

MALAYSIA WATER RESOURCES MANAGEMENT FORUM 2012  
26–27 November 2012

# **WATER RELATED RESEARCH & INNOVATION – ISSUES AND CHALLENGES**

**Ir. Haji Ahmad Jamalluddin B. Shaaban**  
**Director General**

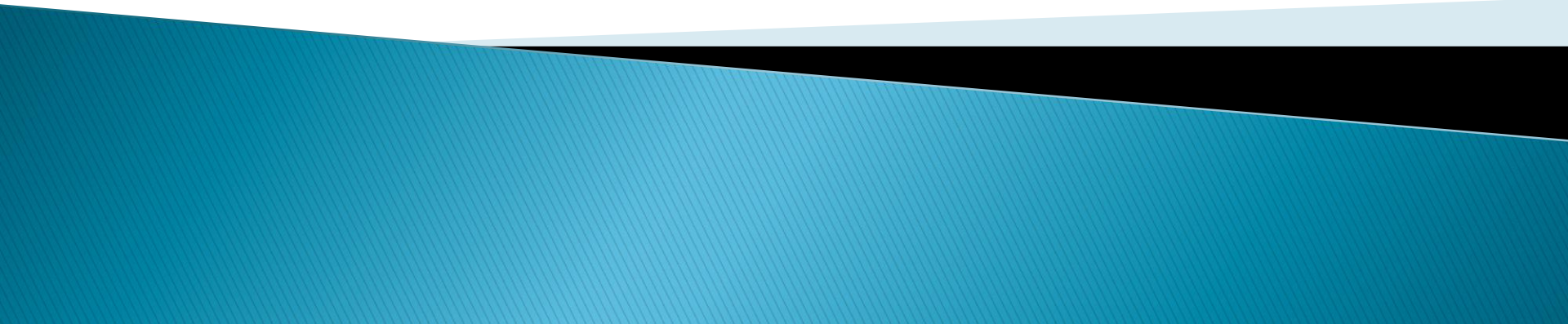
**National Hydraulic Research Institute Of Malaysia (NAHRIM)**  
**Ministry Of Natural Resources And Environment (NRE)**



# Outline

- **Water Issues**
- **Current Research & Way Forward**
  - **River**
  - **Coastal**
  - **Groundwater**
  - **Lake**
  - **Climate Change & Adaptation**

# Water Issues



**.....understanding the issues, impacts  
and consequences .....**

**water excesses, water shortages,  
water pollution**

**“water” AND “climate change”**

## ....water excesses...

- 60% of the annual rainfall occurs in November to January period
- Riverine and coastal areas experience widespread flooding
- 9% of the country is flood-prone



**Flooding in Kuala Lumpur (7 March 2012 - 235mm)**



**Flooding in Hulu Langat (7 March 2012)**



**Flooding in Kajang (2 Dec 2011)**

# ....water shortages....

- The seasonal distribution and spatial variation of rainfall have resulted in several regions of the country facing water stress-related problems
- This is particularly severe in the smaller states and those that have been extensively deforested, such as **Melaka**, **Perlis**, and **Pulau Pinang**
- Extended periods of droughts cause water supply to fall short of water demand in states supporting large-scale irrigation for rice cultivation such as Perlis and Kedah



# Water Quantity Flood / Drought



Seorang remaja di Rancangan Tanah Bella Kampung Bukit Changgang, Sepang **meredah banjir** dengan basikal.



Anggota Jabatan Pertahanan Awam Malaysia **mengangkut penduduk yang terabit banjir** di Rancangan Tanah Bella Kampung Bukit Changgang, Sepang, semalam. (FOTO FATIHZ ISWADI ISMAIL/BIH)

## Sungai Langat paras bahaya

» **Penduduk kawasan dilanda banjir dinasihat berjaga-jaga**

Oleh **Shaarani Ismail**  
bhnews@bharian.com.my

► **Kuala Lumpur**

**P**aras air Sungai Langat di Bukit Changgang, Selangor melebihi paras bahaya 4.39 meter petang semalam, menurut portal Jabatan Pengairan dan Saliran (JPS).

Portal itu juga melaporkan paras air di Sungai Selangor, Kuala Badong pula naik dan melebihi aras amaran 3.83 meter, manakala di Pahang, air di Empangan Rempas, Bentong naik sehingga 113.67 meter melebihi aras amaran.

Sehubungan itu, penduduk di sekitar kawasan terabit dinasihat agar berjaga-jaga.

Menurut portal banjir Majlis Keselamatan Negara (MKN), jum-

lah mangsa banjir di Selangor ialah 1,703 (1,280 di Kuala Langat, Sepang 423), Melaka (90 orang) dan Johor (141 orang).

**1,793 penduduk dipindah**

Di Dengkil, seramai 1,793 penduduk dipindahkan ke beberapa pusat pemindahan banjir sekitar Kuala Langat dan Sepang, berikutan paras air yang naik sehingga paras 0.5 meter selepas

hujan lebat kelmarin.

Antara yang terjejas adalah RTB Bukit Changgang memabitkan 719 mangsa yang ditempatkan di Sekolah Kebangsaan RTB Bukit Changgang, manakala tiga lagi di Genting Sanyen memabitkan 56 mangsa, Dewan Orang Ramai Kampung Bukit Chenggang, 29 mangsa dan Dewan Bukit Tandum memabitkan 86 mangsa.

Pegawai bertugas di Pusat Kawalan Bomba Kuala Langat, Mohd Norfaridly Marshar Sharip, berkata hanya RTB Bukit Changgang menerima peningkatan mangsa banjir berbanding kelmarin berikutan paras air yang naik agak mendadak.

myMetro **Setempat**

### Kajang banjir besar!

Oleh Kalidevi Mogan Kumarappa dan Naimah Mohamed  
am@hmetro.com.my

✉ 🖨 📧 ⚙ A+ A- 🗨

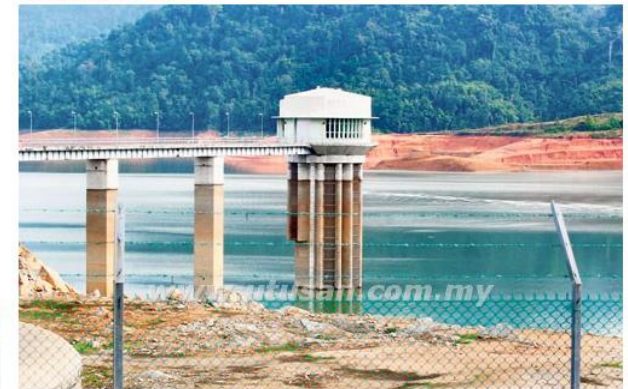


DAM...parkir pusat beli-belah dilanda banjir menyebabkan banyak kenderaan tenggelam.

ARKIB : 06/10/2012

### Air Empangan Sg. Selangor susut

Oleh MD. AZRIN ROSLY  
pengarang@utusan.com.my



**HULU SELANGOR 5 Okt.** - Operasi Loji Rawatan Air Rasa dan Bukit Badong di sini dikuatirinya terjejas ekoran penyusutan paras air di Empangan Sungai Selangor yang turut membekalkan air mentah ke loji berkenaan sejak Mei lalu.

Kedua-dua loji berkenaan membekalkan sebanyak 60 peratus air yang telah diproses bagi keperluan penduduk Lembah Klang iaitu Shah Alam, Klang, Petaling Jaya dan Kuala Lumpur serta 40 peratus kepada penduduk di kawasan Rawang.

# Water Quality Pollution



FRIDAY, OCTOBER 12, 2012

12 Oct 2012

## Expert: Selangor rivers under threat

**KUALA LUMPUR:** Most rivers in Selangor, which are the main sources of water supply in the state, have been found to be polluted and could become a serious threat if not managed properly, a scientist warned yesterday.

Universiti Putra Malaysia Environmental Forensics Research Centre unit head Dr Hafizan Juahir said sections of rivers with clean water were getting shorter because of high land utilisation activities, especially for housing development.

As an example, he said, the length

Hafizan said the latest data obtained by his students on Sungai Langat's condition was presented three days ago.

He said in Hulu Langat district, the situation was getting serious and threatening to the river because there was too much development, especially the building of condominiums and shophouses.

The population increase had also affected the water quality because more washing and domestic waste were dumped into the river.

When asked on the Selangor government's water policy, which em-

22 NATION The Star, FRIDAY 12 OCTOBER 2012

12 Oct 2012

## 'Selangor rivers polluted'

### Scientist worried urbanisation threatening state's main water supply

**KUALA LUMPUR:** Most rivers in Selangor which are the main sources of water supply in the state have been found to be polluted and could potentially become a serious threat to the availability of this basic necessity.

Universiti Putra Malaysia Environmental Forensics Research Centre unit head Dr Hafizan Juahir said the clean water sections of the rivers were getting shorter due to development, especially for housing.

For example, he said, the length of Sungai Langat, the leading source of raw water in the state, was 149.3km-long but the clean water section had been reduced to only 49.3km while the remaining were polluted.

"The entire length of Sungai Langat has entered the Class 3 and 4 categories of being polluted and if the quality worsens, it can be considered a dead river," he said.

He said that in the Hulu Langat district, the situation was more serious as there was too much development especially condominiums, shop houses while population increase had also negatively impacted water quality through washing and domestic waste dumping in the river.

"I am a scientist and a researcher. I speak based on facts of water quality. I see the details of every parameter of water quality or water quality trend index. There is very little clean water left," he added.

Dr Hafizan said many people were confused about the sources of water and that because the country had frequent rain to fill dams, they believed Malaysia need not worry about its sources of water.

"The dams can only hold water for treatment before we supply it to the consumers. But we should examine closely where is the water from? The source of waste is from the river.

"If we only hope for rain, it won't be sufficient to meet the increasing demand of urbanisation. It is inevitable that demand for clean water will keep increasing," he said.

Dr Hafizan said as pollution worsened, the cost of treating water would become more expensive and

this would raise the question of whether the Government could continue providing subsidy.

On the Selangor Government's water policy which emphasised restructuring the water industry rather than overcoming problems such as pollution of water sources and the lack of treated water capacity, Dr Hafizan said: "Without taking into consideration how to control water source pollution, increasing plant capacity and clean water, restructuring would not amount to anything."

He also expressed support for the plan to source water from Sungai Pahang for Selangor, especially since water from Sungai Pahang was not as polluted as rivers in Selangor.



## ....water pollution..

- Rivers and waterways - point and non- point sources of pollution
- Wastes dumped in the Klang Valley into rivers - 60 tons/day
- 90 lakes and reservoirs are 'entropic' as a result of nitrates and phosphates (from fertilisers and pesticides)



### Polluters

- Cities/industries
- Agricultural/live stock activities
- Land clearance

### Impacts on:

- water supply services
- human health
- aquatic ecosystems

# Earthworks, Land Clearing and Sand Mining

10 **NASIONAL** Selasa 29 Mei 2012 **BERITA HARIAN**



IMEJ menunjukkan kegiatan curi pasir di Sungai Kembong Hulu berhampiran PLKN Kem Millenium, Kampung Kuala Pajam di Semenyih, semalam.

