

TREE AND WATER SENSITIVE URBAN DESIGN

By :
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Topic Aim:

To understand the basic trees functionalities as a Best Management Practise tools for surface runoff protection in urban setting

INTRODUCTION



WATER



TREE

Combination Tree and water in stormwater management controlled

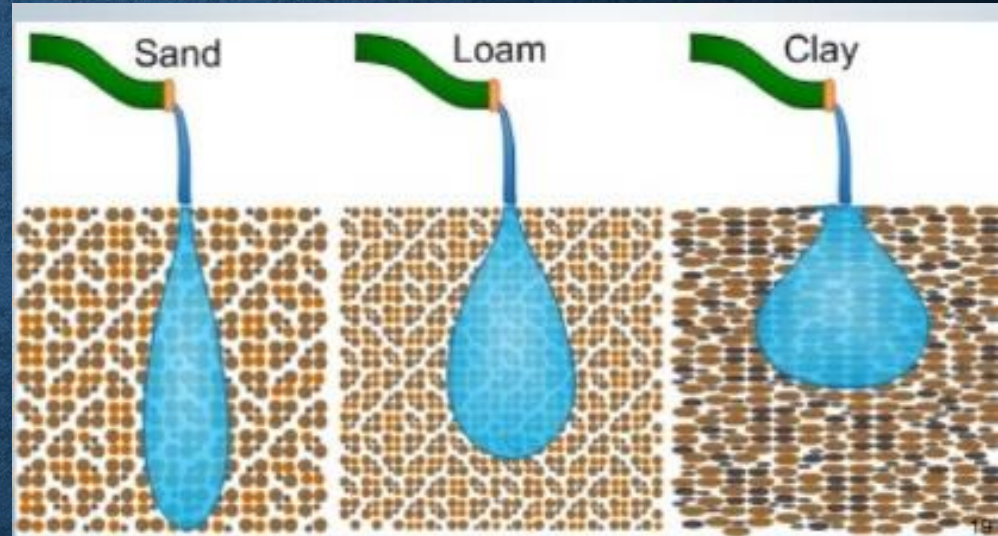


PLANT AND WATER IN TERRESTRIAL ECOSYSTEM

- **Forest and woodlands** – type of terrestrial ecosystem, and the relations water for the trees and how important trees for water in the ecosystem.
- **Original Forest (OF)** – often have extensive and **deep root systems** (maximum 15m) and be able to survive long rain –free periods (Rorberts ,1999),
- The **deep roots**, might produce insurance for the driest years, where by **roots shrinkage increase the infiltration process**. Most **Fine Root Biomass (FRB)** concentrated in the upper 30cm from surface OF floor area.

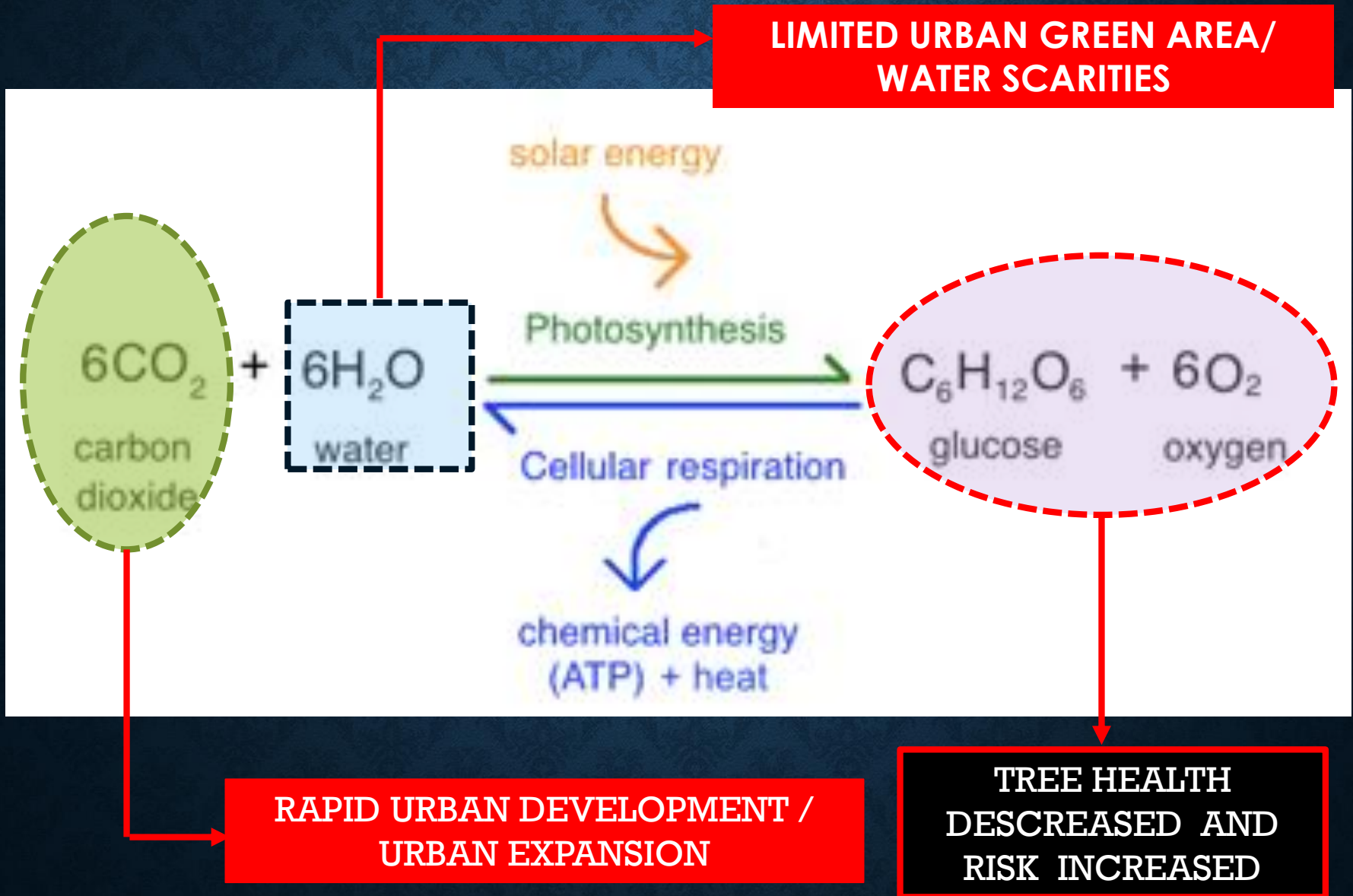
How do the trees play role in controlling run off?

- Vegetation dependent on the **soil water** availability through hydrological processes.
- The **Soil water balances** are influenced by combinations of climate, soil, and vegetation.

