Water for All
Conserve, Value, Enjoy
PUB

Singapore's Experience in Ensuring Water Sustainability

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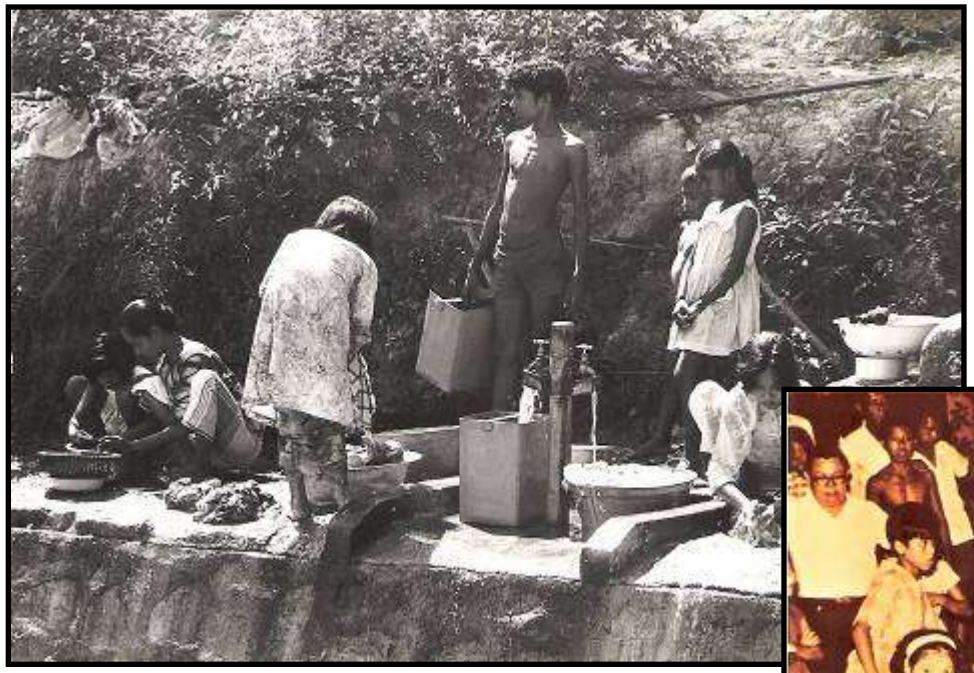
Director, Water Reclamation Plants Department
PUB Singapore
September 2010

Country Information

Land Area	**710 km²**
Population	**5 mil**
Annual Rainfall	**2400 mm**

1960's

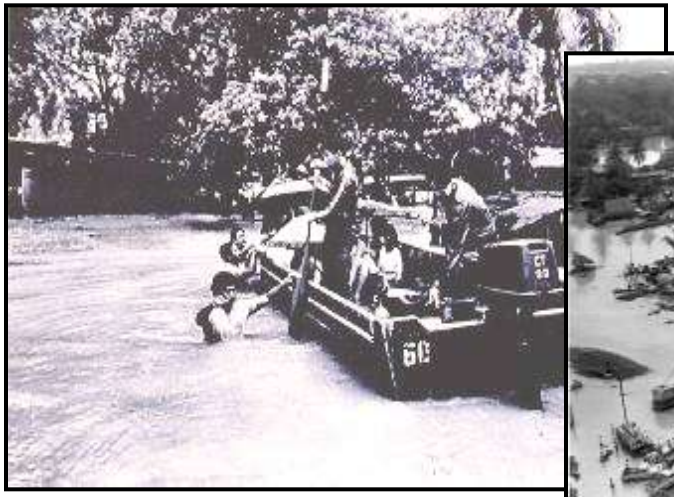


Water resources were scarce…

water rationing

Last water rationing in 1963

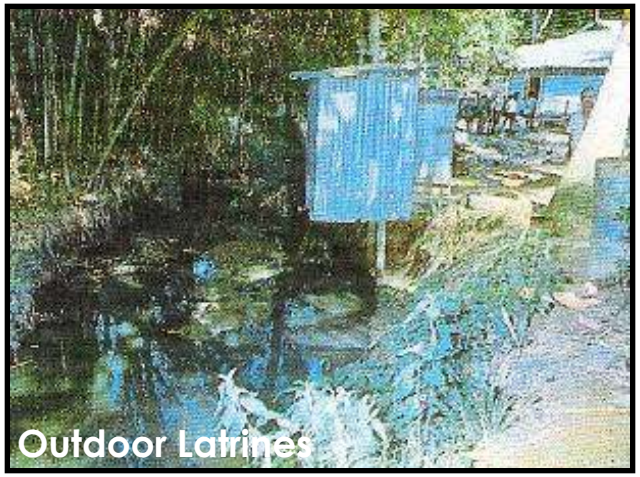
Floods were common occurrences...



1960's

Public Health Concerns

- Proper sanitary facilities were lacking…
- Public Health Conditions were poor…



1960's

Our rivers were polluted...

Singapore today…

Measures Adopted

- Expand **catchments**
- **Demand** Management
- Integrated **Land Use** Planning
- Leveraging on **Technology**
- **Pricing** based on cost recovery
- Strict **legislation**

Institutional Restructuring

Ministry of the Environment (ENV)

