THE WALLSCREEN™ – A WORLD-FIRST APPLICATION FOR SEWAGE TREATMENT PLANT INLET WORKS

Carmel Krogh, Eugene Turco and Joe Turco

Abstract

This paper presents a new concept in sewage treatment plant inlet works design and augmentation and the first installation of a world wide patented product – the Wallscreen™.

The Wallscreen™ concept was developed as a solution to an augmentation of an existing sewage treatment plant in the Hastings Council local government area.

During investigations into upgrading of the sewage treatment plant inlet works, Gene Engineering offered Council an innovative and economic alternative to the installation of a lift pump station.

This alternative consisted of the concept of reducing backwater effects by releasing part of the inflow substantially at right angles to the channel (i.e. overflowing through self cleaning screens in the walls of the channel). This concept led to the development, manufacture and worldwide patent of the intellectual concept and hardware by Gene Engineering of the "Wallscreen"™.

Key Words: Wallscreen, inlet works, sewage treatment, backwater effects, hydraulics

Introduction

Many local Councils and water authorities are currently facing major upgrading of their sewage treatment plants. These upgrades are necessary to cater both for population growth and increased environmental standards.

Many existing sewage treatment plants have limited or no extra hydraulic capacity at their inlet – i.e. they are constrained by the level of some upstream gravity pipe or have a very small available hydraulic profile across the process units. This often leads to the need to install lift pumping stations to allow for additional flows. This can be a major and costly reconfiguration.

Such a situation existed at the Wauchope sewage treatment plant, which lies approximately 20 km to the west of Port Macquarie on the NSW mid north coast and within the Hastings Council local government area. The manual inlet screens at the plant were regularly blocked and the screens needed to be cleaned at least daily. Without this daily cleaning, sewage from the inlet overflowed around the inlet works and by-passed the main treatment units.

In order to overcome this problem, Council decided to retrofit automatic step screens into the inlet. Council commissioned Gene Engineering to carry out the investigation and design for automatic screens. After detailed hydraulic investigations were carried out, it was concluded that insufficient hydraulic head was available to install the screen without causing a backwater effect and surcharging of the upstream sewer main. The feasibility of installing a lift pump station was investigated and costed.

In the course of these investigations, Gene Engineering offered Council an innovative and economic alternative to the lift pump station. This alternative consisted of the concept of reducing backwater effects by releasing part of the inflow substantially at right angles to the channel (i.e. overflowing through self cleaning screens in the walls of the channel). This concept led to the development, manufacture and worldwide patent of the intellectual concept and hardware by Gene Engineering of the "Wallscreen"™.

Theory

A mechanical screen has an open area (A) when clean. As the screen is blinded/loaded by screenings the open area is reduced and the flow theoretically is reduced.

The effect is the kinetic energy ($v^2/2g$) from the velocity of the influent changes to a static head (h), causing hydraulic backwater to build up as the velocity reduces upstream of the screen. In gravity sewerage mains the sewage can backup and surcharge the upstream manhole.

The open area of the mechanical screen can be increased by introducing an extra screen at right angles to the original mechanical screen with its invert set such that the velocity of the channel is above the minimum sedimentation velocity.

The overall result of the increased area is to allow higher flows to be handled in an existing channel thereby reducing backwater effects.

Thus, when the flow (Q) increases, the level rises to maintain velocity due to the constant cross section of the channel. Eventually, the invert of the extra screen set in the wall is reached and the liquid flows through it, thus reducing hydraulic backwater build-up. The longer the weirs edge the lower the hydraulic head build-up within the channel. This concept is shown in Figure 1.

The basic concept of the "Wallscreen"™ therefore involves taking a mechanical screen and orientating the bars horizontally within the channel wall.

The invert of the "Wallscreen"™ can be set at the Average Dry Weather (ADWF) hydraulic level of the main stream channel, or at a higher level (Peak Dry Weather, Peak Wet Weather or Flood), depending on the overall hydraulic profile.

As the flow increases above ADWF, or the downstream main mechanical screen blinds up, the hydraulic backwater builds up causing the influent to flow over the invert of the wall screen – thus being screened at a higher level. Consequently, many Wallscreens™ could be set along a channel at slightly different inverts to handle increased flows. This concept is shown in Figure 2.

