SMARTCOVER

Managing the Impacts of Climate Change on Water Systems

AEA Conference – Tuesday March 9, 2021

Today's Agenda

- Integrated Solution Background & Benefits (could add a slide on how company started)
- Technology Overview "How We Do It"
- Applications and Analytics
  - SSO and CSO Monitoring
  - Optimized Cleaning
  - Inflow & Infiltration
  - H_2S Monitoring
  - Pump and Lift Station Protection
  - Source Drinking Water Applications
- MySmartCover (GUI) Demonstration

How Founded

- Founded by two elected water agency officials
  - Greg Quist, Ph.D. (Rincon MWD, SDCWA, Yale, UCSB)
  - David Drake, EE (SDCWA, Rincon MWD, CalTech, USC)

- Installation and Operations
  - 500+ active installations at public and private utilities throughout North America
  - Excess of of 220 million hours of operational experience
  - Responsible for saving an estimated 40,000 spills

- Industry Innovator - 17 Patents

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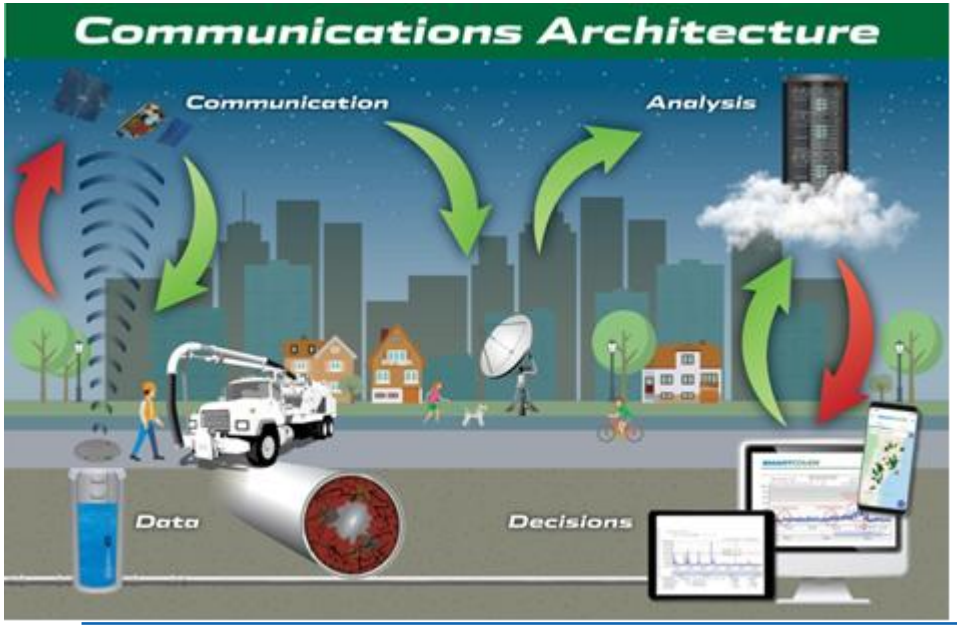
SmartCover Integrated Solution

INSTANT INFRASTRUCTURE



- Robust sensors purpose built for sewers
- Real-time remote sewer monitoring
- Secure and reliable satellite communications
- Data stored on redundant, secure servers
- Data analytics provide actionable insights
- Easy-to-use web-based interface
- Customized alarm and advisory settings
- Access data via any web-enabled device

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LEVERAGING IoT FOR RESILIENCE

SMART TECHNOLOGY FOR WASTEWATER OPERATORS

- Real-time collection system monitoring, reporting and spill prevention
- **Sanitary Sewer Overflow (SSO) & Combined Sewer Overflow (CSO)**
- **Inflow & Infiltration (I&I)**
- **Optimized cleaning**
- Real time condition assessment
- Capital project prioritization
- **H_2S monitoring**
- Storm & surface water monitoring
- Rain, river and tidal data overlay

How We Do It

INSTANT INFRASTRUCTURE

Iridium Ground Stations

SmartCover Servers
Encapsulated Analytics
Real-Time

R/T Data (e.g. weather)

External Data Feeds

Level sensing
H_2S, pressure, etc.

- Full 2-way communications
- DoD level reliability
- Variable transmission with base protocol:
  - 5 min measurement (alarm)
  - 10 min data points
  - 60 min transmissions

Customer Devices

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UPTIME ANYWHERE, ALL THE TIME

INSTANT INFRASTRUCTURE

Iridium data transmission is impervious to power outages and severe weather.

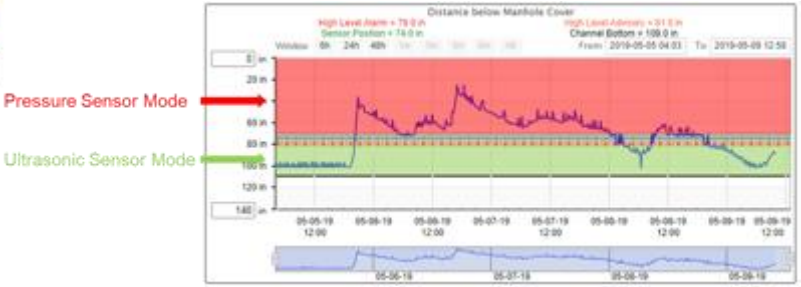
- Iridium network includes 66 active satellites
- Low orbit Earth and polar caps
- Global, redundant coverage
- Small horizon visibility
- Mission critical reliability
- Used by the U.S. DOD
- No issue with underpasses or trees
- 100% reliability during hurricanes, blackouts, sever weather patterns

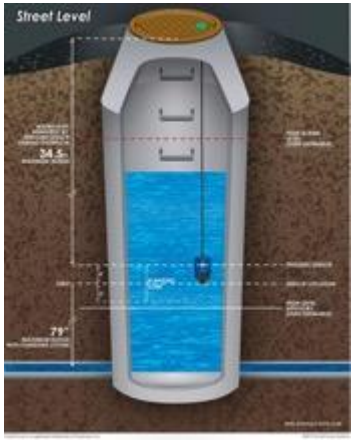
HARDWARE COMPONENTS

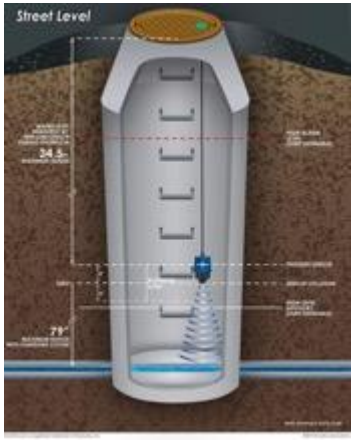
- **E-Box:** computer, data transmission, power management, digital radio
- **PowerPack:** primary battery cells, 2-year lifespan
- **SubSonic Dual Sensor:** 0” to 79” range
- **Antenna:** E-Square or E-Dot flush mount, snowplow resistant, traffic rated
- **Cable:** 15’, 25’ or custom
- **Dashboard:** web-based reports and analytics
- ***No confined space entry***

SUBSONIC® DUAL SENSOR

- Full dynamic range of your manhole
- Accuracy on narrow inverts
- Low maintenance
- Ideal for remote locations

