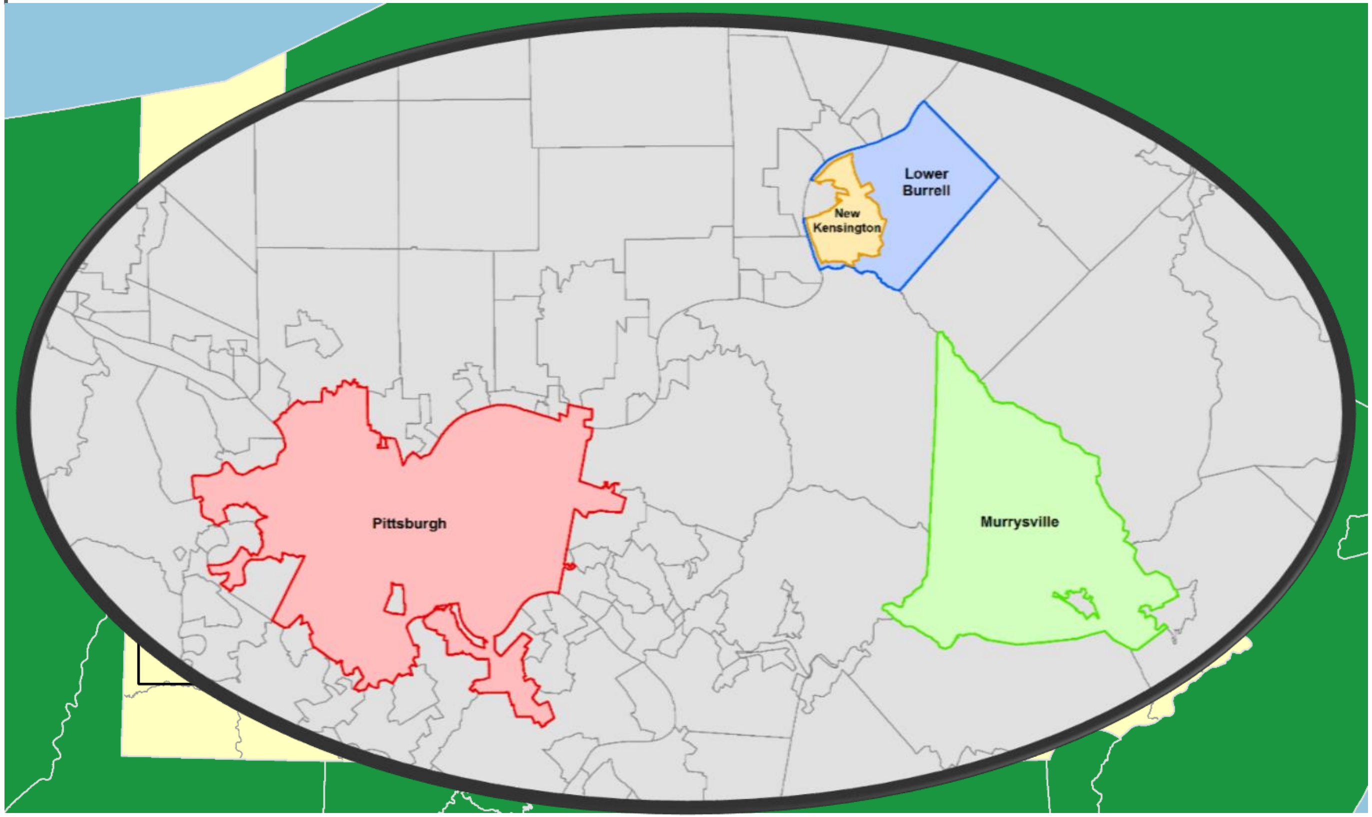
Inflow and Infiltration Removal

Three communities, three approaches.

Presented by Chris Henry, PE

Three Communities

Geographic Location



Why Remove Inflow and Infiltration (I/I)

Consent Order

Residential Complaints

System Capacity

Reduce Treatment Costs

Maintenance Program

Tap Restrictions

Why Remove Inflow and Infiltration (I/I)

Community Approach

1

Franklin Township

Proactive investigation to known hydraulic overloads.

2

New Kensington

Consent order to reduce CSO and eliminate SSO's system wide

3

Lower Burrell

Consent order to eliminate SSO's system wide

Overview of I/I Approach

1. System Mapping
2. Flow Monitoring
3. Hydraulic Characterization
4. CCTV Investigation
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System Mapping

Know your system!

Pipe size and material

Locations of manholes

Depths of manholes

Connectivity

Right of ways

Location of repairs

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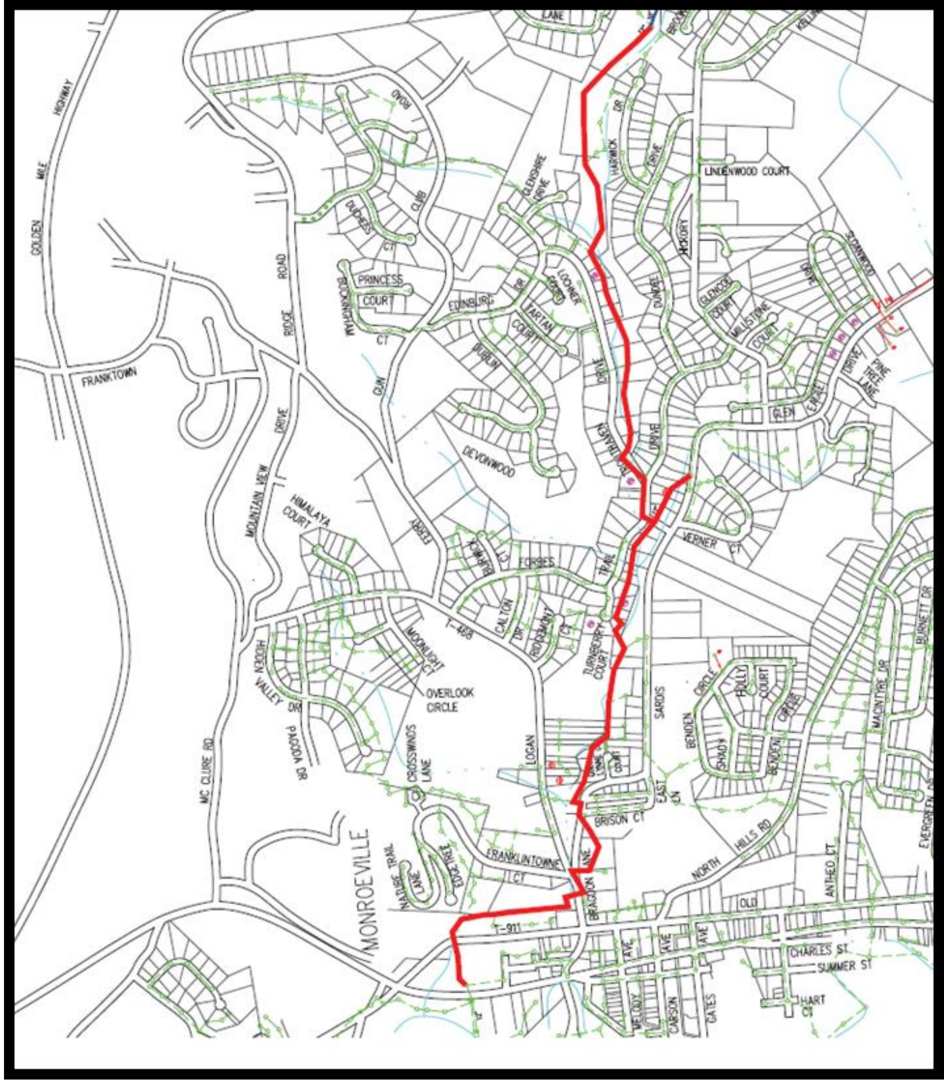

