TECHNICAL-FINANCIAL EVALUATION OF RAINWATER HARVESTING SYSTEMS IN COMMERCIAL BUILDINGS - Case studies from Sonae Sierra in Portugal and Brazil

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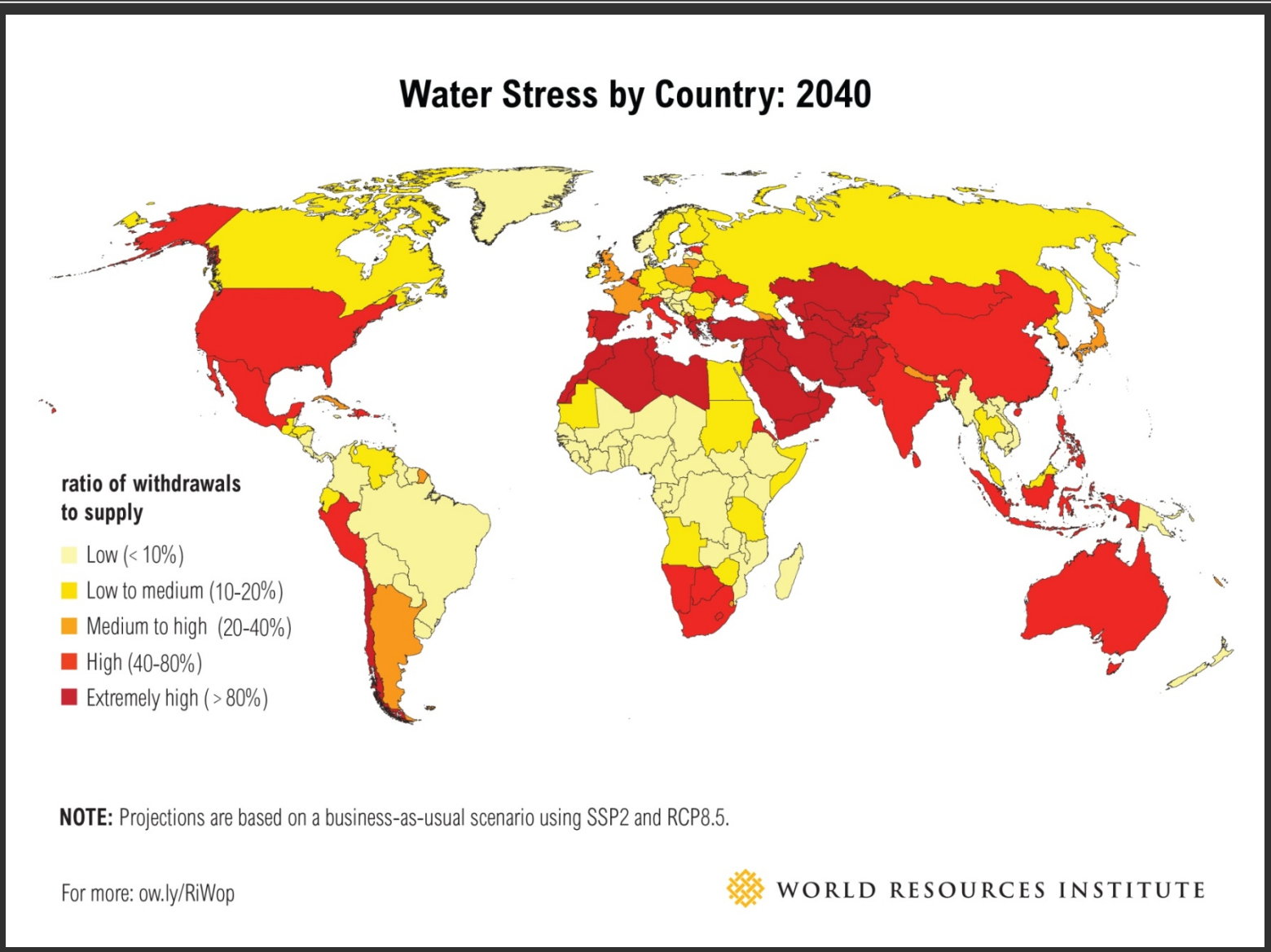
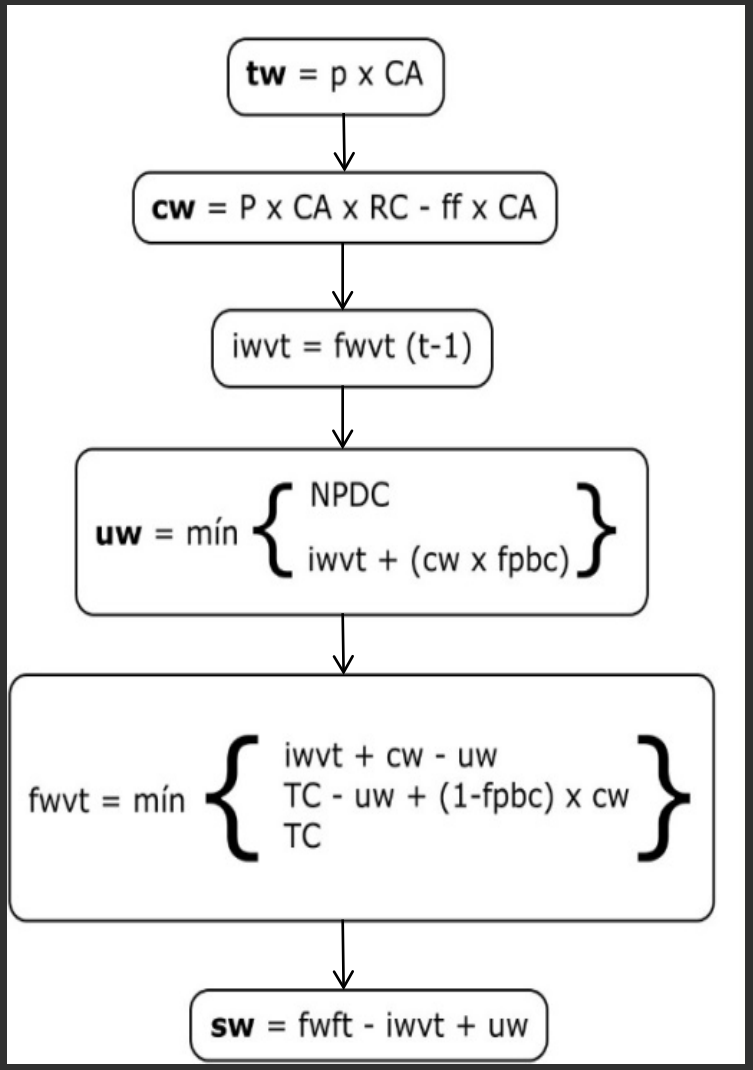
OUTLINE

