world, one in this part of Malaysia and the other in the Amazon in South America. A greenish-black insect measuring

0.5 millimetres, they have the capability to synchronise their blinking so that they flicker on and off in unison, a behaviour trait that other firefly species—all 1,500 species in the world—do not have.

The substance that enables them to light up is found in the berembang (*sonneratia caseolaris*) leaves. Because their lifespan of two to three months is relatively short, the continued viability of the firefly ecosystem is vital to keeping up the population numbers.

Due to the commercial and ecological value of the firefly, the state of Selangor—through FRIM—has been monitoring the firefly population monthly to ensure a sustainable approach to its survival. FRIM's reporting of the firefly monitoring has resulted in Enactment 49 "Zone of Protection in Kampung Kuantan" in 2009. Other research and environmental bodies, such as the Malaysian Nature Society, also conduct studies and programs to mitigate the negative impacts of human activities on the firefly population. FRIM monitors nine locations along the stretch of the Sungai Selangor in Kampung Kuantan.

The areas are:

- Kampung Nyior
- Kampung Masjid Lama
- Kampung Telok Siam
- Kampung Tanjung Beluntang
- Kampung Telok Baharu
- Kampung Sarang Lang
- Kampung Kedah
- Kampung Kuantan

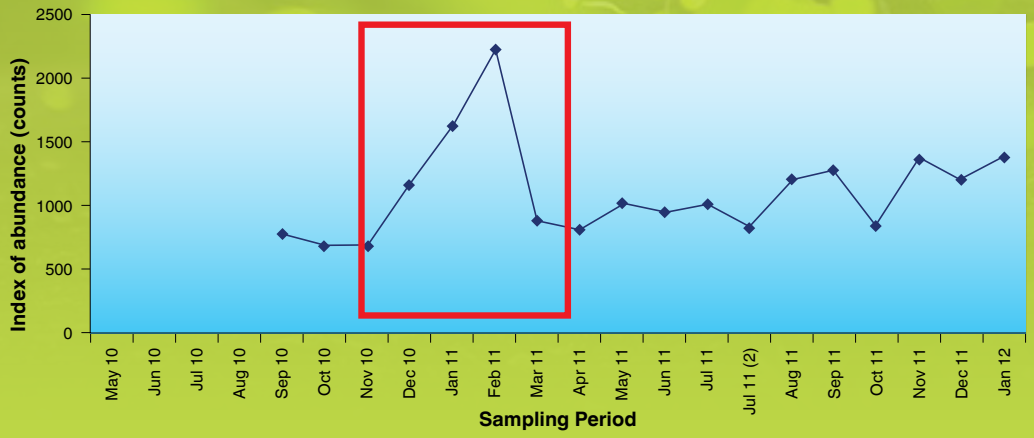
To measure the population of the fireflies, it conducts a yearly study to obtain the "index of abundance". Using high-resolution digital night photography, it shows whether the firefly population is increasing or decreasing. It has been monitoring the population for a period of nine years (2007 to 2015), and as of 2015, results have shown that there has been a decline in the population of 37%.

***FRIM** is a premier institution in tropical forestry research and a full fledged statutory body governed by the Malaysian Forestry Research and Development Board (MFRDB) under the Ministry of Primary Industries*

Firefly Conservation – Indicators of River Health

To preserve this unique entymological as well as tourist feature, a firefly conservation program was started in 2006 by JPS. The program was subsequently funded by FRIM and more recently, by LUAS.

FRIM developed a special technique for monitoring the firefly population comprising high-resolution digital night photography to obtain a form of population measurement called an 'index of abundance' of the adult firefly population every month. Malaysia is the only country in the world to have developed a systematic monitoring programme and technique to monitor firefly population.



Sampling of firefly population from Sept 2010 to Jan 2012
Source: FRIM and LUAS 2012

The trend line shows that there was a marked increase from November 2010 until February 2011 and a sharp drop in March 2011. The highest peak of abundance was mid-year (June to August) from years 2006 to 2008. However, from 2009 to 2011, there was a change in the abundance trend whereby the peak appeared at the end and beginning of the years. This could be caused by a change in rainfall patterns. Other factors could include habitat degradation.

Trend of firefly population in Kuala Selangor
Source: FRIM and LUAS 2012

ISSUE 01

DEGRADATION OF FIREFLY HABITAT

The decline in the firefly population could be attributed in part to habitat degradation caused by the private landowners' clearing of the Zone of Protection, which is 100 metres from the riverbank to inland areas. This involves not only clearing the riverbanks of vegetation, but also vegetation within the Zone of Protection. Many observers have attributed the disappearance of the berembang trees (on whose nectar, and not the leaves, that the fireflies feed) to the decline in the firefly population, but according to FRIM researchers, other trees in the surrounding forest behind the frontline of the berembang trees also provide food and shelter to these insects. Firefly habitat can stretch up 500 metres or even 1 kilometre from the river's edge. The nipah and sago trees also provide shelter to the firefly larvae and food in the form of snails and worms, on which the larvae feed. Landowners clear these trees on their property by the river, leaving intact the berembang trees, but they do not know that by destroying the inland trees, they are also destroying the habitat of the fireflies.

■ **Suggestions :** To counter the decline in the firefly population, FRIM and MNS recommend the acquisition of certain lands along the riverside. An example is the purchase of land that is sensitive in the firefly ecosystem in Tanjung Beluntas in 2011. This would resolve the issue of private land being in the Zone of Protection, which makes enforcement on the land more difficult. Moreover, the persons clearing the land in the Zone of Protection are often leased the land, the actual owners are anonymous and therefore difficult to track down. District authorities suggest gazetting of wider area of protection for the fireflies.

ISSUE 01

RIVERBANK EROSION

Riverbank erosion is one of the factors contributing to the decrease in the firefly community. To counteract the erosion, replanting in the upper portions of the river system is carried out. For example, villagers in Kampung Pengkalan Siam engage in replanting activities. FRIM concurs with the location of replanting activities being undertaken upstream rather than downstream where the river flows faster.

■ **Suggestions by FRIM :**
- Minimise and control land clearing around the area
- Minimise the use of pesticides for clearing as they will seep into the river water
- Leave at least 100 metres of riverside reserve
- River cleaning is done by villagers and volunteer students. Perhaps district and local authorities could have more participation in this initiative. There used to be incentive programs in the form of pay-for-rubbish collection by the villagers. This could be a joint initiative between the land and district offices, local authorities and JPS.

Tree planting at Kampung Kuantan by local government officers and community members
Source: Majlis Daerah Hulu Selangor 2016

Eagles

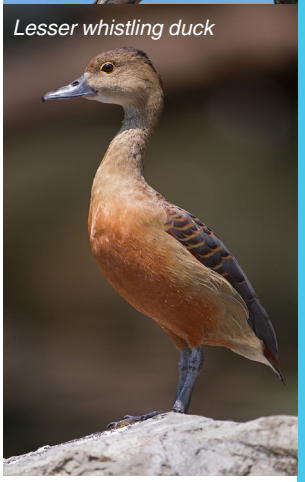
The coastal hills and forests in the lower basin areas of Sungai Selangor are known to be habitats for Brahminy kites and white bellied sea eagles. There is a sizeable population in Kuala Selangor as well as in Jugra, Langat. They have now become tourism features, with boat rides being offered for eagle feeding excursions. For those who prefer eagle-watching on land, there is a jetty for tourists at Pasir Penambang.

Local authorities say that the boats used for these excursions are diesel-operated and the pollution risk from a diesel leak is high.

Other birdlife in the Kuala Selangor area includes a small population of the lesser whistling duck (itik belibes).

Eagle feeding tourist boat

White bellied sea eagles



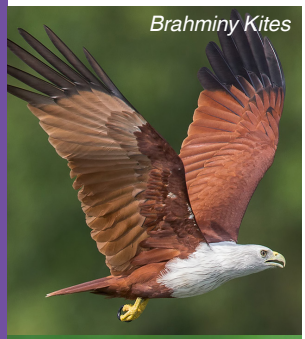
Lesser whistling duck

Migratory Birds

The Selangor coastline is famous for its migratory bird species, and the annual migration of seasonal birds can be observed in places such as Taman Alam Kuala Selangor. Kuala Selangor is environmentally sensitive as it is one of the stops for the migratory birds that carry out their annual migration out of Siberia to the warmer waters down south. Thousands of birds, some of which can fly up to 72 hours non-stop, flock to rest and feed along the shores of Sungai Selangor. One such species are the Milky Storks, which flock regularly at the Ash Pond Janakuasa Kapar Power Station.

A more permanent resident bird species can be found within the peat swamp forests of Hutan Simpan Raja Musa. According to the local authorities at Kuala Selangor, there are now about 155 species that inhabit the area, down from 173 back in 1990.

Bird species within the adjacent dry lowland forests and degraded areas were less diverse with the noted absence of ground birds. The most common birds seen within the ex-mining ponds were grey herons, little egrets, yellow bittern, terns, collared kingfisher and Brahminy kites.



Brahminy Kites

Collared Kingfisher

Mammals

Four decades ago, species of conservation value such as the Sumatran Rhinoceros (*Dicerorhinus sumatrensis*), Asian Elephant (*Elephas maxima*), Black Panther (*Panthera pardus*), Malaysian Sun Bear (*Helarctos malayanus*), Malaysian Giant Fruit Bat (*Pteropus vampyrus*), and Malaysian False Gharial (*Tomistoma schlegelii*) were common along the the river. However, since the 1990s these species have been largely absent as reported by the World Wildlife Fund and the Asian Wetland Bureau.

A total of 28 species of mammals have been recorded in the North Selangor Peat Swamp Forest. Common species included primates such as langurs and macaques, which can still be seen in the areas around Bukit Melawati.

Fishes

Fish distribution is also affected by the condition of the water body. The estuarine influence at the river mouth of Sungai Selangor means that fish species found here are more marine or brackish water tolerant species such as ikan duri (puffer fish), baung (catfish) and chemperas (river barb). The middle reaches of Sungai Selangor mostly comprise peat swamp and ex-mining ponds, and in this area, more common freshwater fishes can be found such as sebarau (Hampala barb) and lampam (river carp). The upper reaches with its more pristine waters are home to sensitive fishes that can only tolerate moderate amounts of pollutants within the river such as kelah (red mahseer) and tengas (copper mahseer).

