Reliability of Stormwater Best Management Practices in Washington DC

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**Industrial and System Engineering**

Background

Combined Sewer Overflow (CSO):

To avoid flood, regulators are designed to let the excess flow, which is a mixture of stormwater and sanitary wastes, be discharged directly into the rivers and creeks.

D.C. Water (2018)

Sanitary Sewer Overflow (SSO):

untreated sewage is discharged from a sanitary sewer into the environment prior to reaching sewage treatment facilities.

Numbers of SSO by the years
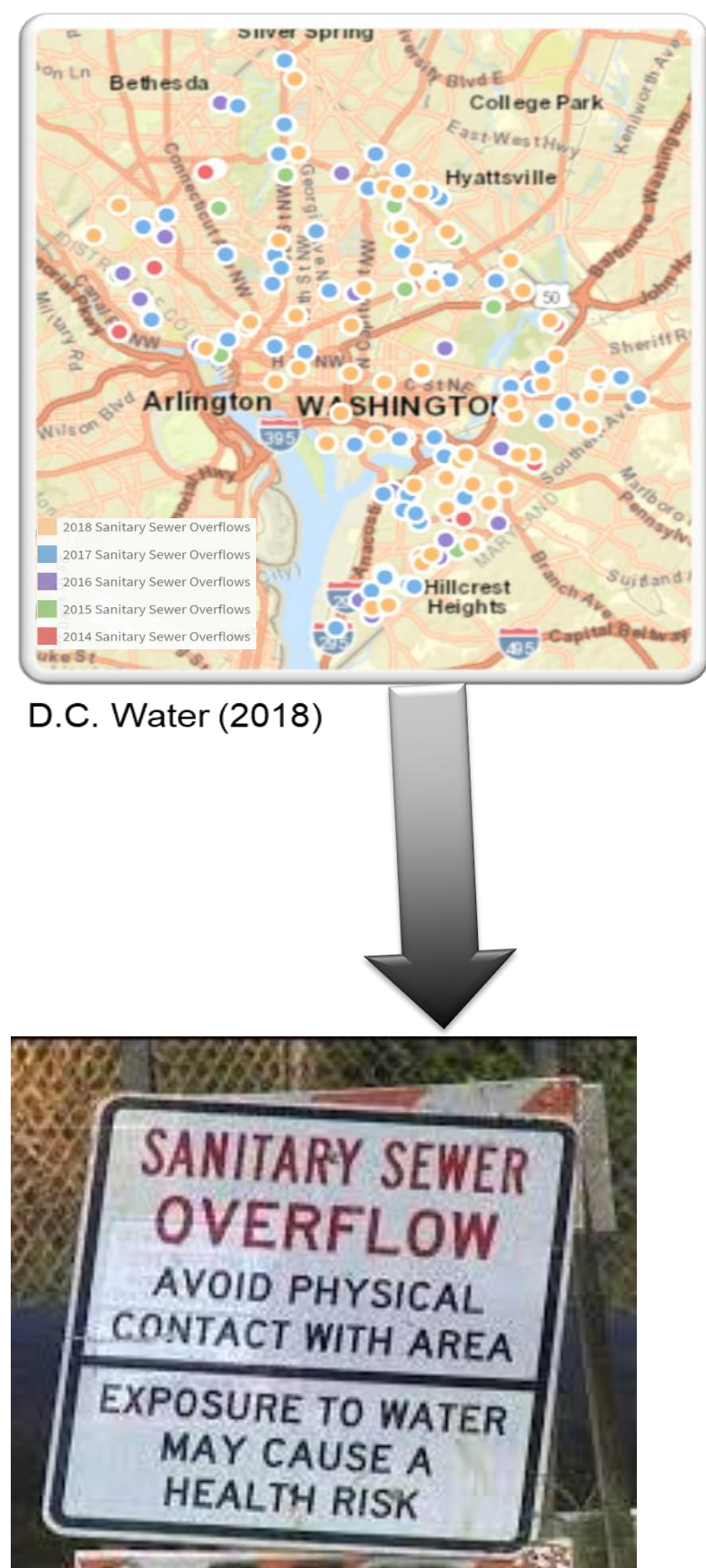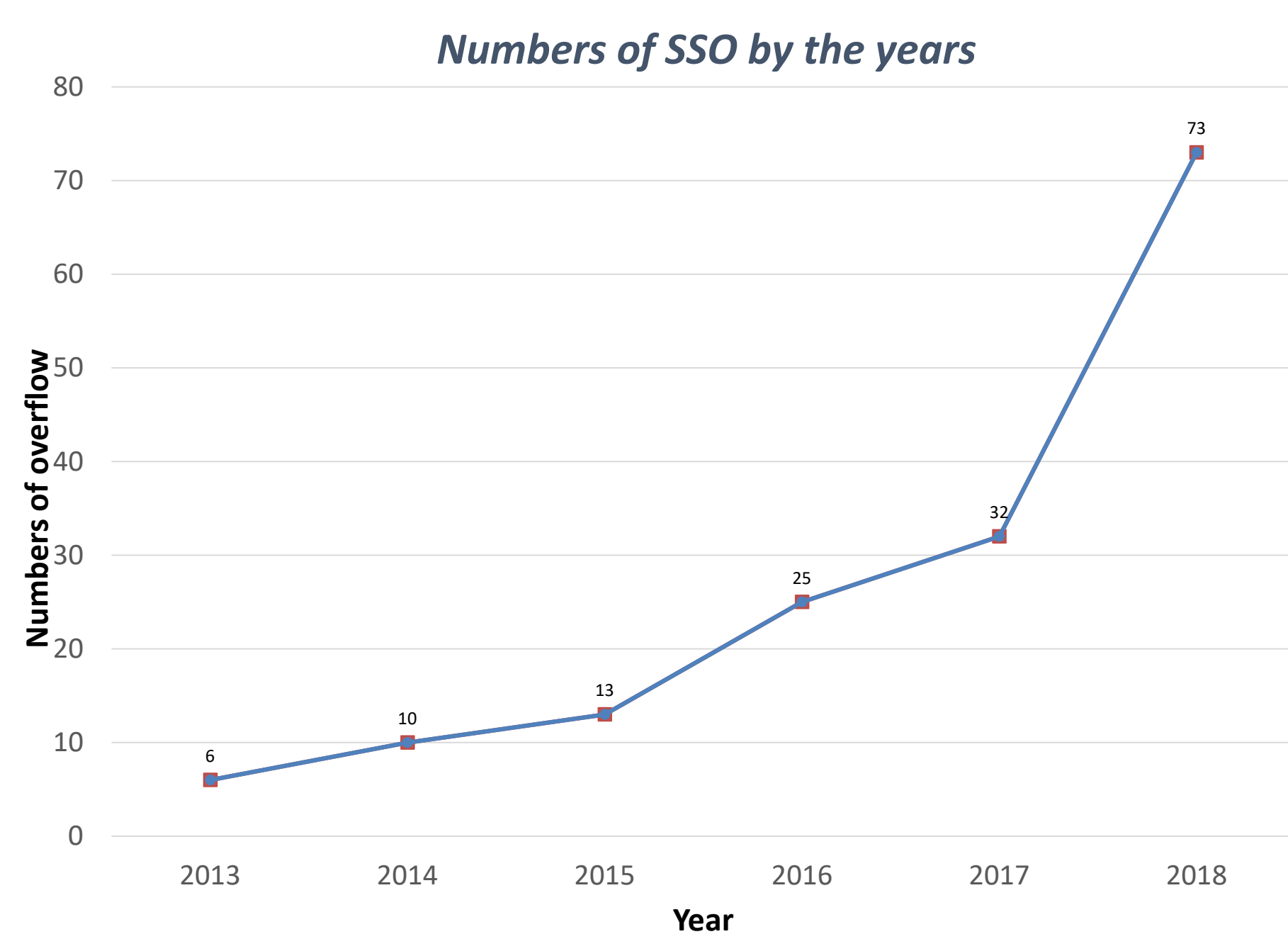
Research Objective & Methodology

Objective

✓ To determine the reliability of current stormwater BMPs system.

