“If It Ain’t Broke Don’t Fix It” Collection System Cleaning

by Jay Boyd

There is an old saying, “if it ain’t broke don’t fix it.” That folksy, simple statement bears quite a bit of truth. Why would we spend money on something that is functioning? For example, why would I spend a few thousand dollars replacing my hot-air heating unit when it works? We get warmth on-demand. Besides, we have other maintenance projects such the backyard fence. It’s nearing its end-of-life, so for a similar expense why not address that?

The heater is functional. I know that there are newer models with better technology making them more efficient, translating into lower use of fuel and heating costs. These new systems have multiyear warranties where mine has none. Plus, the new models run quietly while my heater is a little noisy.

So, asking the question again, is it “broke”? Fuel prices over time will rise and there is a prospect of pay-back with a newer unit. Should a breakdown occur with the old unit, there is a looming prospect of repair, perhaps even an emergency repair, so we have a standing liability. With this perspective, what looks like it “ain’t broke” may well be “broke” considering the higher fuel costs and an uncovered liability for repair. In this context, the heater is more important than the fence. It’s “broke.”

So why the story of the heater? We use many processes and day-to-day routines that get the desired results. Yet are these processes as efficient as they could, and should, be? Like the heater, just because they work and give us the desired effect, does it mean that there aren’t better alternatives with improved outcomes? Can we gain greater efficiency and lower operating costs? To answer this, we’ll look at the recommended best practice of rigorous cleaning of the collection system.

The Story of a Small City

The City of La Mesa is located just 12 miles east of San Diego, California. Called the Jewel of the Hills, between 1910 and 1915 its rolling hills and arid landscape made La Mesa a perfect backdrop for more than 100 Western films shot on-location.

CITY OF LA MESA
JEWEL of the HILLS

Logo for the City of La Mesa, California.
City of La Mesa, California

Today, the city boasts a population of 57,000 residents. It has a quaint downtown village surrounded by residential and commercial areas, all fitting in a 9.1-square mile area where the city owns, operates and maintains its 153 miles of collection system and an additional 50-plus miles of storm system.

A Really Brief History of (Over)cleaning

The goal of federal and state regulators is to stop sanitary sewer overflows (SSOs). Like New York, California’s regulatory State Water Resources Control Board has high standards for compliance and reporting of overflows. Steep fines for noncompliance can be levied, placing high demands on all cities to assure that they comply.

La Mesa’s limited, seven-person maintenance staff is responsible for myriad duties in addition to collection system maintenance. They must address 100 high-frequency cleaning sites monthly ***(Photograph 1)***. This scheduled routine is done to stay ahead of any buildup caused by fats, oils and greases (FOG), roots, debris and sediment, all to avoid the threat of overflows. In effect, the city overcleans as a preventive measure. It’s working.

Photograph 1. Workers cleaning a collection system.
ADS Environmental Services

La Mesa is certainly not alone in their approach. High-frequency cleaning has been considered a “best practice” for decades and appears in many dozens of operations and maintenance (O&M) manuals. Here is just one example of a recommended process found in a USEPA collection systems Capacity, Management, Operation and Maintenance (CMOM) manual from 1999:

> “Scheduled cleaning is proactive in that cleaning is done on a preventive basis to remove material prior to a stoppage occurring. Preventive cleaning activities can be supplemented by additional cleaning on an as-needed basis in cases where predictive information such as previous history, inspection data, pipe age and material, slope, or other information indicates a need for more frequent cleaning.” *(USEPA 1999)*

In the most general sense, overflows are caused by the system’s capacity being challenged in some way. Blockages, where the flow is impeded, is one of them. Cleaning is recommended to keep pipes free of obstructions. How is it determined when to clean? History. This means that to be proactive and stay ahead of historic problems, utilities must overcompensate by overcleaning.

Figure 1 illustrates how overcleaning can affect SSO occurrence.

The City’s Challenge

La Mesa uses high-frequency cleaning and has achieved SSO reductions over the years. From this perspective, as the saying goes, “it ain’t broke.” Or is it? As mentioned, the city cleaned 100 sites monthly, resulting their small staff spending 80% of their time cleaning. Upon taking a closer look, this rigorous cleaning program created an underlying problem: “how do we keep up?” With vacations, sickness, staff turn-over and emergencies all impacting their schedule, keeping up is difficult. This perceived “best practice” may be unsustainable, and adding personnel was not an option. Yet, the city needed a solution to reduce pressure on their staff without any risk of increased SSOs.