RIVER ZONE	UPPER REACHES	MIDDLE REACHES	LOWER TIDAL	ESTUARINE INFLUENCE
Features	Fast flowing, Clean and Clear Water	Slightly silted, peat swamp and ex- mining ponds in the adjacent areas	Slight tidal influence with slight increase in salinity during dry season	Brackish with tidal influence. Narrow strip/belt of mangrove on both sides of the river banks
Group/ Activities	Orang Asli communities, Recreational, Freshwater aquaculture	Recreational and subsistence fishing	Part-time fishers, recreational and aquaculture	Sea fishers, recreational fishers
Documented Fish Species	Kelah, Tengas	Sebarau, Lampam	Baung, Chemperas	Ikan Duri, Kakap Lang

Phytoplankton

Phytoplankton are organisms that are unable to maintain their distribution against the movements of water masses. They play a vital role as primary producers in the aquatic environment, forming the base in the ecological food pyramid and providing food energy for higher trophic levels in the aquatic ecosystems. They are also indicators of the presence of pollution in the rivers.

The presence of *Euglenophyta* species and *Cyclotella sp.* found in the ponds in the lower basin areas indicates industrial waste pollution in the river and ponds. For organically polluted waters, *Euglena sp*., *Oscillatoria sp*., *Scenedesmus sp*., *Navicula sp*., *Nitzschia sp*. and *Microcystis sp*. would be common species.

In a 2015 study carried out by the State of Selangor, *Euglena sp*., *Oscillatoria sp*., *Nitzschia sp*. and *Scenedesmus sp*. were recorded, indicating organic waste pollution in the river and ponds.

Zooplanktons

As a group, zooplanktons are indicators of environmental quality in both lakes and rivers. In particular, the presence of rotifers indicates general organic pollution in the river. This is because rotifers are one of the most sensitive indicators of water quality pollution. Rotifers are good indicators of organic pollution with high biochemical oxygen demand (BOD) and low dissolved oxygen (DO) content. They are distinctly aerobic invertebrates and can only occur within in flowing waters with high BOD and low DO in an aerobic state, and not within environments such as sewage and industrial wastes in an anaerobic state.

Flora

The riverbanks of Sungai Selangor are still mainly vegetated with long stretches of mangrove swamps along Kampung Kuantan and at the river mouth (Hutan Simpan Banjar Utara and Selatan). The remaining river banks are either under oil palm estates or built-up.

Further upstream, the zone characterised by brackish water system are dominated by mangroves around Kampung Belimbing and Kampung Kuantan. Here the groves of berembang trees are home to firefly colonies.

Further beyond, the riverine vegetation gives way to more freshwater species and in most areas where agriculture has been developed, the vegetation comprise mono cropping of oil palm and remnant rubber.

Mangrove Forests

Inhabitants of Pulau Ketam claim decrease of mangroves lead to a decline of the general environment
Source: Arvind Raj, documentary 'Dolphins of Pulau Ketam'

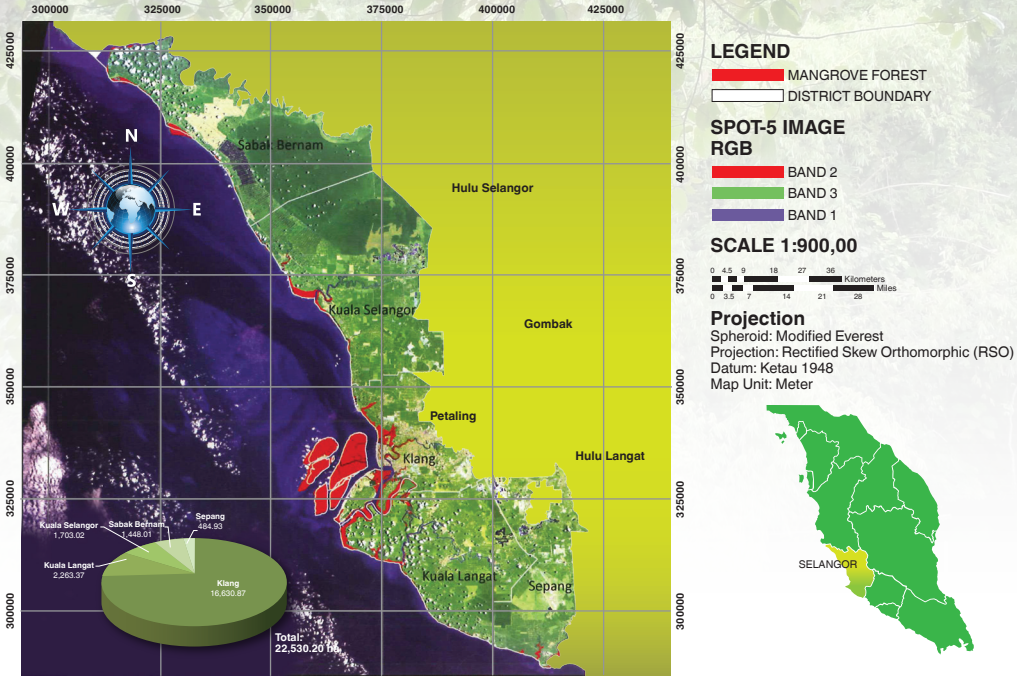
Selangor is one of the states in Peninsular Malaysia that still have large extents of mangroves after Perak and Johor. Situated in the central west region of the peninsula, Selangor has about 90 kilometres of coastline starting from the mouth of Sungai Bernam in the north to the mouth of Sungai Sepang down south. Out of the 22,530.20 hectares of mangrove forest within the state, Kuala Selangor has 1,703.02 hectares or 7%.

The mangrove forest is an important habitat for aquatic and terrestrial fauna. It is an important breeding ground for many tropical commercial fish species, crabs, prawns, and other marine animals by providing food and shelter.

Some ecosystem functions provided by mangroves include:

- Protection from strong winds and waves
- Soil stabilisation and erosion protection
- Nutrient retention and water quality improvement through filtration of sediments and pollutants
- Flood mitigation
- Sequestration of carbon dioxide
- Protection of associated marine ecosystems

In addition, mangroves also directly contribute to the livelihood of the nearby people. Traditional and indigenous coastal populations have found sustenance from mangroves, collecting products and goods in a sustainable manner for hundreds or even thousands of years, including firewood, medicine, fibres and dyes, food, charcoal, and construction material.



Peat Forest

One of the largest peat swamp forests in Peninsular Malaysia, comprising Hutan Simpan Sungai Karang and Hutan Simpan Raja Musa, is located near Bestari Jaya. While most of Hutan Simpan Raja Musa has been encroached, there are still large areas of pristine peat swamp forests.

RIVER-RELATED ACTIVITIES **AND SOURCES OF POLLUTION**

River-Related Activities and Sources of Pollution

Sewage

The company managing the country's sewerage services is Indah Water Konsortium (IWK), which took over operation of the service from the local authorities in 1993, and Jabatan Perkhidmatan Pembetungan (JPP) became the regulatory body. In 2008, SPAN took over the regulatory role and became executor and enforcer of policies created by Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA). IWK was relegated to operator of facilities and certifying body of designs of facilities in new developments. JPP regulates physical works of sewerage systems.

Faced with the challenge of maintaining over 8,000 plants, IWK is currently in the process of rationalisation to ease the task of maintenance. The Federal Government funds IWK as tariffs alone cannot sustain it. Collection of tariffs from home dwellers remain a challenge as public awareness of the importance of sewerage services remains low. The general perception is that water is a necessity for the people whereas sewerage services are something that people take for granted. To address this issue, a joint billing structure is being proposed whereby sewerage services will be billed together with the water services.

The Sungai Selangor basin has three sewage treatment plant (STP) zones. The total of population equivalent within the basin is 582,464 PE. The types of STPs that found along the basin are:

- Imhoff tank
- Bio-filter
- Communal septic tank
- Extended aeration
- Oxidation ditch
- Network pumping station
- Intermediate demand extended aeration
- Active bio
- Oxidation plan

IWK *is the national sewerage company providing sewerage services, operating and maintaining public sewage treatment plants and sewerage pipelines*

JABATAN PERKHIDMATAN PEMBENTUNGAN

JPP *is the government department that provides sewerage pipeline services*

KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

KeTTHA *is the ministry for ensuring availability, reliability and affordability of energy and water services, and to promote green technology for green economy and green living*

- Sequencing batch reactor
- Hi-Kleen
- Loyal extended aeration
- Activated sludge
- Vacuum system

In line with IWK's push towards centralisation of plants, there is a study currently being carried out to build a pond for a centralised STP.

CATCHMENT	ZONE	TOTAL(PE)
SUNGAI SELANGOR	GBK	236,233
	GKS	31,856
	GUS	314,375
Sub Total		**582,464**

Despite ongoing efforts, IWK still faces challenges in managing sewerage services throughout the country.

Total population equivalent (PE) within the Sungai Selangor basin
Source: IWK

ISSUE 01

DIFFERENCES IN EFFLUENT STANDARDS BETWEEN DOE, IWK AND LUAS

Although the STPs are compliant to DOE standards, LUAS uses different parameters and hence IWK STPs are considered as non-compliant. A gap in standards exists between DOE and LUAS.

ISSUE 02

STPs ARE OWNED BY JPP, WHILE IWK ARE ONLY OPERATORS

According to IWK, many people are not aware the JPP are the owners of the STPs. As a result, IWK is often blamed when anything negative regarding sewage is reported.

ISSUE 03

DILUTION FACTOR NOT CONSIDERED DURING DRY SEASON

Readings give uncharacteristically high concentrations.

ISSUE 04

LACK OF MAINTENANCE OF INDIVIDUAL SEPTIC TANKS AND COMMUNAL TANKS

Tanks on private property fall under the responsibility of the respective homeowners. IWK will only provide services up to the main line.

ISSUE 05

GAPS APPEAR WHEN AUTHORITIES' APPROVALS OF DEVELOPMENTS ARE NOT SYNCED WITH STP PLANNING ACROSS THE BASIN

Infrastructure should drive development and not the other way around. This is due to developers increasing the plot ratio of new developments. Hence, STPs are often unable to handle the volume of sewage when the plants are operational. The World Bank Report cites existing infrastructure under IWK as an obstruction to the ease of doing business in Malaysia. There is a need for more concerted efforts for the widespread use of centralised plants for investors to tap into.

ISSUE 06

POUR FLUSH

Pour flush is direct discharge of sewage into river without any sort of filter or treatment. It is a primitive system which is still commonly but dangerously practiced. Such practices are deemed illegal but old houses and homes, especially in rural areas, still continue to use it. There is not enough enforcement by local authorities.

ISSUE 07

PLANT CAPACITY DESIGN ISSUE

Plant design does not accommodate illegal connections (for example, non-registered sewage discharge, toxic waste disposal)

ISSUE 08

MAINTENANCE AND PUBLIC AWARENESS ISSUE

The public needs to know what can and cannot enter sewerage systems. Clogging often happens, hence incurring extra costs for the repair of pipes. Oil and grease are major contributors to pipe clogging.