✓ Analyze the system to evaluate possibilities and improve reliability of system- Moving toward resiliency
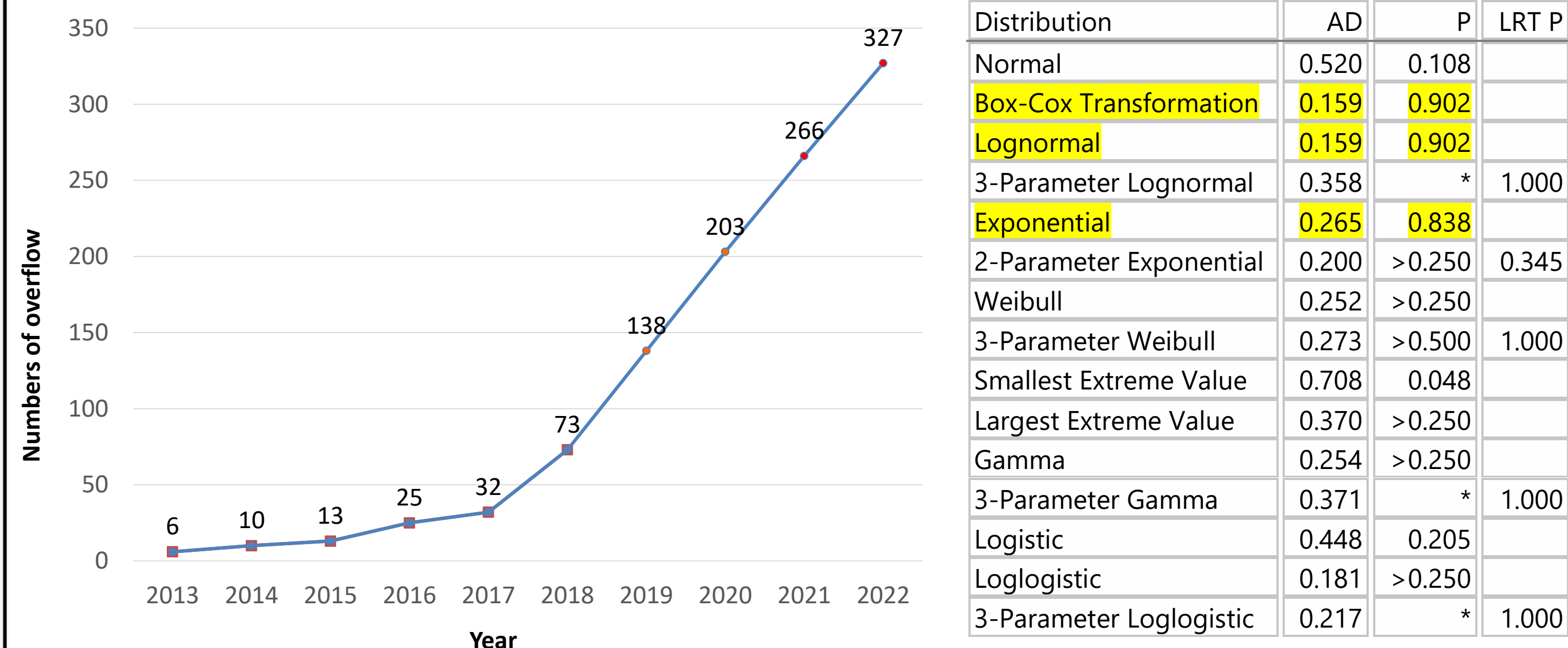
Methodology - Reliability