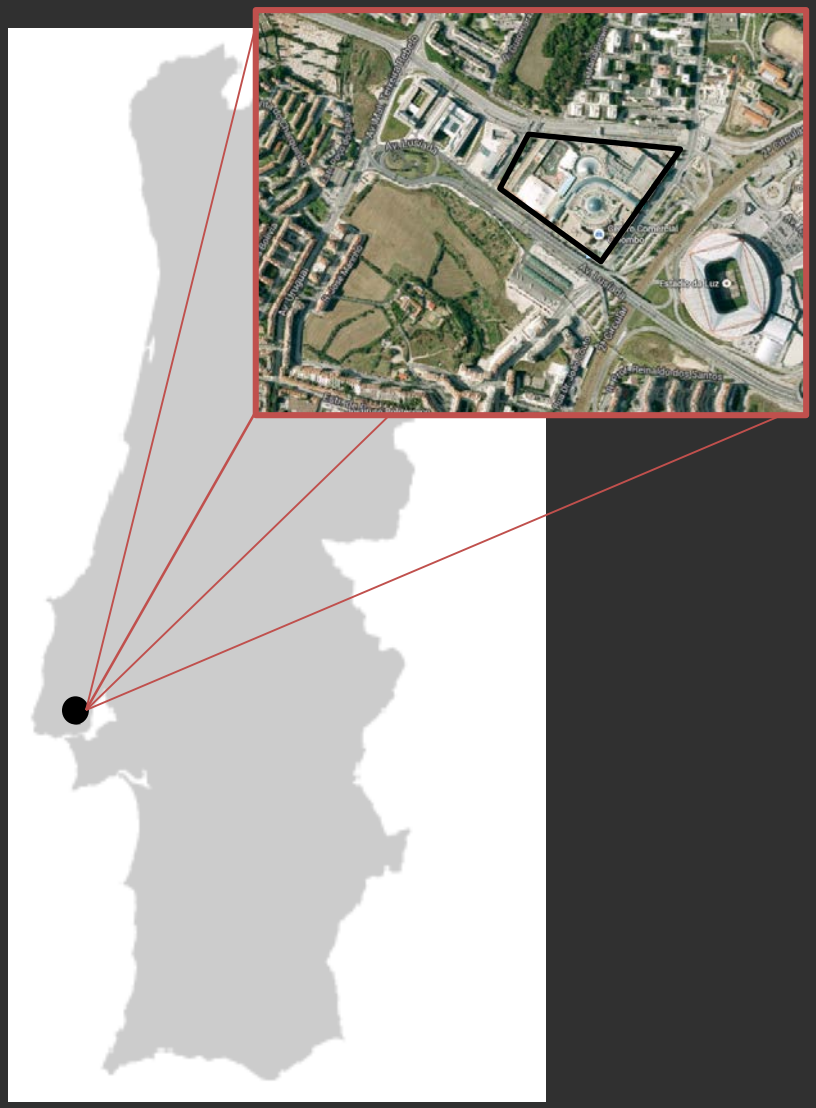
1. Introduction
2. Methodology
3. Colombo Shopping Center
   - 3.1. Validation
   - 3.2. Parametric analysis
4. Case Studies
   - 4.1. Estação Viana Shopping (Viana do Castelo, Portugal)
   - 4.2. Boavista Shopping (São Paulo, Brazil)
5. Final remarks


Water Stress by Country: 2040
ratio of withdrawals to supply
Low (< 10%)
Low to medium (10-20%)
Medium to high (20-40%)
High (40-80%)
Extremely high (> 80%)
NOTE: Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.
For more: ow.ly/RiWop
WORLD RESOURCES INSTITUTE



P - precipitation
CA - catchment area
RC - runoff coefficient
ff - first flush
TC - tank capacity
TDWC - total daily water consumption
NPDC - non potable daily consumption
tw - total water
cw - collected water
iwvt - inicial water volume in the tank
fwvt - final water volume in the tank
(t-1) - indicates the day before
uw - used water
pfbc - precip. fraction before consumption
sw - stored water