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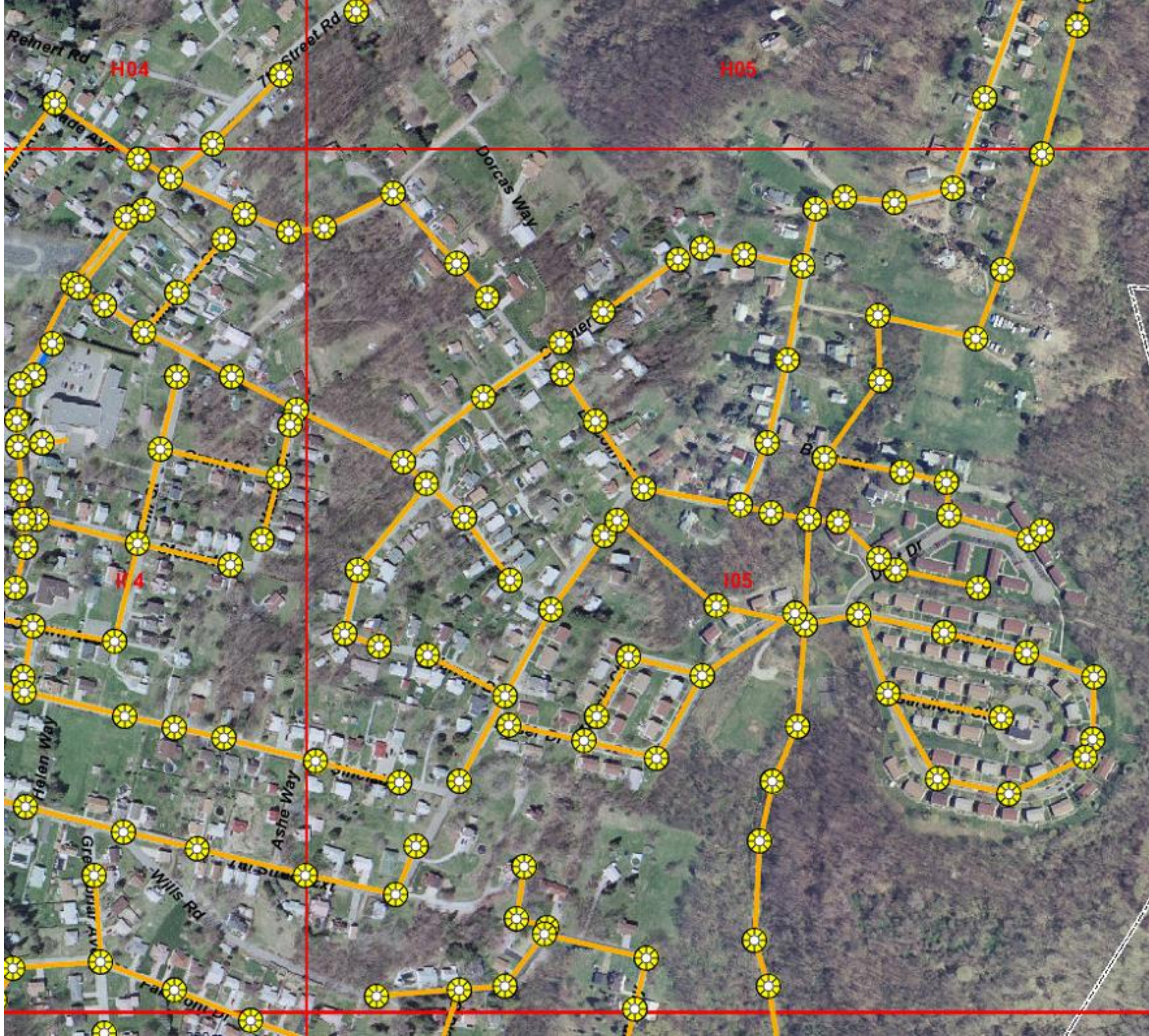

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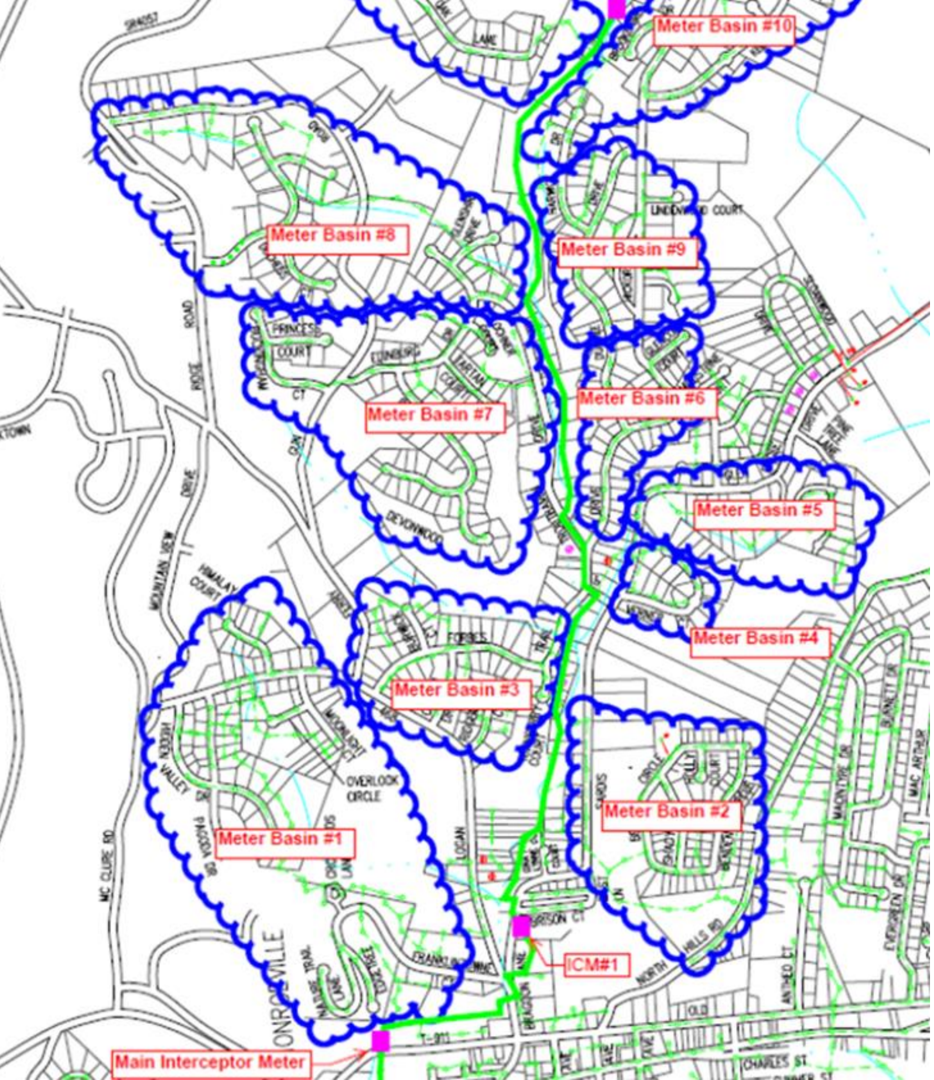