Reliability is defined to be the probability that a component or system will perform a required function for a given period of time when used under stated operating conditions.
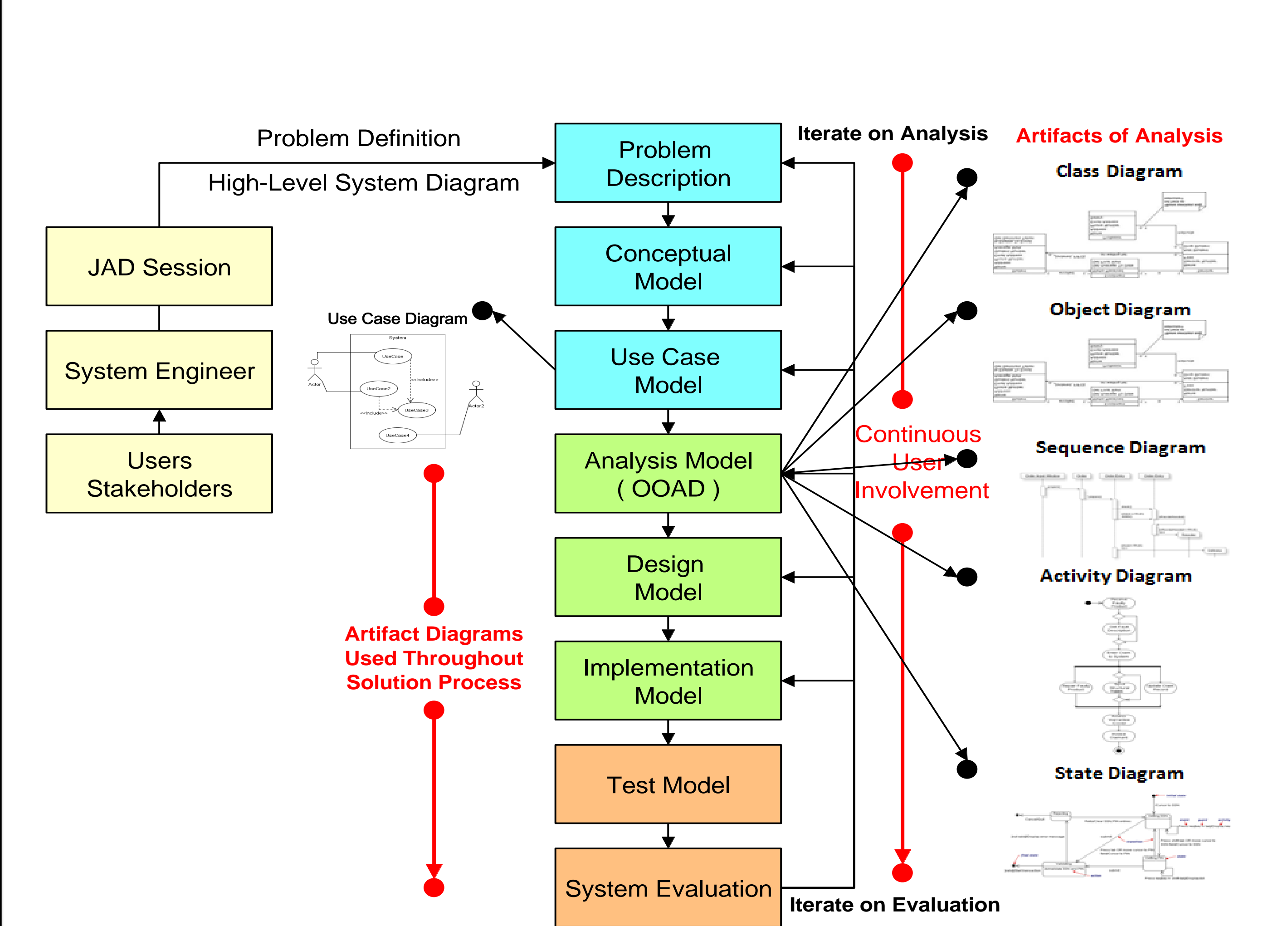
Goodness of Fit

The Anderson–Darling test is a statistical test of whether a given sample of data is drawn from a given probability distribution

Result - Reliability

Result of Goodness of Fit Test

Distribution	AD	P	LRT P
Normal	0.520	0.108	
Box-Cox Transformation	0.159	0.902	
Lognormal	0.159	0.902	
3-Parameter Lognormal	0.358	*	1.000
Exponential	0.265	0.838	
2-Parameter Exponential	0.200	>0.250	0.345
Weibull	0.252	>0.250	
3-Parameter Weibull	0.273	>0.500	1.000
Smallest Extreme Value	0.708	0.048	
Largest Extreme Value	0.370	>0.250	
Gamma	0.254	>0.250	
3-Parameter Gamma	0.371	*	1.000
Logistic	0.448	0.205	
Loglogistic	0.181	>0.250	
3-Parameter Loglogistic	0.217	*	1.000

