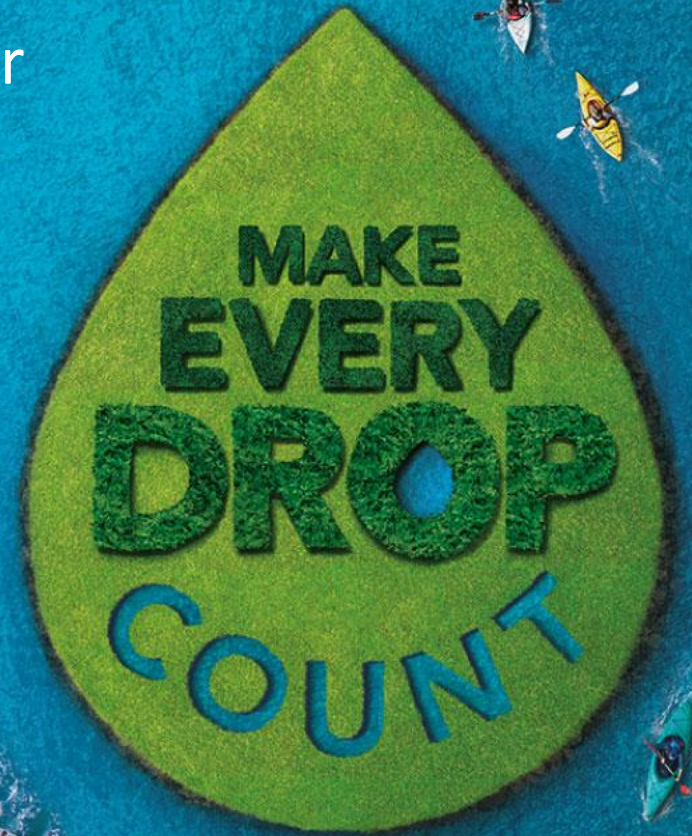


Managing Surface Runoff and Water Pollution Control Measures for Agricultural Developments within Water Catchment Areas

Idaly Mamat
Senior Assistant Director
Catchment & Waterways
(Drainage Planning)