ISSUE 09

NON-PAYMENT OF SEWAGE SERVICE TARIFFS

The Federal Government funds IWK as tariffs alone cannot sustain them. Unlike water, which is considered a necessity for subsistence, sewerage services are something people take for granted. IWK is currently in the process of being restructured. This will result in joint billing whereby sewerage services will be billed together with the water services.

ISSUE 10

DIRECT DISCHARGE OF WASTEWATER INTO DRAINS

Restaurants and wet markets around Kuala Selangor used to have septic tanks, but lack of maintenance has resulted in wastewater to be left untreated and directly discharge into drains that would eventually flow into the river. Unmaintained and faulty private septic tanks around the Bestari Jaya area have also discharged into nearby waterways.

ISSUE 11

SEWAGE AND RUBBISH DUMPING AT JETTIES

Jetties at Kampung Pasir Penambang and Bagan Sungai Yu also experience sewage and rubbish dumping.

Solid Waste

Until 2011, solid waste collection and transportation was managed and carried out under Jabatan Pengurusan Sisa Pepejal Negara (JPSPN), which integrated solid waste management system at the national level. It was established under the Solid Waste and Public Cleansing Management Act 2007 (Act 672). The Act empowered the Federal Government to take over the management of solid waste and public cleansing from the local authorities throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

Another entity, the Solid Waste Management and Public Cleansing Corporation (SWCorp Malaysia), was established to complement and implement the National Solid Waste Management Policy. In Selangor, the contractor carrying out solid waste disposal services was Alam Flora.

In 2012, the responsibilities of solid waste management, implementation, and enforcement was reinstated to the Selangor State Government, which meant that local governments were charged with the task of solid waste management. All nine districts in Selangor now manages the collection, and solid waste transport is handled by the local authorities. The table shows which local authority is servicing each district in Selangor.

***JPSPN** is a federal government agency dedicated to the management of solid waste*

DISTRICT	OVERVIEW OF SOLID WASTE COLLECTION
Sabak Bernam	Local authority: Majlis Daerah Sabak Bernam Daily load estimate: 90 tonnes/day Landfill location: Sungai Besar, Sabak Bernam
Kuala Selangor	Local authority: Majlis Daerah Kuala Selangor Daily load estimate: 170 tonnes/day Landfill location: Jeram, Kuala Selangor
Hulu Selangor	Local authority: Majlis Daerah Hulu Selangor Daily load estimate: 170 tonnes/day Landfill location: 1. Sungai Sabai, Kalumpang 2. Bukit Beruntung
Gombak	Local authority: 1) Majlis Perbandaran Ampang Jaya 2. Majlis Perbandaran Selayang Daily load estimate: 600 tonnes/day Landfill location: 1. MPS – Bukit Tagar,Hulu Selangor 2. MPAJ-Jeram, Kuala Selangor
Hulu Langat	Local authority: Majlis Pembandaran Kajang Daily load estimate: 1000 tonnes/day Landfill location: Refuse Derived Fuel (RDF) plant owned by Recycle Energy Sdn Bhd at Semenyih
Petaling	Local authority: 1. Majlis Bandaraya Shah Alam 2. Majlis Pembandaran Subang Jaya 3. Majlis Bandaraya Petaling Jaya Daily load estimate: 1. MBSA : 480 tonnes/day 2. MPSJ : 500 tonnes/day 3. MBPJ : 400 tonnes/day Landfill location: Jeram, Kuala Selangor Note: Approximately 85% of the solid waste is sent to the transfer station at Section 21, Shah Alam for processing before being sent to the Jeram landfill
Klang	Local authority: Majlis Perbandaran Klang Daily load estimate: 700 tonnes/day Landfill location: Jeram, Kuala Selangor
Kuala Langat	Local authority: Majlis Daerah Kuala Langat Daily load estimate: 190 tonnes/day Landfill location: Tanjung Dua Belas, Kuala Langat
Sepang	Local authority: Majlis Pembandaran Sepang Daily load estimate: 180 tonnes/day Landfill location: Tanjung Dua Belas, Kuala Langat

Current Solid Waste and Collection Management System 2012
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

There are eight landfills in Selangor:

- The sanitary landfill in Bukit Tagar handles solid waste from Kuala Lumpur
- Majlis Bandaraya Shah Alam, Majlis Bandaraya Petaling Jaya, and Majlis Perbandaran Subang Jaya are serviced by a transfer station at Section 21, Shah Alam that compresses the solid waste before sending it to a landfill in Jeram, Kuala Selangor
- Majlis Perbandaran Kuala Langat is served by the South Kuala Langat landfill near Bandar Sri Ehsan, which is northwest of KLIA. It is in a reserved forest area, although it is a distance away from the river.
- Solid waste under Majlis Perbandaran Kajang is disposed of through a refuse derived fuel (RDF) plant owned by Recycle Energy Sdn. Bhd. The system processes solid waste to generate electricity from the energy created during the combustion of separated waste.

LOCAL AUTHORITY	LANDFILL SITES	SIZE (ACRES)	OPERATOR
Majlis Daerah Sabak Bernam	Sungai Besar Landfill	10	Majlis Daerah Sabak Bernam
Majlis Daerah Kuala Selangor	Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Daerah Hulu Selangor	Sungai Sabai, Kalumpang Landfill Bukit Beruntung Landfill	20	Majlis Daerah Hulu Selangor
Majlis Perbandaran Selayang	Bukit Tagar Sanitary Landfill	20	KUB-Berjaya Enviro
Majlis Perbandaran Ampang Jaya	Jeram Sanitary Landfill	700	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Kajang	Solid Waste Recovery Centre (RDF Plant), Semenyih	160	Recycle Energy Sdn. Bhd.
Majlis Perbandaran Subang Jaya	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Bandaraya Shah Alam	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	-	Worldwide Landfill Sdn. Bhd.
Majlis Bandaraya Petaling Jaya	Transfer Station @ Sec 21, Shah Alam ➔ Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Klang	Jeram Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Daerah Kuala Langat	Tanjung Dua Belas, Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.
Majlis Perbandaran Sepang	Tanjung Dua Belas, Sanitary Landfill	160	Worldwide Landfill Sdn. Bhd.

Disposal centres by district and operator 2012
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

Landfills throughout Selangor
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

Landfills throughout Selangor
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

Non-sanitary landfills allow leachates to seep into the ground, and thus must be monitored to ensure that leachate does not infiltrate into nearby waterways. This is especially so as the location of any landfills upstream of water intakes raises the concern of potential river contamination.

In 2015, the three districts—Hulu Selangor, Kuala Selangor and a part of Gombak—generated a combined volume of 430 tonnes of solid waste per day. This amounts to 9% of the state's daily total. According to JPBD Selangor, the rate of solid waste generated per person is 0.8 kg/capita/day. The current state total is 4,924 tonnes per year and is expected to reach 7,200 tonnes by 2035.

YEAR	2010	2015	2020	2025	2030	2035
District				Waste Generated		
Sabak Bernam	85	95	110	134	166	180
Kuala Selangor	168	189	215	244	273	295
Hulu Selangor	158	179	220	262	306	331
Gombak	546	615	754	902	1,017	1,102
Hulu Langat	925	1,043	1,145	1,243	1,330	1,440
Petaling	1,450	1,634	1,673	1,761	1,869	2,023
Klang	689	776	859	914	951	1,030
Kuala Langat	180	203	259	299	339	367
Sepang	169	191	270	335	339	432
Total	**4,370**	**4,924**	**5,505**	**6,094**	**6,590**	**7,200**

Current and projected waste generated in Selangor from 2010 to 2035
Source: Laporan Tinjauan: Kajian Rancangan Struktur Negeri Selangor 2035, B13: Sisa Pepejal

There have been no reports of illegal dumpsites directly adjacent to Sungai Selangor. However, there are incidents of pollutions and illegal landfills within the basin.

- In 2012, there was a leachate leakage into a river at Taman Muhibbah, a former landfill near UNISEL, which was assigned for rehabilitation. The buffer of 20 metres was insufficient to prevent seepage into the river.

- Illegal construction waste sites at Batu Arang, Bandar Sri Coalfields

- The Bukit Tagar landfill in Hulu Selangor experienced a leachate leak and was the pollution source forcing a water intake point shutdown

- Kambing Susu experienced illegal sand mining and a diesel leak incident

According to FRIM, solid waste, consisting predominantly of household rubbish, regularly litter the Sungai Selangor stretch between Bukit Lembing and Kampung Kuantan. There is a log boom belonging to JPS there to catch all the floating trash from upstream. FRIM monitors seven sites between Kampung Pengkala Ladang to Tanjung Labak for any kind of pollution.

JPG is a government agency dedicated to land development and management, including registration of titles

Sand Mining and Quarries

Sand Mining

Generally, quarries in Selangor are operated by large companies that carry out proper operational procedures. District and land offices ensure that operators have applied for permits to move rocks and quarry debris from one location of the mining scheme to another. Thus, each transport lorry must have a docket, which is given after paying royalty to the state.

Sand mining has more local players, although there is one large company that

parcels out sites among smaller players. Although there are illegal operators, especially along the rivers, a number of these are reported by the head of the village or community who are concerned about their environment.

Sand mining is approved by Pejabat Tanah dan Galian Selangor, and applicants must follow the mining scheme stipulated in the State Mineral Enactment (SME). Permits are given on a bimonthly basis, but this depends on the mineral deposit.

The method of operation for sand mining is approved by JMG, while sandwashing is approved by JPS and LUAS. The sand mining and sandwashing industry is structured such that a coalition of operators works through one major operator. There are no individual operators.

Sandwashing is usually carried out upstream of the river basin to maximise the river flow, while sandmining is a downstream activity.

There are sand mining sites located near the HORAS and UNISEL area.

Quarries

All quarry works must be approved by JMG. Quarry operators must follow established procedures, especially for blasting (there is a stipulation that a JMG officer must be present onsite during blasting operations. Effluents must follow JAS and LUAS regulations. Enforcement is done together with Pejabat Tanah dan Galian, but it is based on reports or complaints and monitoring is not done on a regular basis.

ISSUE 01

COMPLAINTS FROM RESIDENTS THAT OPERATORS ARE NOT FOLLOWING PROCEDURES

According to authorities, quarry rehabilitation is merely a best management practice, not a guideline. Also, sometimes the quarry was there first and houses came later, as in the case of Putra Heights.

ISSUE 02

EFFLUENTS FROM SAND MINING FLOWING INTO THE RIVER

This happens when sand mining projects are not properly controlled and monitored. A sand mining site must follow a mining scheme, which is a layout of the mining operations and the methods that will be used. A typical mining scheme consists of tailing, operations office, siltation pond, spillway and stockpile. Different coverage has a different layout configuration. It also describes how deep the operator will dig and what methods will be employed: hydraulics, dry cell, dredging, or open cast. Most importantly, there must be a buffer between any water bodies and the site.

