CARIBBEAN REGIONAL CONFERENCE
WATER LOSS 2023

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MANAGING HEAD LOSS IN WATER TRANSMISSION AND DISTRIBUTION SYSTEMS

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NON-REVENUE WATER

- The difference in the volume of water that is put into a distribution system and the volume of water billed to customers (Frauendorfer and Liemberger 2010, 5).

- A high percentage of non-revenue water is a surrogate for a poorly run water utility company (Bill, Roland and Marin 2006, v).

Table 1: Estimates of Worldwide NRW Volumes

			ESTIMATES OF NRW				
				Ratio		Volume (billions of m^3/year)	
	Supplied population (millions, 2002)	System input l/capita/day	Level of NRW (% of system input)	Physical losses (%)	Commercial losses (%)	Physical losses	Commercial losses	Total NRW
Developed countries	744.8	300	15	80	20	9.8	2.4	12.2
Eurasia (CIS)	178.0	500	30	70	30	6.8	2.9	9.7
Developing countries	837.2[a]	250[b]	35	60	40	16.1	10.6	26.7
				TOTAL		32.7	15.9	48.6

Sources: WHO and authors' estimates.

l = liters; m^3 = cubic meters

a. Based on a total population having access to safe water supply of 1,902.7 million people, with 44 percent of these receiving water through individual household connections.

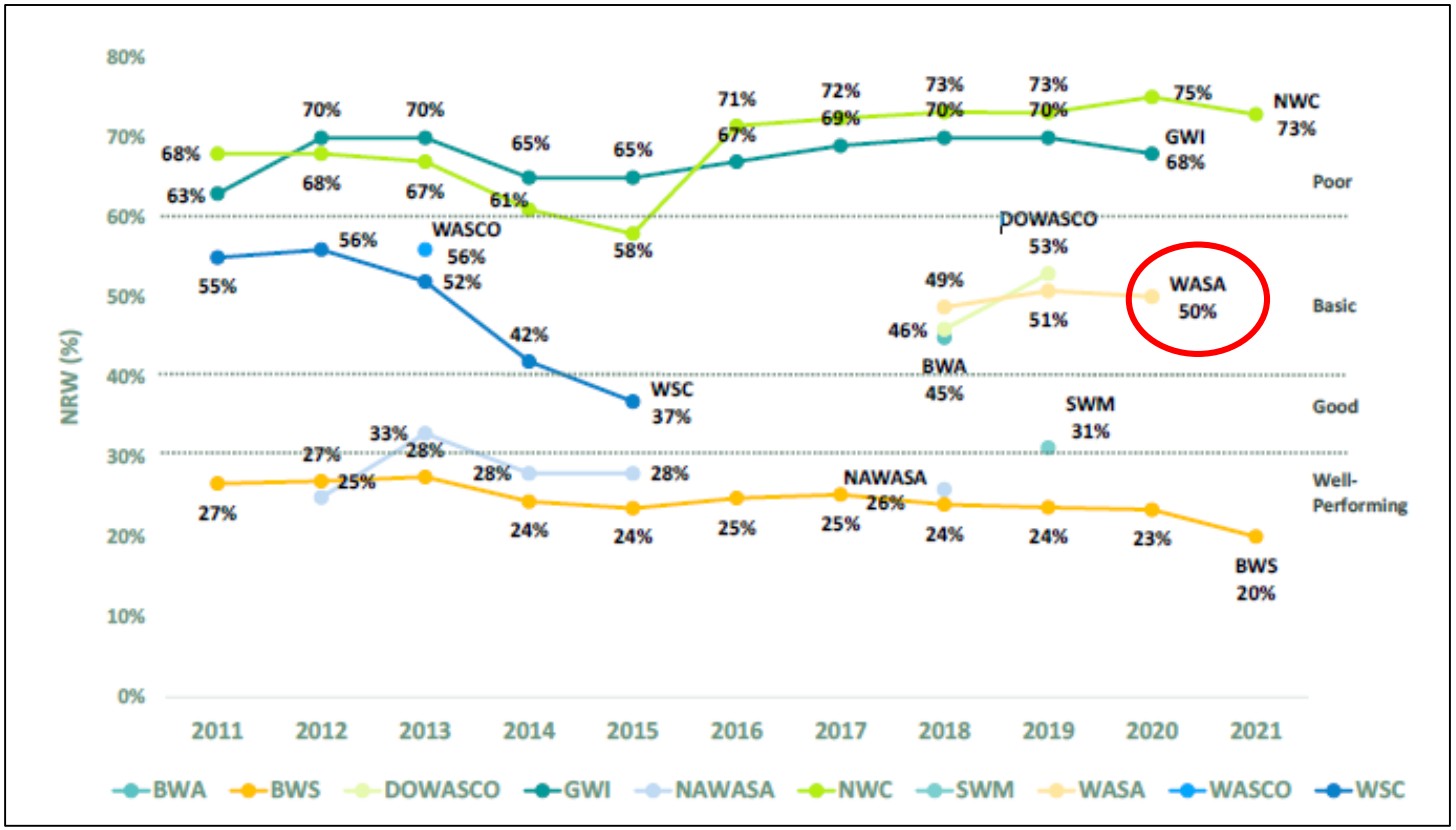
b. This figure reflects a wide discrepancy among developing countries, from 100 l/capita/day for some utilities in the poorest countries or those experiencing severe water shortages to more than 400 l/capita/day in many megacities of Latin America and East Asia. The figure used in this calculation is a conservative average.

