Developments in Water Management and Technologies in Malaysia

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Will look at:
Water resource situation in Malaysia
Water governance
Water management strategies

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GLOBAL WATER RESOURCES

Freshwater supplies are strained due to population growth and increasing agricultural, industrial, commercial, and domestic demands to meet the growth:
→Global water consumption is doubling every ~20 years (Goldman Sachs),
→In 2008, world water market is worth $522 billion (analyst firm Lux Research),
→Water scarcity is amongst the most serious crises facing the world (UN)

Climate change: some regions becoming more arid, while others have hurricanes.
Desertification increasing:
- in Central Asia, eg, Uzbekistan and Kazakhstan and parts of China
- in South and Central America, eg, Chile, Paraguay, Argentina, Peru and Brazil,
- in Middle East especially Iran, etc.
- in more than 25 countries of Africa

Growing water shortage will make food scarcer, potable water less accessible and water-borne diseases even more rampant, making poor countries poorer.

MALAYSIAN WATER RESOURCES

-High rainfall ~3,000 mm

-Torrential rains, most freshwater go to the sea

-Rapid growth in cities lead to freshwater shortages

-New industrial centres face water shortages

-River water pollution problems (river water supplies about 98% of potable water)

-Governance: newly introduced reforms

Water situation in Malaysia

Water resource:

- adequate for small towns and rural areas, for Klang Valley, by 2010 demand exceeds supply,
- the country's river basins have reached their limits of maximum supply,
- but water demands continue to rise as farming, population and industries grow.

Water Access: Good

about 93% of population has access to water, 97% in urban areas, 86% in rural areas

Per capita water consumption: high, double the UN recommended rate.

on average 300 L/head/day, can breach 500 L/head/day in urban areas.

NRW: Bad, very high, at 40.6% in 2002

For every 100 litres of water piped to consumers, only 62 litres reach them!

Main causes are leakages (16-30%), meter under registration (3-7%) and pilferages (1-8%)

Tariff: too low, tariffs do not reflect the cost of supplying water,

Generally, domestic water tariff is cross-subsidized by industry tariff;

- in 2004 RM 0.70 – 2.93/m3 for industry and RM 0.31 – 0.90/m3 for domestic users.
- lower rates for lower income states.

Incentives for efficient use of water are applied through volumetric charges under an increasing block structure (block price rises with use rise)

- Lower tariffs seen as an incentive for industries to develop.
- But a disadvantage to water saving and recycling.
- Increased usage leads to greater volumes of wastewater and pollution problems.

Freshwater Resources & Storage

- Streams and rivers with and without impounding reservoirs contribute 98% of total water used in Malaysia; the remainder is contributed by groundwater.

- There are over 150 river systems in Malaysia, but river flow regimes are irregular and to secure safe yield from surface water sources, storage facilities were constructed.

- Currently, there are 47 single-purpose and 16 multipurpose dams, with a total storage capacity of 25 billion m^3.

- Groundwater accounts for 90% of the freshwater resources, but not extracted due to easy availability of surface water resources.

→ Need to store freshwater on surface or in aquifers, via ASR (aquifer storage and recovery)

Water resources in Malaysia

Annual rainfall	990 billion m^3
Surface runoff	*566 billion m^3*
Evapo-transpiration	*360 billion m^3*
Groundwater recharge	*64 billion m^3*
Surface artificial storage (dams)	25 billion m^3
Groundwater storage (aquifers)	5 000 billion m^3

Renewable water resources = 630 billion m^3 (ie,surface runoff + groundwater recharge)

→annual water availability ~28,400 m^3/capita.
Thus Malaysia has abundant water resources.

Water demand highest in larger cities

Example:
Kuala Lumpur, with a population of 1.4 million (2000), is the heart of the Klang valley region (pop 4.2 million in 2000), Malaysia's most densely populated region.

•Average per capita income in Kuala Lumpur is approximately double the national average, or average purchasing power of city residents (US 25,600) is comparable to that of developed countries such as Greece (US 24,000) and New Zealand (US 26,200) and more than double the Malaysian average(US12,800).

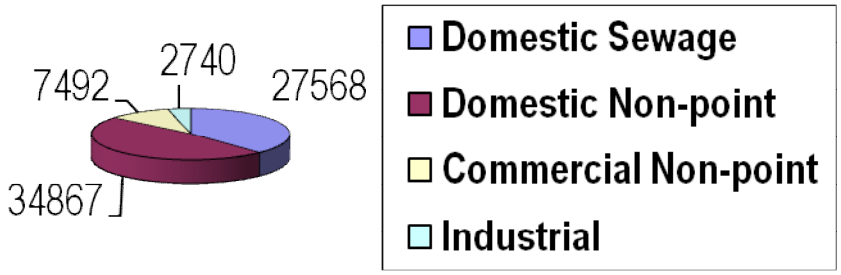
•Average rainfall over Klang basin alone is ~9.4 million m3/day, or about 140% of 2005 demand for whole state including KL, evapotranspiration taken into account.

