MANAGING AND MAINTAINING SEWER RISING MAINS – LESSONS LEARNT

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ABSTRACT

Gold Coast Water (GCW) is currently responsible for the asset management of a large portfolio of water and wastewater infrastructure, serving a population of nearly 570,000 residents and 12 million visitors per year. The city is primarily located on coastal floodplains segmented by a myriad of canals, rivers and tidal waterways, creating complex challenges for the teams that manage, maintain and operate GCWs underground pipe infrastructure.

Within GCWs asset portfolio are 2,831km of sewer gravity mains that are fundamentally reliant on just 379km of sewer rising mains (SRM) to safely and efficiently transfer the city's wastewater to its four treatment plants.

Over GCWs 60 plus years as a growing city, knowledge regarding asset management has steadily grown. These learnings are now being applied in the proactive management and maintenance of the existing SRM network and the installation of new SRMs with some success.

1.0 INTRODUCTION

Since circa 1950, GCW and its predecessors have been responsible for the provision of water and wastewater services to the growing customer base of the City of Gold Coast. This service provision is contingent on an extensive sewer asset base for the collection, transportation, and treatment of sewage throughout the city. A summary of these sewer assets are detailed in Table 1.

Table 1: ***Summary of GCW Sewer Assets.***

Asset Type	Quantity
Sewer Gravity Mains	2,831 km
Sewer Rising Mains	**379 km**
Effluent Mains	110 km
Maintenance Holes	64,895
Sewage Pump Stations	529
Sewage Treatment Plants	4
Other Effluent Assets	4
Effluent Pump Stations	2
Tanker Filling Stations	12

GCW has an ageing asset base and a legacy of underspending on proactive maintenance and renewals in the period from 1950 to the late 1990's. The last 20 years have seen significant organisational change associated with Council amalgamation and water reform, coupled with an exponential increase in regulatory oversight and tightening financial reins. Unfortunately this period also led GCW to experience a rise in reactive maintenance interventions on its SRMs which generally had at their root, premature asset degradation brought about by asset management and operational shortcomings.

It is clear however that our daily challenges are not unique and sharing our experiences in addressing these shortcomings is likely to be of some benefit to other water authorities facing similar challenges. This paper will address the ongoing management of SRMs with a particular focus on lessons learnt and improvements to the management and maintenance of SRMs.

2.0 DISCUSSION

2.1 Asset Lifecycle Management

Lifecycle management is a process used to manage an asset in an efficient and economical way so that the output of that asset is maximised at the lowest possible cost. Figure 1 is one of many models showing the typical phases of an asset's useful life commencing with planning and design. If the correct decisions are made at these critical milestones, the economical ability to realise the asset's intended useful life will be maximised.

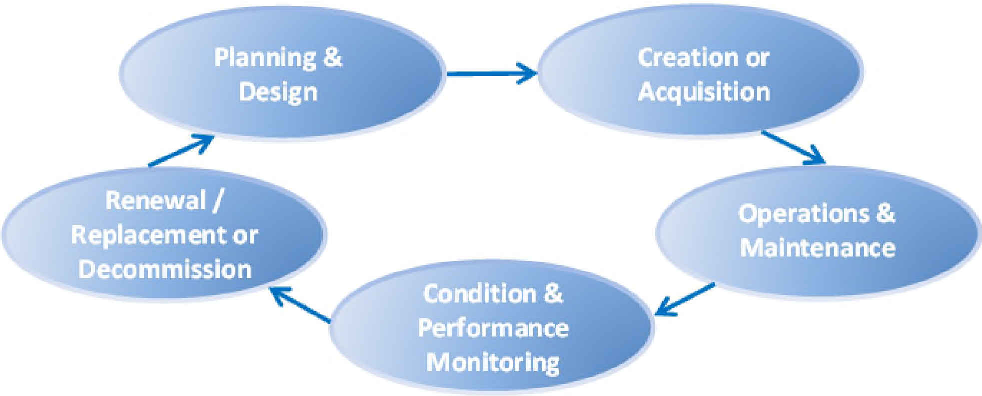

Figure 1: ***Asset Lifecycle Management.***

2.2 Planning and Design

The ability to influence the whole-of-life cost of the asset is most sensitive at the planning and design phase as detailed in Figure 2. This milestone forms the foundation of the lifecycle of the asset; poor planning and design will adversely impact capital and whole-of-life cost, operability, safety, environmental performance, energy consumption, maintainability, useful life, and community impact (visual, noise, odour, etc.).

