Force Main Condition Check-up

Force Mains have Feelings Too

Keynote: Tom Kiefer,

Chief, Bureau of Engineering & Construction

Baltimore County DPW

CWEA Collection Systems Fall Seminar

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Department of Public Works
Bureau of Utilities

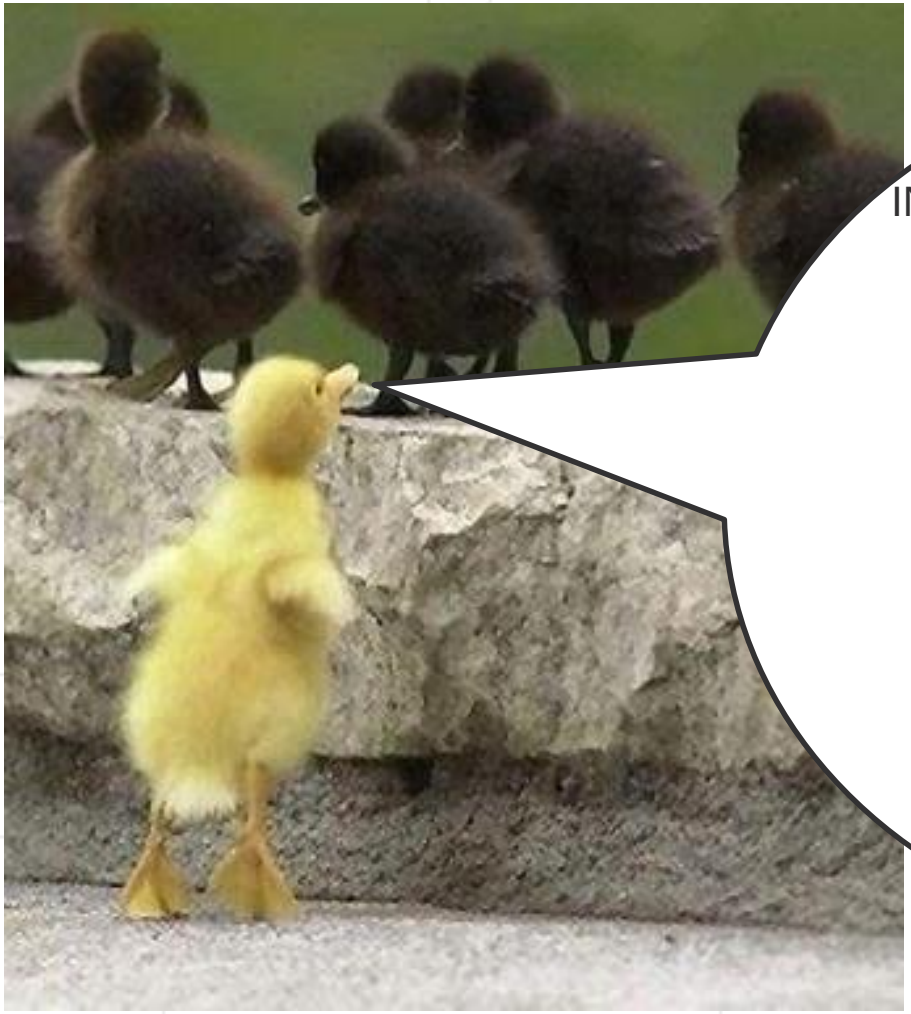
Go Big or Go Home !

It’s all in the commas

I’ll send a crew to fix this

Really?

Had it not been for these 2 letters: C D



IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MARYLAND
NORTHERN DIVISION
UNITED STATES OF AMERICA
and STATE OF MARYLAND,
Plaintiffs,
v.
BALTIMORE COUNTY, MARYLAND,
Defendant.

CONSENT DECREE!