3. COLOMBO SHOPPING CENTER



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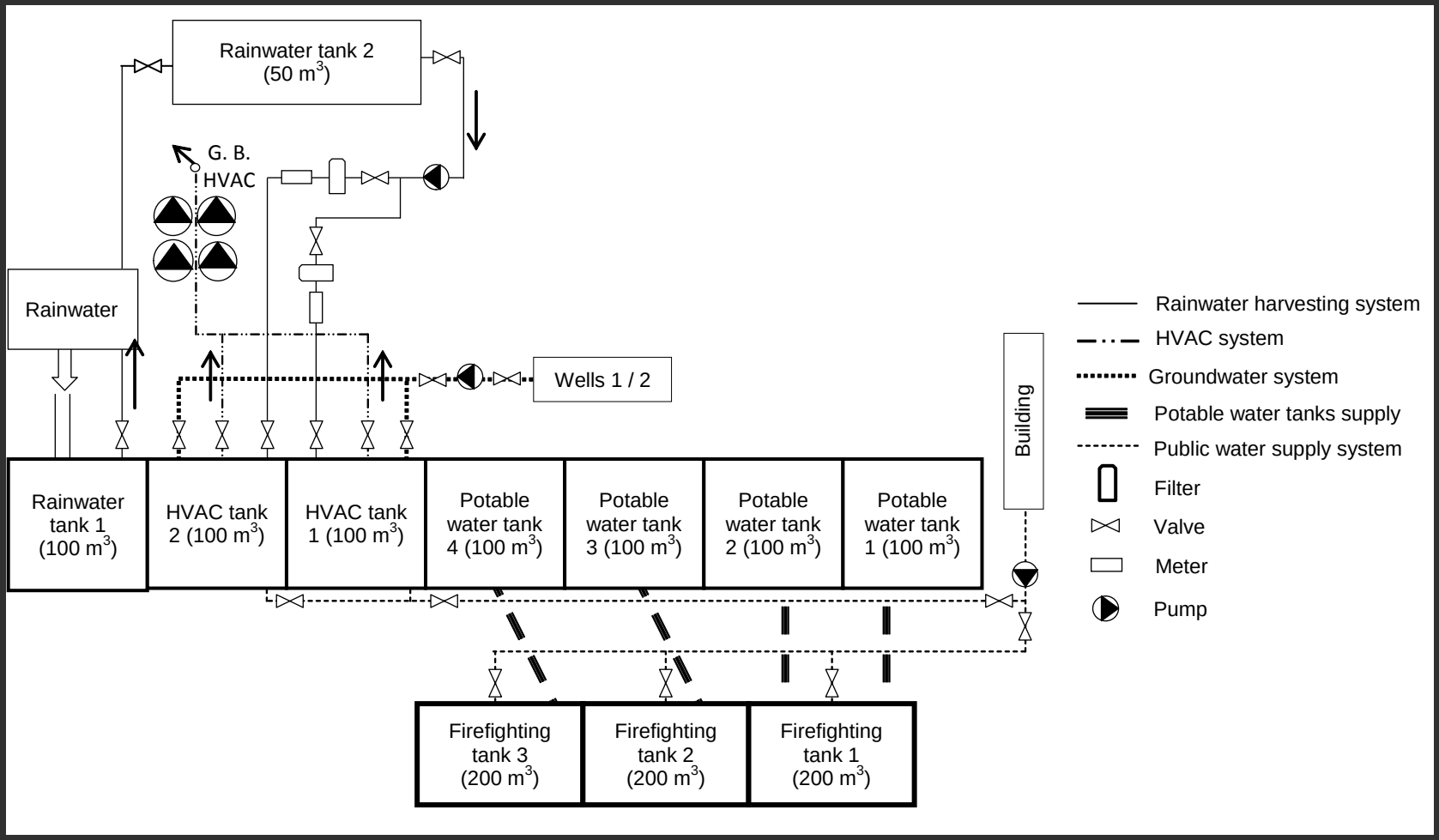
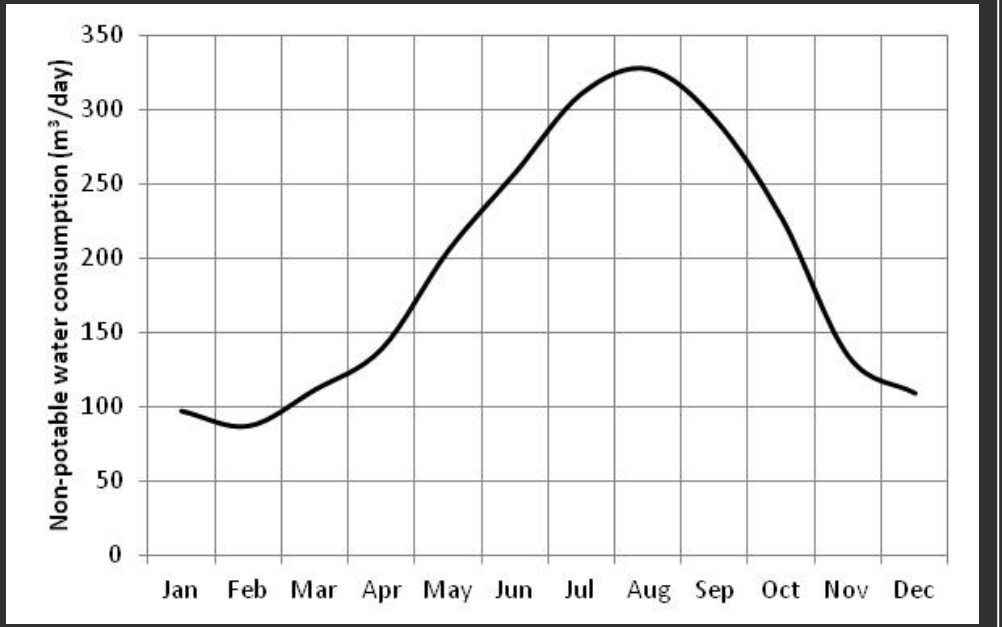


