Micro-Monitoring:
An innovation in monitoring low flows in sanitary sewers

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How Many Storms Do You Need to Quantify I/I?
For the Modeler?

I/I Volume = 3.62(Rainfall) - 0.86

(Including the largest storm, increases the 5 year flow prediction by 20%)
For the I/I guy?

CC-CW-071-MM9 From Feb 25 23:50, 2011 to Mar 04 06:10, 2011 (Duration 6 Days; 1 Hours; 20 Minutes)

Flow, mgd (Total: 0.1597 mg, Max: 0.27 mgd)  ADF, mgd  Rainfall, in (Total: 0.96 in)

Flow, mgd

Rainfall, in

CC-CW-071-MM6 From Feb 25 23:30, 2011 to Mar 03 23:35, 2011 (Duration 6 Days; 0 Hours; 5 Minutes)

Flow, mgd (Total: 0.1399 mg, Max: 0.23 mgd)  ADF, mgd  Rainfall, in (Total: 0.96 in)

Flow, mgd

Rainfall, in
Flow Monitoring for the Modeler

Regional Monitors
(1 per 6 miles of pipe)

How do you distribute the I/I to the upstream pipes?
Flow Monitoring for I/I

We’d really like to know which pipe it comes from?
What is the Problem with Low Flow?
Velocity Readings
Debris
What is a Micromonitor?

weir at low flow, area-velocity at high flow
Micromonitoring Weir

Sensing Probe
Micromonitors do sometimes catch sand or debris.
Micromonitoring – Case Study

Clayton County Georgia:

Reduce SSES costs!

Monitored 118 sites in Spring 2010

Several high I/I basins were identified

SSES Spring 2011 (Smoke, Dye, CCTV, MH Insp.)

Micromonitors Proposed for Basin 071
Regional Monitor 071

Feb 28th Storm

29,000 gal
MM-01

~ 0 gal

Feb 28th Storm

MM-01

MM-01

~ 0 gal

Feb 28th Storm
MM-02

~ 0 gal

Feb 28th Storm

MM-02
MM-03

~ 0 gal

Feb 28th Storm
MM-04

MM4 Upstream Area is one of the only areas in the project area below the stream level, and it is all sand.
MM-04

9,000 gal

Feb 28th Storm
MM-05
MM-05

34,000 gal

Feb 28th Storm
MM-06

Feb 28th Storm

36,000 gal
MM-06 goes through MM-05 and RM-071, so the I/I generated at MM-06 is seen in all three graphs!
Possible Source?
Possible Source?

Riverdale neighborhood normal after
gas-line repair

Residents forced to leave homes for several hours
Riverdale police evacuated 50-60 residents in the Camp Creek neighborhood, Thursday afternoon, after workers nicked a 2-inch natural gas main inside a Clayton County sewer line.

By Kathy Jefcoats
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Riverdale police evacuated 50-60 residents in the Camp Creek neighborhood, Thursday afternoon, after workers nicked a 2-inch natural gas main inside a Clayton County sewer line.

The evacuation, which lasted more than four hours, affected 154 homes, a laundromat, gift shop and church, said Riverdale Police Chief Samuel F. Patterson. The Waffle House on Ga. 85, near the neighborhood, closed voluntarily, as a precaution, he said.

Clayton County Water Authority Spokeswoman Suzanne Brown said a consultant was televising inside the sewer lines about 2:10 p.m., when a root ball interfered with the project. A worker clearing the root ball nicked an Atlanta Gas Light line that had bored into the sewer line, said Brown.
Possible Source?

Amazing Video Shows Explosion on San Bruno Pipeline May Be Triggered by Natural Gas Leak

Mar 18th, 2011 | By admin | Comments Off

We recently received a video from a reader who said he saw this natural gas explosion last week. It’s a fireball nearly three stories high in Minneapolis after a massive natural gas explosion. This screenshot is from video footage taken by Robert Stephens.

There’s no word yet on what caused the explosion, but given that the NTSB has already said it’s got collective hands full investigating the circumstances behind the Sept. 8, 2010 San Bruno natural gas explosion that killed eight people and the December 2010 Detroit natural gas explosion that killed two, we probably shouldn’t hold our breath waiting for details on this one, either.