- Sewerage Department
- Drainage Department

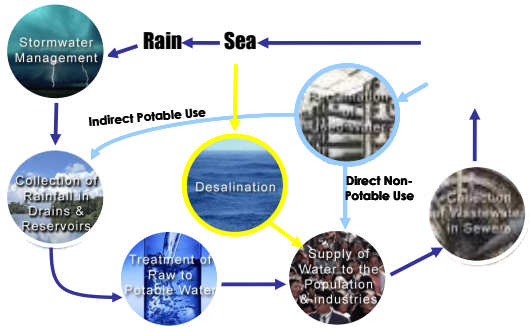
Ministry of Trade and Industry

- Water Department

Ministry of the Environment and Water Resources

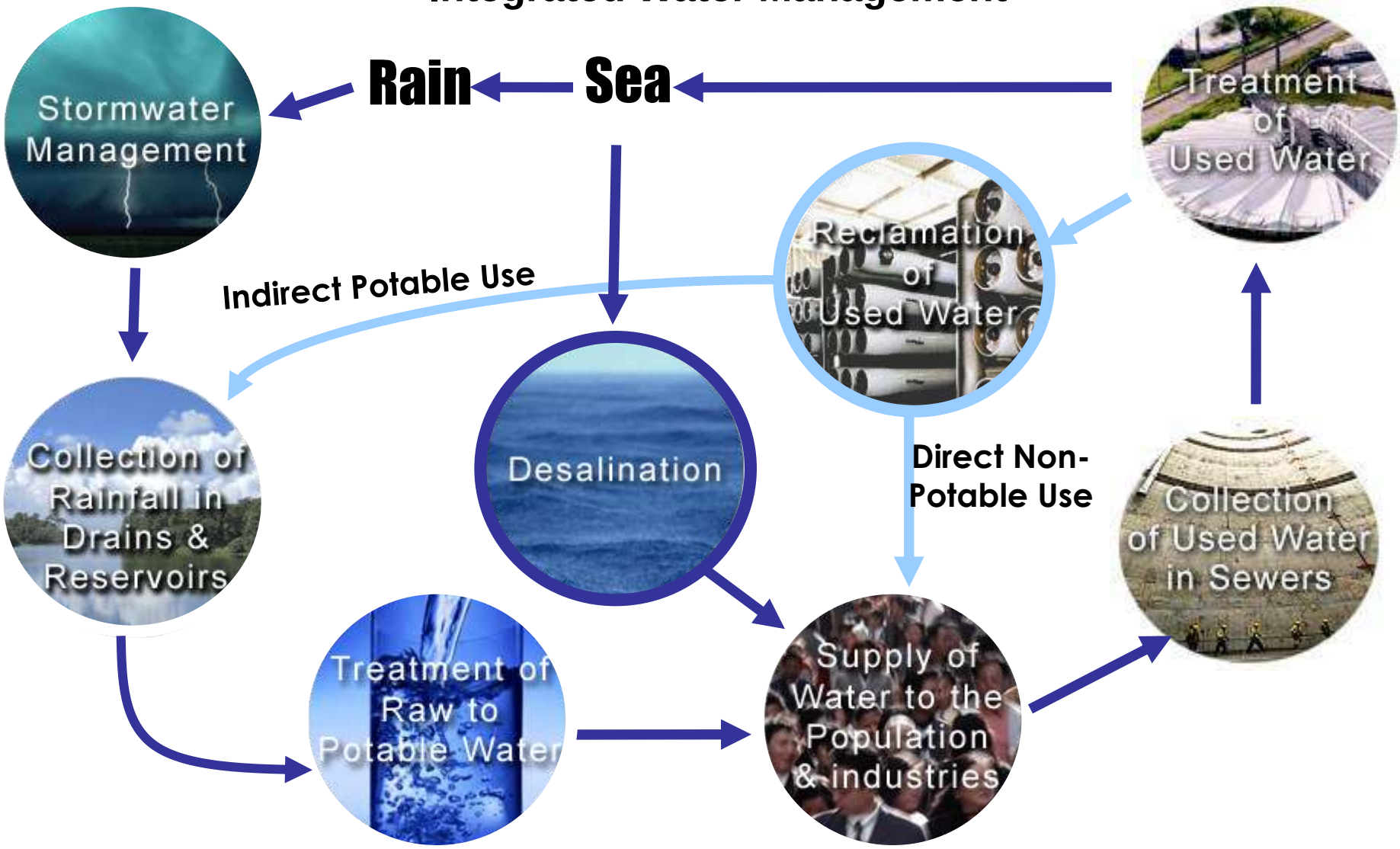
Restructured PUB in-charge of all aspects of the water loop

PUB
Water for All: Conserve, Value, Enjoy



Closing of the Water Loop

Integrated Water Management



Ensuring Water Sustainability

Diversify water supply sources

Ensure diversified sources of water supply for Singapore with the **Four National Taps**

3P Approach

Adopt a 3P approach to engage the 3P partners to use water wisely, keep the water catchments clean, and build a relationship with water

