Experience Sharing on
Attachment Programme to Public Utilities Board (PUB) in Singapore

Engineer/Drainage Projects Division, DSD

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15 August 2013

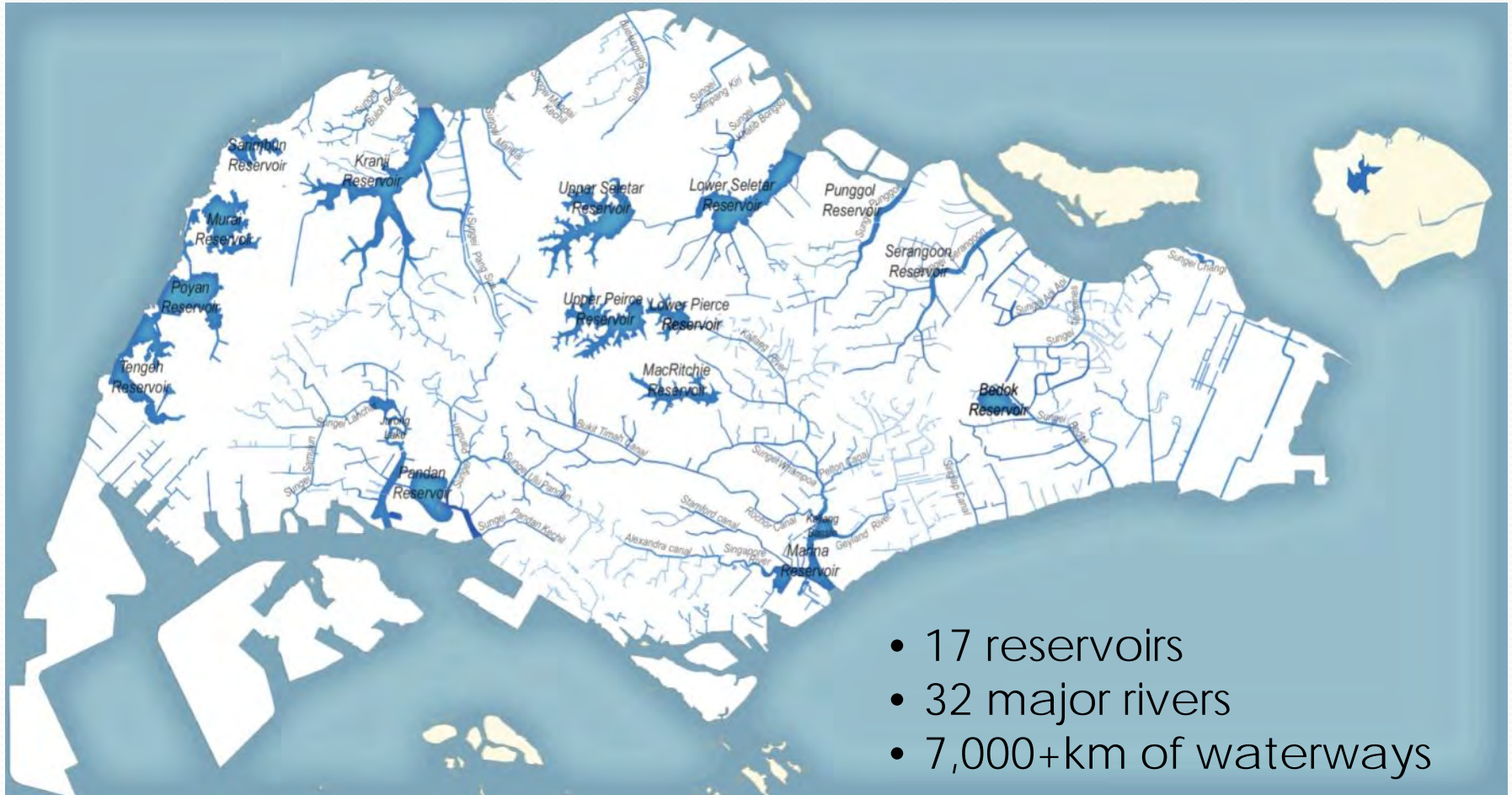# Active, Beautiful, Clean (ABC) Waters Porgramme

