NbS-11: BIORETENTION PONDS AND SWALES

Bioretention ponds and swales can enhance flood management and urban resilience by mimicking natural hydrological processes to capture, store, and treat stormwater runoff. These systems are particularly relevant in Southeast Asia, where rapid urbanization and monsoonal rains contribute to flash floods and water pollution.

Bioretention ponds are shallow, vegetated basins designed with layers of soil, sand, and gravel to filter and depollute water, while swales are gently sloping channels that convey and infiltrate runoff, reducing peak flows and recharging groundwater.

Together, they mitigate flood risks, improve water quality through pollutant filtration and sedimentation, and support biodiversity by creating green habitats.

Beyond technical benefits, they enhance urban landscapes, foster community awareness, and reduce reliance on costly engineered infrastructure, making them suitable for both cities and villages.

Singapore's ABC Waters Program exemplifies their successful implementation, while areas like the Mekong Delta or rural Indonesia could adopt these systems to address localized flooding, sedimentation, and water resource challenges, promoting resilience and sustainability in diverse settings.

LANDSCAPES SUPPORTED

EbA (ECOSYSTEM-BASED APPROACHES)

STORMWATER MANAGEMENT | POLLUTION MITIGATION | GROUNDWATER RECHARGE | COMMUNITY RESILIENCE | HABITAT CREATION | URBAN HEAT ISLAND MITIGATION

MAIN PROBLEMS ADDRESSED

BIODIVERSITY LOSS

FLOOD CONTROL

DISASTER RISK REDUCTION

AIR QUALITY IMPROVEMENT

URBAN HEAT ISLAND

ECOSYSTEM SERVICES AND ACTIONS

SUPPORTING

- **Enhance biodiversity** by creating habitats for flora and fauna within urban and peri-urban areas.

REGULATING

- **Manage stormwater** by reducing runoff, peak flows, and flash flooding through natural filtration and infiltration.

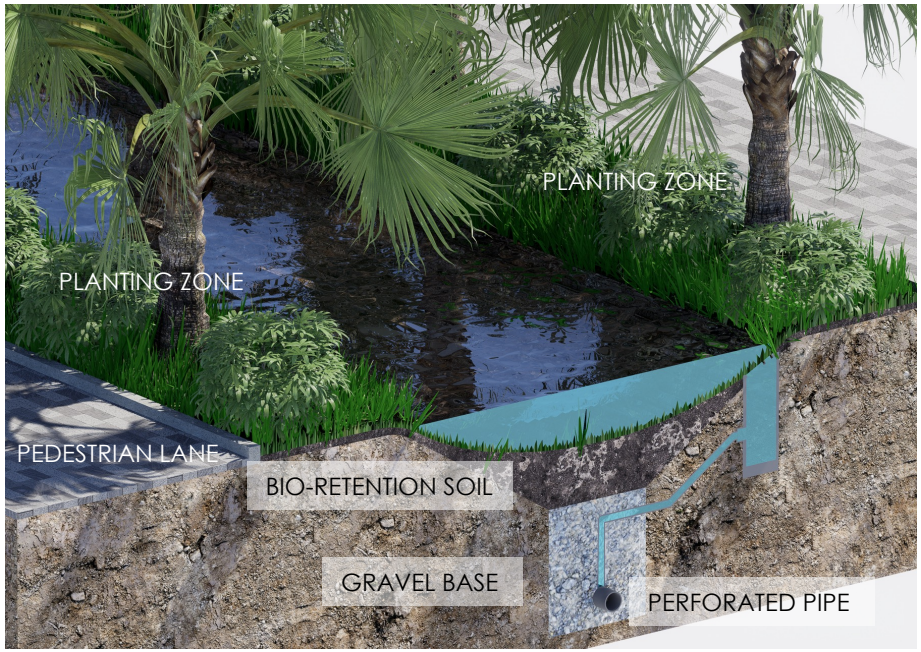
PROVISIONING

- **Replenish groundwater resources** by facilitating aquifer recharge during storm events.

SOCIAL BENEFITS

- **Improve urban aesthetics and public spaces**, fostering recreational opportunities and community engagement in climate resilience efforts.

NbS-11: BIORETENTION PONDS AND SWALES



Bioswale typical section. Source: Citilinks

Bioswale in Kronsberg, Germany

PROJECT'S CHALLENGES & RISKS

- **Space Constraints**: Rapid urbanization and high population density often limit the availability of land for implementing bioretention ponds and swales.
- **Maintenance Challenges**: Inadequate maintenance can lead to clogging, reduced infiltration capacity, and poor vegetation health, undermining long-term functionality.
- **Climate Variability**: Extreme rainfall or prolonged droughts can reduce the effectiveness of bioretention systems, causing overflow or drying out.
- **Pollutant Overload**: High pollutant loads from industrial and urban runoff may exceed the filtration capacity, leading to potential contamination of nearby soil and groundwater.

NbS co-BENEFITS AND THEIR INDICATORS

- **Flood Mitigation**
  Reduction in urban flooding frequency by managing peak stormwater flows.
- **Water Quality Improvement**
  Decrease in nutrient and pollutant concentrations in runoff, measured through water quality testing.
- **Biodiversity Enhancement**
  Increase in native plant and animal species in and around urban green spaces.
- **Groundwater Recharge**
  Measurable increase in local aquifer levels due to infiltration.
- **Urban Heat Island Reduction**
  Reduction in ambient temperatures in areas with bioretention systems, tracked via thermal imaging.
- **Community Liveability**
  Increased recreational use and positive feedback from residents in areas with well-maintained bioretention features.

COST ANALYSIS

- **Direct Costs**
  Initial construction costs range from $15k to $50k/ha, depending on design complexity and materials.
- **Indirect Costs**
  Annual maintenance costs are estimated at $1k to $5k/ha, covering vegetation upkeep and sediment removal.
- **Time Horizon**
  20-30 year lifespan, with a discount rate of 5-8% for long-term economic evaluations.
- **Direct Benefits**
  Flood damage mitigation can save $10k to $30k annually per urban block during heavy rains.
- **Indirect Benefits**
  Improved ecosystem services, such as groundwater recharge and air quality.
- **Risk Assessment**
  Potential failure due to poor maintenance or extreme weather events.

REFERENCES:

Singapore, Bishan-Ang Mo Kio Park : urban park integrating bioretention swales and ponds.
Singapore, East Coast Park.
Australia, Sydney Water's Stormwater Project: Network of bioretention swales and rain gardens.

IMPLEMENTATION OPPORTUNITIES:

Indonesia, Jakarta.
Thailand, Bangkok.
Vietnam, Ho Chi Minh City.
Philippines, Cebu City.