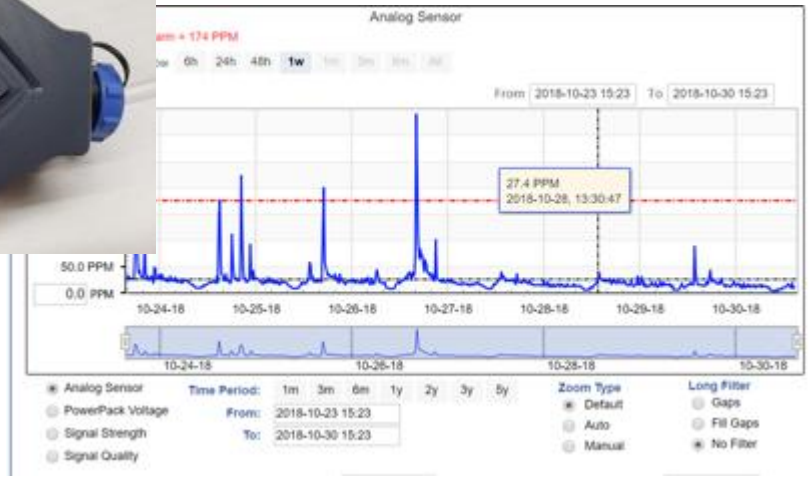






HYDROGEN SULFIDE MONITORING

H_2SCENTS® BENEFITS AND FEATURES



- Min. 3-month calibration interval
- Common interface – integrates with existing SmartCover dashboard
- Measures 0-1,000 ppm
- Ability to overlay H_2S data with level, flow, or rain data

INSTALLATION

INSTANT INFRASTRUCTURE

- Easily attaches to any manhole or hatch
- One step satellite comms activation
- Bracket mounts: flip, side
- Slide impact shield available
- ***No confined space entry***

SCADA/DATA INTEGRATION
APPLICATION PROGRAMMING INTERFACE (API)

SOLUTION

- Standardized programming interface using modern data formats
- HTTPS (Web) based
- JSON (Javascript Object Notation) responses
- Easy to interface with using almost any programming language
- Secured using (JWT) JSON Web Tokens and TLS Encryption

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MOBILE APPLICATION

UNDERGROUND INSIGHTS ON THE GO

- iOS and Android compatible
- Unlimited users
- FREE to all users
- Available through Google Play and Apple App Store

Applications & Analytics

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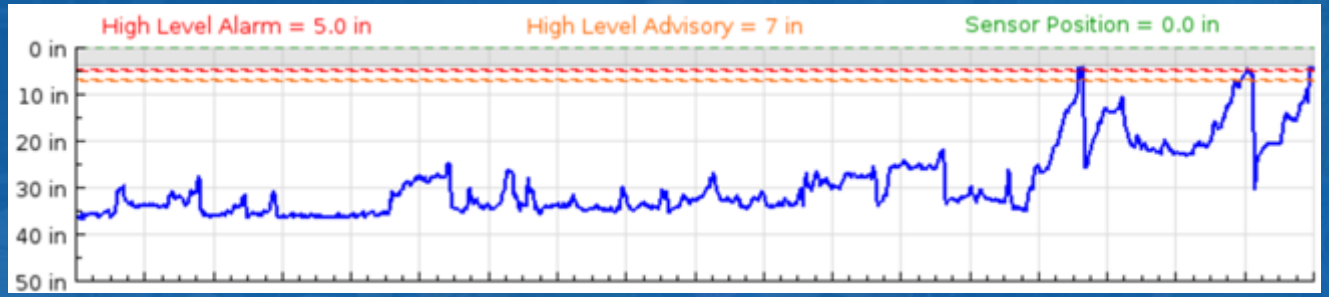
TREND ANALYSIS

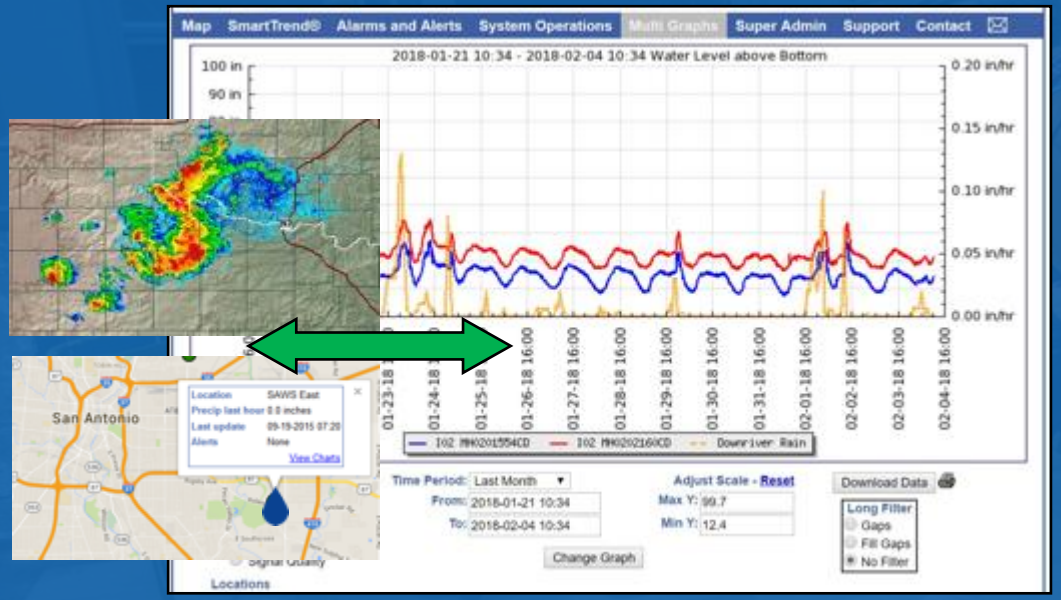
PROPRIETARY SOFTWARE: SmartTrend®



- Daily automated scan of level & flow
- Identifies anomalies
- Issues notifications and alerts
- Dry season vs. wet season
- Planned vs. reactive response
- Prioritize resource allocation
- Lowers risk and costs

DATA INTEGRATION

RAIN, TIDE, RIVER, STREAM OVERLAY



- U.S. National Oceanic and Atmospheric Administration (NOAA) doppler radar and other data sources
- Multiple sites
- Hourly updates
- Download data to spreadsheets
- NO MAINTENANCE
- Automatic software updates
- 0.62 miles or 1km^2 area

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SSO Prevention and CSO Monitoring

COLLECTION SYSTEM CLEANING OPTIMIZATION & SSO PREVENTION

SANITARY SEWER OVERFLOWS

High Flows

- Severe surge from rain or weather system
- Capacity of the system is overwhelmed
- Can be combination of capacity and blockage
- Pump failure

FROG Blockage

- Fats, Roots, Oil, Grease (FROG)

Hot Spots

- Often there are sites with repeat occurrences
- Mitigate with adequate warning

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SPILL ELIMINATION

LONG TERM BENEFITS FOR SMALL UTILITY WITH BIG PROBLEM

SITUATION:

