Optimatics
PLAN SMARTER

CASE STUDY: PRESSURE MANAGEMENT OPTIMIZATION FOR THAMES WATER

Thames Water worked with eight$_2$0 and Optimatics to investigate whether changing dynamic valve settings and installing additional booster pumps to service tall buildings could help reduce leakage losses within their networks.

KEY POINTS

- Minimization of leakage losses
- Optimization of system operations including dynamic regulating valve settings
- 24-hour extended period simulation used in analysis

CLIENT REFERENCE

Thames Water

SYSTEM DESCRIPTION

Thames Water is responsible for supplying water to a number of Pressure Managed Areas (PMAs) within the Central London area, including the Hammersmith PMA and the Putney East PMA. The two PMAs are densely populated and contain many tall buildings: 14,405 in the Hammersmith PMA and 16,360 in the Putney East PMA. The Hammersmith PMA is segregated into a total of 15 district metered areas (DMAs), which are managed by electronically actuated pressure regulating valves (PRVs). The Putney East PMA is segregated into a total of 12 DMAs. Both of the PMAs contain relatively old pipework and are highly susceptible to leakage. Current leakage losses are estimated to be 8.3 ml/day in the Hammersmith PMA and 10.5 ml/day in the Putney PMA. These large losses correspond to substantial, ongoing loss of revenue for Thames Water.

PURPOSE

The purpose of the Thames Water PMA optimization study was to investigate options that would change system operation to reduce leakage losses without adversely impacting on customer service. Leakage from a water distribution network is a function of many factors, including pipe type, pipe age, quality of workmanship during pipe construction, and network operating pressure. Higher network pressures force more water out of openings in pipe joints and imperfections, resulting in higher leakage losses.

Reducing operating pressures by modifying network controls (such as valve and pump settings) can therefore lead to a reduction in leakage losses. A trade-off in reducing operating pressures is that the supply pressure at consumer demand points is also reduced. Consequently, the optimization challenge for the Thames PMAs was to find valve control strategies that could reduce leakage rates without violating minimum pressure requirements at supply points.

PROJECT SCOPE

Optimizer™ WDS was linked to a hydraulic model with a 24-hour simulation time. Optimatics developed an add-in script that calculated leakage losses based on the results of the hydraulic model and field calibration data provided by Thames Water. These losses were converted into an equivalent cost for the purposes of optimization. The optimization problem was formulated to include decisions regarding time-varying PRV settings at key valve locations. A non-typical approach was taken to assess the valve change's impact on the tall buildings, as many of the tall buildings in the PMAs had not been surveyed and it was unknown whether they already had private boosters installed. The approach involved penalizing nodes with pressures below tall building "target pressure" values with a survey cost, plus an expectation booster pump installation cost.

The optimization software carried out hydraulic analyses on solutions proposed by the optimization algorithm, with the aim of minimizing a single objective function containing tall buildings costs, leakage reduction benefits, minimum pressure penalty cost, maximum velocity penalty costs, and penalty costs associated with changes to the distribution of supply from the various water sources.

RESULTS

The initial optimization results produced excellent reductions in leakage losses, however the optimal valve setting patterns found by Optimizer™ involved many oscillating setting changes, which may not have been practical to implement in the field. The patterns were subsequently smoothed out during post-processing, ultimately producing solutions that would generate a leakage benefit of more than £2,000,000 whilst reducing the number of required booster pump stations.