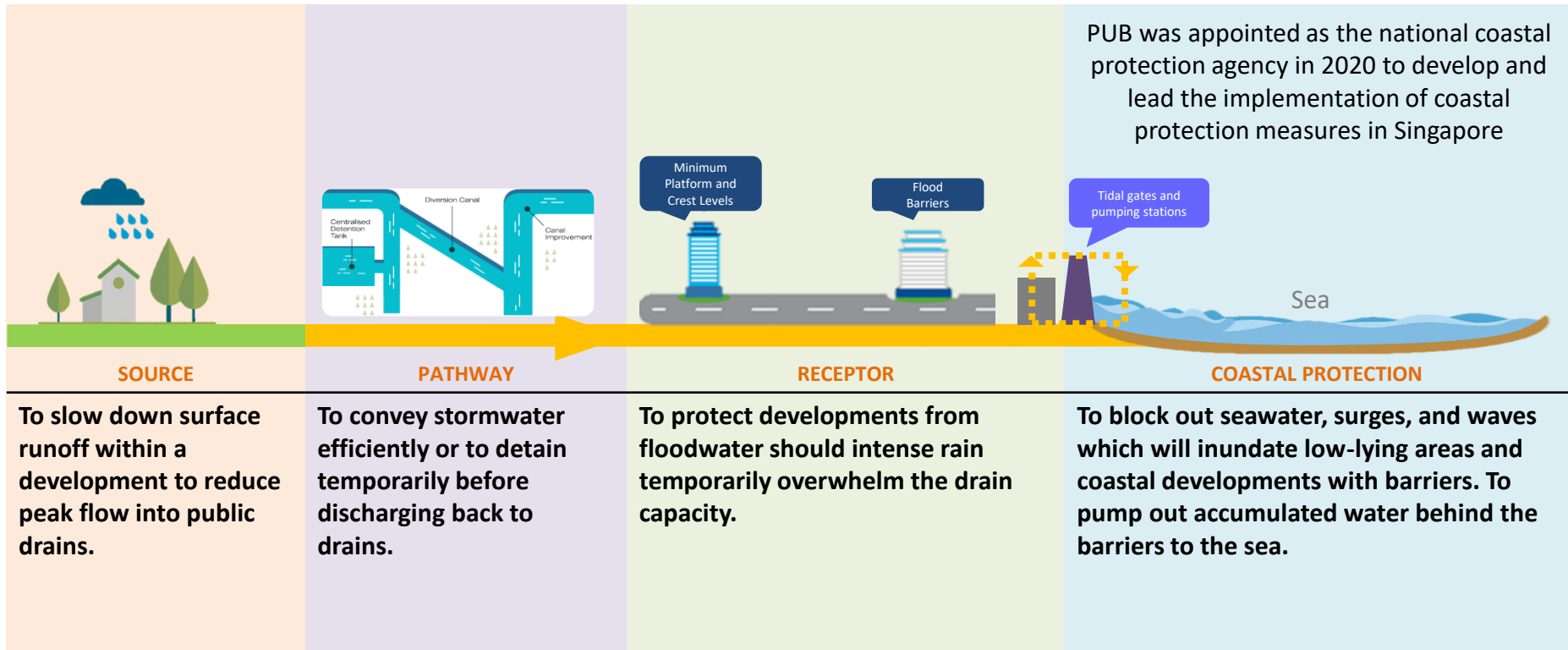
Outline

For Land-Based Agricultural Developments

1. Key Drainage Submission Requirements

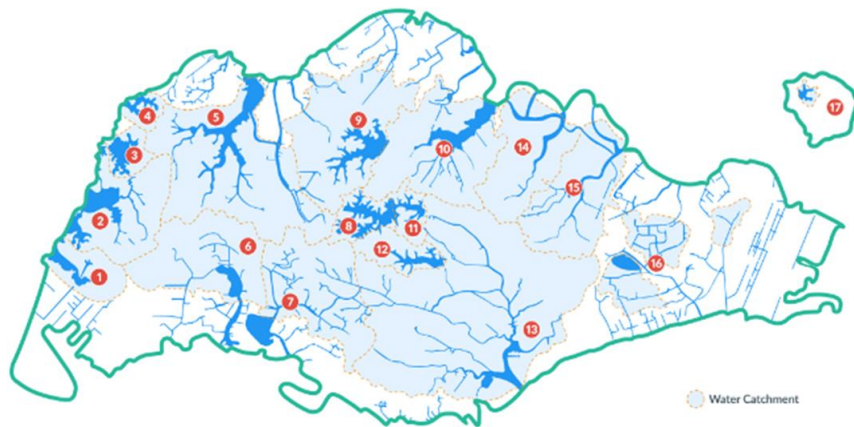
- Managing Peak Runoff – Onsite stormwater detention
- Best Management Practices (BMP) – Source pollution control

Holistic “Source-Pathway-Receptor” approach to enhance flood protection

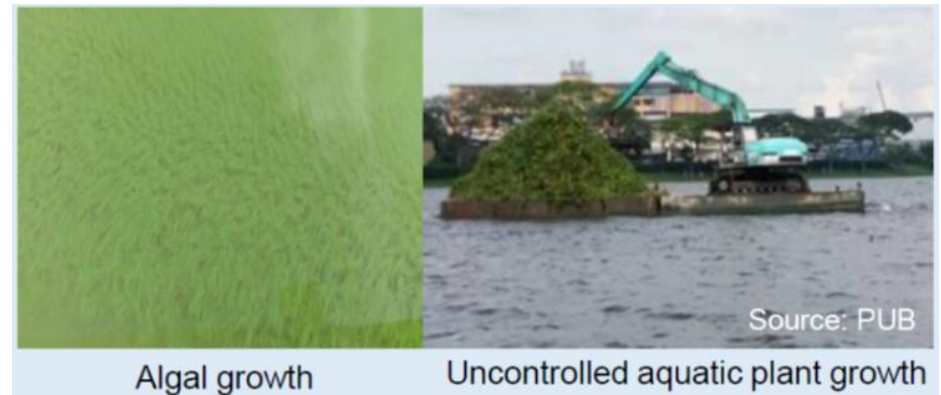


Two-thirds of Singapore is catchment for our drinking water supply

- Unmanaged runoff from agricultural developments may lead to high levels of suspended solids, nutrients (nitrogen and phosphorus) and organics entering the reservoir(s), leading to algae and aquatic plant growth.
- PUB requires water pollution control measures and BMPs to be incorporated in the design of all agricultural developments sited within water catchment areas
- Separate systems are used to collect rainwater and used water



Water catchment area in Singapore (in blue)