•So there is water enough to meet Kuala Lumpur's needs, the question is: can it be captured?

Need for:

-Storage on surface or ASR
-Water savings
-Water Recovery and Reuse
-River water quality improvement to increase intake points

River water pollution



River water pollution

→lowers potable water quality

→or water cannot be for potable uptake

Example: Sg. Klang BOD load (excl. solid waste)
- kg/day

Main sources of river water pollution in Malaysia

-Inadequately treated sewage from centralised STPs

→Nutrients and E-coli

- Inadequately treated industrial wastewaters, eg from SMIs

→ COD, heavy metals and industrial organics

-Surface runoffs

→ SS, oils, BOD

- Erosion

→SS

- Garbage mismanagement

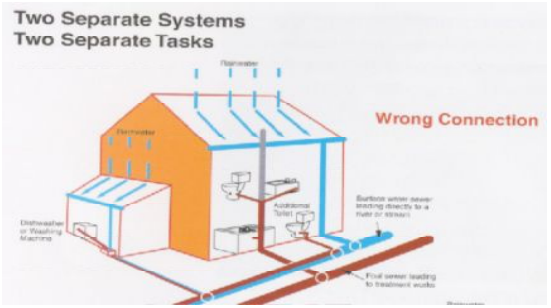
→BOD, SS

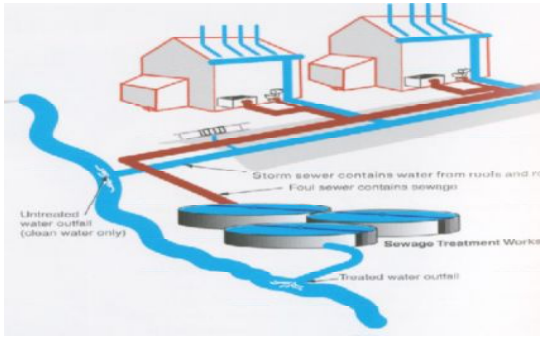
-Wrong connections

→ BOD, COD, nutrients, E-Coli

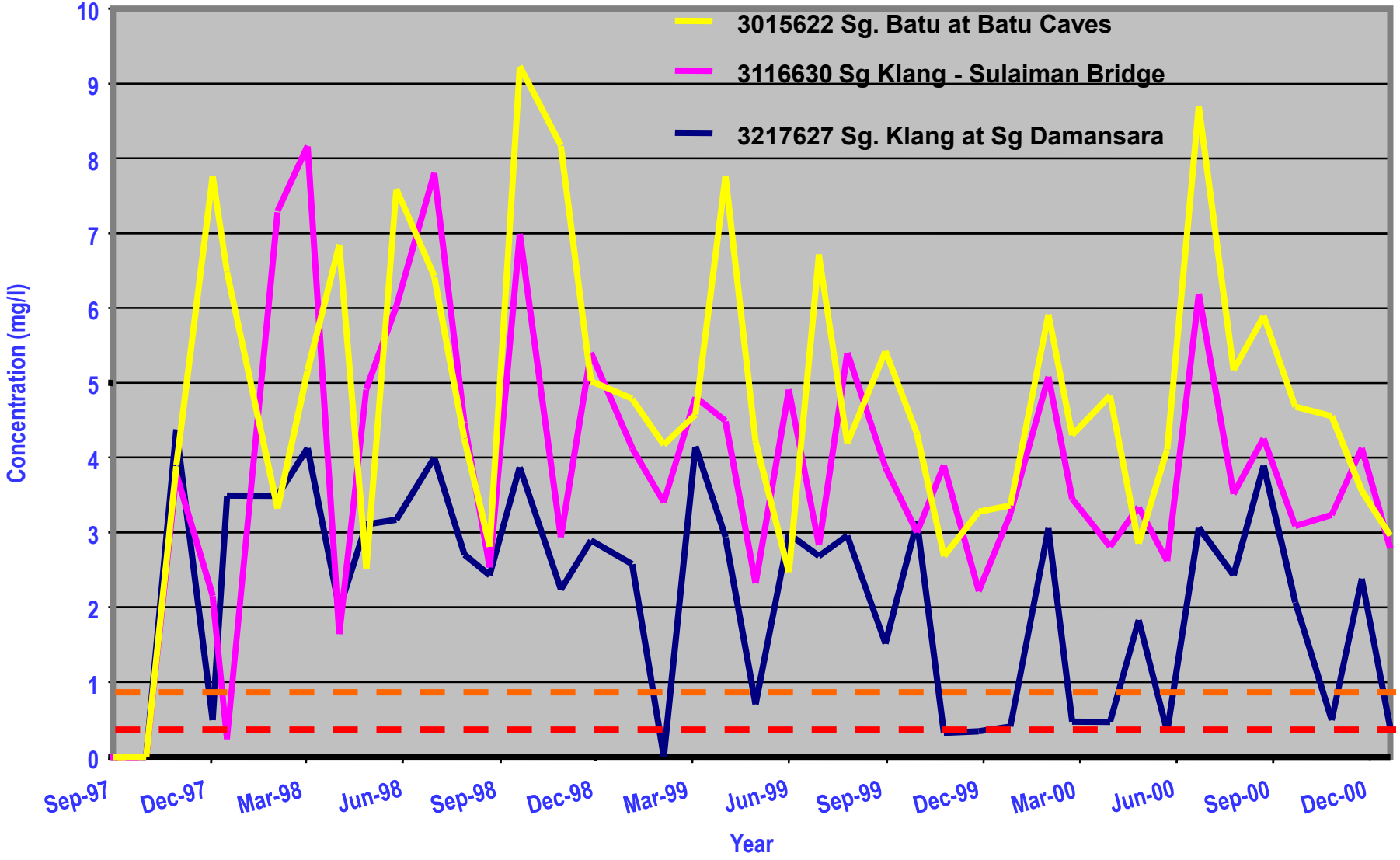
- Septage

→ Nutrients, E-Coli





Ammonium Nitrogen (DOE Data): in most cases Amm-N has to be reduced from ~6 mg/l down to ~0.3 mg/l to achieve Class II, ~95% reduction. Values generally lower since late 1999 despite increasing population in the basin.



Water Management in MALAYSIA

Unoptimised use of water resources and fragmented management resulted in:

- water shortage in cities, agricultural areas and industrial sites
- high NRW
- capital expenditure constraints, mainly due to too low water tariffs
- River water pollution due to financial constraints, lack of coordination, etc

To overcome these problems and optimise water resources management the government in 2006 enacted two legislations: Water Services Industry Act (WSI) and National Water Service Commission Act (NWSC).

Both legislations paved the way for the establishment of:

1) **Water Asset Holding Company (WAHCO)**, a government-owned company under the Federal Treasury, responsible for obtaining financing

- to upgrade water supply infrastructures in the country, and will be relevant until the water services industry reached a full cost recovery level;
- for a holistic management of the water supply and sewerage services

2) **National Water Service Commission, SPAN**, a water industry regulator under the Ministry of Water, Energy and Communications, among whose main tasks are:

- **improving the operational efficiency of the water industry, in particular the reduction of NRW**
- **Improving river water quality via integration of sewage management**

Through the above bodies which became effective in January 2008, the federal government has greatly expanded its influence in the water sector while setting a more holistic approach in management of water and sewerage services.

Among SPAN's Tasks

Regulating Water Tariffs

Full cost recovery necessary to ensure long-term viability and sustainability of water services to consumers, but any increase has to consider affordability, thus,

- existing tariff structures remain, tariff reviews from licensed operators will be based on applications which need to be substantiated by each licensee;
- There will be no automatic tariff increase and licensee will have to meet certain KPIs, which will be monitored through periodic operational audits by SPAN, covering aspects such as:
  a) Level of efficiency achieved by the operator as defined by SPAN;
  b) Operating effectiveness, including meeting defined service quality;
  b) Progress of continuous improvement programme, including addressing NRW and bill collection;
  c) Level of capital expenditure requested by the operator; and
  d) Lease rental charges by Water Assets Management Inc

Ensuring Consumer Satisfaction:

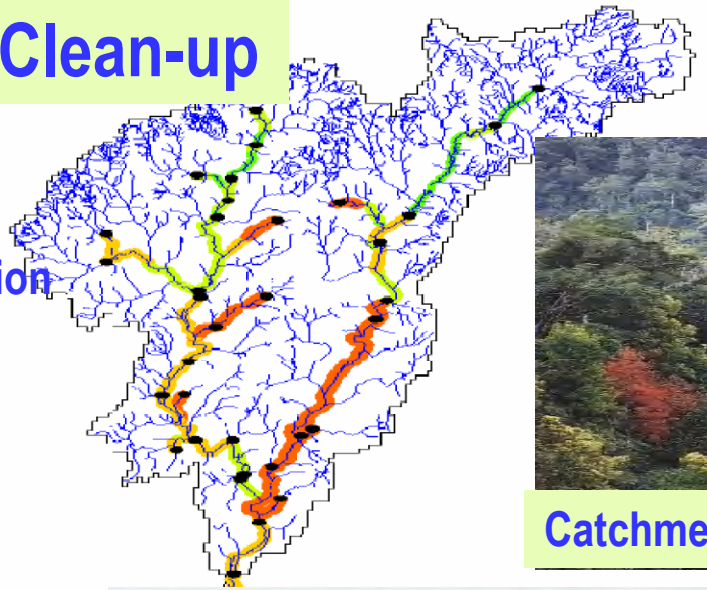
- All operators are required to submit to SPAN consumer codes or client charters;
- Besides achieving performance KPIs operators are required to enhance customer relationship, by leveraging on technology and ICT (eg, call centres and virtual frontline services) to improve customer access and satisfaction.
- SPAN to set-up the "Water Forum", registered under Societies Act 1966 to give feedback on consumer satisfaction of the water industry services.

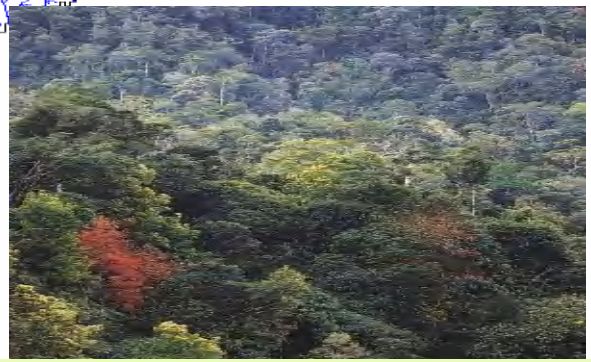
River Water Protection &Clean-up

1.Classification of river sections
2.Mapping and identification of pollution point sources (PS) and non-point sources (NPS)
- Point sources: eg. STP, industrial ETP, landfill, markets, restaurants, etc
- Non-point sources: Agricultural & urban runoffs, septage

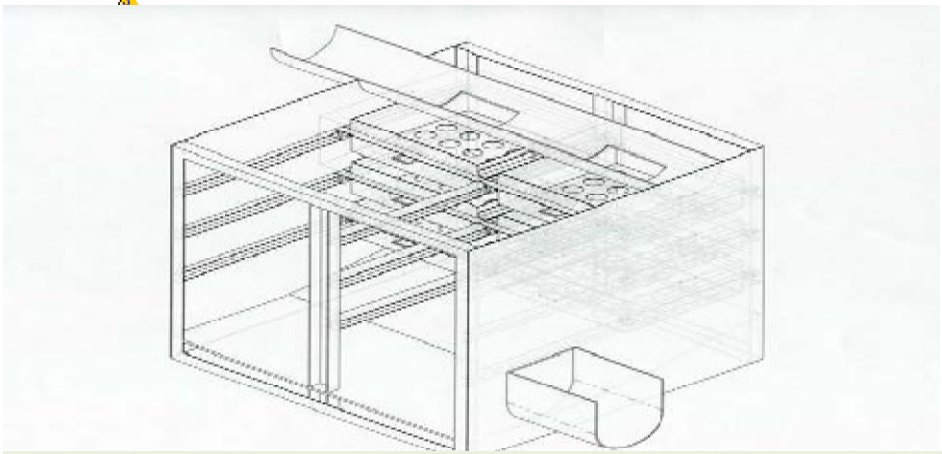
3.Simulate water quality
4.Strategies:
- Minimise NPS
- upgrade existing STPs and ETPs
- Set-up new centralised STPs

5.Pollution prevention approaches
6.Monitoring program
7.Governance
8.Public awareness





Catchment area protection

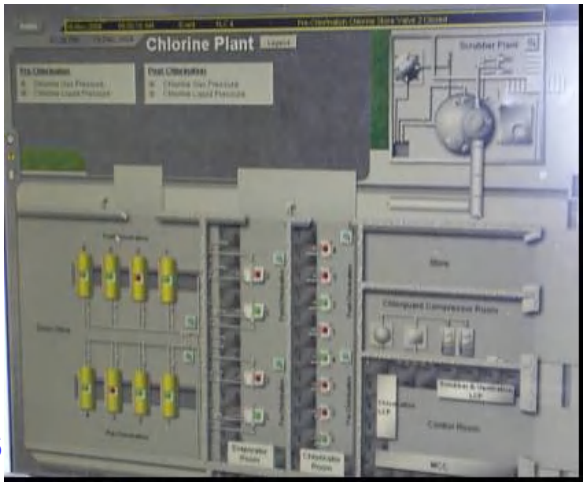


R&D on stormwater trap

Filters first flush, 1st 15 mins of rainfall, thereafter, the bulk of rain bypasses the filter.