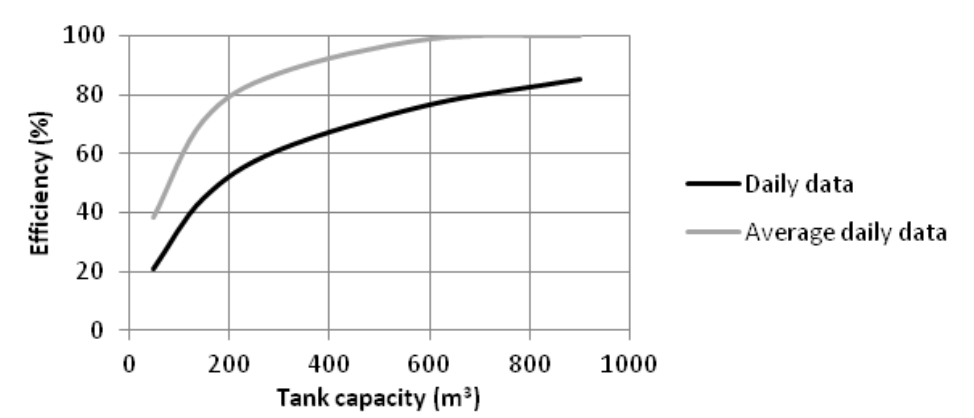
3.1. Validation

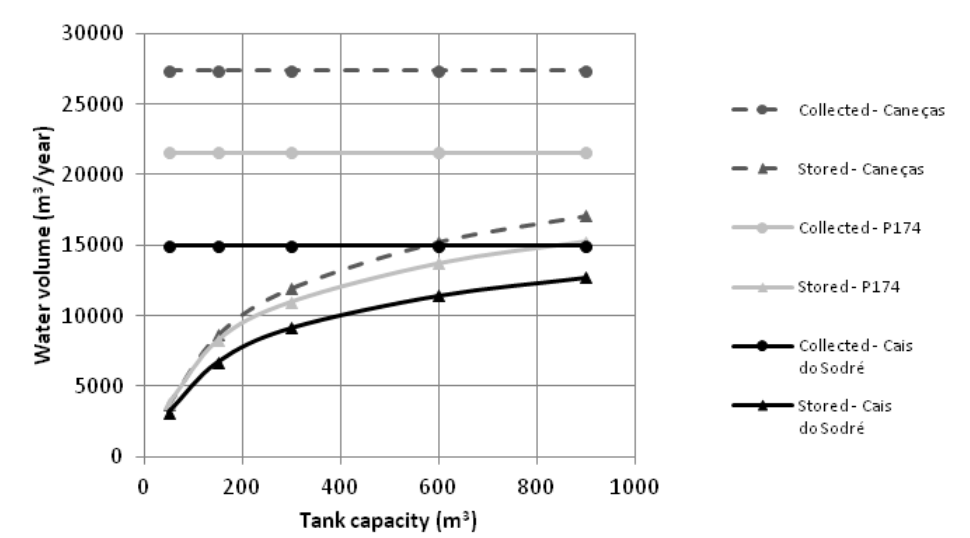
Variables	Value
Collection area (m^2)	40000
Tank volume (m^3)	150
Runoff coefficient	0,8
First flush (mm)	1,0
Annual continuity	No
Fraction of tank full at the beginning of the year	0
Fraction of the precipitation before consumption	0

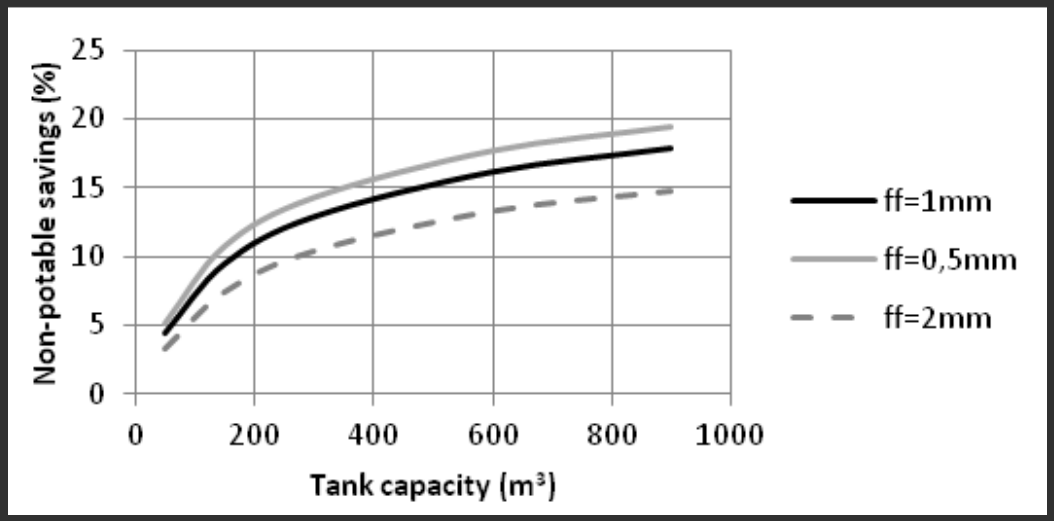


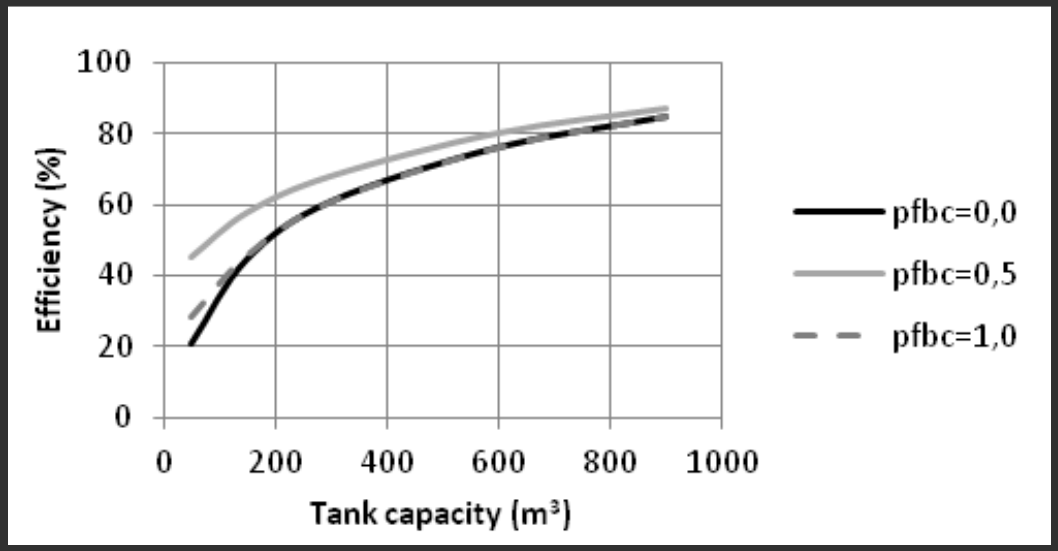
Case	Precipitation	Consumption	Non-potable savings
Measured	Real	Real	9,4 %
Simulated	Cais do Sodré	Real (monthly average)	9,4 %