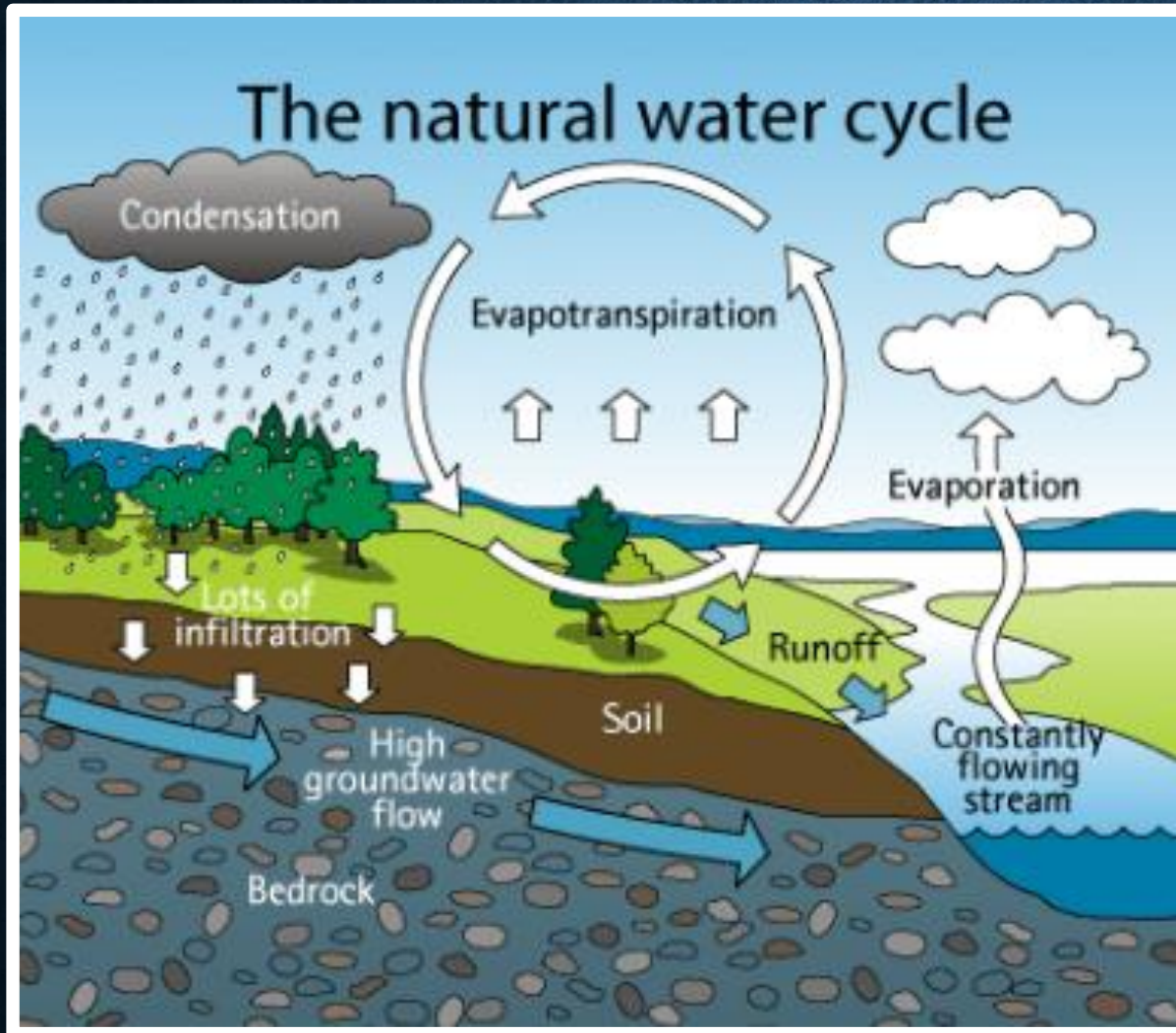


Response of water to different soils

The issues



SOIL MOISTURE AND WATER BALANCE CONTROLLED

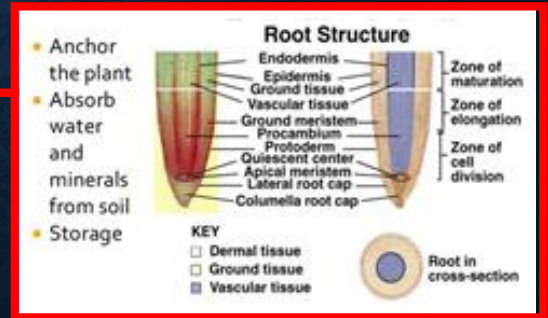
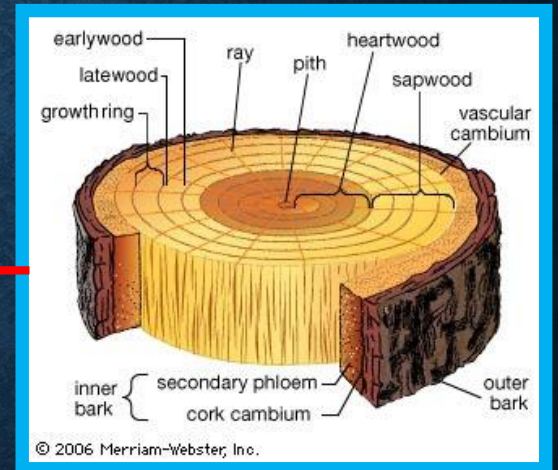
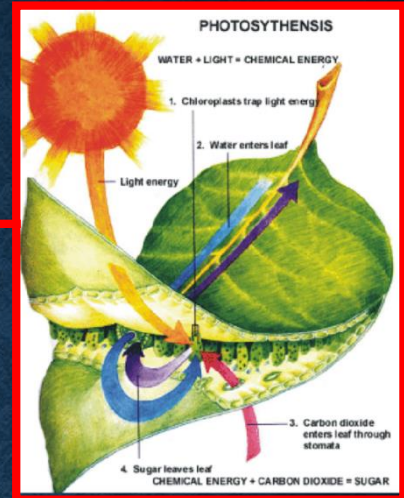
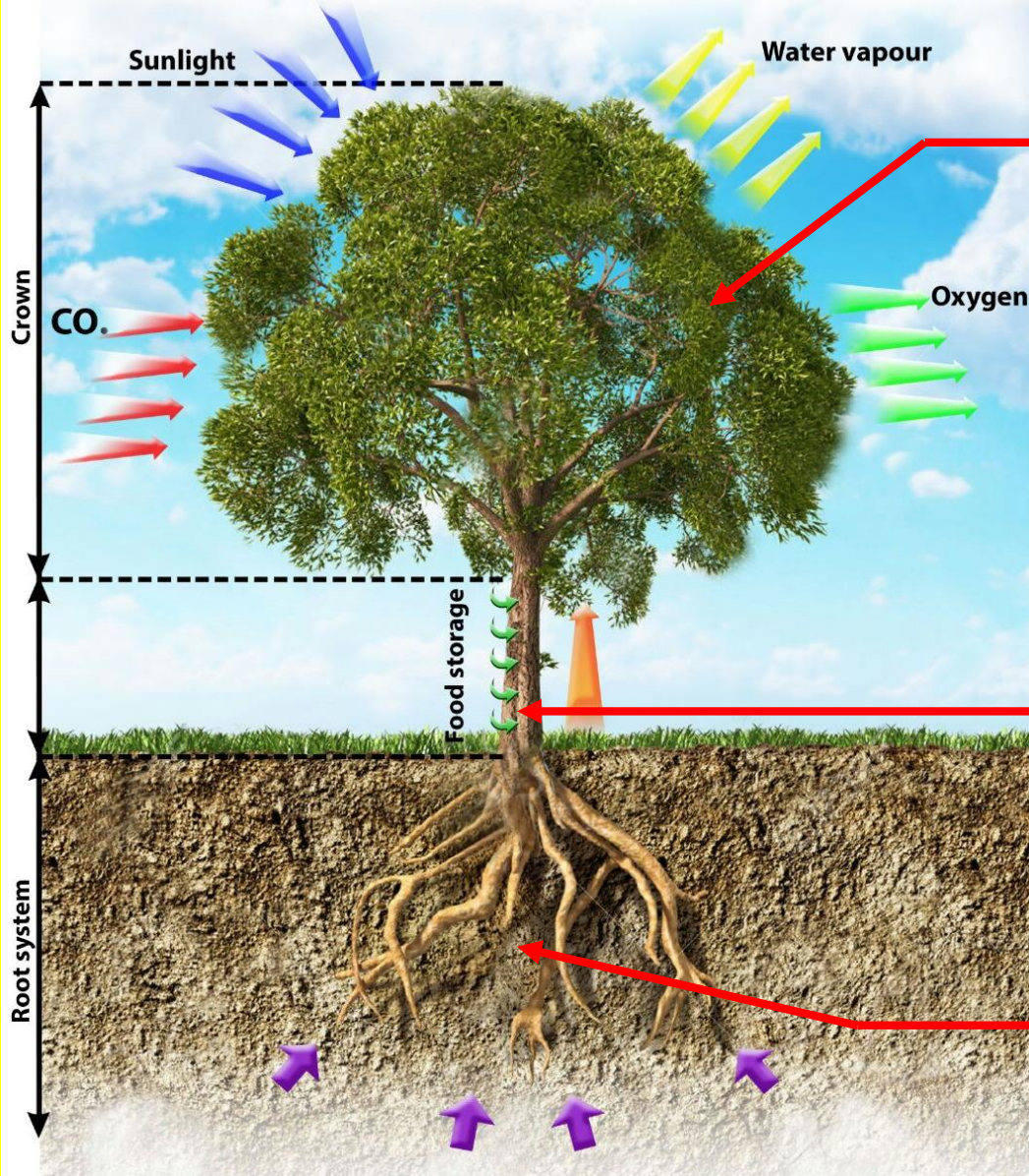


THE QUESTION ?