## Kawasan tadahan air jadi lokasi curi pasir



JENTERA pengaut sibus memungkah pasir di lokasi.

Sungai Kembong Hulu bakal terjejas

Oleh Sarah Sulaiman sarahsulaiman@bharian.com.my

**S**EMENYIH: Masalah bekalan air Selangor diburukkan lagi apabila satu kawasan tadahan air di Sungai Kembong Hulu, dekat sini, dikesan menjadi lokasi kegiatan curi pasir didakwa sejak sebulan lalu.

Tinjauan *Berita Harian* mendapati, kawasan seluas lima hektar itu diceroboh pihak tidak bertanggungjawab secara berleluasa apabila terdapat dua jentera pengaut pasir sibus memungkah pasir masuk ke dalam beberapa lori yang siap sedia menanti untuk dibekalkan kepada pembeli.

Tidak cukup dengan itu, jentera penyembur yang digunakan untuk mengasingkan pasir daripada tanah turut beroperasi aktif dengan dipantau pekerjajanya yang seolah-olah kebal daripada dikenakan tindakan undang-undang.

Lokasi yang berdekatan Pusat Latihan Khidmat Negara (PLKN) Kem Millenium, Kampung Kuala Pajam yang terletak enam kilometer dari pekan Beranang, pemilik kegiatan terbabit bertindak berani apabila



Setiap hari puluhan lori keluar masuk membawa muatan pasir yang siap ducuci melalui lorong tikus yang hanya boleh dilalui kenderaan berat berkitaran keadaan jalan berlopek dan tidak selamat dimasuki kenderaan ringan

Sumber

menyedak mesin penyedut pasir dikenali sebagai mesin pialan dipercayai bagi menyedut pasir hingga mewujudkan kawah besar di sekitarnya.

Sumber berkata, kegiatan itu menjejaskan kualiti air Sungai Kembong Hulu hingga membimbangkan penduduk sekitar berikutan keadaan air tercemar menjadi penyumbang kepada masalah bekalan air di Lembah Klang.

"Kawasan tadahan air itu seharusnya terpelihara daripada kegiatan curi pasir dan sepatutnya pihak berwajib mempunyai unit khas membendung kegiatan ini sebelum keadaan sungai bertambah berke- lodak dengan kesan sisa kotoran air mencuci pasir yang dilakukan mereka," katanya ketika ditemui *Berita Harian* di lokasi kegiatan terbabit, semalam.

*Berita Harian* yang memasuki lokasi terbabit kira-kira jam 11 pagi semalam mendapati terdapat empat lori sedang menunggu giliran diisi pasir dan terdapat beberapa kenderaan pacuan empat roda diletak-

kan di pintu masuk laluan dipercayai tonton upahan yang menjaga kawasan berkenaan.

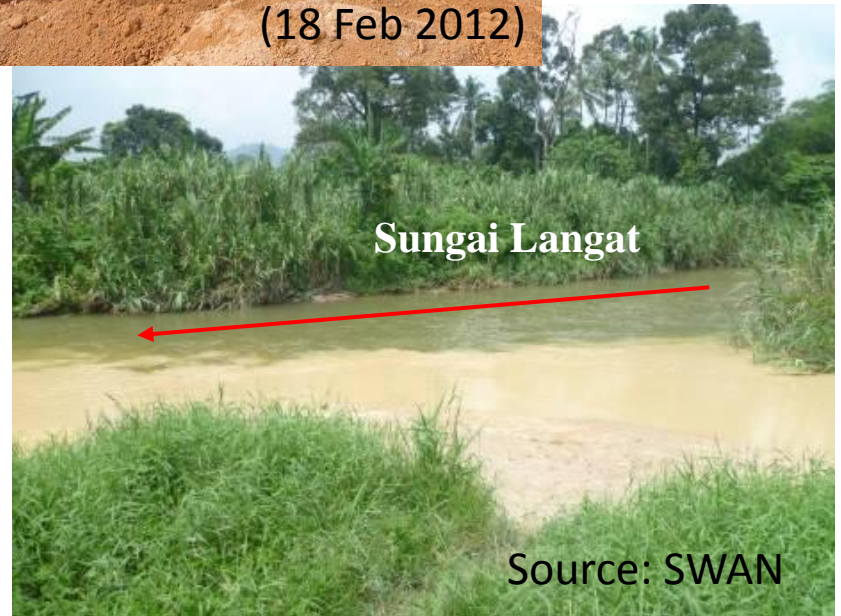
Beberapa pekerja sibus menyusun paip air bagi mesin penyedut pasir, manakala pemandu lori pula keluar daripada kenderaan masing-masing dan berpura-pura memeriksa keadaan lori selepas menyedari kehadiran wakil akhbar ini.

Difahamkan, setiap hari puluhan lori keluar masuk membawa muatan pasir yang siap ducuci melalui lorong tikus yang hanya boleh dilalui kenderaan berat berkitaran keadaan jalan berlopek dan tidak selamat dimasuki kenderaan ringan sebelum ke laluan utama sejauh enam kilometer menuju ke Bandar Mahkota Nilai.

Sumber berkata, ratusan tan pasir sungai dikorek serta dibersihkan hingga menjadi punca sungai di kawasan tadahan air di situ tercemar teruk dan berkelodak, sekaligus menyumbang kepada masalah kemusnahan sumber alam dan bekalan air kepada penduduk sekitar.



(18 Feb 2012)



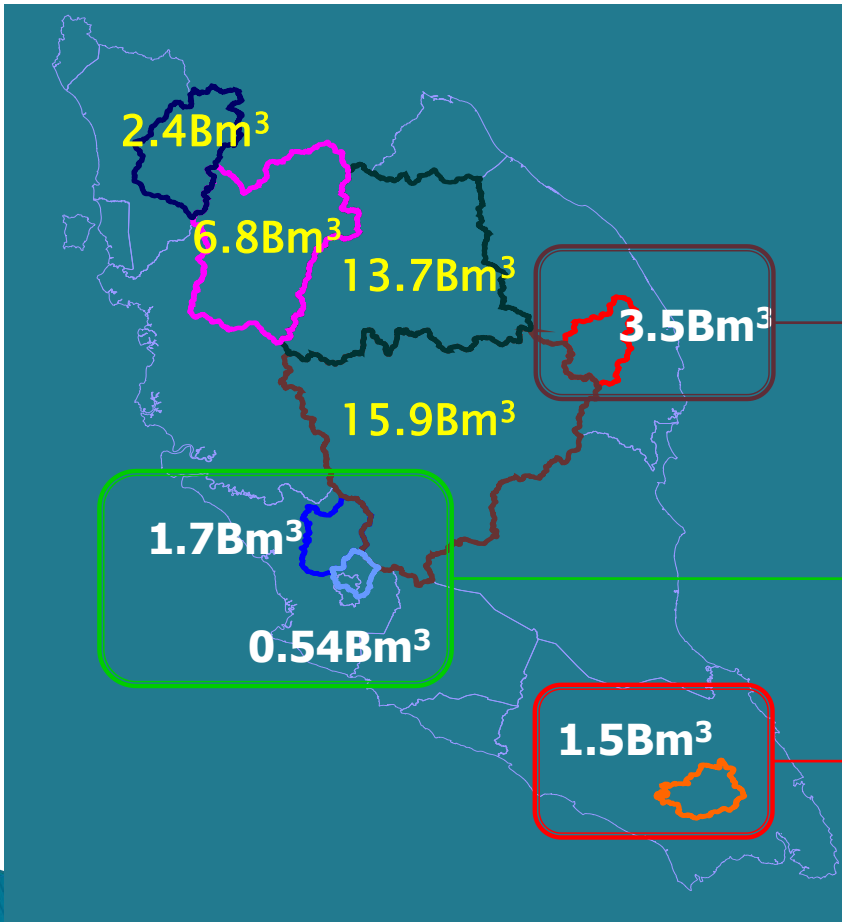
Sungai Langat

Source: SWAN

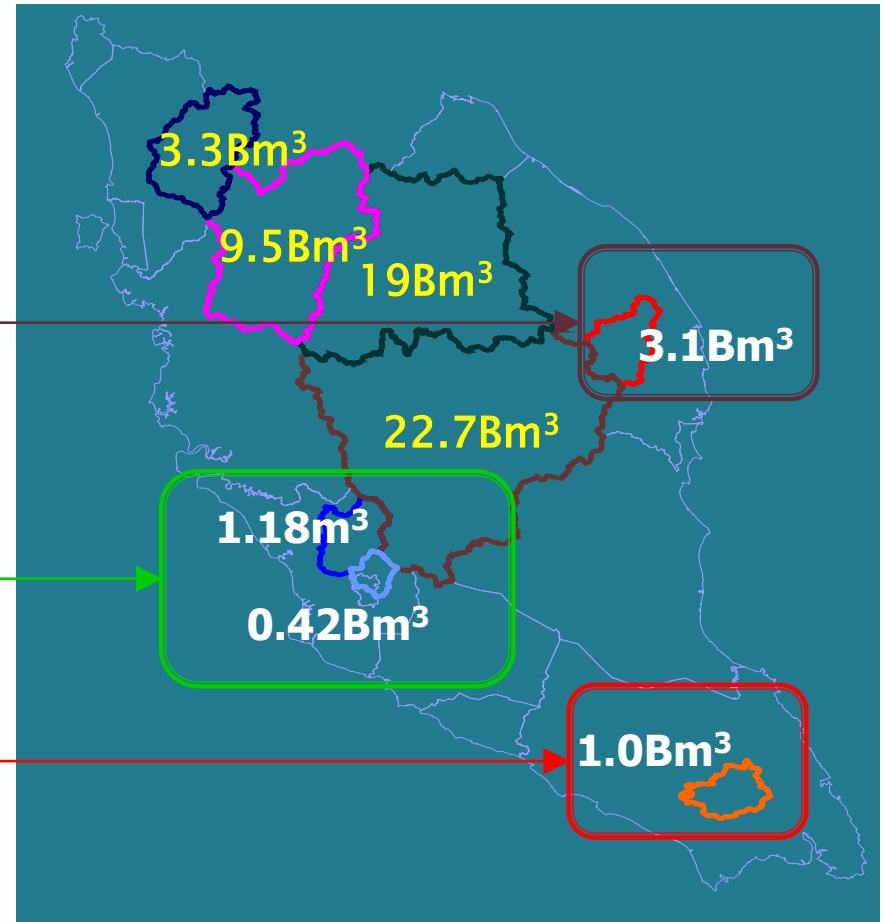
(27 May 2012)