- Full time field staff: 2
- Miles of pipeline: 94 gravity-only wastewater system
- Manholes: 2,000
- Lift stations: 0

PROBLEM:

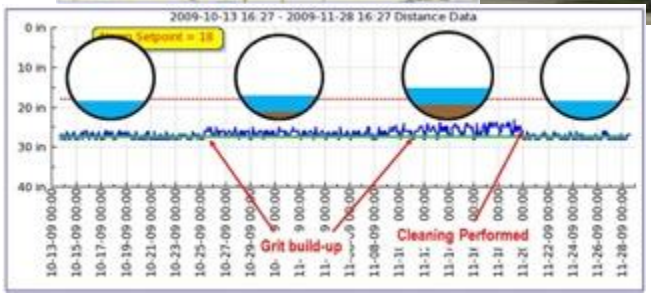
- Historical average spills per year: 10
- Facing ~$400,000 annual fines + clean up costs + litigation expenses
- Not enough resources: limited staff and traffic management for regular cleaning and maintenance

SOLUTION: remote sewer monitoring and AI-based analytics to determine when and where there's a blockage

RESULT:

- A **99% reduction in spills since installation** (November 2006)
- Estimated net savings: > $2.5MM
- Unit at the corner of Crenshaw Boulevard and Rocket Road ensures a sewer spill doesn't disrupt the next SpaceX project

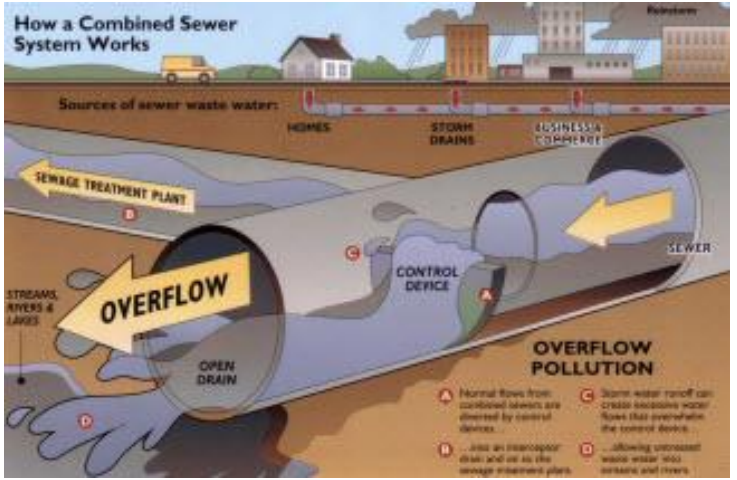
SMALL UTILITY: HAWTHORNE, CA



COMBINED SEWER SYSTEMS

COMBINED SEWER OVERFLOW (CSO) BASICS

- Sewer systems that use the same pipes to collect:
  - rainwater runoff
  - domestic sewage
  - industrial wastewater
- Transports all wastewater to a sewage treatment plant under dry conditions
- Combined sewer systems are designed to overflow
- Normally: treated and then discharged to a water body



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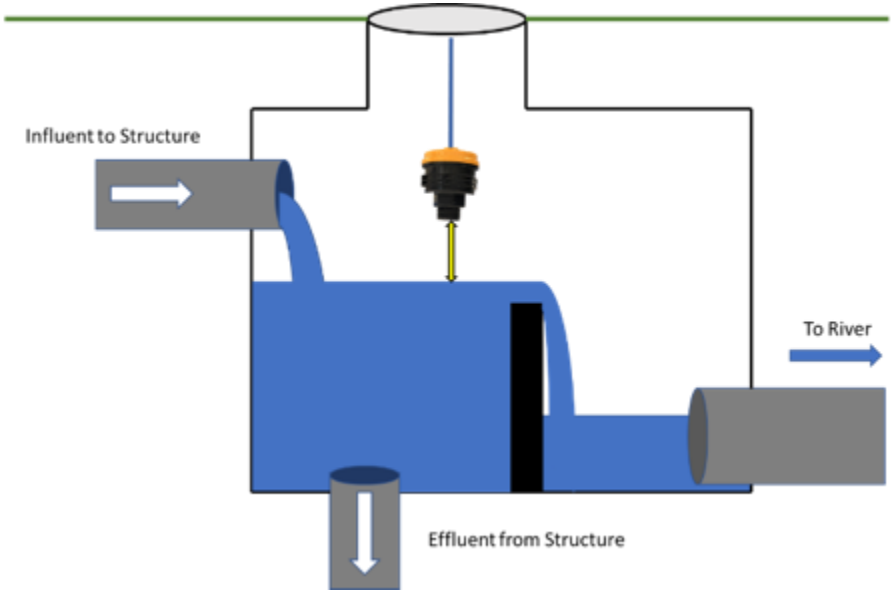
COMBINED SEWER OVERFLOWS

DIVERSION STRUCTURE BASICS



- Standard weir equations used for flow calculation
- No two control/diversion structures are the same!
- Sensor location flexibility is key
- Reliable real-time data during storm events is key

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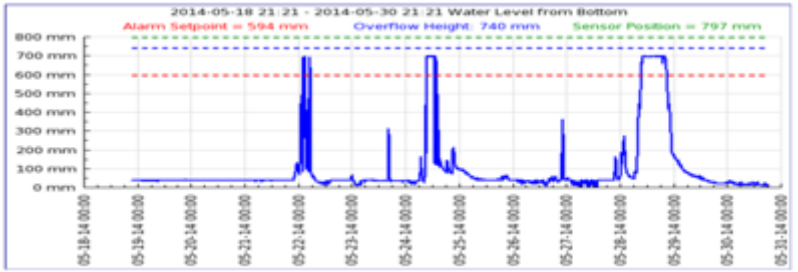
CSO MONITORING

MONITORING RANGE OF LOCATIONS

- Monitoring for normal water levels
- Detect start/stop times of overflows and durations
- Flow quantity
- Built-in public notification



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COMBINED SEWER OVERFLOWS

REGULATORY COMPLIANCE

Regulatory reporting requirements:

- Event occurred
- Start/stop/duration
- Volume
- Notification

How Quickly to Report

- Many states are 24 to 48 hours
- New York: 2 hours to Dept. of Environmental Protection; 4 hours to public
- MA – New regulations just implemented

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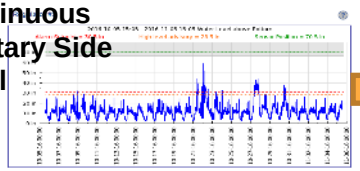
CSO MONITORING: RESULTS

START/STOP/DURATION/VOLUME OF OVERFLOWS

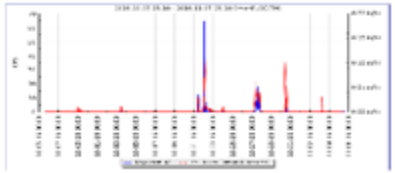
Regulator #2: Hudson River Community, NY

