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RECONSTRUCTION OF EXISTING CONVENTIONAL STORM DRAINAGE SYSTEM IN DEVELOPING COUNTRIES WITH INCLUSION OF BMPs ELEMENTS: A CASE STUDY

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Introduction

- Storm drainage practice-to evacuate excess water “as soon as possible”
- Paper shows potential effects of conventional system reconstruction on:

1. stormwater quantity
2. stormwater quality
3. cost decrease,

with inclusion of BMPs elements:

a. dry detention ponds

b. vegetated swales

- Case study: three mathematical model setup simulation results comparison

Methods

- Simulations of rainfall-runoff processes in StormNET
- Simple pollution model included (pollution build-up/wash-off process)-TSS, TP and BOD concentration simulated
- One raingauge assigned-various rainfall events (50%, 20% and 10% prob. of exceedance)
- Model's sub-catchment characteristisc, conveyance length and pollution input data are the same

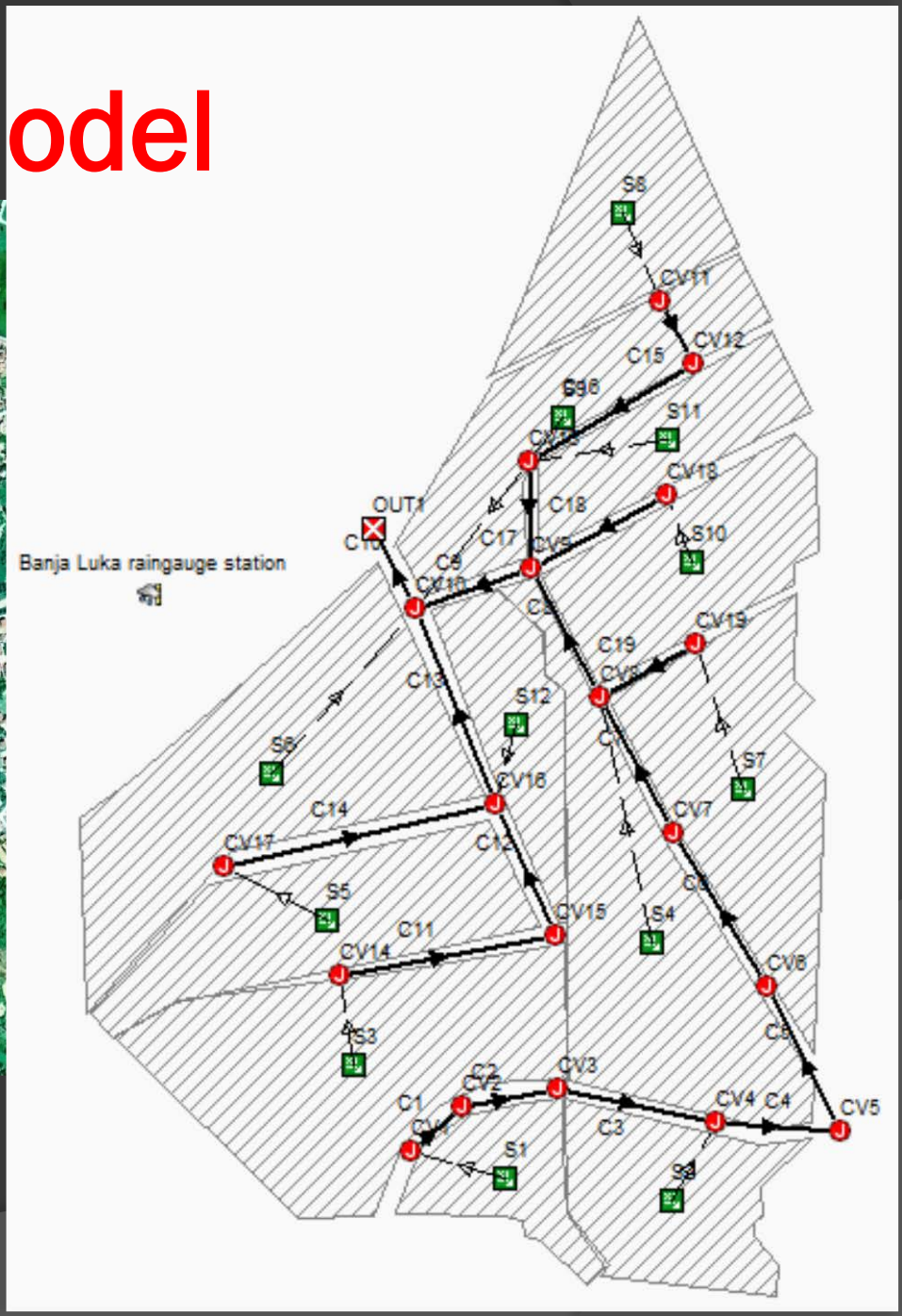
Case study-present state

12 sub-catchments

Input data

a. Pervious area depression depth **4 mm**
b. Impervious area depression depth 1.5 mm
c. Soil conductivity 36 mm/h
d. Manning's roughness for pervious areas 0.35
e. Manning's roughness for impervious areas 0.018
f. Suction head (for Green-Ampt method) 61 mm
g. Initial moisture deficit (porosity minus initial moisture) 0.25

