SeweX modelling tool for corrosion & odour management

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Take-home message

A power model is available to support proactive management of sewer corrosion and odour

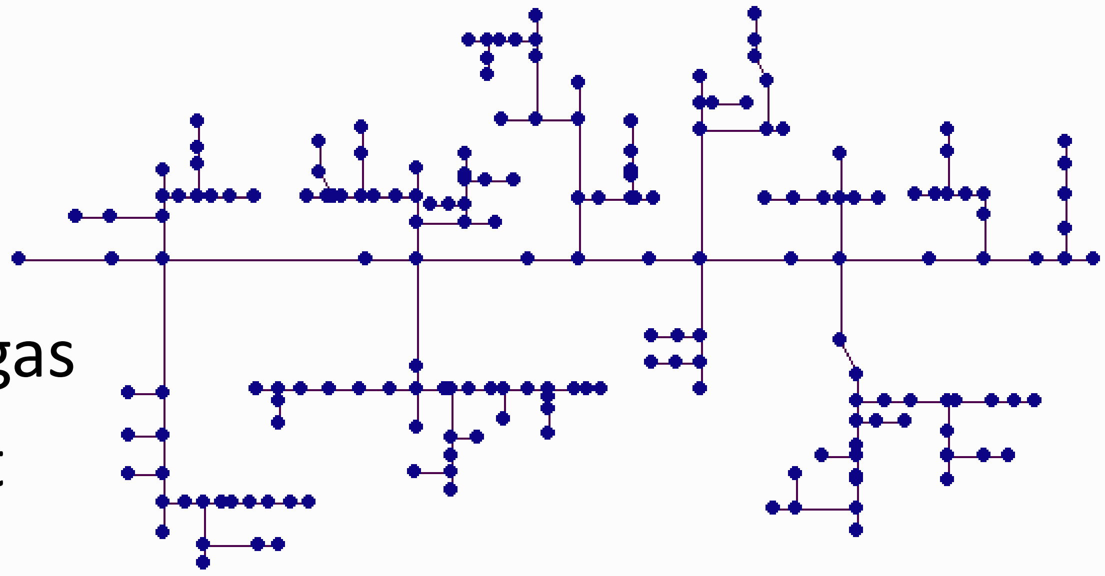
Presentation outline

- An overview of the SeweX model
- SeweX model development – a little history
- SeweX capability
- Inputs required by the model
- Application examples

What’s the SeweX model?

A state-of-the-art *dynamic*, *network* model describing in-sewer physical, chemical and biological processes, predicting:

- Corrosion and odor hotspots
- Optimization of mitigation strategies including both chemical dosing and ventilation
  - Master planning
  - Operational optimization
- Methane emissions as a greenhouse gas
- Feed to a wastewater treatment plant



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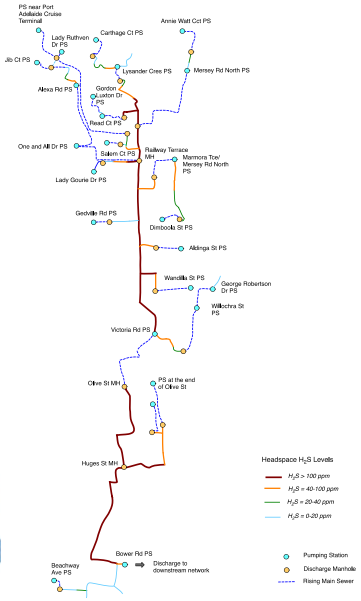
SeweX and sewer modelling

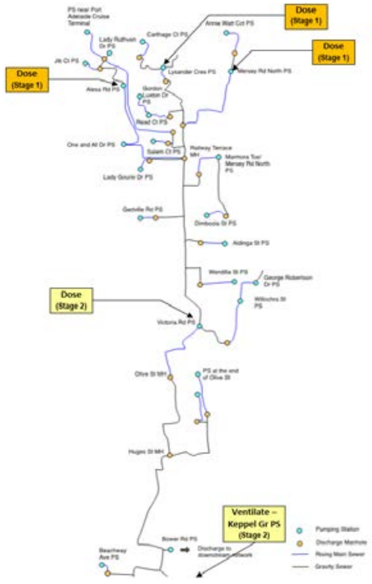
Hydraulic modelling - - - → Ventilation modelling