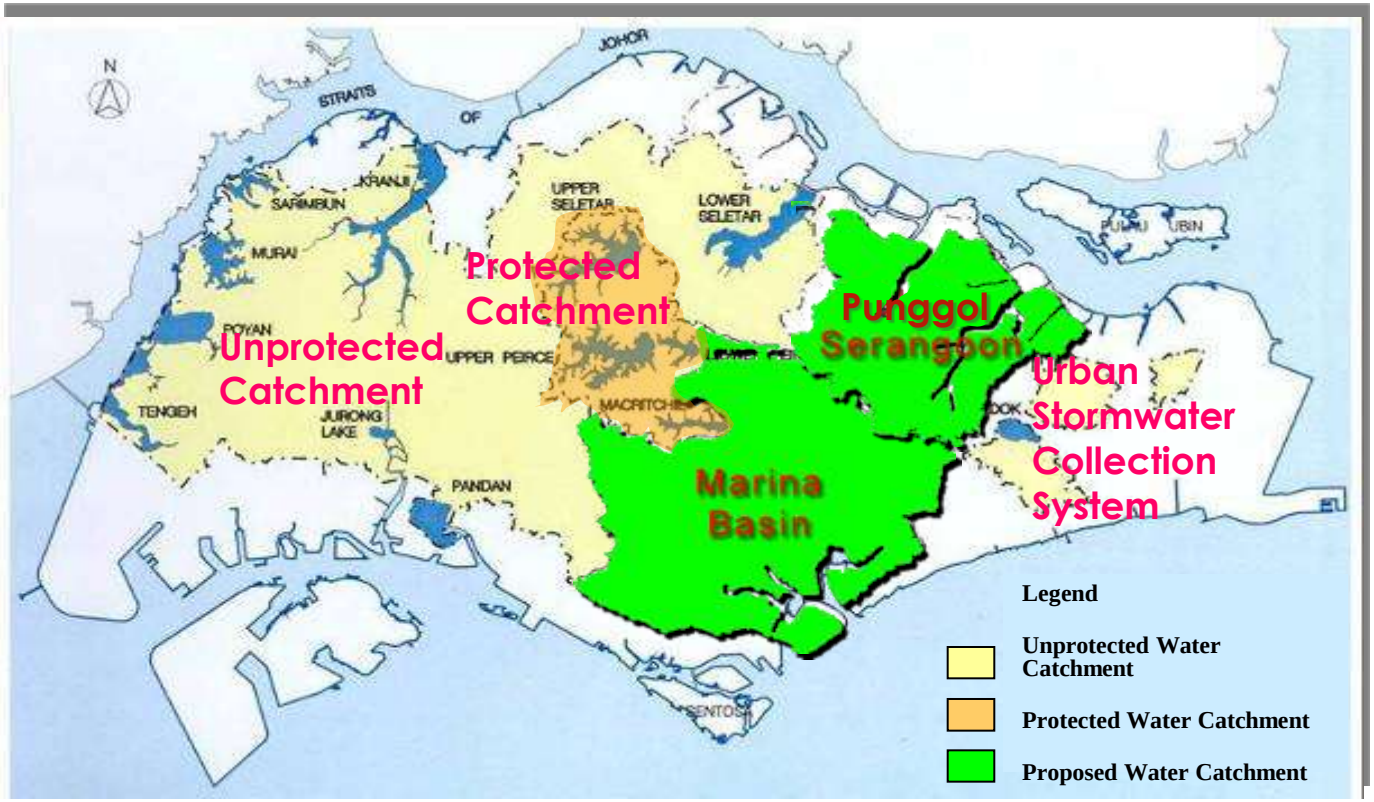
"Water for All"

"Conserve, Value, Enjoy"