In addition, the inlet channel's velocity can be stratified by the invert levels of each Wallscreen™ to carefully control grit sedimentation while allowing fibrous and faecal material to float past towards the main channel mechanical screen.

In the event of a mechanical overload, emergency or power failure an overflow weir is located above the Wallscreen™ to allow the influent to flow over.

Wauchope STP Application

Wauchope Sewage Treatment Plant (STP) is one of five sewage treatment plants operated by Hastings Council. The original plant was constructed in the 1960's as a trickling filter plant with effluent detention ponds for disinfection. The effluent from this plant is reused on the local golf course, adjacent farmland and the residual is discharged to the Hastings River.

In 1992 the trickling filter plant was replaced by an activated sludge plant, constructed adjacent to the existing plant. Only minor modifications of the gravity inlet carrier were carried out during this augmentation. A new inlet structure was built, incorporating a flow measurement flume and manually raked coarse bar screens.

The Wauchope reticulation system has significant inflow/infiltration problems. This was recognized in the design of the augmentation, and a wet weather screened bypass was constructed from the inlet works to the detention ponds, bypassing the main process units. If the wet weather flow is too large for the bypass system, the sewage backs up and surcharges from an elevated manhole on the inlet gravity line.

It was also found, however, that influent was backing up in the inlet works in dry weather due to a significant amount of coarse material being collected on the manual screens. This meant that the bypass around the main process units could be activated too frequently. As a result, the screens were required to be cleaned daily, including weekends.

Council programmed for the installation of automatic step screens to be incorporated in the inlet. It was originally envisaged that these screens could be incorporated into the existing inlet channels with some minor civil modifications.

Gene Engineering was commissioned by Council to undertake the detailed analysis and design for the new inlet screens. It was found that insufficient head was available to successfully install in-channel automatic step screens without exacerbating the backwater effect in both wet and dry weather. The conventional solution to this problem was therefore the installation of an inlet pumping station. (It should be noted that Council had experienced a similar problem at its Port Mcaquarie STP and had installed a lift pump station to overcome it).

Prior to the detailed design of the Wauchope lift pump station being carried out, Gene Engineering devised the Wallscreen™ as an alternative solution to the problem. This led to the development, manufacture and worldwide patent of the intellectual concept and hardware by Gene Engineering of the "Wallscreen"™.

Implementation

After Council accepted the concept of the Wallscreen™, Gene Engineering carried out the detailed design of the Wallscreen™ and associated civil and mechanical works. Council's electrical staff provided drawings for the required control modifications. A local firm manufactured the new control switchboard. Council's sewerage staff carried out the concrete civil works, including foundations. A local firm also manufactured the stainless steel overflow channels including flumes.

Advantages

The implementation of the Wallscreen™ allowed the inlet works at Wauchope to be kept in service during the construction and eliminated the need for an expensive lift station, which would have been required to pump all flows.

In addition, some other advantages of this system include:

-Concentrating the screenings to a small mechanical screen for removal, with the balance screened at a higher level

-Improvement of grit capture upstream of the screen

-Simplicity in design and operation

-The pitch/spacing of the bars and raking mechanism can be adjusted to different sizes without changing the main body of the Wallscreen™

-The screen and drive are incorporated into a self-contained modular unit, which is designed to operate in submerged conditions

-Standard size screens can be replaced or exchanged to ensure long-term reliability

Future Applications

Both this concept and the resultant hardware can be applied to many other areas of