Continuous Sanitary Side Level

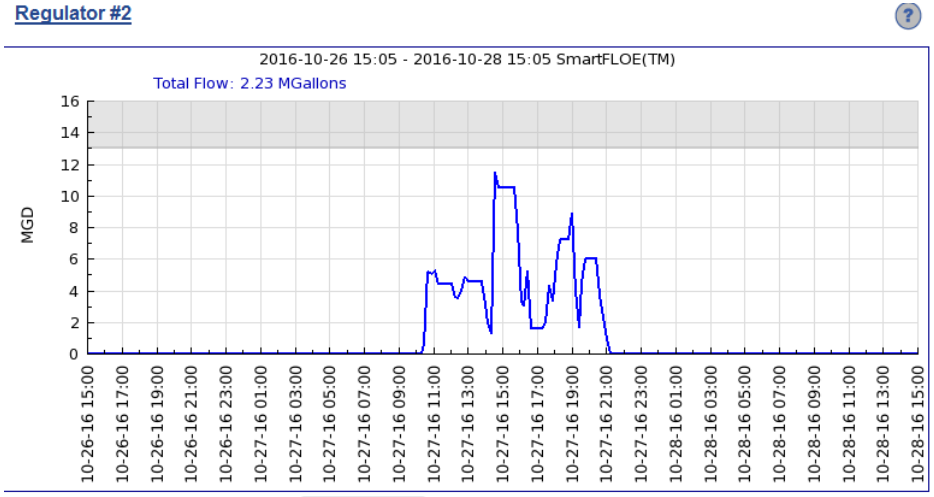


Weir Overflow Rate

Rain and Overflow



Single Storm Event



PROBLEM: HIGH FREQUENCY CLEANING

CURRENT: CLEANING JUST IN CASE

Go from "just in case" to "as needed" saves valuable resources

- Pipes are cleaned on a frequent schedule (monthly, quarterly, semi-annually or annually)
- No system visibility between cleanings
- Accelerates pipe deterioration
- Demand on resources:
  - Personnel
  - Equipment: trucks, infrastructure
  - Management
  - Capital funding
- "Just in case" repetitive cycle results in costly, unnecessary cleanings

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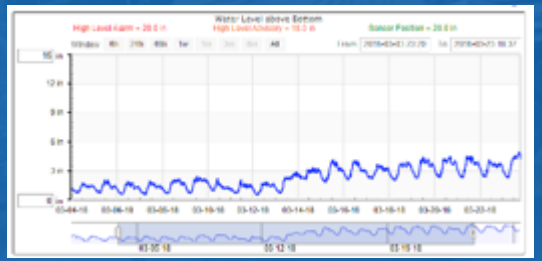
SmartClean® TREND ANALYSIS

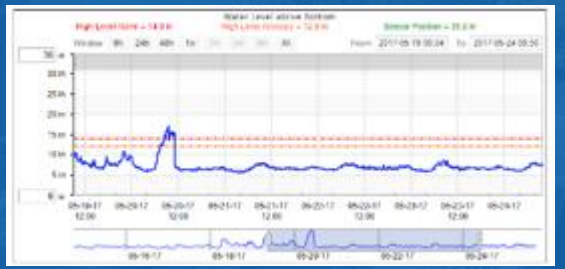
Normal Pattern



Grit Build Up

- Monitors multiple segments
- BOTH up and downstream
- Detects blockages from most common causes -- Fats, Roots, Oils, Grease (FROGS).