I Conventional model

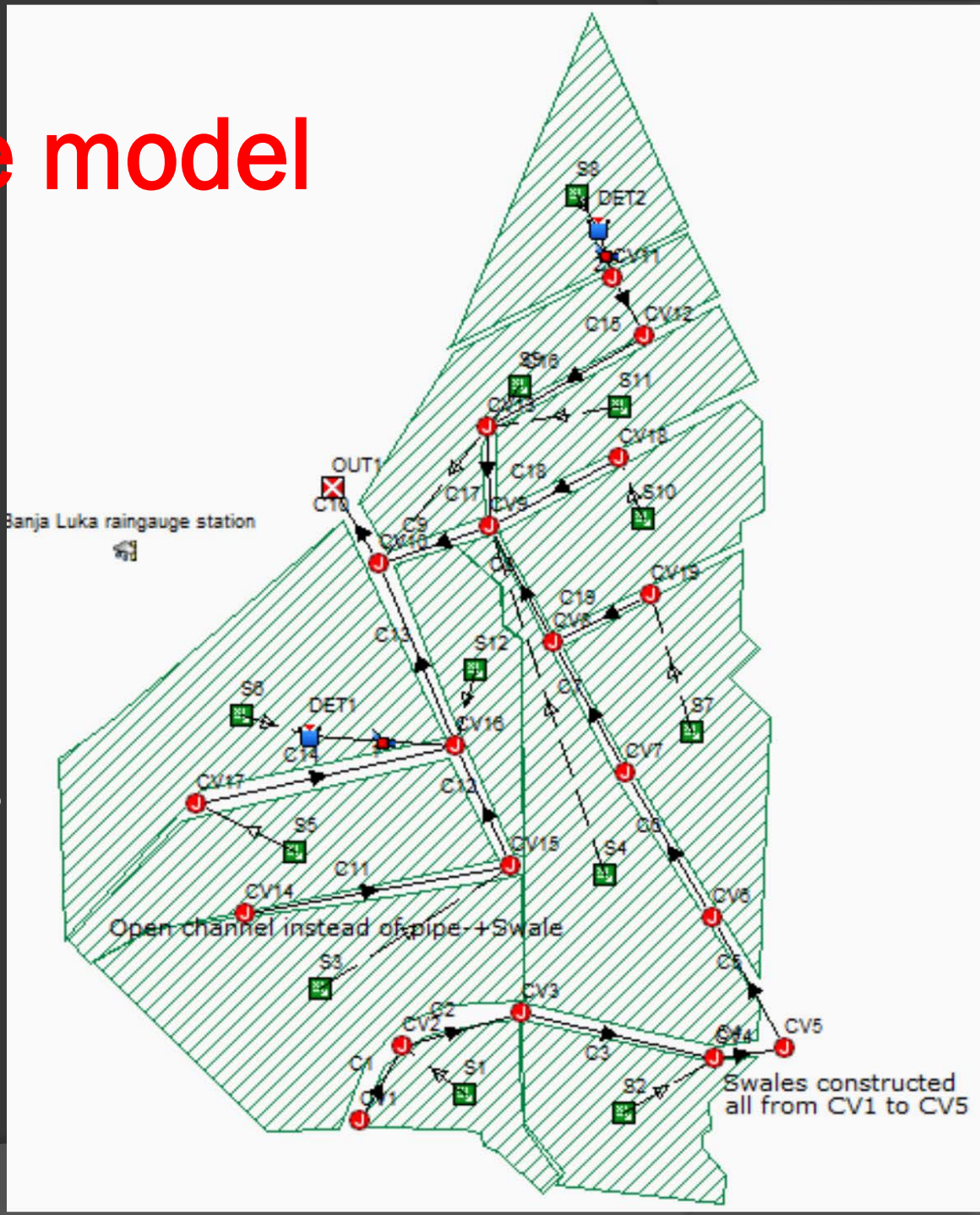


II Conventional with source control

- Same as previous except impervious surfaces are decreased-roofs are connected to pervious areas

III Alternative model