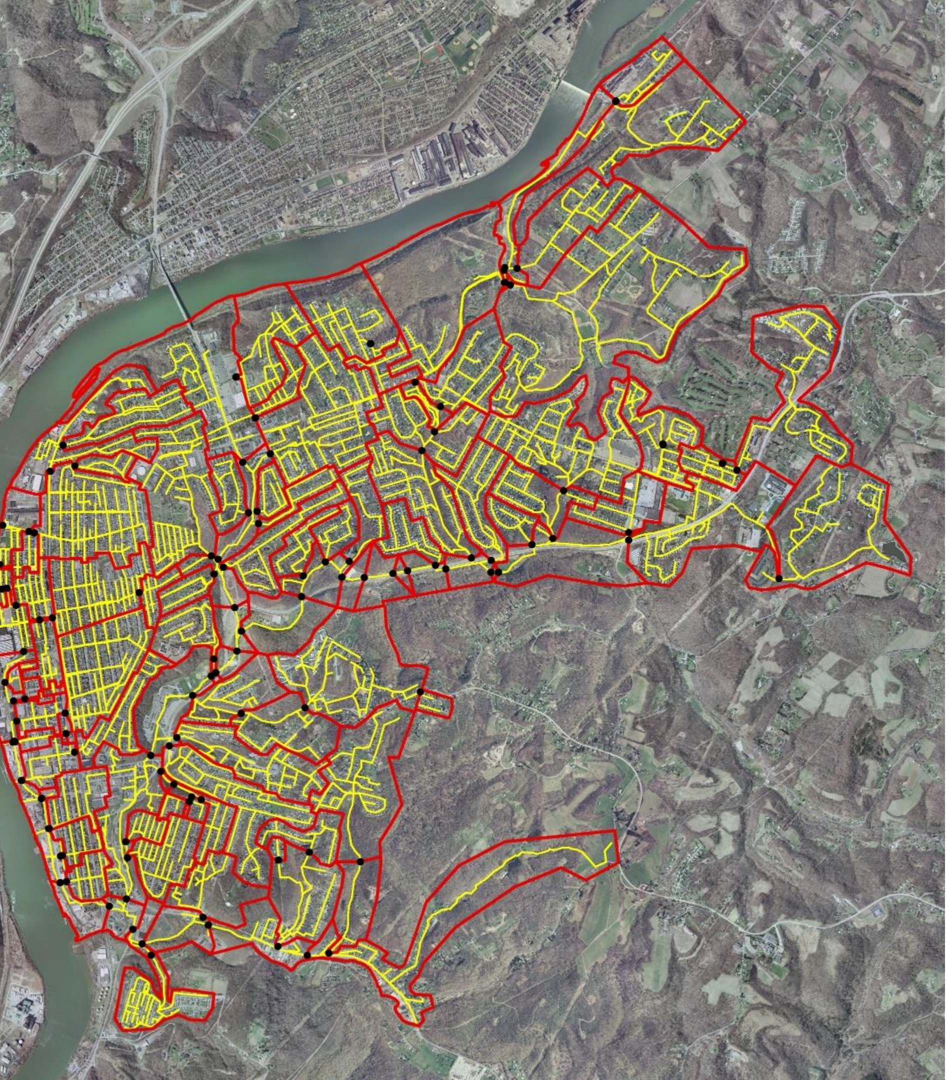
Flow Monitoring

Divided collection system into flow basins based on length of sewer

- Targeted areas of 10,000 linear feet
- New Kensington/Lower Burrell delineated 72 drainages
- FTMSA delineated 13 drainages

Multiple rain gauges depending on the size and topography of the target area

- New Kensington maintains 6 gauges
- FTMSA utilized 2 gauges



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Hydraulic Characterization

Approach

Groundwater

Fast I/I

Minimum night time flow

Average dry weather flows

Diurnal flows

Sanitary Sewer Overflows (SSOs)

Hydraulic overloading

Hydraulic Characterization

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Sanitary Sewer Overflows (SSOs)

Hydraulic overloading

	A	B	C	D	E	F	G	H	I
1		Flow Meter Manhole ID			Rainfall Even	11/10/2015	12/1/2015	12/2/2015	1/10/2016
2	Flow Meter ID		Meter Description	Ave Dry Weather (MGD)	Rainfall Total (Inches)	0.93	0.52	1.07	0.75
3					Peak Flow	1.739	1.036	2.231	2.260
4	Interceptor Meter	5-121A	Main Interceptor at Old Willm. Penn	0.509	Peaking Factor	3.42	2.04	4.38	4.44
5					Peak Flow	0.194	0.108	0.253	Meter
6	Meter Basin #1	5-122C	Franklintowne Branch	0.037	Peaking Factor	5.24	2.92	6.84	Malfunction
7					Peak Flow	0.350	0.183	0.527	0.520
8	Meter Basin #2	A-414	Rustic Ridge Benden Circle	0.045	Peaking Factor	7.78	4.07	11.71	11.56
9					Peak Flow	0.106	0.053	0.168	0.148
10	Meter Basin #3	TBC-5	Turnberry Court	0.011	Peaking Factor	9.64	4.82	15.27	13.45
11					Peak Flow	0.014	0.008	0.016	0.028
12	Meter Basin #4	SR-106	Verner Court	0.005	Peaking Factor	2.80	1.60	3.20	5.60
13					Peak Flow	0.145	0.074	0.216	0.218
14	Meter Basin #5	SR-107	Glen Eagle	0.019	Peaking Factor	7.63	3.89	11.37	11.47
15					Peak Flow	0.178	0.118	0.221	0.236
16	Meter Basin #6	FTD-122	Forbes Trail Drive	0.058	Peaking Factor	3.07	2.03	3.81	4.07
17					Peak Flow	0.156	0.074	0.114	Meter
18	Meter Basin #7	THD-11-4	Trouthaven Drive (Tartan Court)	0.041	Peaking Factor	3.80	1.80	2.78	Malfunction
19					Peak Flow	0.033	0.035	0.065	0.042
20	Meter Basin #8	THD-5-5	Trouthhaven Drive (Glenshire Drive)	0.01	Peaking Factor	3.30	3.50	6.50	4.20
21					Peak Flow	0.164	0.069	0.172	0.198
22	Meter Basin #9	HD-5-8	Harwick	0.023	Peaking Factor	7.13	3.00	7.48	8.61
23					Peak Flow	0.034	0.047	0.101	0.167
24	Meter Basin #10	HD-5-8B	Harwick/Brookshire	0.008	Peaking Factor	4.25	5.88	12.63	20.88
25					Peak Flow	0.095	0.078	0.124	0.159
26	Meter Basin #11	P.O-8-1	Pin Oak	0.052	Peaking Factor	1.83	1.50	2.38	3.06
27					Peak Flow	0.016	0.013	0.015	0.030
28	Meter Basin #12	T-622	Remaley Road	0.003	Peaking Factor	5.33	4.33	5.00	10.00
29					Peak Flow	Meter	0.108	0.140	0.248
30	Meter Basin #13	BR-105	Heritage Estates	0.029	Peaking Factor	Malfunction	3.72	4.83	8.55
31					Peak Flow	1.547	0.841	1.922	1.878
32	Interceptor Check Meter #1	5-127D	Main Interceptor Check @ Auto Body Shop	0.38	Peaking Factor	4.07	2.21	5.06	4.94
33					Peak Flow	0.220	0.132	0.226	0.254
34	Interceptor Check Meter #2	BR-1	Interceptor at 10" to 12" Transition	0.052	Peaking Factor	4.23	2.54	4.35	4.88

