Caribbean Regional Conference – Water Loss 2023

Using Water Quality Degradation and Customer Complaints as a Monitoring Tool for Water Loss in the Caribbean

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OBJECTIVES

Use water quality degradation in a distribution system and customer complaints as a monitoring tool for water loss.

Use A.I. for spatial and temporal relationships between water quality and customers' complaints to identify factors driving degradation of the aesthetics of drinking water and determine its relationship with water loss in a DS.

Use A.I. to develop an analytical framework, followed by the practical implementation of solutions are feasible and is applicable to develop a strategy for water loss management for any municipality or region.

INTRODUCTION

- Water quality deteriorates during transportation
- Water loss reduces safety, supply and perception
- Can result in intermittent supply
- Contaminants can enter the leaking pipes (when external pressure becomes greater than the water pressure in the pipe)
- Biofilm and other accumulated contaminants are susceptible to release
- Customer complaints (appearance, odor, taste issues)
- Compounded effect of water loss

- In many developing countries the concept of water loss management has received little attention compared to severity of the problem
- Significant resources required to install, operate and maintain infrastructure, addressing limited water, increased demands, climate change, increased regulatory requirements, and limited resources
- A well implemented water loss program can protect public health by eliminating the threat of sanitary defects that may allow microbial or other contaminants to enter the treated water

PREVIOUS WORK

Ramsawak et.al., 2020; 2021

In work done with a Western municipality, we were able to identify factors such as water quality, pipe material, pipe age, pipe size, hydraulic conditions that drive metal accumulation (Fe, Mn) in the water, contributing to degradation.

Identified factors that may affect biofilm growth and release in the water distribution system of a Western Canadian city.

Significant correlations between customer complaints and water quality, allowing the use as an indicator for degradation and water loss.

WATER QUALITY DEGRADATION

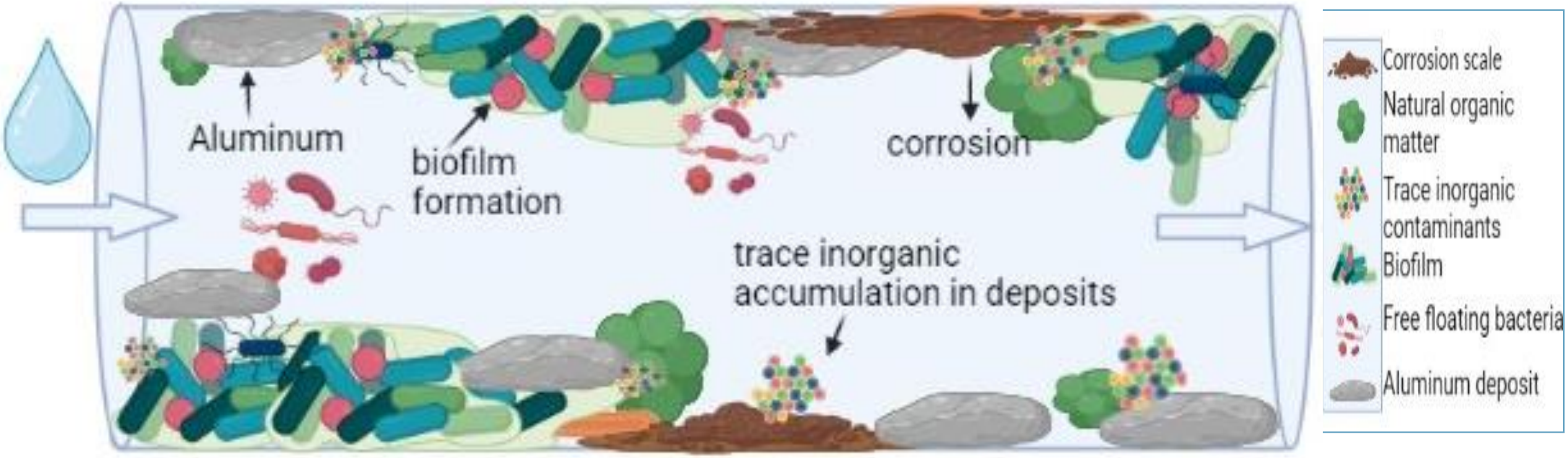


FIGURE 1: A conceptual model of water quality degradation in a drinking water distribution system

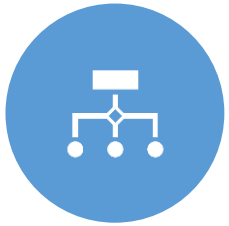
Ramsawak et al., 2021

CUSTOMER COMPLAINTS AS A TOOL

Customer complaints can serve as an early warning system for water quality degradation in a distribution system.

By monitoring and analyzing customer complaints, water utilities can identify trends and patterns that may suggest a particular issue with the distribution system.