- Reconstructed model II
- D1 131m^3
- D2 35m^3
- Swales 260m instead of pipes



Pollution model

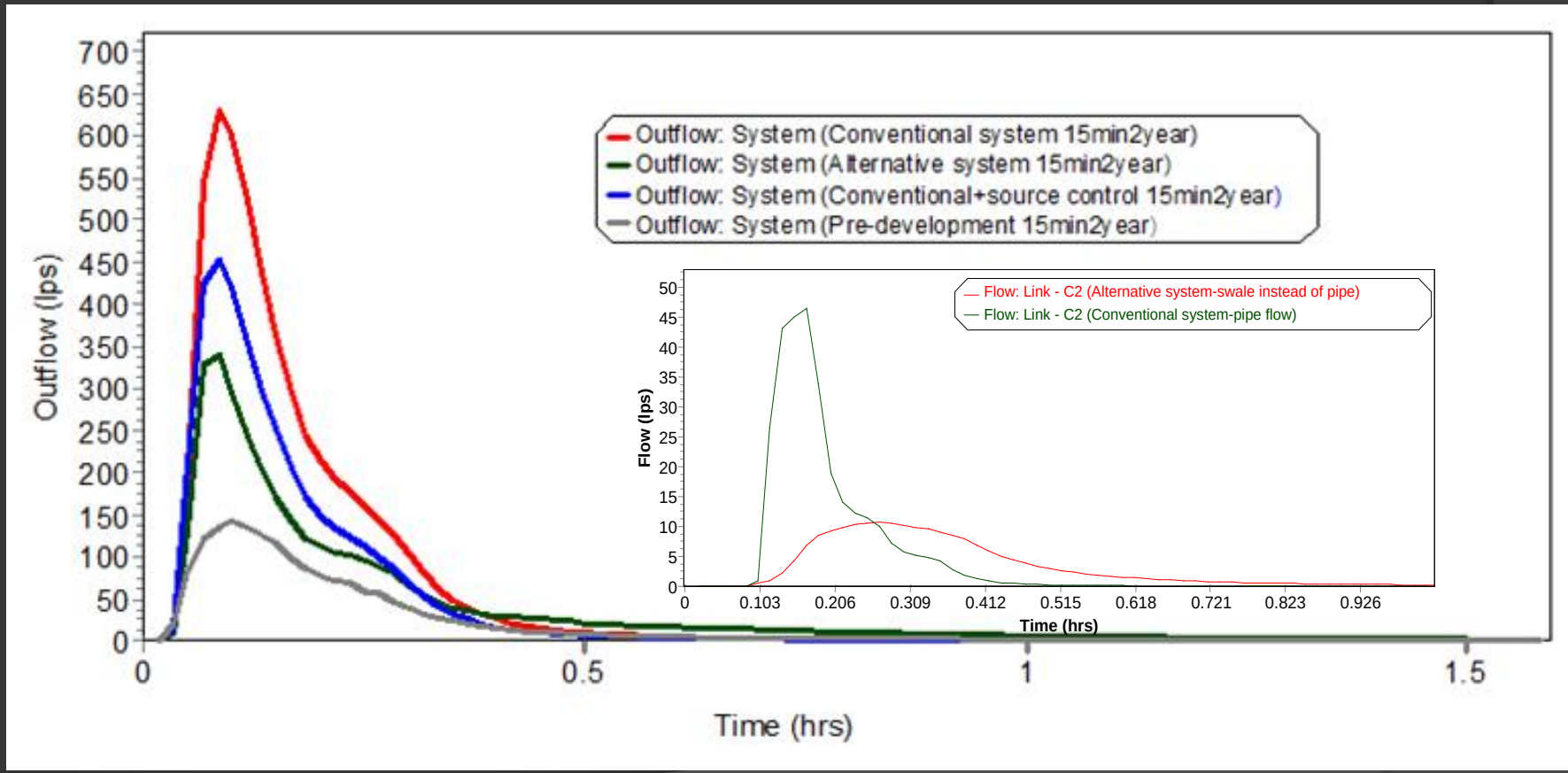
- Typical pollution removals for chosen BMPs elements:
  - TSS 30-65%,
  - TP 15-45% and
  - BOD ~30%.