Kingdom, Liemberger, Marin 2006, 3

NON-REVENUE WATER IN THE CARIBBEAN

(IDB 2021, 14)

- Caribbean: 45%-75%

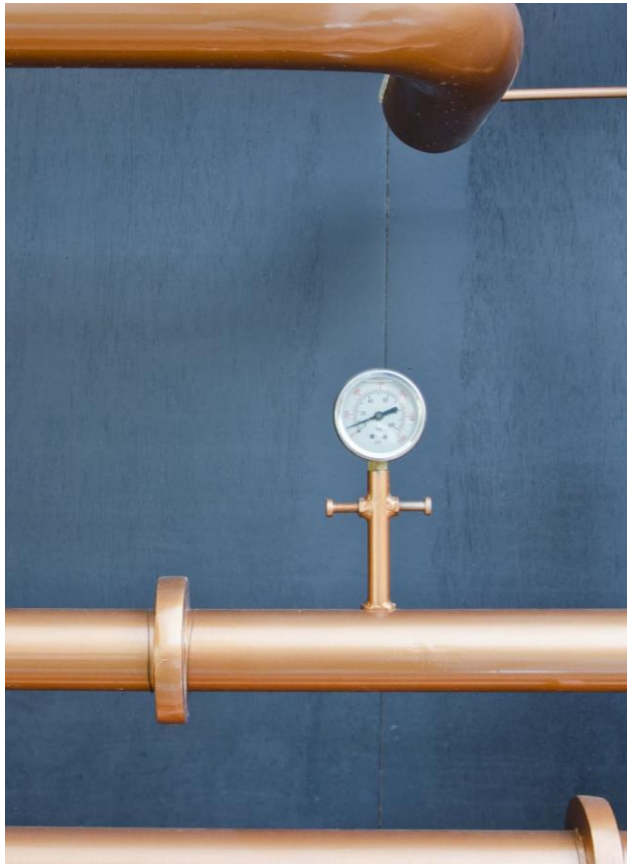


WATER DISTRIBUTION SYSTEMS

- Distribution systems are a series of interconnected components pipes and storage facilities responsible for transporting drinking water directly from the water treatment plants to the customers or from the source of supply to customers (U.S EPA 2021).
- To reduce head loss in urban distribution networks, pressure management must be given significant attention (Monsef, Naghashzadegan, Farmani and Jamali 2018, 397).
- Pressure management, is a means of controlling the water pressure whilst it is in transit along the transmission and distribution system so that the customer receives a sufficient supply (at a minimum head of pressure of 138 kPa at the point of the water service connection).
- Pressures are supplied or boosted using a combination of pumping infrastructure, storage tanks and gravity flow. (American Water Works Association n.d).
- Water pressure can be and is usually controlled or adjusted in water transmission and distribution systems with the use of appurtenances for example control valves.
- Pressure reducing valves and variable speed pumps are the most common means of managing pressures in water distribution systems (Monsef, Naghashzadegan, Farmani and Jamali 2018, 397).

HEAD LOSS IN PIPELINES

- Frictional losses in piping systems and can be a major portion of the total head in a system (Stewart 2019, 29).
- Reduction in total head of a fluid as it moves through the pipeline.
- Friction occurs between the inner walls of the pipeline and the water as the water moves through the pipeline.
- Friction is greater closer to the walls of the pipeline.
- Water loss along the way in the distribution system that never reaches the customer.
- Never reaches its final destination.
- Head loss is one of the causes of non-revenue water.
- It is a real loss.