SeweX

Corrosion & odor hot spots

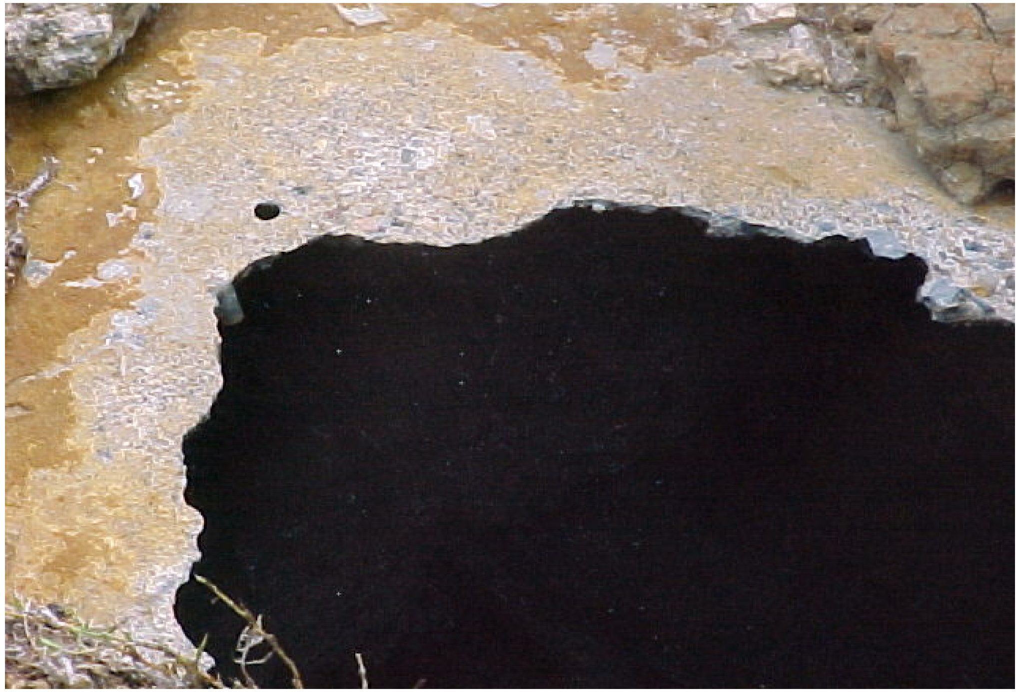


Optimized mitigation strategies (what, where & how)

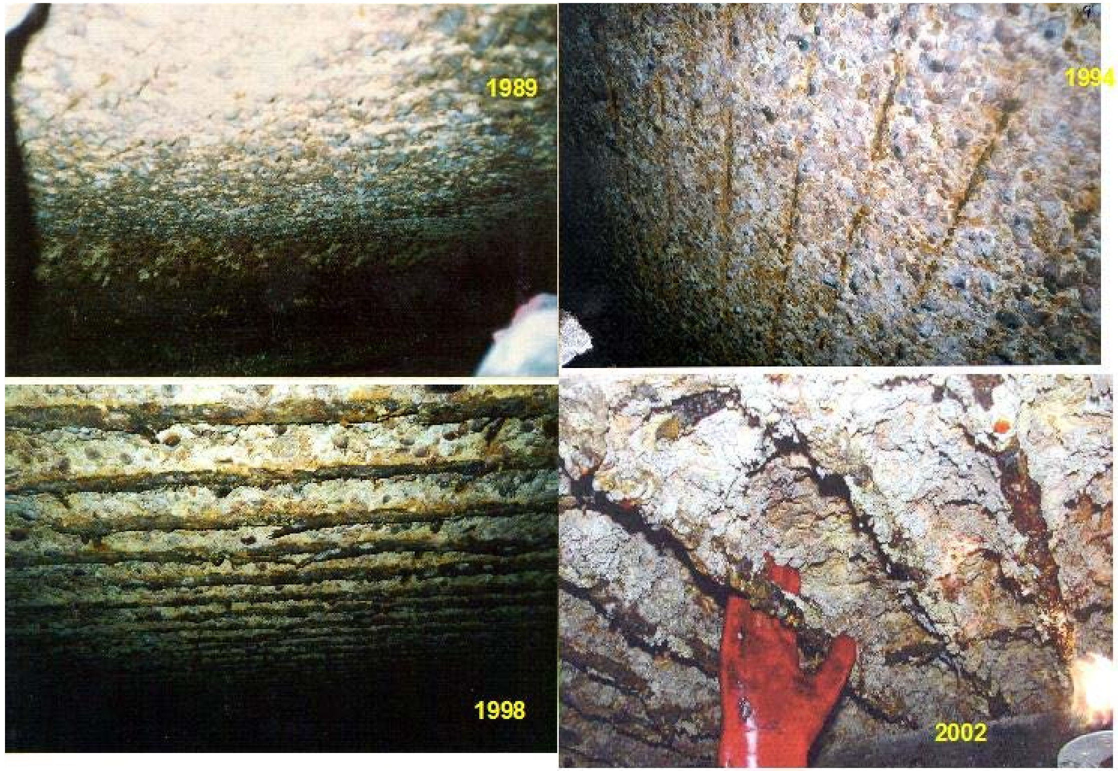


Feed to WWT models

Starting point (2003)