3.2. Parametric analysis

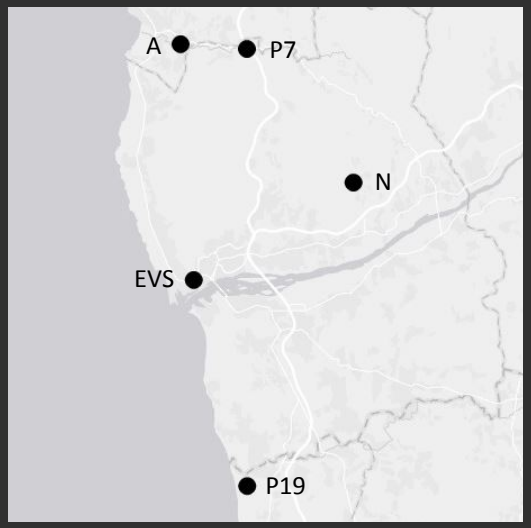





Non-potable savings (%)
25
20
15
10
5
0
0
200
400
600
800
1000
Tank capacity (m³)
ff=1mm
ff=0,5mm
ff=2mm


Efficiency (%)
100
80
60
40
20
0
0
200
400
600
800
1000
Tank capacity (m³)
pfbc=0,0
pfbc=0,5
pfbc=1,0

4.1. Estação Viana Shopping (Viana do Castelo, Portugal)



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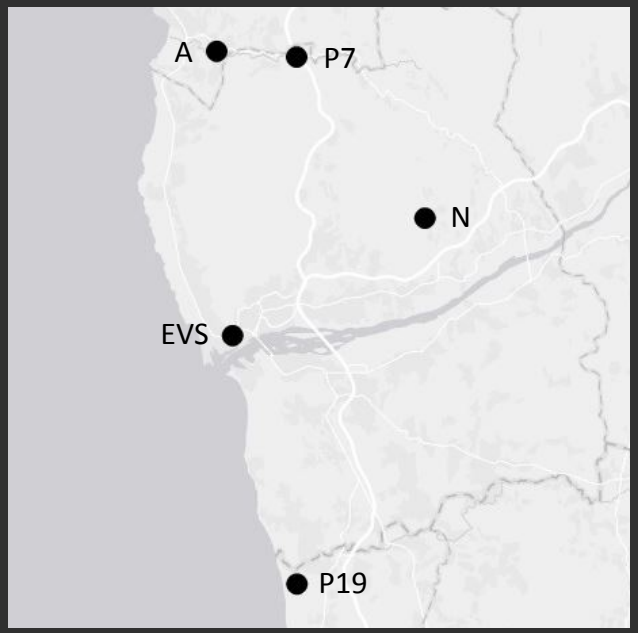