HOW THE URBAN TREE HEALTH COULD BE IMPROVED BY UNDERSTANDING SOIL MOISTURE AND WATER BALANCE CONCEPT IN PROTECTING AND STRENGTHENING URBAN ECOSYSTEM ?

THE INDIVIDUAL TREE HEALTH IMPROVEMENT WILL BE REDUCE THE PROBABILITIES OF URBAN TREES FAILURE.

Living cycle within the tree

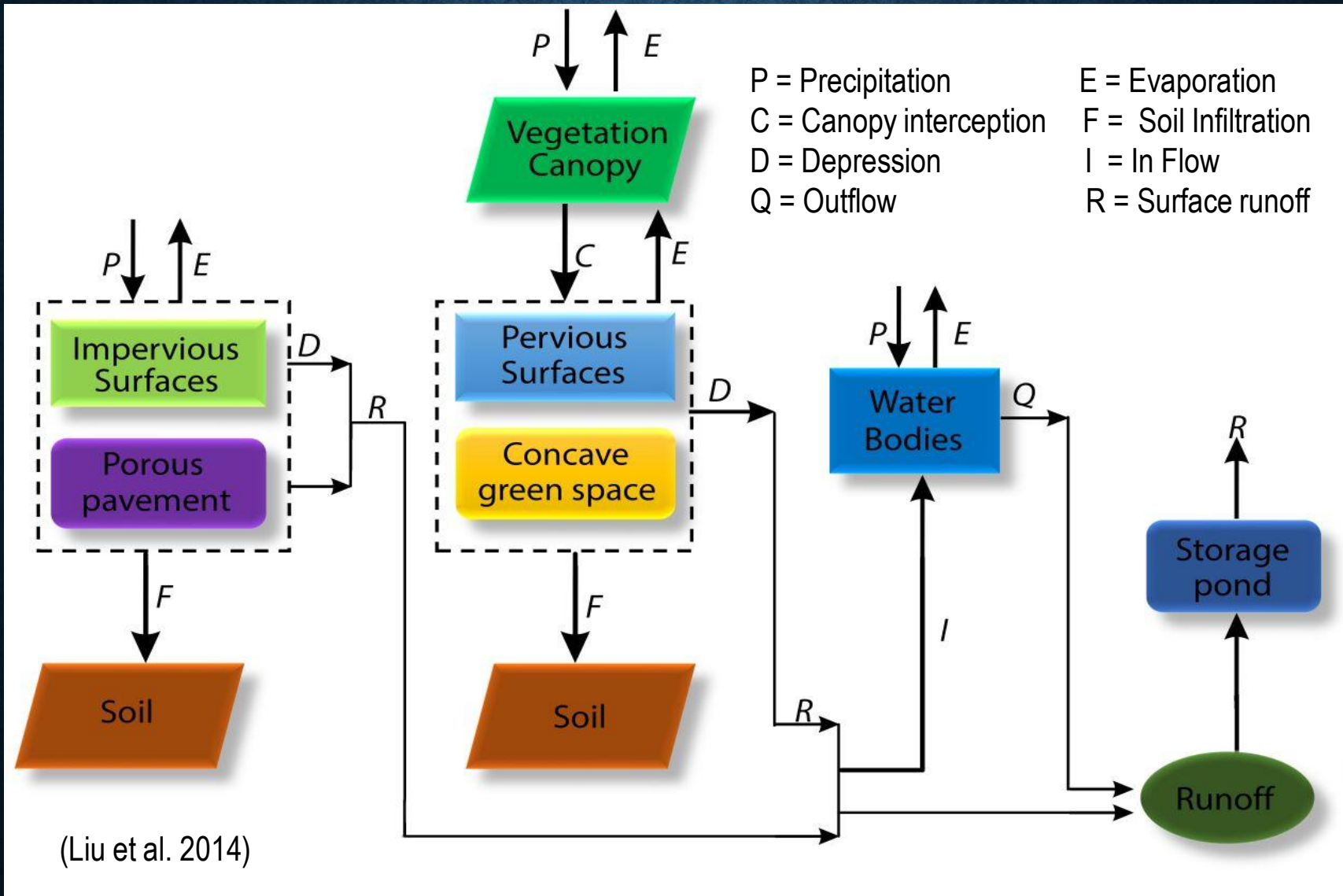


The issues

Impervious surfaces alter the hydrological nature of surface runoffs, prevent the infiltration of surface water into the ground, greatly increase storm runoffs in terms of volumes and peak flow (Goonetilleke et al., 2005; Whitford et al., 2001), and consequently causing floods in cities

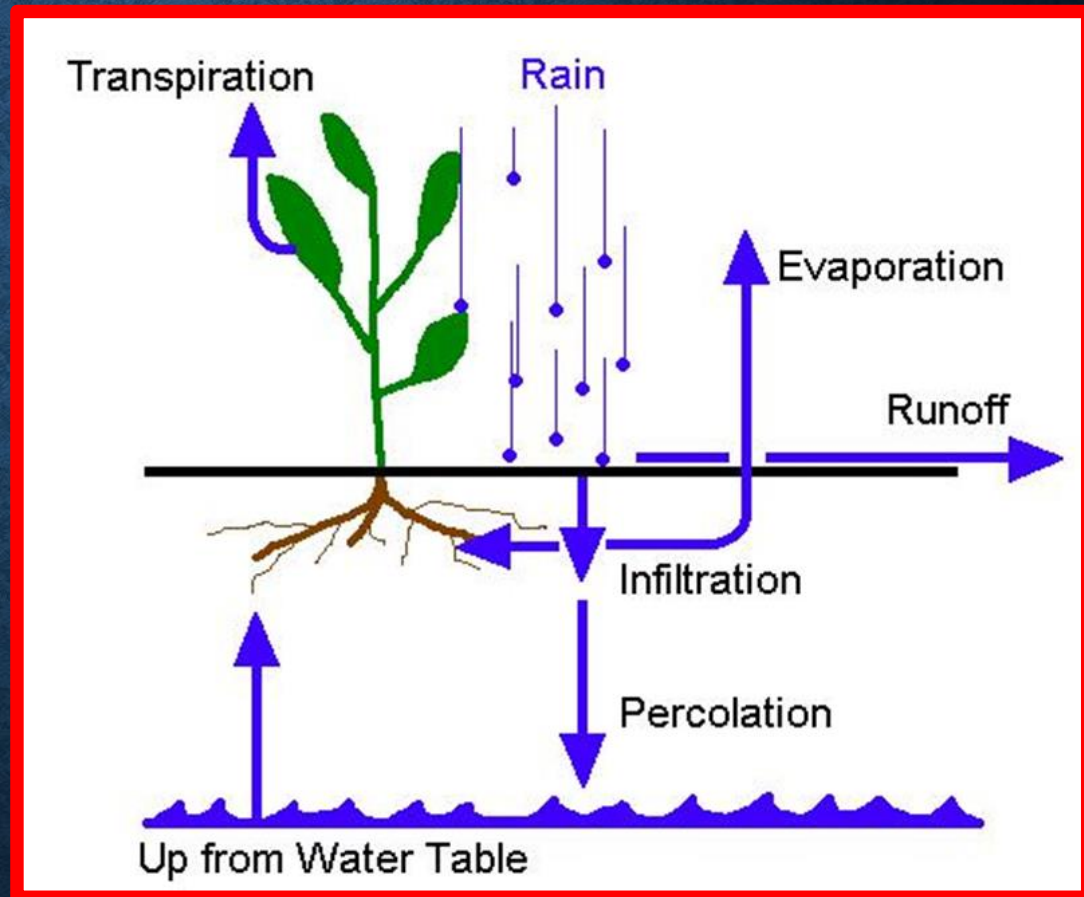


SCHEMATIC DEPICTION OF THE CALCULATION OF URBAN STORM WATER RUNOFF – The modification the nutrient cycle