Hydraulic Characterization

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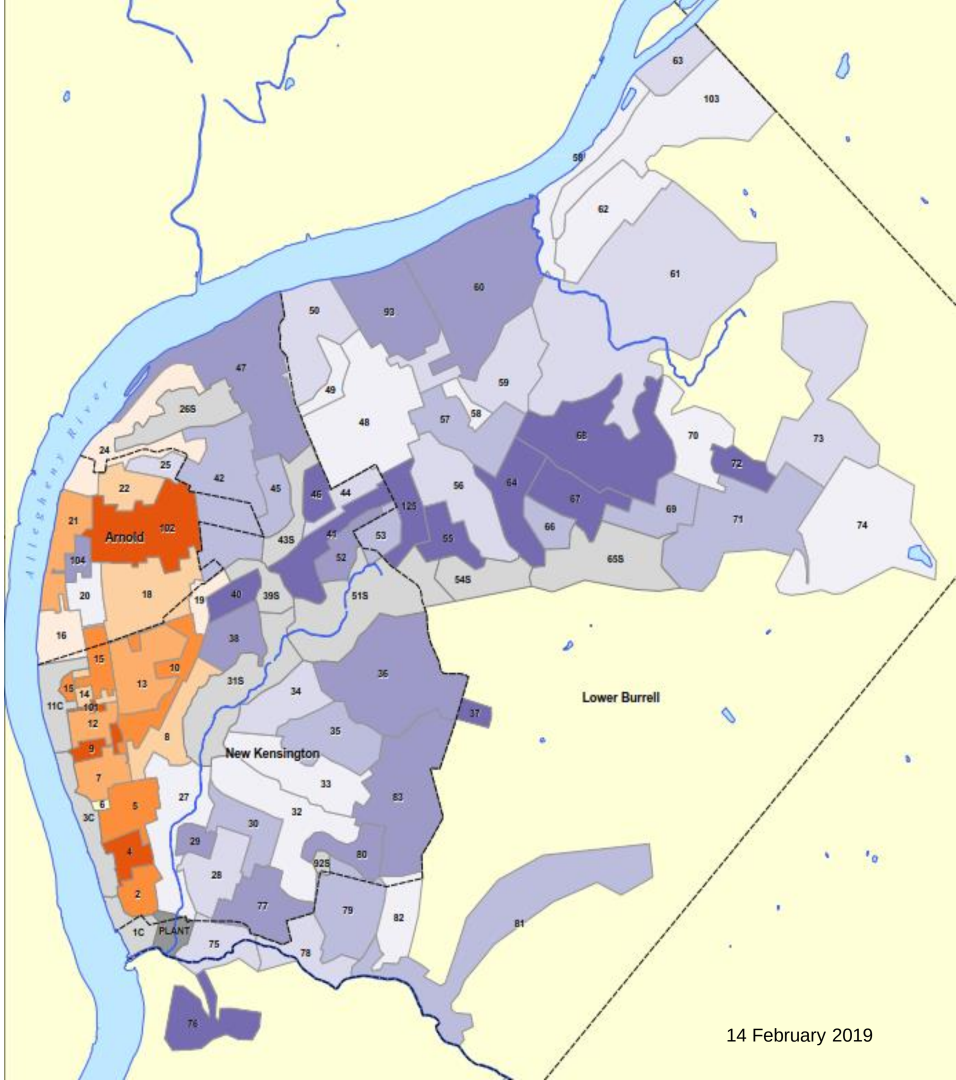
Sanitary Sewer Overflows (SSOs)

Hydraulic overloading



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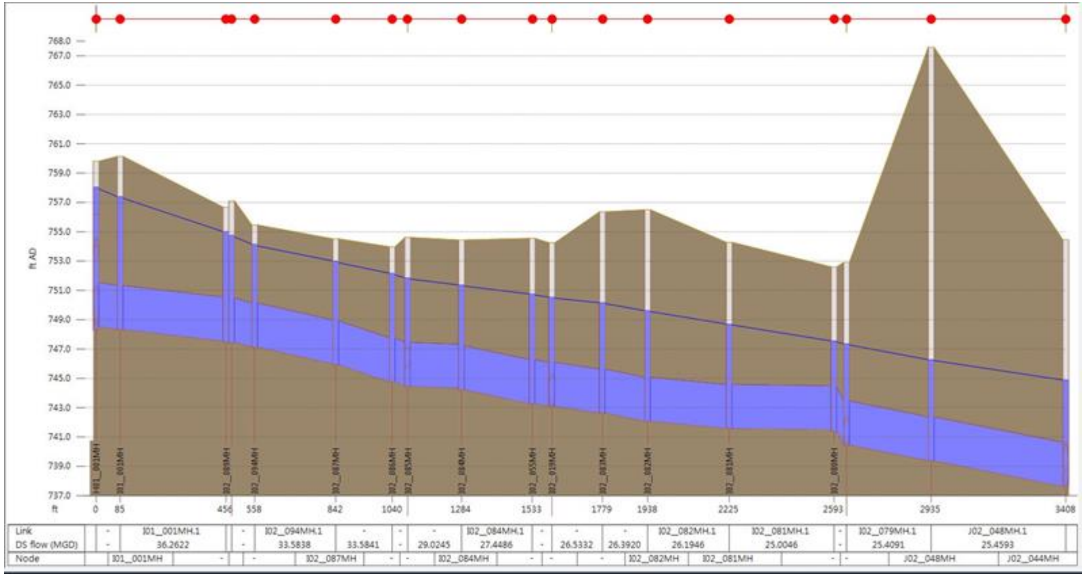

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CCTV Inspections

Approach

Who performs Closed-Circuit Television (CCTV) Inspections?

- Contractor
- Owner

When do you conduct inspections?