This can be used to take proactive measures

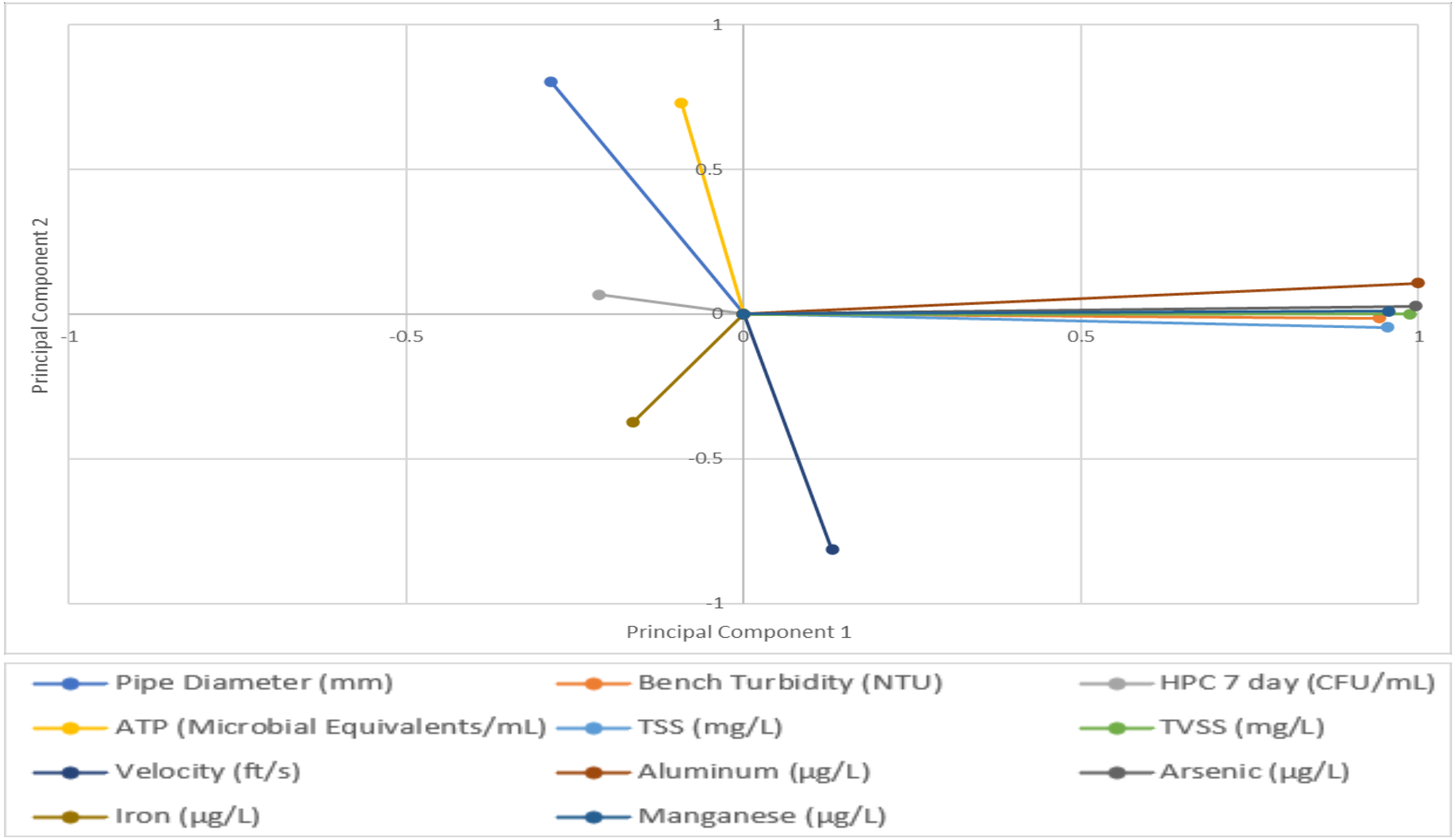


By tracking customer complaints over time, utilities can monitor the effectiveness of their remedial actions and ensure that the problem has been fully resolved.

Overall, customer complaints can be a valuable tool for identifying and addressing water quality issues in a timely manner, thereby safeguarding public health and ensuring that customers receive safe and reliable water service.

PRINCIPAL COMPONENT ANALYSIS (PCA)

- PCA to investigate pipe material, length and velocity on metals, age, and diameter
- Arsenic had highest contributing factor to PC 1, with Mn and Al in close vicinity.
- Physical parameters that had the largest impact on the variance was velocity, and pipe diameter (negatively correlated)
- This PCA concept can be used to identify degradation of water systems and help with mapping out a maintenance system.