■ **Action:** There is a committee under LUAS for emergency response to river pollution, which is the Jawatankuasa Kecemasan Pencemaran Sumber Air, which comprises many agencies such as JAS, JPS, JMG, pihak berkuasa tempatan and others.

ISSUE 03

NEED TO CONTROL WATER MOVEMENT TO PROTECT THE PEAT FORESTS

According to JMG, in order to better monitor the health of the peat swamp forests, modeling should be carried out to control water movement. The soil of the peat forests is largely made up of homogens with high transivity that allows water to flow at 7,000 cubic metres per day. This means that water from peat forests can find their way into sand mine pits. To prevent groundwater intrusion into the pit, a clay bund is installed as the digging goes deeper. During this time, monitoring of the groundwater is important.

The objective of having proper monitoring is to protect the aquifer regime in terms of quantity and quality. Starting a few years ago, all proposed large-scale sand mining projects are now required to have modeling and an environmental impact assessment. Smaller projects must produce an environmental management plan.

■ **Suggestion:** When sand mining, operators are encouraged to pay attention to peat areas to ensure that they do not dry out.

Development and Earthworks

Development should be more controlled by local authorities, especially during earthworks when mud starts flowing into rivers. There should be best management practices, such as silt traps. EIAs have been completed for some of these developments, but the implementation does not follow.

Alteration of Resources

Significant River Works

Significant works done within the Sungai Selangor basin involved flood mitigation, upgrading of drainage system and river management program.

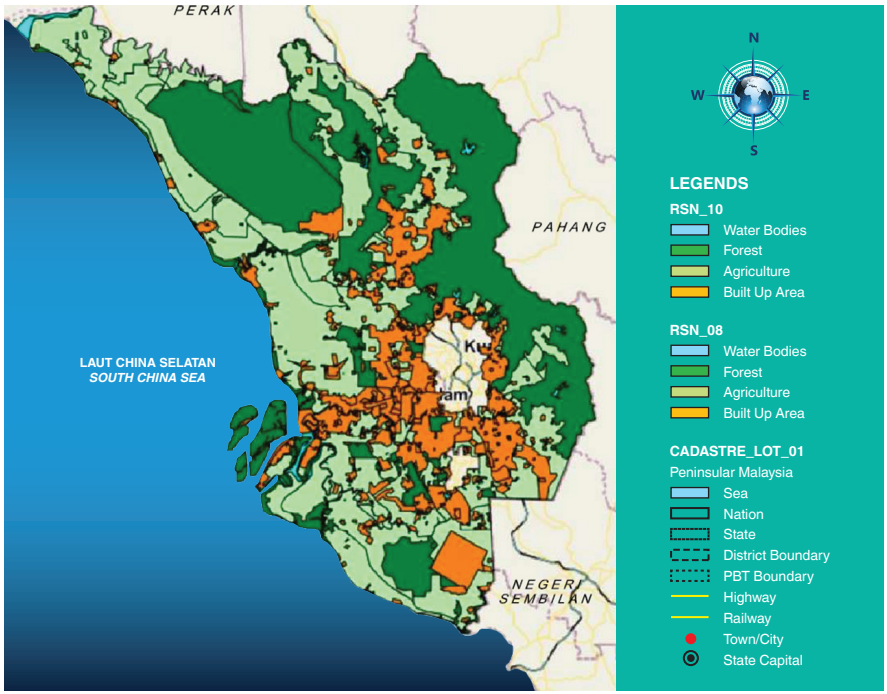
1.0	**FLOOD MITIGATION**
1.1	**District of Gombak**
1.1.1	Flood mitigation project at Sg. Kundang (from Pekan Kundang to Sg. Garing)
1.1.2	Flood mitigation project at Sg. Rawang Phase 2
1.1.3	Flood mitigation project at Sg. Gong (from upstream to estuary)
1.2	**District of Hulu Selangor**
1.2.1	Flood mitigation project at Sg. Choh
1.3	**District of Kuala Selangor**
1.3.1	Flood mitigation project at Tanjung Karang, Kuala Selangor
1.3.2	Flood mitigation project at Benteng, Kg. Lubok, Kg. Bukit Belimbing
2.0	**UPGRADING DRAINAGE**
2.1	**District of Kuala Selangor**
2.1.1	Upgrading of drainage system project at Sg. Tengi, Tanjung Karang (dredging)
2.2	**District of Hulu Selangor**
2.2.1	Upgrading of drainage system project at Sg. Kubu
2.2.2	Upgrading of drainage system project at Sg. Liam
2.2.3	Upgrading of drainage system project at Sg. Guntung
2.2.4	Upgrading of drainage system project at Sg. Serendah
2.2.5	Upgrading of drainage system project at Sg. Selangor
3.0	**RIVER MANAGEMENT PROGRAME**
3.1	**Across Sungai Selangor**
3.1.1	Reserve management of Sg. Selangor

Significant river works within the Sungai Selangor basin
Source: JPS Selangor

Jabatan Pertanian *is an agency that encourages and monitors agricultural activities*

Agricultural Activities

There are 43,000 registered farmers in Selangor. On average, there is a ratio of one farmer per two hectares of land. In Selangor, agriculture occupies approximately 298,000 hectares of land (37% of total land in Selangor) and contributes about 1.7% to the state GDP. Agriculture activities are carried out in various scales and production efficiency by entities ranging from large companies orestates to small holders and government corporations.



A breakdown of agricultural land use in Selangor for the year 2012 shows that palm oil and rubber occupied 199,805 hectares (67% of the total agriculture area), but these farms generally do not draw water from water bodies except for nursery irrigation. The biggest water use in the farming sector is irrigation for paddy planting in the Northwest Selangor IADA which

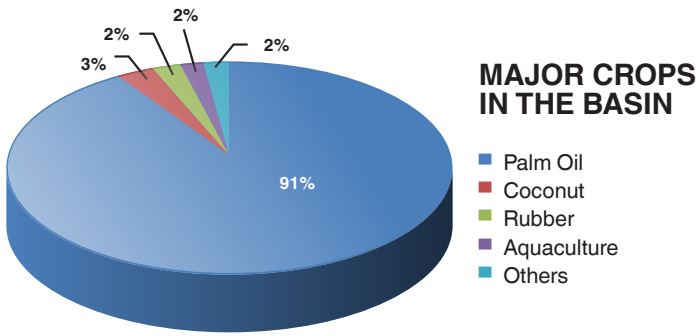
occupies 18,610 hectares of land and uses about 700 MCM of water per year. Faced with limited water resources, increasing demand for potable water supply is deepening the conflict for water allocation between the farming community and other users of river water.

TYPES OF CROPS	COVERAGE AREA (HECTARES)						VARIATION
	2012	2015	2020	2020	2030	2035	
Oil Palm	168,239	165,833	163,427	161,021	158,615	156,206	12,033 (7.2%)
Rubber	31,566	30,460	29,354	28,248	27,142	26,033	5,533 (17.5%)
Paddy	18,610	18,610	18,610	18,610	18,610	18,610	0 (0)
Other crops	79,613	77,241	74,869	72,497	70,125	67,752	11,861 (14.9%)
Wasteland	520	416	312	208	104	0	520 (100%)
Total	**298,548**	**292,560**	**286,572**	**280,584**	**274,596**	**268,601**	**29,947 (10%)**

Projection of agricultural land based on type of crops in Selangor (2012 – 2035)
Source: Kajian Semula Rancangan Struktur Negeri Selangor, 2020

In the Sungai Selangor basin, agriculture occupies 22% of land use in the basin. Commercial plantations as well as small plantations for palm oil can be found along Sungai Batang Kali and downstream Sungai Kerling.

The major crop cultivated in the basin is overwhelmingly palm oil, followed distantly by rubber and coconut. There are also many other crop types that were cultivated such as watermelon, jackfruit and vegetable. However, they tended to belong to individual owners on small plots of land. In the pie chart, they constitute the thin slivers of the pie.



Common crops grown in the Sungai Selangor basin
Source: Jabatan Pertanian 2011

A breakdown of the major crops by district shows that Kuala Selangor has the largest tracts of land for palm oil.

TYPE OF CROPS	AREA (ha)			TOTAL AREA (ha)
	Hulu Selangor	Gombak	Kuala Selangor	
Palm Oil	2,932	214	20,445	23,561
Rubber	478	-	170	647
Other	152	348	1,289	1,789
			Total	**26,027**

Source: DOA 2011

Good Practices

Jabatan Pertanian (DOA) provides awareness and education on good farming practices to farmers through an incentive program called Malaysian Good Agriculture Practice (MyGAP). Introduced in 2010, MyGAP promotes incentives for good agricultural practices. Farmers who comply will be awarded a certificate of good practices, which is globally recognised. This is significant because target market countries, such as the European Union and Japan, require the certificate before accepting Malaysian agricultural imports into their countries.

Currently, there are 500 farmers who have the certification. However, most farmers do not follow or pursue such promoted practices. Farmers cannot be forced to comply with these guidelines, although to be a legal operation, they must register their farming enterprises with the district and land office.

Regulation

There are currently efforts to further regulate the pesticide industry. A Pesticide Act is in the process of being drafted. However, the revision is only for enforcement on the supply side and defining and regulating the types and classes. There is no monitoring on the use of the pesticides and fertilisers by the end-users and how much they can discharge into the rivers.

ISSUE 01

FERTILISER/CHEMICAL RUN-OFF

Current legal regulations cover only the fertiliser industry on the supply side and not the end-users. DOA has guidelines that limit and schedule the amount of pesticides/fertilisers that can be used, but has no power for enforcement. Local authorities have reported seeing changes in the colour of the river water when there are large amounts of chemical runoff into the river. Agricultural fertiliser and pesticides runoff have previously affected the firefly population at Kampung Kuantan as well as the felling of mangroves. There is a need to spread more awareness and education among the users on the use of fertilisers and pesticide use.

ISSUE 02

ALGAE BLOOMS

Overloading of nitrogen and phosphorous levels in rivers from excessive nutrients promote sudden growth of cyanobacteria, which produces harmful toxins into the water. When the blooms die off, a deoxygenizing process takes place due to the sudden die-off of mass cyanobacteria. Large and frequent blooms will destroy entire aquatic ecosystems leading to regional 'dead zones', especially at river deltas where the nutrients are concentrated from all over the river basin.