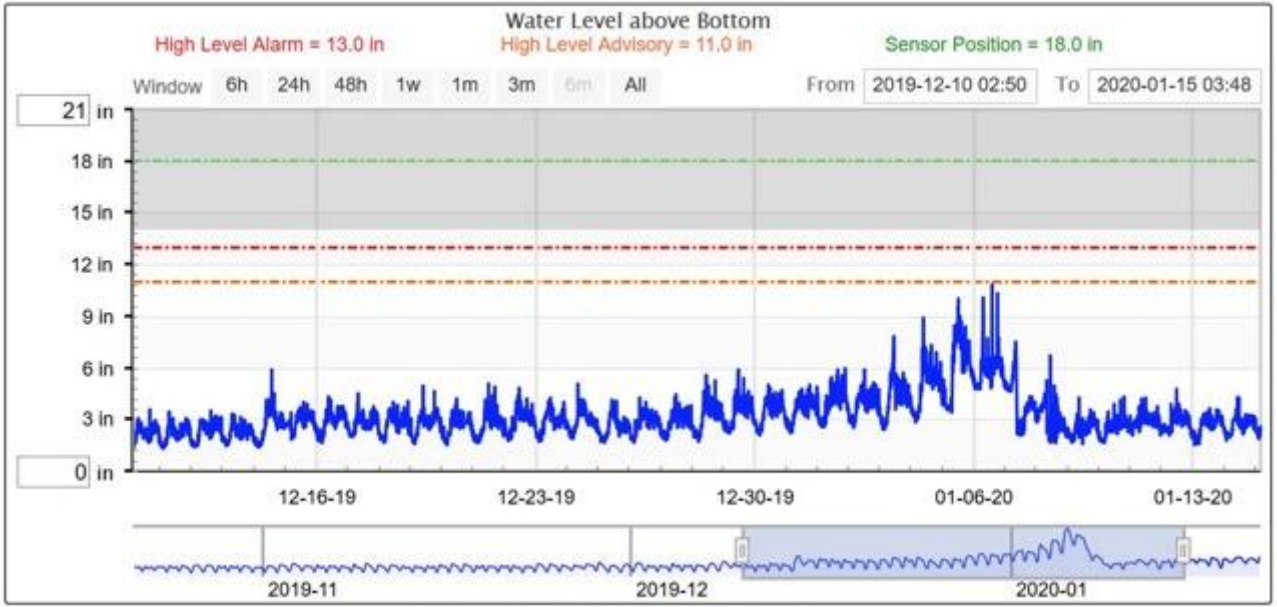
US Patent 9,482,568



Upstream Blockage

Downstream Blockage

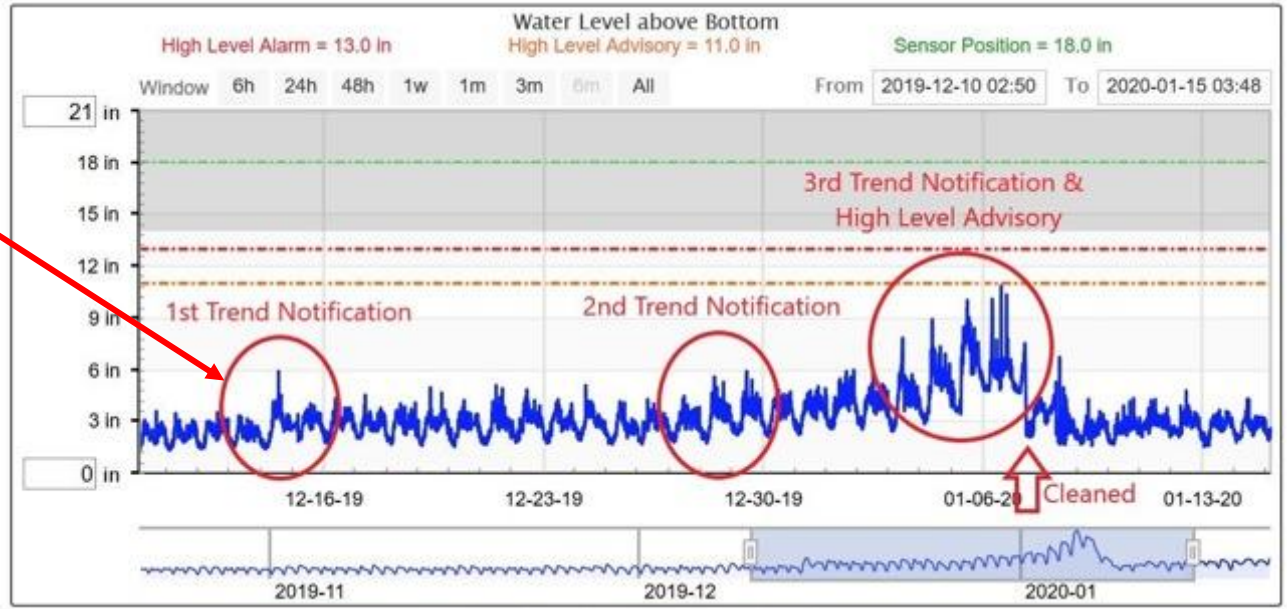
SmartClean® EARLY WARNING



SmartClean® EARLY WARNING

1st Advisory 3 Weeks Prior to Required Cleaning

Helps Trigger and Prioritize Cleaning Activity As Needed



= NO SPILL!

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REDUCE CLEANINGS WITHOUT SPILLS

BIG COST SAVING AND RESOURCE ALLOCATION

SITUATION:
- EPA Consent Decree with an estimated cost of $1 billion
- High frequency cleaning (HFC) at 824 sites

PROBLEM:
- Cleaning whether needed or not – no way to know
- Heavy concentrated rainfall during seasonal storms
- 1,246 cleanings expected at over 200 high risk locations
- Significant resources, crews and traffic management dedicated to cleaning

SOLUTION: SmartClean® remote sewer monitoring and patented AI-based analytics to determine when and where to clean

RESULT:
- Cleaning as needed shows a **95% reduction**
- Only 65 cleanings as indicated by the sewer status reports and NO SPILLS

LARGE TEXAS UTILITY

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CASE STUDY: SAN ANTONIO, TX

FIFTH LARGEST COLLECTION SYSTEM IN THE U.S.

San Antonio Water System (SAWS) system:
- ~ 5,589 miles of sewer main
- ~110,655 manholes
- 3 WW treatment plants

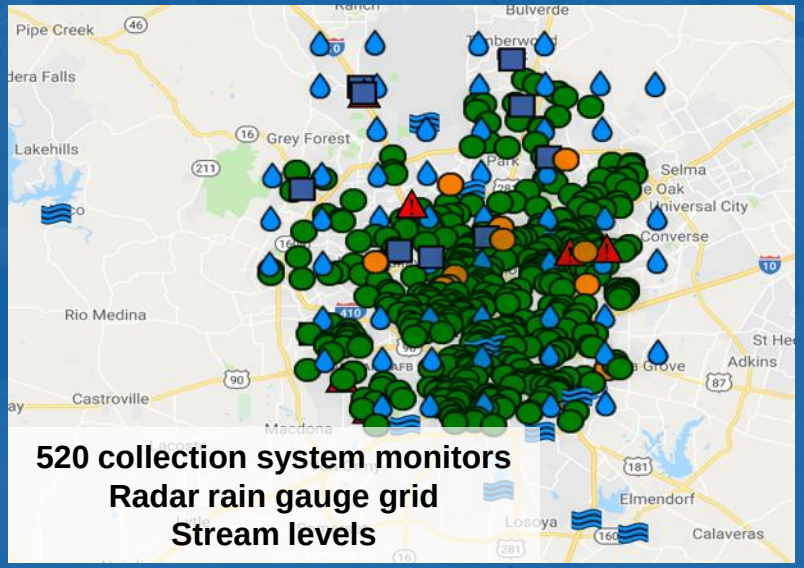
2009: Spill prevention program begins

2013-2015: Consent decree CMOM leads to high frequency cleaning schedule:
- 204 monthly cleaning sites
- 620 quarterly sites

2015-2016: 12-month, cleaning optimization pilot

2018: Expanded SmartClean® program
- 200 sites added
- 5-year service agreement

Current System Deployment



520 collection system monitors
Radar rain gauge grid
Stream levels

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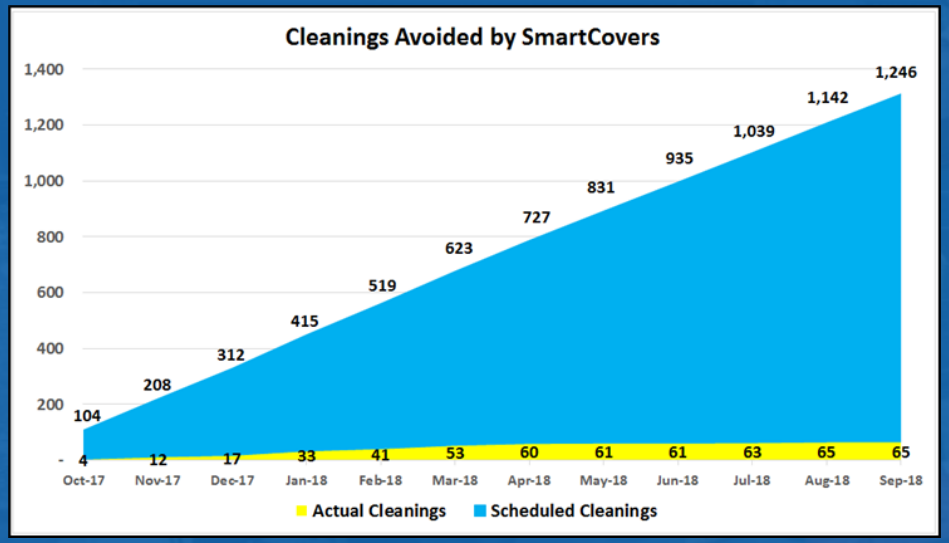
CASE STUDY: SAN ANTONIO, TX

FIFTH LARGEST COLLECTION SYSTEM IN THE U.S.