- Dry weather
- Wet weather

CCTV Inspections

Results

CCTV Inspections

Results

CCTV Inspections

Results

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System Rehabilitation

Approach

- Excavate and replace
- Trenchless repairs
- Cured in Place Pipe (CIPP)
  - Sectional lining
  - Manhole to manhole lining
- Slip lining
- Grouting
- Manhole rehabilitation
- Lateral rehabilitation

System Rehabilitation

Approach

- Franklin Township
  - Sewer mains with active infiltration
  - Upstream and downstream manholes
  - All lateral connections
- New Kensington
  - Sewer mains with structural defects and roots
  - All lateral connections
- Lower Burrell
  - Lined entire project area
  - All manholes
  - Only break in lateral connections

System Rehabilitation

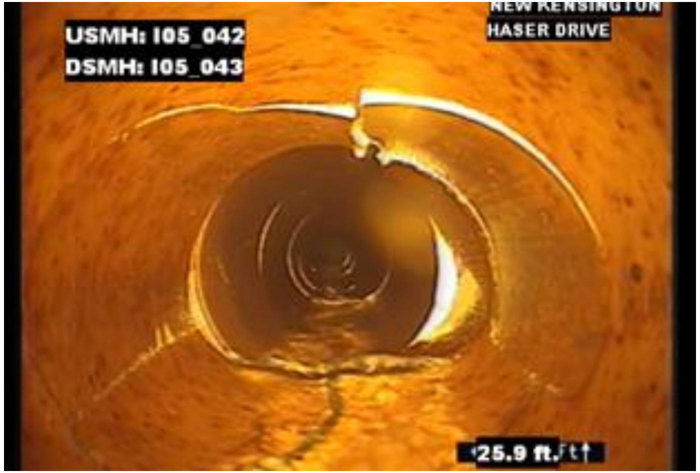
Fractured, Broken, and Deformed Pipe

Cured In Place Pipe (CIPP)

- Hot water
- Steam
- Ultraviolent

Potential issues

- **CIPP will take the shape of the host pipe**
- **Upstream and downstream access required**
- **Host pipe should be cleaned and inspected immediately prior to lining**
- **Active gushers and runners need to be stopped**



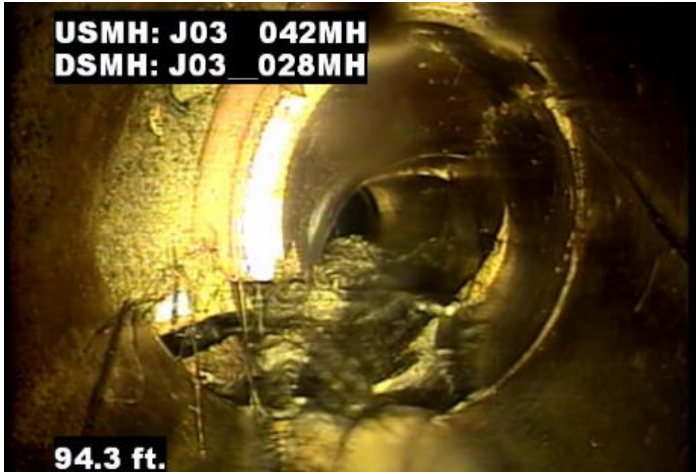
System Rehabilitation

Collapsed Pipe

CIPP can not be inverted through the defect

Excavation is required

- CIPP may be installed after the excavation point repair



System Rehabilitation

Manhole Rehabilitation

Rehabilitation technologies for:

- Corrosion protection
- Structural build back
- Inflow/Infiltration

- ### Inflow/Infiltration technologies

- Cover inserts
- Chimney seals
- Lining systems
- Chemical grouting

System Rehabilitation

Manhole Rehabilitation

Manhole lining systems

- Trowel/spray applied
- Epoxy
- Polyurethane
- Modified polymer stress skin panel
- Cementitious

- ### Potential issues

- **Surface preparation is critical for proper adhesion of the liner to the manhole.**
- **Conduct spark testing for pinholes**
- **Don't forget the bench and channel**

System Rehabilitation

Lateral Connections

Lateral rehabilitation methods

- CIPP mainline lateral connections (LCR)
- Grouting
- Excavation and replacement

Potential Issues

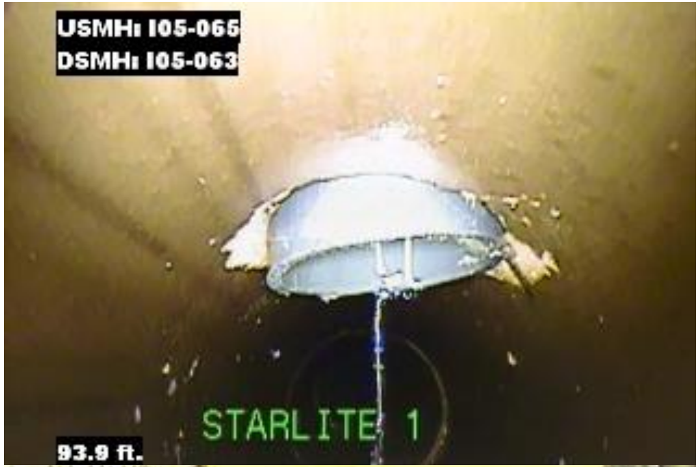
Where does lateral become private?

LCR further reduces the diameter of the main

Upstream and downstream access points

Debris/roots may prevent insertion

Alignment may prevent insertion

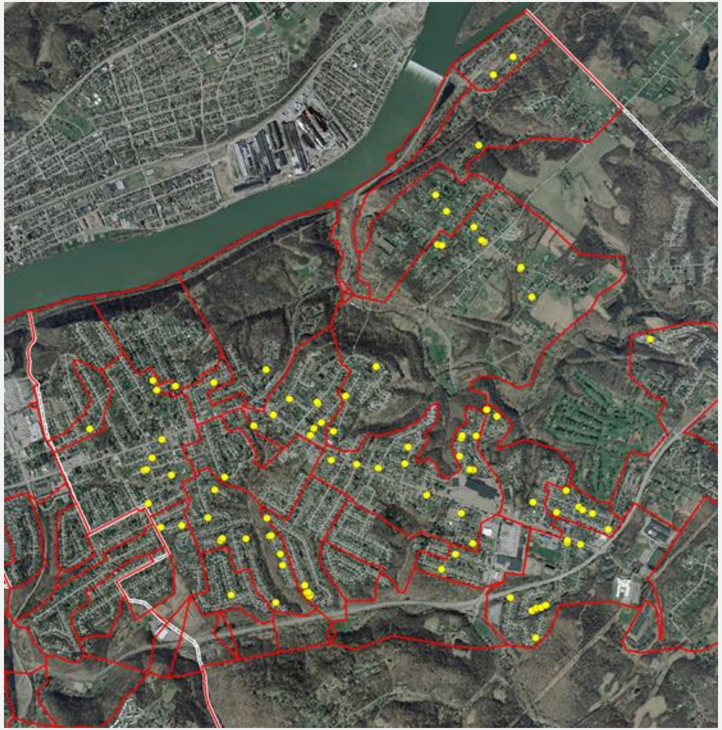


System Rehabilitation

Private Laterals

- Who is responsible?

- Private lateral inspection programs
  - Requirement of a house sale.
  - Requires CCTV inspection of all underground sewer pipe.
  - 1st year of program saw 50% failure rate.
  - Escrow is required for estimated repairs at time of sale.



System Rehabilitation

What was learned

- Know your system!
- Pipe conditions can degrade between inspection and construction.
- Where does private property start on a lateral.
- I/I will migrate along a liner to a lateral or manhole.

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Post-Construction Flow Monitoring

Approach

Reinstall flow meters for 3 month period in the same locations.

Ideally want to observe 2-3 significant storm events and a extended period of dry weather

Learn from results.