FOUR NATIONAL TAPS

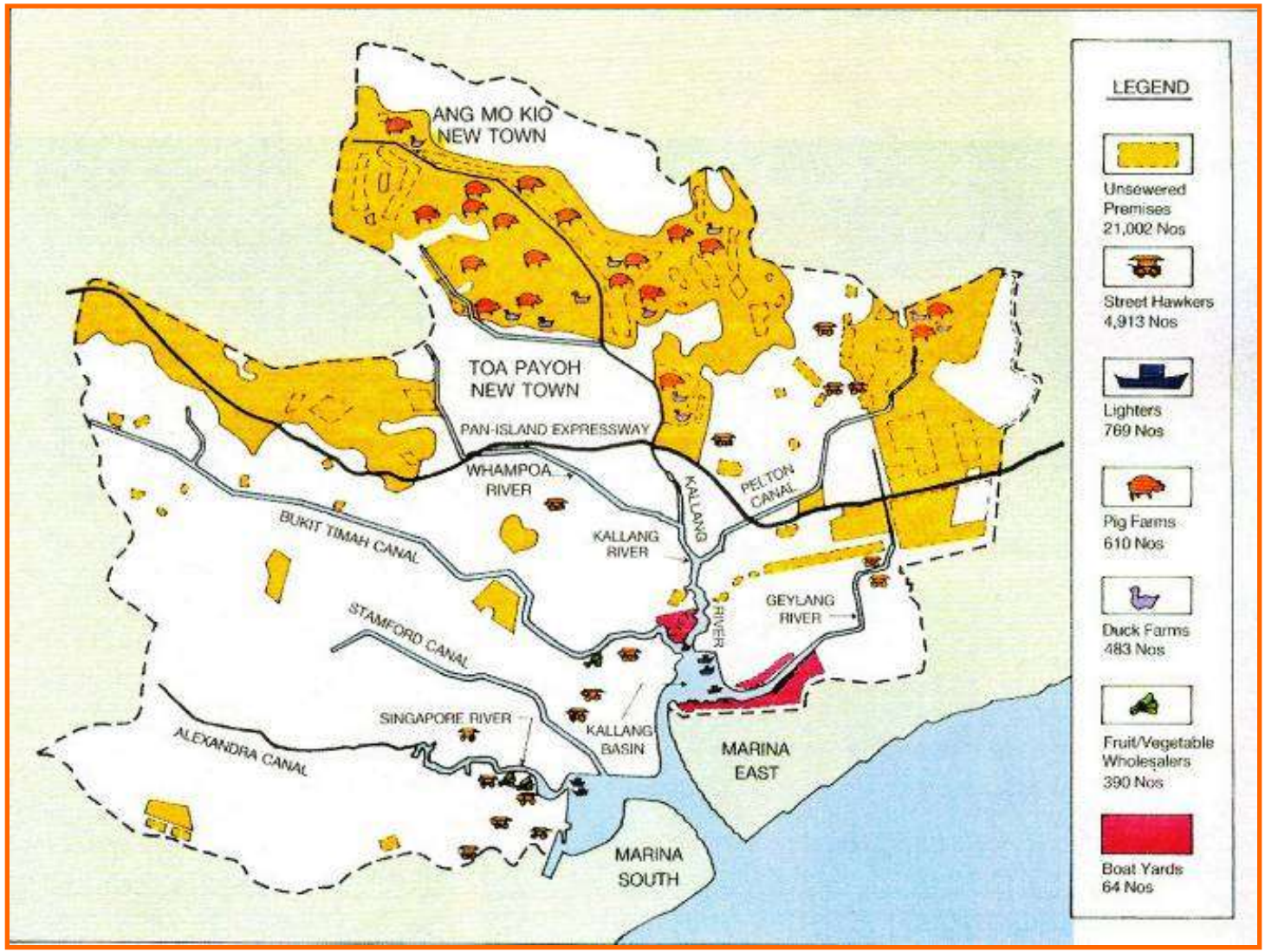
1st National Tap - Local Catchments

1st National Tap - Local Water Catchments

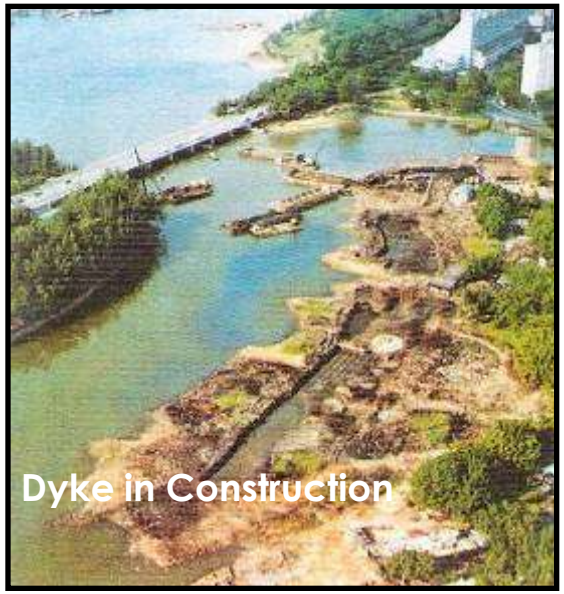


- Half of Singapore is already water catchment
- Catchment area will be increased from half to two-thirds by 2011
- Further increased to 90% in the future with Variable Salinity Plant

Sources of pollution were identified



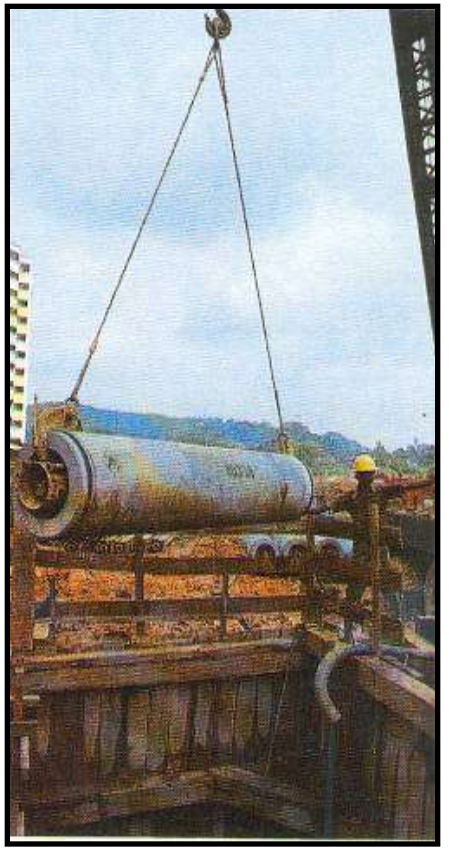
Case Study: Singapore River Clean-Up



Dredging & improvement works…

Relocation of businesses & industries

Resettlement of squatters into proper public housing…



Laying of new sewers

→ Separate rain and used water collection systems

Case Study: Singapore River Clean-Up

1970s

1990s

Case Study: Singapore River Clean-Up

Clean Rivers

3-in-1 Marina Barrage Project

1st city reservoir in the world

- Water supply
- Flood control
- Lifestyle attraction

Punggol-Serangoon Reservoir Scheme

~ First class waterfront environment and water lifestyle activities at housing new towns in the 21st century is now a possibility

Punggol Dam

Sengkang New Town

Punggol New Town

Lor Halus Wetland

Serangoon Reservoir

Pulau Serangoon

Serangoon Dam

2nd National Tap - Imported Water from Johor

Two water agreements with Johor, Malaysia

- 1961 to 2011
- 1962 to 2061

PUB pipelines carrying water from Johor

3rd National Tap – "NEWater"

- First advanced wastewater reclamation plant set-up in 1974
- Shut down in Dec 1976 after 14 months of continuous operation because of
  - High cost
  - Unreliable technology
- Re-look in 1998
  - Demonstration plant set-up in 2000 and run over 2 years to test operational robustness and reliability
  - More than 20,000 tests for some 190 water quality parameters

NEWater Process

Treated Used Water

Microfiltration

Reverse Osmosis

Ultraviolet Irradiation

NEWater

Technology was there.

We needed to gain **public acceptance**

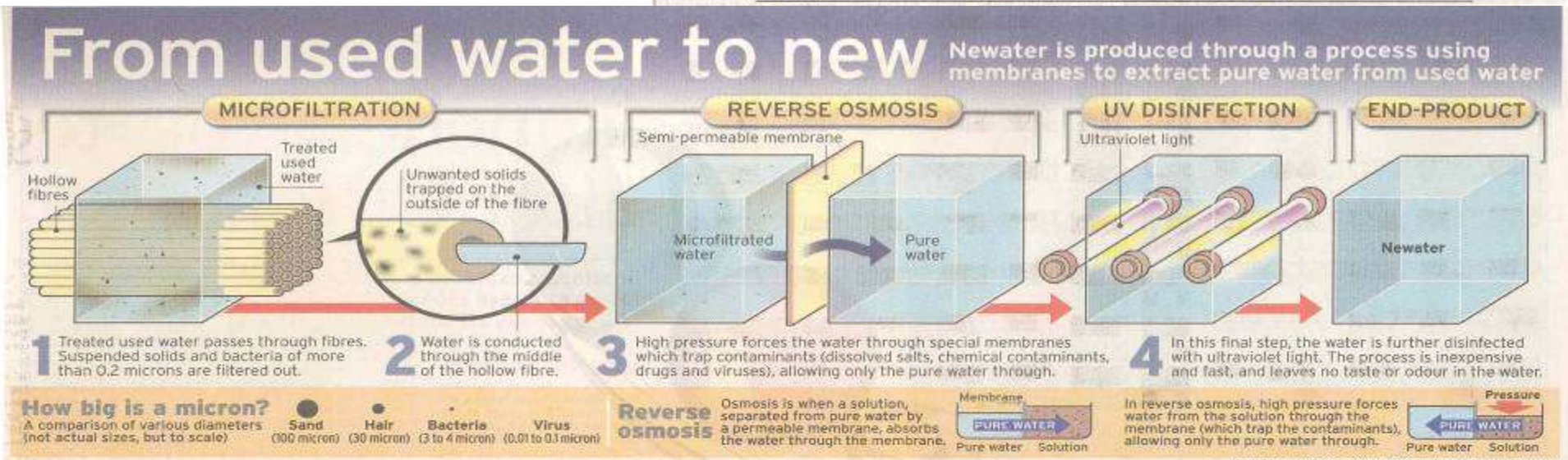
NEWater -Political Endorsement

- Launch of supply of NEWater and opening of the Visitor Centre by then Prime Minister in 2003
- Political leaders drank NEWater in major occasions