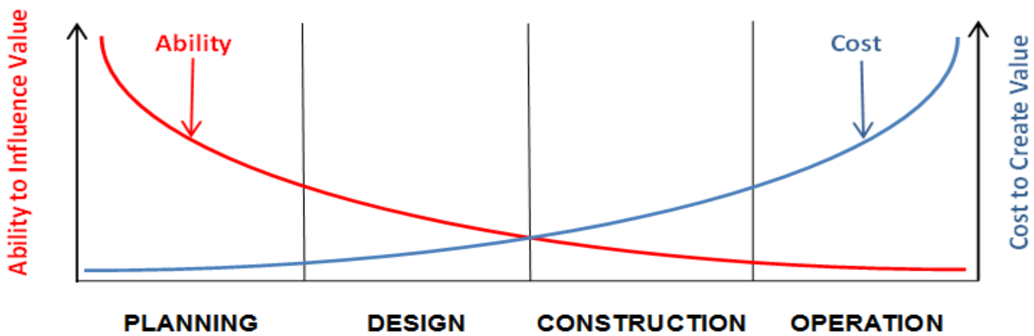

Figure 2: ***Ability to Influence an Asset during Lifecycle Phases.***

GCW has encountered numerous situations in which the unfavourable outcomes identified above have been realised which in retrospect could have been avoided.

Table 2 identifies certain aspects that if considered and implemented appropriately during the planning and design phase can mitigate the potential for undesirable asset outcomes.

Table 2: ***Aspects for Consideration during Planning and Design.***

Aspect	Example
Service Locations	The more detailed the investigation prior to design the less risk of unforeseen conflicts occurring during the construction phase that can result in unfavourable project outcomes.
General Investigations	Factors that should be confirmed during design include: potential acid sulphate soils, ground water, bearing capacity of the soil, allowable shutdown/connection timeframes, etc.
Internal Corrosion	Ensure the pipe is inert to internal corrosion particularly where the hydraulic grade line (HGL) is less than 5.0m at pump stop.
Material Flexibility	Ensure that proposed materials have flexibility or are accounted for with a detailed design and methodology. Some pipe materials such as epoxy lined/coated mild steel cannot be cut or welded; this introduces difficulties with construction and ongoing maintenance.
Construction Methodology	It is essential that the design is considerate of the most practicable construction methodology. A disconnect between design and construction can lead to incorrect pipe materials being specified and priced, conflicts with other existing utility services, greater capital cost, and project delays.
Construction Expediency	Construction expediency is a major impact on the capital cost. Aspects that can impact expediency include depth of cover, construction adjacent to existing features, inconsistent alignments, etc. The design should aim to maximise construction expediency where practicable.
Gas Release Valves (GRV)	The design needs to ensure that the locations of proposed GRVs are readily accessible and that odour impacts can be adequately managed to avoid community impacts. In all instances the design should endeavour to minimise the number of fittings that require ongoing maintenance as these will increase the whole-of-life cost.
Access Points	The design should consider introducing access points on the asset for future condition monitoring e.g. replacing 100mm junctions for gas release valves with 300mm junctions to provide for a suitable access point for CCTV access.
Emergency Repair	The design needs to adequately consider how the asset could be reactively repaired promptly in the event of failure. This may eventually be a costly reality if not considered appropriately.

Further to the above, it should be noted that a key success factor of this phase is stakeholder engagement. It is imperative that all relevant stakeholders are engaged to ensure that the new asset will meet all business requirements e.g. confirm that the nominal diameter of the proposed main will adequately service the growing demand with the network's modelling team.

2.3 Creation or Acquisition

This phase of the asset lifecycle is particularly sensitive to delays and unforeseen issues. The construction of an asset is the most costly single undertaking in the assets lifecycle, and ensuring that this milestone is achieved as effectively and efficiently as possible must be a key success factor.

As many of a growing municipality's assets are developer-contributed, it is essential to ensure that these acquired assets meet all mandatory standards and will function as intended for the duration of their useful lives.

Table 3 identifies some aspects in which the project success is particularly sensitive to this phase of the asset lifecycle.

Table 3: ***Aspects for Consideration during Creation or Acquisition.***

Aspect	Example
Detailed Construction Methodology	SRM shutdowns can often be logistically onerous whilst only providing a short window for the connection works to be undertaken. A construction methodology should be requested from the contractor prior to construction. This is to ensure that all potential issues have been considered and accounted for e.g. connecting large diameter mild steel to ductile iron requires a weld collar which may be overlooked in the design.
Inspect and Audit	It is important that the installation of a new asset is inspected by an adequately qualified / experienced person. This is to ensure that the asset is installed in accordance with the specification which aims to maximise the assets useful life. Poor workmanship can significantly impact an assets ability to achieve its intended useful life.
As-cons	Ensure that certified as-constructed drawings are received and stored into the asset data management system. Maintaining accurate records will become paramount to maintaining and operating the asset throughout its life.

