FLINDERS / SHOREHAM SEWERAGE PROJECT

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BACKGROUND

Since installing the first pressure sewer system (PSS) in Australia at Tooradin, Warneet and Cannons Creek, Melbourne Water Retailer South East Water has discovered the enormous benefits of using pressure sewer technology within its Backlog Sewerage Projects.

The benefits are a result of being able to construct sewer mains in road reserves constructed predominantly by boring. This results in significant reduction in disturbance to the environmental and local community during the project delivery.

1.0 INTRODUCTION

South East Water's alliance with Thiess Services and Siemens - ***'us'*** - Utility Services; is responsible for South East Water's design, construction and ongoing operations.

'us' – Utility Services recently completed the design and construction of the Flinders Pressure Sewer Project. This project required both reticulation systems for both Flinders (800 properties) and Shoreham (450 properties) and a transfer system to convey all sewage some 21km to the existing Somers WWTP.

In summary the project required the following components (refer schematic below):

- Pressure Sewer Systems for the townships of Flinders and Shoreham
- Flinders Transfer Sewerage Pumping Station;
- Flinders to Shoreham Rising main;
- Shoreham (low level) Sewerage Pumping Station;
- Shoreham to Balnarring gravity induced main;
- Balnarring Flow Control Valve Facility

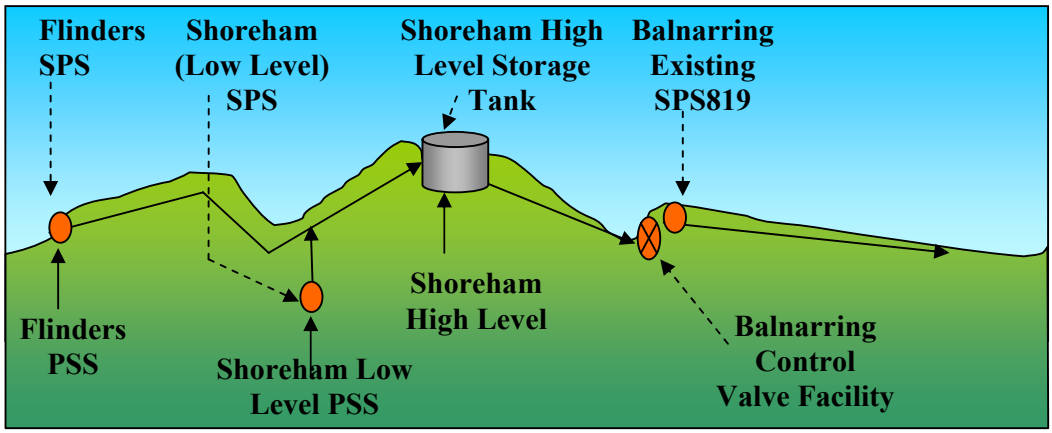

Figure 1: ***Schematic of the Flinders/Shoreham Sewerage Transfer System***

Due to the technical difficulties that needed to be overcome for the project a highly innovative approach needed to be adopted. An important partnership for the project was developed with the engineering consultancy, to provide a high degree of robust

innovation to the transfer system.
This was undertaken through a cost plus arrangement which focused on engineering innovation rather than design cost control.

1.1 Weaknesses of original South East Water PSS's

Through the experience of installing and operating Australia's first pressure sewer systems in Tooradin, Warneet and Cannons Creek a number of weaknesses had been identified. These weaknesses included:

- The customer involvement in system operation
- Difficulties shutting down or isolating parts of these pressure sewer systems
- High risk of relatively large sewer spills from main leaks
- Effect of high system peaks on downstream infrastructure
- Issues with submersible pump maintenance on customers properties (i.e. mess)
- The need for pump rotor/stator replacement every 10 years
- The pipes within the system required to be oversized to protect pumps from pressure peaks
- Low flows in systems causing the pipe work to be not self cleansing (causing solids build up & air entrapment)

These weaknesses were seen to be opportunities for improvement for this project

The key developments for this project included:

- Pump Over Pressure Protection;
- Telemetry linked Control System;
- Longer life rotor and stator, with the ability to pump up to 60m head; and
- Ability to undertake "on-site" dry-well maintenance of the pump.