# ....water & climate change...

**40-y runoff volumes of selected drainage system**



**future runoff volumes of selected drainage system**



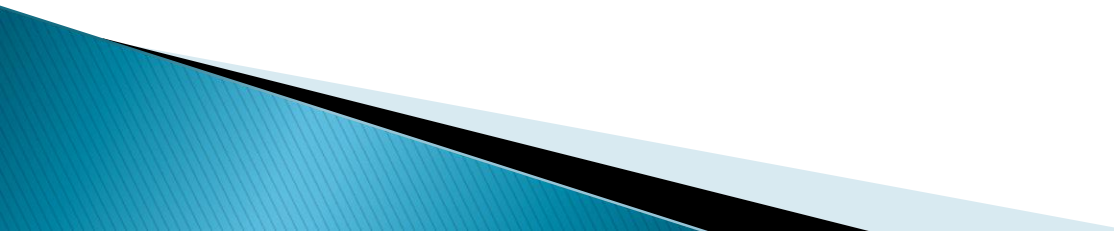
# Current River Research



# INTRODUCTION

- Rivers provide 97% of all the water used in Malaysia
- Important functions to people:
  - Flora and Fauna
  - Recreation
  - Transportation
  - Source of food and income
  - Religion

# Challenges

- ▶ Climate change
  - ▶ Urbanization
  - ▶ Floodplain management
  - ▶ Increase of water demand
- 

# River Research Projects

1. Urban Stormwater Drainage System Study (Kota Damansara, Selangor)
2. Flood Hazard Map for Sg. Johor
3. Segamat River Flood Modelling Using Infoworks RS
4. Real Time Flood Forecasting for Sg Melaka, Langkawi using infoworks Floodworks
5. Flood Hazard Mapping Using Two-Dimensional River Modelling for Sungai Muar, Johor

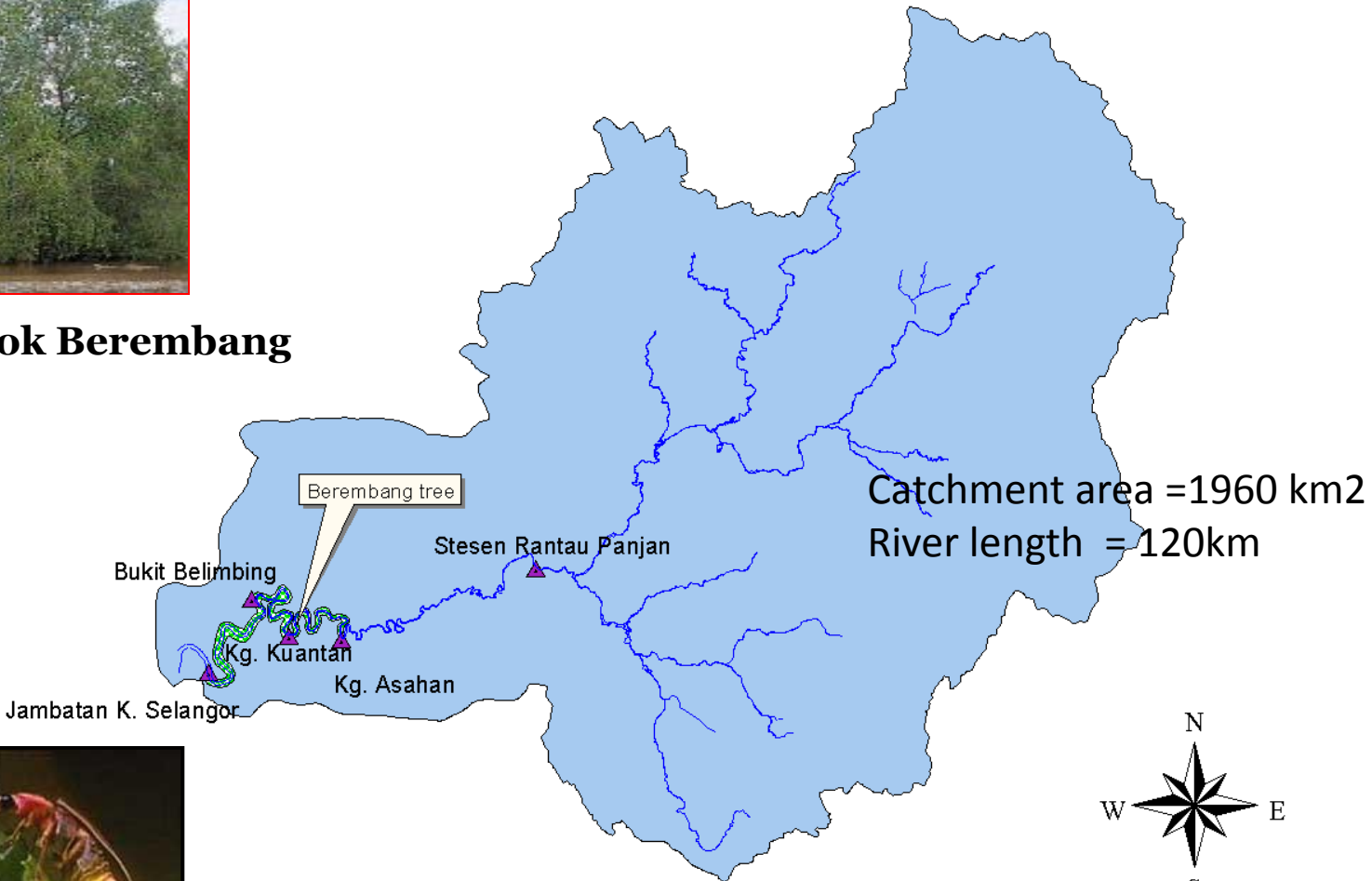
# R&D by NAHRIM

## Saline water intrusion

Sg. Selangor basin



**Pokok Berembang**



**Kelip-kelip**

Image: European Physical Society

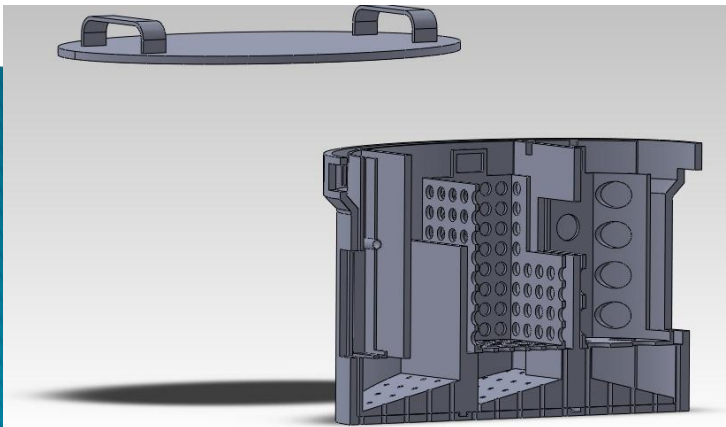


# Outcomes

1. Provide useful information to the relevant agencies in terms of managing the quantity and quality of river in Malaysia.
2. Supported the strategies towards IRBM & IWRM through R & D

# INNOVATION OF HYDRAULIC PRODUCT SMART DRAINAGE TRAP (SMADRAT)

- An innovation product of NAHRIM, SMADRAT designed as a device separator capable of trapping rubbish, sediment and oil & grease
- Installed (in line) for urban drainage system
- Provided with emergency spillway
- Allows infiltration and recharging groundwater
- Can be easily maintained
- Strong, durable and has a long life span
- Cost effective



BRITISH INVENTION SHOW 2012,  
LONDON



Double Gold for Innovation in  
Environmental Engineering



Gold Medal for Excellent in Industrial  
Category

# Current Coastal Research



# SEA LEVEL RISE (SLR)

In 2010, NAHRIM carried out “The Study of the Impact of Climate Change on Sea Level Rise on Malaysia Coastlines”

- To produce a few projections of SLR for 21<sup>st</sup> century (2010 to 2100)
  - Using: tide gauge data (25 years); satellite altimetry data (17 years); and GCM Projections.
  
- Methodology
  - Linear Trend Analysis on: tide gauge data and satellite altimetry data.
  
- Assimilation of mean projection of SLR with:
  - 49 simulations of 7 AOGCM models
  - at satellite altimetry locations along Malaysian coastlines

# SEA LEVEL RISE (SLR)

## Study Results

Source: NAHRIM 2010

### Sea Level Rise Rate (mm/y)

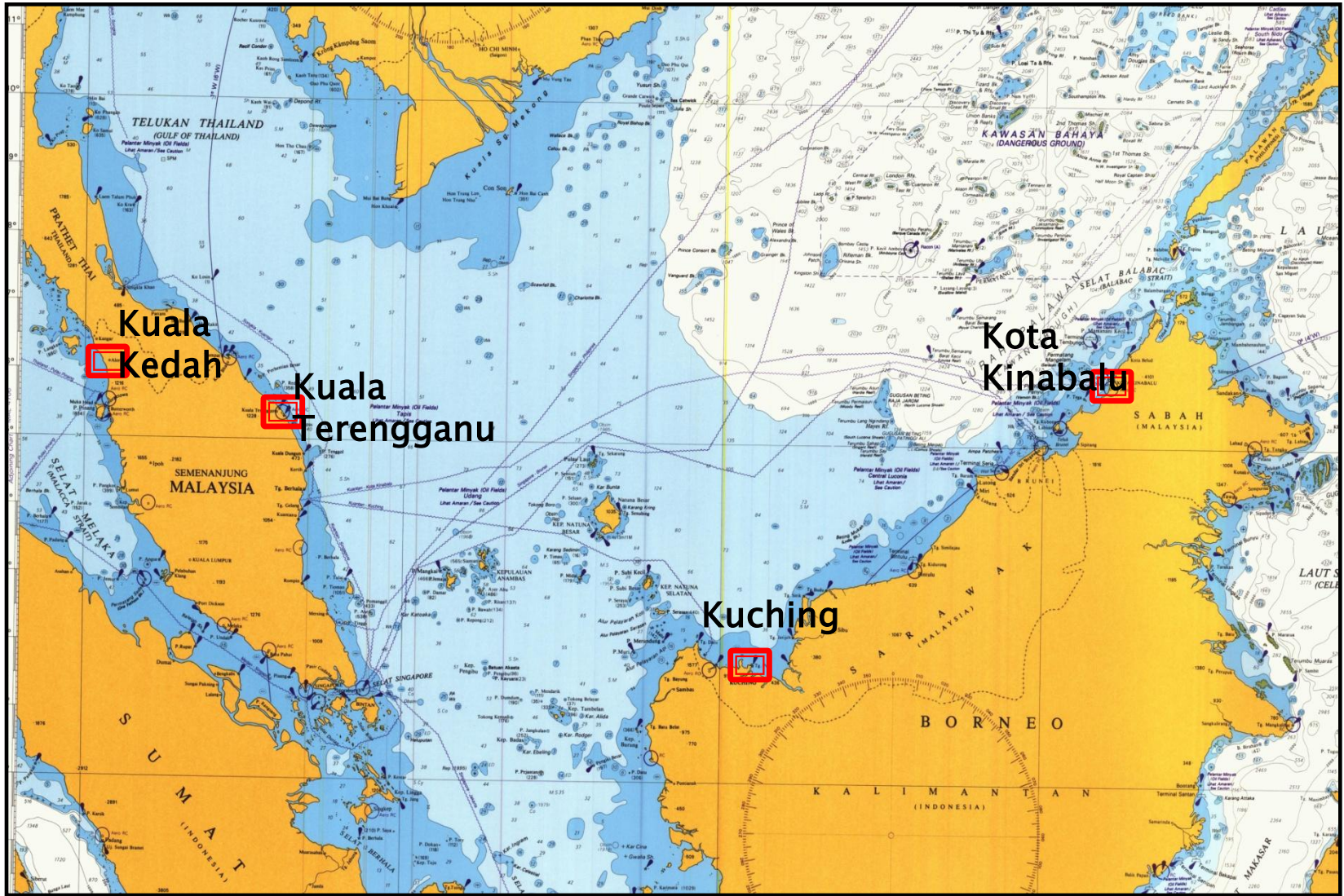
	Malaysia	Global
Tide gauge	0.2 – 4.4	1.2 – 2.2 *
Satellite Altimetry	2.73 – 7.0	2.4 – 3.8 *