Indeed, there’s a great story in the Minneapolis Star Tribune this morning about...
Possible Source: Gas Line
I-I Elimination

**Pre**

1.17 inch Storm

**Post**

1.29 inch Storm
I-I Elimination

Pre

Post
I-I Elimination

![Graph showing Q vs I for 071: Pre and Post comparisons with data points for 2010 and 2013.]
CCWA Case Study - Summary

**INFLOW:** In the intense Feb 28\(^{th}\) Storm, almost all of the inflow recorded at the downstream monitor 071 originated in **Sub-basin 6.**

18% of the Basin

All remaining sub-basins show no measurable direct Inflow.
Micromonitoring: Nightly Flows Florence, KY

28 Sites in Florence Micromonitored

Let’s just look at the nightly flows from two adjacent MM
Micromonitoring: Florence Sites

6 homes, 1 business

10 homes

30 second data, Adjacent manholes.
Micromonitoring: Domestic Usage

30 second level data, Adjacent manholes.
Micromonitoring: Domestic Usage - Sharonville

- Slight Flow increase due to Rainfall.
- Sump Pump?
- Toilet Flush Between Micromonitors
- Shower
Show pictures for each point in animation

Bhuvana, 4/29/2011
Old Clay Pipe in Kentucky

SD1 estimates that the first round of Micromonitoring saved $250K in scheduled rehabilitation.
Old Clay Pipe in Kentucky

SSES results show that 6 out of 8 houses tested positive. There were 2 driveway drains and 8 downspouts connected.

Site3_2150080
15 Pine Hill

Micromonitoring results from the Cold Spring area of SD1 in Northern, KY
Old Clay Pipe in Kentucky

SSES results show that 6 out of 8 house tested positive. There were 4 driveway drains and 5 downspouts that were connected.

Micromonitoring results from the Cold Spring area of SD1 in Northern, KY
Old Clay Pipe in Kentucky

Neighborhoods to Investigate
Old Clay Pipe in Kentucky

Neighborhoods to Investigate
Old Clay Pipe in Kentucky

Neighborhoods to Investigate
Milford Center

Pump Station

Water Plant

Phase 1 Monitor
Phase 2 Monitor

* Monitors 01, 02, 07 were left in for Phase 2.

Percentage of total I-I from subbasin

Ratio of I-I to Pipe Length, >1 (red) means more than average I-I

Results have high uncertainty

6-18-12

06

0.9% (0.13)

03

0.9% (0.13)

07

* (This subbasin does have significant infiltration after the storms.)

06-18-12

04

13% (0.42)

08

0.9% (0.13)

13

5% (1.46)?

09

0% (0)

02

0% (0)

01

* (This subbasin does have significant infiltration after the storms.)

05

1.2% (0.08)

08

0.8% (0.75)

09

0.1% (0.09)

10

73% (10.5)

11

0.4% (0.20)

12

1.1% (0.64)

01

9% (0.73)
Milford Center: all I/I from One small Street
Milford Center: all I/I from One small Street

**MI-MM12-R1 From Jun 21 23:20, 2012 to Jul 03 00:35, 2012** (Duration 11 Days; 7 Hours; 15 Minutes)

- **MI-12**
- **NO Inflow**

**MI-MM10-R1 From Jun 21 23:35, 2012 to Jul 03 01:35, 2012** (Duration 11 Days; 2 Hours; 0 Minutes)

- **MI-10**
- **High Inflow**
## SWDCMA Micromonitoring in Aston

I/I volume during June 13, 2012 storm, 0.15 inch storm

<table>
<thead>
<tr>
<th></th>
<th>Length of Upstream Pipe (LF)</th>
<th>Percentage of Total Pipe in Basin</th>
<th>Volume I/I in Largest Storm (gal)</th>
<th>Volume I/I per LF of Pipe (gal/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM (total)</td>
<td>5,909</td>
<td>100%</td>
<td>4,047 *</td>
<td>0.68*</td>
</tr>
<tr>
<td>Subbasin flow</td>
<td>2,800</td>
<td>47%</td>
<td>Net negative</td>
<td>Net Negative</td>
</tr>
<tr>
<td>Williams Drive</td>
<td>1,306</td>
<td>22%</td>
<td>2,811</td>
<td>2.2</td>
</tr>
<tr>
<td>Anvil Road</td>
<td>1,803</td>
<td>31%</td>
<td>2,440</td>
<td>1.3</td>
</tr>
</tbody>
</table>

* Appears to be underestimated. Stantec did not operate this meter.
SWDCMA Micromonitoring in Aston
Micromonitoring: Limitations

Current sizes are 6, 7, 8 and 10” pipes

Overestimates during surcharge and steep pipes

Difficult to install with curved fillet
B2

Show pictures for each point in animation

Bhuvana, 4/29/2011
Micromonitoring: Advantages

Significant I/I sources (the cost effective ones)

Low flow

No CSE (one-man crew)

Non-Invasive

Used at Poor Quality sites

**LOWER COST!!**
Show pictures in animation for each point
Bhuvana, 4/29/2011
What Contributes Most to the Low Cost?

The One Storm Answer!!
Show pictures in animation for each point
Bhuvana, 4/29/2011
Micromonitoring: Questions?