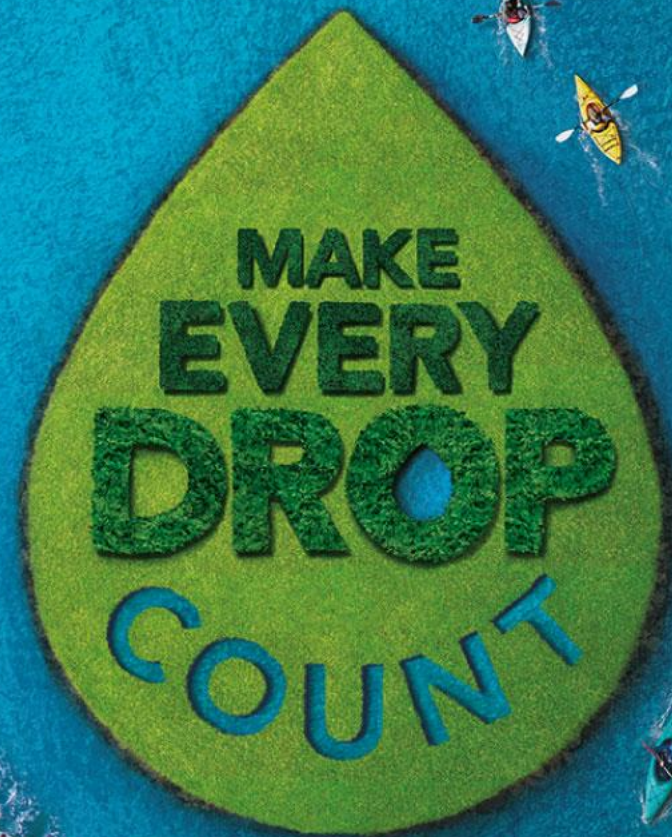


Algal growth

Uncontrolled aquatic plant growth

Key Drainage Submission Requirements

Managing Peak Runoff – Onsite
Detention Systems

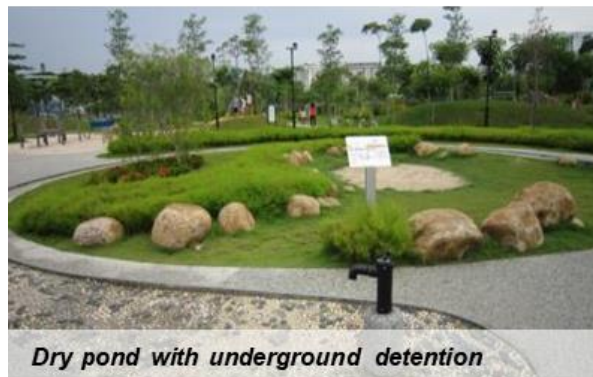


1. Managing Peak Runoff – Onsite Detention Systems

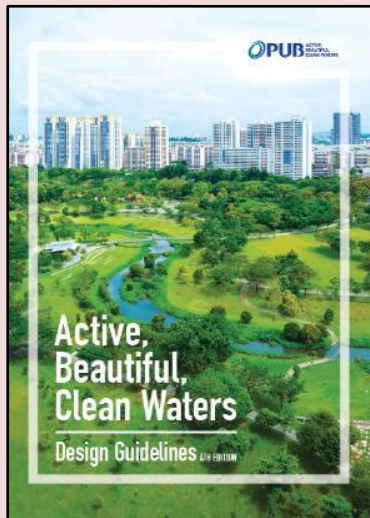


Source Control

- New and redevelopments (0.2 hectares or larger) are required to implement onsite detention measures to slow down stormwater runoff entering the public drainage system
- Maximum allowable peak runoff** to be **discharged to the public drains** will be calculated based on a **runoff coefficient of 0.55**, and for design storms with a return period of 10 years and for various storm durations of up to 4 hours (inclusive).



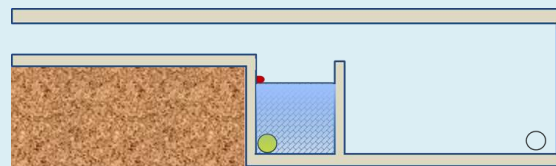
Examples of Detention Systems to Suit Farming Needs