\* IPCC (AR4  
2007)

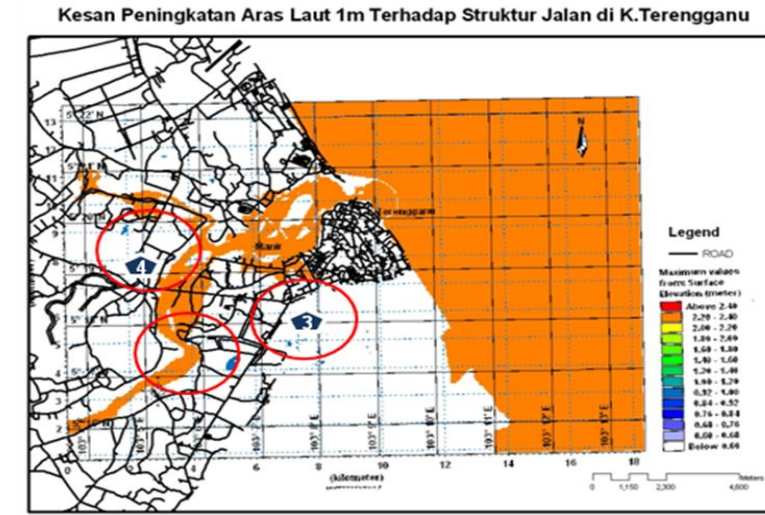
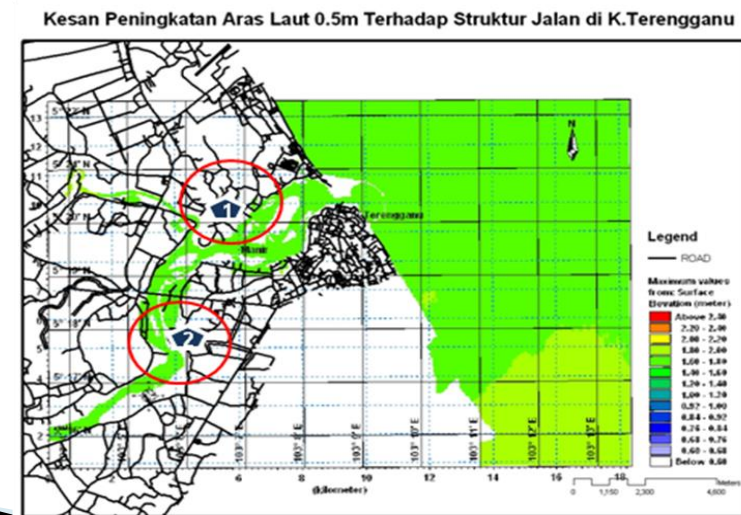
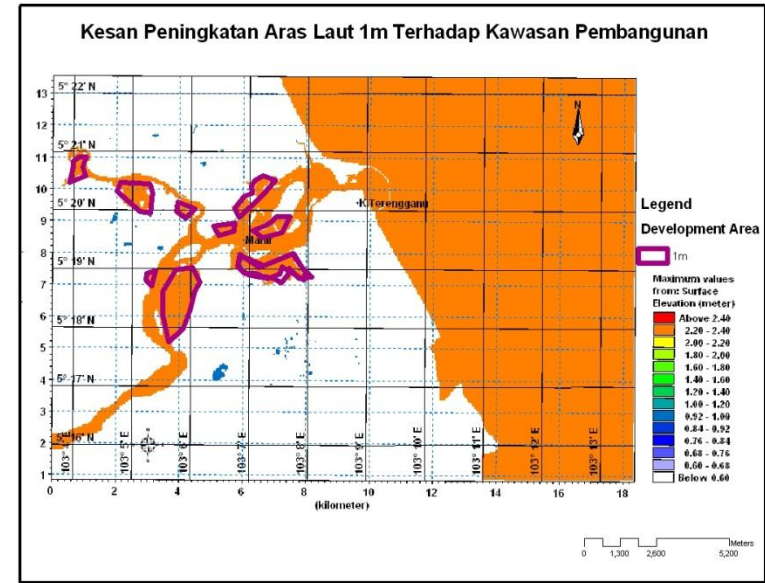
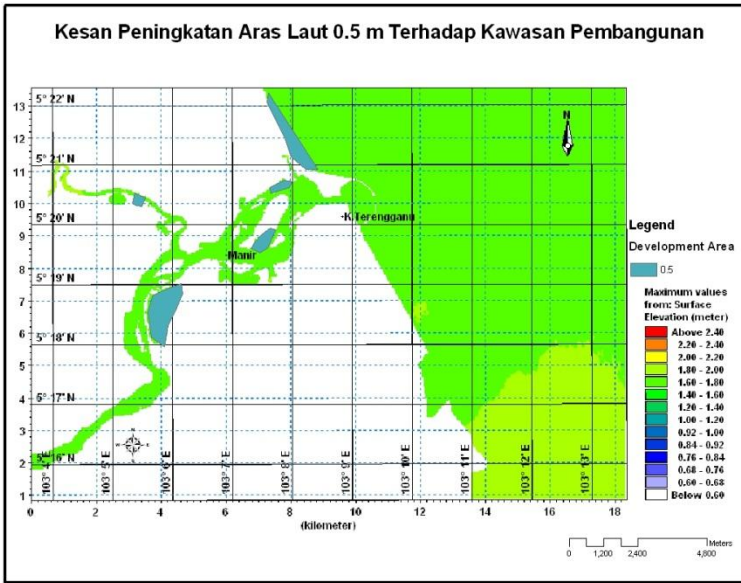
### Projection on Sea Level Rise at 2100

	Sea Level Rise (m)	Note
<b>Projection 2100 (Peninsular Malaysia)</b>	0.25m – 0.52m	Maximum Sea Level Rise – north-west and north-east Peninsular Malaysia (Kedah & Kelantan)
<b>Projection 2100 (Sabah &amp; Sarawak)</b>	0.43m – 1.06m	<ol style="list-style-type: none"><li>1. Maximum Sea Level Rise –north &amp; east coast of Sabah.</li><li>2. Inundation at low lying and river mouth area in southwest Sarawak (Meradong, located between Batang Igan &amp; Batang Rajang).</li><li>3. Inundation at low lying and rivermouth area in Sabah (Tawau, Semporna, Lahad Datu, Sandakan &amp; Kudat).</li></ol>

# SEA LEVEL RISE STUDY IN MALAYSIA



# INUNDATION MAP FOR KUALA TERENGGANU



**NOTE:** 1 : Jalan Masjid , 2 : Jalan T9 (Kg. Kota), 3 : Jalan Kuala Hiliran (Losong), 4 : Jalan Tengku Mizan

# Current Groundwater Research





# IMPACT OF CLIMATE CHANGE ON GROUNDWATER RESOURCES

## A. Change in Recharge

- ▶ Change in diffuse recharge due to change in rainfall
- ▶ Change in diffuse recharge due to land use change.
- ▶ In other areas, afforestation has reduced recharge leading to declining groundwater levels
- ▶ Change in river recharge due to change in river stage
- ▶ Temperature and CO<sub>2</sub> may affect evapotranspiration > portion of rainfall that infiltrates

*Non climate factors: land use changes, population growth, poor management*

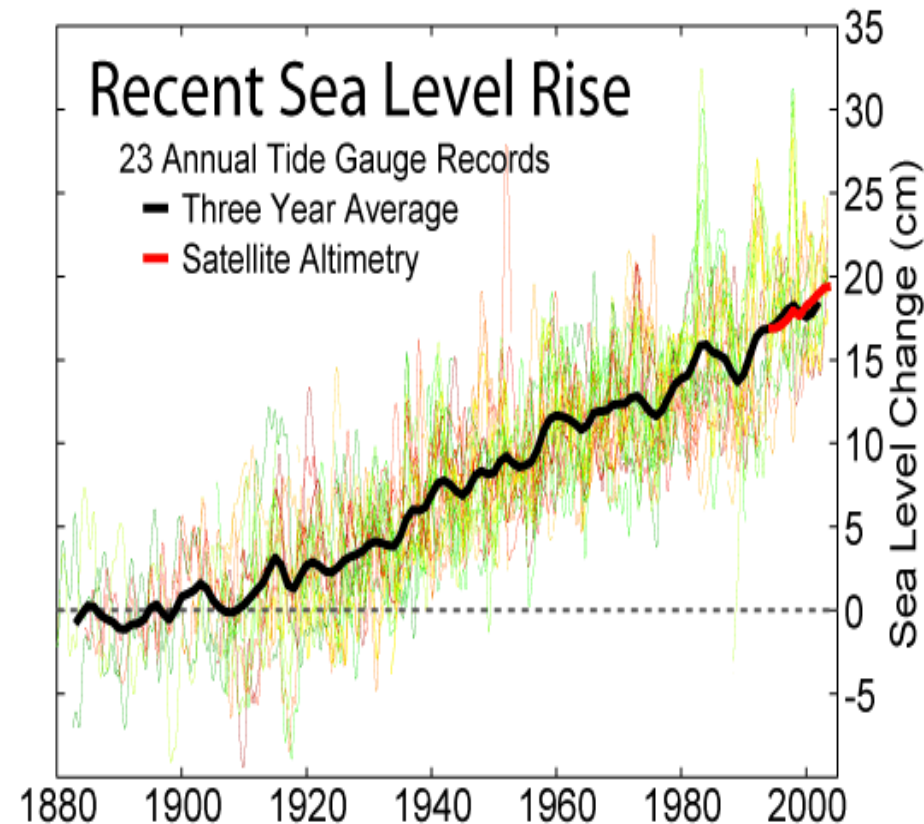
# IMPACT OF CLIMATE CHANGE ON GROUNDWATER RESOURCES