1. **Introduction**

2. **Overview of ABC Waters Programme**

3. **ABC Waters Planning Strategy and Design Features**

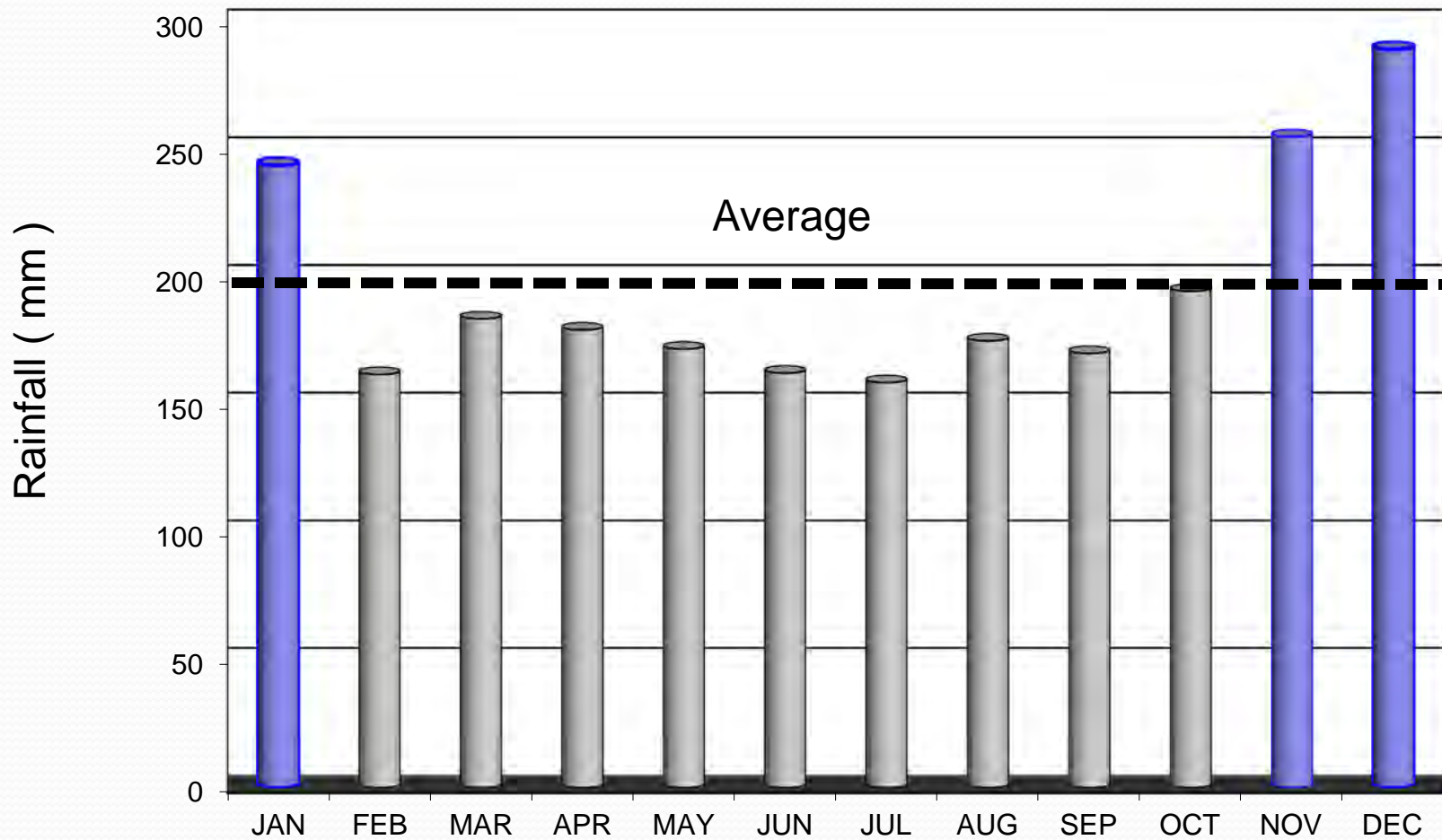4. **Case Study:- Bishan Park**

1. Introduction

Singapore Blue Map

- 17 reservoirs
- 32 major rivers
- 7,000+km of waterways

Singapore Monthly Rainfall

Types of Drains and Canals

Canal

Outlet drain

Open roadside drain

River

Closed roadside drain

2. Overview of ABC Waters Programme

ABC Waters Programme: *Sustainable Stormwater Management*
What it is all about

Active

- Realizing the potential of our waters
- Building people-water relationships through increased interaction with water
- Educating people on the implications of an urban catchment

Beautiful

- Improving quality of life and biodiversity through waterway enhancements
- Integrating waterbodies and waterways with their urban landscape

Clean

- Improving water quality
- Cultivating environmental responsibility among people

ABC Waters Masterplan

- ABC Waters Masterplan was launched in 2008
- Over 100 projects by 2030
- Phase 1 - 28 projects to be implemented by 2012
- Phase 2 - FY2012 to 2016 is being planned

Sungei Whampoa-St George's Lane

Kolam Ayer Waterfront

RC31 @ River Vista

Alexandra Canal

Bishan Park

Pang Sua Deck

3. ABC Waters Planning Strategy and Design Features

What happens to rainwater?
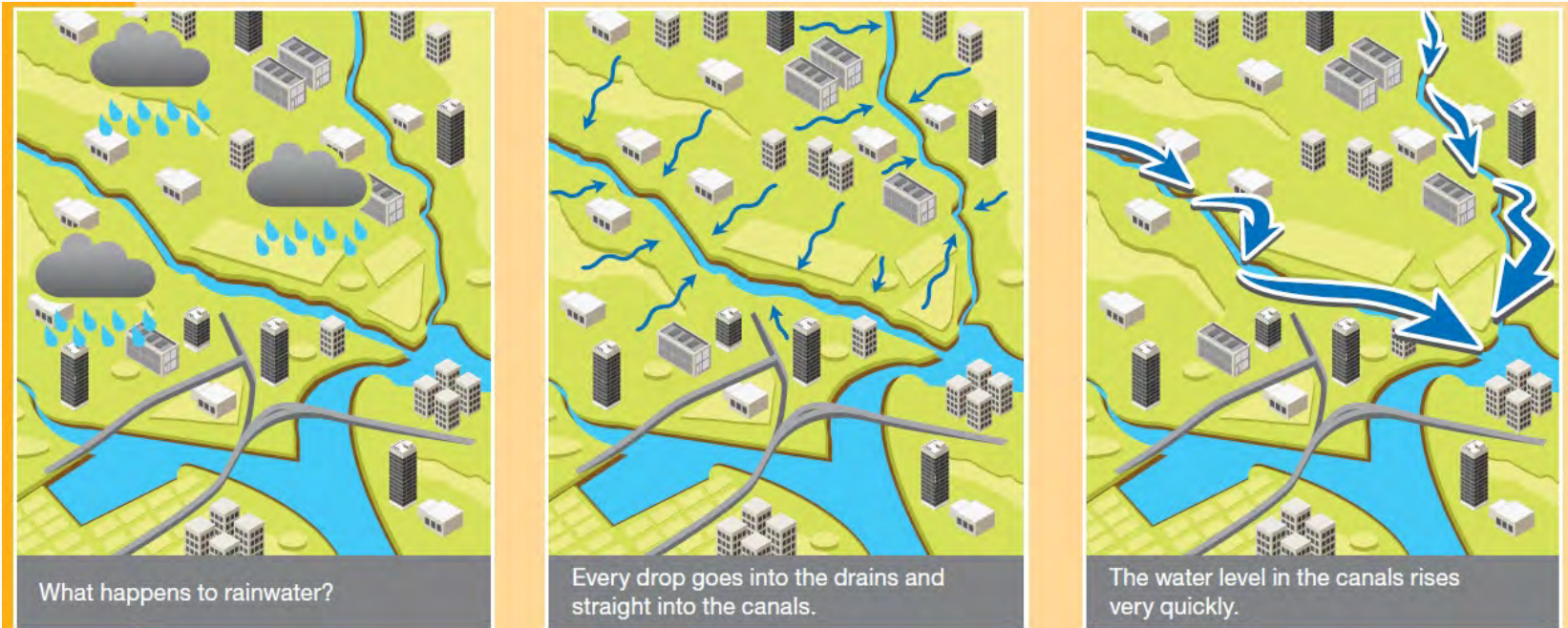
Every drop goes into the drains and straight into the canals.

