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Integrating hydrogen sulphide modelling into wastewater system management

Vorreiter, L.*, Nobi, N.* Kerr, R*. Nguyen, T. and Yuan, Z.*****
*Sydney Water Corporation, 1 Smith St Parramatta, NSW. Australia
**NextGen Water. Australia
*** University of Queensland, Australia

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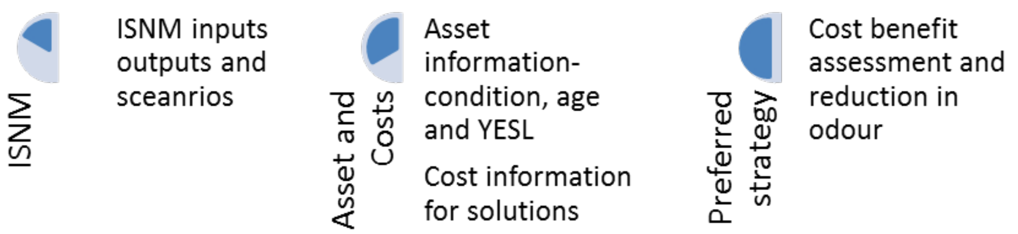
Summary of key findings

Sydney Water has integrated the outcome of hydrogen sulphide, ventilation and hydraulic modelling of its wastewater networks into a decision support tool (ISNM and ICODSS) to select cost effective corrosion and odour control measures. Strategies for 10 of its 26 wastewater systems have been developed, of which five are currently being implemented. Cost savings of over $100 million have been identified using this approach.

Background and relevance

Sydney Water spends over $50 million a year managing odour and corrosion in its wastewater system. This money is spent on renewal of corroded assets as well as chemical dosing and odour treatment to reduce hydrogen sulphide levels in the wastewater network and odour impact on communities. To better manage these costs and avoid an escalation in sewer deterioration, a need to develop integrated and proactive cost effective corrosion and odour management strategies for the wastewater systems was identified. To achieve this, Sydney Water worked with the University of Queensland to develop the hydrogen sulphide model (SeweX) (Sharma et al. 2008), as part of a $20 million, five-year Sewer Corrosion and Odour Research (SCORe) program, funded by the Australian Research Council (ARC) and many Australian Water Utilities and universities. Sydney Water adapted this model, developed its own dynamic ventilation model (Wang 2012), and in conjunction with its hydraulic model established the Integrated Sewer Network Model (ISNM). The output of this model, combined with asset condition and solution cost information (Gonzalez 2014) was the foundation of an integrated corrosion and odour decision support tool (ICODSS). This tool enabled the solutions, either capital works or optimisation, to be cost effectively implemented to resolve corrosion and odour issues.



The outcomes of the ISNM and ICODSS applied to the Malabar and Cronulla systems are presented.

Methodology

Effective management of corrosion and odour in wastewater systems is complex due to the many biological, chemical, hydraulic and material interactions occurring. To provide a structure for testing solutions, understanding the causes and their resolution was critical for selecting and testing appropriate management options. To achieve this, a hierarchy of controls process was included in the ISNM and ICODSS process as follows:

1. ISNM model build, calibration and scenario testing to achieve average hydrogen sulphide levels below 5ppm by:
    a. Testing, point source organic load reduction

   b. chemical dosing scenarios and ventilation scenarios

2. Asset information inputs for cost benefit analysis
   a. Collection of asset data, including sewer type, asset age and years to end of service life.
   b. Collection of actual cost data for capital and operating costs
   c. Collection of population data for determining odour impact.
   d. Generation of corrosion rate curves, odour dispersion contours and odour intensity procedures

3. ICODSS - Development of tool to process all this information and undertake 30-year cost benefit analysis to enable the selection of the best option/strategy.

Results and Discussion

The Malabar wastewater system is Sydney Water's largest system transporting 400ML/day and serving 1.5million people. The hydraulic residence time in this system is over 30 hours, providing the ideal environment for septic conditions and the generation of hydrogen sulphide. Over the past 20 years, major corrosion of the system and odour complaints lead to the implementation of chemical dosing and ventilation of the network, however dosing regimes and locations were not optimised.

The Cronulla system transports only 55ML/day (dry weather) however the system is over 50km long and includes new pressure systems connected on the outskirts of the network delivering septic sewage. The major issue for this system is odour with corrosion limited to parts of the network.

Malabar currently has 8 chemical dosing units and five odour control units on the system. Up to 60 tonnes a day of ferrous chloride is dosed into the system in summer to reduce hydrogen sulphide levels. Despite this large amount of dosing it was still estimated that without a changed approach, over $300m would need to be spent over the next 30 years for sewer rehabilitation. Using the ISNM model to test solutions and applying costs through ICODSS, it was shown that by reducing organic loads from trade waste and improving distribution of dosing it would be possible to achieve up to a 50% reduction in chemical dosing and extend the life of the sewer, reducing the cost of rehabiltation. Figure 1.1 shows that three chemical dosing units can be decommissioned with two new ones to be installed and Figure 1.2 shows the cost and odour profile of the prefreered management option. The ventilation strategy is currently being re-evaluated.

