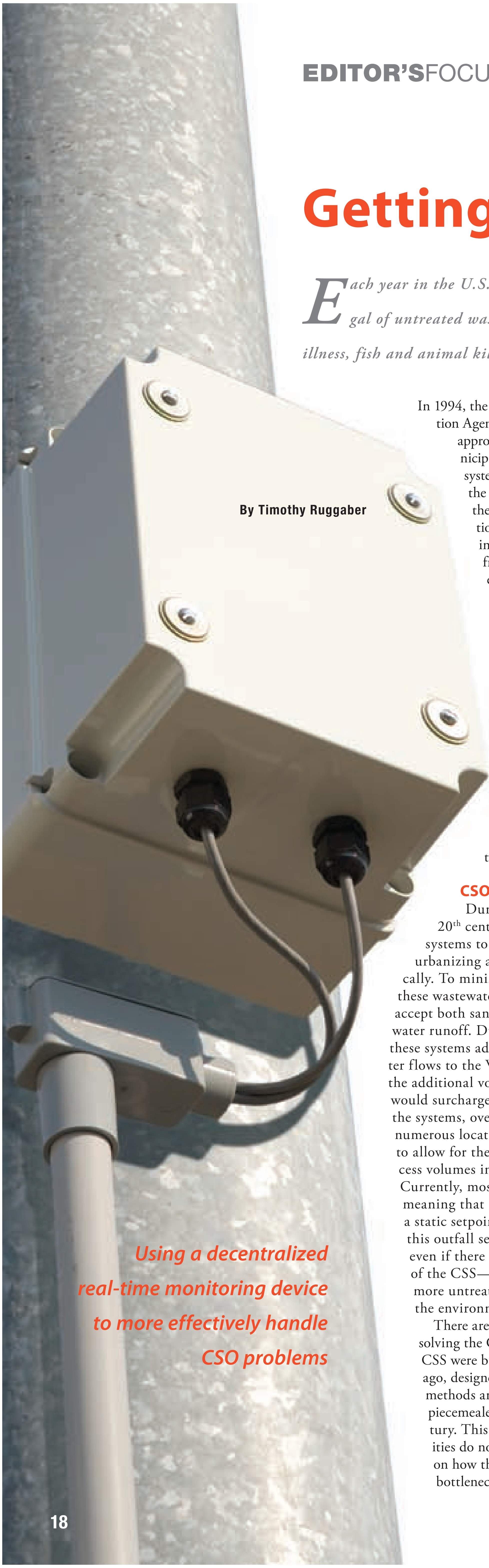


Getting Real with CSO

Each year in the U.S., combined sewer overflow (CSO) events result in the release of 850 billion gal of untreated wastewater into rivers, streams and lakes. These releases cause extensive human illness, fish and animal kills and the eutrophication of the receiving waters.

Using a decentralized real-time monitoring device to more effectively handle CSO problems

By Timothy Ruggaber

In 1994, the U.S. Environmental Protection Agency (EPA) mandated that the approximately 750 American municipalities with combined sewer systems (CSS) drastically reduce the frequency and severity of their CSO events. Current solutions to CSO problems mainly involve large and expensive infrastructure improvement and expansion projects. Typically, these projects attempt to reduce CSO events by expanding wastewater treatment plants' (WWTP) capacity or by separating the storm and wastewater sewers. These solutions, however, can be expensive and disruptive to the public. CSOnet provides municipalities with the data they need to determine how to fix their CSO problems and the tools to implement those control solutions.

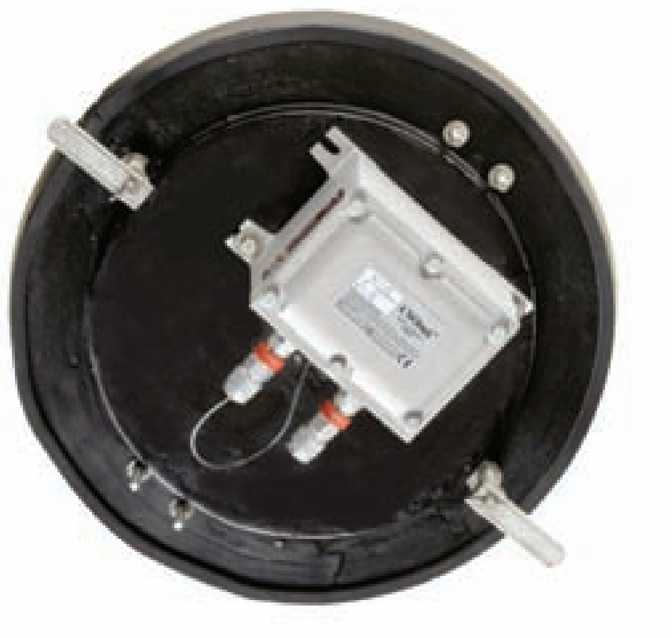
CSO Challenges

During the first half of the 20th century, construction of sewer systems to transport wastewater in urbanizing areas increased dramatically. To minimize construction costs, these wastewater systems were built to accept both sanitary wastewater and storm water runoff. During times of dry weather, these systems adequately carried wastewater flows to the WWTP. In wet weather, the additional volumes from rainfall runoff would surcharge the systems. To relieve the systems, overflow points were built at numerous locations within the systems to allow for the discharge of these excess volumes into the local water bodies. Currently, most CSS are passive systems, meaning that each of these outfalls has a static setpoint. Whenever flow exceeds this outfall setpoint, an overflow occurs even if there is still capacity in the rest of the CSS—and with each overflow, more untreated wastewater enters the environment.