NEWater demonstration plant, 2000

HOW HWEE YOUNG/ST

Bottoms up: *Professor Ong Choon Nam (second from left), chairman of the NEWater panel and an expert on human health and toxicology, and Tan Gee Paw (second from right) leading the experts in drinking the reclaimed water*



Graphics: ANGELINA CHOY and LEE CHEE CHEW

Praise for S'pore's reclaimed water

Water reclamation plant here uses the best technology in the world, says a world-renowned water quality expert

By DOMINIC NATHAN

"Here, you have taken the best of the best and put them

Environmental Protection Agency.

All in all, 20,000 tests have been done.

A total of 191 different parameters were evaluated, from the colour of the water to detecting the presence of bacteria, viruses, hormones and

the reclaimed water with natural minerals and other beneficial compounds which are removed during the purification process.

The addition of fresh water also helps overcome the "yuck factor" in drinking reclaimed water, added Prof Rose.

PANEL: Most have no problem with taste

THE Straits Times tested Newater on 21 people and 19 said it tasted different from tap water. It is more like distilled water, because minerals and other compounds found in tap

process. Some also said the smell of chlorine, which is added early in the treatment process, reminded them of swimming pool water. All but one said they would have no problems

CHEERS! to 37 years ... and Newater

Grassroots leaders happy with Newater's quality

Most of those at PUB talks do not mind drinking reclaimed water but no date has been set yet on when homes will get it

Getting a taste of things to come. PUB staff will educate the public on Newater. A television documentary will be shown and people will also be able to visit the Newater plant in Bedok

ALMOST every grassroots and community leader who attended the educational talks on Newater in the last few weeks is convinced it is safe and clean enough to drink, said Environment Minister Lim Swee Say. [illegible]

HELPING TO KEEP PRICES DOWN

'The whole purpose of introducing Newater is to reduce the increased cost of future supply of water in Singapore... If you compare the capital cost of Newater versus desalination's, Newater costs about half that of desalination. In terms of energy consumption, it's about one-quarter to one-fifth. As a result, the total cost of Newater production is about half that of desalination. So the introduction of Newater helps prevent the need to increase the price of water in future.'

— Environment Minister Lim Swee Say [illegible]

...ains of the ... filled the ... stood, an- ... l rendition ... treated to ... sung with ... sity many ... efore. ... l were af- ... Emily ... s really ... help but ... sing." ... n every ... was one ... m the ... Table-

We'll drink to that

GEORGE GASCON

Good enough to quench the thirst

THE name may not be the cleverest or the most elegant, but NEWater represents the most significant breakthrough in Singapore's search for solutions to its long-term water needs.

of Singapore's current water consumption of 300 million gallons daily. But come 2011, the volume that comes on-stream could amount to more than 55 mgd, when two more NEWater plants, in Seletar and Ulu Pandan, come into operation.

To be sure, the reclaimed water — which, after treatment, becomes purer than tap water — will find only industrial uses for now. Still, it's a helpful start that will free up more potable sources for Singaporeans. Notably, Singapore's wafer fabrication plants — which consume copious amounts of ultra-pure water — are switching to NEWater. And if NEWater meets the mark for wafer fabs, with its exacting demands for high-grade water, surely it's more than good enough for other industries that don't have such ...

take to the idea of quenching their thirst with treated waste water. And knowing the details of the advanced filtration and sterilisation technology may not be enough. But it's really a case of mind over matter, and assurances that NEWater has been declared safe to drink by an international panel (even if the taste is a bit flat) and indeed, found to surpass the World Health Organisation's drinking-water standards, should, over time, gain ground with the public.

Surely Singaporeans — who now readily drink from the tap — don't assume that the rivers and reservoirs that currently feed Singapore's water pipes are free of virus, bacteria or other micro-organisms. And the treatment for NEWater removes organisms of up to 0.0001 micron in size (a ...

Clarity in Public Communication (NEWater)

- Good Branding
- Choice of words
  - “Used Water” vs “Wastewater”;
  - “NEWater” vs “Reclaimed Water”
  - “Water Reclamation” vs “Sewage Treatment”
- Emphasis
  - Concept is not new
  - RO technology
  - Indirect Potable Use

newater
visitor centre

- NEWater Visitor Centre is the focal point of our public education on:
  - ✓ Role of NEWater as one of the 4 national taps
  - ✓ The importance of water
  - ✓ The technology behind NEWater
- Targets mainly our younger generation (eg students)
- Opened in Feb 2003; 400,000 visitors to-date

3rd National Tap – "NEWater"

Kranji NF

Woodlands NEWater SR

Mandai SR

Seletar NF

Tampines

Jurong Hill 65 SR

Ulu Pandan NF

Bedok NF

Changi NF

Pulau

er PIPELINES

er PIPELINES

P LINES

ED NEWater SERVICE
IR AT MANDAI HILL 68

Water SERVICE RESERVOIR

EXISTING NEWater FACTORY

INDUSTRIAL WATER PIPELINES

- **NEWater Infrastructure Plan (NIP) and NIP Extension pipeline projects in progress to meet growing demand by industries**
- **NEWater to meet 30% of water needs by 2011**