Flexibility

…..but blank slate

- Consent Decree entered in 2005

- CD allowed flexibility how to investigate

From CD Par. 8: “Inspection/evaluation of Force Mains shall be carried out utilizing one or more methodologies appropriate to the specific characteristics of each Force Main…”

- Need to come up with an investigation plan

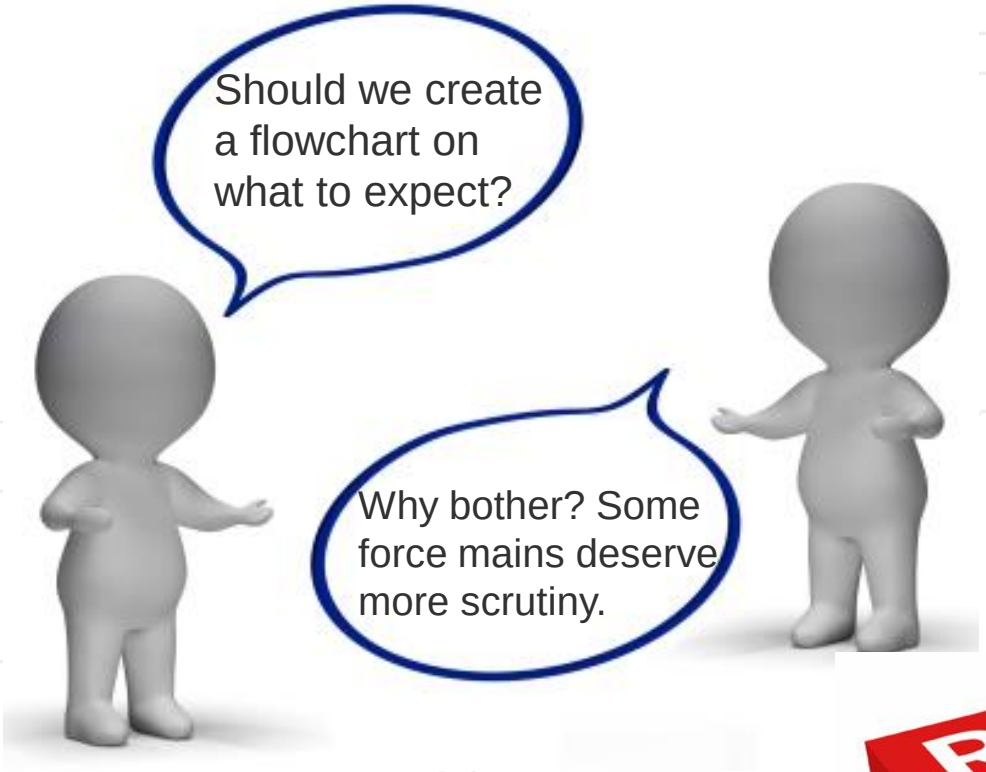
How do you Investigate Force Mains?

Are all kids treated the same, or do we have a favorite?

- Are all force mains treated the same?

- Are some force mains special and treated differently?

Expectations from Force Main Investigations



By another name…

Our Little Bundles of Joy

Dip and Ci

…and PeaCeCe twins. our unpredictable ones

Just Like a Recalcitrant Teen

Most days are fine…

…and then one day….
erupts with no warning.

How do you Investigate Force Mains?

- Are all force mains treated the same?

NO

- Are some force mains special and treated differently?

YES

Applying the Rules

- Do you apply the same rules over the full length of the force main?
- Used the same methodology for one end to the other because it was simpler.
  - Why make it so hard?
  - Who says we're wrong?

The Most Important Rule

Create a set of rules that could be applied by anybody so that it was not up to the individual judgment of whoever inspected the force main