River water pollution and treatment challenges

Use of Chlorine controller minimises formation of trihalomethanes in water due to presence of greater numbers of trace organics originating from households, industries etc.



Additional treatment at site: most commonly multimedia filtration with manual or auto backwash.

Some On-going R&Ds

Study on performance of upgraded biological processes using plastic filter media in treating sewage effluent.

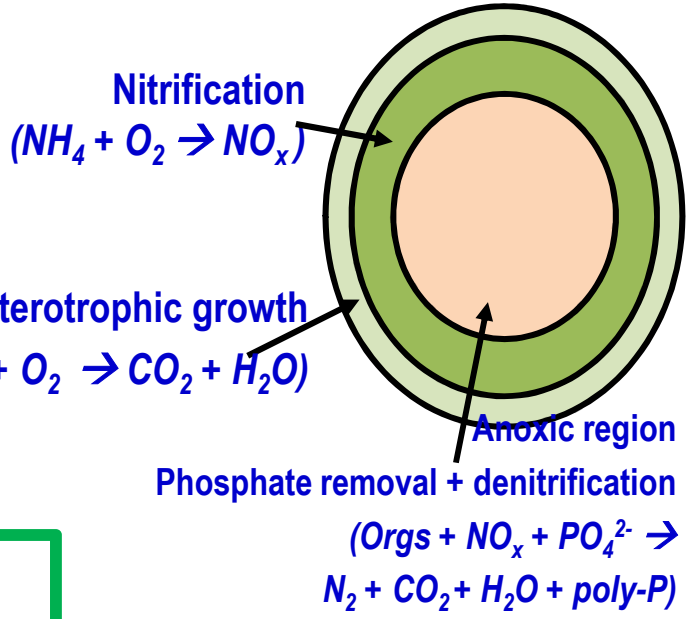
R&D on Multimedia biofilm systems to enhance removal of trace organics and nutrients.

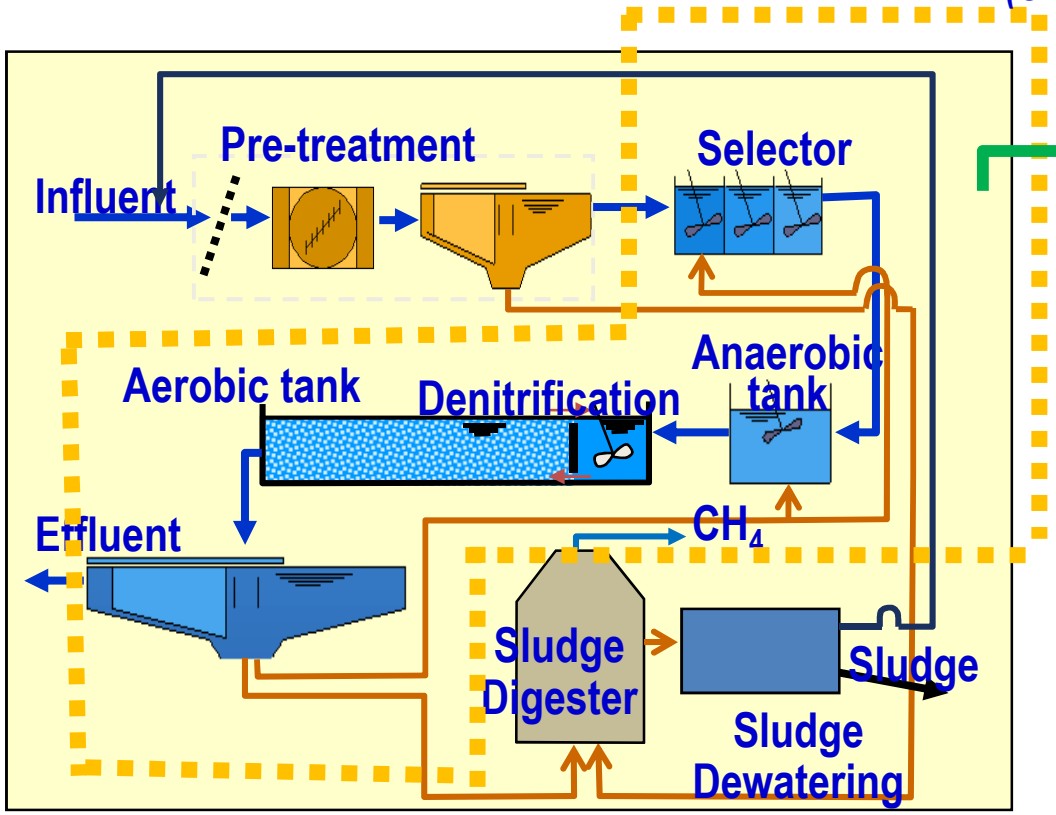
R&D on cost effective methods of oxidation pond upgrading, including on baffles installed to improve hydrodynamic flow in oxidation ponds