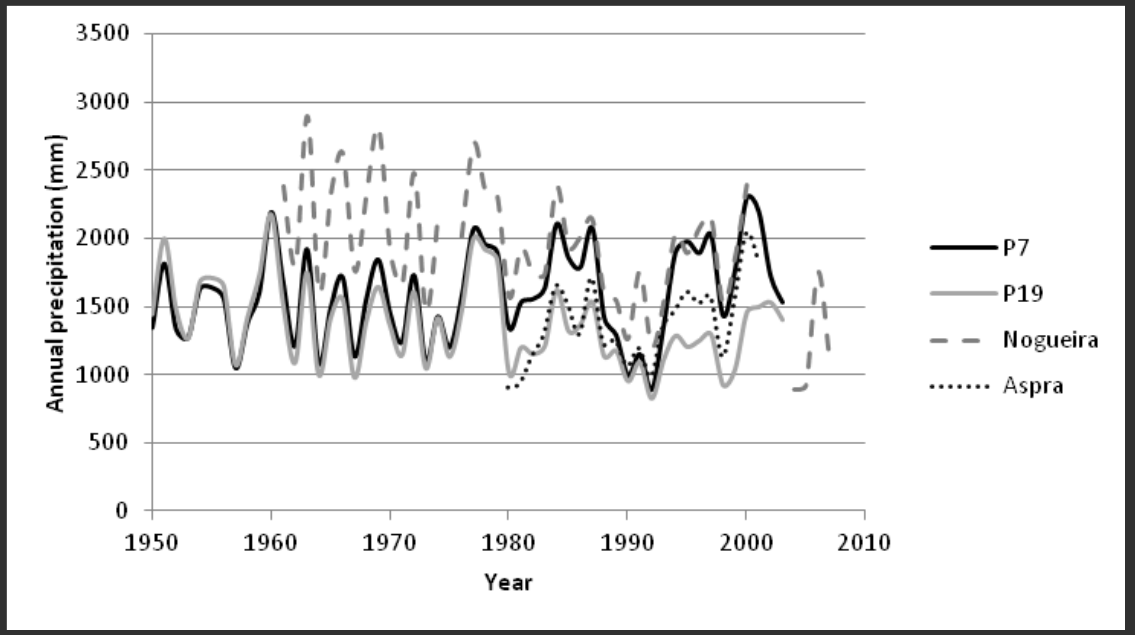

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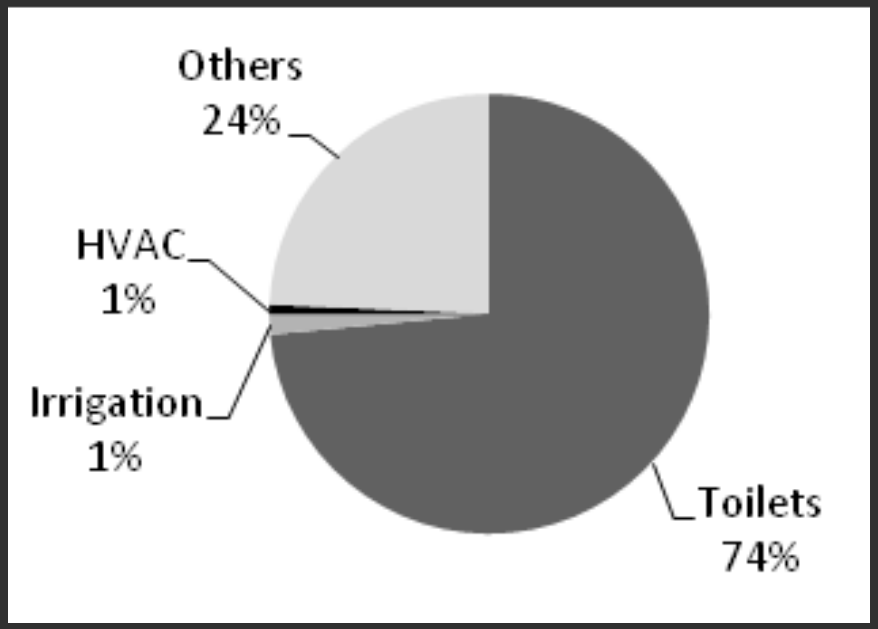
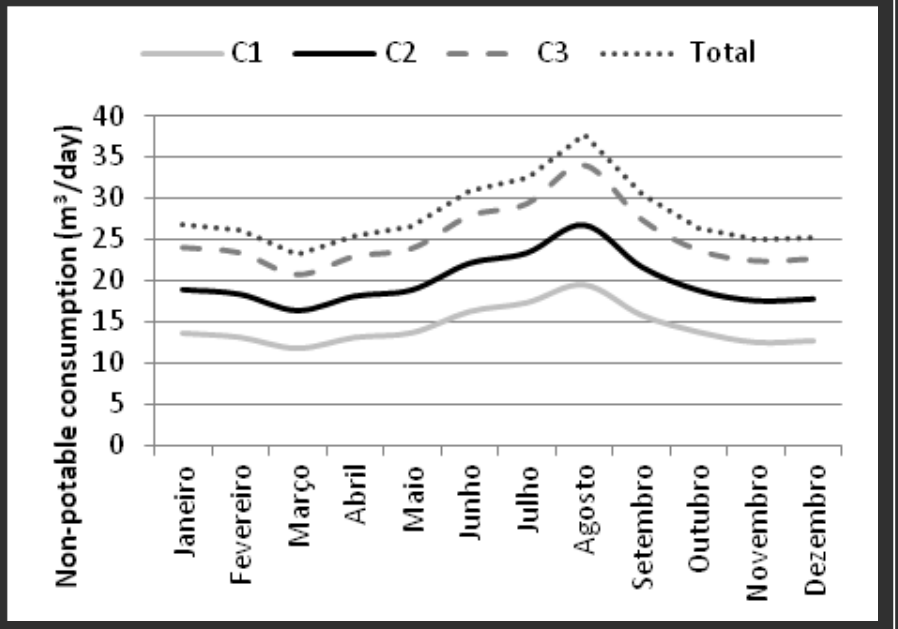
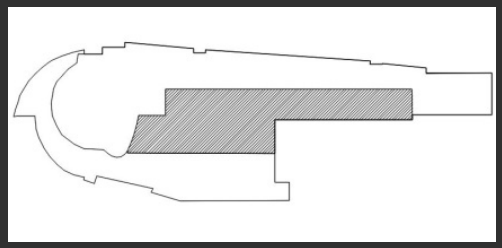
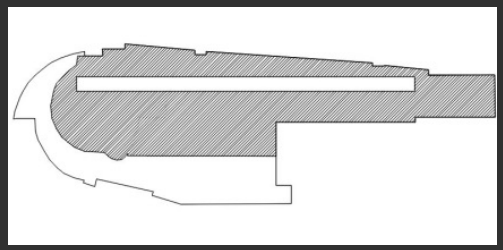
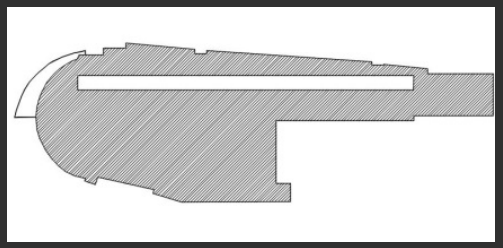




