Events Recognition System (ERS) for Water Treatment Processes

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Background

The supply of drinking water in the required quality and quantity depends largely on a continuous and secure water treatment at Water Treatment Works (WTWs). United Utilities (UU) faces considerable challenges in ensuring that WTWs operate effectively and efficiently. Reliable and accurate sensor data from WTWs, which are normally heavily monitored and automated, can be beneficially used for the rapid detection and diagnosis of abnormal WTWs' process conditions.
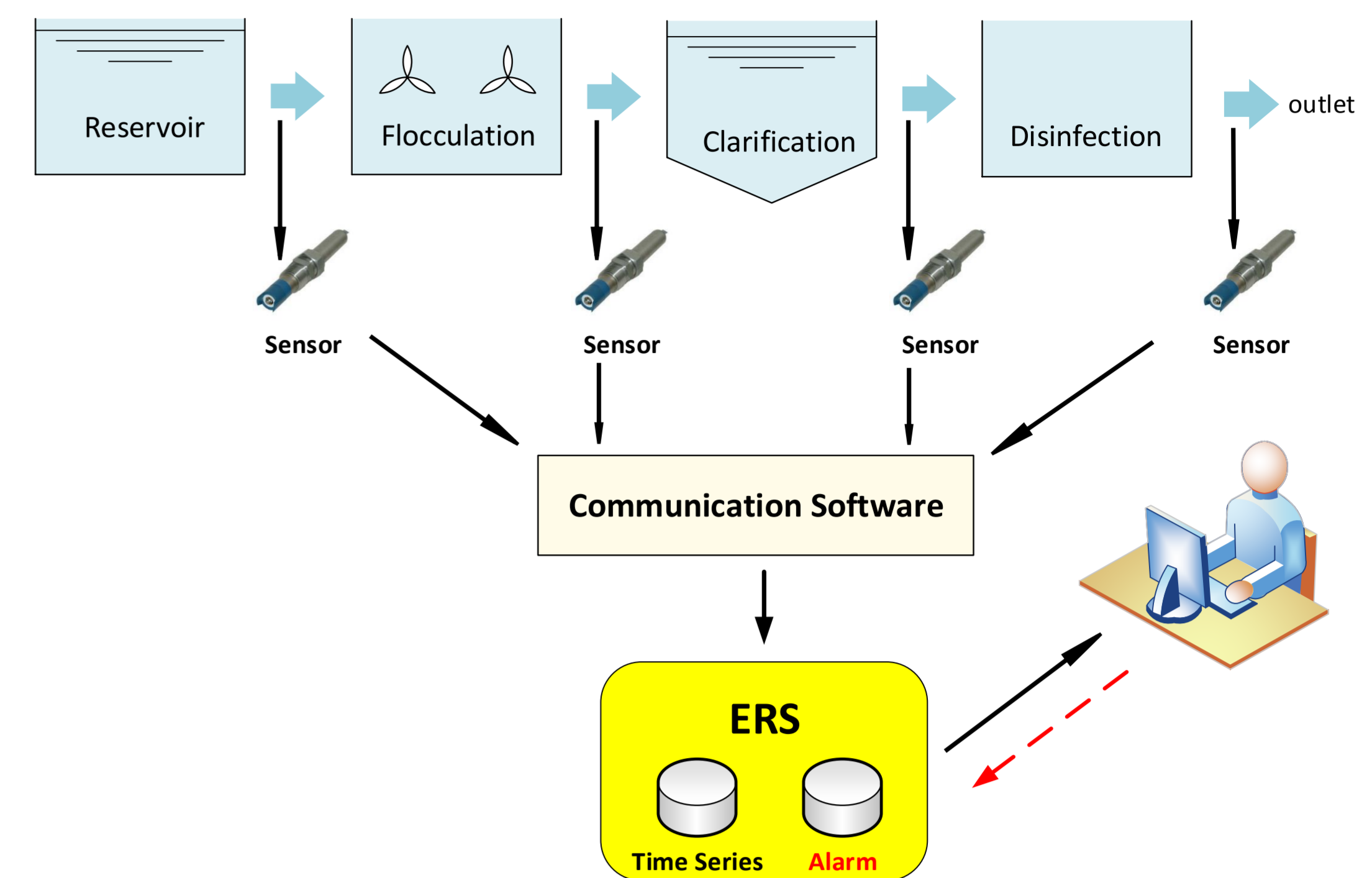
General ERS schematic for WTW application

Aim

To develop and test a new technology for real-time sensor data validation and predictive and/or proactive recognition and diagnosis of failure events (sensors and/or processes - including precursor features of an event). This will enable UU to move towards proactive and predictive alarms - i.e. based on leading indicators - and allow more proactive interventions to be identified and implemented with the aim to prevent failures before they impact the customers and/or the environment (e.g., address issues before they reach a critical point where a process may need to be shut down).