ABC Waters Design Features



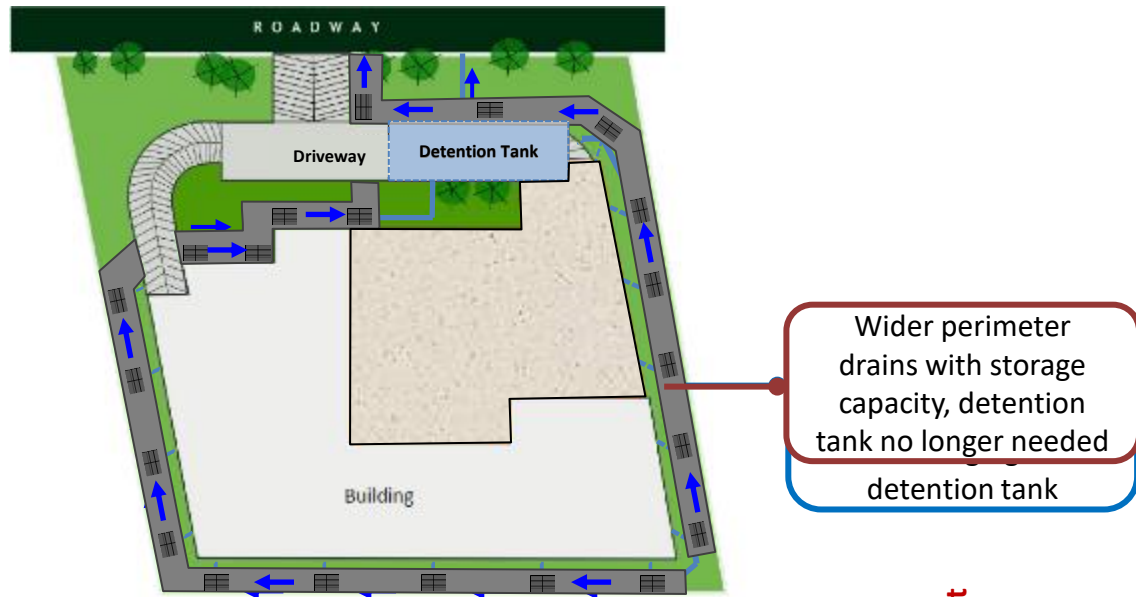
Enlarged perimeter drains with controlled orifice discharge



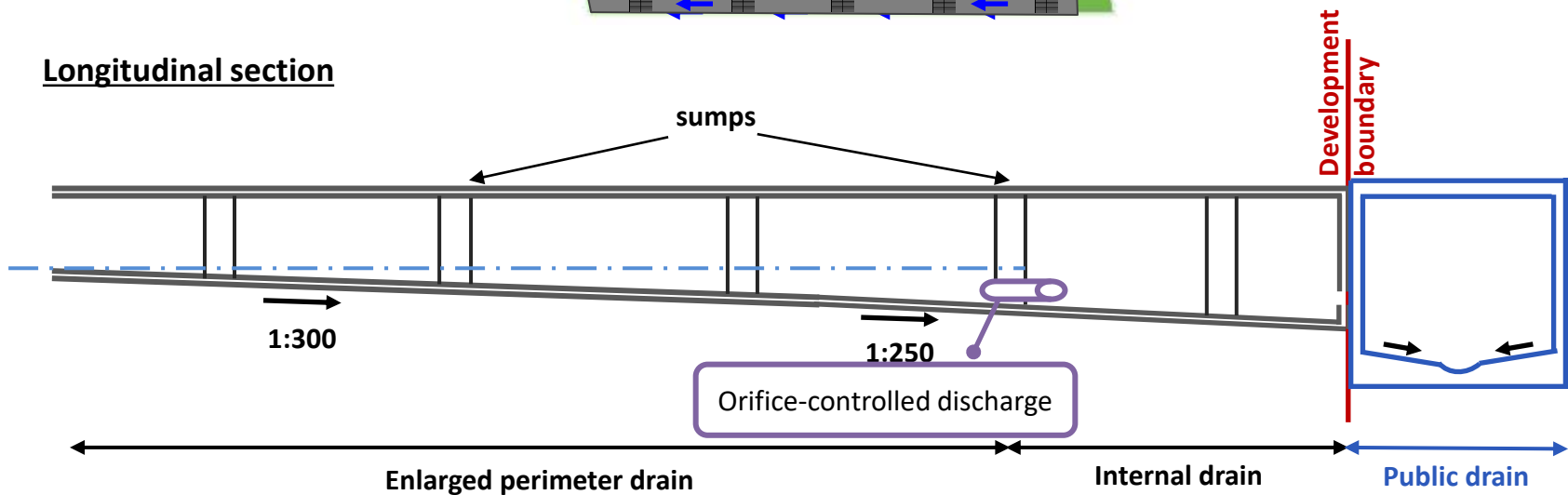
Combined Stormwater Detention & Rainwater Harvesting System