A1: 4280 m^2	A2: 9920 m^2	A3: 13470 m^2
		

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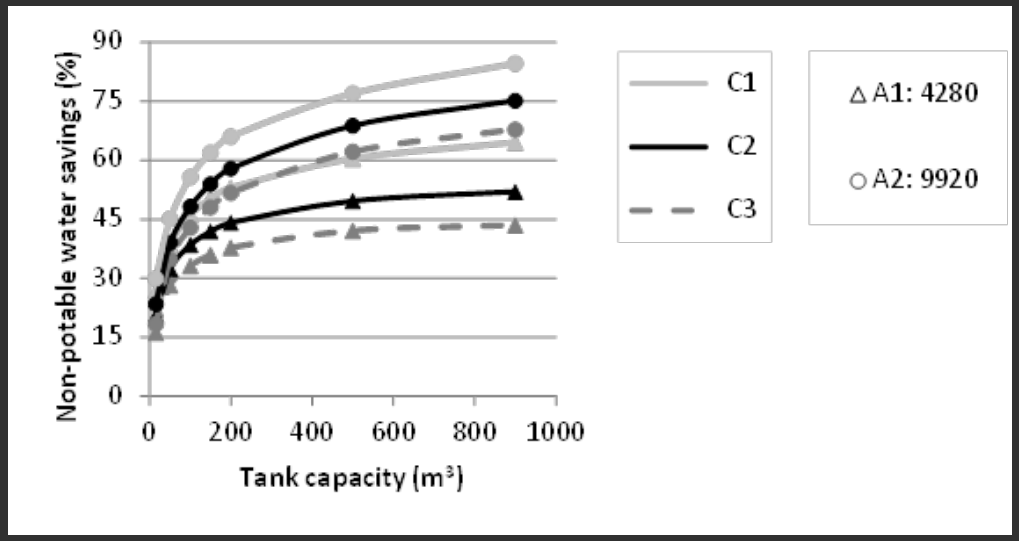
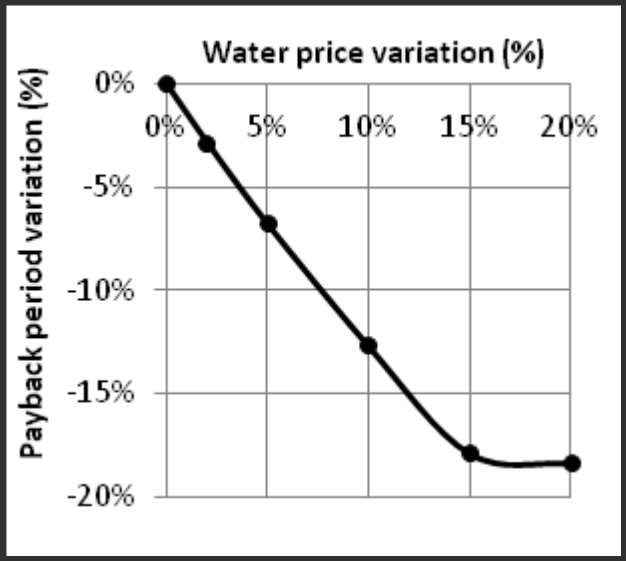
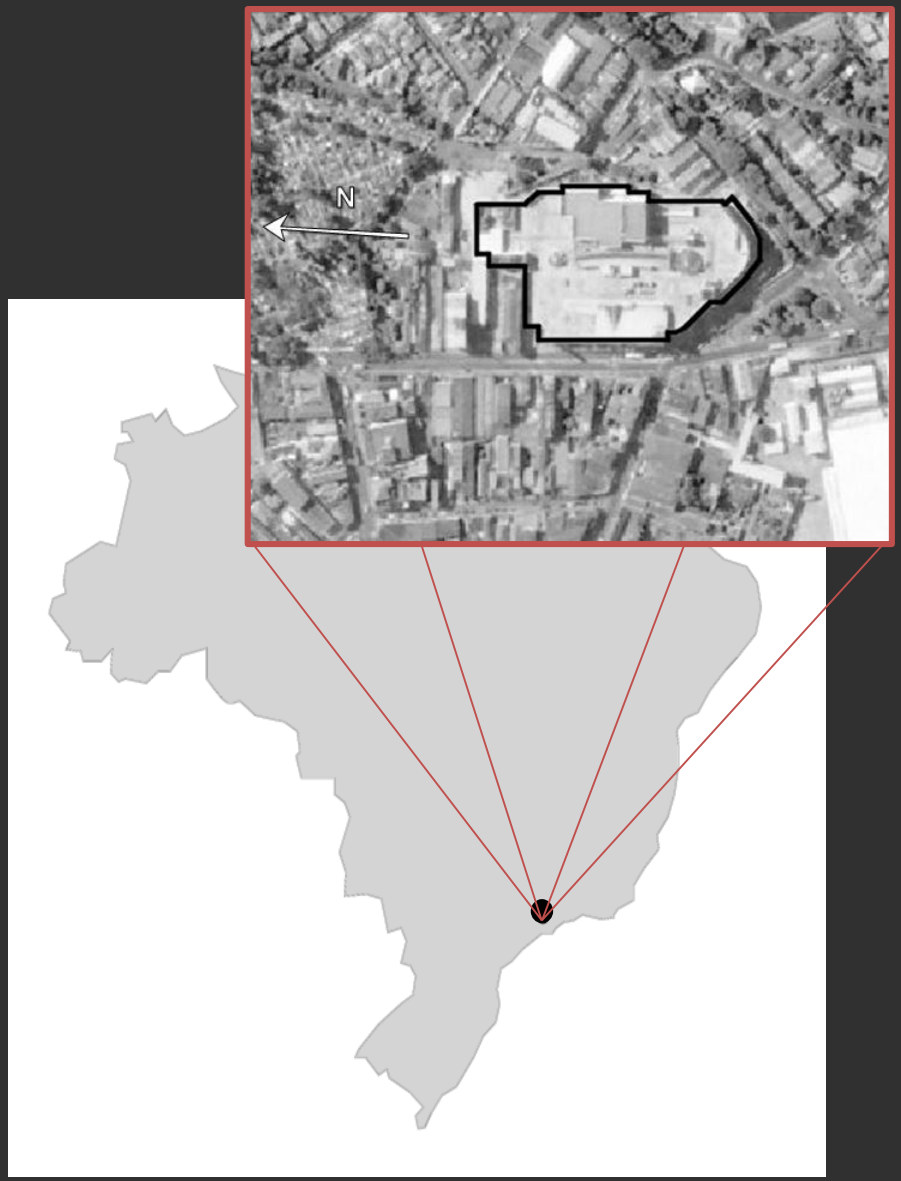


The payback period varied between 18 and 42 years, with the most favourable situation corresponding to a catchment area of 9.920 m^2 and a 200m^3 tank