Additionally, like so many other systems across the U.S., the La Mesa collection system had older pipes. The city was concerned that

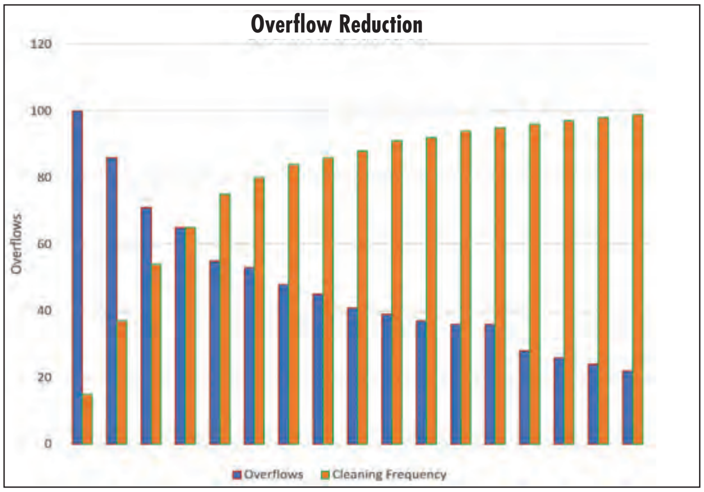

Figure 1. This graph is an amalgamation of multiple U.S. utilities' results. It shows that as cleaning frequency increases (orange), SSOs decrease (blue). Although individual results vary from utility to utility, they all demonstrate this inverse relationship. *ADS Environmental Services*

high-pressure spray from the frequent cleaning operation promoted accelerated wear on already marginal pipes. Cleaning was a necessity, but they needed to balance that against detrimental wear exacerbating pipe failure.

A New Vision

Recognizing that their current practices were "broke," they were determined to create a new process with three objectives:

1. Reduce demands on the operations team.
2. Reduce the threat of premature pipe wear, especially on older pipes.
3. Maintain and even improve SSO prevention.

The city realized that the main issue with their process was cleaning frequency. It was based on the site's history, and the cleaning schedule was set up accordingly. If the site had a history of many problems, it was cleaned with higher frequency than a site with a history of fewer problems.

Aside from when the site was cleaned by the field crew, the utility had no way of knowing the condition of the site between cleanings. In effect, they were blind to the real-time conditions of the site.

With this realization, the city called on a trusted supplier of monitoring equipment and services with whom they had previously done successful flow metering projects. They met and discussed the situation and their forward-looking vision. The city learned from the supplier that a growing cadre of utilities were investigating and implementing a new process that optimized cleaning. Using remote site monitoring, utilities gained ongoing visibility to sites previously being cleaned at high frequency. The monitors would continuously measure and communicate conditions to cloud-based software and could be viewed on desktops, tablets or smartphones ***(Figure 2)***. This software can detect when a blockage is developing, based on machine learning. The software provided the data and could alert the utility's staff when it was time to clean.

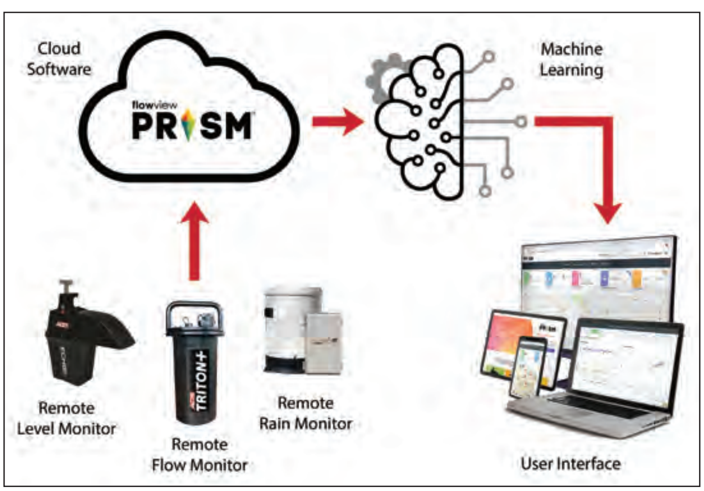

Figure 2. The remote monitors continuously measure and communicate conditions to cloud-based software. This software uses machine learning to recognize a developing blockage. The software alerts the users through interfaces when cleaning is necessary. *ADS Environmental Services*

In multiple studies conducted by the supplier with utility partners, it was shown that cleaning frequency was safely reduced by 67 to 93%. The city was quite interested in this approach. It had the potential to meet their objective for lower cleaning frequency while also decreasing risks from SSOs.