Enlarged Perimeter Drains with Orifice-controlled Discharge

Site plan

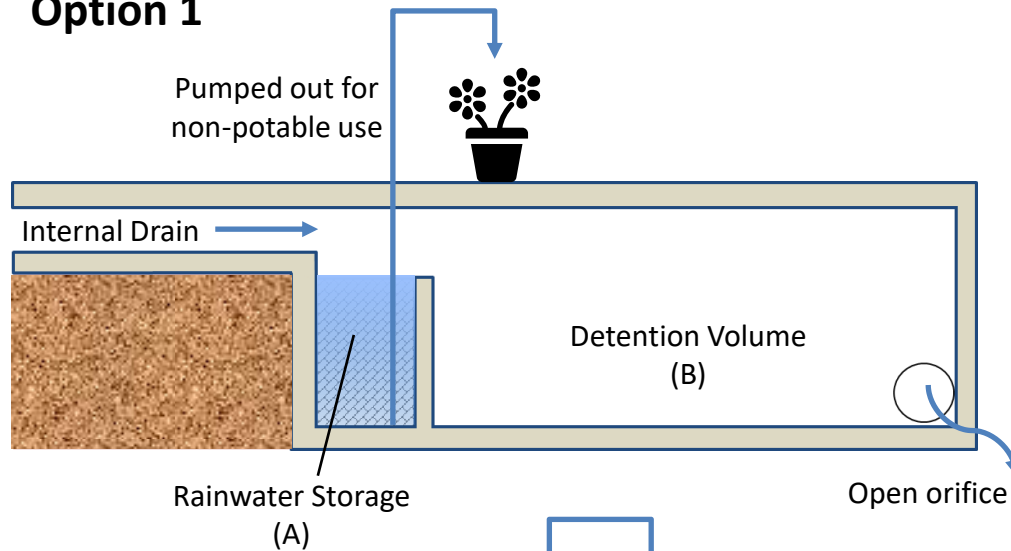


Longitudinal section



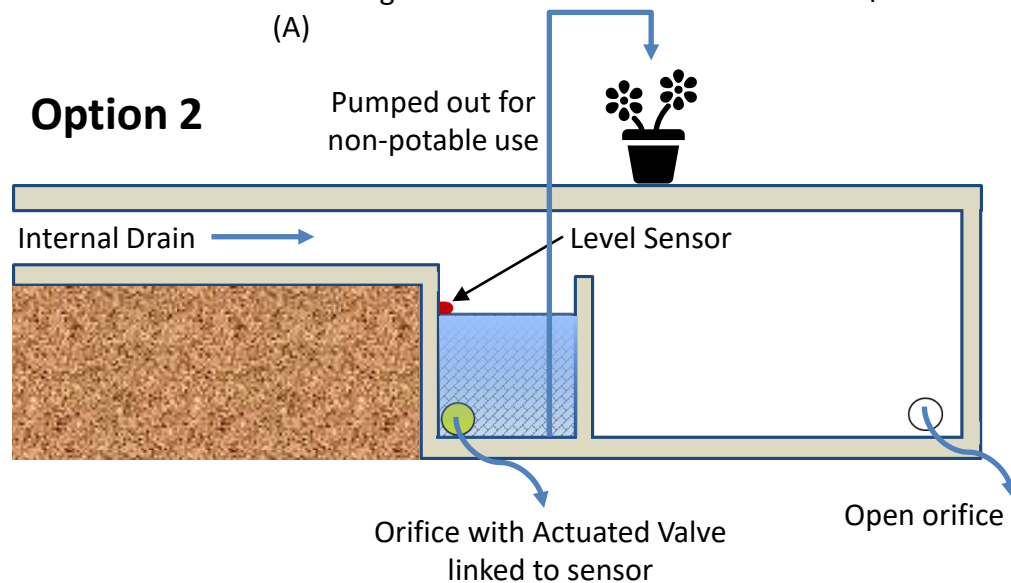
Examples of Combined Stormwater Detention and RWH Systems

Option 1



- Rainwater harvesting volume and Stormwater detention volume are separate
- Volume (B) must be emptied with 4h after rain and kept empty to prepare for the next storm