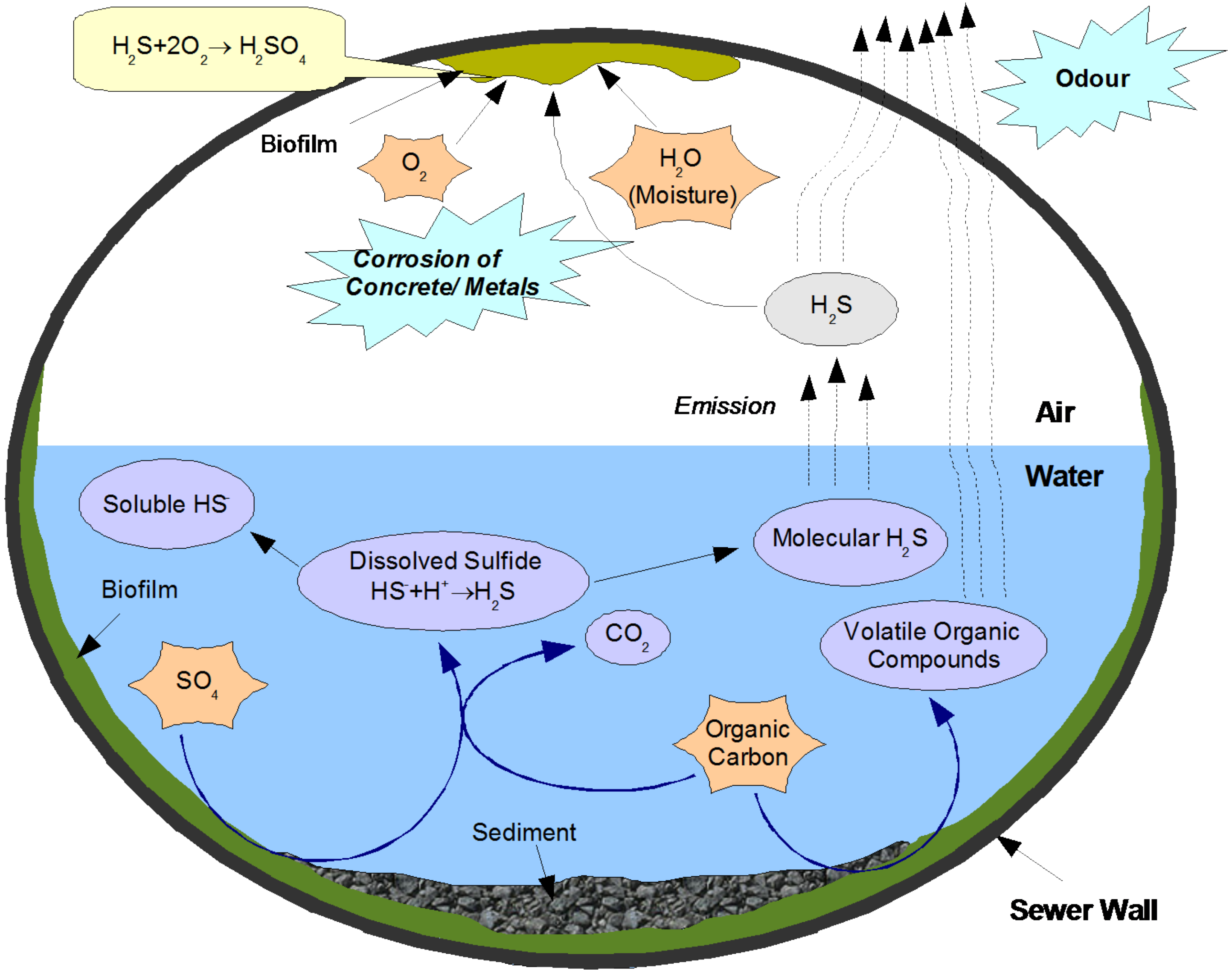


Collapsed 900 mm Gravity Main of GCW after a short service time of 12 years (Feb 2003)



The rapid corrosion of a large SWC gravity main (2.9m wide, 2m high, 10km), rehabilitated with a cost of $100M

Starting point (2003)