AIM AND OBJECTIVES

AIM

To investigate head loss occurring in a water transmission and distribution network supplying water to an area located at the farthest end of the transmission system.

General assumptions made during this investigation were:

1. All major offtakes along the transmission system are closed once that area is not scheduled to receive a supply.
2. The leakage rate is properly managed and therefore losses occurring due to leaks can be considered minimal.

OBJECTIVES

Objective 1

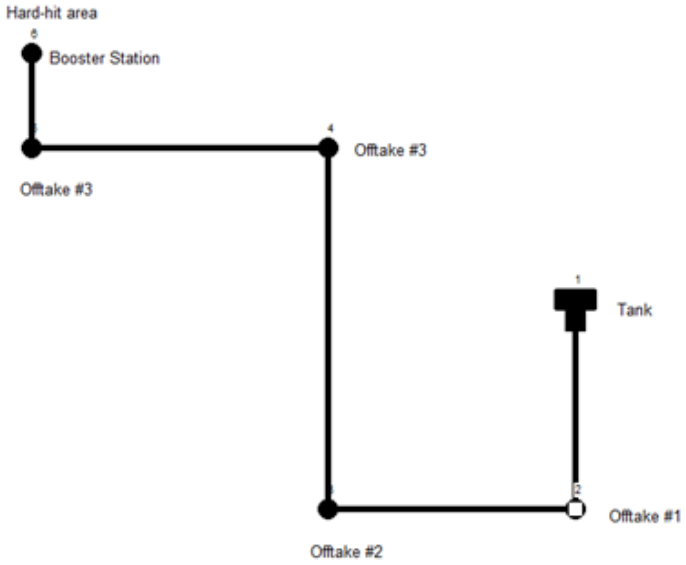
To construct and simulate a transmission and distribution network using EPANET simulation software.

Objective 2

To calculate head loss in the transmission and distribution pipelines transporting using the Darcy-Weishbach equation.

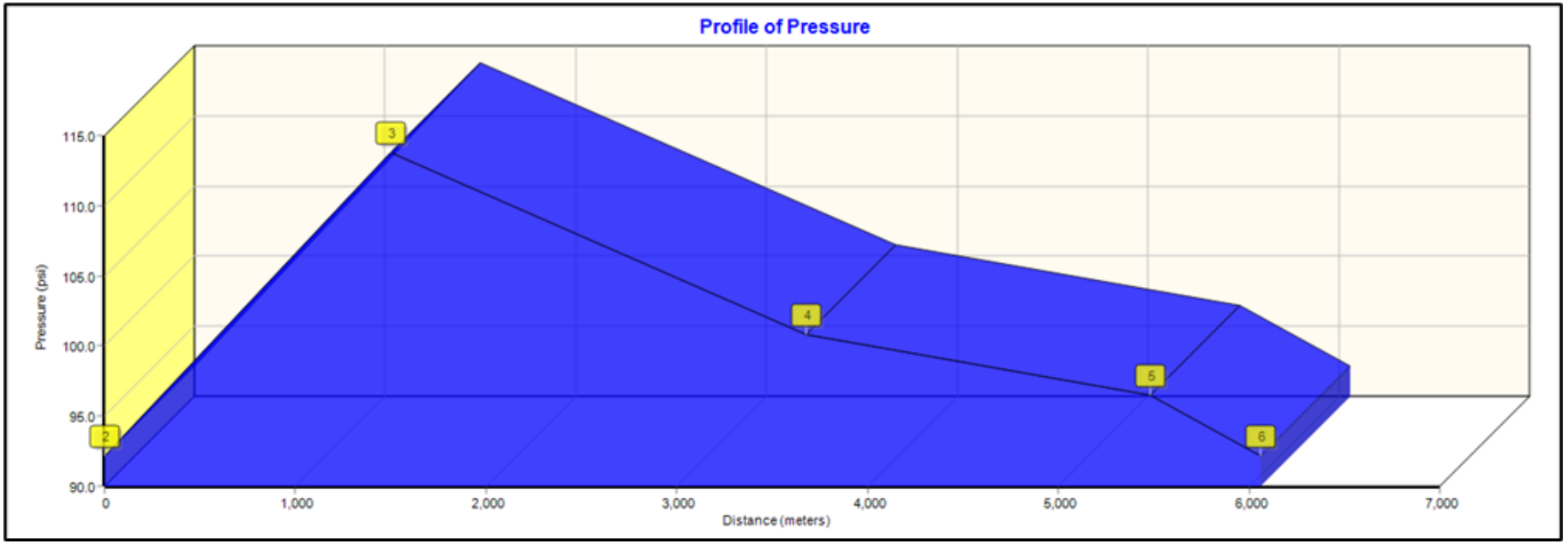
Objective 3

To provide recommendations that can alleviate or eliminate head loss taking place in the respective pipelines to ensure an improved supply of water to customers (with the recommended minimum pressure head of 20 psi.)