Cost analysis

- Comparison of construction costs
  - Conventional system prices
  - Alternative system prices

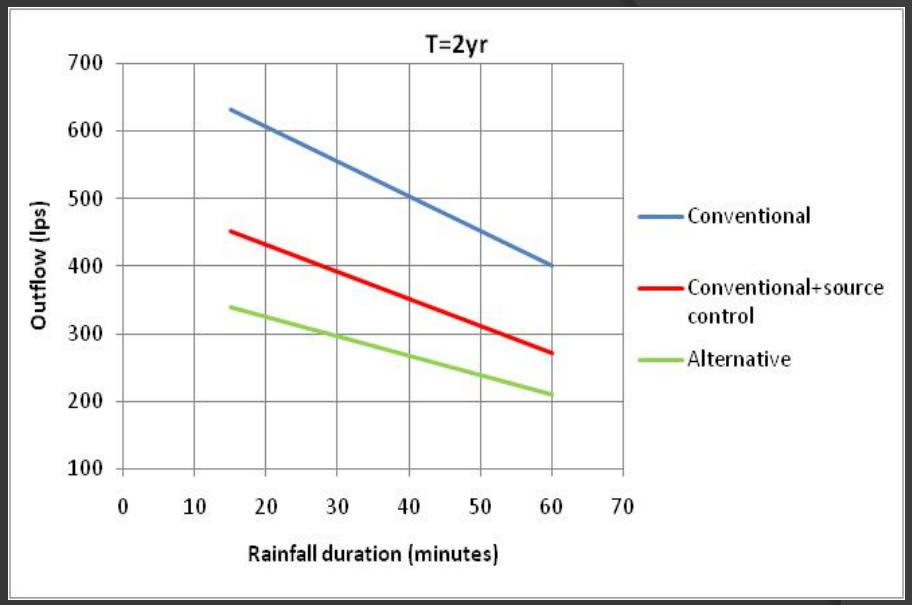
Results

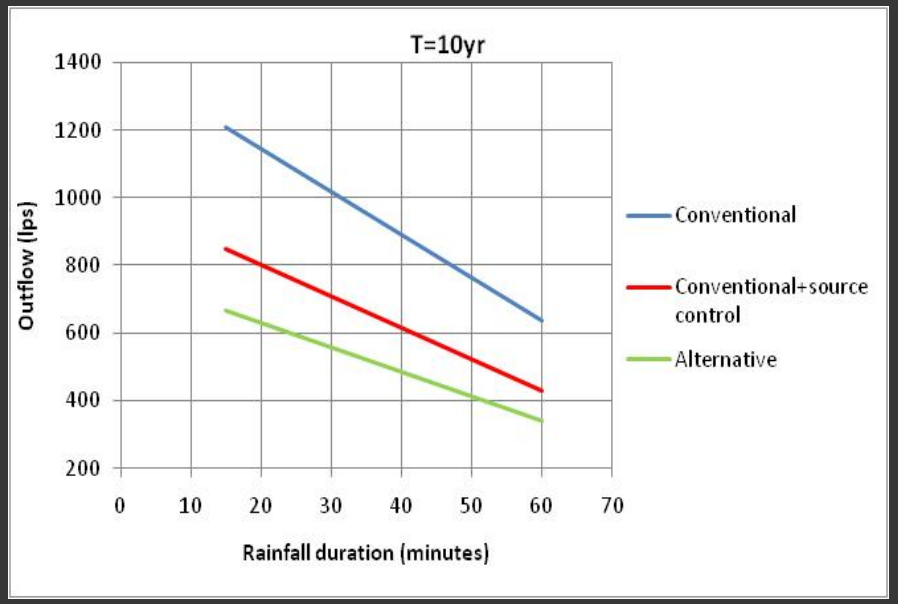
- Runoff hydrographs comparison

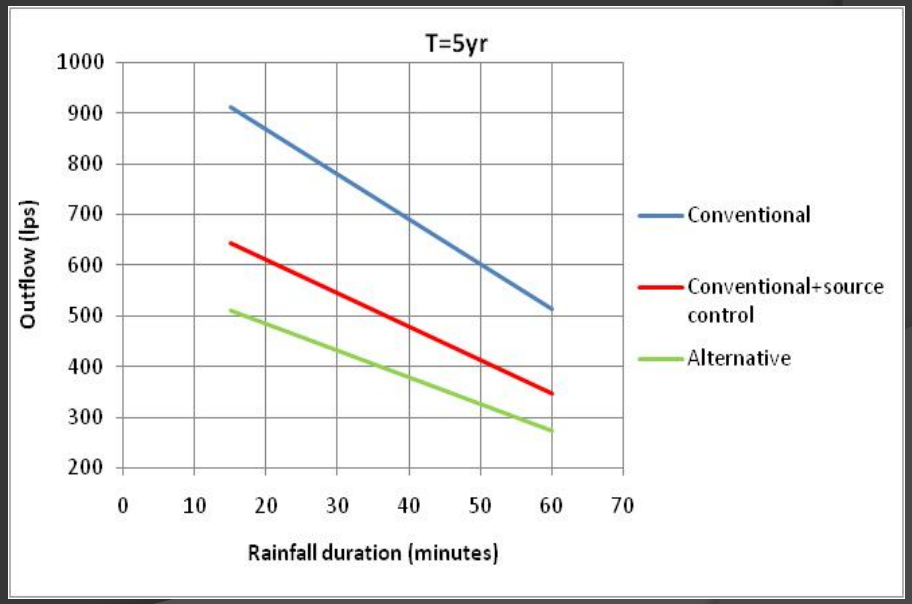


Results

- Catchment runoff v. rainfall duration and model setup

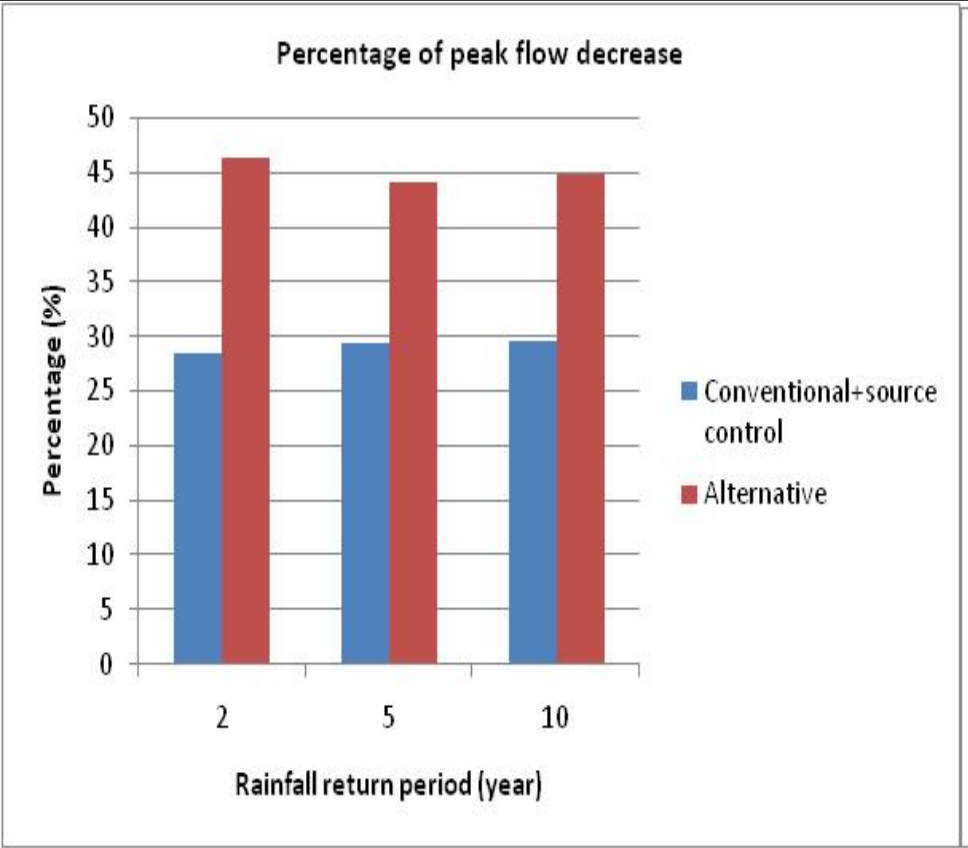


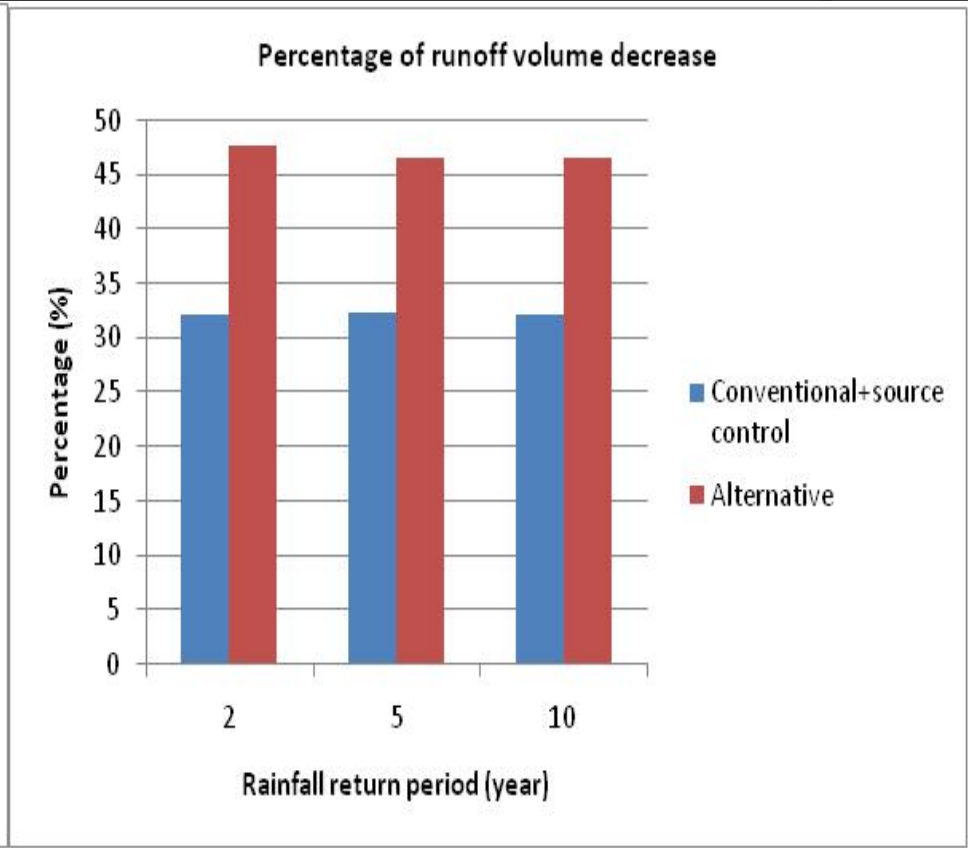




Results

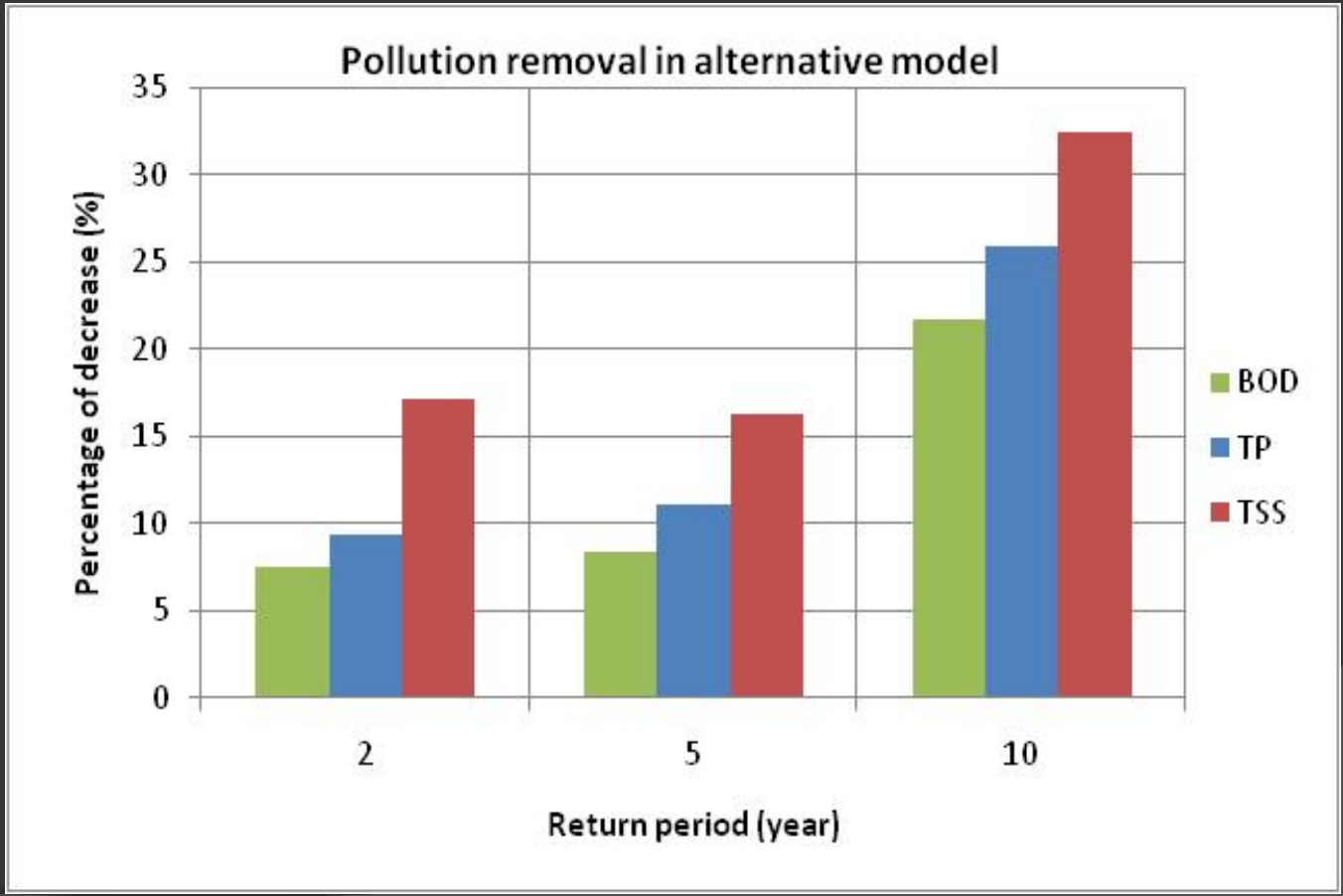