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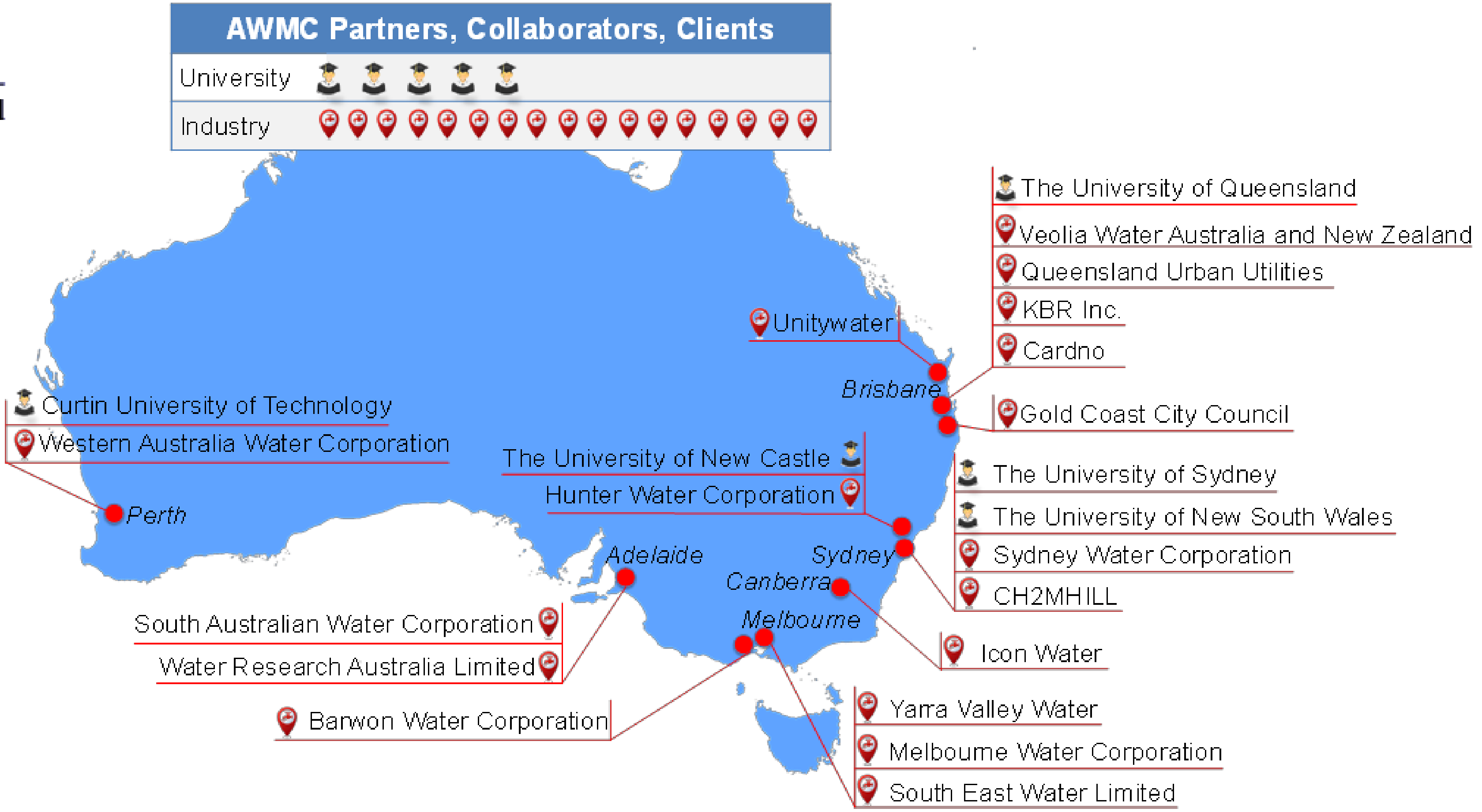
Partnership in Australia and beyond (>$30M)

Australian Government
Australian Research Council

- Partners outside Australia
    - DC Water
    - Brown & Caldwell
    - USP Technologies
    - Aquafin NV
    - PUB, Singapore
    - DCM Process Control



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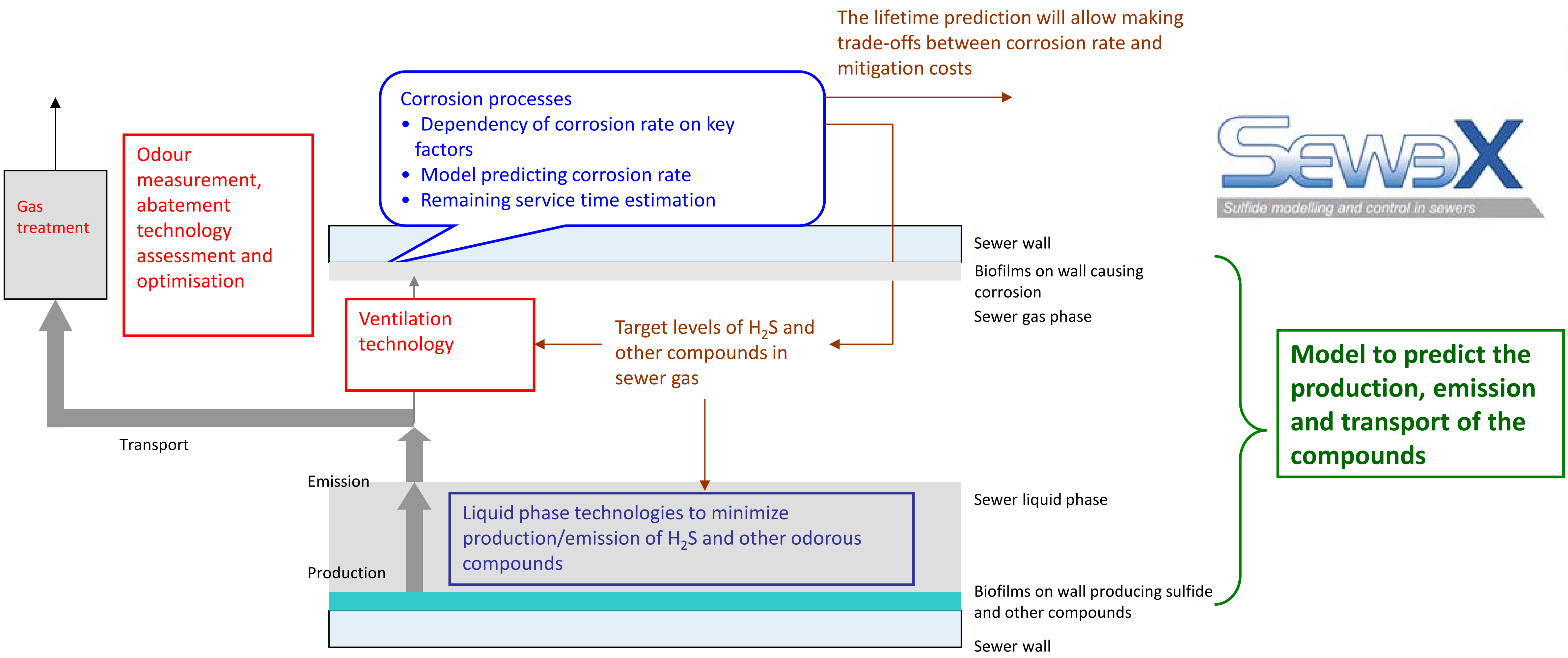
Research done to date