Expected Cleanings	1,246
Actual Cleanings	65
Reduction in Cleanings	95%
Estimated Cost/Cleaning	$500
Estimated All-In Cost of Expected Cleanings	$623,000
Average Cost of SmartCover Optimization Program	$289,960
Projected Average Net Savings	$333,040
Projected Annual Average ROI	115%
Projected 10-Year Net Savings	$3,330,400

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CASE STUDY: SAN ANTONIO, TX

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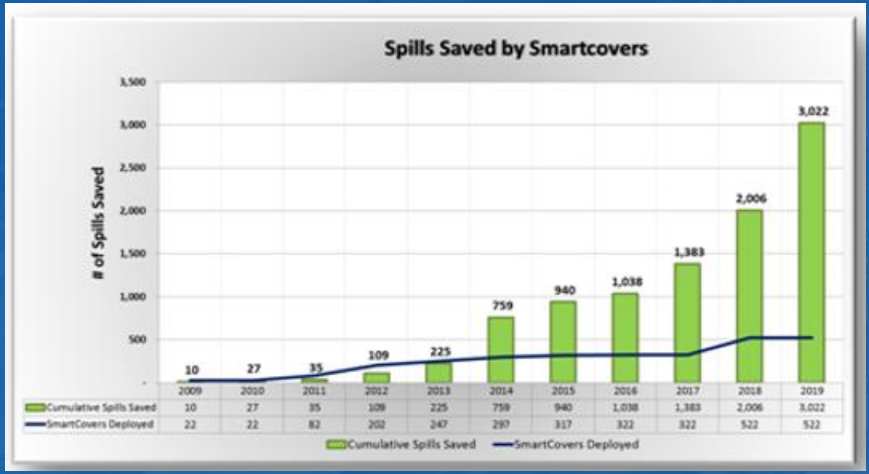

Spills Saved between 2009 - 2019	3,022
Estimated Average Cost/Spill	$5,000
Gross Savings from SSOs Saved	$15,110,000
SmartCover Program Cost 2009- 2019	$3,640,000
Projected 10-Year Net Savings	$11,470,000
Annual ROI	315%

CASE STUDY: SAN ANTONIO, TX

FIFTH LARGEST COLLECTION SYSTEM IN THE U.S.

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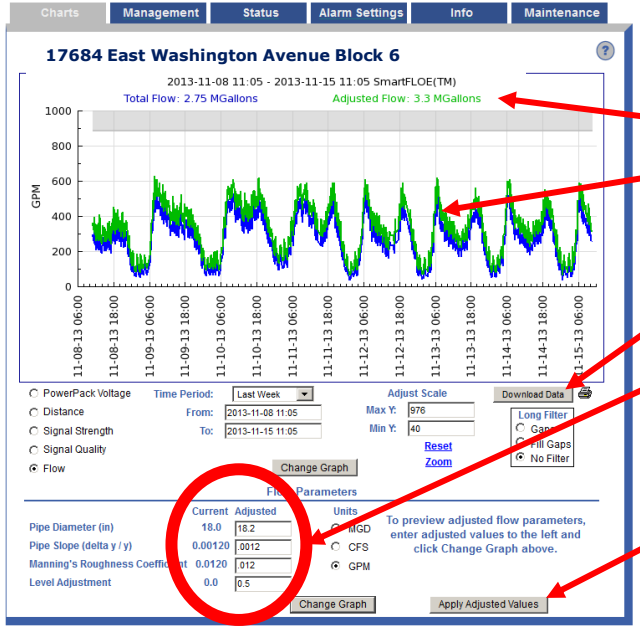
I & I APPLICATIONS

FLOW APPLICATION: SmartFLOE



- Patented application
- Adjusted flow curve and total flow
- Download displayed data
- Mannings Equation – Open Channel Flow
  - Pipe diameter
  - Slope (☐y/y)
  - Roughness coefficient, pipe material
- Store changed parameter settings
- Adjustable parameters for:
  - Error correction
  - Modeling
  - Calibration to AV meter

Mannings Equation

Estimating Open Channel Flow

$$Q = \frac{1.49}{n} * A * R^{\frac{2}{3}} * S^{\frac{1}{2}}$$

Where:

Q = Flow Rate, (cfs)

n = Manning's Roughness Coefficient (unitless)

A = Flow Area, (sf)

R = Hydraulic Radius, (ft)

S = Slope of Energy Gradient, (ft/ft)

- Adjustable parameters for:
  - Error correction
  - Modeling
  - Calibration to AV meter
- Under the **correct conditions**, Manning's equation and level only will provide results nearly as accurate as more expensive and labor-intensive area-velocity (AV) meters
- Weirs, flumes, or other appropriately engineered structures can use level measurements to directly calculate flow, and these results are well accepted and do not require AV meters for flow determination.

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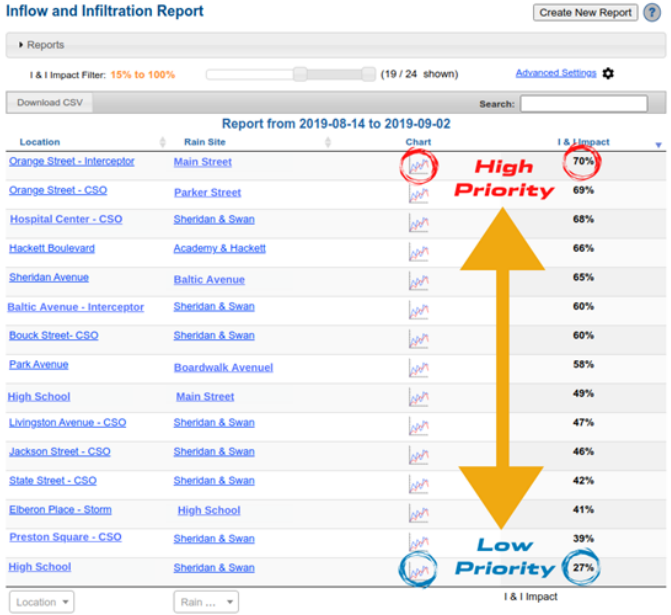
I & I APPLICATIONS

PROPRIETARY SOFTWARE: IInSight™

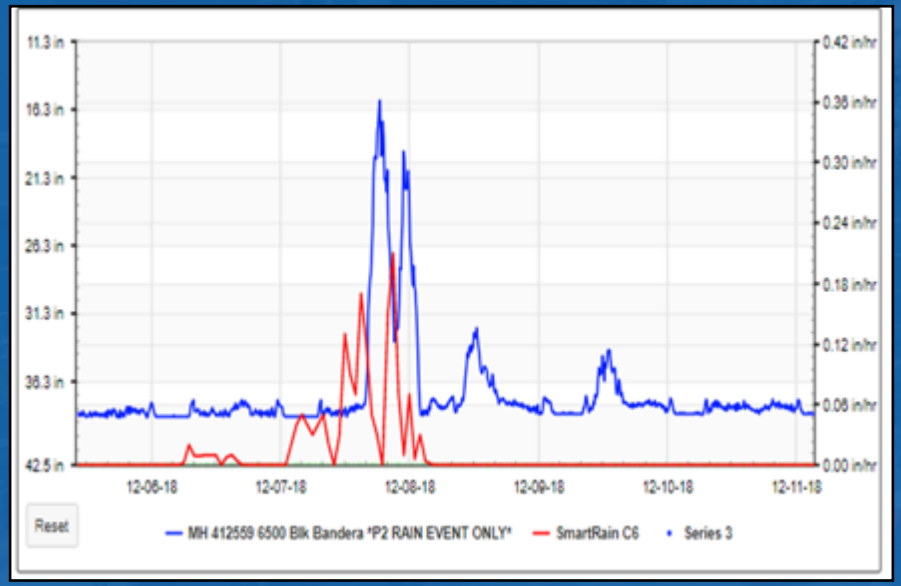


I&I Impact Report can provide:

- Insights on when and where I&I is occurring
- Location ranking for where the I&I impact is highest
- Quantifying the correlation between localized rainfall and sewer response
- Analyzed data from single or multiple rain events
- Focused I&I inspection, rather than global

I&I APPLICATIONS

PROPRIETARY SOFTWARE: IISight™



- Once the composite graph is selected, click and hold on the lower left corner and drag to the upper right corner, the selected area expands for inspections
- Both signals in detail
- NOTE slight delay from rain to sewer level
- Isolate more details, i.e. a single manhole vs. upstream rainfall

PROBLEM: HYDROGEN SULFIDE

LACK OF VISIBILITY IN COLLECTION SYSTEMS & PLANTS

- Bioreactions within a collection system and wastewater treatment plant processes generate Hydrogen Sulfide (H_2S).