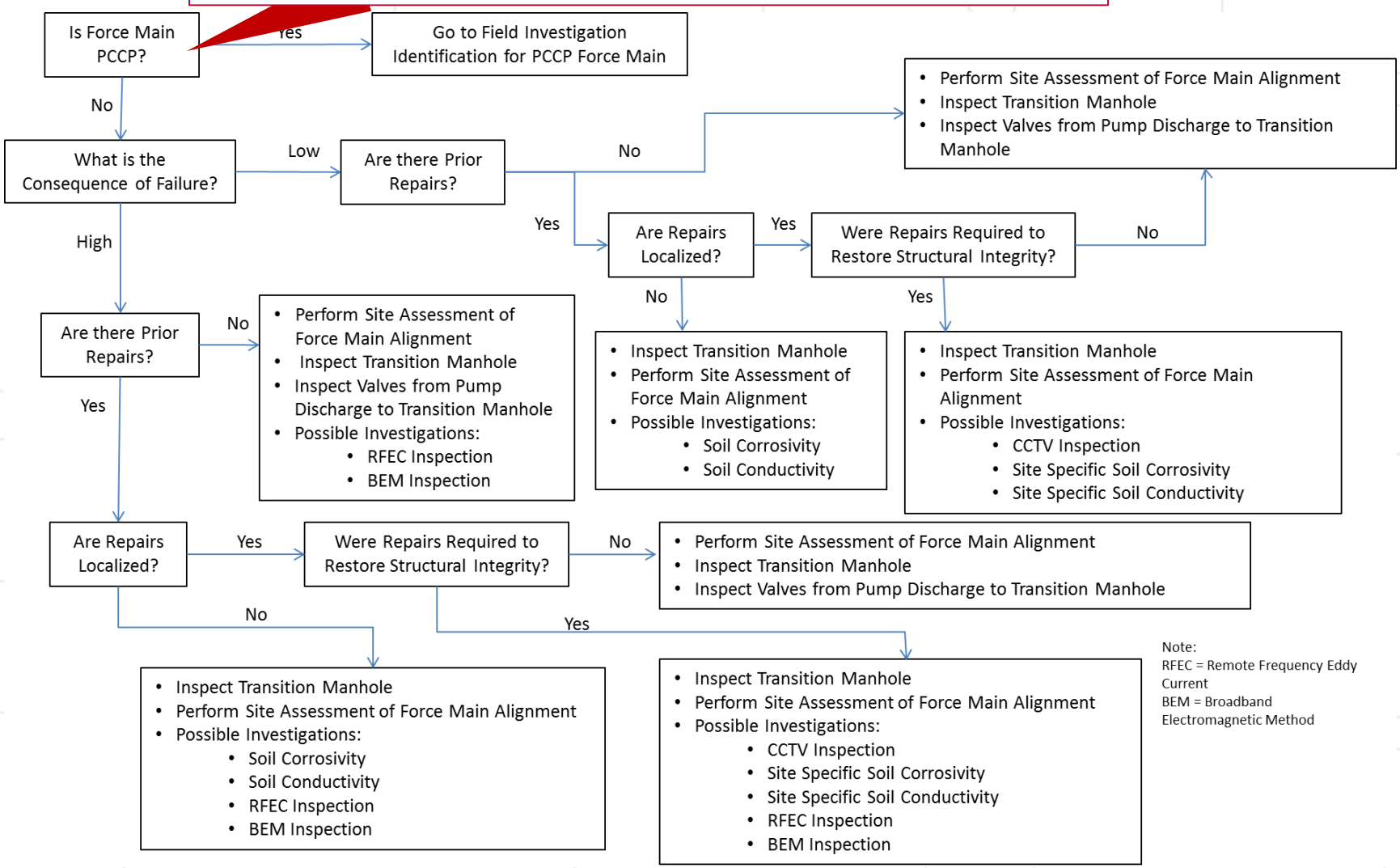
Changing the Rules

- Rules took months to develop
- Do rules change as you learn more?

- How strongly do you feel about change?

Rules for DIP and CI

(PeeCeCe Twins) have different rules



Health-Based Rules

- We summarized the force main's health history using institutional and anecdotal knowledge from the workforce who took care of the force mains.
- Just like a doctor, we used this health history to decide whether or not to do internal investigations.
  - We did a walk over of each force main to look for anomalies that would be a clue that we could be having a problem either now or in the future.

Ignorance is not Bliss

You can't ignore any of your children…it won't make them go away. It's better to be proactive than…

…reactive!
(really?!)

The Next Set of Rules

What do we do with all of the assessment information?