NEWater - Uses

Indirect-Potable Use

- ✓ Reservoir recharge
- ✓ 41,000m^{3}/day being injected currently

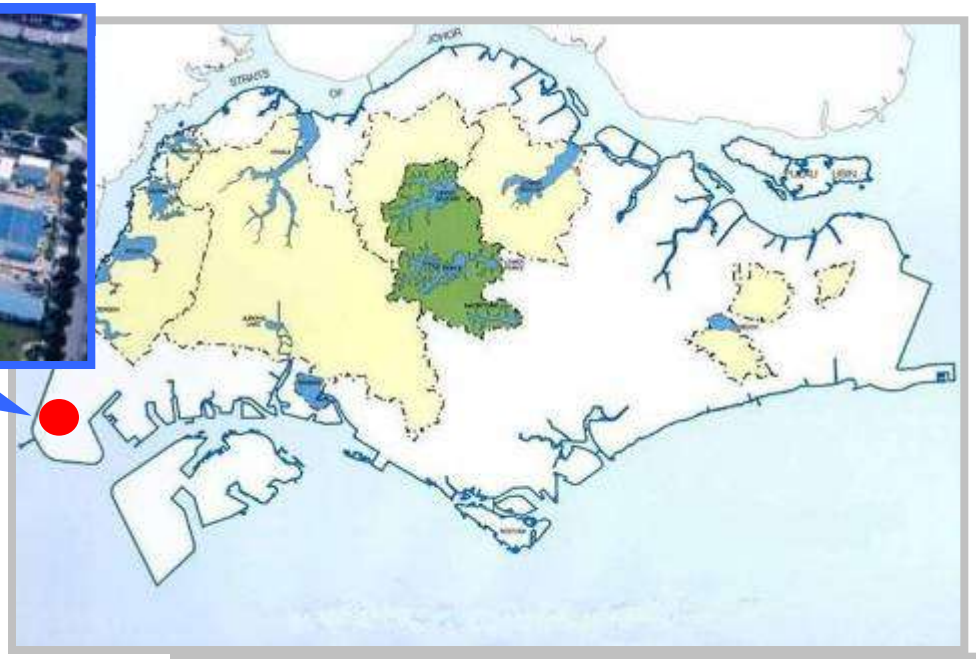
Direct Non-potable Use (154,500m^{3}/day)

- ✓ Wafer fabrication
- ✓ Power station
- ✓ Air-con cooling
- ✓ Landscaping

Used Water Collection System

- 3310km of used water pipelines island-wide
- DTSS has more than 48 km of concrete tunnel to as low as 55 metres underground. Diameter between 3.3 to 6 metres

4th National Tap - Desalinated Water



- ✓ **20-yr DBOO 30 mgd (136,000m³/day) SingSpring Desalination Plant commissioned in 2005**
- ✓ **Tender launched in 2010 new 70 mgd desalination plant**
- ✓ **Plan to have desalination capacity meet 25% and 30% of water needs by 2020 and 2060 respectively**

Public-Private Partnerships (PPPs)

- Increasing private sector participation thru' public-private partnerships (PPPs)

- Design-Build-Own-Operate (DBOO) projects
  - SingSpring Desalination Plant (1st in public sector)
  - Ulu Pandan NEWater Factory
  - Changi NEWater Factory

Ensuring Water Sustainability

Diversify water supply sources

Ensure diversified sources of water supply for Singapore with the **Four National Taps**

3P Approach

Adopt a 3P approach to engage the 3P partners to use water wisely, keep the water catchments clean, and build a relationship with water

"Water for All"

"Conserve, Value, Enjoy"

Water Conservation Strategy

Water Conservation

Water Conservation Strategy

Pricing

Reflect the strategic importance and scarcity value of water

Voluntary

3P approach

Promote ownership of water conservation

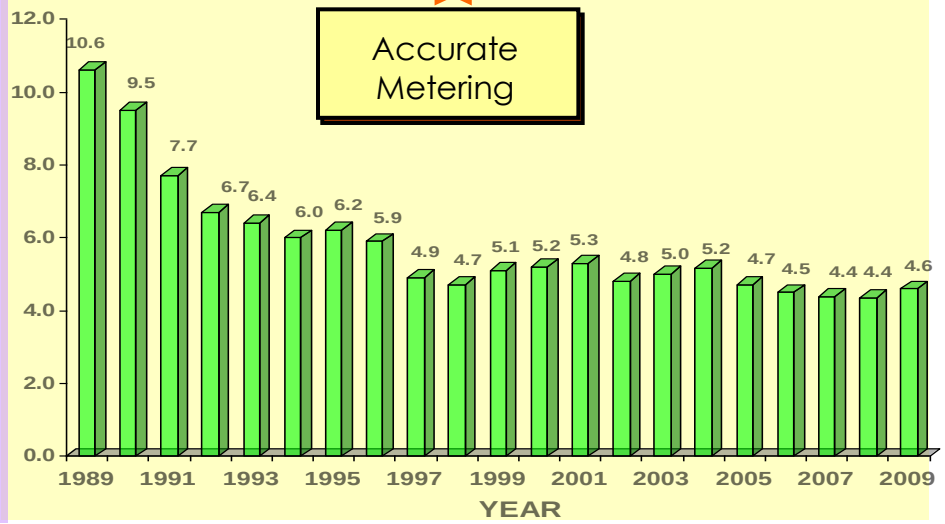
Mandatory

Cut down on excessive flow and wastage of water

UFW Control

Measures To Control UFW

- Network Management
- Strict Legislation
- Leakage Control
- Accurate Metering



Water Pricing Policy

- Restructured in 1997 based on marginal cost pricing
- Water Conservation Tax applied from the first m^3 of water consumed
- Full cost recovery