4.2. Boavista Shopping (São Paulo, Brazil)



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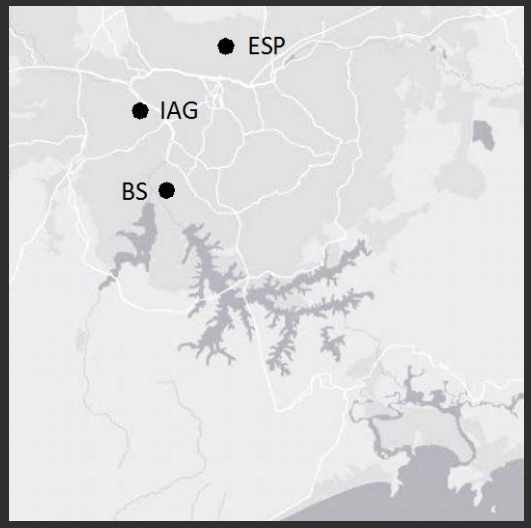
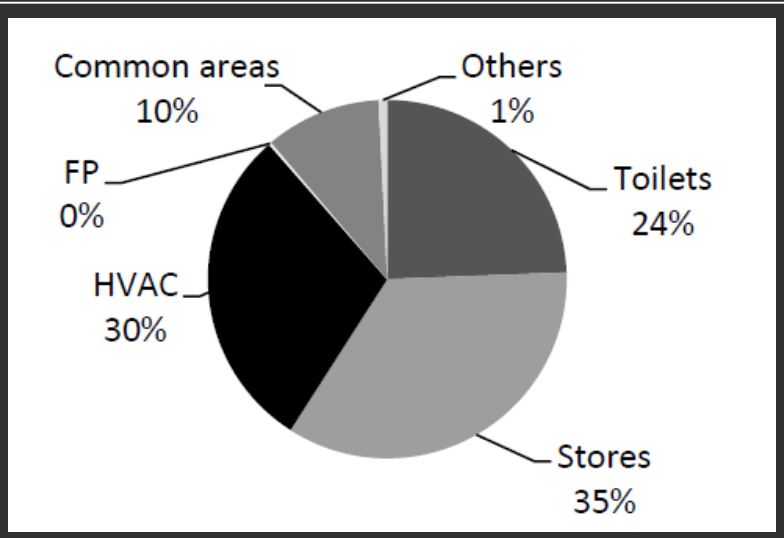
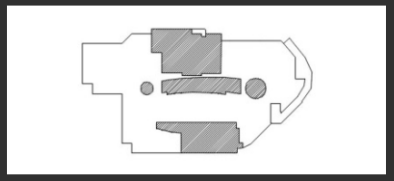
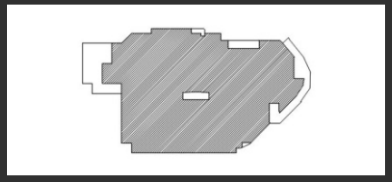
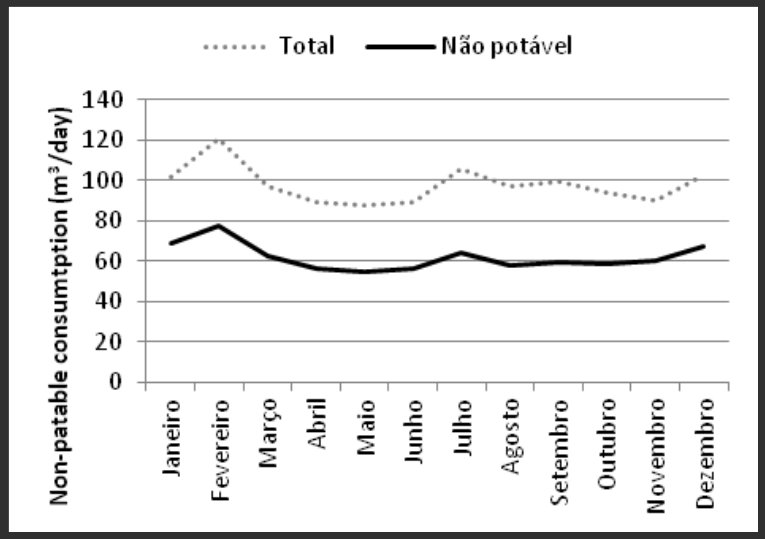




B1: 4190 m^2	B2: 12240 m^2
	



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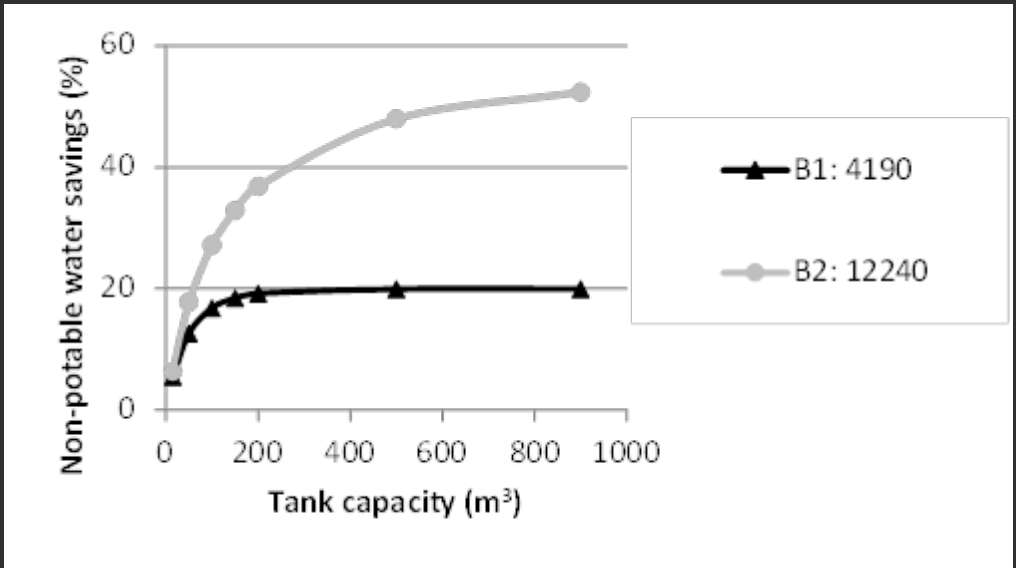

Case	Tank (m^3)	Rainwater used (m^3/ano)	Annual savings (BRL/ano)	Implementation costs (BRL)	Operation and maintenance costs (BRL/ano)	Payback period
B1 4190 m^2	100	3802,3	94107,4	129968,0	2599	18 months
	150	4173,1	103285,3	148173,3	2963	18 months
	200	4344,0	107514,5	165524,7	3310	20 months
B2 12240 m^2	200	8337,4	206351,5	165524,7	3310	10 months
	300	9563,7	236700,6	200863,0	4017	11 months
	400	10323,0	255495,0	236201,2	4724	12 months

- Rainwater harvesting systems design should be case specific due to the differences on water consumption and rainfall amounts and patterns
- Consumption pattern on commercial buildings tend to have small daily variability but potentially high monthly variability
- Commercial buildings (excluding the food court areas) present high fractions and significant amounts of non-potable water use, favouring the use of solutions such as rainwater harvesting
- Water savings potential are highly detached from financial viability of the investments:
  - Water cost vs investment cost
  - Constraints from standards (water quality and mix of public supply with alternative water sources)