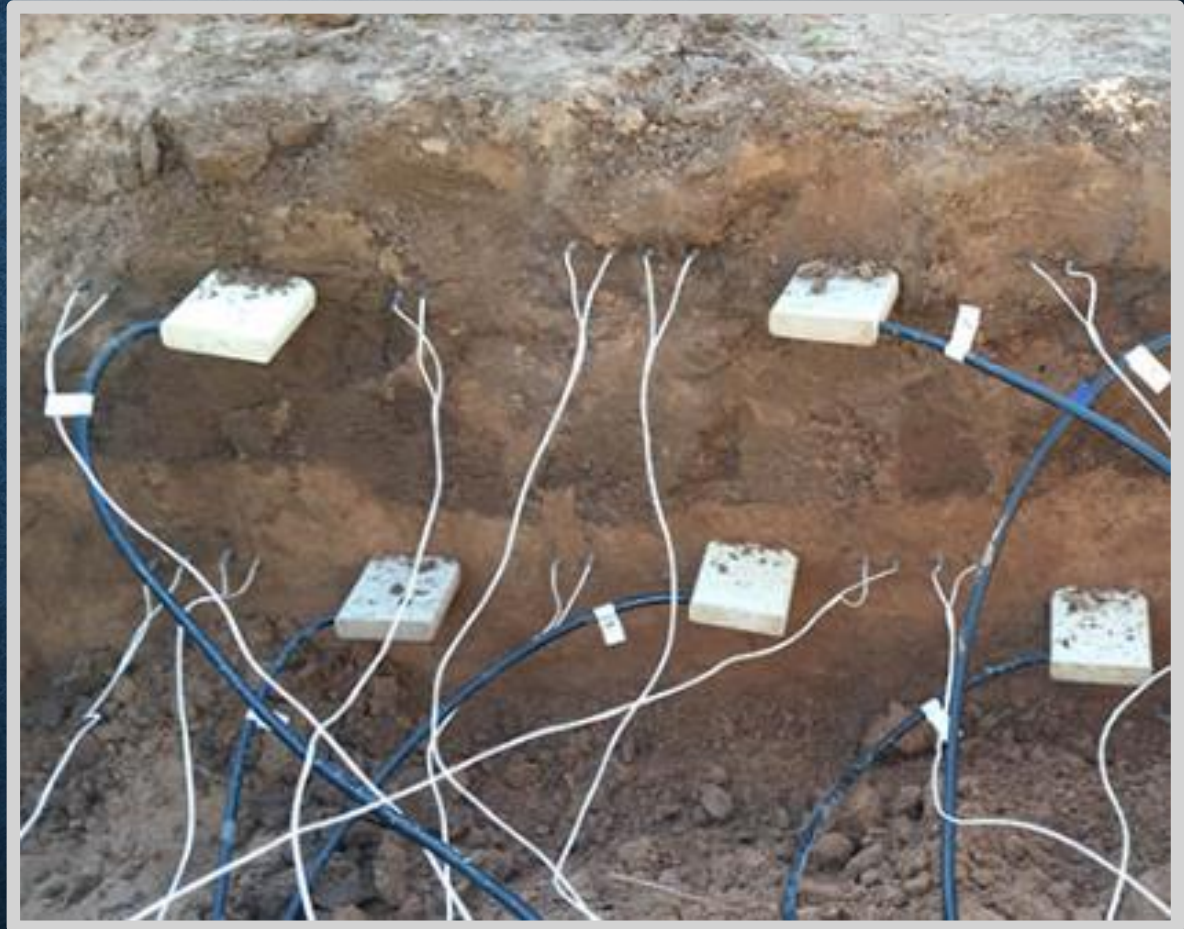
How do the trees play role in controlling run off?

- the soil water content controls the rates of rainfall infiltration, deep percolation, and runoff.
- Soil moisture conditions affect the heat on soil surface.

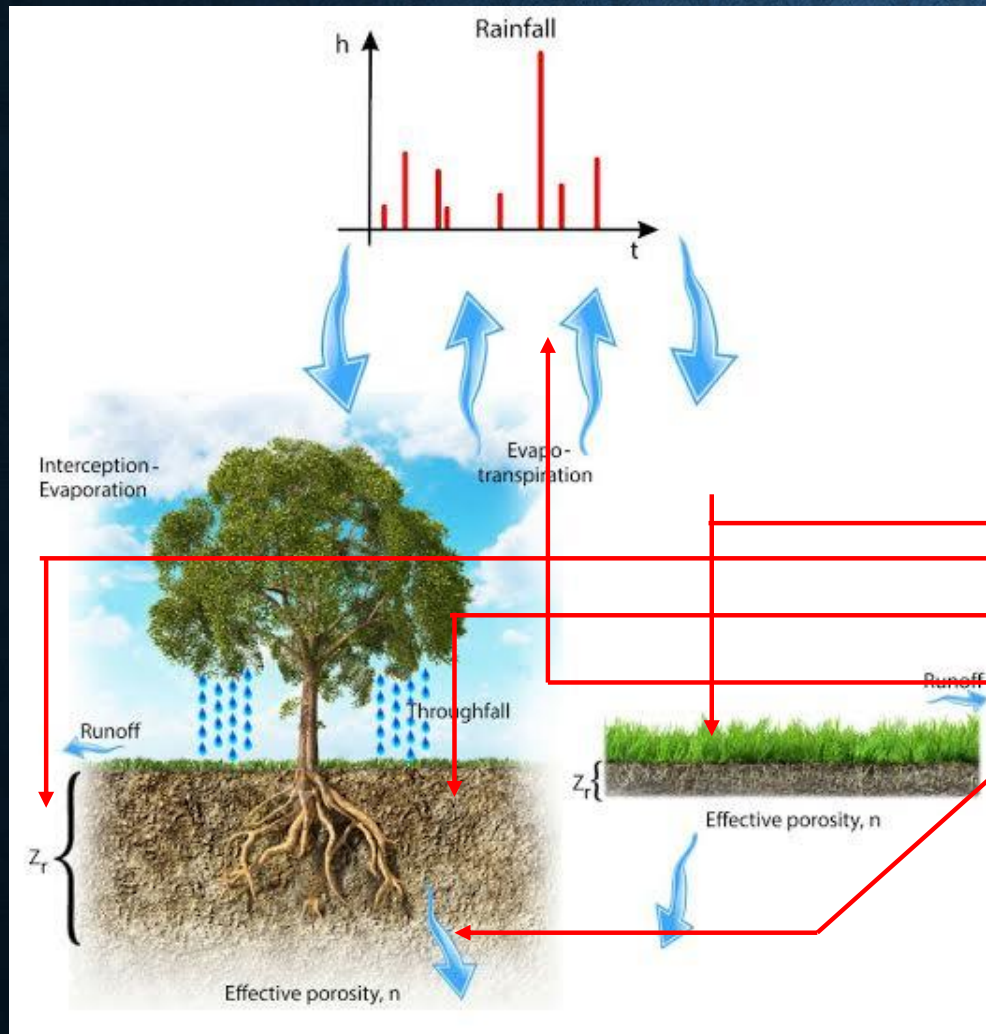


How do the trees play role in controlling run off?

- **Soil moisture controls** also the dynamics of **terrestrial ecosystems**, especially in conditions of scarce water availability



Trees role in controlled soil moisture dynamic and water balance



$$NZR \frac{ds}{dt} = I(S, T) - E(S) - L(S)$$

WHERE

N : POROSITY

ZR : THE ACTIVE DEPTH OF SOIL

S : RELATIVE SOIL MOISTURE CONTENT

$I(S, T)$: RATE OF INFILTRATION FROM RAINFALL

$E(s)$: THE RATE OF EVAPOTRANSPIRATION

$L(s)$: THE RATE OF LEAKAGE OR DEEP INFILTRATION

ECOHYDROLOGY OF WATER-CONTROLLED ECOSYSTEM

(RODIGUEZ-ITURBE & PORPORATO, 2004)