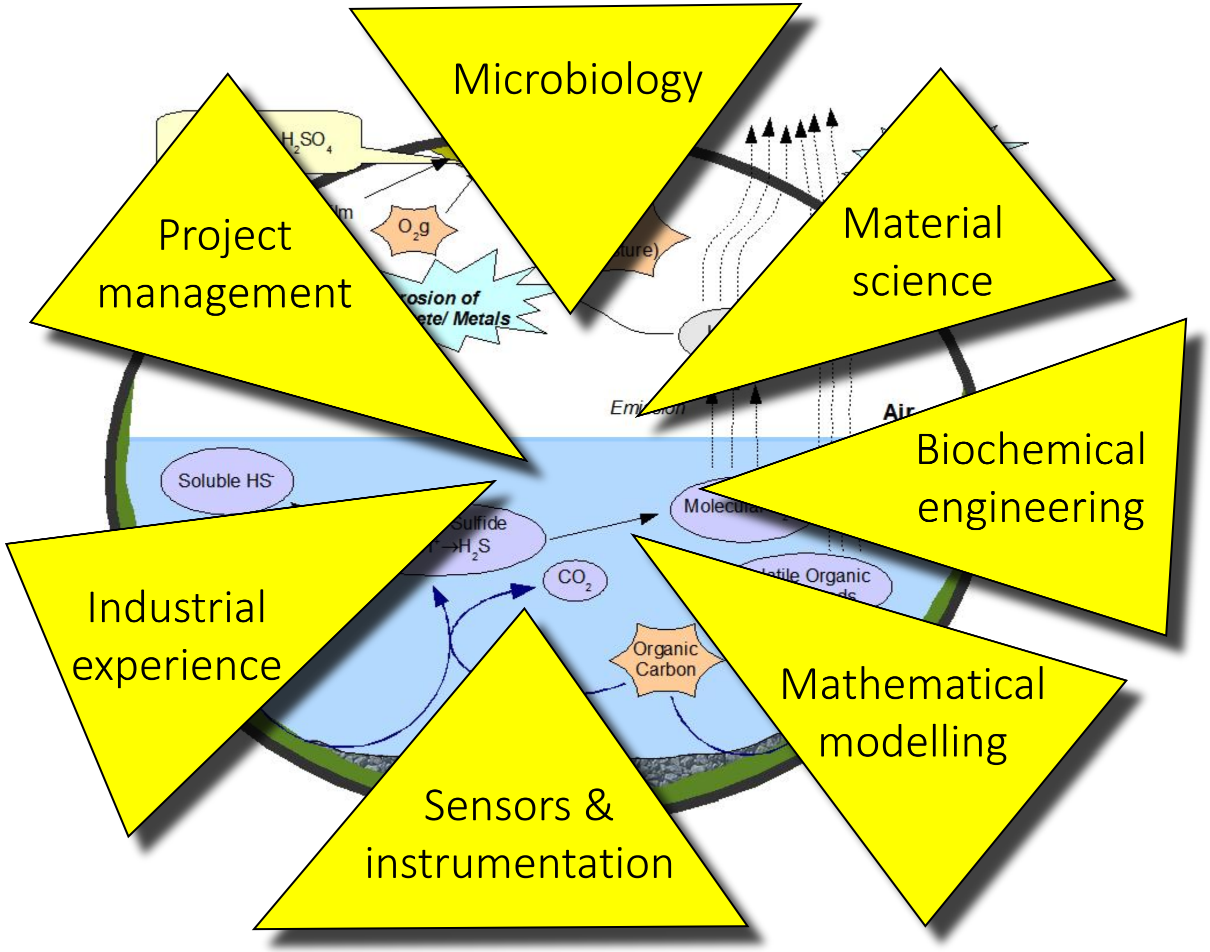
SeweX
Sulfide modelling and control in sewers

Research methodology

- An integrated approach

Research methodology

- An integrated approach



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SeweX capability

- Version 0 in 2003 for rising mains based on literature
- Improved, calibrated and validated over 13 years
  - Biochemical reaction models enhanced
  - Impact of flows on kinetics incorporated
  - Reactions induced by chemical addition modelled (O_2, nitrate, iron, $Mg(OH)_2$, Caustic, FNA)
  - Methane prediction included
  - Extended to gravity sewers (gas/liquid mass transfer, air movement)
  - Interface with hydraulic models
  - Physicochemical reactions, pH prediction
  - pH inhibition
  - Sulfide consumption by air-phase biofilm
  - Interface with wastewater treatment model for integrated simulation
  - ARMA model for flow prediction to support on-line chemical dosing control
  - In-sediment reactions
- Many real-life application over the past 13 years
- On-going improvement with new knowledge generated