Work done on the development of the new ERS prototype

1) Collection, verification and analysis of historical sensor and other data for Wybersley WTW;
2) Identification and detailed analysis of major events (i.e. cases of complete shutdown) in the past 5 years;
3) Identification of additional minor events by visual inspection and other analyses;
4) Review of existing UU alarms (generally reactive – based on single signals going out of spec – lagging indicators) and performance (too many false alarms);
5) Identification of correlations/other relationships across multiple signals, seeking out leading indicators i.e., dosing pumps;
6) Development of preliminary univariate detection methods and their initial testing;
7) Work alongside other UU initiatives aimed at enabling greater visibility of WTW processes.

Wastewater visualization

Leading indicator - example
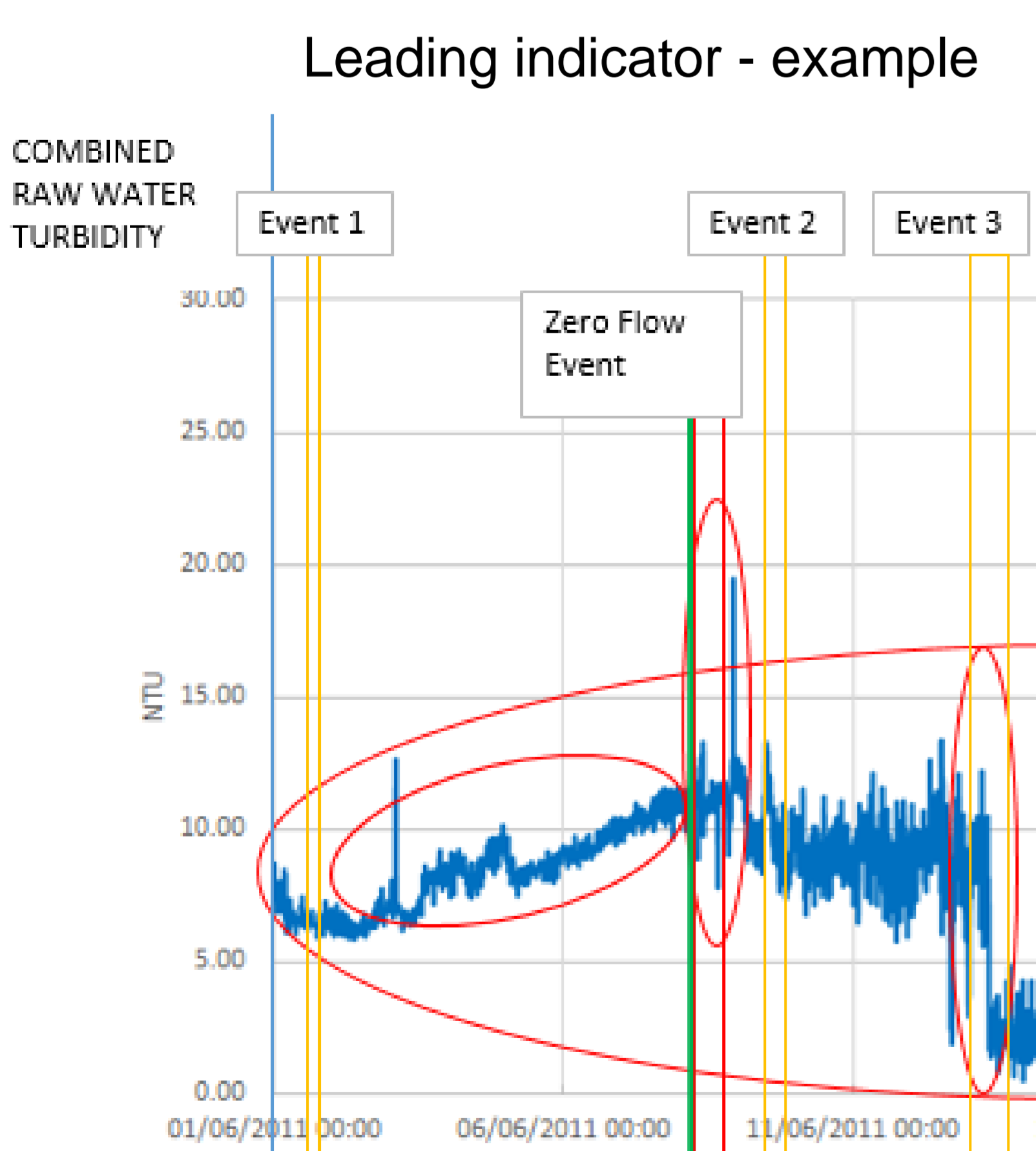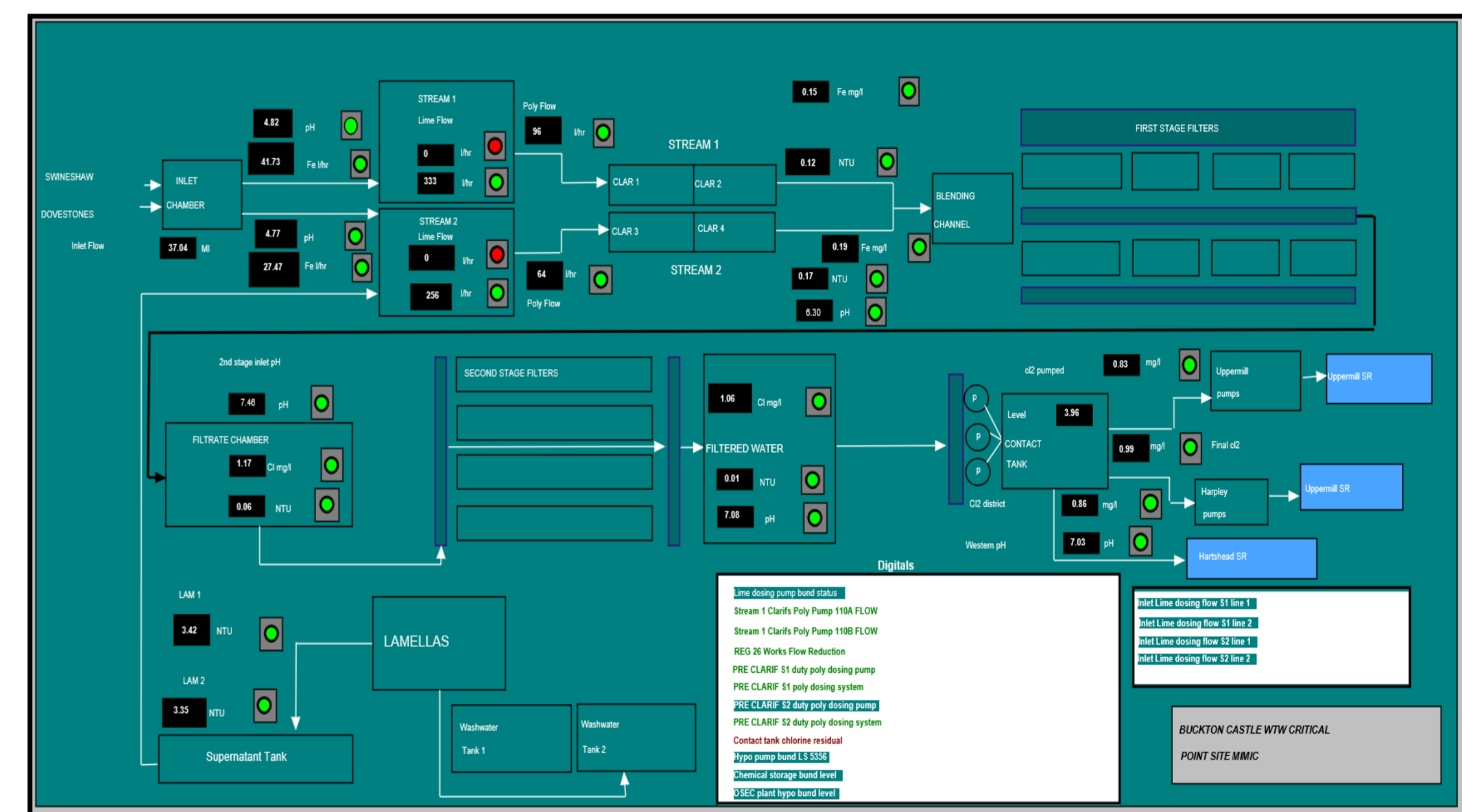
Future Work Plan

1) Identification of typical causes of events/issues;
2) Development of more complex rules for event detection – multivariate analyses, accounting for simultaneous/related anomalies in different signals;
3) Development of methods to detect faulty sensor data and to verify how and when this data can be trusted;
4) Development of methods to determine the root cause of a problem – distinguishing a faulty sensor from a faulty process;
5) Development of methods to identify the best proactive intervention and follow on response to reduce negative impacts.

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