## B. Change in Discharge

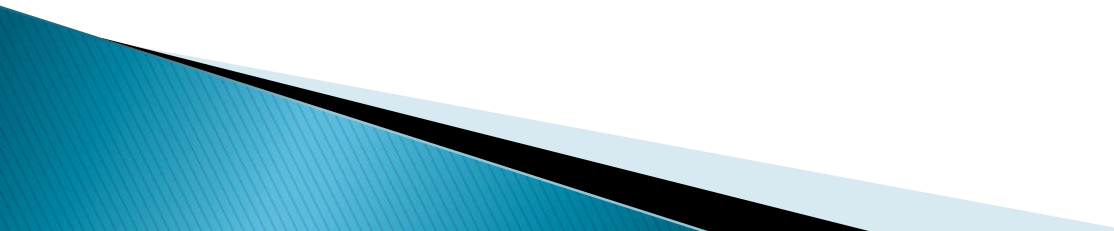
- Increase in demand for extraction
- Due to changes in river stage

## C. Change in Storage

- Due to change in recharge
- Due to change in extraction
- Due to sea level rise – lead to water intrusion



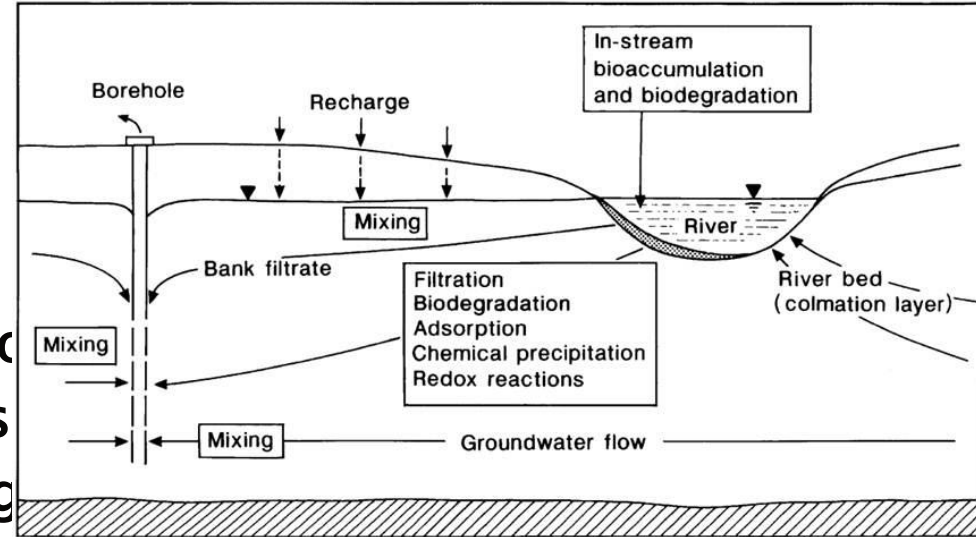
# R&D On Groundwater As An Adaptation Tool To Climate Change Impacts

1. Bank Infiltration: A Case Study For Alluvial River Bank
  2. Study on the Effectiveness Of Managed Aquifer Recharge (MAR) Technique for the Groundwater Resources Management in Pulau Tioman
- 

# Advantages & limitations of Bank Infiltration

## ADVANTAGES:

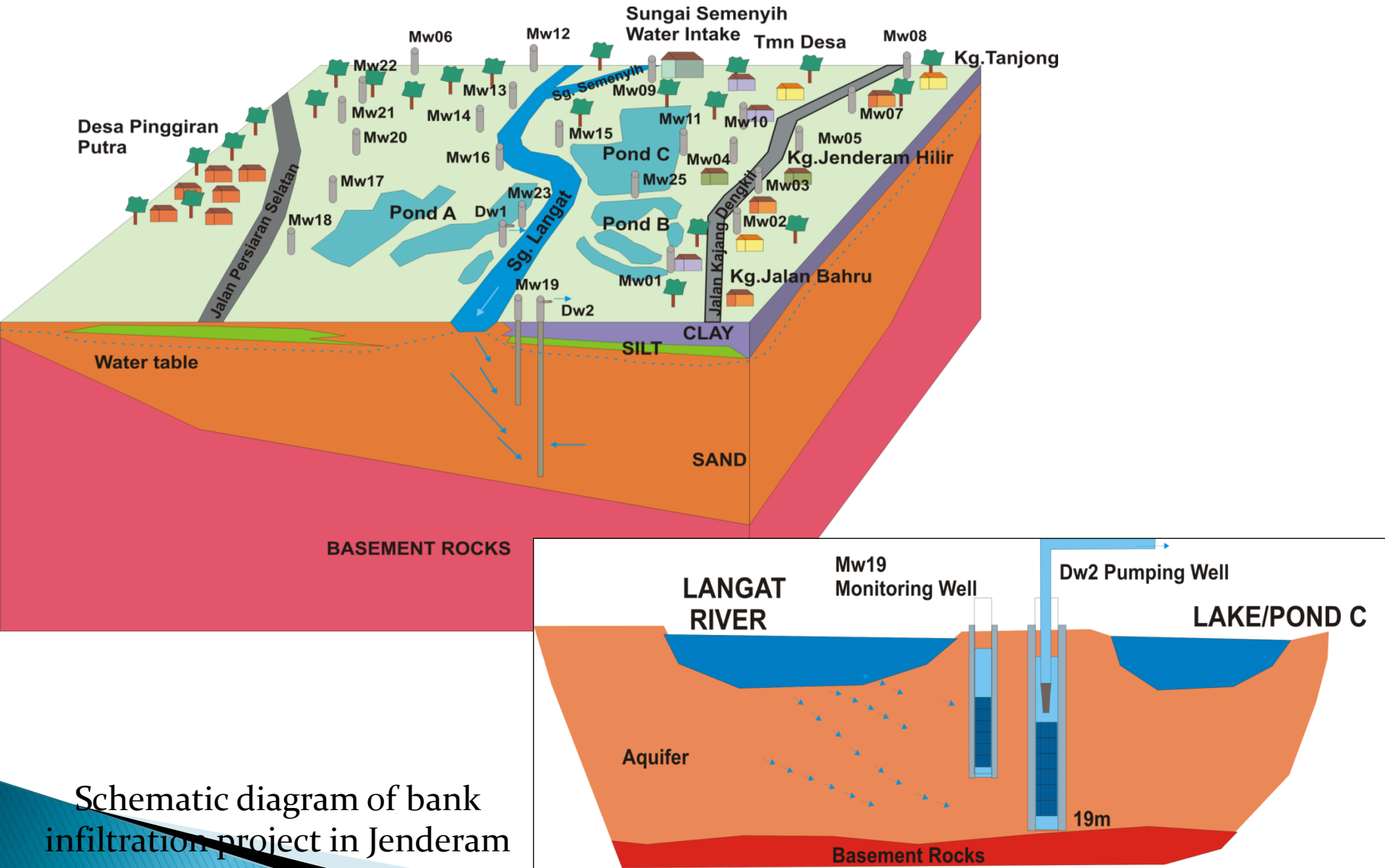
- ▶ Turbidity Control
- ▶ Organic Contaminant Reduction
- ▶ Reduction in Sludge
- ▶ Microorganism Removal
- ▶ Reduction of Water Treatment Costs Through Three Different Processes i.e. Physical, chemical and biological



## LIMITATIONS:

- **Formation of Organic Mat:** Organic mat is usually developed at the river/aquifer interface. When the river floods this organic mat may be washed away and the performance of the BI decreases
- **Riverbed Clogging:** presence of suspended solids or organic matter can create layers that reduce or eliminate the permeability of the riverbed, causing reductions in the water yield

# Bank Infiltration

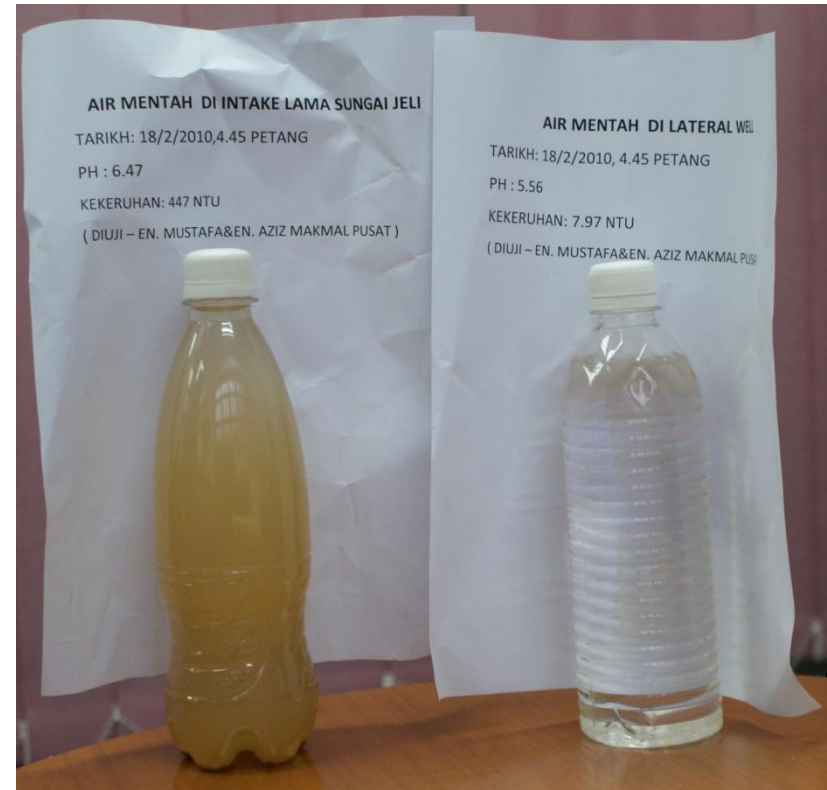


Schematic diagram of bank infiltration project in Jenderam Hilir, Selangor

# Bank Infiltration – RAW Water Quality



Langat



Jeli

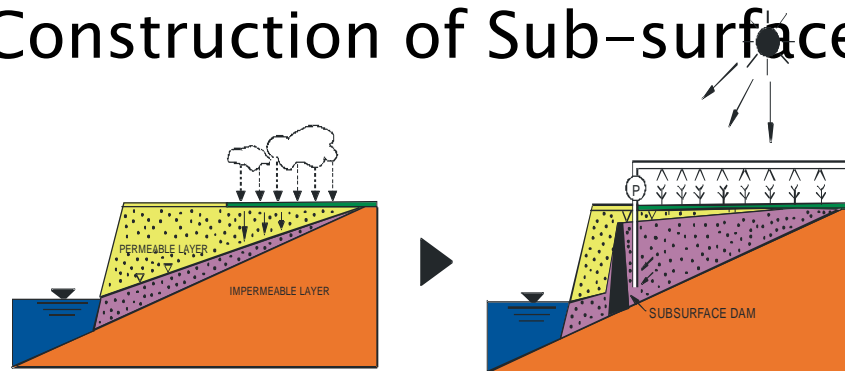
Parameter	Sungai Langat	Groundwater
pH	6.7	7.1
Turbidity (NTU)	328.0	14.0
Conductivity $\mu\text{S/cm}$	211	94
$\text{NO}_3$ (mg/l)	9.1	1.12
Total Coliform	>2420 MPN/100ml	<1 MPN/100ml
E. coli	1414 MPN/100ml	<1 MPN/100ml