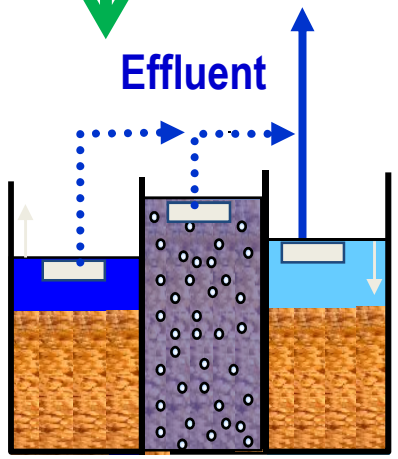
Application of Magnetic Technology in Assisting Sedimentation of Sewage, with studies on effects of magnetic fields to other physical parameters of sewage.

R&D on Development of Granular sludge

- Straightforward (no return sludge, less sludge handling)
- Small area requirement
- Simultaneous N,P and COD removal & settling in one reactor







SBR Granular Sludge Reactor

Continue on Some On-going R&Ds

EXAMPLE
River Water SS removal by ultrafiltration membrane of Modified Hydrophilic Polymer
Recovery ratio : 95% - 98%
Operating pressure : 0.5 - 1.5 bar
pH range : 3 - 11
Filtration rating : 0.1 - 0.01 micron
Filtrate quality : < 1.0 NTU

R&D Sewage Effluent Reuse to identify:

- **potential users**
- **their required quality,**
- **most cost effective method to improve effluent quality for suitable reuses.**

Membrane technology for effluent reclamation has been successfully experimented at Shah Alam public STP.

Training & WTP Upgrading

Training ensures optimum operation and water quality

Training of water plant personnel has traditionally been done by British and European companies. A very successful example is that done by the Swedish group Scanvironment which has successfully trained over a thousand personnel in the following areas:

• Treatment Process, Trouble shooting and Upgrading:	Scanvironment
• Process & Control, Sampling, Analyses	Team Aqua Sweden
• Chemical handling and dosing	Team Aqua Sweden
• Instruments and Control systems	Swedmeter
• Rotating Machines	TPD
• Electrical Systems	ABB
• Distribution System	Jacobsson&Widmark
• Preventive Maintenance, Maintenance Systems	TPD

Trainings based on real problems at selected plants have put the Malaysian personnel at par with technologies and latest development in Europe. The hands-on training indicated simple possibilities for improved operation.

NO.	No of WTPs upgraded according to states till 30 June 2007	No. of WTP Completed	No. of WTP In progress
1	PERLIS	22	0
2	KEDAH	1	6
3	PULAU PINANG	3	27
4	PERAK	61	26
5	SELANGOR	34	41
6	NEGERI SEMBILAN	6	17
7	MELAKA	64	8
8	JOHOR	44	31
9	PAHANG	5	2
10	KUALA LUMPUR	10	12
11	PUTRAJAYA	1	0
	Total	251	170