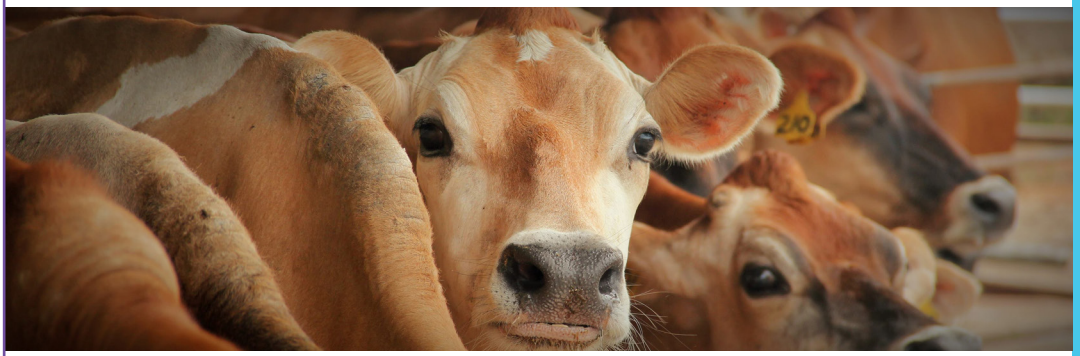
ISSUE 03

EFFECTS OF CLIMATE CHANGE

Farmers and authorities are reporting extreme dry and wet weather as well as rain events that are more severe than before. This has been observed within the past five years. Jabatan Pertanian report a 20% to 30% loss in value of production. To mitigate the negative effects of drought on crop production, there has been research done by MARDI on aerobic rice, which has far less water consumption compared to conventional paddy rice. However, the yield of aerobic rice is lower than conventional rice, making it not yet feasible for crop replacement.

JPV is an agency for animal disease control, inspects livestock farms and processing plants, controls production of livestock, livestock products and animal feed

Livestock Farming



In Selangor, there are three enactments regulating the livestock industry, starting with the Undang-Undang Pendaftaran Lembu Kerbau 1971. The swine sector later saw its own enactment, as did the poultry sector. The enactment for bovine livestock focuses more on nuisance caused by livestock rather than on regulatory matters. Unlike other states, Selangor's enactment does not focus on registration of bovine livestock, and as such, does not address current issues and is weakly enforced. On the other hand, enactment on the poultry and swine sectors deal with registration and health issues. At this moment, poultry and swine livestocks are licensed.

Livestock Population

In Selangor, the population of livestock consists predominantly of poultry. Poultry comprise broilers, hens, Baka breed, and free-range chicken. In terms of population, there were 8 million broilers and 10.3 million hens. Pigs came next at 273,630 followed by goats at 23,536. Beefing cattle came next at 18,409 and dairy cows are last at 6,098.

TYPE OF LIVESTOCK	2009	2014	% PERBEZAAN
Beefing cow/Buffalo	28,056	18,409	-34.30
Dairy cows	6,297	6,098	-3.10
Sheep/Goats	46,324	23,536	-49.10
Broilers (chicken and duck)	7,696,920	8,013,569	+4.10
Hen (chicken and duck)	4,649,400	10,285,211	+121.20
Pigs	254,141	273,630	+7.60

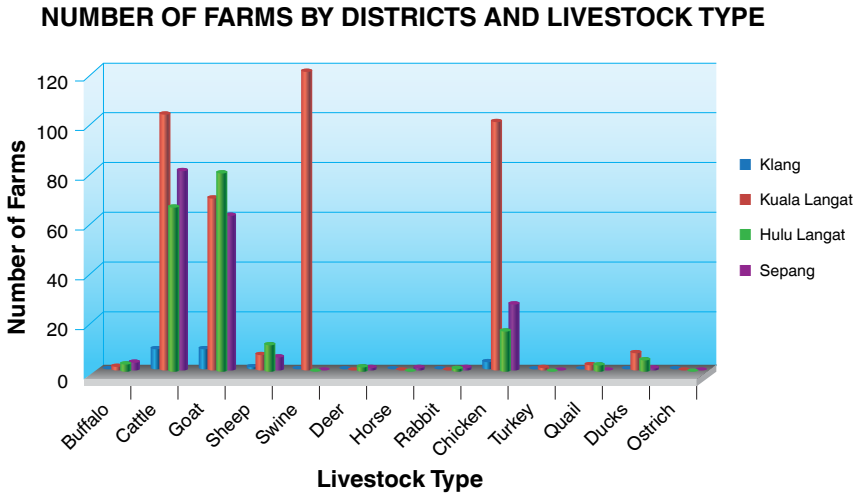
Figures of livestock in Selangor 2014
Source: Department of Veterinary Services Selangor

DISTRICT	HULU SELANGOR		KUALA SELANGOR	
Livestock Type	**Farm**	**Population**	**Farm**	**Population**
Buffalo beef	5	287	-	-
Dairy buffalo	1	110	-	-
Beef cattle	87	2,582	158	2,444
Dairy cattle	21	798	3	62
Heifer	7	420	1	16
Goat	87	3,823	83	1,336
Dairy goat	2	98	2	140
Sheep	8	136	1	60
Swine / Pigs	-	-	-	-
Deer	2	390	-	-
Horse	-	-	-	-
Rabbit	-	-	4	1,070
Broiler chicken	19	775,560	38	2,213,800
Egg laying chicken	5	6,900,000	11	2,355,000
Breeding chicken	-	-	5	373,200
Free-range chicken	6	888	3	452
Turkey	-	-	-	-
Broiler quail	3	600	1	20,000
Egg laying quail	-	-	1	80,000
Broiler duck	1	50	-	-
Egg laying duck	-	-	3	7,015
Ostrich	-	-	-	-
Total	**254**	**7,685,742**	**314**	**5,054,595**

Number of farms and population of livestock in Sungai Selangor basin
Source: Department of Veterinary Services, Annual Report 2014

In the Sungai Selangor basin, most of the farms are for rearing beef cattle and goats. Beef cattle have the highest number of farms (87 in Hulu Selangor and 158 in Kuala Selangor), followed by goats (87 in Hulu Selangor and 83 in Kuala Selangor). The next livestock dairy cattle, trail behind.

However, in terms of population, poultry are the most numerous. While the number of farms are smaller, egg-laying chicken have the highest population at 6,900,000 and 2,355,000 in Hulu Selangor and Kuala Selangor respectively, followed and broiler quail at 775,560 and 2,213,800.



Swine Livestock

Following the nipah virus outbreak in 1998, there was a relocation exercise to migrate pig farms to a centralised location in Daerah Kuala Langat. There are none in the Sungai Selangor basin.

Poultry Livestock

The area with the biggest poultry population is Kuala Langat, followed by Kuala Selangor, then the rest are small-scale operations, with Petaling having the least number of poultry population.

There is no quota set for the poultry sector, but it follows local authority zoning. Any application for big-scale poultry farming must get approval from relevant agencies such as the land and district offices, JPBD, local authorities and LUAS and follow local authority zoning. Upon approval, JPV will issue a license. For smaller scale operations with less than 500 birds, it is considered subsistence farming and there is no need for licensing.

Bovine Livestock

As of 2013, there are 313 cow and buffalo farms in the Sungai Selangor basin. They are not licensed by JPV. The method of raising cows is free-range grazing, although this practice gives rise to issues of trespassing on private property and destroying cultivated patches of vegetation. There are guidelines provided by JPV for good husbandry practices.

Good Practices

DVS promotes Good Animal Husbandry Practices, a worldwide standard for animal husbandry that was developed by the World Organisation for Animal Health. It covers all aspects of animal husbandry such as infrastructure, drainage, waste management, effluent management, shelter, health, and biosecurity. Abbatoirs are regulated under federal law, which has many requirements.

One of the challenges faced by JPV is that not all farmers follow the guidelines that have been prepared by the agency. However, awareness and education activities by the agency is ongoing.

Jabatan Perikanan *is an agency that develops and manages the national fishery industry*

Aquaculture and Fishery

Jabatan Perikanan Negeri Selangor (DOF) is the agency that regulates and monitors aquaculture and marine fishery. DOF Selangor's functions comprise registration and licensing of aquaculture operators and fishing vessels, data collection and inventory. DOF responds to reports or complaints from the public on aquaculture activities by conducting investigations with JAS or with LUAS, which is backed by the Emissions or Discharge of Pollutants (Selangor) 2012 Enactment.

Currently, DOF regulates marine aquaculture and marine fishery. This means that licenses for marine aquaculture are compulsory and must be registered with DOF. For marine fishery, licenses are determined by vessel size and the type of fishing gear and equipment onboard.

There is no law yet for inland aquaculture, and registration for aquaculture licenses is still on voluntary basis. An act to give power to DOF for regulating inland aquaculture is in the works and expected to be out next year. Likewise, an enactment to give DOF the power to enforce the rules and regulations tied

to inland fishermen is expected to be passed next year. The Kaedah-Kaedah Peraturan Perikanan Darat was drafted at the federal level in 2015, but not yet accepted at the state level.

Selangor DOF's jurisdiction extends three nautical miles out from the low tide line. Any waters beyond that falls under federal law. As DOF Selangor is a representation at the state level of a federal agency, it enforces both state and federal law in coastal waters.

Aquaculture

Currently, there are about 614 inland aquaculture businesses registered under Jabatan Perikanan in Selangor. However, the number of total or unregistered farms is unknown. Out of the registered businesses, 80% are small-scale operations. The rest are larger commercial entities, which make up 20% to 30% of production yield. In Selangor, the aquaculture business is mostly made up of cockle breeding, occupying an area of 4,850 hectares. The district of Sabak Bernam has the most cockle breeding farms (53), while Kuala Selangor district has 29 and Klang district has seven.

RIVER BASIN	DISTRICT	NO. OF AQUACULTURE FARMS
Sg. Langat	Kuala Langat	111
	Sepang	
	Gombak	
Sg. Selangor	Kuala Selangor	221
	Hulu Selangor	
	Gombak	
Sg. Bernam	Sabak Bernam	108
	Hulu Selangor	
Sg. Klang	Klang	160
	Petaling	
	Kuala Langat	
	Sepang	
	Gombak	

Number of aquaculture farms by river basin
Source: Jabatan Perikanan 2015

TOTAL LANDINGS

TYPES	DISTRICT	LANDINGS (METRIC TONNE)		
		2012	2013	2014
Cockles	Klang, Kuala Selangor, Sabak Bernam	5,895.56	5,200.75	3,377.92
Marine Prawn	Kuala Langat, Kuala Selangor, Sabak Bernam, Sepang	5,895.56	5,200.75	3,377.92
Caged Marine Fish	Klang, Sabak Bernam	3,113.19	2,444.96	967.97
Freshwater Fish	All districts	14,856.91	16,114.45	7,773.03

Note: Data for 2014 is up until July
Source: DOF website (2015)

Fishery

Captured fishery refers to marine fishing, while inland fishery refers to fishing in the rivers and ponds. In terms of yield and production, the captured fishery industry comprises commercial enterprises while inland fishery consists of small-time fishermen who fish for their own consumption. The size of the inland fishery industry is smaller than that of marine fishery, at a ratio of 2:5. The volume of inland fishery landings in 2015 was 377 metric tonnes.