KIS

Our Risk Matrix

Risk Assessment Matrix

Criticality of Failure	Risk of Failure		
	0.1 to 7.59	≥7.60 and < 10.79	≥ 10.80
0.1 to 4.19	1	2	3
≥ 4.20 and < 4.79	4	5	6
≥ 4.80	7	8	9

Low Priority - No repair, re-inspect in 10-15 years

Moderate Priority - Complete any repair, re-inspect in 5-10 years

High Priority - Complete repair, re-inspect in 0-5 years

- Prioritizes planned repairs and future re-inspections
- Justifies future funding requests
- Helps to manage resources and justify future RFBs

What is our LoF and CoF?

- Developed based on individual discretion
- LoF and CoF combine to provide a risk rating for individual force main

Force Main Assessment Scale

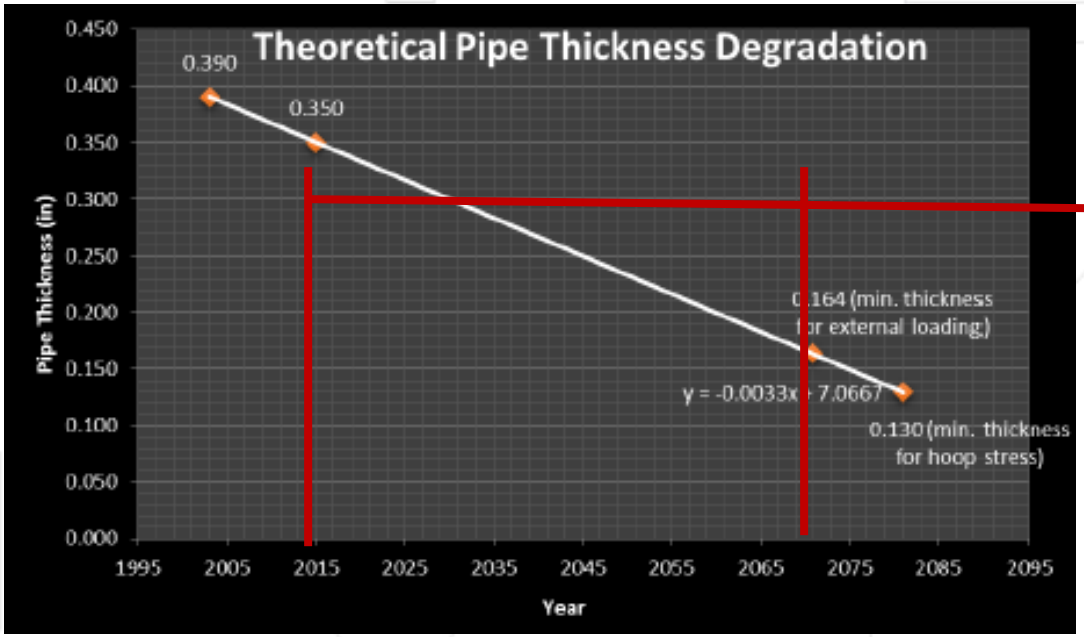
Purpose of Analysis	Criteria	Weighting	Normalized Weighting	Relative Importance Factor
Likelihood of Failure	**Inspection Evaluation (Structural Condition)**			
	Good	0	0.00	5
	Moderate	1	0.50	
	Poor	2	1.00	
	Pipe Material			
	Cast Iron	1	0.50	4
	Ductile Iron	1.5	0.75	
	PCCP	2	1.00	
	Pipe Age - Installation Date			
	1980 to Present	1	0.20	3
	1960 to 1979	3	0.60	
	1935 to 1959	3.5	0.70	
	< 1935	5	1.00	
	Depth			
	Existing Depth < Theoretical Max. Allowable	0	0.00	2
	Existing Depth > Theoretical Max. Allowable	1	1.00	
	Operating Conditions			
	Flow Conditions			
	Operating Internal Pressure < Theoretical Allowable Operating Pressure	0	0.00	1
	Operating Internal Pressure > theoretical Force Main Allowable Operating Pressure	1	1.00	
	Max. Operating Internal Pressure < Theoretical Force Main Allowable Operating Pressure	0	0.00	1
	Max. Operating Internal Pressure > Theoretical Force Main Allowable Operating Pressure	1	1.00	
	Transient Analysis			1
	Surge Valve Present	0	0.00	
	Surge Valve Not Present	1	1.00	
	Cathodic Protection			
	Yes	0	0.00	1
	No	1	1.00	
	for Cast/Ductile Iron	1	1.00	
	Corrosion Protection			
	for Cast Iron Pipe	0	0.00	1
	Yes	0	0.00	
	No	1	1.00	
	Past Performance			
	Soil Resistivity			
	> 3000 ohm-cm	0	0.00	1
	< 2999 ohm-cm and > 2000 ohm-cm	1	0.50	
	< 1999 ohm-cm	2	1.00	
	Soil Corrosiveness			
	PH < 4	1	1.00	1
	3.99 < PH < 8.5	0	0.00	
	PH > 8.5	1	1.00	