1.2 Telemetry linked Control System for the Township Pressure Sewer Systems

The ability to quickly shut down pressure sewer systems after main leaks or failures, can be hindered by the complexity of manually shutting a PSS down and the response times which can be up to 2-3 hours (for remotely located systems).

Using telemetry, ***'us'*** – Utility Services have developed:

- A remote "global shutdown system" to be used during failure or leak events, to shut off all pumps within a system remotely (reducing sewer spills to the environment);
- Ability for operations staff to obtain pump unit information remotely for fault diagnosis, prior to attending pump "call outs"; and
- Remove completely the customer interface to PSS pump operation.

1.3 Use of Over Pressure Protection (OPP) as a control mechanism

Although the main purpose of OPP is to ensure pump life it has important benefits when used as a means to control the entire PSS. This OPP allows shutting of large sections of the pressure sewer by closing valves within the PSS, rather than turning off individual pumps.

The largest benefit of OPP to the Flinders Sewerage System has been the ability to engage the individual emergency storages in each property, rather than having additional

contingency storage at the Flinders Sewerage Pump Station.
The Flinders SPS has been designed with no emergency storage and a small pressure vessel instead of a wet well.

2.0 FLINDERS/SHOREHAM TRANSFER SYSTEM - KEY DESIGN CRITERIA

2.1 Flow

The system has been design to meet the normal peak flow requirements of Flinders (20l/s), Shoreham (11 l/s) and Point Leo (4 l/s). However, the pressure sewer systems can create considerably higher flows (up to 6 times greater than the normal peaks) during recovery operations, after power outages or planned shut downs.

2.2 Siting of key infrastructure

The community expressed a clear direction that the sewer infrastructure for this project could not impact on the amenity of Flinders and Shoreham. Therefore, the location of all key infrastructure is as far as practical away from private residences.

2.3 Solids, Odour & Slime Considerations

Odour generation from the sewage in this transfer system is likely because of the detention times in the upstream PSS networks and the long detention time of the transfer system itself. High levels of sulphides generated in the transfer pipeline system have the potential to cause odour and corrosion problems.

Pipe wall slimes are a significant source of sulphide generation. They can also contribute to a reduction in pipeline hydraulic capacity, especially in such a long pipeline. As such, the pipelines were designed for removal or 'shearing' of slimes, by ensuring a velocity of greater than approximately 1.07 m/s (which creates a shear stress on the walls of the pipes greater than 2.87 Pa – required for stripping slimes). By adopting this velocity solids are also re-suspended and transported during system operation.

This velocity on a long pipeline creates relatively high friction losses. Between Flinders and Shoreham the friction losses/pressure of the system (to achieve 1.07m/s) is between 95-115m head, requiring high head pumping.