Case study 1 : Water shortage and soil compaction

Tree Condition

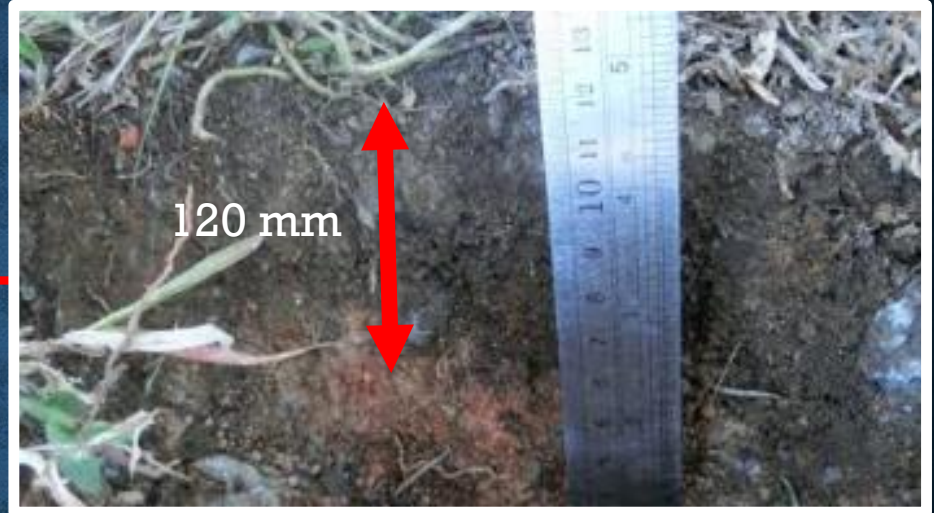
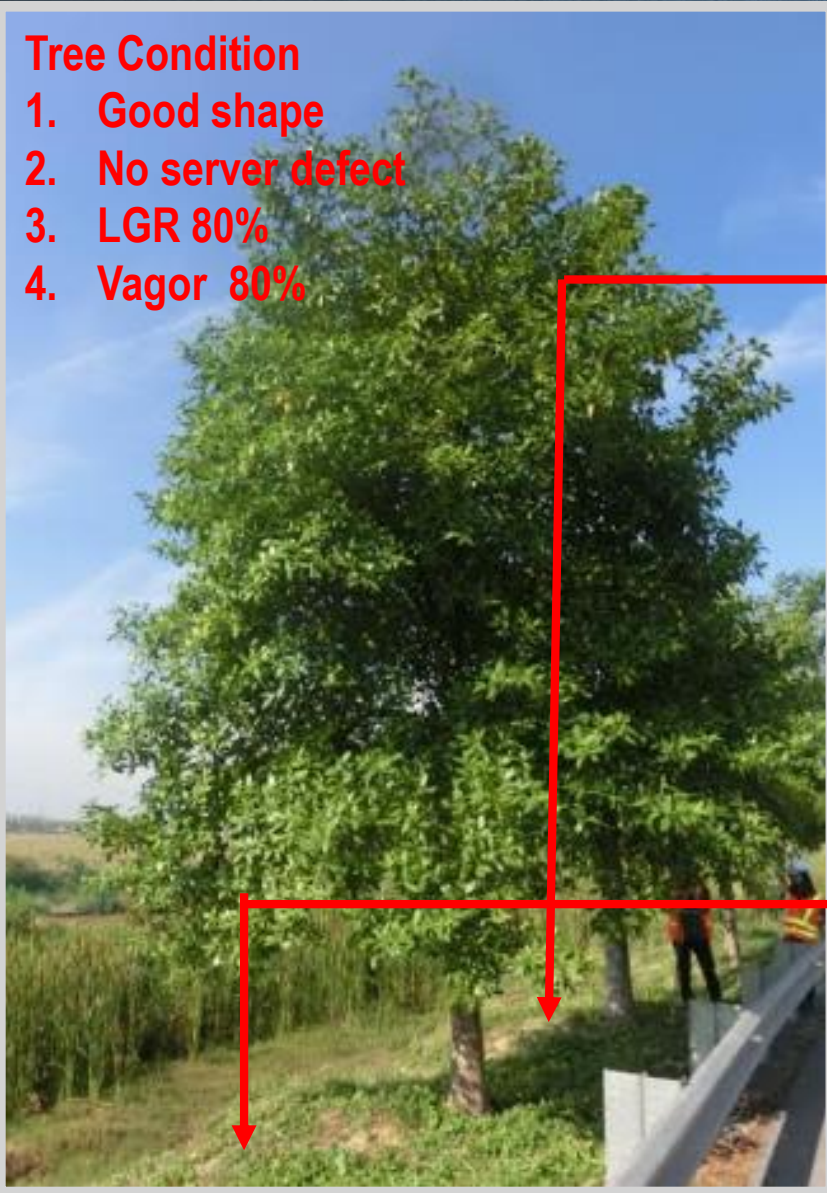
1. Stunted growth pattern
2. Moderate defect
3. LGR 60%
4. Vagor 60%
5. Shallow roots

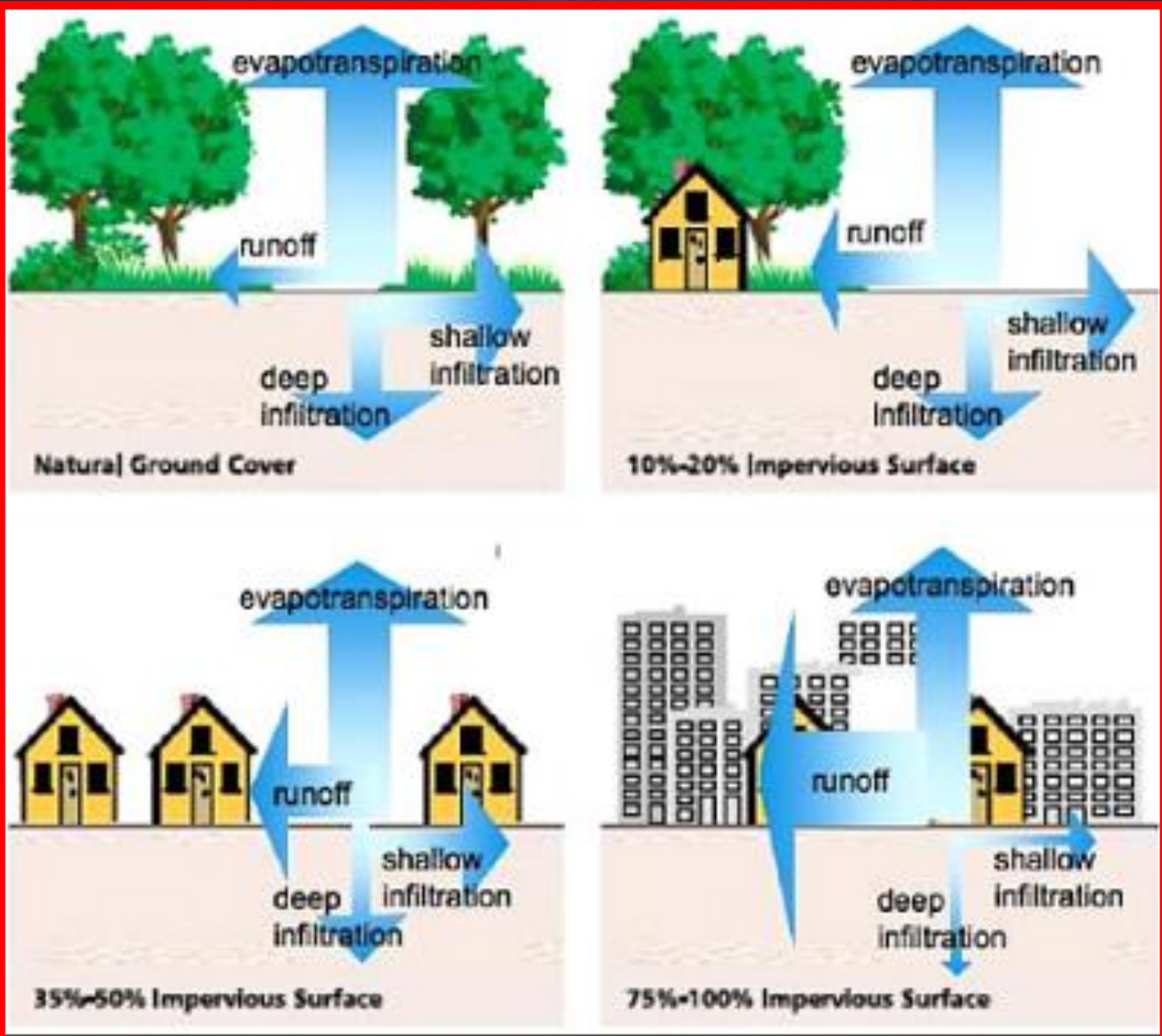


Case study 1 : Water shortage and soil compaction

Tree Condition

1. Good shape
2. No server defect
3. LGR 80%
4. Vagor 80%





Mimic the nature into the man made environment



Fine Root Biomass (Root crown diversity) increase the soil water penetration and soil moisture balance.