Force Main Assessment Scale

Consequence of Failure (Recommendation Prioritization)				
	Accessibility			
	Accessible	0	0.00	2
	Inaccessible	1	1.00	
	Diameter			
	6" and Smaller	1	0.20	3
	7" to 11"	2	0.40	
	12" to 16"	3	0.60	
	17" to 24"	4	0.80	
	25" and Larger	5	1.00	
	Proximity to Public Areas[1]			
	> 250 ft	0	0.00	1
	≤ 250 ft	1	1.00	
	Proximity to Environmentally Sensitive Areas[1]			
	> 250 ft	0	0.00	1
	≤ 250 ft	1	1.00	

When do New Rules Apply?

After you learn new information

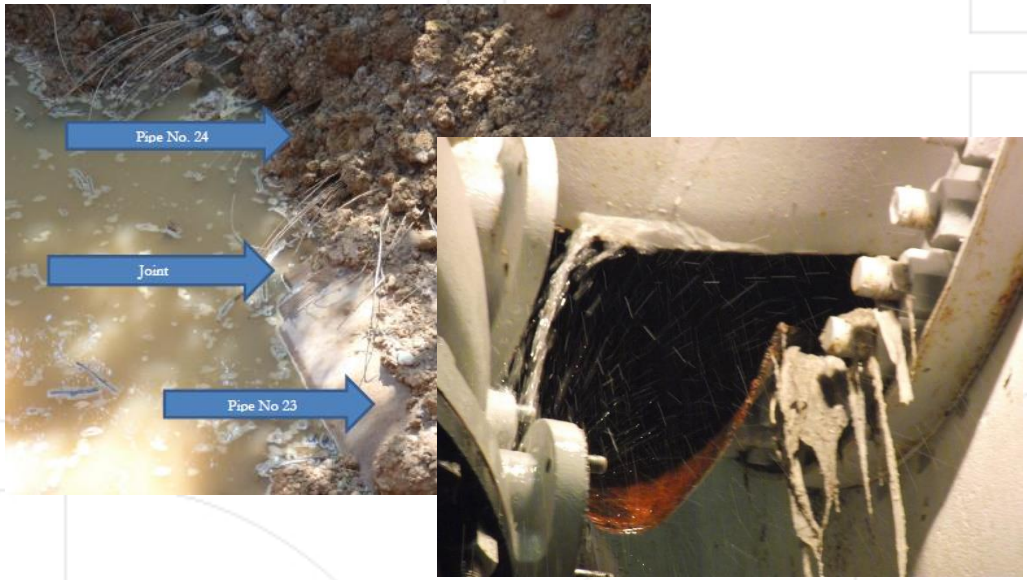


50 years to reach theoretical minimum pipe wall thickness

- Flexible rules allow us to do more limited investigations, if needed.
- How do you make a recommendation about how soon to complete follow up investigations?

Using What got us Here

Is all of this Necessary?