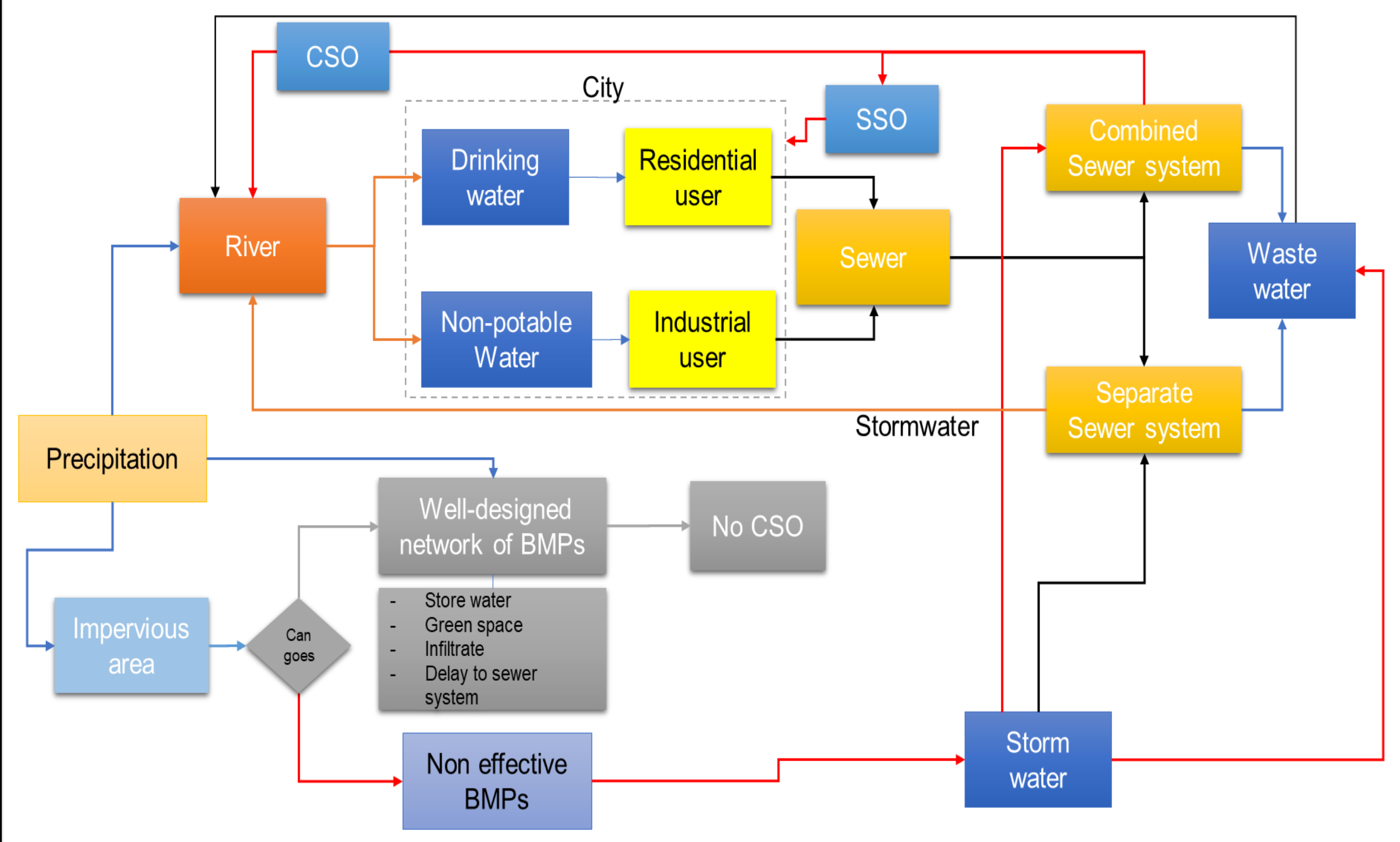