- The presence of H_2S can cause:
  - Sewer pipe crown corrosion leading to reduced pipe life and risk of catastrophic failure
  - Corrosion of treatment plant process equipment leading to premature failure
  - Escalation of wastewater treatment chemical costs
  - Negative impact to chemically enhanced primary treatment (CEPT) processes
  - Community odor complaints

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SOLUTION: H_2Scents®

REAL-TIME REMOTE HYDROGEN SULFIDE MONITORING

- H_2Scents® enables reliable, real-time measurement of H_2S levels over extended periods of time.
- Knowing where the H_2S problem is allows for targeted mitigation strategies
- Applications where the H_2Scents® system can be deployed include:
  - H_2S studies (collection system and treatment plant)
  - Monitoring odor and corrosion hot spots
  - Chemical dosing optimization for H_2S control
- Municipal locations where the system can be deployed include:
  - Force main discharges
  - Pump station wet wells
  - Gravity lines
  - Siphons
  - Headworks/bar screens
  - Aerated grit basins
  - Primary clarifiers
  - Solids dewatering operations

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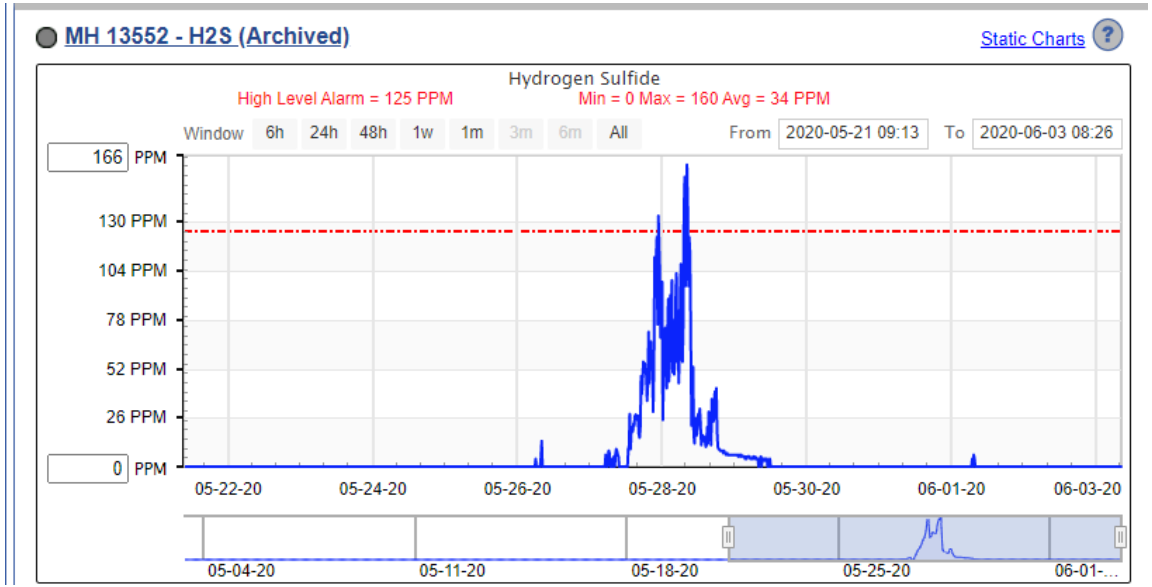
H_2Scents® System Monitoring Example

Detected Chemical Feed Interruption



- System located in OH
- Chemical feed ran out at a remote dosing site
- Customer received an alarm notification when H_2S exceeded trigger value
- **Resulted in a quicker response and less down time to avoid community odor complaints**

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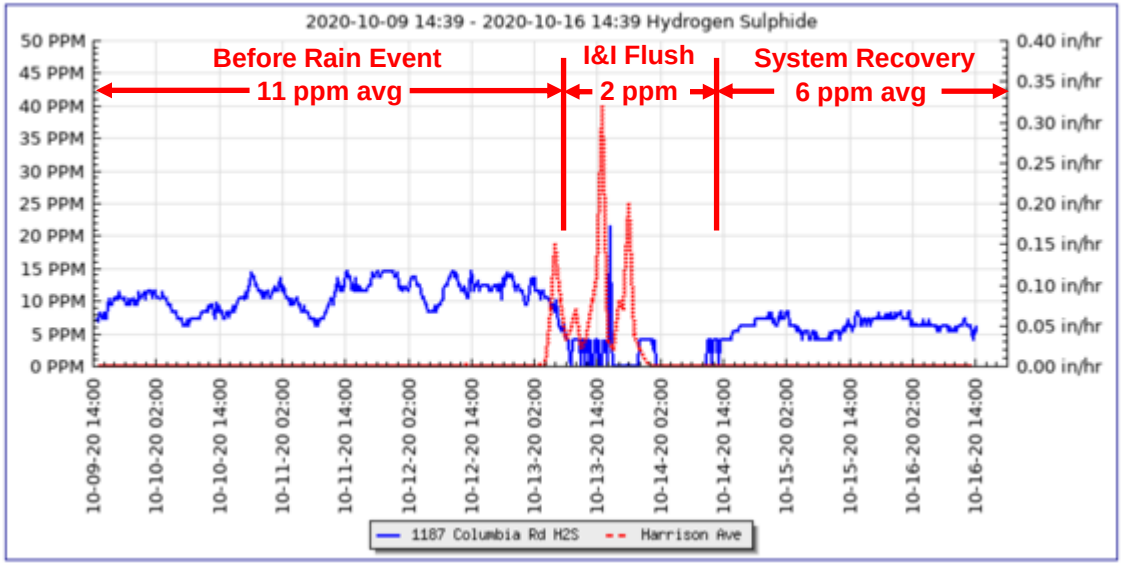
H_2Scents® System Monitoring Example

Measured Impact of Rain (I&I) on H2S Levels



- System located in MA
- Rain event had a significant impact on H_2S levels (82% reduction) in first 24 hours
- After the rain event, average H_2S levels remained 45% below pre-event levels for days
- **Demonstrates potential to use H_2Scents® to reduce odor control chemicals during rain events**