THE ISSUES



Rain droplet



The impervious surface



The increasing water volumes



Exceeding the water limit

To improve the water infiltration



IMPREVIOUS SURFACE

To improve the water infiltration – The combination of previous and impervious surface for surface runoff controlled



PREVIOUS SURFACE

MASSIVE LAND CLEARING – EARTHWORKS/ VEGETATION REMOVAL



The reality



Limit soil Volume



Limited green spaces

Tree functionalities ignorance during the development





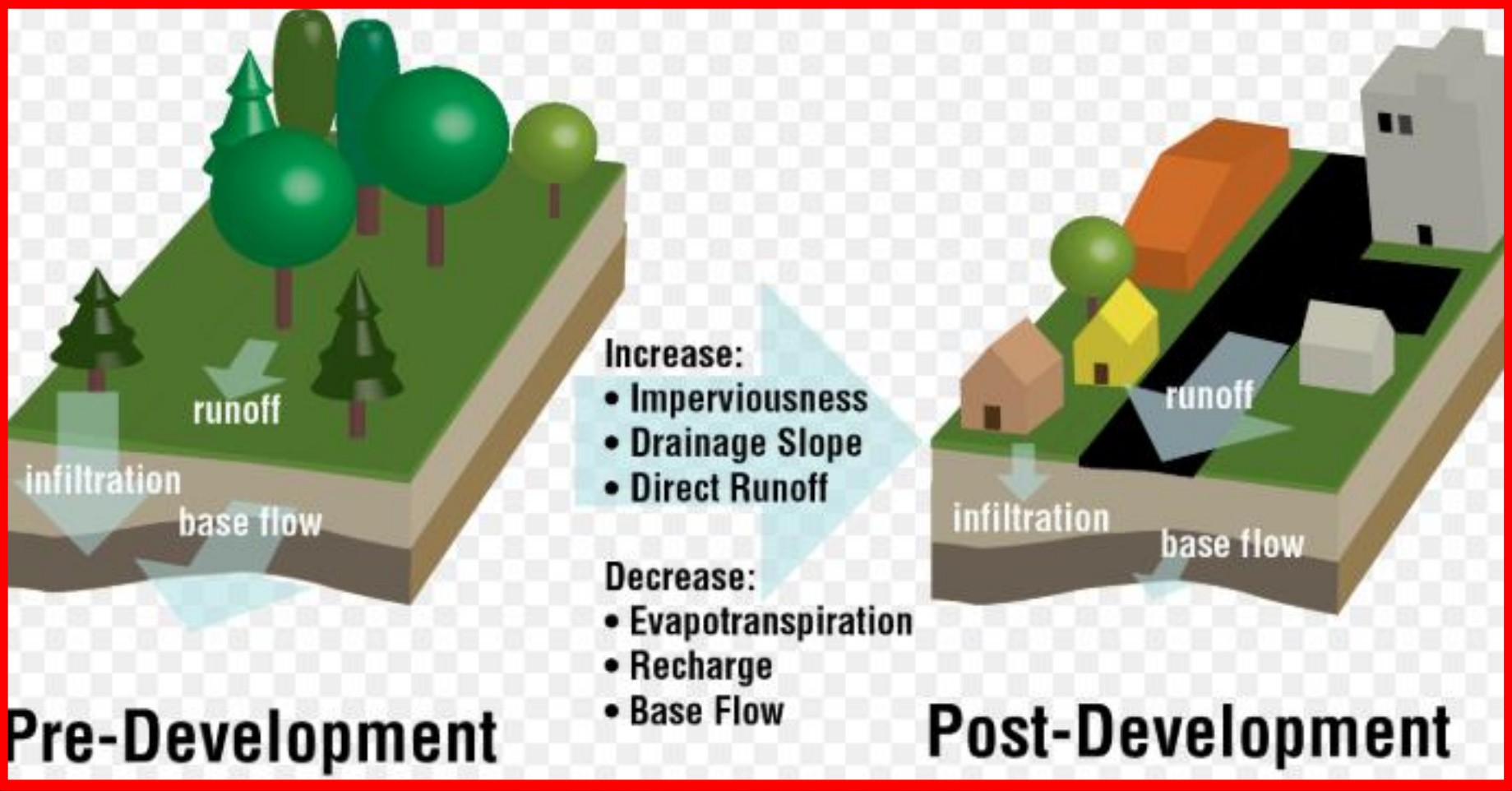
HASHIM DESIGN AND ASSOCIATE SDN BHD.