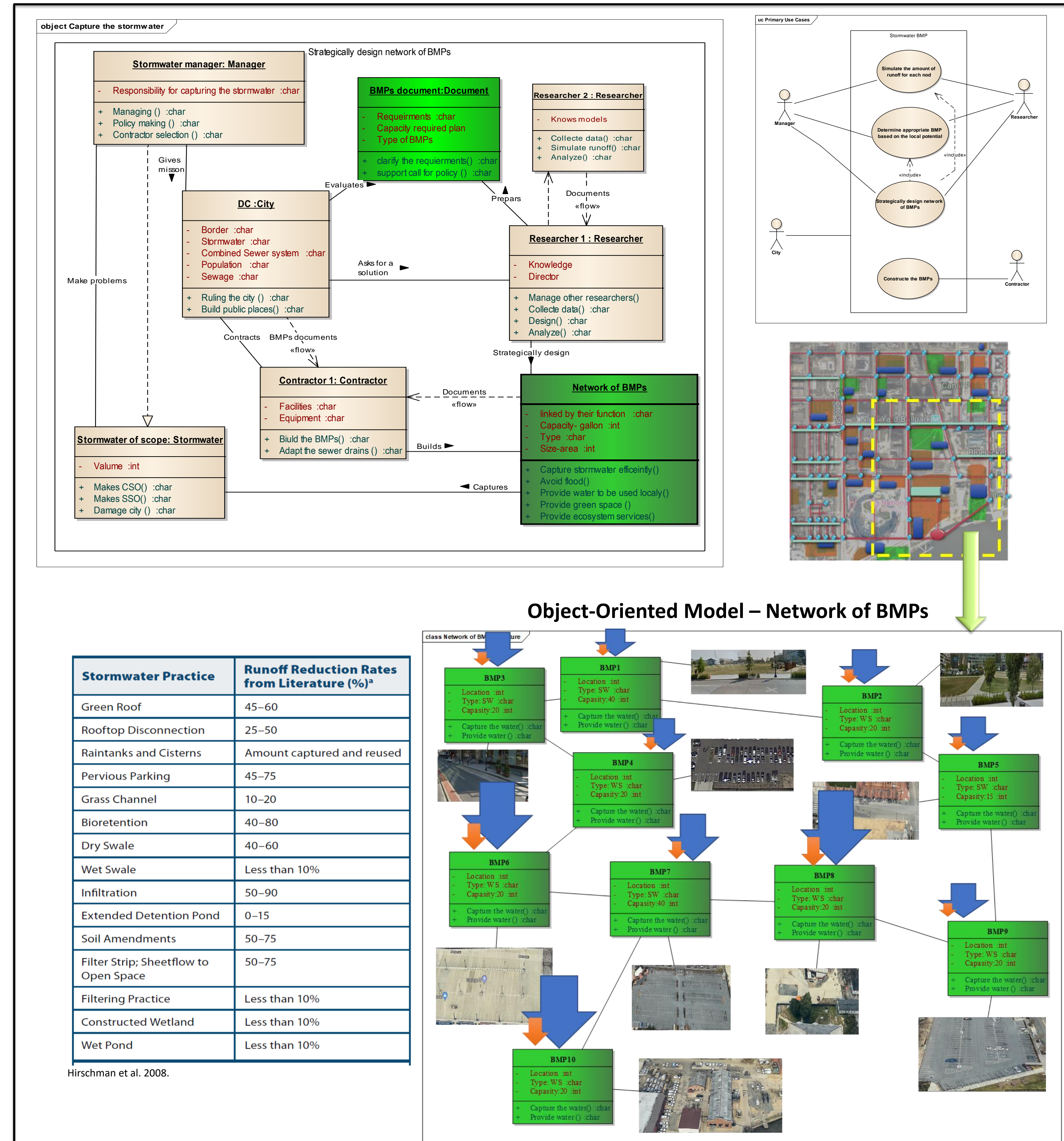## Methodology – System Analysis