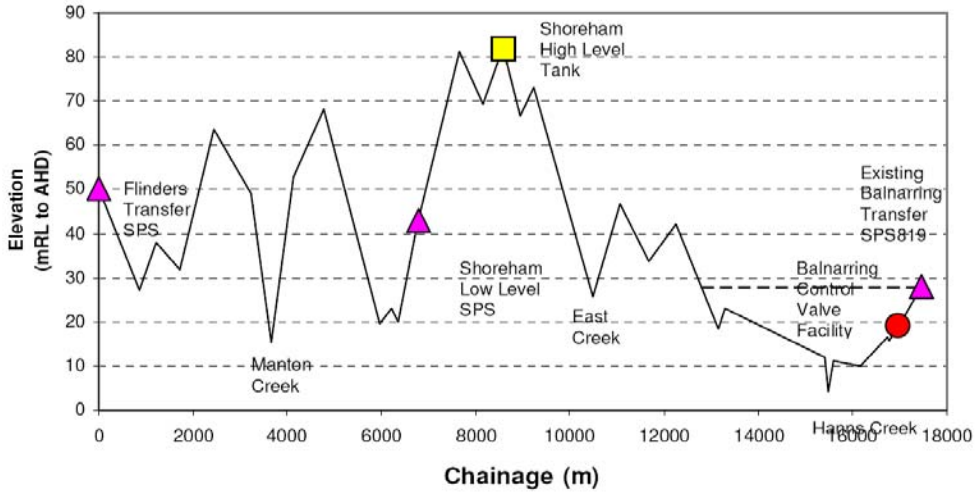

Figure 2: *Elevations of the Flinders/Shoreham Sewerage Transfer System*

3.0 FLINDERS TO SHOREHAM HIGH HEAD PUMPED SYSTEM

The Flinders to Shoreham transfer system will be unique to South East Water. With the recent introduction of pressure sewer technology to Australia, there has been very little development of a pump station concept (where they need to be incorporated as part of a pressure sewer system).

The complexity of incorporating a pump station within a pressure sewer system is due to the potential large variation in flows into the pump station, from the pressure sewer system. For example, normal flows from the Flinders Pressure Sewer System see a daily peak at around 20 l/s, however, in a power outage recovery scenario – seen after a power outage when every pump in the network will try to pump all at once – the flows into the pump station can be as high as 120 l/s.

The technical solution, developed during the functional design, is to utilise a pressure vessel as a wet well. This vessel operates:

- Normally at atmospheric pressure with an open air release valve;
- As a wet well that can fill, seal and become pressurized in an emergency situation;
- When operating as a pressurised well the pressure would trigger the "over pressure protection" in each individual pump unit within the PSS and engage the emergency storage within each property (which already have 24 hours storage capability incorporated within them);
- As a control mechanism, which can throttle back flows from the upstream pressure sewer system, by limiting the flow into the pump station;
- With the pumps controlled by wet well levels (like typical pump stations); and
- With no Emergency Storage as in normally required at pump stations

Other details that make this transfer system unique compared to SEW's current sewerage pumping stations include:

- The long distance and undulating topography from Flinders to the Shoreham Tank; and
- The high head and low flow (e.g. Flinders PS 150m head @ 20 l/s) pumping requirements of the system, requiring the use of progressive cavity style pumps.