The water level in the canals rises very quickly.

Fig. 2.1   Traditional stormwater management.

Mostly dry

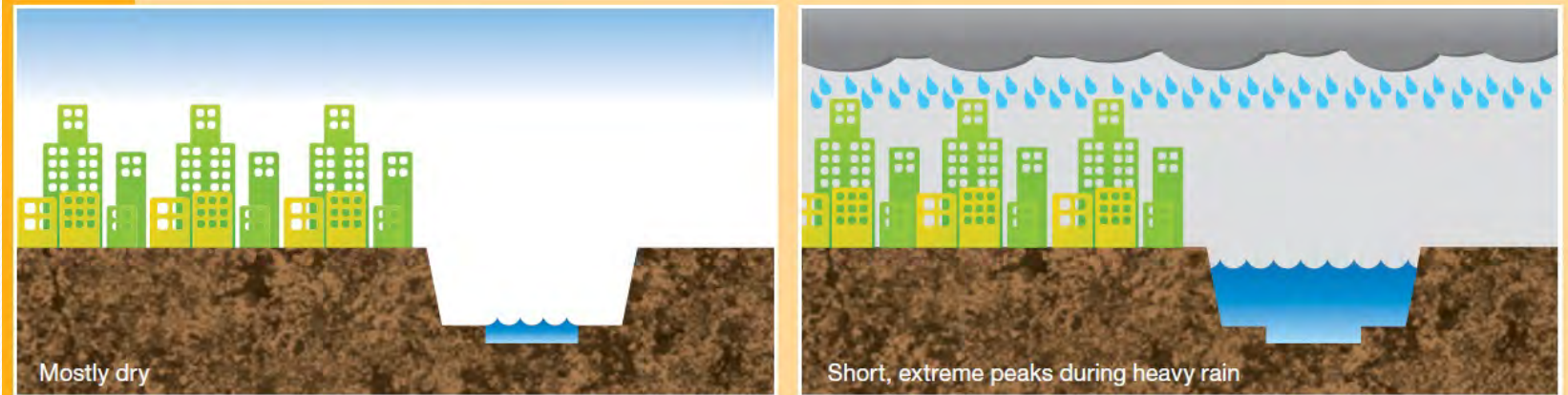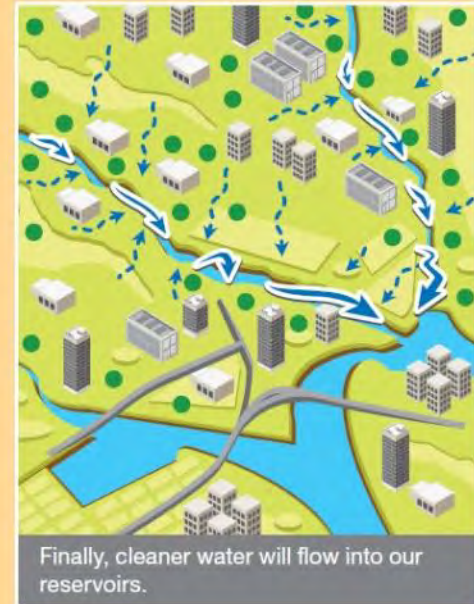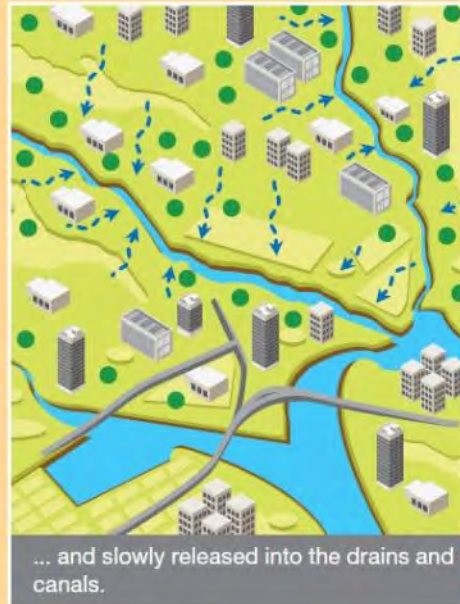Short, extreme peaks during heavy rain

Fig. 2.2   Water levels in the canals under traditional stormwater management.

ABC Waters Management

- Involves detaining and treating storm water run-off on site using ABC Waters design features before being discharged to drains and canals
- Leads to regulated flows and lower peaks

Every drop of stormwater is treated on site...

... and slowly released into the drains and canals.

Finally, cleaner water will flow into our reservoirs.

ABC Waters Management Strategy.

Regulated flows and lower peaks

Water levels in the canals if the ABC Waters management strategy is applied catchment-wide.

Performance Objectives

Table 3.1 – Stormwater quality objectives for Singapore

Pollutant	Stormwater Treatment Objectives
Total suspended solids	80% removal or less than 10 ppm (90% of all storm events)
Total nitrogen	45% removal or less than 1.2 ppm (90% of all storm events)
Total phosphorus	45% removal or less than 0.08 ppm (90% of all storm events)

Performance curves developed to guide the professionals in the design of ABC Waters design features are available in the Engineering Procedures for ABC Waters design features.