Parameter	Sungai Jeli	Groundwater
pH	6.47	5.54
Turbidity (NTU)	447	7.97

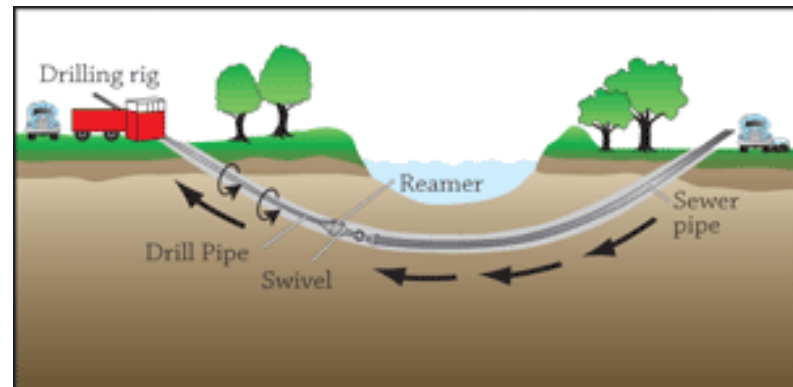
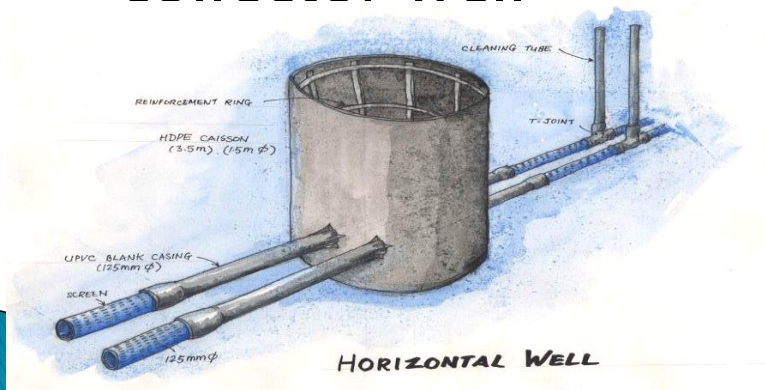
# EVALUATION OF MANAGED AQUIFER RECHARGE (MAR) TECHNIQUE

There are 3 possible options to implement MAR in this study

- ▶ Option 1: Construction of Sub-surface dam



- ▶ Option 2: Construction of horizontal well with collector well



# **Current Lake Research**

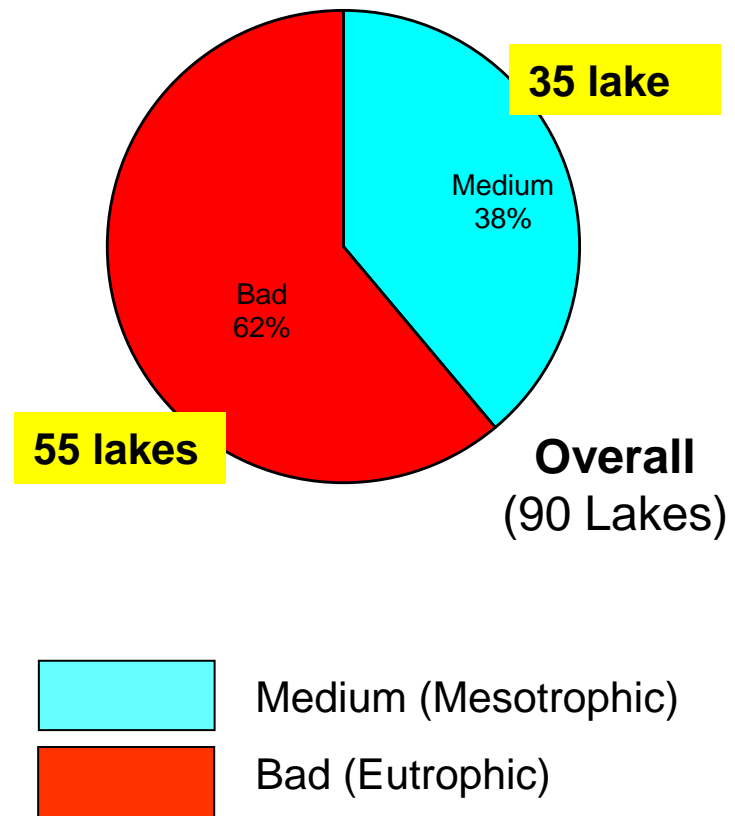


# Issues and challenges related to lakes and reservoirs in Malaysia

- Eutrophication
- Pollution
- Sedimentation

# National study on lake eutrophication

- ▶ Desk-study in 2004–2005
  - 90 major lakes
- ▶ Trophic State study in 2012
  - 15 major lakes



# Eutrophication of lakes and reservoirs

*algal bloom*



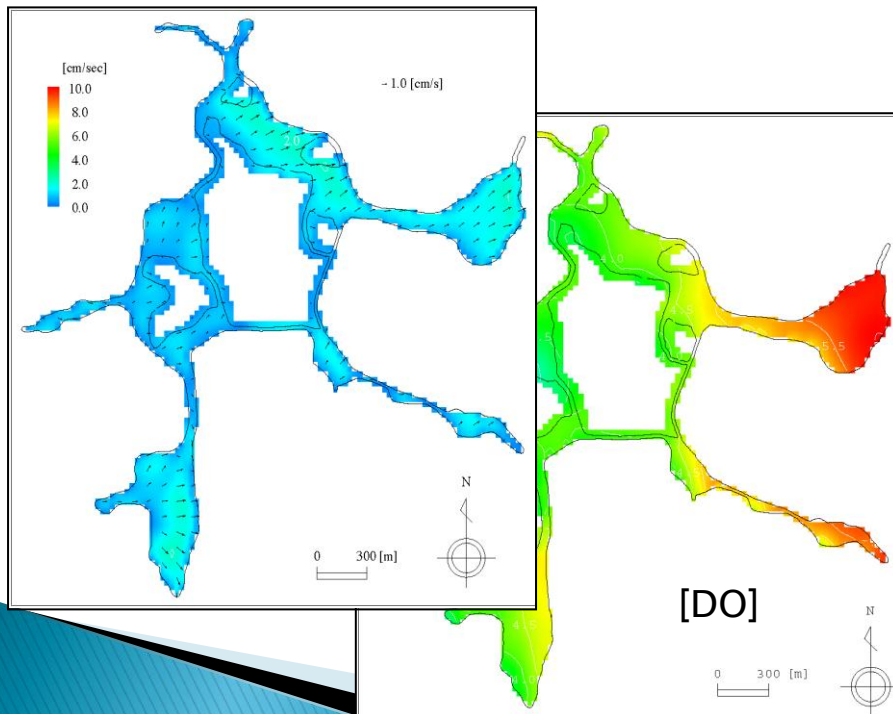
# Eutrophication of lakes and reservoirs

## *macrophyte bloom*



# Past studies

- Development of Nutrient Response Model for Lakes
  - Lake Chini



# Future Research

- ▶ Rehabilitation of Lake Chini
  - Action Plan for Water Quality Improvement
    - Ecosystem studies of Lake Chini
    - Hydraulic and Ecosystem modelling of lake and river
    - Development of sustainable Catchment and Drainage Management Plan

# Management of Lakes / Reservoir Basins

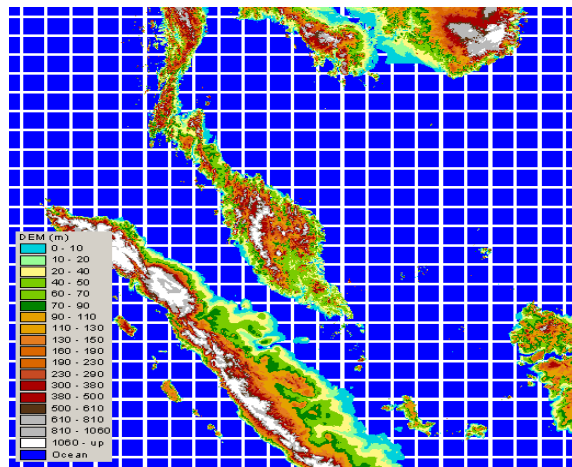
- The Strategic Plan for Lake and Reservoir Management which has been agreed by the National Water Resources Council;
  - NAHRIM as a Centre for Lake Research
    - ASM/NAHRIM facilitated completion 8 Lake Briefs in 2009/2010
    - Embarking on a 5-year programme to facilitate the completion of 93 Lake Briefs.
    - Developing National Lake Inventory / Lake Database
    - Embarking on various research including developing ecosystem models for lakes
    - Development of Detail Action Plan for Integrated Lake Basin Management.