River Clean-up
Examples of completed STPs

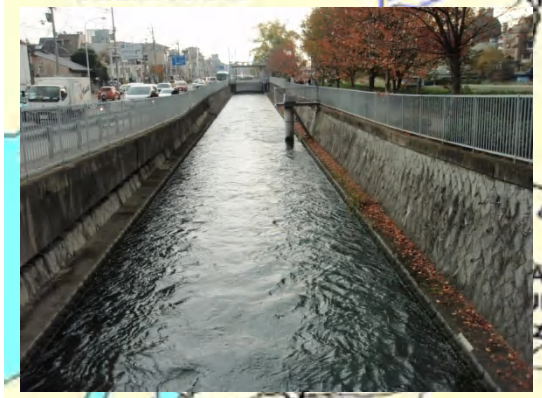
Bandar Tun Razak, Kuala Lumpur

Bunus, Kuala Lumpur

Kelang Selatan, Kelang, Selangor

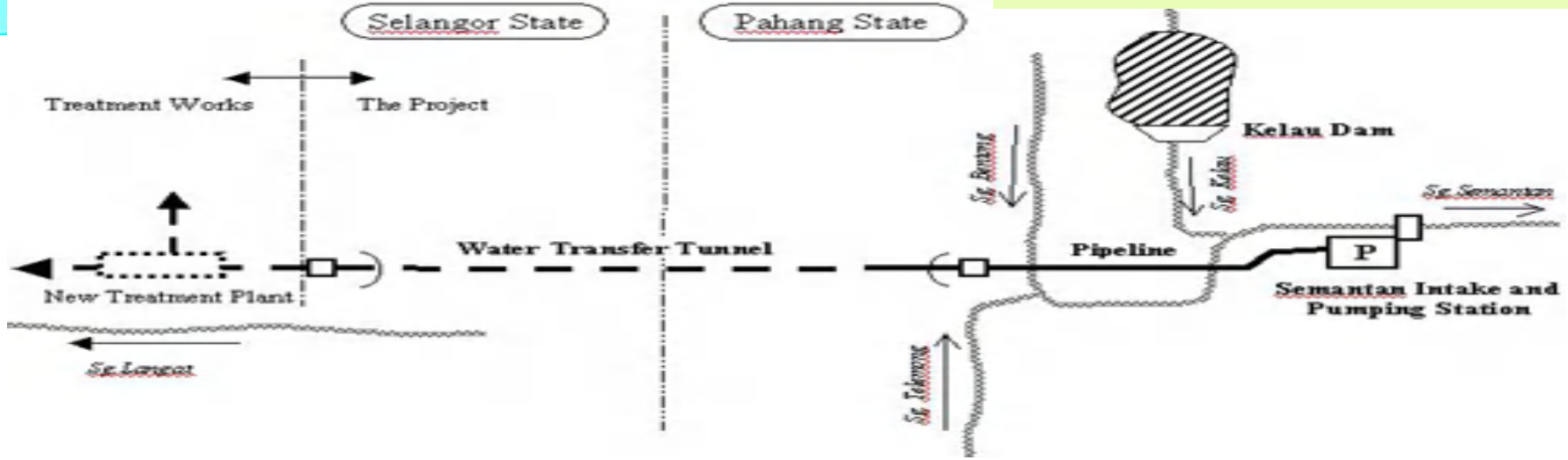
Puchong, Selangor

Water Resource Pahang-Selangor Water Transfer



The Project utilizes runoffs from rivers efficiently with provision of a reservoir in Sg. Kelau. The reservoir release is abstracted at the intake in Sg. Semantan and pumped to a connecting basin at the transfer tunnel inlet.

Raw water is transferred through the tunnel with gravity flow to an outlet connecting basin and distributed to receiving basins of a planned treatment plant via gravity flow.



Water Resource: Groundwater abstraction and ASR

Results on hydrological modeling for KL suggest that two extraction strategies are feasible:

- •permanent small scale extraction (2.5% of water demand) or
- •large scale temporary extraction (25% of water demand).

Preliminary economic comparison with Selangor-Pahang Water Transfer suggests costs of groundwater extraction are competitive, especially for large scale temporary extraction.

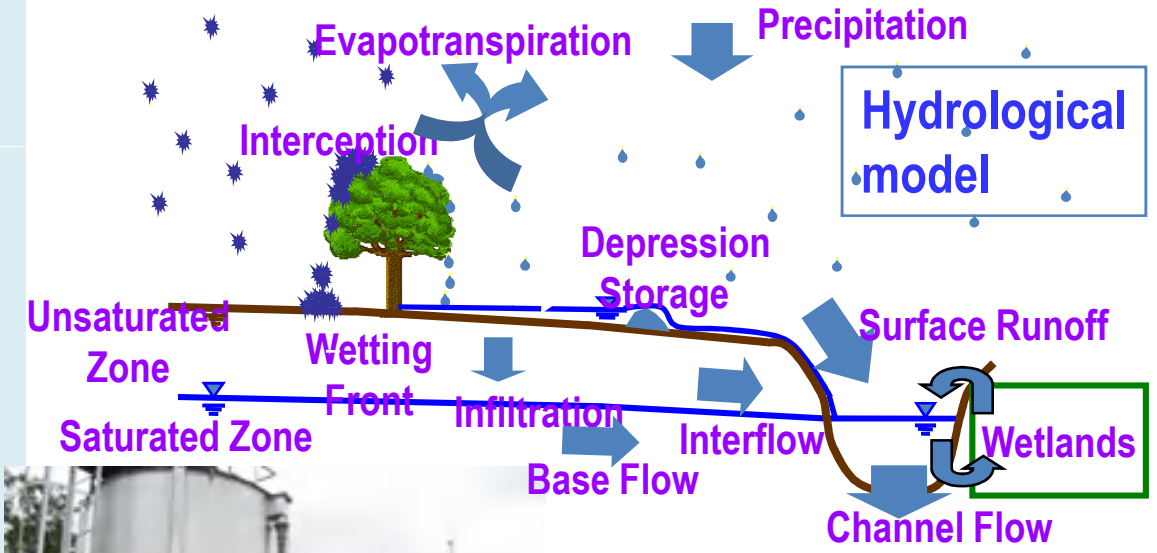
Largest threat to groundwater development for KL is pollution, due to shallow groundwater table (~5 m deep), by:

- •Leachate from landfills,
- •Leaks from storage tanks
- •Illegal well disposals

There is keen interest now on bank and pond bed filtration for ASR

Groundwater accounts for 90% of freshwater resources in Malaysia. Technical feasibility is evaluated by constructing a groundwater flow model capable of predicting the physical effects of groundwater extraction, using:

- •borehole data (groundwater depth),
- •remote sensing data (elevation, evaporation)
- •water balance data (rainfall, hydrological measurements, leakage from water pipes).

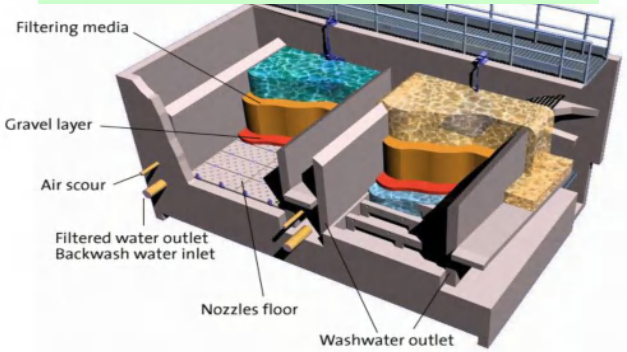


Groundwater being fairly clean, treatment is simple.
Groundwater treatment plant at 10m3/h

Renewable Water Sources

- constructed wetland and ponds for runoff polishing and recharging of groundwater
- innovative, effective and affordable treatment units

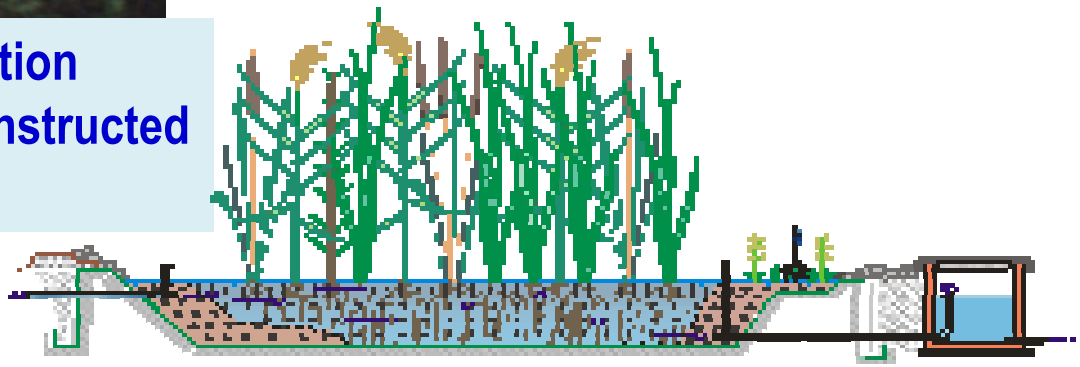
Innovative, effective, affordable treatment units for water reuse.



Constructed wetlands (shown here sandbags holding newly planted reeds)

Rainwater harvesting

Urban retention ponds & constructed wetlands



Water saving options

Irrigation water saving via Fertigation or subsurface drip irrigation

Water saving fittings

this showerhead uses only 9L/min instead of 20-30 L/min for same effectiveness.

Cascade water reuse in agriculture

Cascade water reuse in industries via water pinch analysis

Malaysian GBI (Green Building Index)
Water efficiency ,WE (Water saving fittings, Water reuse, rainwater harvesting, etc) accounts for 10% of the index.

CONCLUSION

Water scarcity in agricultural, large cities and industrial areas are only due to unoptimised distribution and usage, as typical in tropical developing countries.

Climate change, bringing extreme weather events may worsen problems.

To overcome problems of water availability, river pollution, NRW, financing, etc, Malaysia has revamped management of water industry to be under two centralised bodies:

- SPAN, to be in charge of water services management;
- WAHCO to be responsible for financing of water and sewerage infrastructures.

Those two bodies will enable

- a more integrated approach to water resource management, and
- facilitate implementation of innovative technologies, for renewable water resources and for agriculture, industries and housing.