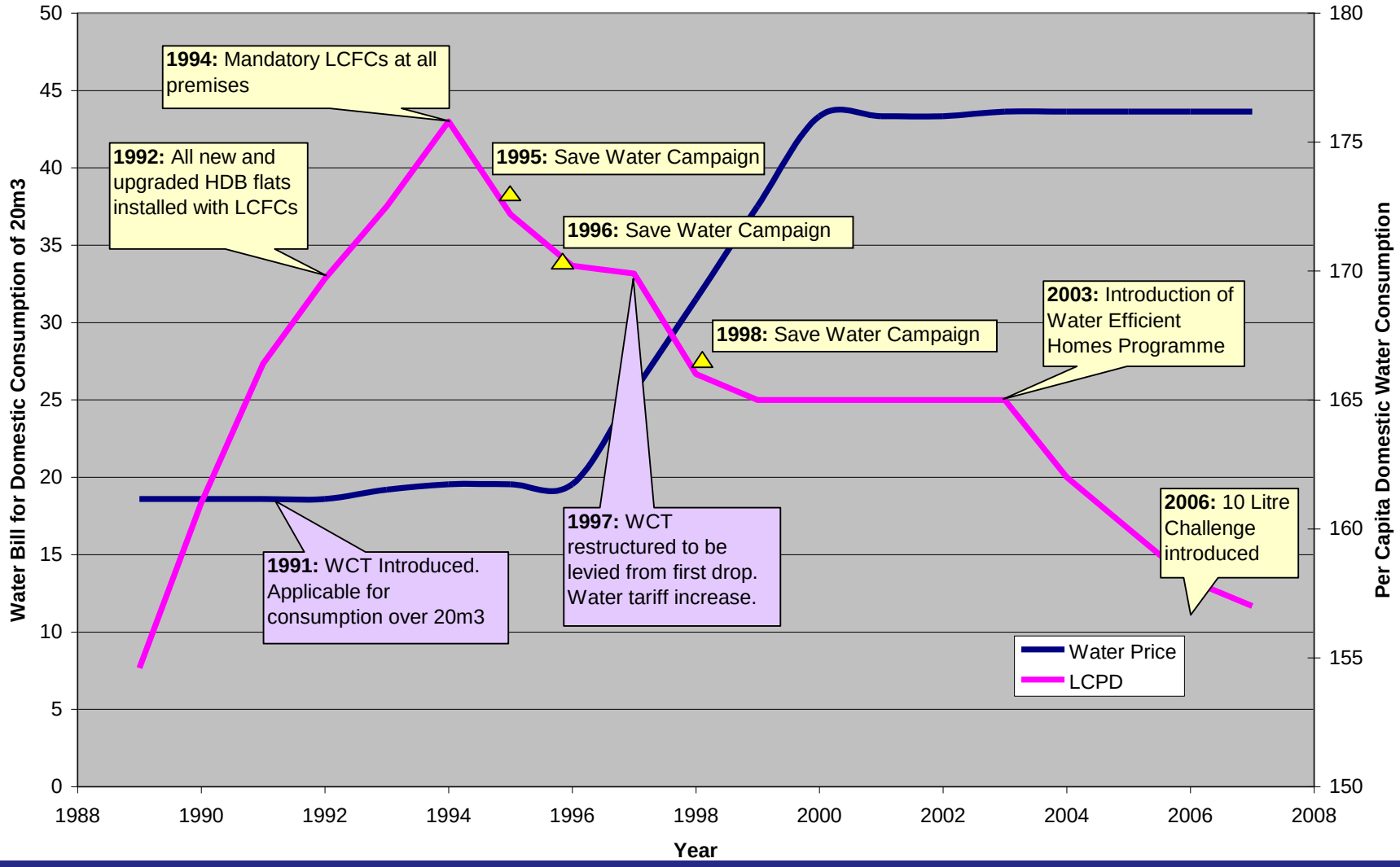
		Before 1 July 1997				W.e.f. 1 July 2000			
Tariff category	**Consumption block (m3 per mth)**	**Tariff (¢/m3)**	**WCT (%)**	**Total (¢/m3)**	**WBF (¢/m3)**	**Tariff (¢/m3)**	**WCT (%)**	**Total (¢/m3)**	**WBF (¢/m3)**
Domestic	1 to 20	56	0	56.0	10	117	30	152.1	30
	20 to 40	80	15	92.0	10	117	30	152.1	30
	Above 40	117	15	134.6	10	140	45	203.0	30
Non-domestic	All units	117	20	140.4	22	117	30	152.1	60

1: Water Conservation Tax – Tax on consumption to reinforce the water conservation message

2: Waterborne Fee – Volume-based used water fee

3: Sanitary Appliance Fee – Fixed used water fee based on the number of sanitary appliances

Water Conservation Measures & Consumption



Water Demand Management

- Sustained public education
  - Public exhibitions
  - Educating the young
- Use of water saving devices
  - Water Efficient Homes and Buildings
  - Water Efficiency Labelling Scheme (WELS)
- 10-Litre Challenge (domestic sector)
  - 147 lppd by 2020
  - 140 lppd by 2030
- 10% Challenge (non-domestic sector)

Public exhibitions

More than 500 products labelled under WELS

Pilot testing of dual flush LCFCs in HDB estates

Water Detective Programme launched in about 140 primary schools

Connecting with the Community

- Engaging the community to participate and take ownership

Friends of Water
>1200 individuals & organisations contribute towards water cause

Water Network – partnership panel to reflect 3P sectors' views & suggestions

Our Waters Programme
49 adopters to help take care of waters

Water Volunteer Groups
61 groups formed in various constituencies

ABC Waters - Public Awareness

Engaging the Community

Our Waters Programme

- Community adoption programme for waterways

Recreational Activities in Reservoirs

- Wakeboard World Cup
- Queen's Baton Race
- Kayaking, Dragon-boating, Canoeing

Active Beautiful Clean (ABC) Waters Programme

Long-term strategic initiative

- To transform our utilitarian drains, canals and reservoirs into vibrant, aesthetically pleasing and clean flowing streams, rivers and lakes

- To bring people closer to the water so that they will cherish and take ownership

- To create a seamless blue-green network well integrated with the adjacent

"…Turn Singapore into a City of Gardens and Water"
– PM Lee, ABC Waters Public Exhibition - Feb 2007