There are several factors that make solving the CSO issue difficult. Most CSS were built more than 100 years ago, designed using now outdated methods and loads and have been piecemealed together over the last century. This means that most municipalities do not have enough information on how their sewers operate, where bottlenecks occur and where all of the problem areas are. Many communities have done some temporary flow monitoring in order to create a computer model of the system, but even the best models have error ratings of up to 20% and do not possess the detail needed to focus in on certain problematic areas. Hence, many municipalities develop CSO abatement plans that do not effectively and efficiently address the problems in their systems due to the lack of useful information.

CSOnet can greatly reduce these difficulties and expenses through real-time monitoring and control (RTMC), which uses remote sensing and coordinated, automated valves to maximize inline and offline storage and flows to the WWTP. The goal of CSOnet is to maximize the potential of the existing infrastructure and minimize the need for new construction, thereby cutting the cost of any CSO abatement plan.

Features of the CSOnet System



CSOnet is a modular, decentralized approach to RTMC, which sets it apart from many existing systems. CSOnet uses real-time flow information from the critical points in the sewer system to actively control the passage of water through the CSS with the use of valves and gates. The process is similar to that of traffic control using traffic lights. Modern traffic-control systems are able to actively control traffic light green/red light times to avoid congestion during rush hours. In a similar way, CSOnet monitors the CSS and actuates valves and gates distributed throughout the CSS to avoid surcharged conditions that cause overflows. Most existing RTMC systems utilize programmable logic controllers (PLCs) to gather data from sensors mounted in the sewer, which is then sent to a centralized computing center via a SCADA system. While this system has been shown to be effective, it can be also limited and cumbersome. For example, each monitoring site requires an external power source, an electrical cabinet, a PLC, high-power radios and an open area of land for the equipment. This setup is expensive, which limits the number of monitoring sites a municipality can have, and the power and space requirements limit where the sites can be.

With its decentralized approach to RTMC, CSOnet avoids all of those limitations. In its most basic form, CSOnet is a wireless network of monitoring points (also known as instrument nodes or INodes) and data acquisition points (also known as Gateways). An INode collects data from a sensor mounted in the sewer and uses a radio to transmit it to a nearby Gateway. The Gateway then uploads this data to a secure website via cellular or Wi-Fi connection, where it can be accessed anywhere at any time by the municipality. This wireless network approach enables CSOnet to be quickly and inexpensively deployed and to be incrementally implemented, meaning the system can easily grow from one monitoring point to 10 points, to 100 points.

Rather than needing a PLC, a power source and a SCADA system, the INode is all self-contained in a manhole cover assembly. The INode's antenna is encased inside of the highway-rated manhole cover, which is made of a composite fiberglass material. The necessary electronics and batteries are contained in an explosion-proof enclosure mounted to the underside of the manhole cover. An INode can be installed in any manhole in a matter of minutes and can start sending data instantly.

The Gateway effectively replaces the centralized computing center. The coffee-can sized node is mounted above ground, typically on a utility or traffic signal pole, so that it can collect data from surrounding INodes, which it then uploads to the Internet. In addition to collecting data, the Gateway can be connected to and control an actuated valve. The Gateway contains an embedded PC, which analyzes the data collected from the surrounding INodes, and then adjusts the valve accordingly. If more than one control point exists in a CSS, the Gateway communicates with the other Gateways via the Internet to ensure that the Gateway's actions will not cause flooding or CSO events downstream.

South Bend Installation

After a successful pilot demonstration in 2005, the city of South Bend, Ind., decided to implement the CSOnet system across the entire city. South Bend is a medium-sized city of 107,000 people located in north central Indiana. Its CSS covers 13,100 acres and contains 36 CSO outfalls. The city decided to use CSOnet to fulfill the following objectives, many of which will fulfill the Nine Minimum Controls required by the U.S. EPA:

- Monitor every CSO outfall to determine when and how much overflow occurs.
- Provide an early warning and prevention system for dry weather CSO events.
- Determine the potential areas for inline storage in larger pipes.
- Collect data to further calibrate South Bend's SWMM model.
- Determine the locations of possible bottlenecks in the interceptor and trunklines.
- Determine the effective storage capacity of retention ponds.
- Prevent basement backups.
- Maximize flows to the WWTP.
- Maximize storage in inline and offline storage areas.

The CSOnet system is implemented in two primary phases. Phase One, which was deployed in spring of 2008, is a real-time monitoring system that monitors 110 locations throughout the CSS. This system is able to accomplish the first six objectives through the monitoring of all 36 outfalls, 42 locations throughout the major trunklines, 27 locations along the interceptor and five retention basins.

Phase Two will implement the control of several critical points throughout the CSS. The data gathered by CSOnet after the Phase One implementation will serve to further refine the control strategy. Not only will CSOnet be used to maximize the storage potential of inline and offline storage areas, but it will also be used to increase flows to the WWTP during storm events. Preliminary studies have determined that actively controlling the amount of water diverted to the interceptor line could reduce CSO discharge volumes by up to 25%. Larger savings could be accomplished through the integration of existing retention ponds and in-line storage to the CSOnet system.

Valid Solution to CSO Problems

Preliminary studies conducted by independent environmental consulting firms indicated that the CSOnet system has the potential to reduce the $400-million CSO Long Term Control Plan budget by $110 to $150 million in new construction. The promise of these savings, as well as the flexibility and ease of installation of [CSOnet,] is making real-time monitoring and control a feasible and enticing option. WWD

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