# Current Climate Change and Adaptation Research

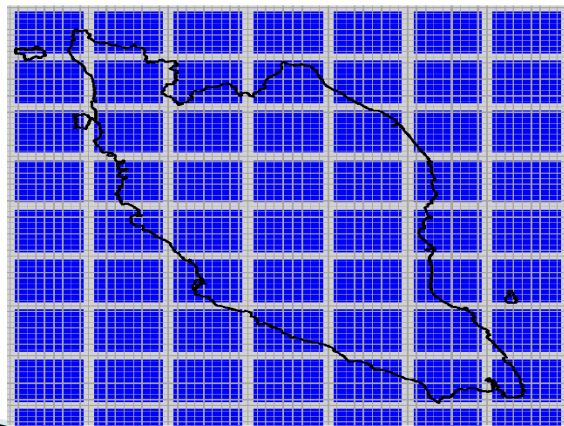




# ...revisit climate change modeling and projection for Peninsular Malaysia.....



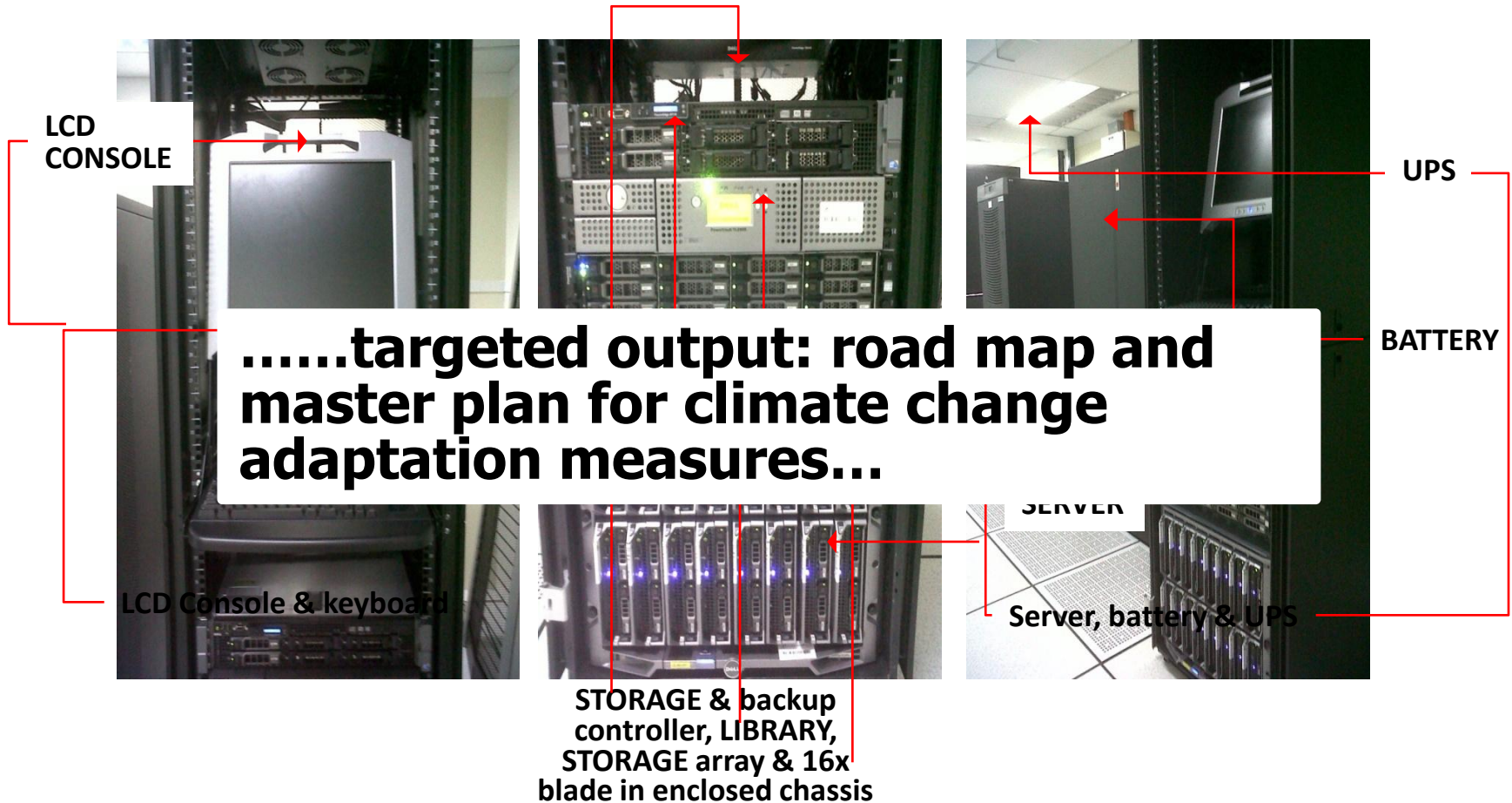
18km x 18km



6km x 6km

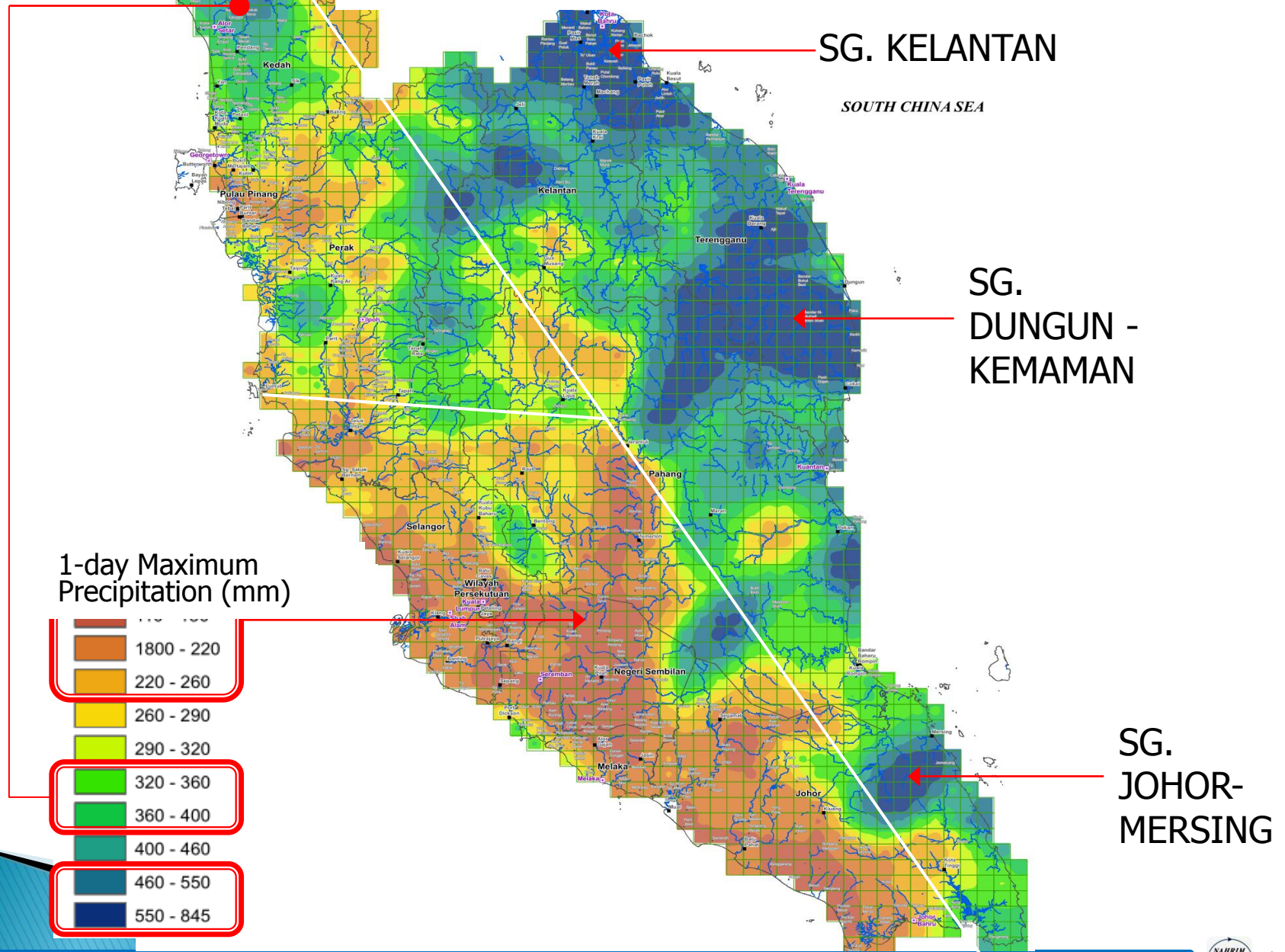
- **2006 - Downscaling** Canadian GCM1 (~ 410km resolution), to **fine spatial resolution** (~9km)
- **Extention study:**
  - **3 GCMs** – MPI-ECHAM5, CCSM3 and MRI-CGCM2.3.2
  - **15 scenarios** – SRES A1B (5), B1 (5), A2 (1) and A1Fi (1)
  - Downscaling GCMs (~150-310km) to watershed scale **spatial resolution of 6km**
  - **Hourly** time interval resolution
  - Study period – 18 months ( Sept. 2012 – Feb. 2014)

# HIGH PERFORMANCE COMPUTING (HPC) SYSTEM



.....would be able to runs dynamic downscaling processes about 20 years simulation per day.....

