

CONDITION ASSESSMENT OF SINGAPORE'S SEWER RISING MAINS

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EXECUTIVE SUMMARY

Singapore is a small nation surrounded by seawater on all sides, and storing much of its water supply in above-ground open area storage reservoirs. Accordingly, it is possible that a failure on its sewer mains can significantly impact on the surrounding environment, and in some situations even affect its water supply. In order to become proactive the Singapore government decided to assess the risk of failure of a selection of its sewer rising mains, totalling slightly in excess of 150km.

Materials investigated included grey cast iron in diameters DN100 to DN200, ductile iron in the range of diameters DN100 to DN900, and coated mild steel in diameter range DN450 to DN1275. The oldest of these mains was installed in the mid-1960's. However, due to constantly high ambient temperatures and the presence of highly corrosive soils, there appears to be a greater risk of corrosion failures of these pipes than those located in more temperate climates. Indeed, there has already been a small number of "failures" on some mains.

Because the 127 mains selected represented a variety of materials and diameters, it was necessary to utilise several techniques including:

- Desktop Study to accurately define characteristics and location of mains;
- Linear Polarisation Resistance (LPR) soil testing which had been used previously in Sydney and Melbourne;
- Coating Defect Survey (CDS) a technique used extensively in the oil and gas industry on welded steel pipelines;
- EnviroStat statistical algorithms developed by Tyco Water;
- PipeFail algorithms developed by Tyco Water;
- Criticality analysis also developed by Tyco Water;
- TesTau Electromagnetic in-line non-destructive evaluation technique developed by Monash University; and
- Mainscan hand-held electromagnetic non-destructive evaluation technique developed by Russell NDE Systems of Canada.

The first 6 listed above are non-evasive techniques, which don't require shut down of mains, and can obtain large amount of data in a cost-effective manner. Mainscan can be used from both inside the main, requiring shutdown, and outside, not-requiring shutdown, but TesTau requires complete shut-down of the main. The work was conducted over a period of approximately 12 months, beginning in April 2002, with Desktop Study and LPR and CDS investigations obtaining preliminary information that allowed for planning of more detailed and involved studies. The investigation was performed within an existing contract of mains rehabilitation performed by a leading Singapore civil contractor, Tiong Seng.

Important outcomes of the project include:

- Estimates of probability of failure for each of the individual sewer rising mains;
- Ranking of Criticality of each main;
- Identification of mains and section of mains for renewal/refurbishment;
- Cost-benefit analysis comparing total replacement/refurbishment to inspection and selective replacement/refurbishment.

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