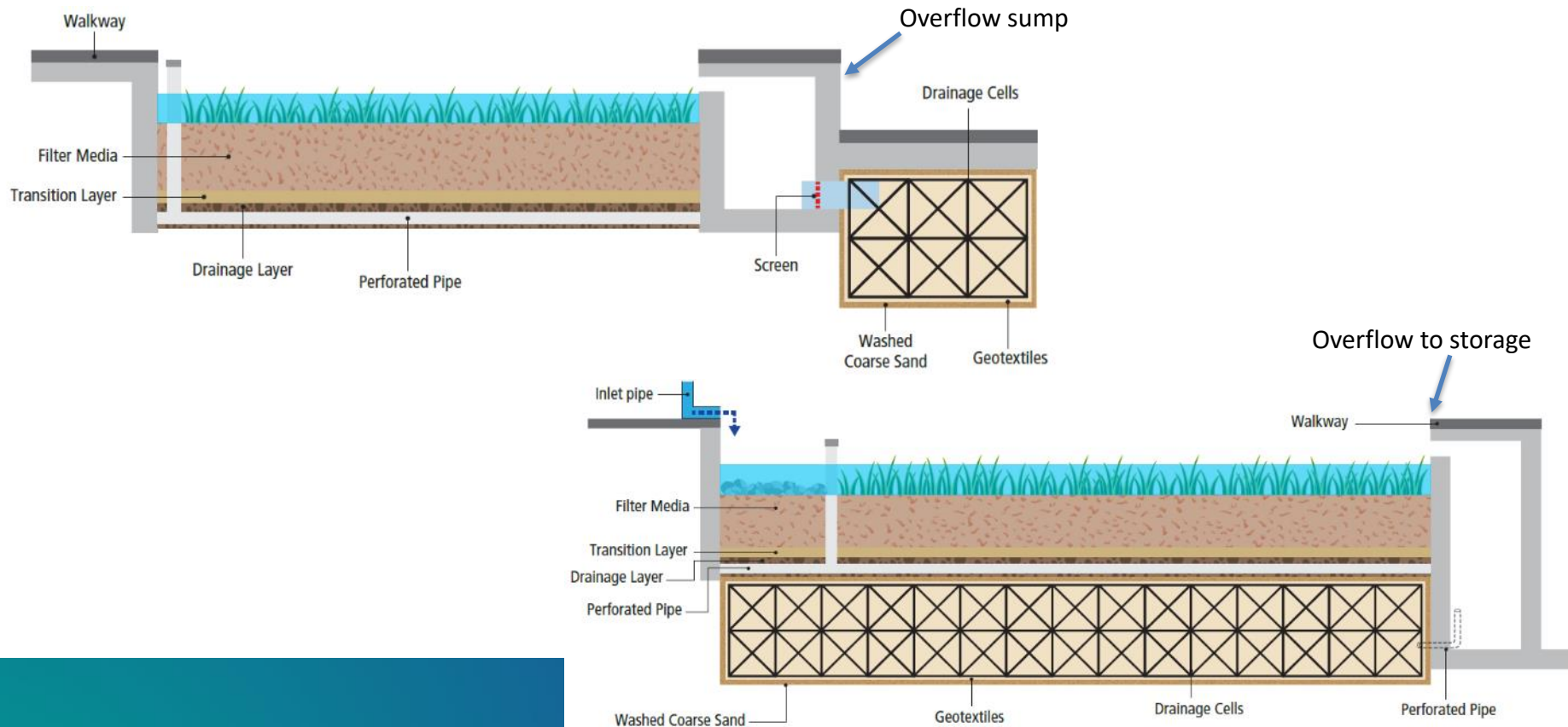
Option 2



- Sensors could be deployed in the design to optimize the rainwater harvesting and stormwater detention volume
- Outcome-based: design calculations must show that the maximum allowable discharge is not exceeded, and the required detention volume is provided within 4h after the storm

ABC Waters Design Features as Detention Systems

- ABC Waters design features can be designed as an online detention system to offset the volume required for structural detention tanks
- ABC Waters design features itself can provide storage e.g. within the extended detention depth and thick drainage layer of a bioretention basin
- **Hybrid systems** – ABC Waters design features integrated with drainage cells to provide additional storage volume



Resources

ON-SITE STORMWATER DETENTION TANK SYSTEMS
TECHNICAL GUIDE



1



CONDENSED BOOKLET ON ENGINEERING PROCEDURES FOR ABC WATERS DESIGN FEATURES
2018 EDITION



2

GUIDANCE NOTES FOR THE APPLICATION OF RAINWATER COLLECTION SYSTEMS

An application to obtain the approval of PUB under s.51 and comply with the following requirements:



3

BPU online portal:

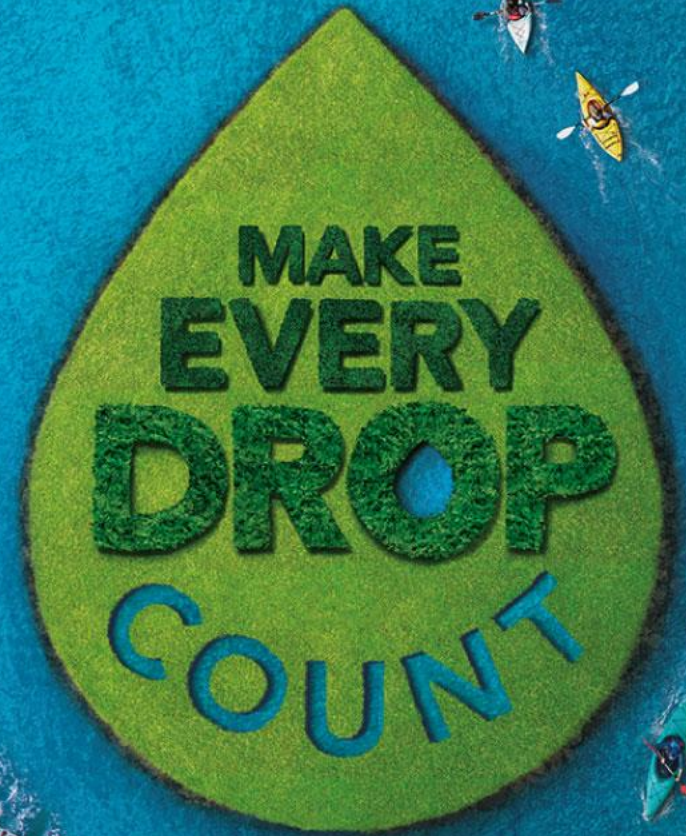
4



1. <https://www.pub.gov.sg/Documents/detentionTank.pdf>
2. <https://www.pub.gov.sg/Documents/Condensed Booklet of Engin Procedures.pdf>
3. <https://www.pub.gov.sg/Documents/GuidanceNotes.pdf>
4. <https://bpu.pub.gov.sg/Forms/EForms/Instruction?form=Drainage>

Key Drainage Submission Requirements

Best Management Practices – Source
Pollution Control



What are the benefits of implementing BMPs?



Source: NParks

Cut-off drains channel runoff to the **water treatment pond** and pond water can be used for irrigation



Source: SFA

Use only **pesticides and herbicides approved by SFA** to ensure food and environmental safety



Source: SFA

Sheltered vegetable plots help to contain nutrients and retain moisture to support plant growth



Source: NParks

Good housekeeping allows optimal use of plot space



Source: PUB

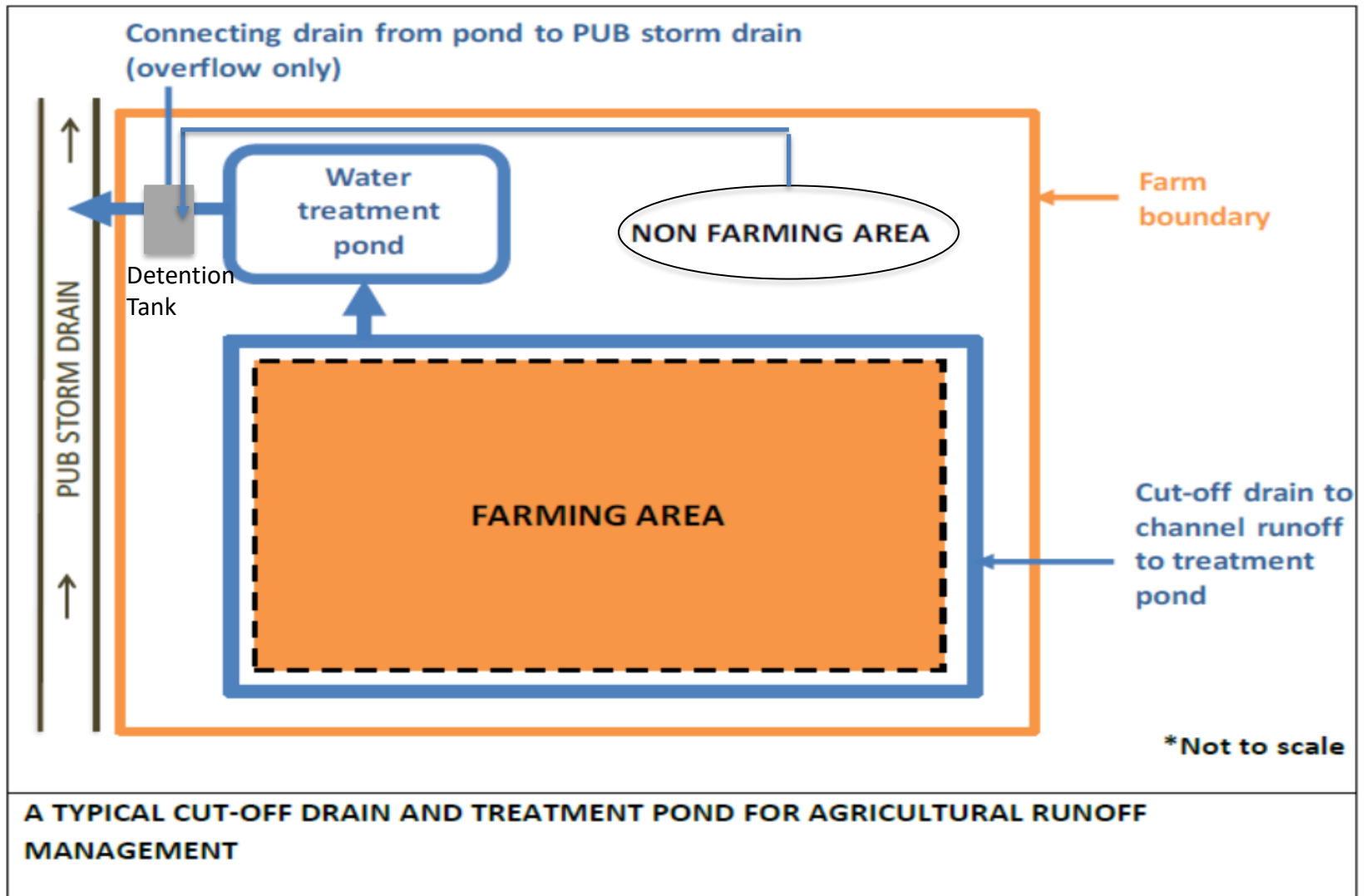
Growing wetland plants in the water treatment pond allows for a more environmentally sustainable treatment process compared to chemical treatment