Project Implementation

- 3 completed pilot projects with more activities and good community support

ABC Waters @ Kolam Ayer ABC Waterfront

ABC Waters @ Bedok Reservoir

ABC Waters @ MacRitchie Reservoir

Ongoing ABC Waters Projects

- 12 ABC Waters projects under construction

Sungei Punggol - Sengkang Floating Wetland

- **Features**
  - Floating Wetland
  - Fruit themed pavilions
  - Viewing Gallery

ABC Waters Projects – under construction

Lower Seletar Reservoir (Family & Rowers' Bay)

- **Features**
  - Performance stage
  - Heritage bridge
  - Rain Garden
  - Viewing deck

ABC Waters Projects – under construction

Alexandra Canal

- **Features**
  - Constructed Wetlands
  - Canal edge plantings
  - Community plaza

ABC Waters Projects – under construction

Jurong Lake

- **Features**
  - Geyser
  - Boardwalk
  - Wetlands
  - Viewing Plaza

ABC Waters Projects – under construction

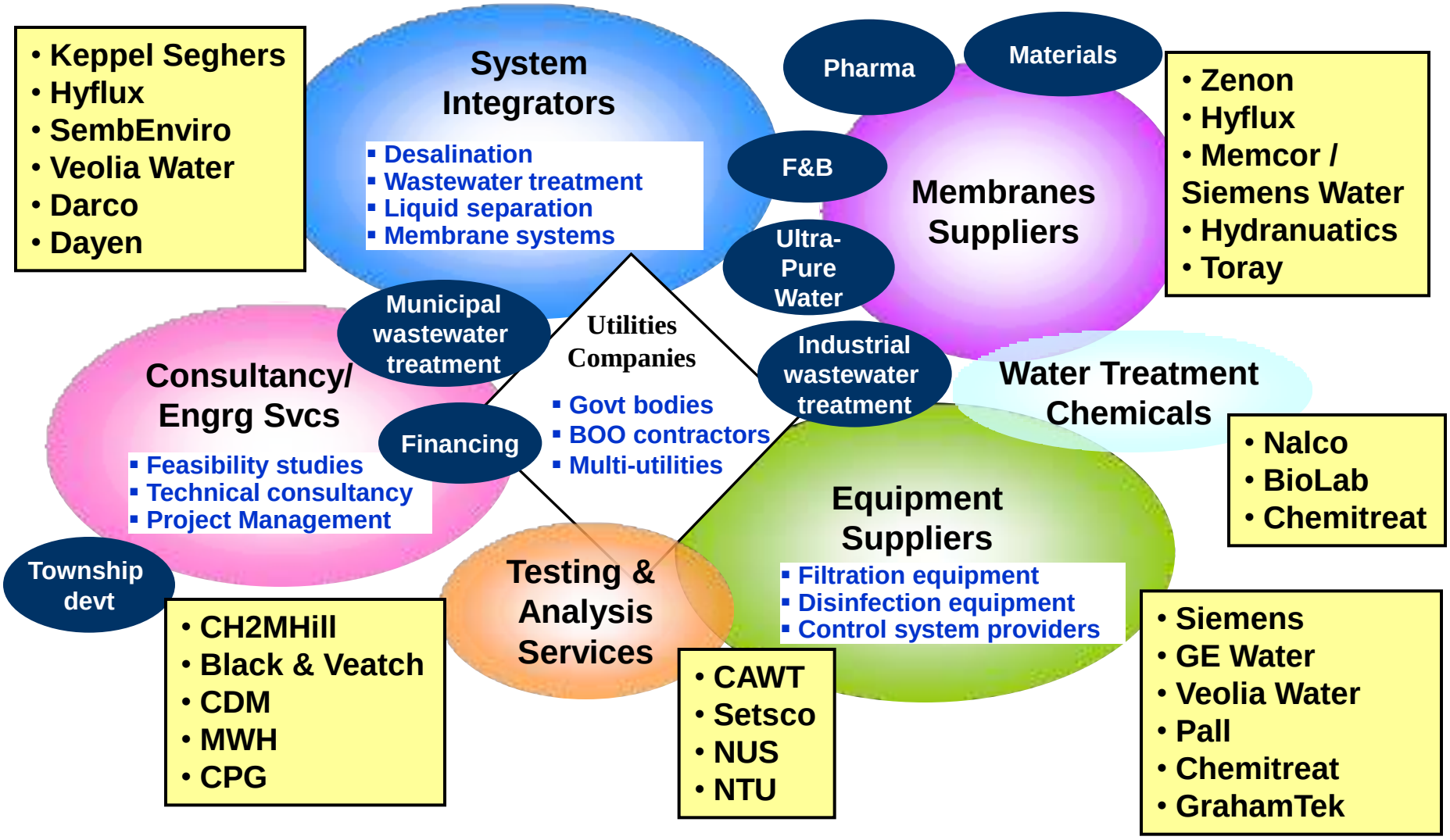
Kallang River – Bishan Park

- Features
  - Cleansing biotopes
  - Amphitheatre
  - Water playground
  - Alfresco dining by the river
  - Water cascade

Artist Impression of other ongoing ABC Waters projects

Growing the Water Industry

~ *Companies throughout the water value chain*



Singapore International Water Week

4 - 8 July 2011

Sustainable Water Solutions for a Changing Urban Environment

- The **global platform for water solutions**
- Brings together **policymakers, industry leaders, experts and practitioners**
- Address challenges, showcase technologies, discover opportunities & celebrate achievements
- **Key highlights** include **Lee Kuan Yew Water Prize, Water Leaders Summit (by invitation only), Water Convention, Water Expo & Business Forums**

Year	No. of attendees	No. of countries participated	Value of deals, tenders & investments announced	No. of co-located events	No. of participating companies in Water Expo
2008	8,500	79	S$380m	42	350
2009	10,000	82	S$2.2b	76	420
2010	14,000	112	S$2.8b	120	514

Thank you




SINGAPORE QUALITY AWARD for business excellence 2006 WINNER

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