Patapsco Force Main

Redhouse Run Force Main

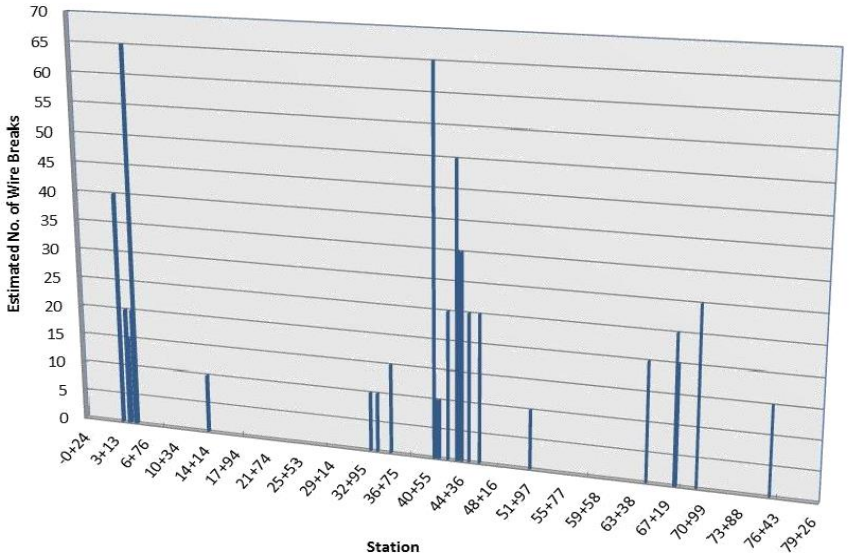
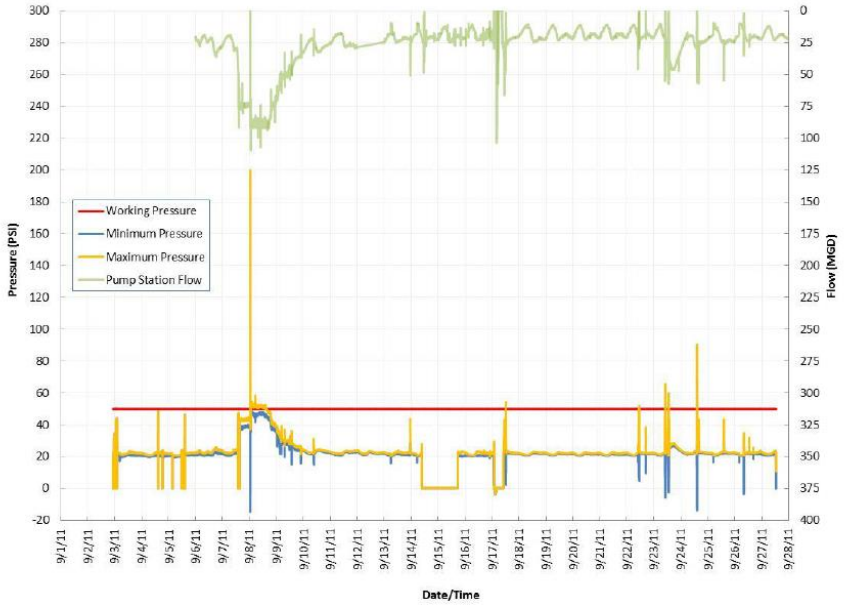


Figure 5 – Electromagnetic Inspection Results by Station



Is all of this Necessary?

Patapsco Force Main

- EM inspection told us how many wire breaks and where they're located, but that information is only of limited use.
  - So where is the threshold where the number of wire breaks is a problem?
- Pressure spikes and transient pressures that exceeded the original design pressures.


Corsica force main


Hawthorne 2 force main

Hyde Park force main


Baurenschmidt force main

Is all of this Necessary?

Encrustation Inclusions

- Why do inclusions only exist in some CIP and DIP force mains?
- Why are inclusions more severe in CIP?
- What effect, if any, do the inclusions have on pumping operation?
- How do we remove the inclusions?
  - Pilot study in 2017

The Fix is Never Pretty

What are some Lessons Learned for Future Designs?

Why don't we include in the original design wider easements so that we can make a repair without disturbing private property?

Why don’t we include in the original design pipe access for future inspections?

With such significant advances in document management, why don’t we keep better documentation?

Department of
Public Works
Bureau of Utilities

Thank you!

Tom Kiefer, PE
Chief, Bureau of Engineering & Construction
Baltimore County Department of Public Works
Email: tkiefer@baltimorecountymd.gov