Post-Rehabilitation Flow Monitoring

Results

New Kensington

MB083

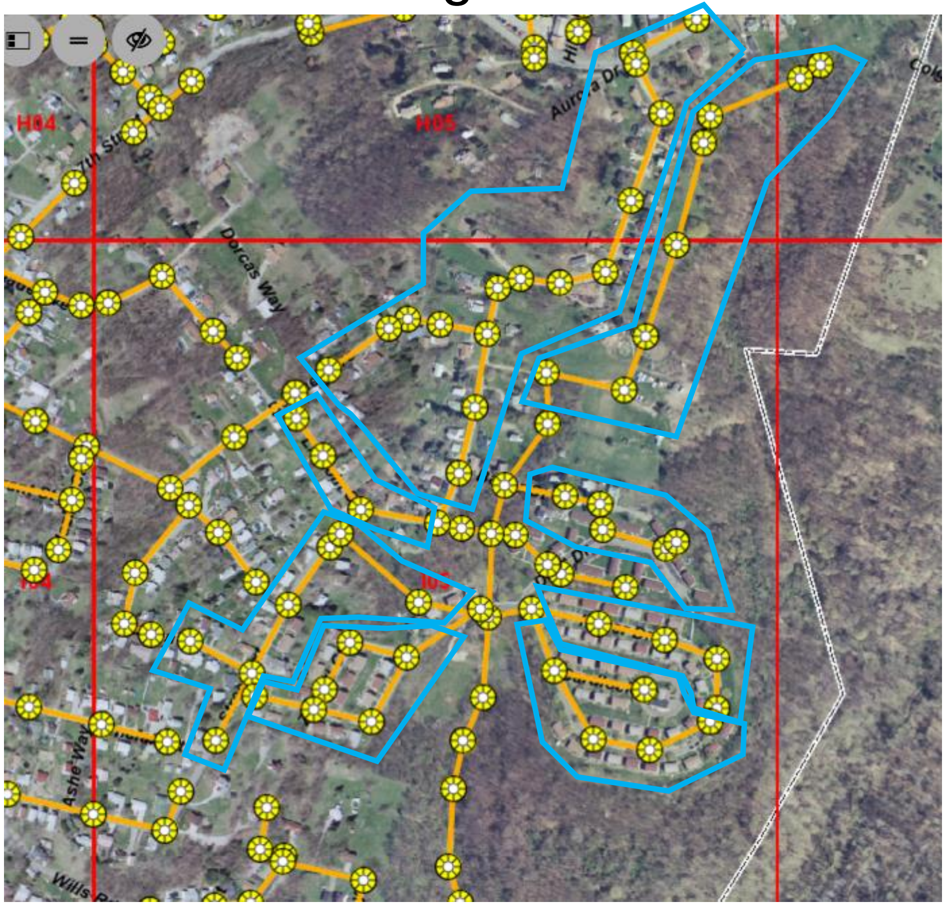
Flow studies

April – June 2012

6.2 inches of rain

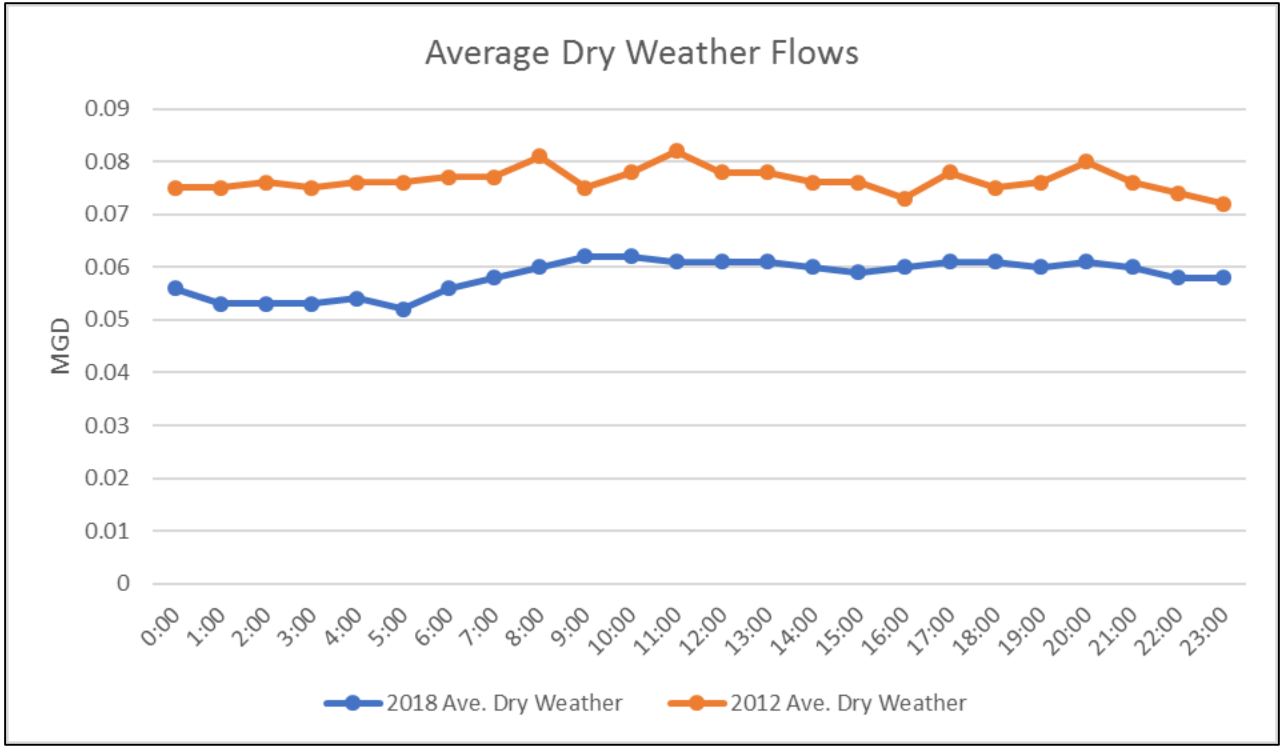
April – June 2018

11.68 inches of rain



Post-Rehabilitation Flow Monitoring

Results



Post-Rehabilitation Flow Monitoring