Problem Definition:

The reliability of system is relatively low.

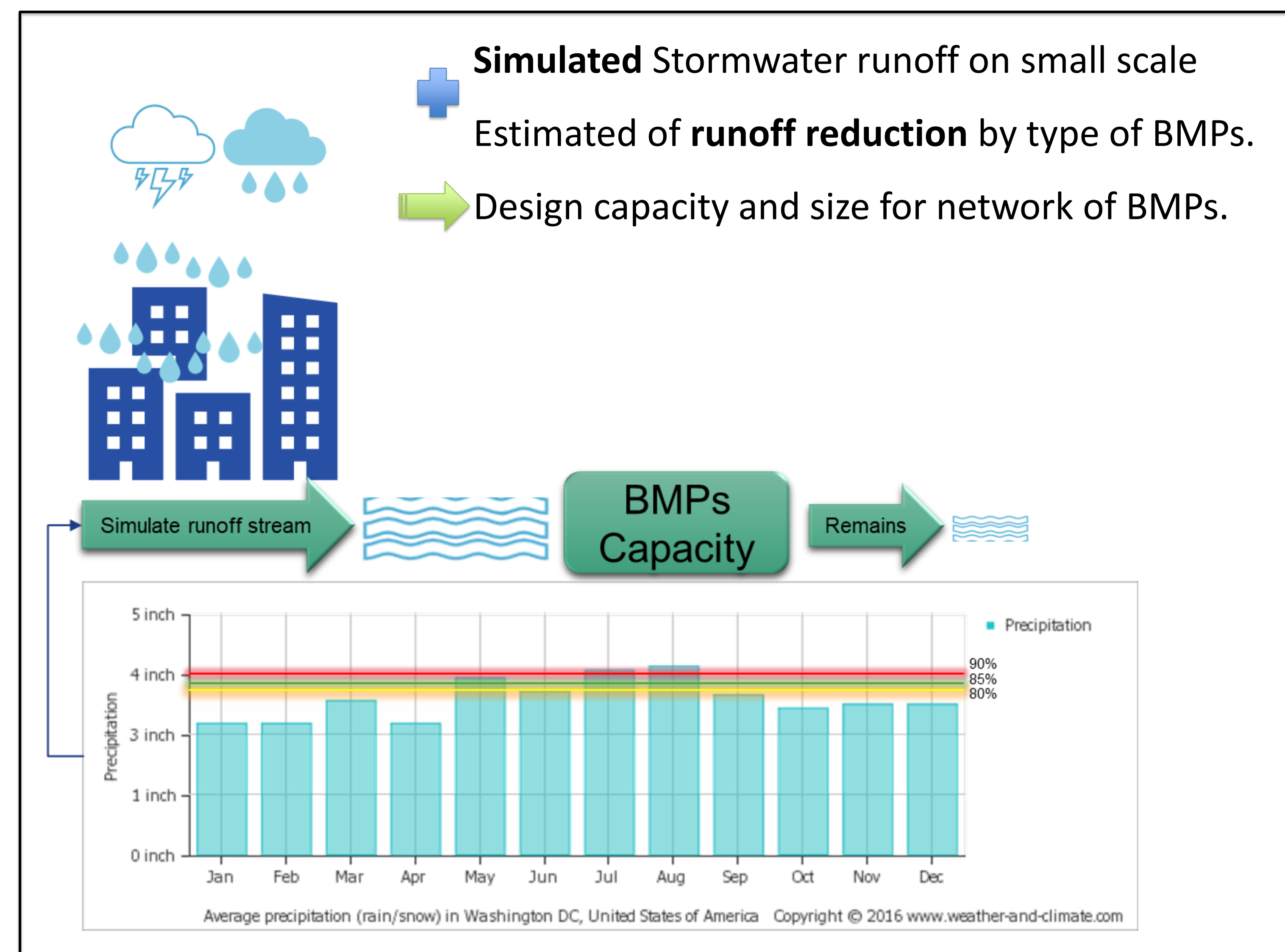The current BMPs cannot prevent overflows. (SSO&CSO)

Conceptual Model

Object-Oriented Model

Object-Oriented Model – Network of BMPs

Stormwater Practice	Runoff Reduction Rates from Literature (%)*
Green Roof	45–60
Rooftop Disconnection	25–50
Raintanks and Cisterns	Amount captured and reused
Pervious Parking	45–75
Grass Channel	10–20
Bioretention	40–80
Dry Swale	40–60
Wet Swale	Less than 10%
Infiltration	50–90
Extended Detention Pond	0–15
Soil Amendments	50–75
Filter Strip; Sheetflow to Open Space	50–75
Filtering Practice	Less than 10%
Constructed Wetland	Less than 10%
Wet Pond	Less than 10%

Hirschman et al. 2008.

Results and Conclusion

Simulated Stormwater runoff on small scale

Estimated of **runoff reduction** by type of BMPs.

Design capacity and size for network of BMPs.

Average precipitation (rain/snow) in Washington DC, United States of America   Copyright © 2016 www.weather-and-climate.com

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