The Test and the Technology

The supplier and La Mesa agreed to establish a pilot. Ten high-frequency (e.g., monthly) sites were selected. The supplier provided a new-generation level-only monitor at each site. These new-generation level monitors were equipped with three sensors: an ultrasonic sensor, a pressure sensor and an alignment sensor.

The ultrasonic sensor was capable of precision measurement to a distance 20 feet from the sensor to an 8-inch invert below. It had five configurable alarms. Its low-flow alarm was valuable for detecting upstream blockages. As well, there were four high-level alarms to provide optimum redundancy and assurance against SSOs.

The pressure sensor was capable of monitoring fully 8 inches above the unit if submerged and could measure an overflow event. The third sensor monitored the remote unit's alignment. This was important to assure that the remote system was always monitoring invert levels and no other manhole surfaces, enabling acquisition of high-quality data and avoiding false alarms. In all cases, users could be notified by text message or email if an issue arose. Moreover, if the condition corrected itself, users would be notified.

In addition to the alignment sensor, these remote units used a stabilized mounting method to maintain a fixed position ***(Photograph 2)***. No sensor movement meant no errant measurements and, therefore, no false alarms.

The system was equipped with a new cellular communications technology called LTE-M. Unlike voice-based cellular, LTE-M signals could be transmitted from an antenna located inside the manhole, providing quality connectivity. This made installation fast and movement to another site easy. With the system software, users could view remote sites in real time through quick summary dashboards.

During the study, the greatest challenge was to break old habits of routine cleaning based on a rote schedule. Rather, the field team cleaned when the remote system indicated to do so. The team wanted to trust the system and be able to rely on data quality. This trust was essential for the success of the study. Earlier technologies had suspended the sensors from cables, which were susceptible to movement that created false alarms and eroded the user's trust in the system. To overcome this mistrust, the remote units in this study used a stabilized mounting method, fixing the ultrasonic sensor's alignment to the water. This reduced the chances for false alarms to help build confidence in the reliability of the system.

Results & Savings Opportunities

The results were tabulated monthly ***(Figure 3)***. The pilot period was four months. Previously, 10 sites would have been cleaned each

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Photograph 2 (top and bottom). Fully stabilized monitors enable high-quality data collection. The units are shown mounted above the invert in each instance. *ADS Environmental Services*

month under the old protocol and totaled 40 cleanings. ***Figure 4*** shows site conditions that do not indicate a need for cleaning. As shown in ***Figure 5*** and ***Figure 6***, two sites required cleaning in the first four months, a 95% reduction in cleanings.

The tabulated data indicates that monthly cleaning frequency could be reduced in all cases. Effectively, these sites were being overcleaned. Two of the sites might need quarterly cleaning driven by remote sight monitoring systems' feedback. Based on this data, changing the monthly schedule (12 times per year) to a quarterly schedule (4 times per year) would be a significant reduction in staff time spent on cleaning.

La Mesa would still maintain their annual full-system cleaning policy but would also realize significant time savings by reducing high-frequency cleaning. In turn, the operations maintenance team would be given back time to address other tasks and be better able to keep up with other maintenance demands.

In sum, this pilot demonstrated that the city's new vision would meet their three objectives:

1. Cleaning frequency and corresponding pressure on the field staff could be reduced.
2. Reduced cleaning of high-risk pipes enabled asset life extension.
3. Full-time site monitoring at these sites assured that SSOs would be mitigated.

Showing the Money

Upon completion of the study, the utility's management saw a clear opportunity to financially justify this new optimized cleaning process. They knew the true cost of cleaning with a comprehensive accounting for all factors, including but not limited to:

- Amortized cost of the truck.
- Annual insurance cost.
- Parts and labor for truck maintenance.
- Fuel usage.
- Burdened field labor costs.

Fully accounted, the cost per segment cleaned was $400. This meant that with every segment not cleaned there was a corresponding $400 savings. During the first four months, cleaning would have cost $16,000 ($400 times 40 sites). Instead, using the optimized cleaning process they cleaned twice, costing them $800 ($400 times two sites). This was a savings of $15,200.

They also knew that this savings would not simply be in the form of cash. It was a productivity savings. As stated previously, the city's personnel could not sustain their pace. If they were not to fall behind, they would have to add staff. Alternatively, they could opt to clean less and accept an increased risk of SSOs. The latter would not be acceptable because with that risk came the potential for substantial penalties. Fortunately, optimized cleaning brought a new alternative.