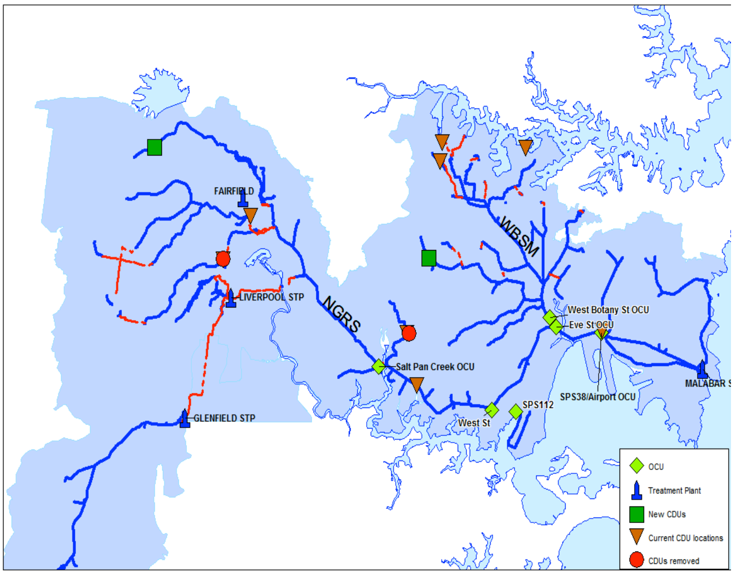


Figure 1.1:Malabar system - preferred dosing strategy

The outcome of applying the decision support tool to the Cronulla system identified that corrosion and odour issues can be adequately addressed with only one additional chemical dosing unit while the existing four units were to be optimised. Due to the pipe size in the system, the cost benefit of implementing corrosion and odour management in Cronulla is lower than for the larger Malabar system.

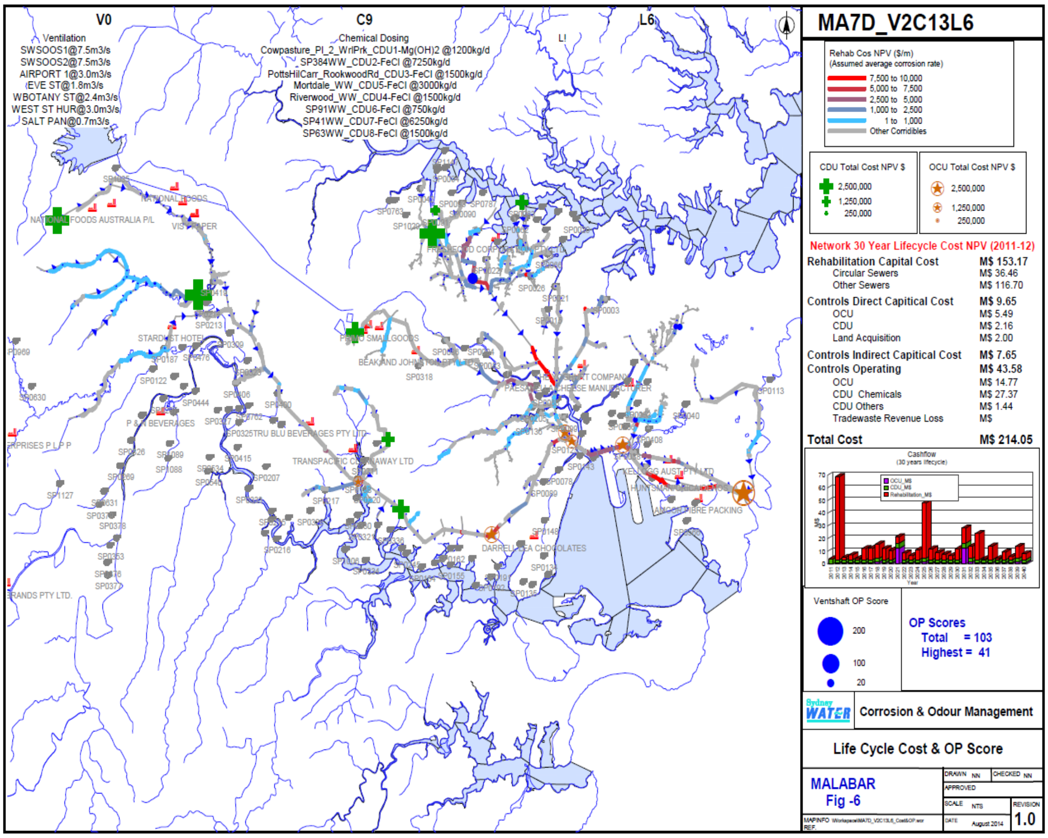


Figure 1.2: Malabar system Cost and Odour profile.

Conclusion

Corrosion and odour management of wastewater systems is complex and dynamic as the inputs change and systems grow over time. Hydraulic modelling is well developed and is used for system capacity configuration and growth planning. The building of dynamic and calibrated hydrogen sulphide generation and ventilation models has enabled Sydney Water to prepare corrosion and odour system management strategies to reduce costs and risks of asset failure and community impact from its wastewater system.

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