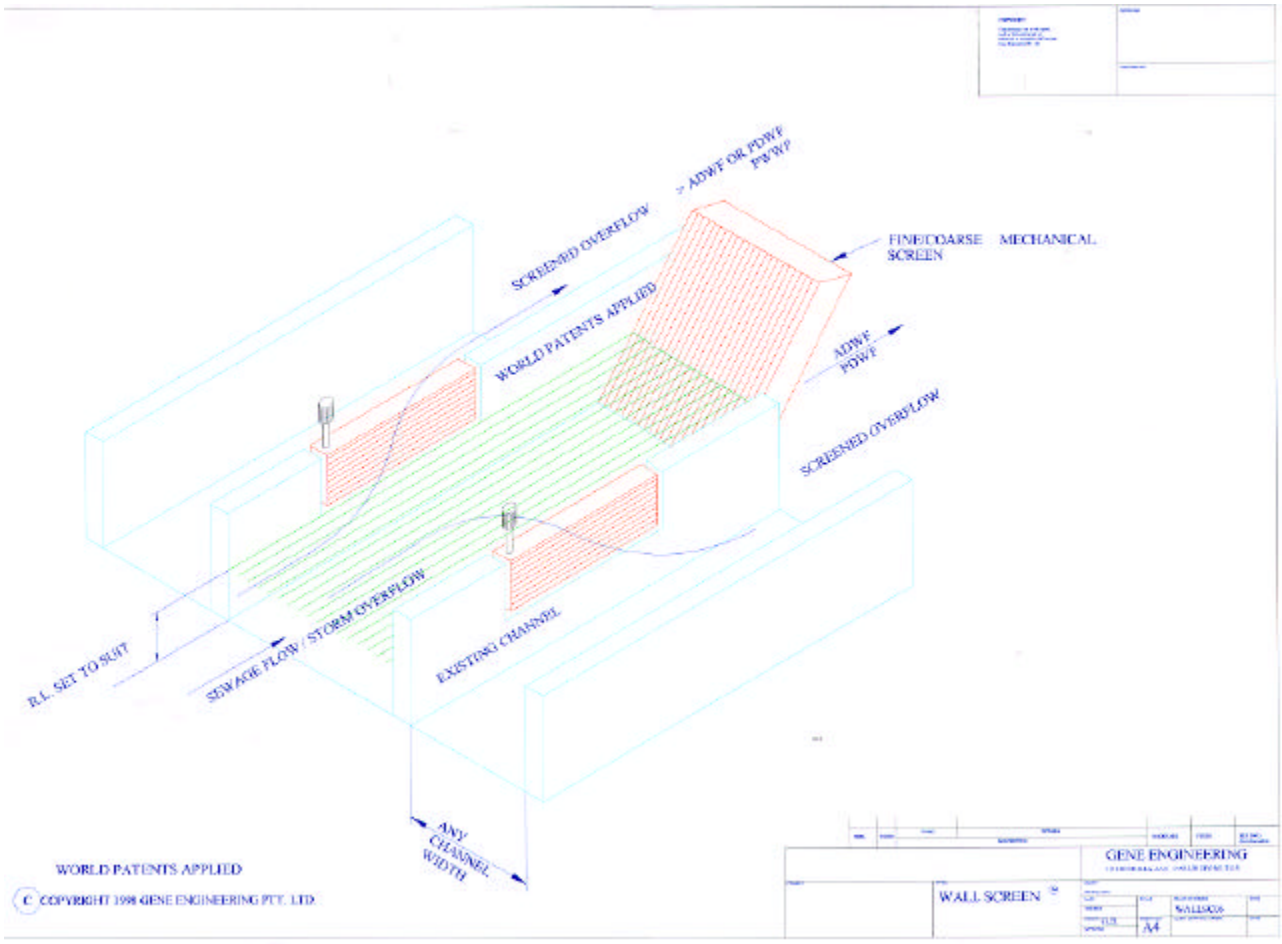
screenings and waste control. For example the “Wallscreen”™ could be used in trash racks for water supply, pump stations, storm water runoff and industrial applications.

Conclusion

The Wauchope Inlet Screens project has shown that private industry and local government can work together to find cost-effective and innovative solutions to “conventional” sewerage problems if some lateral thinking opportunities can be allowed into the project.

The project allowed a complex “larger” problem to be broken down into smaller, simpler pieces, which had the advantage of allowing much of the preparatory work to be carried out locally.