Some of the fish species caught in the Sungai Selangor basin are perch (sepat), helicopter catfish (tapah), catfish, knifefish/chitala (belida), snakehead, giant freshwater prawns, minnow (seluang), spotted catfish (lundu), tilapia, gourami (kaloi), and river carp among others.

Carp

Gourami

Beardless Barb

Diminishing Species

Some of the river fish population were found to be dwindling in Selangor, and these are gourami (temakang), carp, barb or sliver shark minnow (terbul), hampala barb (sebarau), beardless barb (temperas), bulu barb (tenggalan), and eels.

To counteract this trend, a DOF program called Program Pelepasan Benih Ikan Sungai was initiated to preserve inland fishery species. As of 2015, a total of 392,500 metric tonnes of fry was released into the rivers of Selangor.

PARTICIPATING DISTRICTS	TOTAL RELEASE OF FRY (METRIC TONNES)	SPECIES
Kuala Selangor	30,000	Freshwater prawn
Hulu Selangor	182,500	Java or goldfoil barb
Kuala Langat	38,000	Java or goldfoil barb
Hulu Selangor	24,000	Java or goldfoil barb
Hulu Selangor	30,000	Pangas catfish
Kuala Langat	4,000	Pangas catfish/Asian redtail catfish
Kuala Selangor	51,000	Freshwater prawn
Shah Alam	5,000	Pangas catfish
Sabak Bernam	10,000	Asian redtail catfish
Kuala Selangor	7,000	Asian redtail catfish

Volume of fish fry released in Selangor waters
Source: DOF 2015

LKIM

***LKIM** is an agency that provides assistance to local fishermen through financial incentives, skills development and technology improvement*

Jetties

DOF does not own any jetties, either inland or marine, although it does have some for cockle landings.

Jetties for Cockles

NO.	YEAR	COST	NO. OF JETTIES	LOCATION / DISTRICT
1	2009	-	4	Sementa/Klang Tok Muda/Klang Sg. Semilang/Kuala Selangor Sg. Buloh/Kuala Selangor
2	2010	RM909,190.20	3	Bagan Tengkorak/Kuala Selangor Pasir Panjang/Sabak Bernam

Source: JPV website (2017)

Lembaga Kemajuan Ikan Malaysia (LKIM) and LUAS are the agencies in charge of the jetties. However, it is the DOF that specifies zones in marine waters where vessels can enter.

ZONE	VESSEL TYPE	GEAR
A	Sampan/outboard engines	Traditional
B	Inboard engine below 25 GRT	Purse seine or trawler
B1	Inboard engine below 40 GRT	Purse seine or trawler
C	Inboard engine below 70 GRT	Purse seine or trawler
C2	Inboard engine 70 GRT and above	Purse seine or trawler

**GRT = gross rate tonnage*
Source: DOF Selangor and Perak

Promotion of Good Practices

In 2015, Kementerian Pertanian dan Industri Asas Tani Malaysia introduced the Malaysian Good Agricultural Practices (MyGAP) program, which provides certification for exporting goods in the agriculture, veterinary and aquaculture sectors. MyGAP ensures good and sustainable practices through strict and stringent requirements. In Selangor, there are only seven aquaculture businesses with MyGAP certification, most of them larger-scale aquaculture enterprises.

The certification allows them to export to key markets such as the United States, the United Kingdom and the European Union, which require the certification. An example of a good practice advocated by DOF is a treatment pond for each aquaculture site where wastewater from the pond will be directed into the treatment pond before being released back into the river. This is necessary to prevent high levels of BOD from polluting the river.

In the aquaculture sector, MyGAP is an extension of DOF's already existing Skim Pensijilan Ladang Akuakultur (SPLAM) and Sijil Amalan Akuakultur Baik (SAAB) industry requirements. MyGAP is mainly targeted to the prawn industry, and there are seven registered with LUAS for emissions and discharge control. The reasons cited for not more participation by the smaller-scale operators is that MyGAP is strict and costly to implement.

In addition, DOF Selangor provides a subsistence allowance of RM200 per person to assist inland fishermen. In the Sungai Besar district, there were 51 beneficiaries; in Hulu Selangor 19 beneficiaries; and in Kuala Selangor, 26 beneficiaries.

ISSUE 01

NEED TO REVIEW LICENSING PROCEDURES AND RATE FOR AQUACULTURE TOL

Since 2014, some aquaculture activities such as caged culture are required to get a temporary occupation license (TOL). This is a requirement by the district and land office before DOF can issue licenses to aquaculture operators. However, this created a situation for caged culture operators who had started operating before 2014 to be fined by the district and land office for not having a TOL. This is currently being worked out, but operators have resisted the TOL imposition, saying it is too costly for them.

ISSUE 02

WATER CHARGES IMPOSED ON AQUACULTURE PROJECTES

In 2012, an act to charge aquaculture operators on water abstraction was passed and the practice was put into effect in 2015. This created a problem for operators when notices and summons were issued for non-payment as they said they were not informed and made aware of the new law and practice. They also pointed out the need for a scale of water rates, as their use of water was different from that of other water businesses, such as mineral water industry. For the mineral water sector, water is the end-product whereas water for aquaculture was an operational necessity. The imposition of the standard flat rate for commercial water made it difficult for aquaculture operators to stay in business.

ISSUE 03

CHALLENGES TO SELANGOR FISHERY PRODUCTION DUE TO VARIOUS MARKET FACTORS

Captured fishery still comprises 70% of the state's total catch, but Selangor is ranked 5th in production amongst Malaysia's states in 2015. Land for aquaculture activities is costly, and with rising operational costs, fish from Perak is being sold in Selangor markets as they are cheaper than fish from Selangor itself. At the same time, the consumer demand for marine fish is greater than that for freshwater fish. Low consumer perception of freshwater fish such as tilapia gives rise to increased demand for captured fishery products. DOF Selangor is looking for ways to rebrand inland fish to the general public.

ISSUE 04

AQUACULTURE AFFECTED BY POLLUTION

Aquaculture farms are affected by pollution from various sources. Sungai Buloh prawn culture along the river delta uses heavily polluted water for their ponds. This is due to massive loads of pollutants that have flowed and accumulated at the river delta from all over the river catchment. Most likely from palm oil plantations and factories. The stretch of Selangor's coast from the Bernam river delta to the Langat river delta have long been home to numerous cockle farms. In recent years, cockle farm complaints about water contamination have increased in vast numbers. Many complaints have suspected the pollution to be due to pesticides and fertilizers from rice farms further upstream. In Sungai Sembilang (Kuala Selangor tributary), leachate from a sanitary landfill nearby affected the water quality of the river which has affected the cockle farms further downstream. Reports on cockle health found that there are high levels of heavy metals.

ISSUE 05

IMPACTS OF CLIMATE CHANGE

DOF Selangor says that the years 2012 to 2015 have not been good for aquaculture, citing extreme heat and the effects of the El Nino phenomenon. In this and other river basins, many aquaculture enterprises incurred losses due to flooding and rising water temperature.

ISSUE 06

DIFFICULTY OF MYGAP ADOPTION BY AQUACULTURE OPERATORS

MyGAP promotion to aquaculture operators has been difficult primarily due to the stringent regulations, the cost of compliance, and additional paperwork. Agencies suggest the issuance of SAAB, a lower level of certification to get more registration numbers first, then gradually promote the MyGAP certification.

ISSUE 07

NEED FOR BETTER COORDINATION AND COMMUNICATION AMONG AGENCIES

DOF has been restructured such that enforcement now falls under another agency called the Agensi Penguatkuasaan Maritim Malaysia (APMM). In addition, as a federal agency implemented at the state level, DOF Selangor saw that much of the communication and decision making tends to be centralised at the top and does not trickle down to the state level. With DOF functions being relegated to different organisations and implemented at various levels, communication and coordination becomes important to address linkages and maintain coherence in policy making and program designs.

ISSUE 08

PRAWN AQUACULTURE REPLACES MANGROVE AND CUT BACK ON MANGROVE FORESTS

Prawn aquaculture enterprises are encroaching on mangrove forests and thus must be controlled. In just three days, broad swaths of mangroves can be cut down and wiped out. Operators get approval for a fixed number of acres, but in practice take up more acres than permitted. There have been replanting projects with Jabatan Perhutanan, but they are not sustained regularly. Another problem arises when the shrimp ponds are cleaned out. Authorities do not know what is inside the ponds and these discharges are being released into the environment. Shrimp wastewater can have adverse effects to receiving waters due to their high concentrations of TSS, TN and TP.

Wet Markets / Restaurants / Food Outlets

Effluents from eateries and wet markets dumped into drainage system gets flushed into the waterways during rain. To prevent this, grease traps are part and parcel of the licenses issued to these sites. Hence if they are not maintained, the licenses will be revoked.

Recreation

There are a number of parks and animal sanctuaries along Sungai Selangor, such as the Sungai Dusun Wildlife Centre, the Hornbill Conservation Centre, Sungai Pakeh Firefly Park and Inki Recreational Park. Towards the coast, there are many homestays which enjoy the view of the lush, green expanse of paddy fields.

One of the concerns of district authorities is for riverside resort owners to improve or upgrade water treatment and sanitation at recreational areas so that river water is not contaminated for tourists and river users. Riverside resort owners must also ensure that they have a proper septic tank for wastewater and not discharge directly into the river or into unlined pits that leach contaminants into the recreational waters.

IMPACT OF POLLUTION
AND OTHER HUMAN ACTIVITIES

Water Borne Diseases

River pollution can have negative impact on human health, in the form of water-borne diseases such as cholera and acute gastroenteritis. It can cause skin diseases while constant exposure to heavy metals in the water will give rise to respiratory problems and nervous system failures.

Types of common water-borne diseases are typhoid, leptospirosis, salmonella, and E. coli.

DISEASE	EFFECTS	CAUSE
Typhoid	Abdominal pain, diarrhoea, cramps, high fever	Salmonella in contaminated water
Leptospirosis	Flu-like symptoms with stiffness of neck. Can lead to meningitis and liver and kidney disease	Direct contact through animals such as rodents or contact with contaminated water
E-coli infection	Nausea, vomiting, cramps, diarrhoea. Can lead to kidney failure, anemia and dehydration	E. coli bacteria in wastewater

Source: JKNS

The most common sources of pollutants are:

COMMON SOURCES OF POLLUTION

Leachate from landfills	Contain heavy metals and agriculture wastes such as pesticides
Sewage	Wastewater that flow directly into the river
Industrial effluents	From textile, furniture, and latex factories
Illegal sand mining and land use	Contributes to higher turbidity of the river water
Agricultural activities	Fertilisers
Aquaculture and animal husbandry	Waste from animals directly flowing into the river

Source: JKNS 2012

Although water treatment plants handle most pollutants, there are some bacteria that cannot be eradicated by standard water treatment. It has been found that protozoans such as Cryptosproridium and Giardia are resistant to chlorine, the chemical used to treat pollutants. These protozoans are parasites that live in the intestine and cause persistent diarrhoea in children as well as nausea and fatigue. However, this depends on the treatment process, such as the dose of chlorine, coagulant, media filter and water pH.