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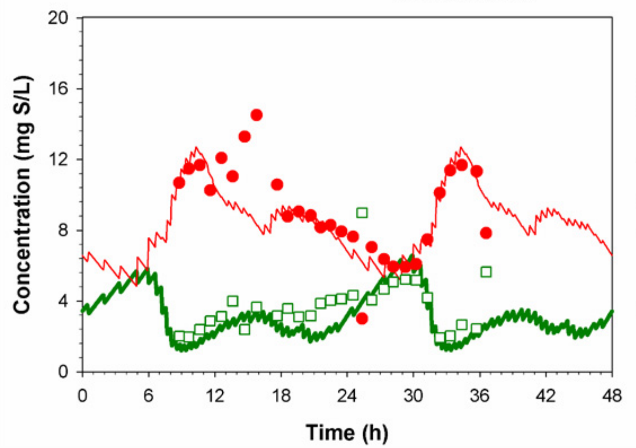
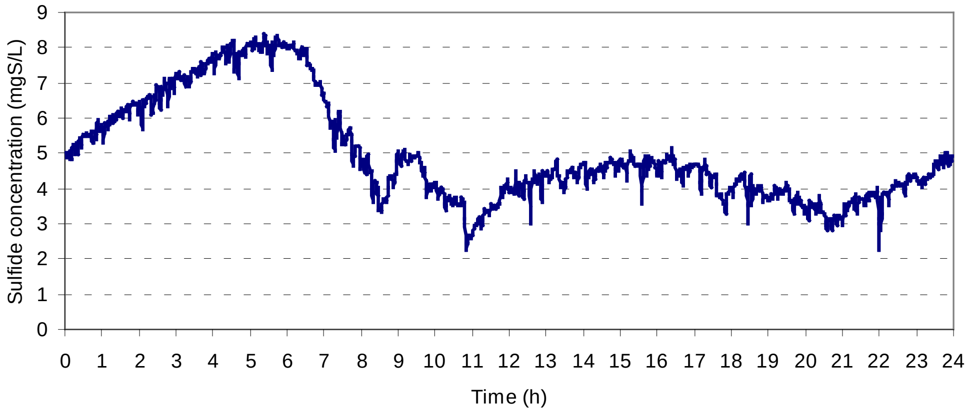
Data requirements

- Sewer details - from GIS, layout map etc.
- Hydraulic data - from hydraulic model, SCADA data and wet-well details
- Air flow data - from an external model (optional)
- Wastewater composition - historical data, measurement campaign, assumptions in the case of domestic sewage
- Other information
  - Chemical dosing if any, sewage temperature, humidity, odour control facilities if any