* Stormwater quality objectives may be revised as more monitoring results are gathered over time

Design should also fulfill necessary hydraulic requirements, mosquito control and rain water harvesting (if applicable) requirements

Catchment Elements

Surfaces found in urban environment – i.e. the catchment elements are listed in the figure below

ABC Waters design features could be integrated into most of these catchment elements

ABC Waters Design Features

ABC Waters Design Features
- Green treatment features using plants and soil media to clean the water through sedimentation, filtration and nutrient uptake

Types
- Green Roof and Planter Box

- Bioretention Swale

- Rain Garden (Bioretention Basin)

- Sedimentation Pond

- Constructed Wetland

- Cleaning Biotopes

Green Roof and Planter Box

Requirements:-
- Low maintenance vegetated roof system
- Use lightweight engineered soil medium

Benefits:
- Much less surface run-off on roof
- Cool down building and reduce "heat-island" effect
- Development of recreational spaces

Green roof
Green roof
Balcony
Balcony
Garden
Garden
Planter box
Planter box
Ground level greenery
Ground level greenery
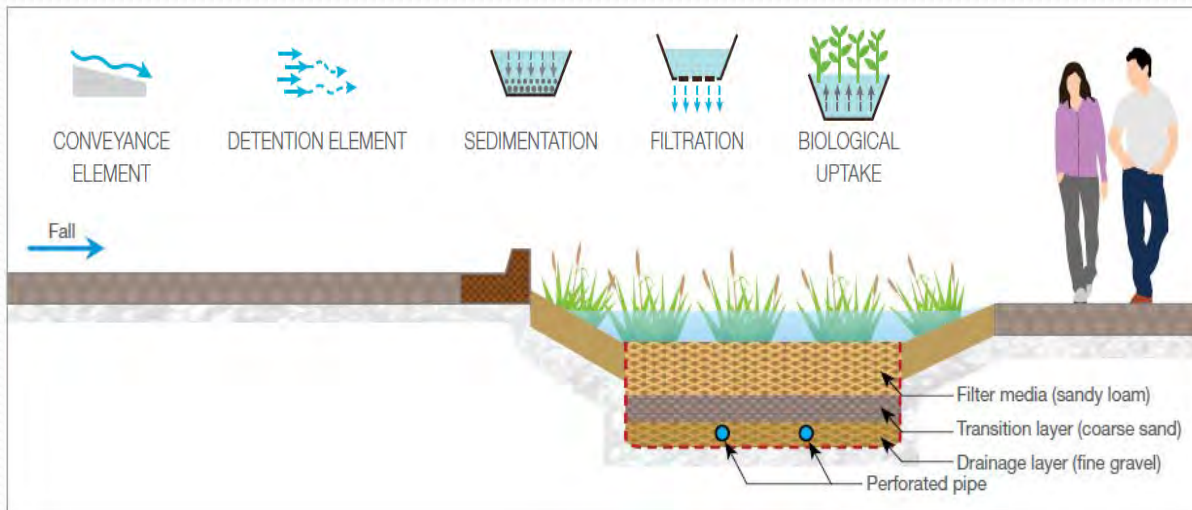

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Green Roof and Planter Box

- Low maintenance vegetated roof system
- Cleansing biotopes and bioretention planter boxes can be implemented in a tiered or multi-level and sequential systems
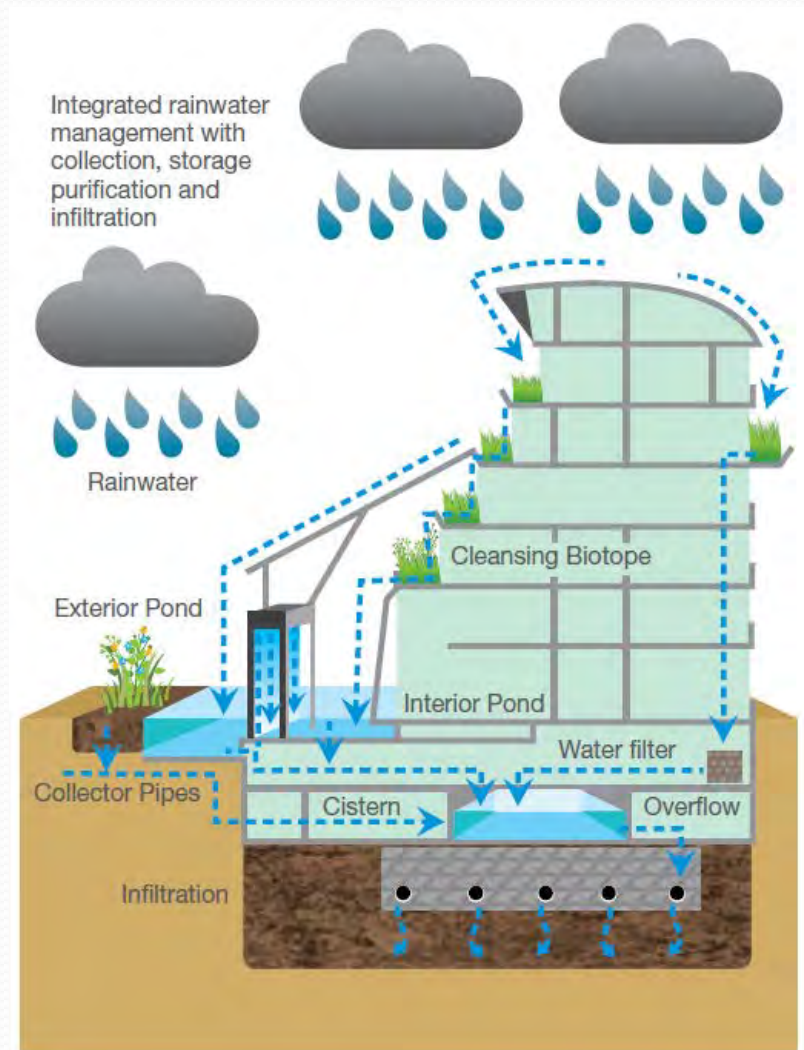
Bioretention Swales

- Provide efficient treatment of stormwater via infiltration
- Reduce flow velocity
- Provide attractive streetscape and landscape features in urban development
- Applicable to treat runoff from road, car park and residential area

CONVEYANCE ELEMENT

DETENTION ELEMENT

SEDIMENTATION

FILTRATION

BIOLOGICAL UPTAKE

Fall

Filter media (sandy loam)
Transition layer (coarse sand)
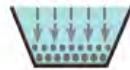Drainage layer (fine gravel)
Perforated pipe
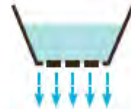
Bioretention Basins (Rain Gardens)