Currently, the Engineering Services Unit under Jabatan Kesihatan Negeri Selangor (JKNS) is in the process of drafting a bill called the Safe Drinking Water Act which is now being tabled in Parliament. This Act and the Water Safety Plan (WSP) are initiatives to improve the quality of drinking water and subsequently, the quality of human health.

Untreated sewage poses a threat to public health since it contains pathogenic bacteria and viruses that cause deadly diseases such as cholera, typhoid, and hepatitis A.

A sanitary survey is carried out by JKNS every four months on a district-by-district basis. These tests are usually taken near the water intakes or at river confluences. It tests for seven parameters. If there are any signs of contamination in the test results, JKNS will test the upstream rivers.

Since 2000, JKNS's Engineering Services Unit has been conducting sanitary surveys, which is routine monitoring of water quality from the water intake to the water treatment plants and up to the reticulation system. The surveys are conducted systematically district by district. If there is a water quality violation, JKNS will conduct investigation together with the treatment plant operator and water supplier. JKNS also conducts an immediate investigation upon receiving a report on the quality of drinking water.

One of the measures that JKNS has taken is to inform the public through hazard warning notice boards describing the risk of infection and preventive actions to be taken.

***JKNS** is a government agency that safeguards public health and monitors the environment for factors that impact human health*

Water Supply Distruption

From 2012 to 2015, water treatment plants within the Sungai Selangor basin experienced shutdowns for extended periods of time due to water supply disruptions. In most cases, the causes of the water disruptions were high amounts of turbidity, high fluoride and ammonia amount, excessive amount of water weeds, minor oil spills, and high river water levels due to floods.

It was noted that in the period between 2012 and 2014 the number of water disruptions increased while in 2015, the number dropped to 88 incidents. Most of the shutdowns occurred at the WTPs at Batang Kali, Sungai Buaya and Sungai Rangkap.

WATER INTAKE POINT	WATER DISRUPTION (HOUR)			
	2012	2013	2014	2015
Bukit Nanas	-	-	-	-
Sg. Batu	-	-	-	-
Gombak	-	3.17	-	-
Sg. Rumput	-	-	-	-
Sg. Pusu	-	-	-	-
Ampang Intake	13.42	90.68	13.5	2.17
Sg. Keroh	-	-	-	-
Wangsa Maju	-	-	211.42	-
Total	**13.42**	**93.9**	**224.9**	**2.2**

Water Disruption at water intake point within the Sungai Selangor basin
Source: PNSB

Some of the notable incidents are:

- In 2012, the Kuala Kubu Baru WTP stopped operations for four hours due to high raw water turbidity while the SSP1 WTP stopped operations for 135 hours as a result of high amounts of fluoride, ammonia and turbidity in the river water. For SSP2 and SSP3 (Sungai Rasa), operations stopped for 15 and 17 hours respectively. The cause was abnormal odour and turbidity.

- In 2013, the Rantau Panjang WTP shut down for 16 hours due to oil spillage, while SSP1 recorded the longest period of shutdown, 201 hours, because of floating debris and high ammonia level. In the same year, oil spillage caused both SSP2 and SSP3 (Badong) to stop operating for 16 hours respectively. At SSP3 (Sungai Rasa), operations stopped for 24 hours due to turbidity. 2013 marked the highest number of shutdowns, which cumulatively totaled 273 hours.

- In 2014, there were shutdowns at three WTPS—Rantau Panjang, SSP2 and SSP3 (Badong)—for nine hours at each plant due to oil spillage, while SSP1 shut down for 47 hours due to high ammonia level, floating debris and oil spillage. SSP3 at Sungai Rasa experienced shutdowns for 60 caused by high levels of turbidity.

- In 2015, SSP1 had to shut down its operations for 26 hours due to floating debris, oil spillage and high level of turbidity. SSP2 had the least number of shutdowns totaling 2.6 hours, and this was due to diesel spillage and odour. For SSP3 at Badong, operations stopped for 13 hours while SSP3 at Sungai Rasa stopped for 46 hours. This was due to turbidity, floating debris, and oil spillage. This year saw the lowest shutdown period which totaled 88 hours.

Other incidents during the 2012-2015 period have included quarry sediment pond overflowing during a storm event. The intake plant had to shut down to prevent choking of the filters. The normal limit for intakes is 1,000 nephelometric turbidity unit (NTU); this incident saw an NTU of 8,000. When events like this happen, the water concessionaire PNSB would report it to the district and land office, whereupon investigation into the cause of pollution would start.

There have been suspected cases of chicken effluents causing pollution of the water near the intakes. The fact that it is a non-point pollution that was dumped in the early hours of the morning made it difficult to pinpoint the offenders, although authorities and water concessionaires strongly suspect the nearby chicken farms. Different water treatment plants have different technologies (e.g. Wangsa Maju – DAF system, Sungai Kepong – membrane, SSP2 – active flow), and some are more sensitive to certain types of pollution than others.

Water concessionaires also cite the effects of El Nino bringing upon drought conditions caused by lack of rainfall. When the dam reaches critical drought conditions, the State Economic Planning Unit calls operators and LUAS for actions to take. If there is not enough water during drought, one of the first actions taken is to draw down from the balancing reservoir. For more serious or extended cases, alternative water source solutions at each river basins are deployed.

Flooding

Owing to heavy rainfall events typical of the Malaysian climate, floods are persistent occurrences that wreak damage on properties, result in loss of lives and incur great inconveniences to the public. Major floods occur mainly due to heavy rainfall resulting in flows exceeding the carrying capacity of the rivers and cause flood waters to overflow from the river into the low laying areas.

Between the period 2012-2015, the Selangor River Basin experienced widespread, large-scale floods that wreaked havoc on people's lives, ruining homes, businesses and other property.

In 2012, flash floods in May with a water level of three metres struck 10 villages and causing the loss of thousands of ringgits' worth of merchandise at shops in Kuala Kubu Baru. Some media accounts attribute the cause of the flooding to river sand mining activities that caused alterations in the riverbed of Sungai Selangor.

In November of the same year, Sungai Selangor at Kuala Badong exceeded the danger level. Flooding was widespread, affecting Kuala Langat and Sepang as well as Kuala Selangor. A total of 247 families evacuated to relief centres, many of them in Kuala Selangor.

2015 was another year of flood disaster that resulted in 621 people being evacuated to shelters throughout Selangor. A notable flood event was in December 2015 in areas around Kuala Selangor when water levels rose, causing flash floods that inundated homes and businesses. The flood, which hit Ijok,

Kampung Bukit Kapar, Kampung Parit Mahang, Kampung Seri Sentosa Batu 15 and Puncak Alam, was described as the worst in the past 20 years.

According to the National Security Council's flood portal, Selangor had a total of 938 flood victims in 2012.

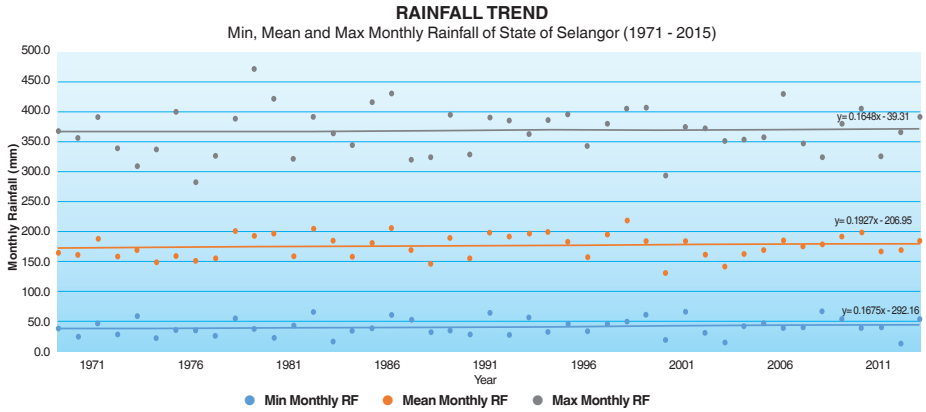
DATE	AREA AFFECTED	RELOCATION CENTRE/ NO. OF HOUSES AFFECTED	DETAILS
May 8, 2012	Batang Kali, Kuala Kubu Baru	10 villages Shops lost thousands of ringgits worth of merchandise	Flash floods where water rose to three metres. Probable cause is riverbed sand mining that choked up Sungai Selangor
Nov. 10, 2012	Kuala Selangor	938 flood victims 247 families in Selangor who were staying at four relief centres in Kuala Langat and one each in Sepang and Kuala Selangor	Sungai Selangor in Kuala Badong exceeded the danger level
Aug. 11, 2015	Puncak Alam, Bestari Jaya	20 children and five teachers trapped	Waters rose to over one metre
Dec 16, 2015	Kampung Parit Mahang, Jeram Kuala Selangor	147 victims Sekolah Rendah Pasangan, Kampung Asahan (76); Bukit Kuching Community Hall (24); Surau Ladang Tuan Mee (40); Surau At-Taukikiah, Puncak Alam (10), Bukit Kuching community hall (24)	

Flood-prone areas in within the Sungai Selangor basin (2012-2015)
Source: JPS

Rainfall Trends

In Selangor, data from 61 rainfall stations are compiled at Bahagian Saliran dan Air Hujan, JPS to analyse rainfall trends in the state. The analysis is based on monthly data from 1971–2015, and it can be categorised into three plots, which are minimum, average and maximum. The graph shows that every year the data has a positive correlation coefficient, and the slope of the regression line is positive. There is an increasing trend in the amount of monthly rainfall. The trend line shows that the maximum amount of monthly rainfall has increased by a factor of 0.1648 for each year in Selangor.

This implies that the human activities are highly vulnerable to such changes in rainfall trend and there is clear indication that climate change is happening in the state. The map below shows that flooding mostly occurs at Batang Kali. Other flood-prone areas are Tanjung Karang and Sungai Darah near HORAS and UNISEL as well as Kampung Baru Ijok and Kampung Sentosa. Some agricultural areas in the lower basin area are also prone to flooding.