Manual sampling - 2003

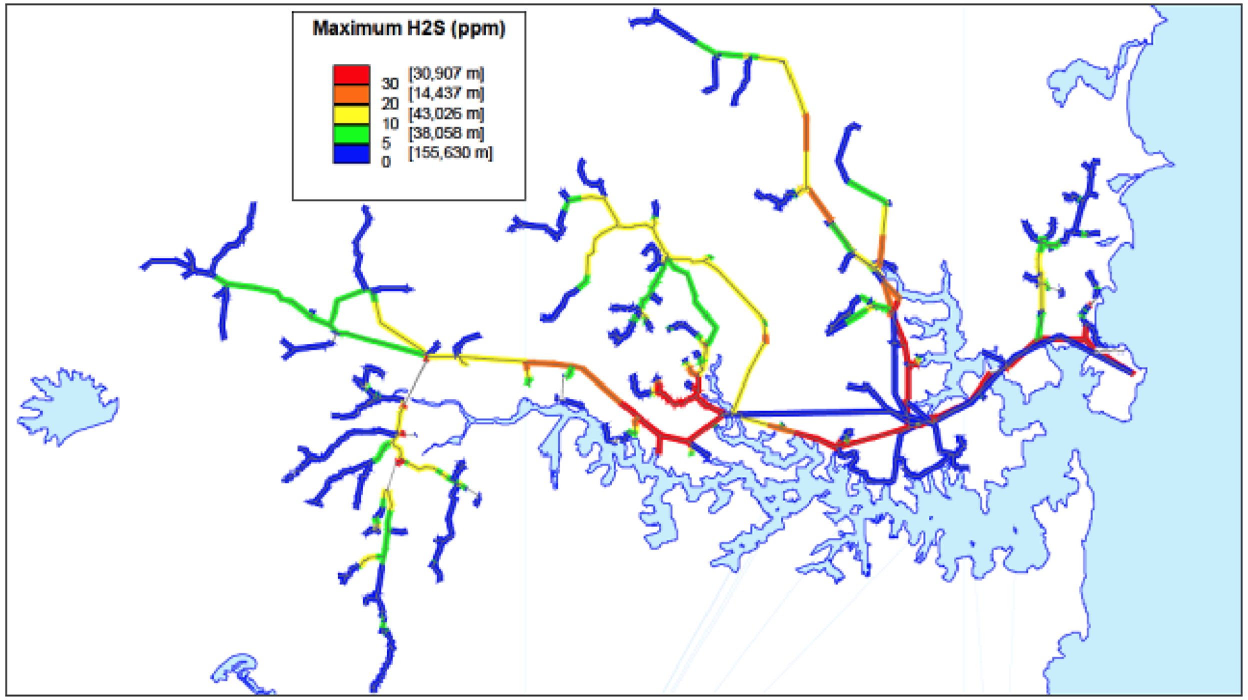


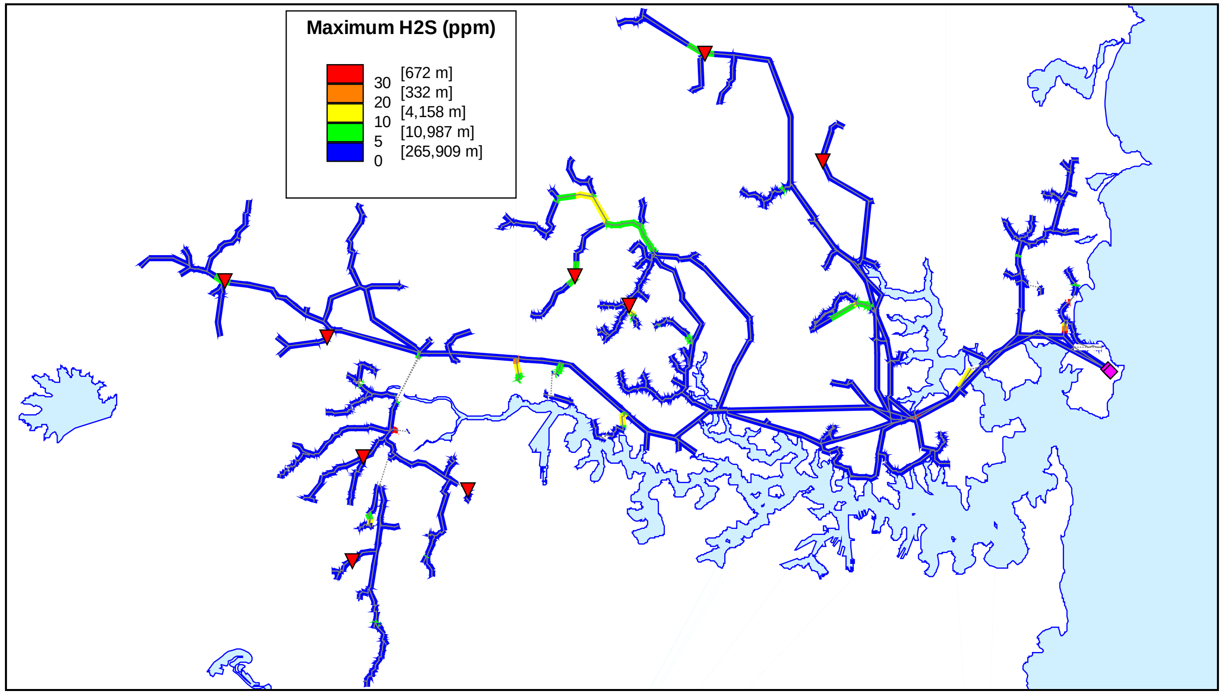
On-line monitoring - today



Case study 1: master planning at catchment scale

Application of the SeweX model to one catchment saved SWC $90 millions





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Nguyen et al. (2015) Nov 1-7.