- Vegetated land depression to detain and treat stormwater runoff
- Reduce flow velocity
- Encourage habitat creation and promote biodiversity
- Beautify surrounding landscape
- Applicable at residential area, car park and green buffer
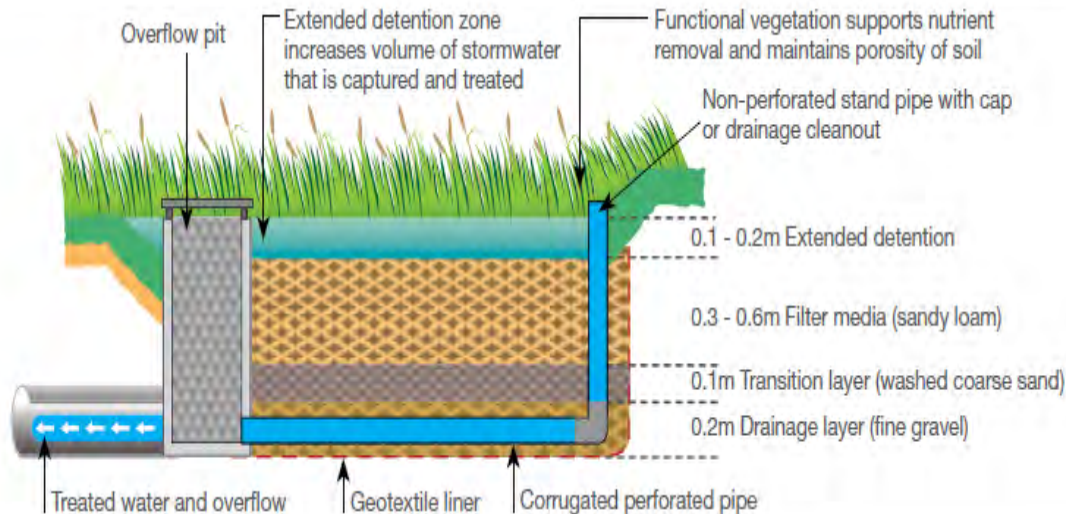

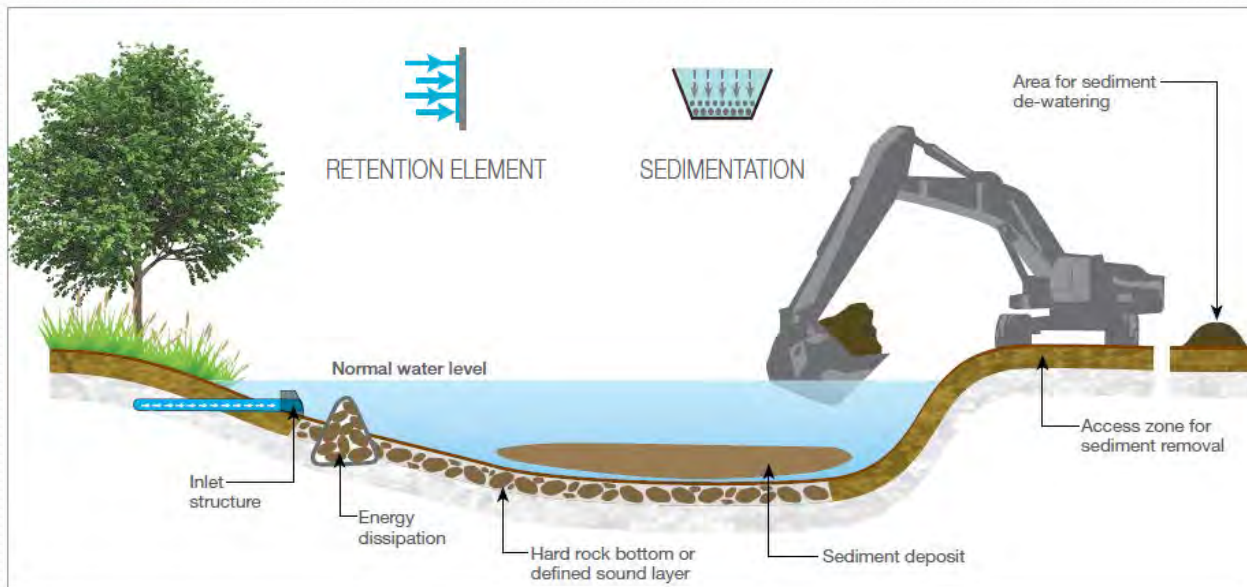DETENTION ELEMENT   SEDIMENTATION   FILTRATION   BIOLOGICAL UPTAKE

Overflow pit

Extended detention zone increases volume of stormwater that is captured and treated

Functional vegetation supports nutrient removal and maintains porosity of soil

Non-perforated stand pipe with cap or drainage cleanout

0.1 - 0.2m Extended detention

0.3 - 0.6m Filter media (sandy loam)

0.1m Transition layer (washed coarse sand)

0.2m Drainage layer (fine gravel)