Rainfall trend within the state of Selangor
Source: JPS

The State Government has identified the flood-prone areas as follows: Taman Sentosa, Rantau Panjang, Sungai Udang, Telok Pulai, Pandamaran Taman Chi Liung, Bayu Perdana, parts of Klang Port, Bandar Putri, Padang Jawa and its surrounding areas.

Flood-prone areas in within the Sungai Selangor basin (2012-2015)
Source: JPS

Flood Mitigation

In view of the flood problems, the government implemented several projects. In the wake of the devastating floods that struck Selangor in December 2015, JPS Selangor, upon recommendation by the Chief Minister, agreed to install two permanent pumps to lock water at Parit Merbau and Parit Gajah in Kuala Selangor to pump out water flooding in several areas in the district.

On a larger scale, the Flood Prevention Task Force under the Selangor State Secretariat announced its plan in 2015 to implement 33 projects over the next five years to combat floods in the state. The projects, which are part of the Eleventh Malaysia Plan, included the widening of drains, building culverts and the upgrading of pump houses, retention ponds and static pumps. The projects, which are carried out by JPS Selangor, would be conducted in four districts—Gombak (eight projects), Petaling (11), Hulu Langat (four projects), and Klang (10 projects).

The projects addresses one of the major causes of the floods, which was the clogging of rubbish in the drainage system. The upgrading of the drainage system and infrastructure, which can accommodate normal rainfall, was to cater for heavier rainfall events, such as those experienced in recent years.

Flooding at Kg Baru Ijok
Source: JPS Ampang

Flooding at Kampung Sentosa
Source: JPS Ampang

Aquaculture and Commercial Fishing

Fish populations being monitored by field officers
Source: Jabatan Perikanan 2016

Aquaculture and fish are sensitive to changes in the river water environment and there have been cases of entire populations along stretches of rivers being affected. In 2015, a sanitary landfill in Sungai Sembilang, Kuala Selangor experienced leaching of heavy metals that affected the cockle population there.

In these cases, local authorities and relevant agencies say that communication among LUAS, JAS and the reporting agencies is important. Because reporting agencies on the ground act on complaints by the public, they need to know the causes and particulars of the case so that they can report back to the inquiring party.

In Kuala Selangor, Sabak Bernam and even Kuala Langat, cockle breeding is a big industry. Thus, it is worrying that the number of spatfall landing has reduced over the years. Selangor is still a major producer of spat, and as such, water quality is important.


IMPACT OF
CLIMATE CHANGE

Impact of Climate Change

In discussions with various agencies throughout Selangor, several mentioned experiencing the impact of climate change. Seasonal monsoon patterns were changing, and more extreme conditions were being experienced during rainfall and droughts. These are anecdotal observations made by officers in technical agencies such as water concessionaires who cite droughts caused by lack of rainfall due to changes in the climate.

To verify the impact of climate change in Malaysia, specifically Selangor, the Institut Penyelidikan Hidraulik Kebangsaan Malaysia (NAHRIM) weighs in on this issue.

In 2014, NAHRIM carried out an Impact Assessment Study on climate change, which included impacts on the river basins. Two river basins in Selangor were studied: Sungai Selangor and Sungai Klang. It covered changes in rainfall, evapotransportation, and assessment of water availability. As climate change is a gradual process, it runs scenarios in 30-year slices.

In the same year, NAHRIM also completed the climate change modelling for Peninsular Malaysia. Called the Regional Hydro Climate Model, it is based on three global climate models and presents four scenarios: worst case, two middle cases, and best case. **Studies have shown that the phenomenon of El Nino, which exacerbates drought**

conditions and normally occurs every eight to nine years, occurs more frequently now, at every three to four years. La Nina, which brings heavy rainfall and flooding, still follows local monsoon seasons, but the situation may change as global climate conditions plays on local conditions.

In reviewing the possible case scenarios, NAHRIM suggests several adaptation measures to be undertaken:

- Ensure that new urban developments have built-in climate change mitigation measures. This calls for a holistic approach that includes non-structural as well as structural measures.

- Encourage low-impact development. Low impact means development that encompasses good stormwater management. We already have guidelines for low impact development in the form of the Malaysian Stormwater Manual (MSMA).

- When planning for new developments, planners must not only consider past rainfall history in the development area, but also projections.

- As climate change affects water resources, NAHRIM suggests that LUAS incorporate climate change impacts and measures in their long-term planning of water resources.

APPENDICES

Appendices

Appendix A. Water Quality Index

Since 2001, JAS has been conducting water quality monitoring programme to detect changes in river water quality and to identify sources. JAS collects water samples at regular intervals from designated stations to determine physic-chemical and biological characteristics.

The WQI serves as a basis for environmental assessment, whereby categorisation and designation of classes according to beneficial usage as stipulated in the National Water Quality Standards for Malaysia (NWQS).

The WQI is calculated based on six parameters, which are dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammoniacal nitrogen, total suspended solids (TSS), and pH.

WQI	STATUS
>80	Clean
60-80	Slightly polluted
<60	Polluted

WQI Class	Range	Water Usage Description
I	<92.7	Conservation of natural environment
		Water supply I – practically no treatment needed (except disinfection or boiling only)
		Fishery I – very sensitive aquatic species
II	76.5 – 92.7	Water supply II – conventional treatment required
		Fishery II – sensitive aquatic species
		Recreational use with body contact
III	51.9-76.5	Water supply III – extensive treatment required
		Fishery III – common, of economic value and tolerant species
IV	31.0-51.9	Irrigation only
V	<31.0	Water unsuitable for any of the above uses

Appendix B. Effluent Standard

Until 2008, effluent discharges were stipulated under the Environmental Quality Act 1974 and the Environmental Quality (Sewage and Industrial Effluent) Regulations 1979.

In 2009, revisions were introduced by Kementerian Sumber Asli dan Alam Sekitar, resulting in two sets of regulations—the Environmental Quality (Sewage) Regulations 2009 (EQSR) and the Environmental Quality (Industrial Effluent) Regulations 2009.

Standard	Temp	(C)	pH	BOD	COD	SS	NH^3-N	NO^3-N	P	O&G
Category 1 (Rivers)										
Standard A	40	6.0-9.0	20	120	50	10	20	5	5	
Standard B	40	5.5-9.0	50	200	100	20	50	10	10	
Category 1 (Lakes)										
Standard A	40	6.0-9.0	20	120	50	5	10	5	5	
Standard B	40	5.5-9.0	50	200	100	5	10	10	10	
Category 2										
Standard A	n/a	n/a	20	120	50	50	n/a	n/a	20	
Standard B	n/a	n/a	50	200	100	50	n/a	n/a	20	
Category 3										
CST (STD A & B)	n/a	n/a	200	n/a	180	n/a	n/a	n/a	n/a	
IT (STD A & B)	n/a	n/a	175	n/a	150	100	n/a	n/a	n/a	
OP (STD A & B)	n/a	n/a	120	360	150	70	n/a	n/a	n/a	
AL (STD A & B)	n/a	n/a	100	300	120	80	n/a	n/a	n/a	
MP (STD A)	n/a	n/a	60	180	100	60	n/a	n/a	20	
MP (STD B)	n/a	n/a	60	240	120	60	n/a	n/a	20	

No	Parameter	Unit	Standard	
			A	B
1.	Temperature	°C	40	40
2.	pH Value	-	6.0-9.0	5.5-9.0
3.	BOD5 at 20°C	mg/l	20	50
4	COD	mg/l	50	100
5	Suspended Solids	mg/l	50	100
6	Mercury	mg/l	0.005	0.05
7	Cadmium	mg/l	0.01	0.02
8	Chromium, Hexavalent	mg/l	0.05	0.05

9	Arsenic	mg/l	0.05	0.10
10	Cyanide	mg/l	0.05	0.10
11	Lead	mg/l	0.10	0.5
12	Chromium, Trivalent	mg/l	0.20	1.0
13	Copper	mg/l	0.20	1.0
14	Manganese	mg/l	0.20	1.0
15	Nickel	mg/l	0.20	1.0
16	Tin	mg/l	0.20	1.0
17	Zinc	mg/l	1.0	1.0
18	Boron	mg/l	1.0	4.0
19	Iron (Fe)	mg/l	1.0	5.0
20	Phenol	mg/l	0.001	1.0
21	Free Chlorine	mg/l	1.0	2.0
22	Sulphide	mg/l	0.50	0.50
23	Oil and Grease	mg/l	Not detectable	10.0

Appendix C. Potential Sources of Raw Water

Shows the categories of pollution found in river water and how they are measured. Possible sources of pollution are listed.

Group	Parameter	General Potential Sources
Microbiological	Total Coliform	Sewage effluent – residential and livestock farming
Physical	Turbidity	Earthworks, sand mining, heavy rainfall
	Color	Industrial effluent, mining pools, swamps
	pH	Industrial effluents, swamps
Inorganic	BOD	Agriculture, natural vegetation, leachate, waste disposal, livestock farming, industrial effluents, earthworks, swamps
	COD	Agriculture, natural vegetation, leachate, waste disposal, livestock farming, industrial effluents, earthworks, swamps
	Ammonia	Domestic waste, industrial effluent, leachate, sewage effluent
	Total nitrogen	Agriculture, natural vegetation
Iron & Manganese	Industrial effluent, earthworks	
Heavy Metals		Industrial effluent, earthworks
Pesticides		Agriculture, recreation

Appendix D. List of Parameters and Limits of Discharge

Activity	Parameter	Limit for Discharge
Freshwater aquaculture in ponds or cages	Ammoniacal Nitrogen (NH_3-N)	5 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Total Suspended Solid (TSS)	100 mg/l
	Nitrogen Nitrogen (TN)	10 mg/
	Phosphorus (TP)	1 mg/l
Marine shrimp aquaculture in ponds	Ammoniacal Nitrogen (NH_3-N)	5 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Total Suspended Solid (TSS)	100 mg/l
	Nitrogen Nitrogen (TN)	10 mg/l
	Phosphorus (TP)	1 mg/l
Development and earthworks	Total Suspended Solid (TSS)	100 mg/l
	Oil and grease	10 mg/l
Livestock other than pigs	Ammoniacal Nitrogen (NH_3-N)	
	Biochemical Oxygen Demand (BOD5) at 20°C	200 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	500 mg/l
Swine livestock	Ammoniacal Nitrogen (NH_3-N)	200 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	100 mg/l
Pets	Ammoniacal Nitrogen (NH_3-N)	300 mg/l
	Biochemical Oxygen Demand (BOD5) at 20°C	50 mg/l
	Chemical Oxygen Demand (COD)	500 mg/l
	Total Suspended Solid (TSS)	250 mg/l
Mining and related activities	Total Suspended Solids (TSS)	50 mg/l
	Oil and grease	1 mg/l

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