One other important factor to consider is that the rate of cleaning reductions throughout the course of one year would not be 95% but is anticipated to be something less. With 100 high-frequency sites we can assume that some of these would need to be cleaned multiple times but at a reduced frequency from the previous routine. With that in mind and using a very conservative estimate of a 50% total reduction across all sites, the cost of implementation could still be justified. For example, if there was a 50% reduction across the 100 high-frequency sites being cleaned 12 times annually, the result would be a total reduction of 600 cleanings. At $400 per cleaning, $240,000 in savings could be achieved. With this savings, the acquisition of the new-generation level monitors would have a payback of less than one year.

Getting Beyond Broke and Fixing It

Cleaning is an important and necessary requirement for operations and maintenance toward the end of lowering SSOs; it should not be eliminated. Yet, like we saw with the heater story, just because something works doesn't make it a "best practice." It may not look "broke," but it may not be the "best" either.

One of the essential tenants of all work practices is to seek continuous improvement, both in work processes and with ourselves. Much has changed in the past two-plus decades. Technology, once expensive and often highly complex, is now inexpensive and easy-to-use. It is this significant change that enables a new approach to cleaning.

To be clear, this study does not suggest that cleaning is no longer necessary. Instead, it suggests that the mechanism to determine cleaning frequency can, and should, change. Remote site monitors can more effectively determine the necessity to clean. It right-sizes frequency, telling you when to clean. With this change, we can realize some major benefits:

1. Reduction of time-pressure on operations to clean, with corresponding monetary savings.
2. Reduced pipe wear by lowering mechanical stress on high-risk pipes and thus extending the asset's life.

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Site Location	Jul-18		Aug-18		Sep-18		Oct-18		Nov-18		Dec-18	
	Clean?	Type	Clean?	Type	Clean?	Type	Clean?	Type	Clean?	Type	Clean?	Type
70thSt	No		No		No		No		26-Nov		No	
Colorado	No		No		No		No		11/26/2019		No	
EchoDr	No		No		9/17/2018	Grease	No		11/26/2019		No	
HarbinsonAve	No		No		No		No		11/26/2019		No	
JessieAve	No		No		9/11/2018	Grease/Roots	No		11/26/2019		No	
JullIettePl	No		No		No		No		11/26/2019		No	
LakeMurray	No		No		No		No		11/26/2019		No	
NeboDr	No		No		No		No		11/26/2019		No	
PanormoDr	No		No		No		No		11/26/2019		No	
PineSt	No		No		No		No		11/26/2019		No	

Figure 3. Tabulated cleaning frequency results. Green cells in the chart indicated no cleaning was performed while red cells indicated cleaning did occur. *ADS Environmental Services*

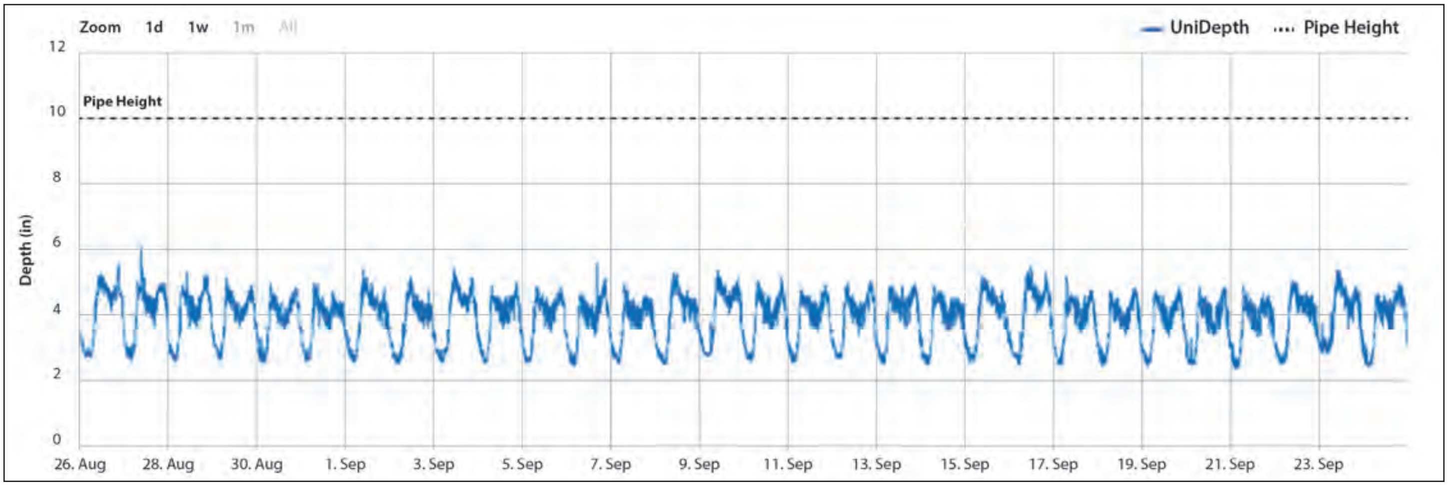

Figure 4. Continuous remote site data provides ongoing visibility. In this instance, a regular diurnal flow is evidenced. *ADS Environmental Services*