EPANET SIMULATION: NETWORK MAP OF TRANSMISSION AND DISTRIBUTION SYSTEM

EPANET SIMULATION: (PRESSURE VS DISTANCE)



Source of supply → Hard-hit area

DARCY-WEISHBACH EQUATION

$$h = f \frac{L}{D} \frac{V2}{2g}$$

h= frictional pressure head loss (ft of head)

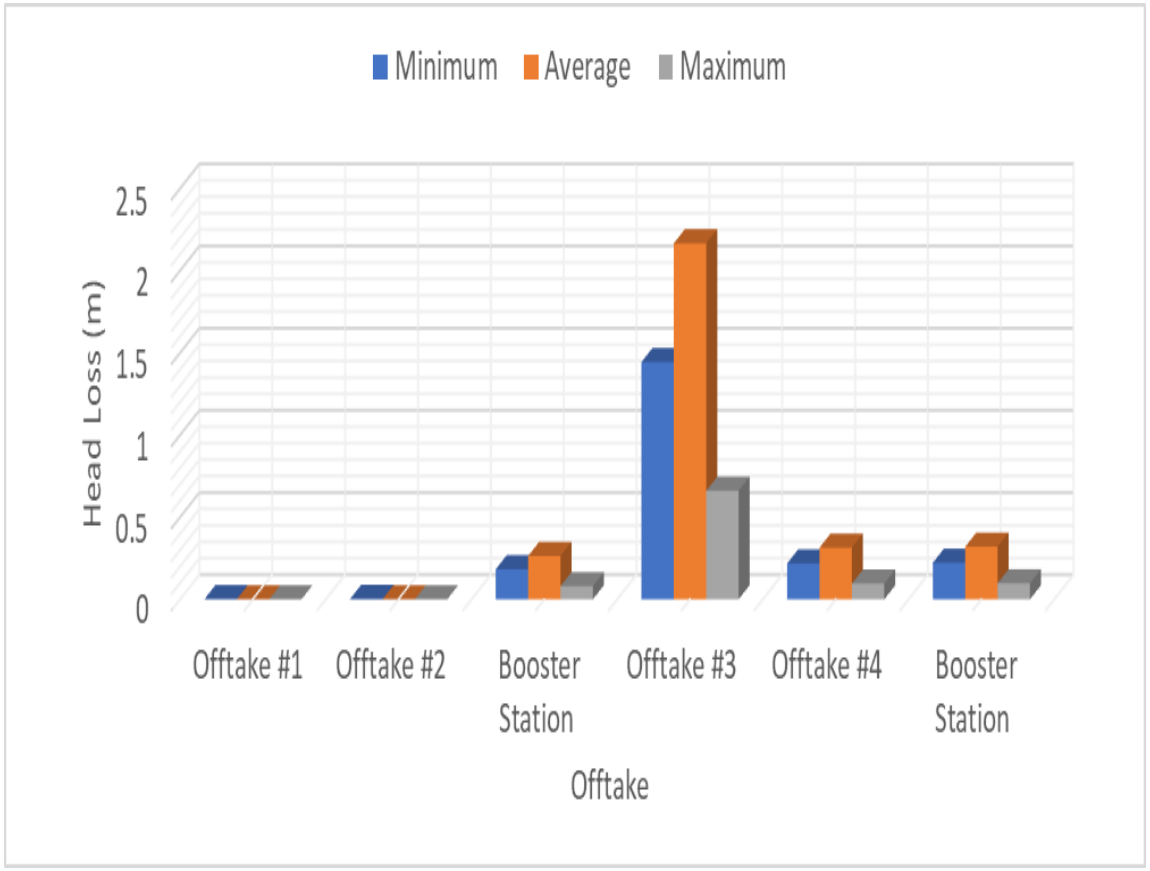
f = Darcy friction factor (dimensionless),

L = pipe length (ft),

D = pipe inside diameter (ft),

V = average flow velocity (ft/s),

g = acceleration due to gravity (9.81 m/s^2)

