

CENTAURTM

ACTIVE SYSTEM MANAGEMENT TO REDUCE STORM OVERFLOWS



- ✓ Minimise escapes and pollution through intelligent use of existing infrastructure
- ✓ Autonomous system based on Artificial Intelligence
- ✓ Easy deployment, maintenance and operation



Repeater



Control Station



Urban Flooding
Target Site

Sewer
Target

CENTAUR™ is an autonomous, localised system which utilises existing network storage capacity

- ✓ Reduce flood risk
- ✓ Prevent spills from CSO's
- ✓ Control flows to pumping stations and wastewater treatment works
- ✓ Less costly than capital, space intensive, engineering solutions
- ✓ Complements traditional approaches and Green Infrastructure

Hub

Monitoring Station

Target Site

Wastewater
Treatment Works

er Overflows

et Site

What is **CENTAUR™**?

CENTAUR™ is an intelligent, autonomous, localised system which utilises existing drainage network storage capacity for urban flood risk reduction and similar applications. The novel technology boosts sewer network capacity by using a gate to control the flow and optimally utilise latent storage capacity.

How does **CENTAUR™** work?

Each CENTAUR™ system involves the installation of water level sensors at key points within the sewer network. Level information is communicated using a proprietary radio protocol to the CENTAUR™ Hub. The modular system uses Fuzzy Logic based Artificial Intelligence to dynamically control the pass forward flow.

How can **CENTAUR™** be used?

CENTAUR™'s key benefit is the creation of new capacity from existing infrastructure. This is created at low cost relative to alternative civil engineering enlargement schemes, and without the associated disruption. CENTAUR™ is ideal in situations where space and capital are limited. Extra capacity can be targeted at reducing flood-risk, environmental impact and energy consumption. It results in a net reduction in risk instead of transferring the problem elsewhere.

CENTAUR™ can be used as a quickly-deployed mitigation measure up front of major schemes, offering interim protection.

CENTAUR™ is protecting a World Heritage Site in Coimbra, Portugal, which has been prone to flooding in the past

The system in Coimbra has performed flawlessly since commissioning in October 2017. The CENTAUR™ solution has controlled over 60 events in this time, including a 2-year return period storm event.

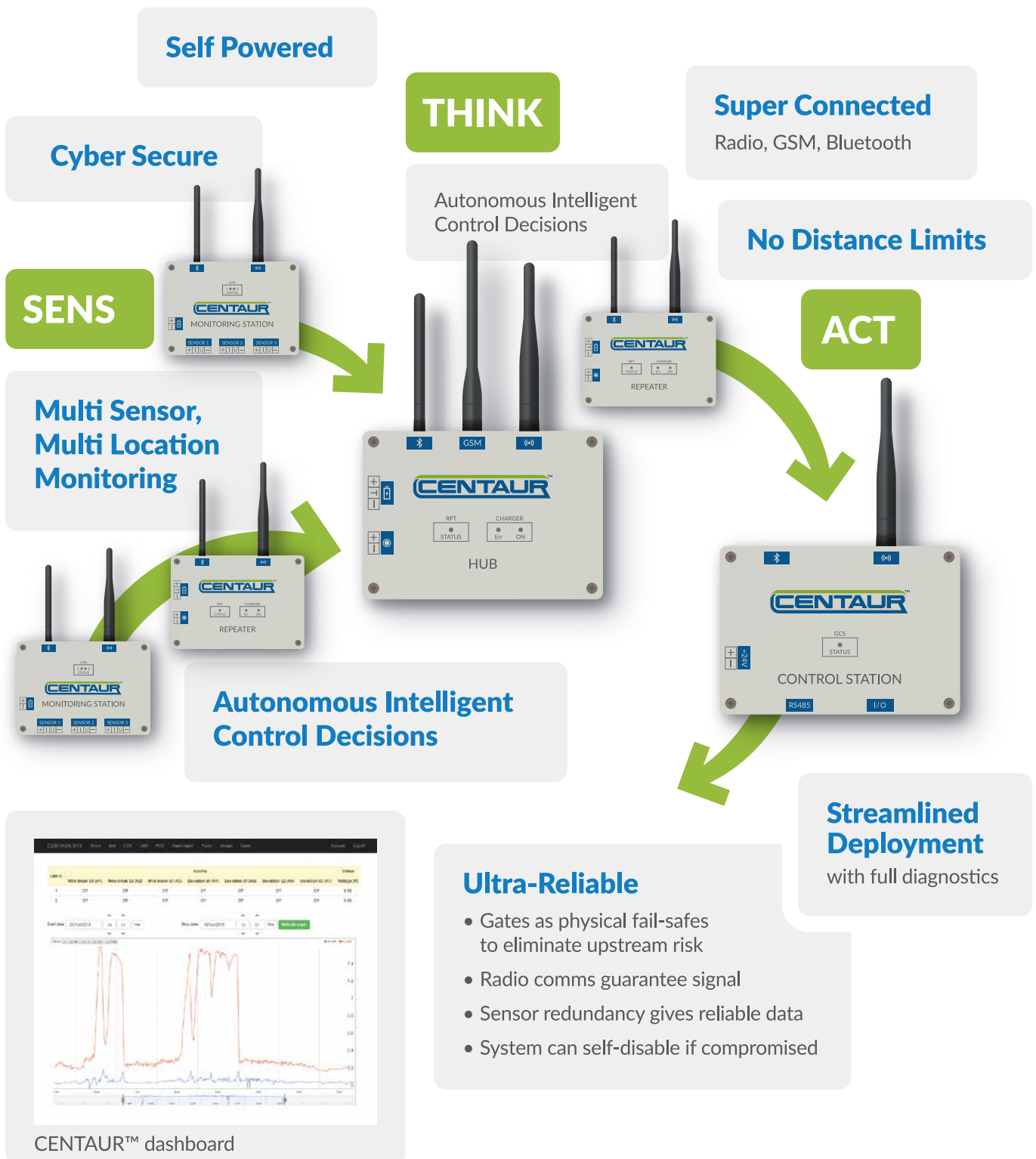
CENTAUR™ has effectively reduced the downstream CSO spill frequency and volume by 78% and over 87% respectively.¹

