Disruptive Clean Technologies in Stormwater

ERIN ROTHMAN
CEO
My name is Erin. I have 15 years of experience as a stormwater and remediation consultant. I’ve worked on projects with cities across the U.S. I’ve spent more time in sewers than I ever expected, and it’s an honor. And I’ve learned a hell of a lot about sensors, software, and analytics over the past 3 years.

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STATE OF STORMWATER (AND WASTEWATER)

Source: Congressional Budget Office, using data from the Office of Management and Budget and the Bureau of the Census. Includes water supply and wastewater treatment facilities, water containment systems (dams, levees, reservoirs and watersheds), and sources of freshwater (lakes and rivers).
STATE OF STORMWATER (AND WASTEWATER)

1 MILLION MILES OF PUBLIC SEWER PIPES

$1.4 TRILLION REQUIRED FOR UPGRADES

Aging, Overuse, Water Quality Issues
STATE OF STORMWATER (AND WASTEWATER)

$48 BILLION REQUIRED TO ADDRESS CSOs

CLIMATE CHANGE
In 2018: 25 cities set new annual rainfall records; FIVE 1000-year events

$88.5 BILLION TO REDUCE SSOs TO ONE EVENT EVERY 5 YEARS
STATE OF STORMWATER (AND WASTEWATER)

FLOODING & CLIMATE CHANGE

- 75% of declared disasters in the U.S. are from flooding
- $14.1 BILION drop in property values along the east coast from flooding & sea level rise (2005 to 2017)
- $3.6 TRILLION in impacts to coastal infrastructure
STATE OF STORMWATER (AND WASTEWATER)

NO VISIBILITY INTO OUR SEWER INFRASTRUCTURE

= inability to monitor, maintain, and retrofit

530 MILES of sanitary mains
500 MILES of storm sewer drains
1,020 MILES of combined sewers
277 storm drain outfalls
43 combined sewer outfall control systems
MARKET NEED

$12.5 BILLION
Total annual U.S. market opportunity (stormwater monitoring only, incl. CSOs and fines)

85,000
Cities, water utilities, ports, states, and DOTs in the U.S. alone

$400
Per household average annual stormwater spend

$100,000+ ARR
Average per customer
STATE OF STORMWATER (AND WASTEWATER)

1,100 CITIES
Discharging more than 10 million gallons of sewage to rivers, lakes, and oceans every day

+830 CITIES
Cities with aging and illegal combined sewer systems that require upgrade/replacement

+COASTAL CITIES
Prioritized due to tidal intrusion
Consolidating monitoring, data analytics, automation, and control could potentially generate **up to $320 billion in cost savings from the total expected capital expenditures** and operating expenses for different water and wastewater utilities between 2016 and 2020.

Data feeds and cognitive computing could significantly assist system managers by providing **near-instantaneous support information for many of the routine and immediate response decisions** that must be made in the municipal and industrial sectors.”
REAL-TIME MONITORING & REAL-TIME CONTROLS

HARDWARE
Sensors, meters, monitors, and actuators

COMMUNICATIONS
Wireless networks between hardware and systems

SOFTWARE
Dashboards, analytics, insights, and data visualization
REAL-TIME MONITORING & REAL-TIME CONTROLS

1. Maximizing existing infrastructure and optimizing operations and responses to be proactive, not reactive.

2. Providing savings in capital and operational spending.

3. Improving asset management and understanding of collection and treatment system performance.
REAL-TIME MONITORING & REAL-TIME CONTROLS

Improving long-term control plan (LTCP) implementation, modification, and development.

Meeting regulatory requirements.

Prioritizing critical assets and future capital planning.

Optimizing collection system storage capacity to reduce peak flows and the occurrence of overflows.

Enabling effective customer service and enhancing public notification.
ROADMAP TO IMPLEMENTATION

DEFINE YOUR VISION
What do you need? Want? What are your wildest infrastructure management dreams?

IDENTIFY YOUR SCHEDULE.
Change is hard, so give your team time to embrace and implement your vision.
IMPLEMENATION!

Deploy the technologies and the platform, and make sure everyone has the tools they need to make this a success.

CONTINUOUS IMPROVEMENT
IT STARTS WITH DATA

FLOW

LEVEL

CONTINUOUS MONITORING

RAINFALL
<table>
<thead>
<tr>
<th>CAUSE OF PROBLEM</th>
<th>POTENTIAL SOLUTION</th>
<th>REQUIRED DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall-derived I/I</td>
<td>Pipe replacement</td>
<td>Level &amp; flow</td>
</tr>
<tr>
<td>Undersized Pipes/Facilities</td>
<td>I/I &amp; IDD mitigation</td>
<td>Sewer &amp; land characteristics</td>
</tr>
<tr>
<td>Illicit flows</td>
<td></td>
<td>Temperature*</td>
</tr>
<tr>
<td>FOG</td>
<td>Improved O&amp;M</td>
<td>Level, velocity, &amp; flow</td>
</tr>
<tr>
<td>Sedimentation</td>
<td>Cleaning/flushing</td>
<td></td>
</tr>
<tr>
<td>Roots/debris</td>
<td>Pipe replacement</td>
<td></td>
</tr>
<tr>
<td>Pipe breaks</td>
<td>Repairs</td>
<td>Flow measurements</td>
</tr>
<tr>
<td>Leaking manholes</td>
<td>Pipe Replacement</td>
<td></td>
</tr>
<tr>
<td>Offset joints</td>
<td></td>
<td></td>
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</table>
### Actionable Insights = System Optimization

#### Reduce Flooding

<table>
<thead>
<tr>
<th><strong>Cause of Problem</strong></th>
<th><strong>Potential Solution</strong></th>
<th><strong>Required Data</strong></th>
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<td>Facility upgrade</td>
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<td>Illicit flows</td>
<td>I/I &amp; IDD mitigation</td>
<td>Operational &amp; physical constraints</td>
</tr>
<tr>
<td></td>
<td>Add green/grey infrastructure</td>
<td>Critical elevations</td>
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COST SAVINGS

By implementing just real-time monitoring, the EPA estimates that the costs paid by communities from flooding and sewage overflows can be reduced dramatically.

**$88.5B**
Total

**$7.5B – 50%**
of estimated O&M, annual

**ELIMINATE SANITARY SEWER OVERFLOWS**
by tracking and identifying undersized pipes and rainfall-derived I/I (inflow & infiltration), sediment & debris buildup, pipe breaks and leaks, offset joints

**$7.5B – 50%**
of estimated O&M, annual

**MINIMIZE OPERATING COSTS**
by reducing high electricity costs for pump & gate ops

**$6B**
Fines, fixes, and litigation, annual

**MINIMIZE MAINTENANCE COSTS**
by tracking and identifying equipment failure rates and sedimentation issues

**$270B**
Flood damages in 2017

**MINIMIZE CSOs**
by tracking and identifying rainfall-derived I/I and undersized facilities

**REDUCE FLOODING RISKS**
by tracking and identifying rainfall-derived I/I and undersized facilities
BUT WE STILL HAVE SOME LIMITATIONS: RTC REQUIRES DATA

BUT

DATA ARE EXPENSIVE
So I asked myself: how do we get as much data as possible from as large an area as possible... underground?

...and how do we make it actionable?
NETWORKED APPROACH TO REAL-TIME MONITORING

DATA: Advanced Infrastructure Analytics and Mapping

VIA

Patented design for low-cost, high-reliability sensors (Scutes™)

Cloud-connected via IoT
NETWORKED APPROACH TO REAL-TIME MONITORING

FLOW

LEVEL

+ TEMPERATURE!

VELOCITY

10X COST REDUCTION