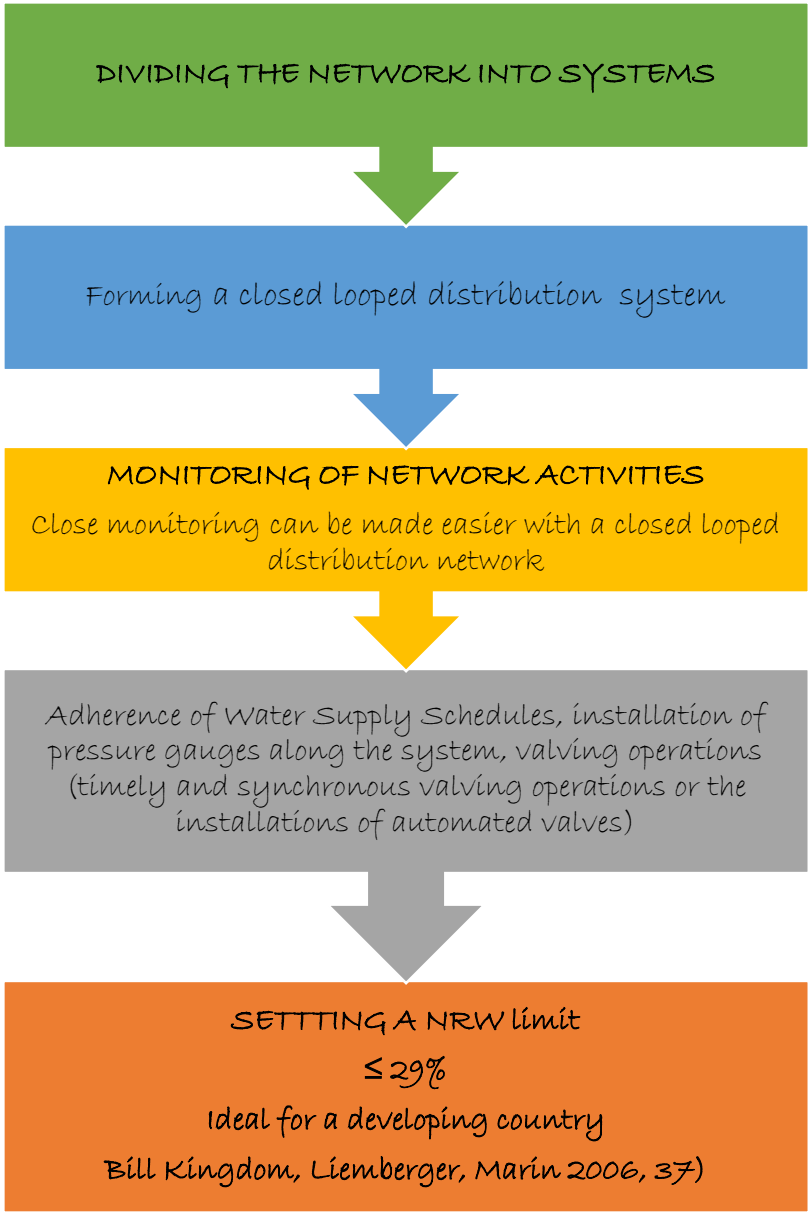


SOLUTIONS TO MANAGING HEAD LOSS IN WATER TRANSMISSION AND DISTRIBUTION SYSTEMS

1) Leakage recovery
2) Dividing the network into sections
3) Quick assessment and repair
4) Monitor network activities
5) Take control of the network pressure
6) Use all the available data and think smart
7) Set a NRW limit and follow up
8) Look for ways to tackle illicit consumption
9) Quality products and solutions
10) Training and education

(AVR Group)

SOLUTIONS TO MANAGING HEAD LOSS IN WATER TRANSMISSION AND DISTRIBUTION SYSTEMS



CONCLUSION

- Head loss in water transmission and distribution pipelines in inevitable as distance from the source of supply increases.
- Friction between the inner walls of the pipeline and the water cannot be intercepted during the supply of water from the source to the customer.
- Friction loss taking place would also vary depending on the material of the pipeline.
- Solutions would be to keep the number of leaks to a minimum, frequent servicing of appurtenances along the system to avoid losses with additional installation of appurtenances such as air valves.
- Installation of booster stations along the system, especially at points where pressures decrease would greatly help.
- Dividing the network into systems.
- Monitoring of network activities.
- Setting a NRW limit.
- Inevitable but, head loss can be controlled.

THE END

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THANK YOU FOR YOUR ATTENTION!!!