Source: PUB

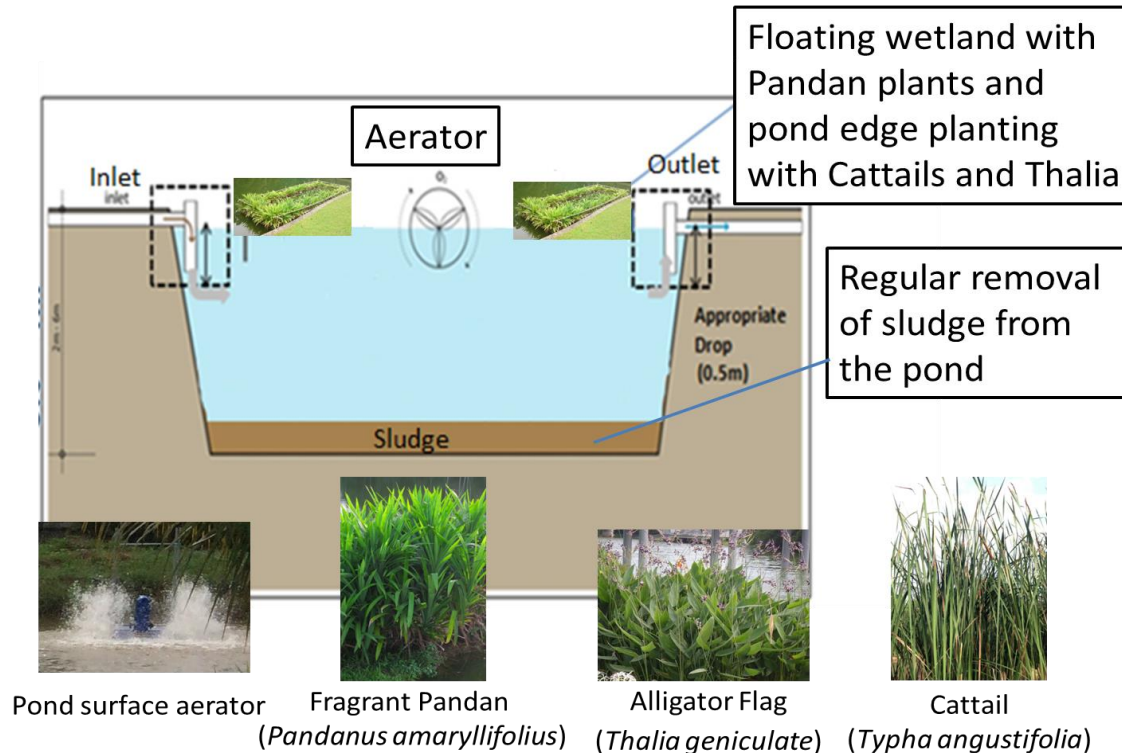
Closed-loop water recirculation system to manage any nutrient-rich runoff for reuse within the site

Best Management Practices (BMP) – Typical Design




A typical treatment pond

- Farm owners and Qualified Persons (QPs) can provide alternative proposals on BMPs to meet the pollution control requirements for PUB's evaluation.
- Details on the construction of wetlands and vegetated swale can be found in the [ABC Waters Design Guidelines](#).



Thank You



MAKE
EVERY
DROP
COUNT