2.4 Operations and Maintenance

On average, operating and maintenance costs are responsible for a significant portion of the whole-of-life cost of the asset. Costs associated with this phase can be reduced through the implementation of the following factors:

- Appropriate consideration of operational and maintenance processes and tasks during the planning and design phase.
- Ensuring the asset was constructed in accordance with the relevant standards.
- Ensuring assets are incorporated in a well-designed and risk-based preventative maintenance programme.

Understanding the sensitivities of an asset during the operation and maintenance phase is vital to ensuring that it is safeguarded from poor management and maintenance decisions. Previously GCW and its predecessors were receiving numerous and consistent odour complaints from residents due to the release of odoriferous compounds from GRVs.

As a short-sighted solution to the increasing complaints in the early 2000's, GCWs network operators closed a number of GRVs which progressively resulted in the premature degradation of the SRMs due to large volumes of hydrogen sulphide gas (H_2S) being trapped at high points within the predominantly cement lined mains. At this time GCW were spending approximately $2.0M per annum on reactive maintenance repairing failing SRMs.

Through simply putting these GRVs on a scheduled maintenance programme at an annual cost of $350,000, in addition to $100,000 for odour management, implementing a number of operational strategies to reduce network detention times, and trialling oxygen and chemical injection in the network, the reactive maintenance of SRMs was reduced to $750,000. This represents an annual reduction of $800,000 in reactive maintenance on SRMs. This firmly supports the fact that Band-Aid solutions do not often result in cost-effective outcomes. Long term, solutions should target the root cause and not the symptom, or at the very least manage the symptom appropriately.

2.5 Condition and Performance Monitoring

Authorities responsible for the expenditure of public funds have a responsibility to do so in a prudent and efficient manner. However, the vast majority of renewal programmes are still founded on scopes that have been determined through desktop condition grade scores that estimate an asset's condition based on material type, age, size, history of failures, consequence of failure, presence of potential acid sulphate soils, etc.

It is likely that mains have been replaced in the past due to inaccurate desktop condition grade scores or minor failures that did not reflect the true condition of the entire pipe asset. GCW are aware that there are more prudent ways of developing scopes for asset replacements than desktop assessments. This phase of the asset lifecycle is responsible for mitigating the eventuality of these situations.

GCW intend to place more emphasis on the term "prudent" through the development of a contract for ongoing condition assessment investigations. During the early development of this contract, extensive market research was undertaken with numerous industry professionals. Following this research a register was created that identified the numerous condition assessment technologies and their capabilities, limitations, etc. Furthermore the register divided the various technologies into three tiers:

1. Non-destructive and non-invasive.
2. Non-destructive and invasive.
3. Destructive.

It is anticipated that the condition assessment contract will enable GCW to increase its prudency and efficiency with regards to asset renewals as well as identifying the assets failure mode, condition, and prospective remaining useful life.

2.6 Renewal / Replacement or Decommission

The decision to renew, replace or decommission assets should be risk-based and formulated with as much objective information as possible to achieve the optimal outcome. One of the most important outcomes of the condition assessment process detailed above will be the development of asset degradation curves for GCWs passive pipeline assets.

Renewal programmes can be better planned to ensure that the timing of these activities is aligned with the assets remaining service potential. Early intervention can waste capital whilst late intervention can result in regulatory breaches and costly repairs. Some instances where it may be appropriate to renew / replace an asset are when:

- There is objective evidence to support the assertion that the asset is near the end of its useful life and that it is more economical to replace the asset than continue to maintain it.
- There is a limited window of opportunity to align the renewal works with other proposed works where efficiencies exist, e.g. traffic control and surface reinstatement will be undertaken by a party responsible for other works at the same location.

Generally SRMs are not decommissioned without their parallel replacement due to the fact that redundancy is universally scarce in SRM networks. However, in instances where redundancy is available, an asset manager may simply choose to decommission an asset where it has a high consequence of failure that poses an unnecessary risk to the business.

3.0 CONCLUSION

The importance of effectively managing and maintaining SRMs should not be underestimated. SRMs are a fundamental component of an extensive network of integrated assets that are responsible for the collection, transfer, and treatment of a city's wastewater.

It is a business's responsibility as a monopoly service provider to deliver the most cost-effective service possible to its customers. Appropriately, the business should aspire to maximise the assets' efficiencies whilst fostering a culture of continuous asset management improvement.

Asset Managers should be aiming to ensure the following goals are achieved:

- Maximisation of the assets' useful life at the lowest cost.
- Continual optimisation of operating and maintenance costs.
- Effective and timely management of risks at the lowest possible cost.
- Compliance with statutory obligations.
- Provision of a healthy and safe work environment.
- Asset performance is improved and aligned with customer expectations.
- Investment predictability throughout the asset lifecycle is achieved.

The intent of this paper is to highlight issues that GCW has encountered and to promote awareness amongst other service providers of the risks and opportunities associated with the management and operation of SRMs.