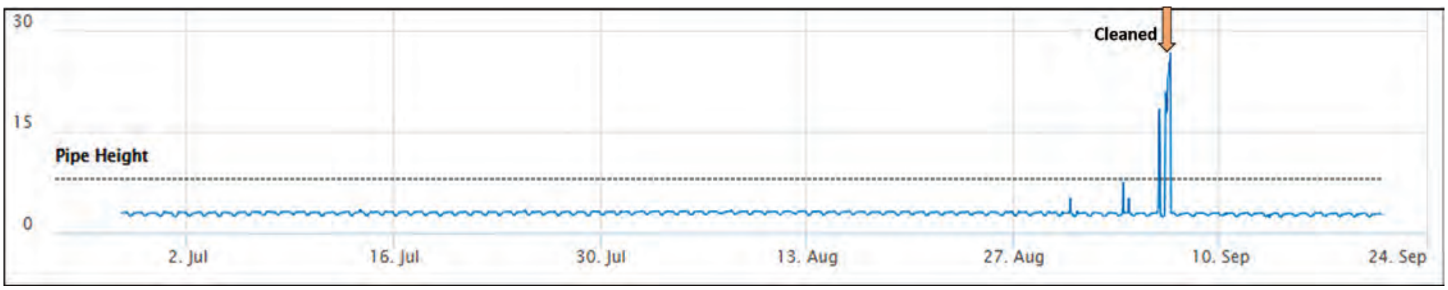

Figure 5. Remote site data at this location, for the period from early July to late September, indicated that cleaning was needed in early September when the depth increased significantly over the baseline measurements. The pipe height is about 8 inches. *ADS Environmental Services*

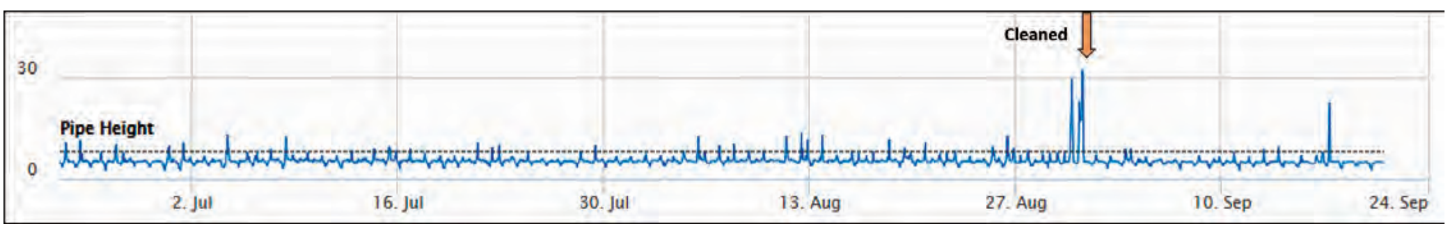

Figure 6. Remote site data at another location, for the period from early July to late September, indicated that cleaning was needed in early September when the depth increased significantly over the baseline measurements. *ADS Environmental Services*

3. Acquisition of continuous remote site monitoring to prevent SSOs where such protection previously was absent.

Reduced cleaning frequency brings some additional benefits. There's less time spent in the streets, reducing worker exposure to traffic while the public benefits from less traffic disruption. Fewer truck trips means lower carbon emissions. Finally, continuously acquired data can be used for better understanding of the collection system's capacity, its response to wet weather, and even contribute to model calibration.

In conclusion, the practice of cleaning to reduce SSOs isn't "broke" but the mechanism to determine frequency may be. Remote site monitoring brings a new opportunity to improve the cleaning process. The real challenge before us is recognize what is "broke" and then get to the task of fixing it.

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Reference

USEPA. 1999. *Collection Systems O&M Fact Sheet Sewer Cleaning and Inspection.* EPA 832-F-99-031. United States Environmental Protection Agency Office of Water. Washington, D.C. September 1999.