# 1-day maximum precipitation map

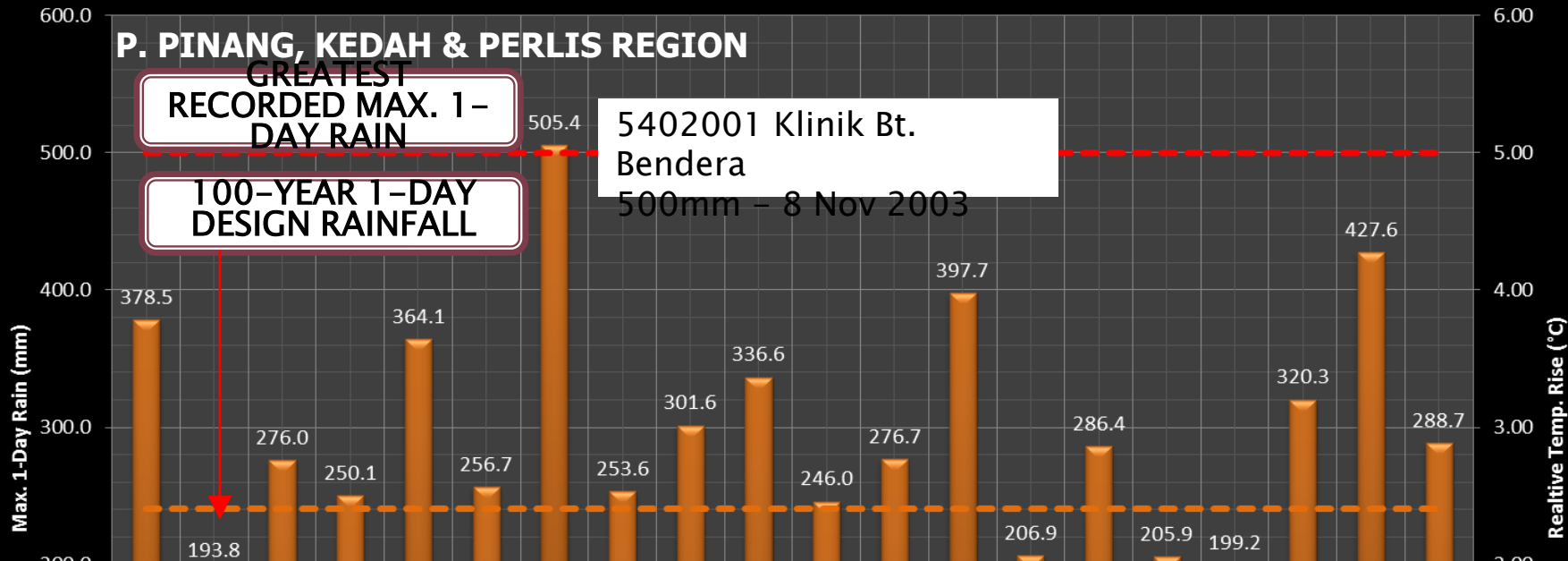


# P. PINANG, KEDAH & PERLIS REGION

**GREATEST  
RECORDED MAX. 1-DAY  
RAIN**

**100-YEAR 1-DAY  
DESIGN RAINFALL**

5402001 Klinik Bt.  
Bendera  
500mm – 8 Nov 2003



2025

2031

Legend

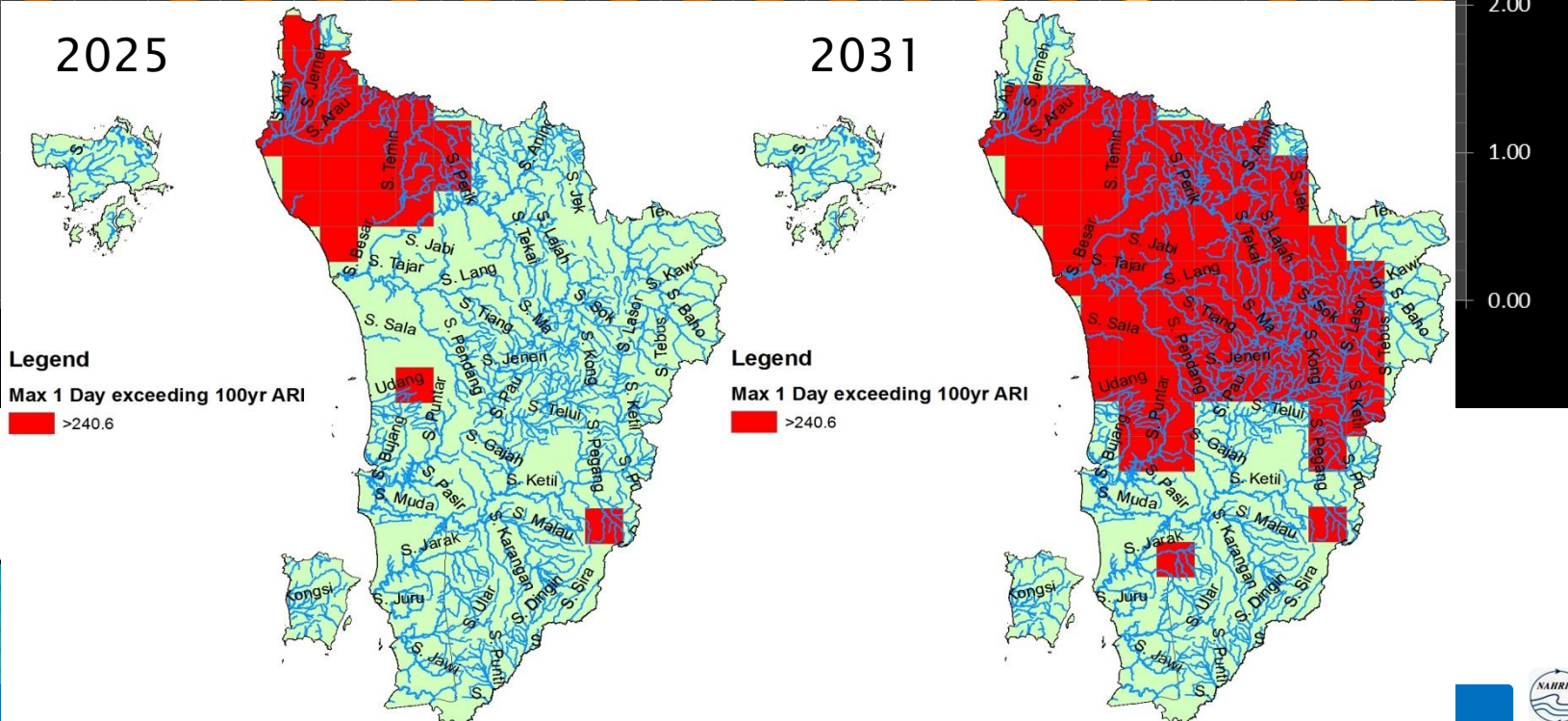
Max 1 Day exceeding 100yr ARI

>240.6

Legend

Max 1 Day exceeding 100yr ARI

>240.6



**....develop engineering methodology  
and design standards...**

# .....common questions in water resources engineering .....



Bekok Dam



Tanjung Piai Mangrove



Redang Island

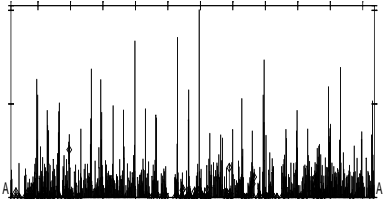
Related issues due to the frequencies of hydrologic and precipitation phenomena:

- **How high should a bund be, and what is the risk to those living behind it?**
- How to characterize and identify a 100-year floodplain?
- **How to manage a reservoir to accommodate uncertain runoff?**
- How much storage in a reservoir should be allocated to irrigation versus other competing future needs?
- **How safe is the structure under extreme flood conditions?**
- How to size the spillway for a rare flood?
- What criteria should be used to “recertify” flood mitigation structures where the flow frequencies have changed or are in the process of changing?
- **How should our procedures on life-cycle infrastructure management and performance accommodate our evolving understanding of climate change?**
- What flood/drought frequency distribution should be used in a particular analysis to accommodate climate uncertainty?

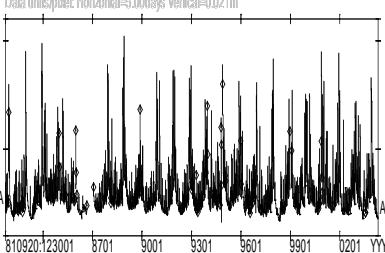
# .....hydroclimate data transformation into hydrologic & hydraulic design...



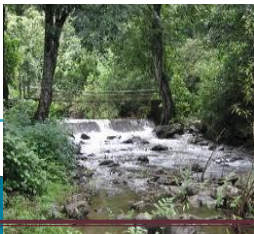
Data units/interval: Horizontal=8.0days Vertical=0.84mm



site 5328044 KG. SG. TONG at TERENGGANU Rain mmi/day (Total=94149)



site 5229436 SG. NERUS at KG. BUKIT,TERENGGANU Stage m



**HYDRO-METEOROLOGY DATA**



**HYDROLOGY MODELING**

**HYDRAULIC MODELING**

**WATERSHED - "MEDIUM - SYSTEM"**

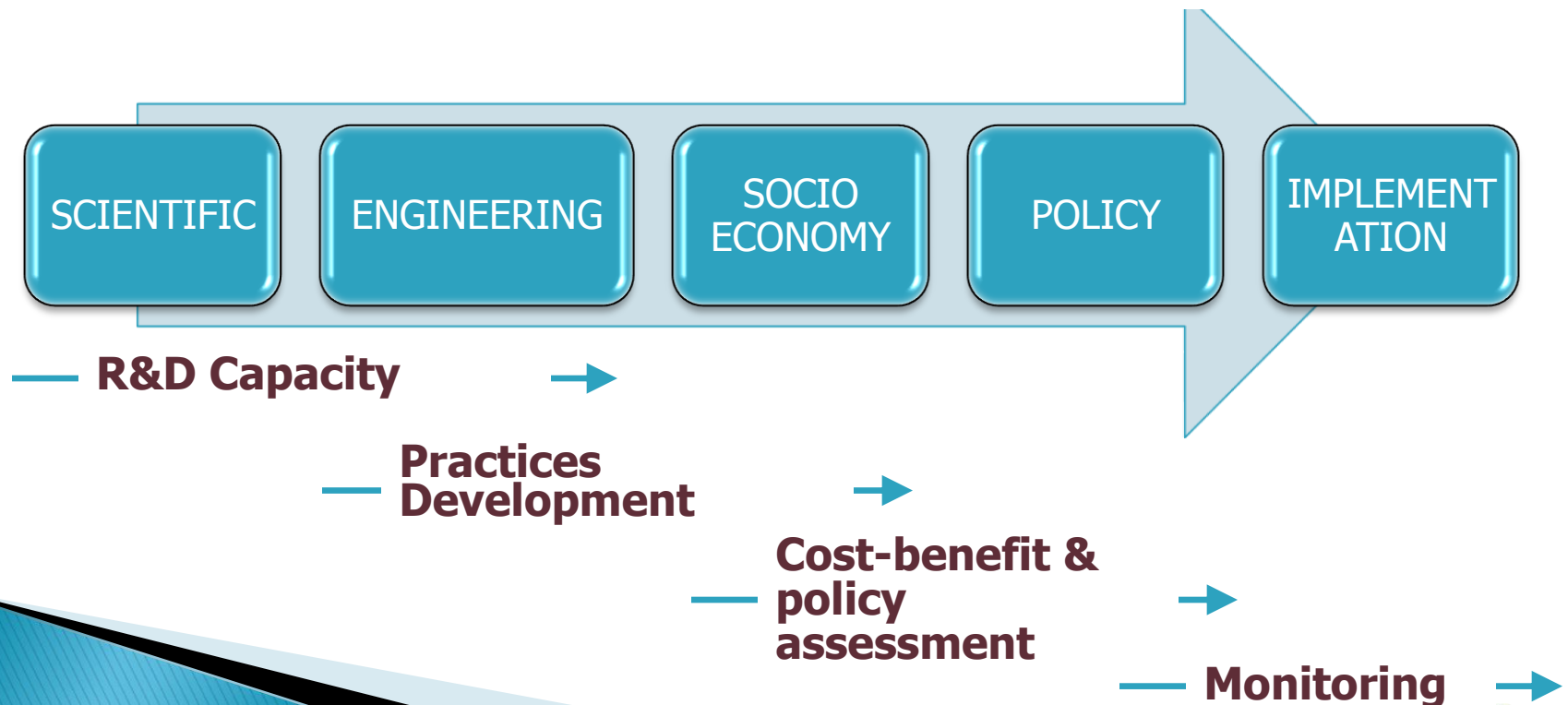


**HYDRAULIC STRUCTURES**

# .....Summary.....

- Pathway to bridge the gap between scientific knowledge into engineering knowledge and practices is developed
- Methodology to mainstreaming climate change adaptation in water sector in order to cushion the impacts of climate and non-climate forcing is established

## — **PATHWAY OF KNOWLEDGE DEVELOPMENT** →





# Thank You