Treated water and overflow   Geotextile liner   Corrugated perforated pipe
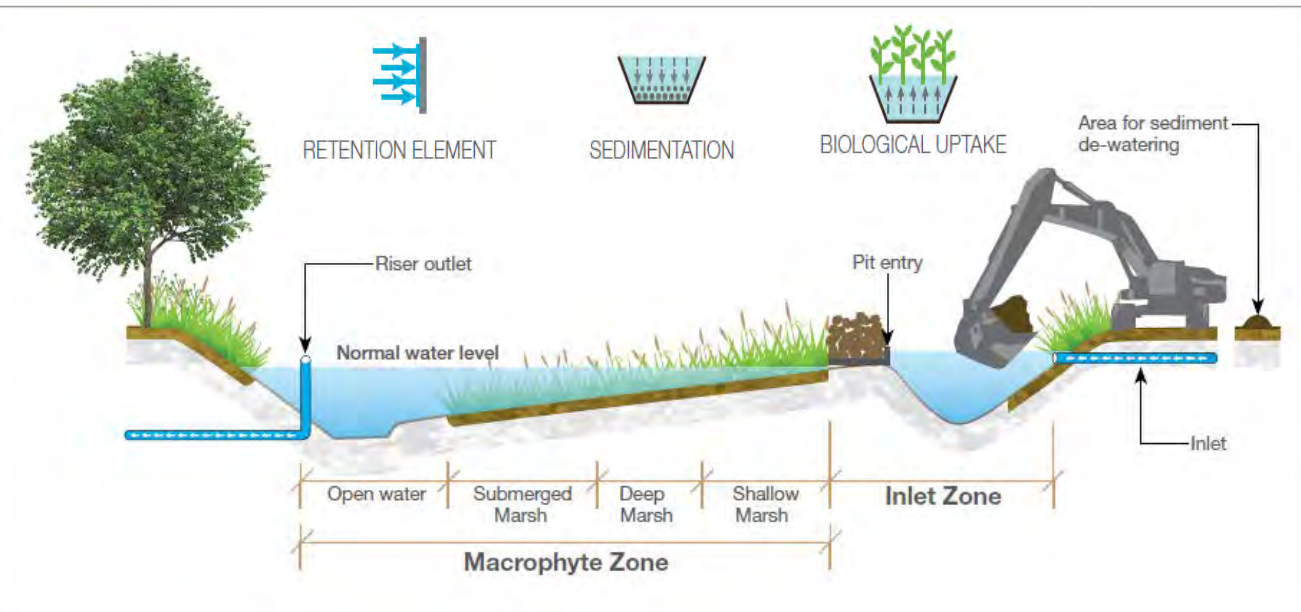
Sedimentation Basins

- Pond to provide temporary retention
- Regulate flows entering the downstream treatment system
- Provide pretreatment for downstream treatment systems such as engineered wetland or bioretention system
- Stored water can used for non-potable use
- Encourage habitat creation and promote biodiversity
- Beautify surrounding landscape

RETENTION ELEMENT

SEDIMENTATION

Area for sediment de-watering

Normal water level

Access zone for sediment removal

Inlet structure

Energy dissipation

Hard rock bottom or defined sound layer

Sediment deposit

Constructed Wetlands

– Remove fine to colloidal particles and dissolved contaminants
– Wetland can be constructed on different scales, from building scale to regional scale
– Microorganisms can absorb nutrients and contaminants from the runoff
– Encourage habitat creation and promote biodiversity
– Beautify surrounding landscape

Surface Flow Wetland
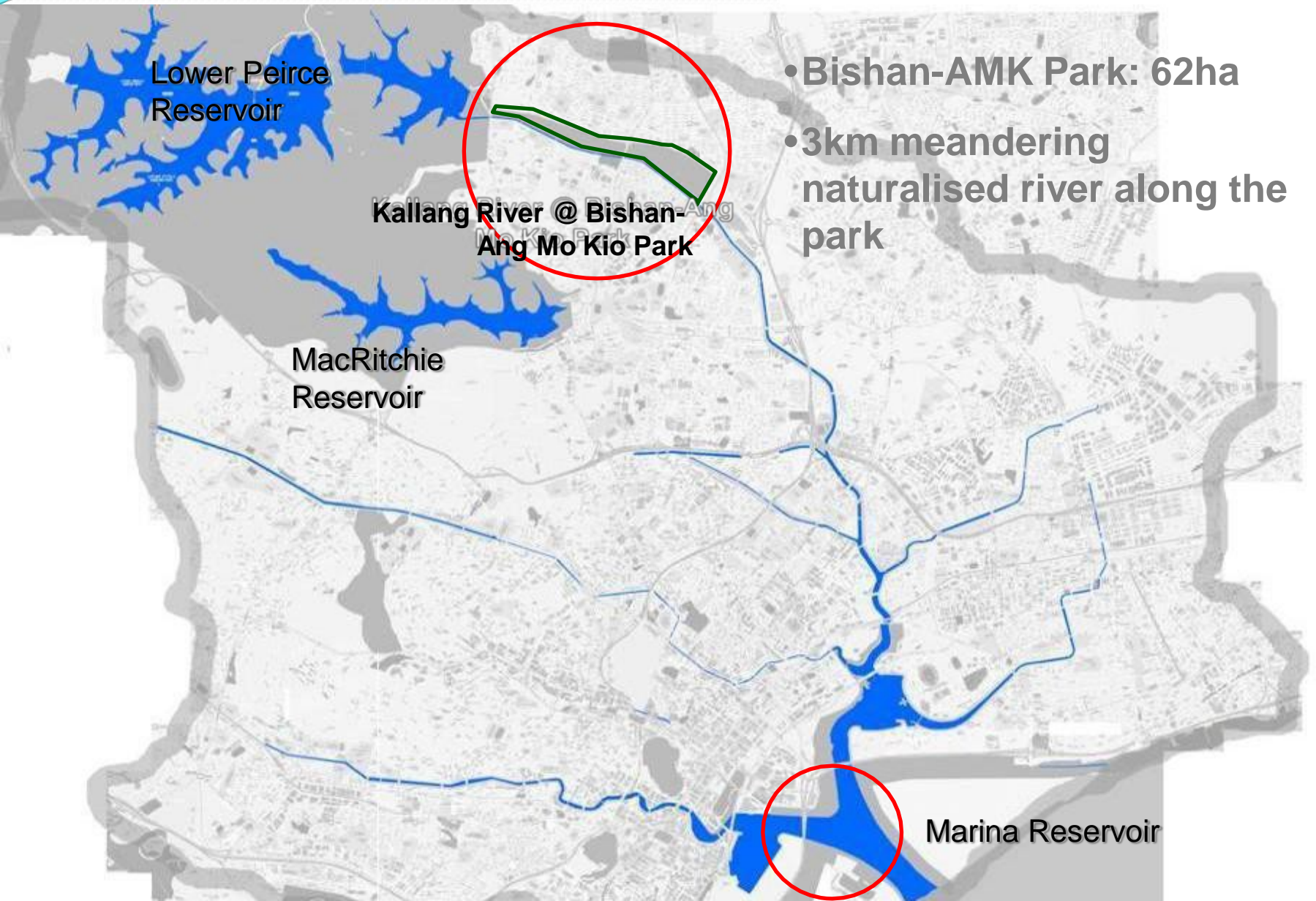

Sub-surface Flow Wetland

Floating Wetland

RETENTION ELEMENT   SEDIMENTATION   BIOLOGICAL UPTAKE

Area for sediment de-watering

Riser outlet

Pit entry

Normal water level

Inlet

Open water | Submerged Marsh | Deep Marsh | Shallow Marsh | Inlet Zone

Macrophyte Zone

Cleansing Biotopes

– Cleansing Biotopes are a form of artificially constructed wetland with recirculation.