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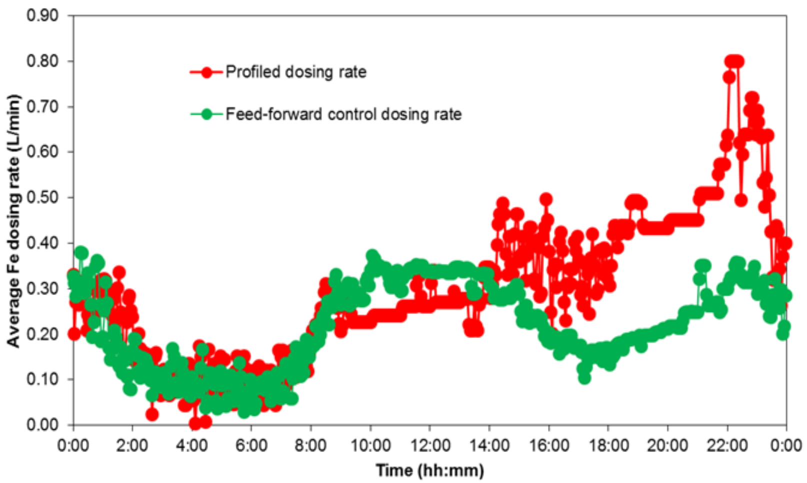
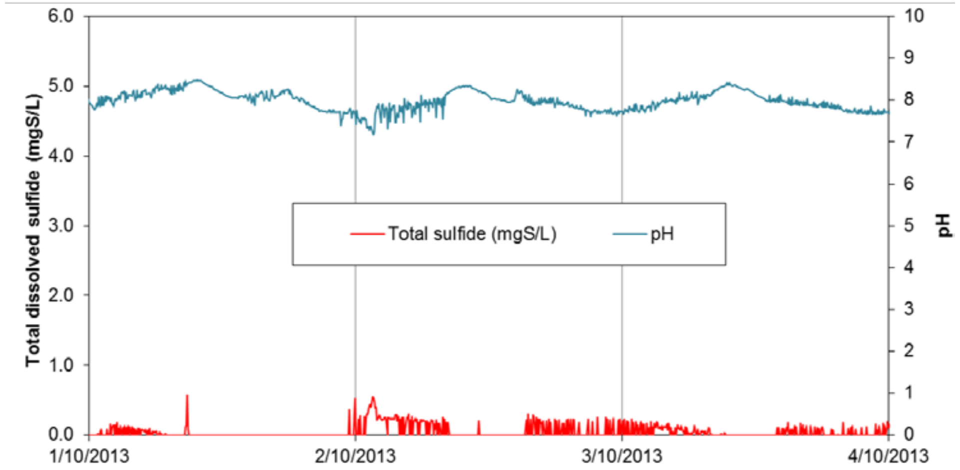
Case study 2: operational optimisation for selected pipes



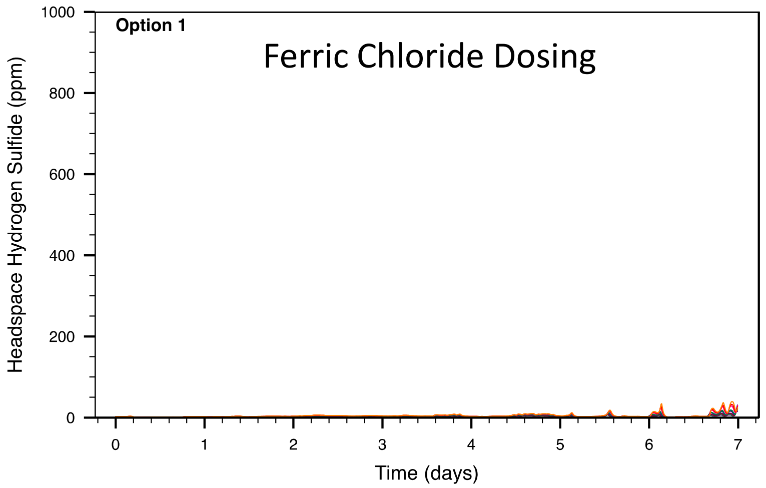


Parameters	No dosing	Profiled dosing	Feed-forward dosing
Sewage flow (ML/d)	21	20.9	20.9
pH	7.4 ± 0.2	7.3 ± 0.2	7.4 ± 0.2
Average TDS (mgS/L)	1.65	0.13	0.07
90% TDS (mgS/L)	3.08	**0.46**	**0.23**
Iron dosage (L/day)	0	**433**	**318**

25% chemical saving!

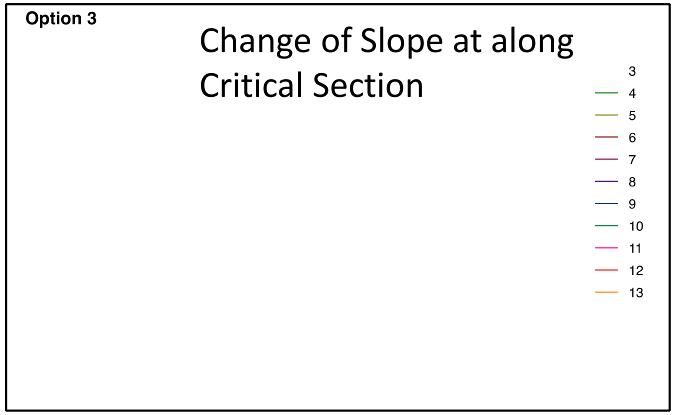
Annual saving can be higher due to rainfalls.

Case study 3: Impact of trade waste discharge



Trade Waste Sulfide Discharge
Control at 1 mg S/L

Trade Waste Sulfide Discharge
Control at 5 mg S/L



Headspace
H_2S

Case study 4: Estimating CH_4 emissions from a large catchment by developing empirical equations

Rising mains

$$r_{CH_4} = 3.452 \times 1.06^{(T-20)} \times D \times N^{0.202} \times (0.396)^{(1-N \cdot t_p/1440)}$$

Gravity mains

$$r_{CH_4} = 0.419 \times 1.06^{(T-20)} \times Q^{0.26} \times D^{0.28} \times S^{-0.138}$$

Other applications

- Flow diversions
- Expansion of service area
- Change in water use pattern
- Integrated modelling of sewer and wastewater treatment plant

Take-home message

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Sulfide modelling and control in sewers

Acknowledgements to team members and partners

Thank You