Ramsawak et al., 2020

SPATIAL ANALYSIS USING GIS

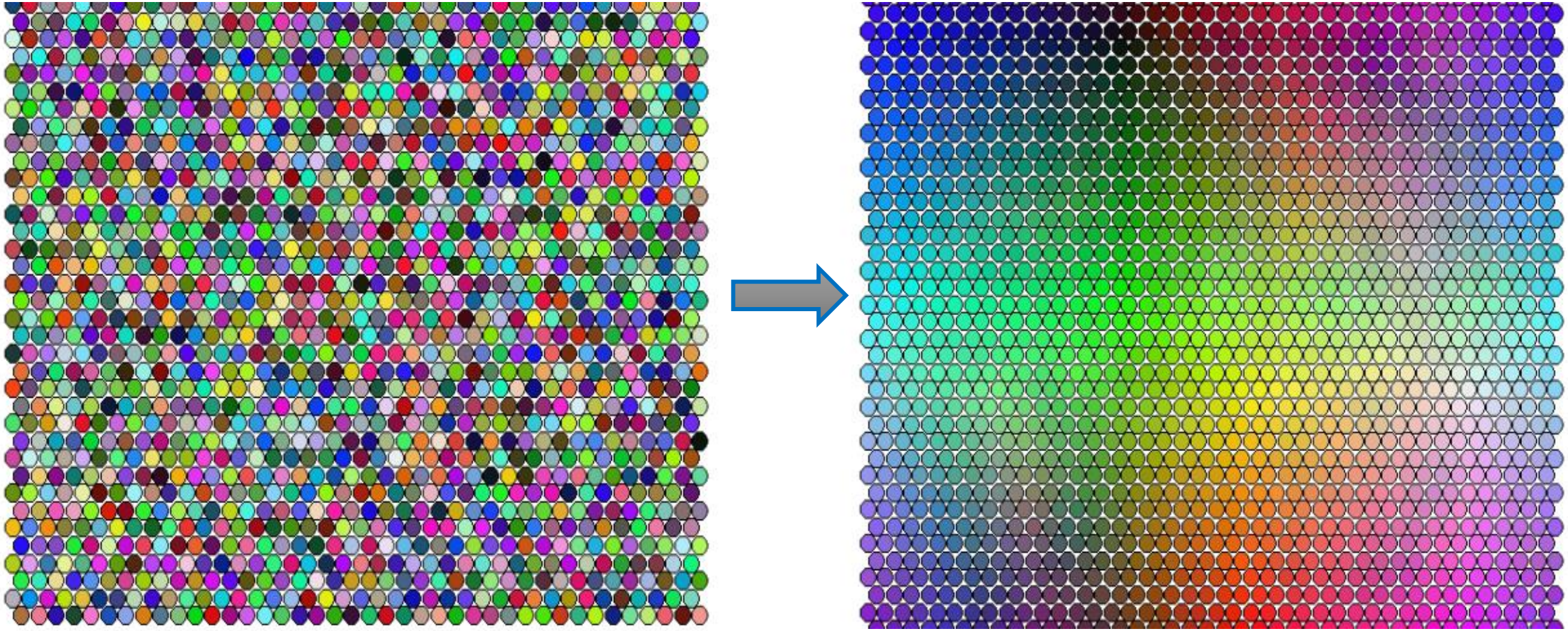
Geographic information system (GIS) used to visualize spatial relationships within the distribution system.

Locations of customer complaints were first mapped within the city quadrant to observe the general trend of water quality events

Use pressure zones to assess the spatial relationship between water quality events within the network.

Spatial analysis aims to inform the source of these events – in identifying clusters within pressure zones or at individual residences.

SELF ORGANIZING MAPS



SUMMARY

- Statistical tools to explore water quality degradation and customer complaints as an indicator of water leakage: SPSS, PCA, GIS and SOM
- Understanding factors influencing water degradation and the effect on customer complaints can contribute to improved water management, household and distribution infrastructure, utility services, and crisis communications
- Water quality problems and customer complaints are clustered in space and time; adopting a temporal and spatial analysis within defined areas, can identify potential “hot spots” for changes in quality in a DWDS
- Point or segments of contamination in a DS, used with customer complaints to identify type of contaminant or source impacting the quality, but is dependent on consumer demographics
- Customer complaint data is essential to for proper representation of issues in specific locations

- Several mechanisms contribute to aesthetic degradation in a distribution system including precipitation inside the pipes, corrosion, sediment intrusion due to breakage and/or repair
- Degraded aesthetics does indicate possible contamination, but it can indicate inefficiencies in the treatment process, loss of Cl residual in bulk water.
- Water quality data can be evaluated against an established baseline to observe temporal and spatial variations and should be used to complement other data sources (including consumer complaint and public health surveillance data) for a comprehensive analysis.
- Influent/effluent water quality at the water treatment facility can be used as a potential indicator of water quality problems within the network

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Thank you!

Interested in our research? Please contact:

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QUESTIONS?