Details of a typical cleansing biotope profile
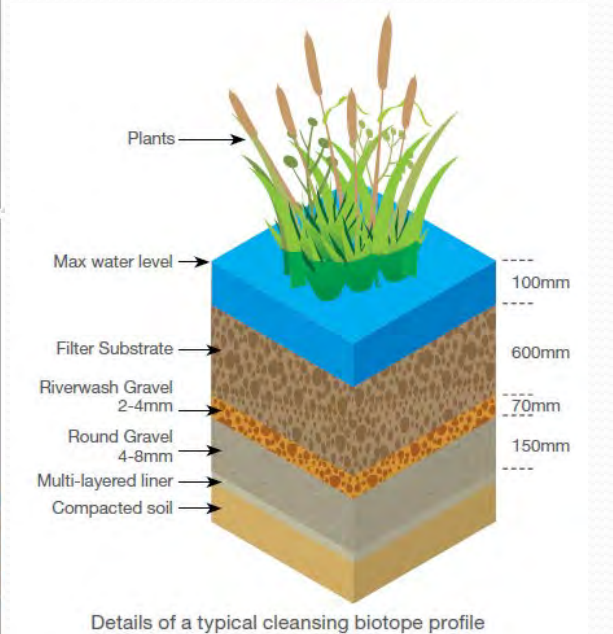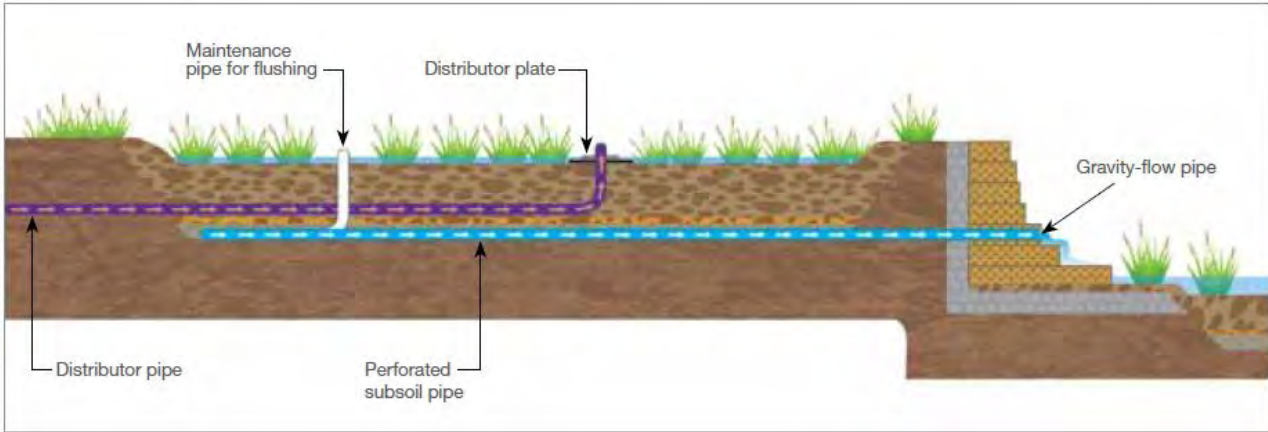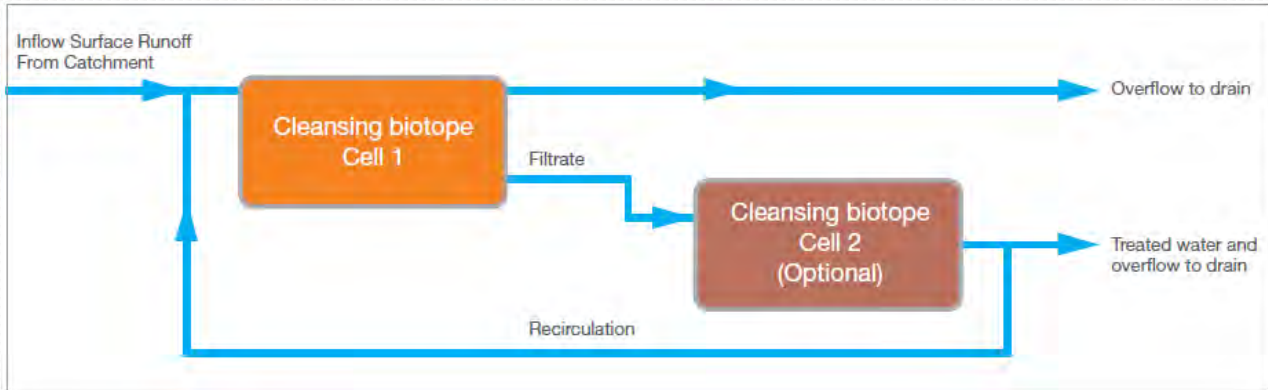
4. Case Study – Bishan Park