“The CENTAUR™ system has been successfully working in Coimbra, managing peak flows and reducing flood risk in an important area of the city. Through utilising existing storage capacity within the wastewater network, volume is retained during periods of intense rainfall and only discharged once the flow has reduced downstream.”

Telmo Paula, Aguas de Coimbra



¹ Simões, N., et al. (2018) Real-time CSO spill control using existing in-sewer storage, 11th International Conference of Urban Drainage Modelling (UDM), Palermo, Italy, 2018.



Modelling CENTAUR™

Until recently, CENTAUR™ was modelled in InfoWorks ICM using the RTC tool. This involved configuring the CENTAUR™ gate as a controller with threshold levels at the Target Site and level constraints at the Storage Site. These thresholds and constraints decide opening and closing increments for the gate in subsequent time-steps. However, this is an approximation rather than a direct simulation of CENTAUR™'s Fuzzy Logic control algorithm. This approximation results in a modelled underperformance relative to the actual technology.

Innovyze have now configured functionality that will allow the direct simulation of the Fuzzy Logic driven action of CENTAUR™ within InfoWorks ICM. This functionality is in the November 2019 release of the software.

During development, the Fuzzy Logic driven action of CENTAUR™ was simulated directly in SWMM through the use of MatSWMM. CENTAUR™ can still be simulated in this way.



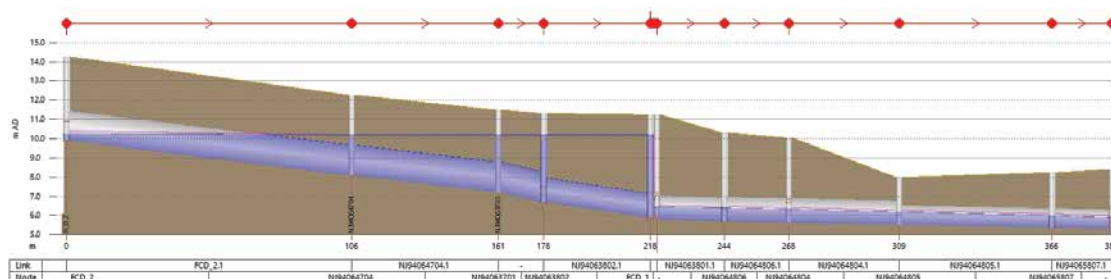
**MatSWMM is an open-source software package for the analysis and design of real-time control strategies in urban drainage systems. It interfaces with SWMM on a time-step by time-step basis and can be used to simulate Fuzzy Logic algorithm control.*

Locating Existing Storage Capacity within Wastewater Networks

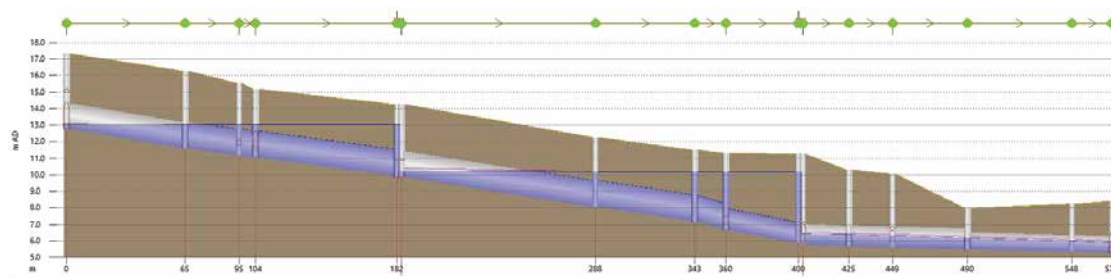
Periods of intense rainfall are simulated and the amount of available storage which exists upstream of the target site is observed using Long Sections.