Source Water and Other Case Studies

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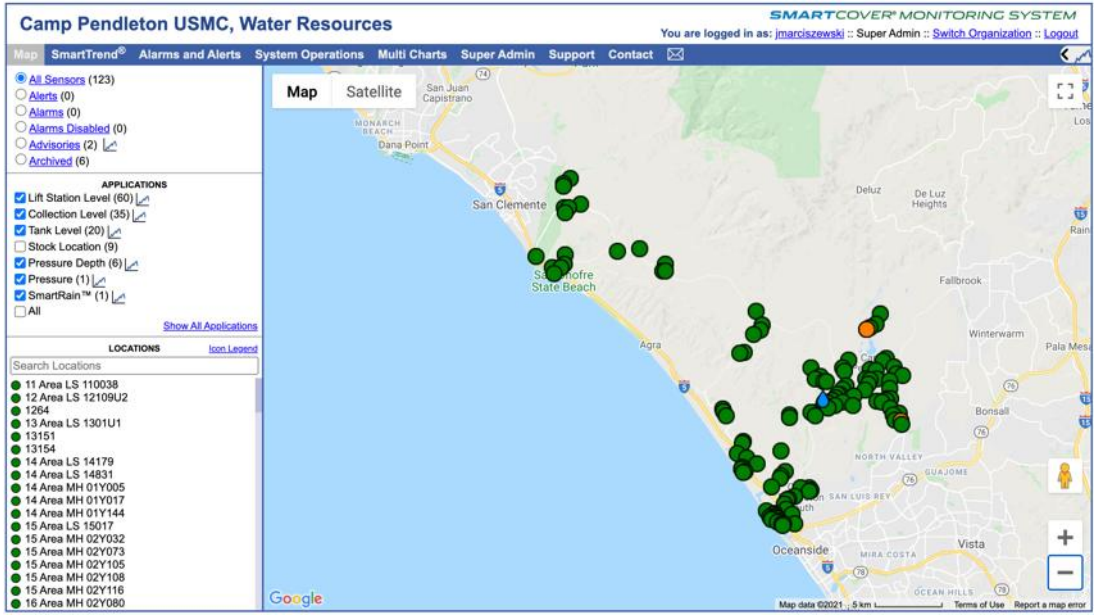
Camp Pendleton, U.S. Marine Core Base

SmartCover Deployed Across A Range of Applications



- Wastewater System: 237 miles of widely dispersed infrastructure, including gravity mains, force mains, and laterals -- ranging from 4” to 36” in diameter, 62 lift stations, and 3,140 manholes.
- Water System: 24 wells, 375 miles of water mainlines, and 23 reservoirs.
- Daytime population of 70,000 people.
- Need visibility to identify key issues before disruption, including SSOs, Lift station visibility, and Water tank levels.
- Want military-grade, satellite comms to assure unparalleled uptime

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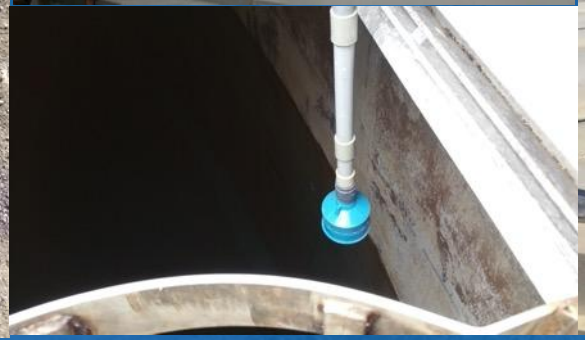
Camp Pendleton: Tank Level Monitoring

Tank Levels and Water Pressure



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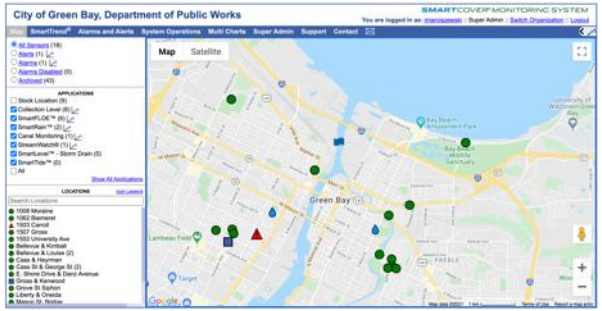
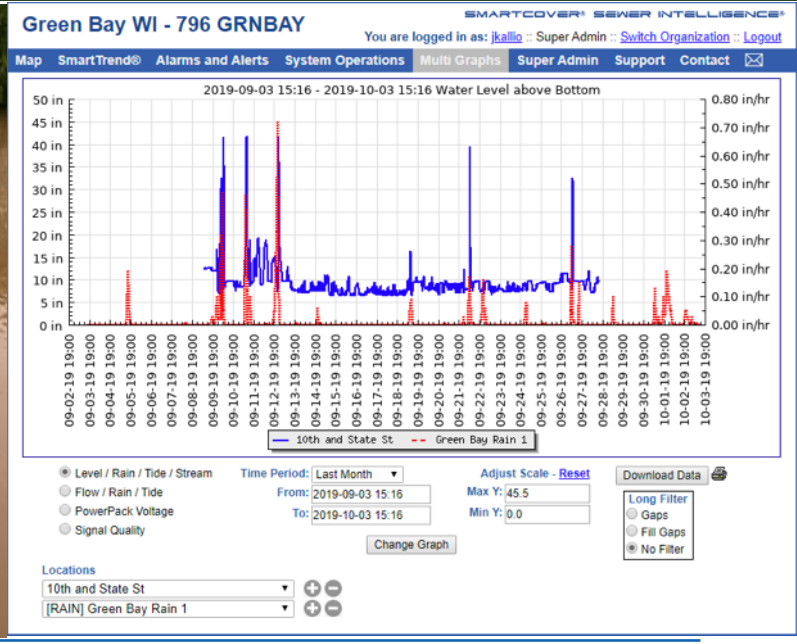
Green Bay, Wisconsin

Monitoring Rapid Rise and Fall of the East River



According to David Wiesman, Superintendent at the City of Green Bay

"Rapidly rising river levels have historically presented significant challenges with regard to spills. Our ongoing use of SmartCover, along with our adaptive deployment approach, is enabling Green Bay to respond quickly with data-based decisions for managing inflow and infiltration, as well as gain insights into longer term planning, maintenance and capital improvement decisions."



SMARTCOVER

BLACK SWAN SEWER MANAGEMENT

ANTICIPATE UNEXPECTED EVENTS WITH REMOTE MONITORING

SITUATION:

- Black swan event: drunk driver knocks down 2 power poles
- 2AM New Years Day
- Pre-event mitigation: deployment of remote monitoring by SmartCover

PROBLEM:

- Seven lift stations without power for extended period of time
- Nearby Pacific Ocean is critical to protect from spilling
- Limited crew and generators

RESULT

- Three crew members shuttling 2 generators around manually relying on SmartCover reports to triage the sites with level rising
- NO SPILLS, no reports to write
- Happy New Year!

LOS ANGELES AREA UTILITY

SMARTCOVER

Utility Benefits

INSTANT INFRASTRUCTURE

- 7/24 Communications: Satellite more reliable to cellular
- Single platform providing many benefits
- Automated, done-for-you trend data analysis
- NO CONFINED SPACE ENTRY
- Integration with NOAA and USGS for real-time analysis / forecasting
- Alarm feature for authorized or unauthorized entry
- Extended 2 year battery life gives off-grid assurance
- Multiple remote access methods: Desktop, Mobile app, API

GET IT ON Google Play

Download on the App Store

SMARTCOVER

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