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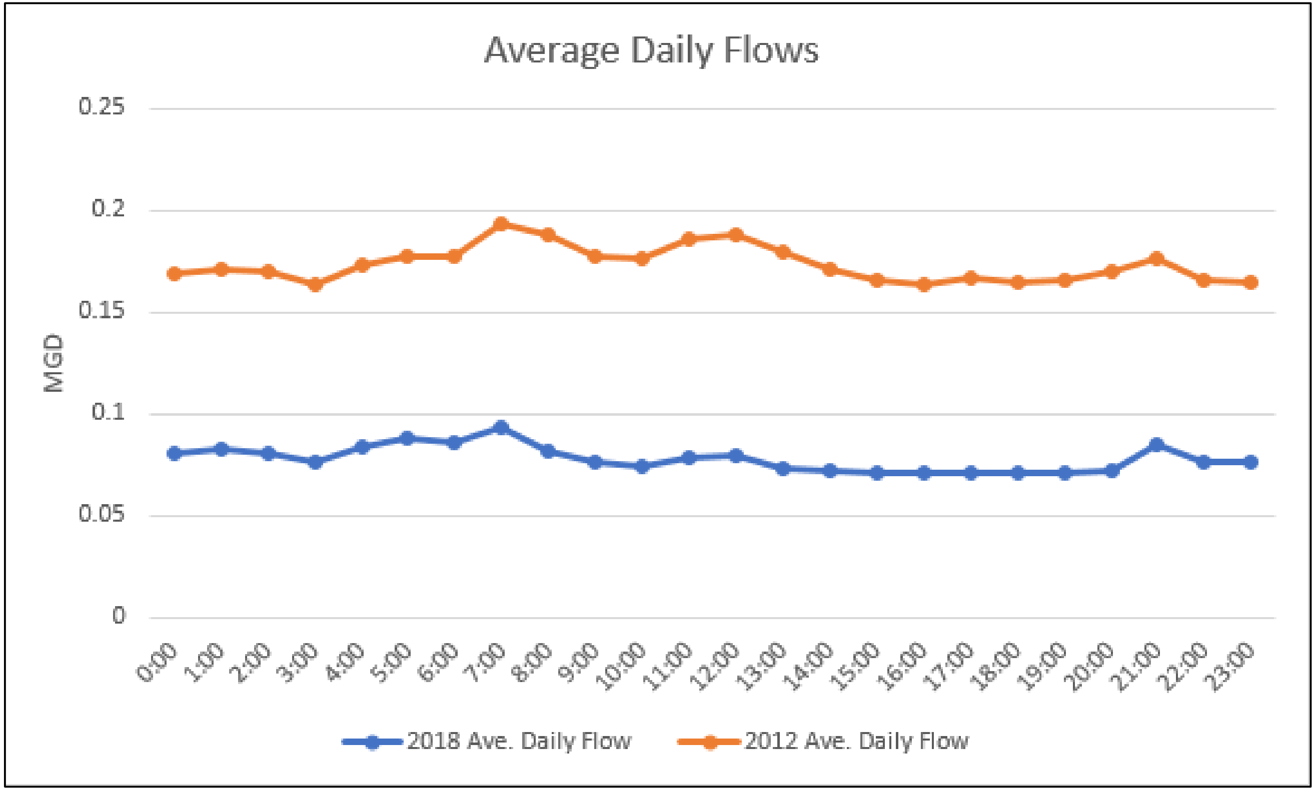

Post-Rehabilitation Flow Monitoring

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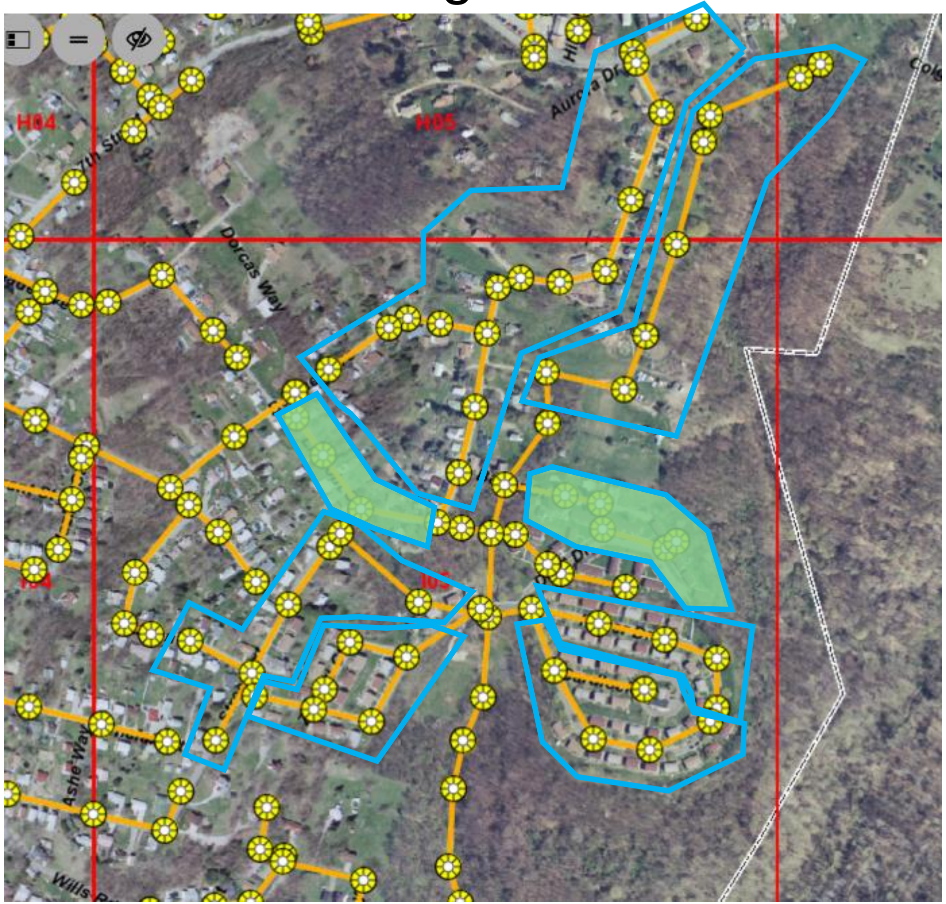

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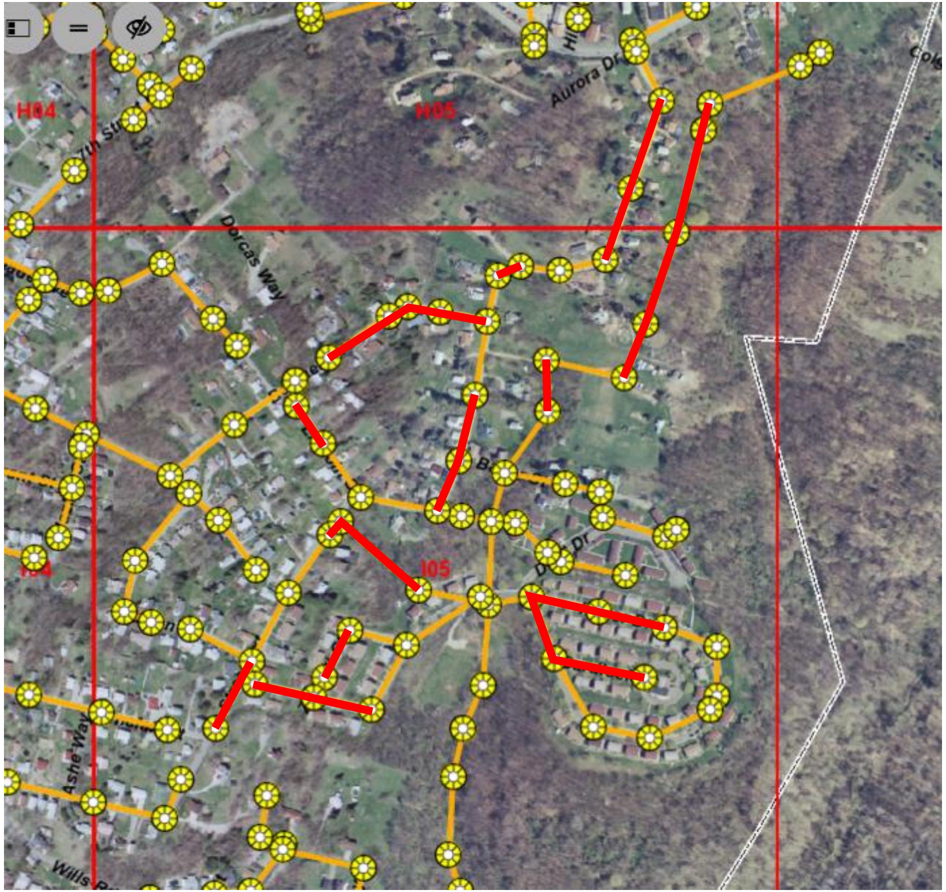