Physical limitations, such as cellars, are considered in the selection of candidate storage sites.

It should be noted that for sewer overflow spill management, CENTAUR™ can often drastically reduce the volume and frequency of spills through use of very small amounts of adjacent upstream storage.



One Gate CENTAUR™ System utilising 208m³ of Storage Capacity*



Two Gate CENTAUR™ System utilising 295m³ of Storage Capacity*

*based on a 1-year return superstorm event

Owning and Operating CENTAUR™

CENTAUR™ can have a high impact for low cost, but the system has further advantages.

Installation

A feature of CENTAUR™ is its low disruption and ease of installation.

CENTAUR™ modules are mounted on lamp posts or other convenient structures, or in manholes. They are self-powered either by solar (above ground) or battery (below ground) with a minimum 5 year battery life.

The only minor works required is at the gate manhole, where a small kiosk with a single phase power supply, and a 50mm diameter duct to the manhole are required. For larger gates, a three phase power supply and an enlarged manhole lid may be required, but the gate will likely be solving a problem that justifies this expense.

EMS has the capability to install and commission CENTAUR™ systems. However, you may want to service this with existing contractors. EMS remains flexible and can provide these services or support other parties.

Operation and Maintenance

CENTAUR™ is autonomous. It doesn't require oversight by operational staff. It is also designed to be reliable and require little maintenance.

The system reports faults by exception. However, CENTAUR™ was designed for ultra-reliability, with redundant sensor operation, and with operational fail-safes, for example relief weirs and self-disabling features. Hence, faults should be few and far between and will be minimised by annual preventative maintenance. EMS recommends an on-site check once a year.

EMS can provide annual maintenance and call-out services. Alternatively, we can provide second line support to others in providing these services.

Ownership

For long term deployment, e.g. over a period of 20 years, the most economical solution is for the client to buy and own CENTAUR™. In this case, EMS can assist in whole life cost analysis to give a full understanding of the cost of ownership.

CENTAUR™ may be used in shorter term deployments. For example, the system may be deployed for a period upfront of a larger scheme, used to mitigate risks in the interim. In such cases, it may be preferable for the client to lease this system. Leasing can be bundled with installation, operation and maintenance.

Data

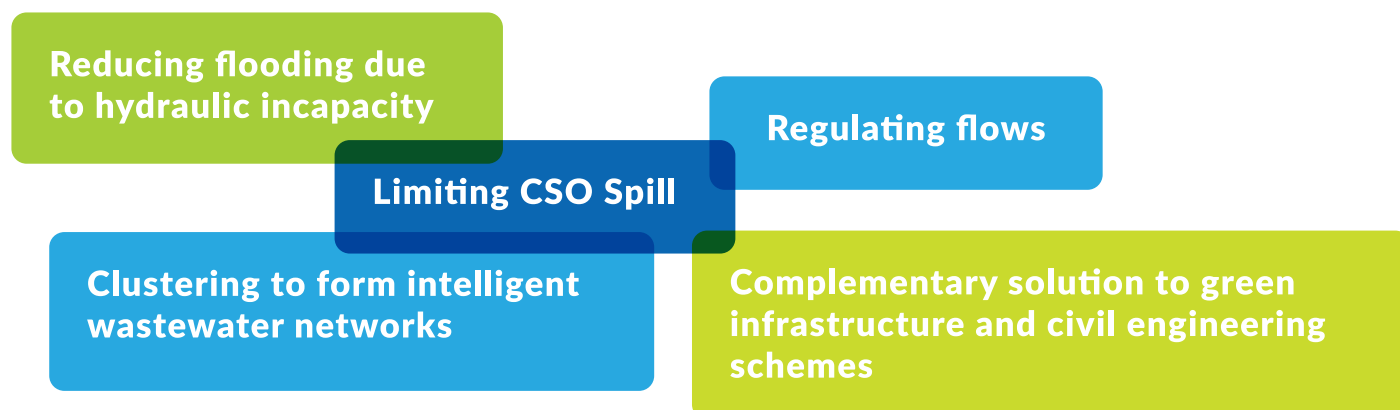
The data recorded by CENTAUR™ is stored in a database that is accessible from the CENTAUR™ dashboard. This includes level and gate position data.

We consider that this data belongs to the client. However, with the agreement of the client, this data is used in anonymity by EMS for development purposes.



CENTAUR™ Use-Cases

Autonomous systems are able to sense, think and act in isolation. They are able to adapt to circumstances and evolving infrastructure. Through mimicking and replacing human reasoning, autonomous systems perform narrow tasks very effectively



There are other potential use cases where CENTAUR can be used as a technology platform including irrigation, potable networks and wastewater treatment.

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