- Percentage of peak flow and runoff volume decrease in comparison to conventional model





Results

- Pollution removal in alternative model



Results

- **Cost analysis**

Construction work	Cost [€]
Construction site preparation	13.112,00
Earthworks	65.149,00
Concrete works	10.129,00
Masonry	6.685,00
Pipe purchase and installation	39.362,00
Other (additional) works	26.276,00
Σ	160.713,00

Construction work (conventional elements)				Cost [€]
Construction site preparation				9.995,00
Earthworks				52.830,00
Concrete works				8.840,00
Masonry				4.934,00
Pipe purchase and installation				17.706,00
Other (additional) works				20.040,00
BMPs element	Size	Unit	Cost [€/units]	Cost [€]
Detention pond (1+2)	166	m^3	12	1992
Swales	304	m^2	8	2432
Σ				118.769,00

Save 42,000€ or 26% cheaper

Conclusions

- Impact of urbanization and design of conventional drainage system enlarge catchment runoff for almost 5 times
- With simple source control both peak runoff and runoff volume are decreased for cca 30%
- Alternative system with included sustainable decreases peak runoff and runoff volume for cca 45%,
- Pollution are removed for 8-30%
- Cost savings are 26%
- Reconstruction of conventional system is simple with huge positive effects

THANK YOU FOR YOUR ATTENTION

Reconstruction of existing conventional storm drainage system in developing countries with inclusion of BMPs elements: Case study

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