18/9/2019

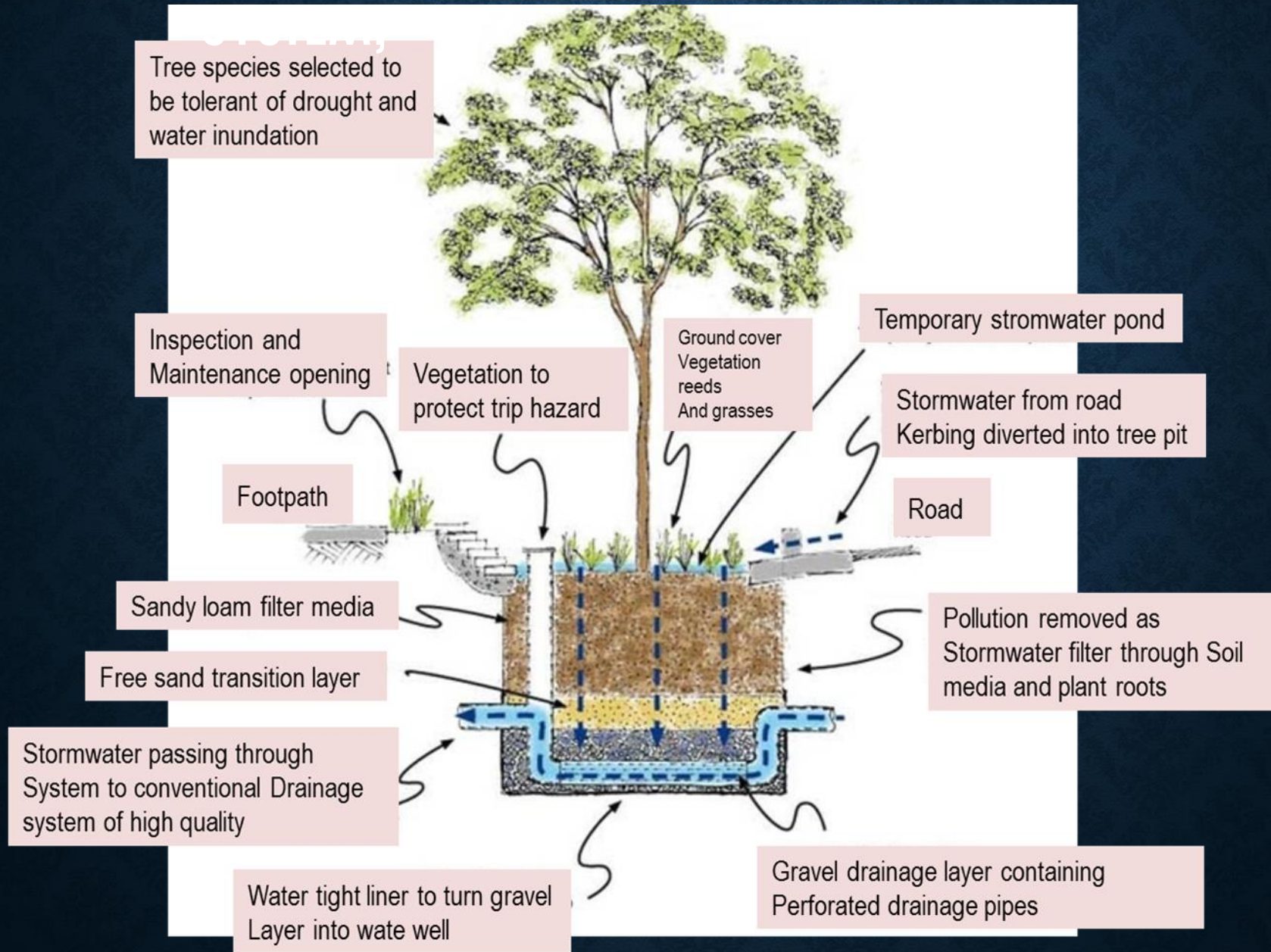


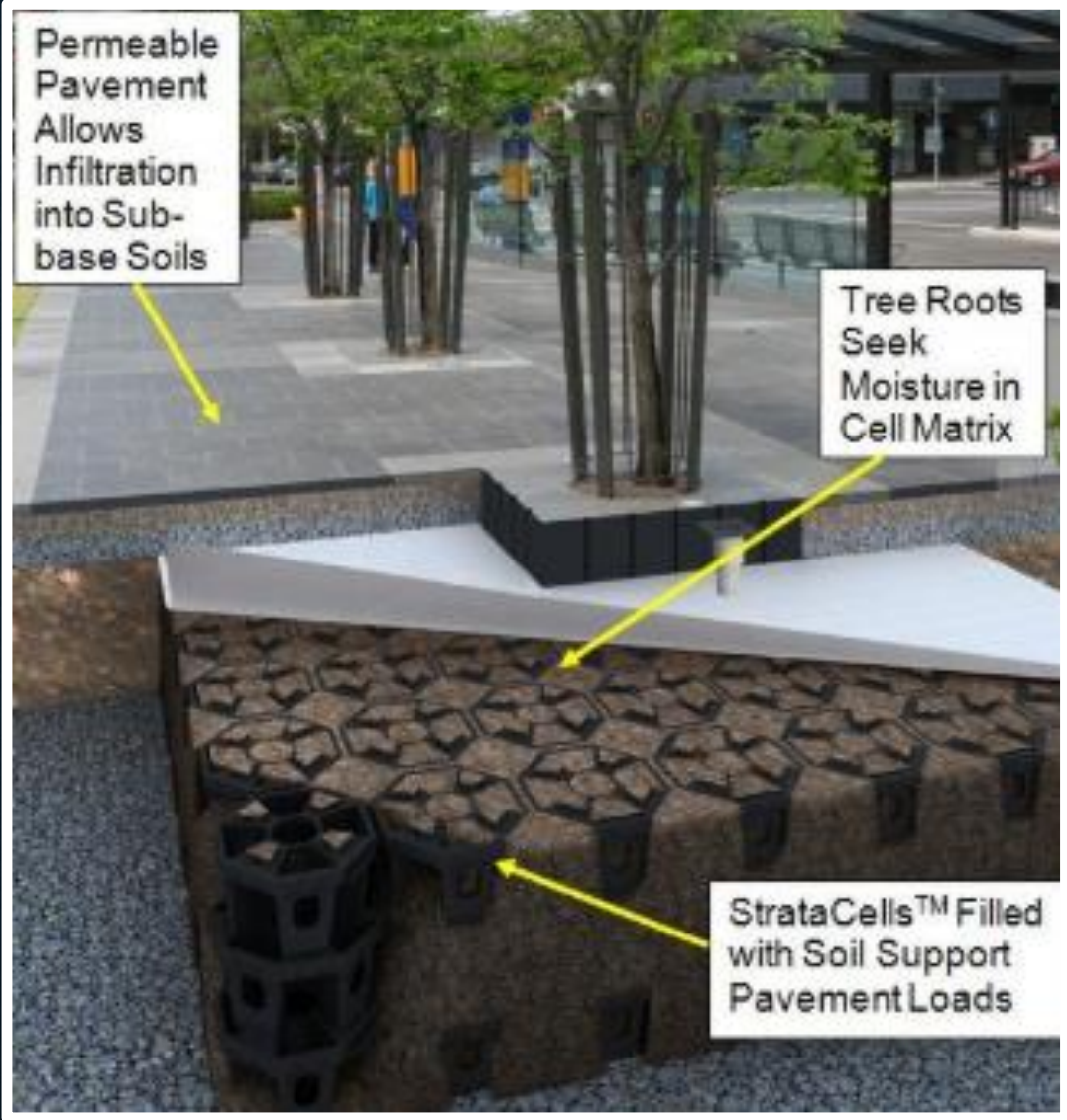
- **Green Water (GW)** is the interception loss from the foliage (direct evaporation of rainfall **trapped** on the surface of **leaves and stems** of plants and trees). Influence **precipitation pattern** in neighbouring areas.
- Trees are important in **controlling the erosion** of incoming rainfall, whether rain infiltrates or form rapid runoff.
- OF in **upper catchment zone** is important to protect and stabilize stream flow further downstream .
- **OF act as sponges**, providing buffer-stock supplies of dry season flow.
- **Deforestation** increase in stream flow and reduces the dry season flow in the river.(Sandstrom, 1995)





THE CONCEPT : STREET WATER HARVESTING







The Development Goal



The terrestrial and ecotone enhancement

The solution

1. Technology investment
2. Best Management Practise implementation
3. Enhance professional collaboration
4. Increasing 30% green space
5. Policy and guideline enhancement
6. Public awareness enhancement and continuously knowledge expansion
7. Increase skill competency

The Case Study

1. Titik Tengah Semenanjung –Lanchang
2. National Elephants Conservation Center – NECC Kuala Gandah

Project aim :

- 1.The integrations of stormwater management into surface runoff and terrestrial zone protection
2. The enhancement of soil moisture for tree health improvement

Project Status :

98% completed .