Kallang River @ Bishan-Ang Mo Kio Park:
A part of the Marina Catchment

Lower Peirce Reservoir

Kallang River @ Bishan-Ang Mo Kio Park

MacRitchie Reservoir

Marina Reservoir

- **Bishan-AMK Park: 62ha**
- **3km meandering naturalised river along the park**
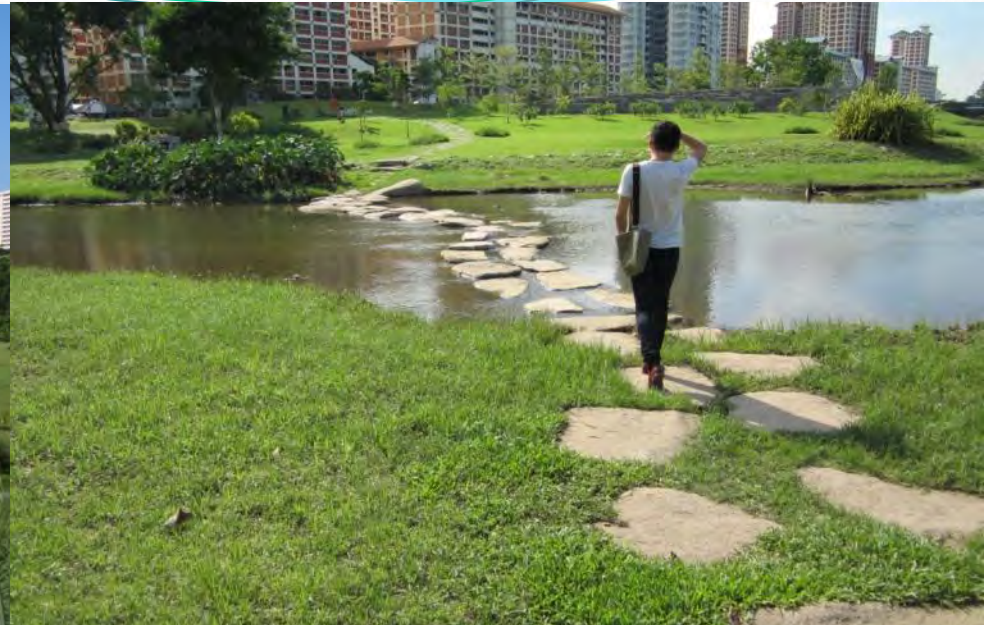
Vision of the New River:

- **natural** river with gentle soft slopes, intergrated with the park

- creating **new habitat** for flora and fauna

- increasing the **biodiversity**

- creating **interactive experience** with the river

- bringing **people** to the water and wildlife

Playground

Riverside Gallery

Recycled Hill

Stepping Stones

Cleaning biotope: Cleansing feature in Pond Gardens

Form of artificially constructed wetlands	Effective and natural water treatment system	*Cleansed pond water from biotope used for water playground*	*Used water from water playground will flow back into pond*	*Reduces use of potable water & makes amenities more sustainable.*

River Monitoring System

To warn public on rising water levels in river during storms, a surveillance and early alert system has been put in place along the river, consisting of:

- Safety Nodes

    - Blinker light

    - Siren with pre-recorded messages

    - Life Buoy

    - Safety node signage

- Water level sensors

- Depth markers

- CCTVs

- River lighting

- Safety line

- Surveillance personnel

- Warning signages

Blinking lights

Speakers for announcements and sirens

Life buoy

FOR YOUR SAFETY

UNTUK KESELAMATAN ANDA

为了您的安全

உங்கள் பாதுகாப்புக்கு

Please move beyond the **RED** marker when the warning lights and announcements are activated. Water level is rising rapidly.

Sila tuju ke belakang penanda **MERAH** apabila lampu amaran menyala dan pengumuman dibuat. Paras air sedang naik deras.

请在警告灯和公共警报启动时退到 **红色** 标记后方。河里的水位正急速上升。

எச்சரிக்கை விளக்குகள் மற்றும் அறிவிப்புகள் இயக்கப்பட்டதும், **சிவப்பு** கம்பத்திற்கு பின் செல்லவும். வேகமான நீரோட்டம்.

In case of emergency, please call **995**

Jika berlaku kecemasan, sila hubungi **995**

如有警急状况，请拨电 **995**

அவசரகாலத்தின் போது, **995** என்ற எண்ணை அழைக்கவும்

Location Plan for Safety Nodes and Water Level Sensors

■ Water level sensors   ● Safety Nodes

Pierce Sec Sch

Bishan Park Condo

Ang Mo Kio Ave 1

Sin Ming Walk

Sin Ming Ave Carpark

Sin Ming Ave

Asian Golf Academy

Water Level Sensor

CCTVs

- CCTVs will be placed along the river to aid in surveillance,

- Pan tilt zoom camera (PTZ Camera) & Fixed camera

-To cover all angles of the main river, in particular the high activity areas
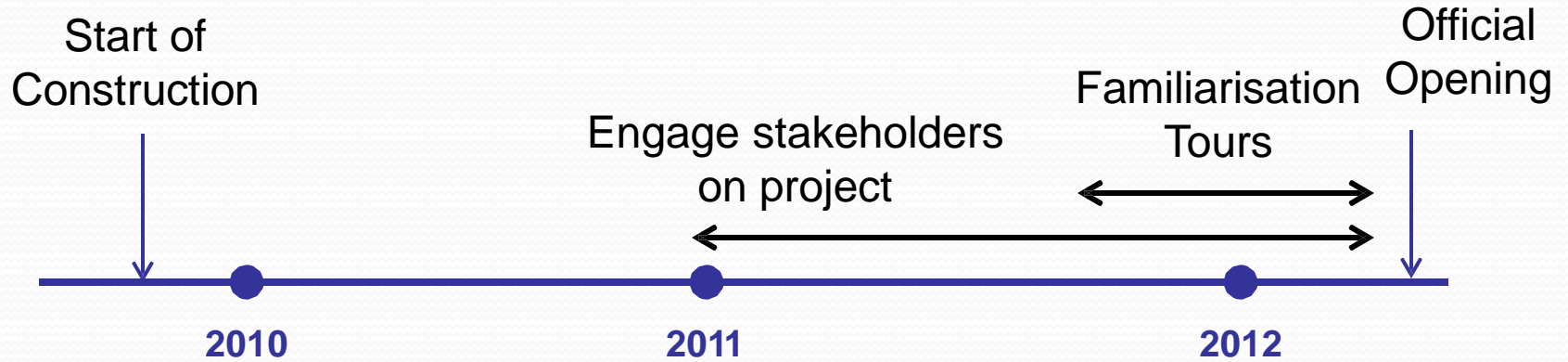
River surveillance personnel – CISCO

-Works with PUB operations to ensure river safety

-24 hours surveillance of the waters.

Community Engagement for Bishan Park

Timeline of Events

Start of Construction

Engage stakeholders on project

Familiarisation Tours

Official Opening

2010   2011   2012

Thank you