Figure 1



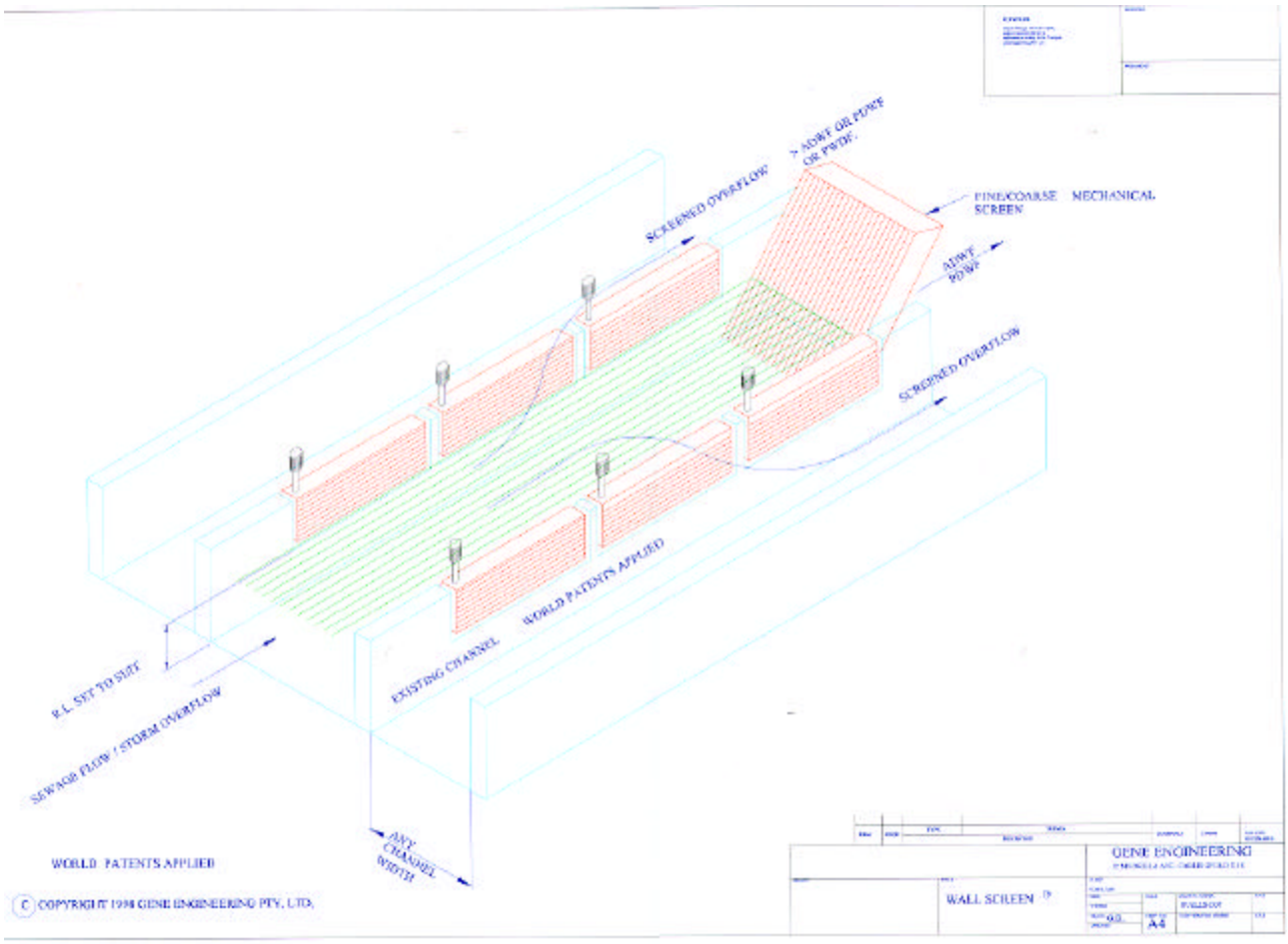


Figure 2

Author Biography

Carmel Krogh is the Sewerage Manager for Hastings Council

Ph: 02 65 818564

E-mail: carmelk@hastings.nsw.gov.au

Eugene Turco is a Partner of Gene Engineering

Ph: 0417 414801

Joe Turco is a Partner of Gene Engineering

Ph: 0417 282039