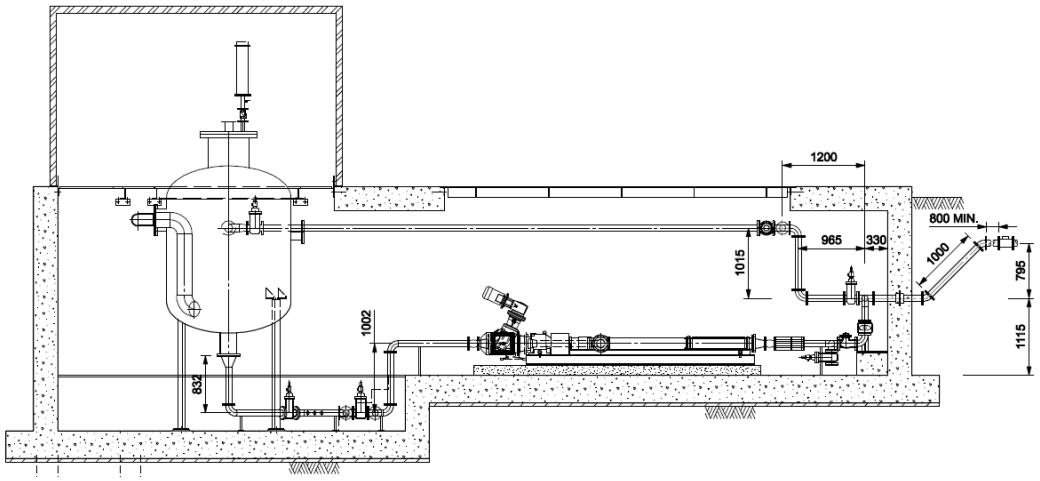

Figure 3: ***Cross-section plan of the Pressure Sewer Pump Station concept***

4.0 SHOREHAM TO BALNARRING GRAVITY INDUCED TRANSFER SYSTEM

The transfer main from Shoreham High Level Tank (high point at RL 82m AHD) to the Balnarring Outfall PS (RL 30m AHD) falls approximately 50m. With the fall this section of the transfer system can operate with gravity induced flows – controlled by the Balnarring Control Valve (BCV) at the low point of the system. This transfer system then discharges into the existing Balnarring Outfall System, which also operates as a "gravity induced" system (with booster pumping during peak operation).

The location of the SHLT was selected to maximise driving head while ensuring the location was as far as practical away from private residences. The SHLT has been designed similar to a traditional pump station with wet well and emergency storage. It operates also similar to a pump station with the BCV opening when a set level is reached in the tank and when the tank empties the valve closes.

The purpose of the BCV facility is to prevent the Shoreham to Balnarring transfer main from draining which would cause odour issues (when foul air would be purged during system refilling). As the Shoreham to Balnarring pipeline includes an extremely long flooded section it is important to keep the pipeline full to ensure the system is self cleansing.

The control valve will act as a sewage pressure sustaining valve keeping the transfer main full of fluid between the SHLT and the existing Balnarring Outfall pump station. This valve will also act as a system scour valve. It will normally be closed allowing sewage to build up behind it. Once it is opened a flushing flow will be released through the transfer main cleansing the system.. The operation of the BCV is shown in the figure below:

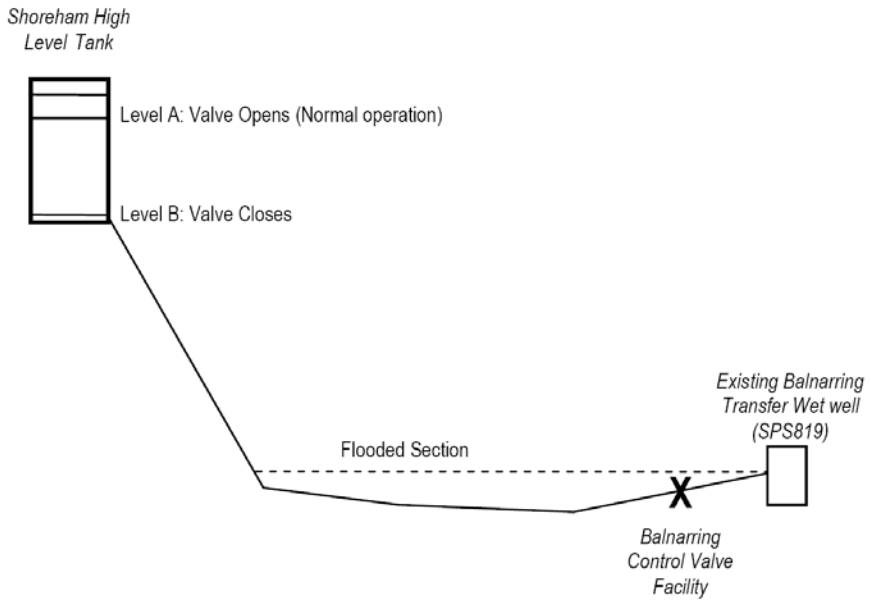

Figure 4: ***Shoreham High Level Tank to Balnarring - Control System Schematic***

5.0 TRANSFER SYSTEM ODOUR CONTROL

Both gas phase and liquid phase treatment is required to manage odours in this system.

The gas phase treatment at the key upstream facilities (e.g. pump stations) is undertaken using forced mechanical ventilation (fans) dispersing diluted air through a 6m high vent stack.

Chemical dosing of magnesium hydroxide is also undertaken to manage odours in the downstream (discharge) end of the system.