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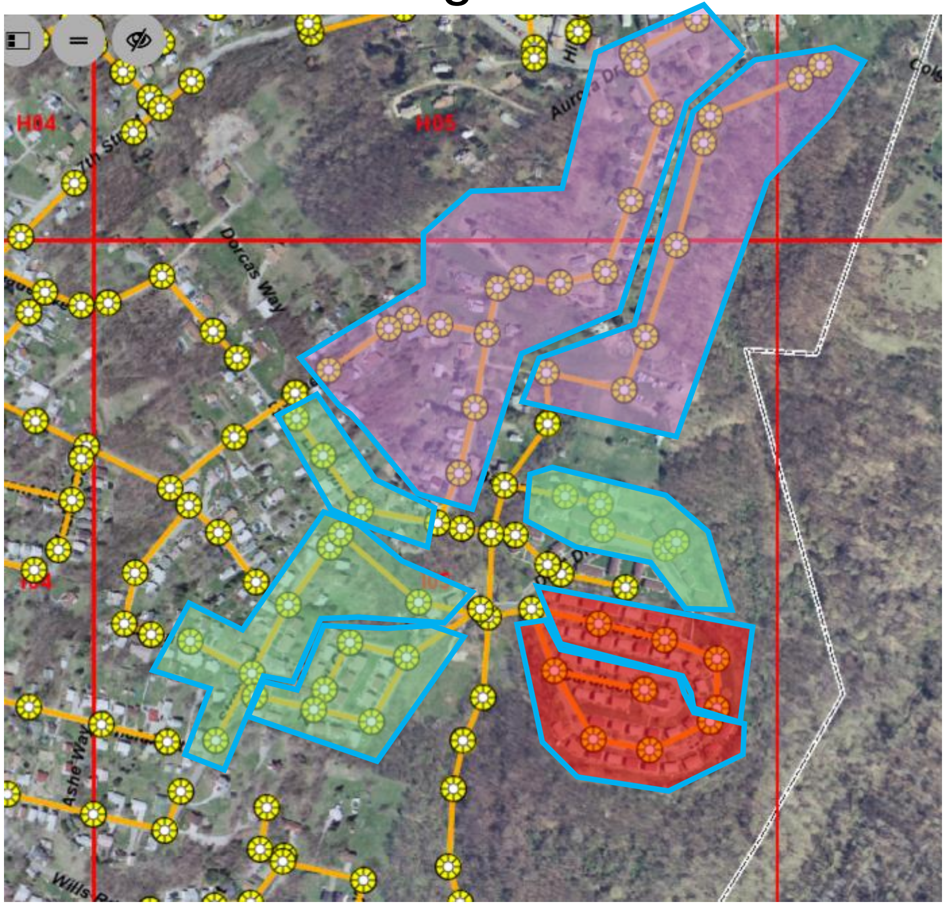
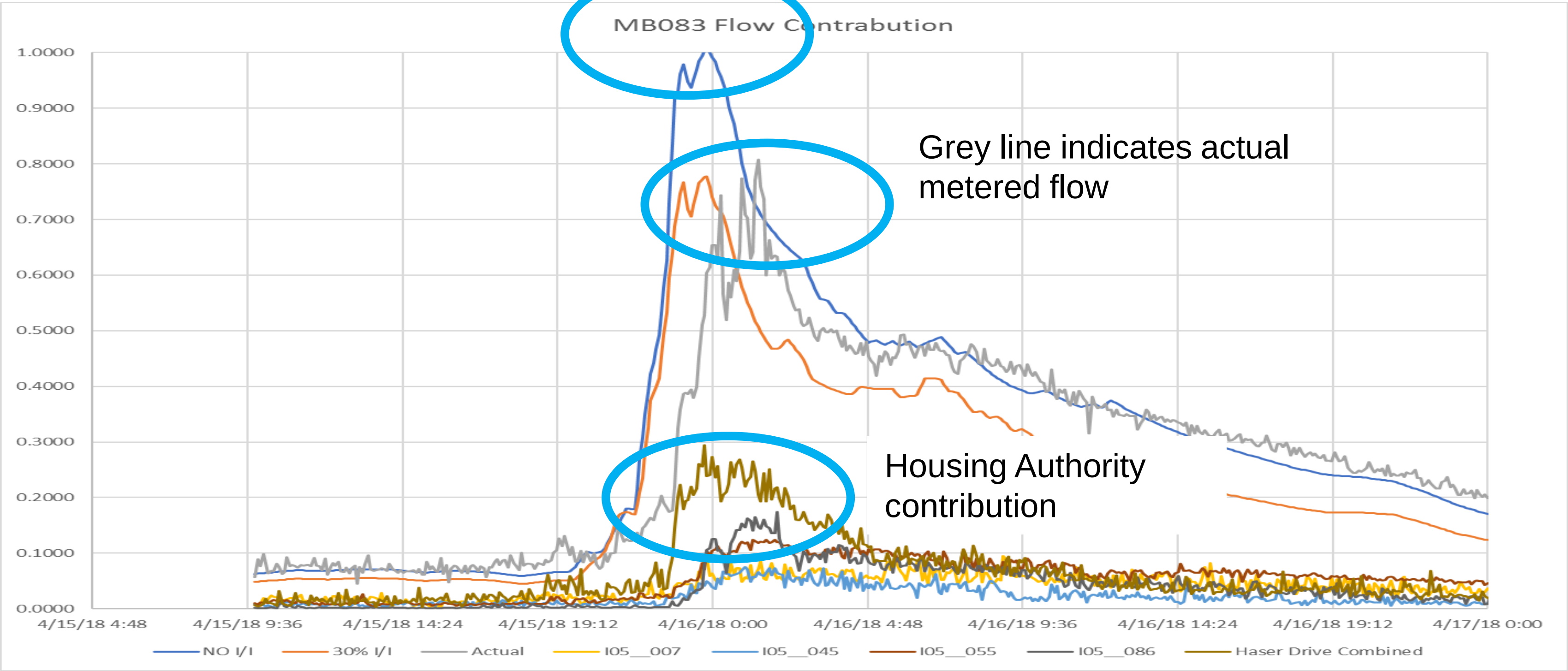


MB 083 Contribution

Modeled Peaks with No I/I



Grey line indicates actual metered flow

Housing Authority contribution

Flow Monitoring Observations

Housing authority accounts for ~1/3 of wet weather flow in MB 083

2018 data indicates high wet weather groundwater contribution as compared to 30% I/I model

Several storm events with peak flows as predicted by 30% I/I removal model

Dry weather groundwater contribution has decreased by approximately .005-.01 MGD (1.8 MG and 3.65 MG annually).

Overall reduction in peaking factors

Reduction in fast flow I/I response in micro basins.

Thank you