Titik Tengah Semenanjung, Lanchang



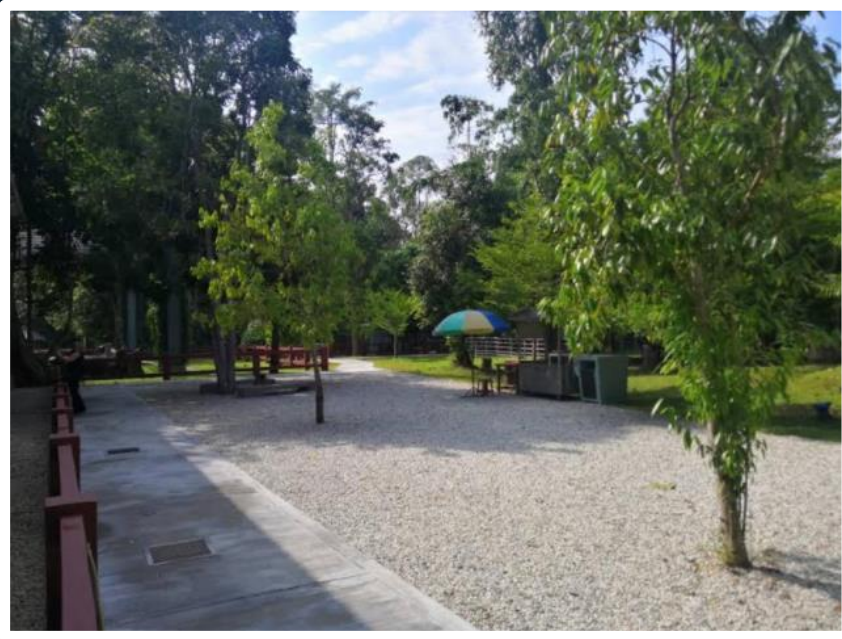
Titik Tengah Semenanjung, Lanchang



Titik Tengah Semenanjung, Lanchang



NECC, Kuala Gandah , Pahang



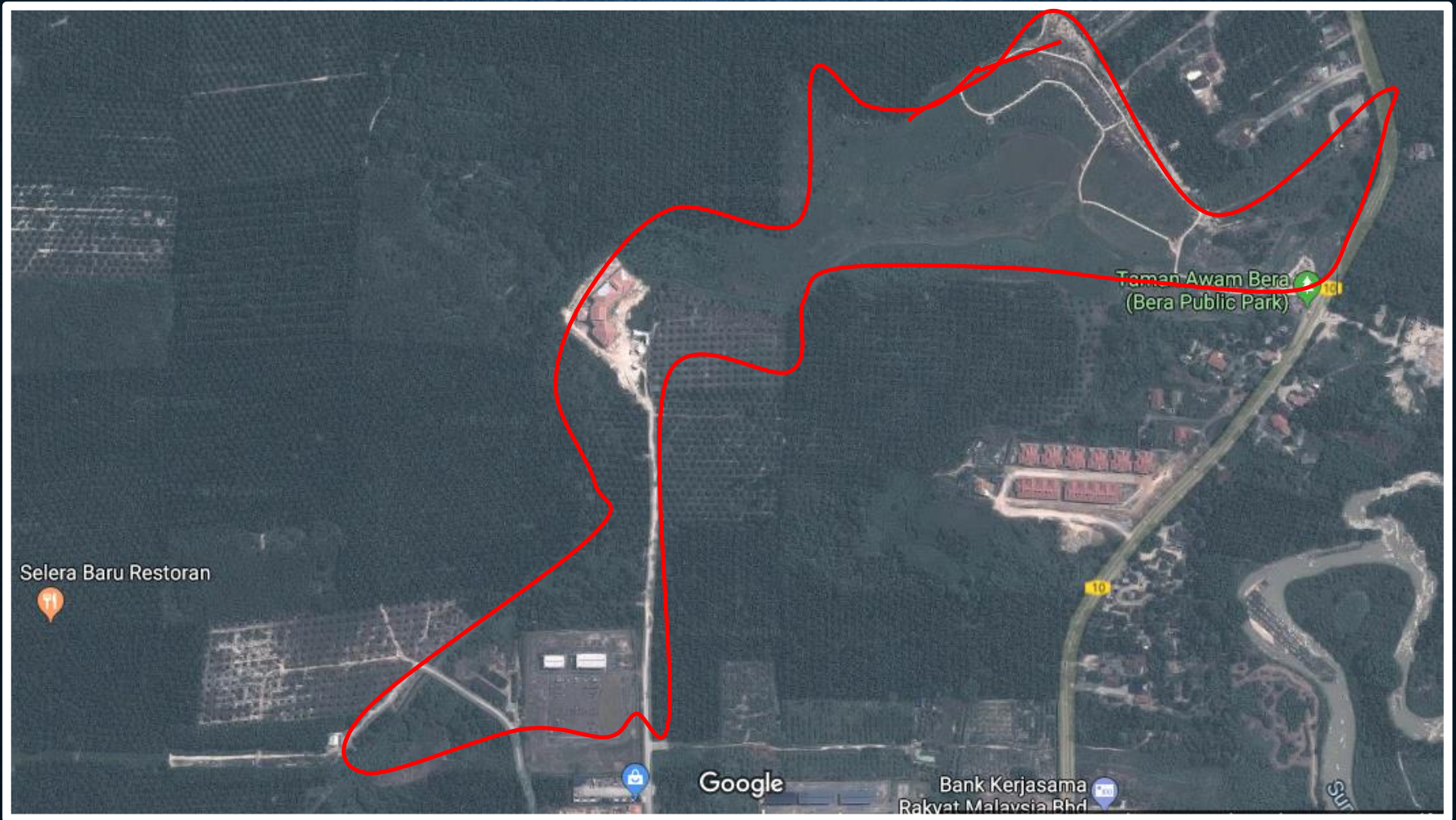
The Case Study

200 acre Mengkarak Public Park, Bandar Bera. In line water Quality and quantity of Sg Paya Pagar rehabilitation and revitalization project.

Project aims : To improve water qualities and create a main focal activities nodes in the park.

Project status : 20% completed, suspended due to project fund constraint.

The site location



The master plan layout



20% of sustainable storm water urban drainage construction completed



The Case Study

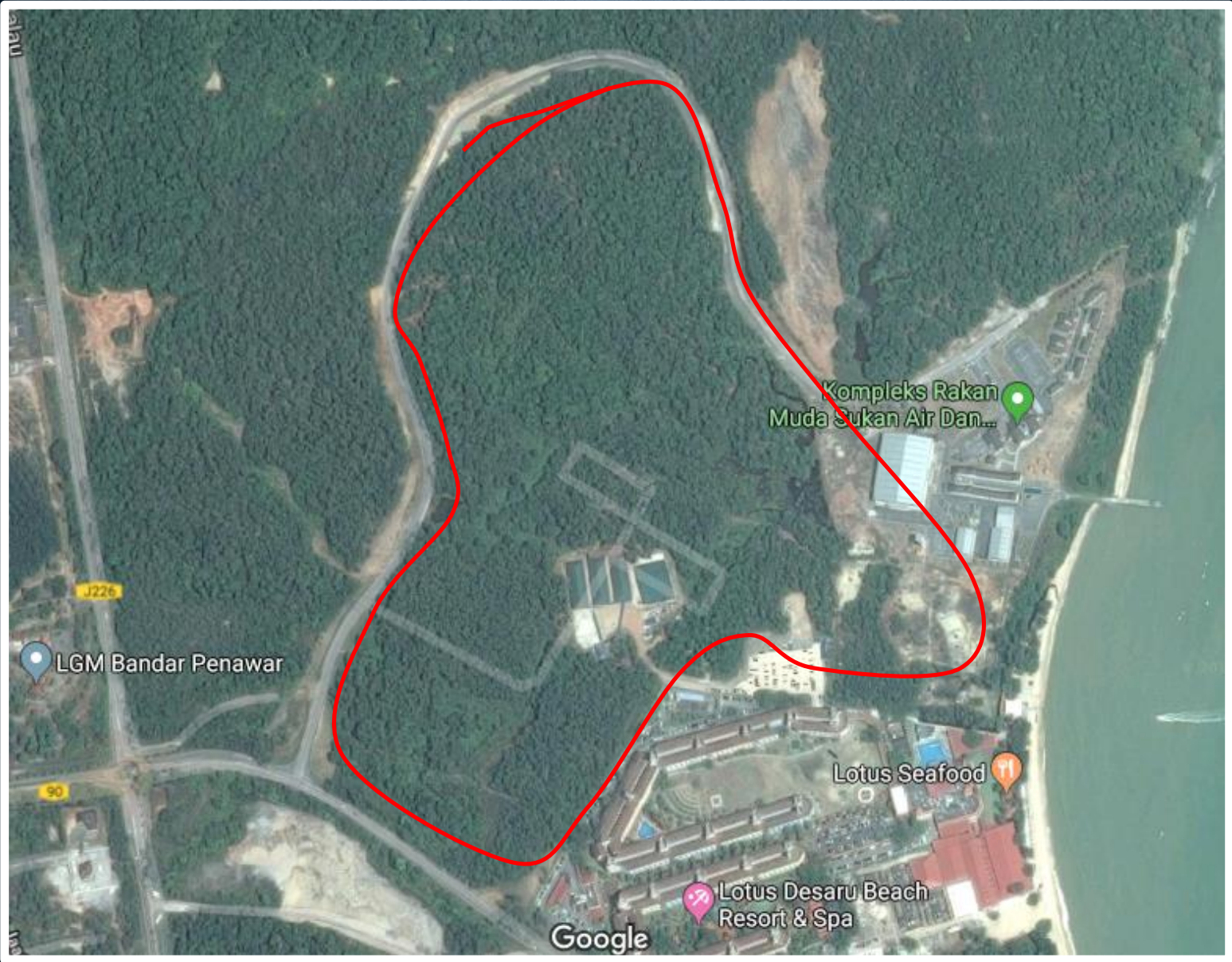
The Staff Village, Desaru Coast , Johor Bahru

Project aim:

Tree preservation and Desaru Beach protection

The implementation of erosion and sediment control and surface runoff protection. Project status : Design concept, Tendering and earth works clearing activities. The conceptual idea has force to abandon due to project goals changes by newly restructured client board committee

The Site Location : Staff Village Desaru,



Site Inventory for tree preservation order



Master plan conceptual development



Master Plan Development



EARTH WORKS AND TREE PRESERVATION



Trees Protection Zone during earth works.



THE SOIL / TREES PROTECTION DURING EARTH WORK



Summary

1. Soil Moisture Dynamic And Water Balance influence the Tree roots growth and soil organic matters diversity.
2. Soil preservation would protect deep root zone and increase water infiltration rate into the soil structure.
3. Tree preservation influence the mean value of crop management cover factor value
4. The increasing green spaces would influence the ARI discharge water volume and storm water drainage design.

Summary :

The moisture controlled and water dynamic balance protection would stimulate plants growth and reduce tree risk failure .





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Conclusion

The Increase 30% of urban greenways will reduce urban surface runoff / flash flood and add value to development properties as well trees health.

Cover Story

The creek and other water bodies, formed by natural spring water from nearby tropical forests, are precious and important for developments such as Setia Eco Park. Here, water bodies play an important role in creating a sustainable ecological system for wildlife and provide a healthy environment for the community.

Photo courtesy of Bandar Eco Setia

THANK YOU

El Jaguar Velador

A close-up photograph of a dense forest of green ferns. The fronds are vibrant green and have a fine, feathery texture. The lighting is soft, creating a rich, layered appearance. In the center of the image, there is a faint, semi-transparent watermark in a cursive font that reads "El Jardín del Valle".

El Jardín del Valle

We need more trees , please !!!!