The Autobahn of Vapor Intrusion – Pathway Evaluation from a Sole Source Impacted Subsurface Sewer

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Agenda Slide

01Introduction

02 Case Study

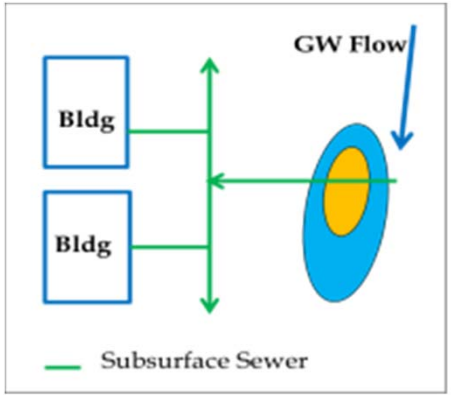
03 Mitigation

04 Mitigation & Results

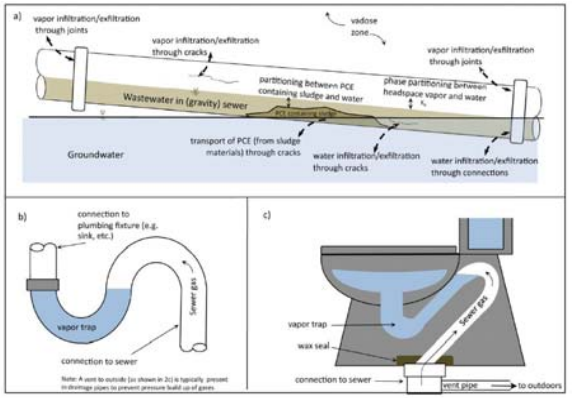
05 Conclusion

Introduction

- Understand the sewer gas to indoor air migration pathway
- Present a sewer gas to indoor air pathway case study where the sewer and the impacts begin on-site
- Present effective receptor and source-based mitigation measures



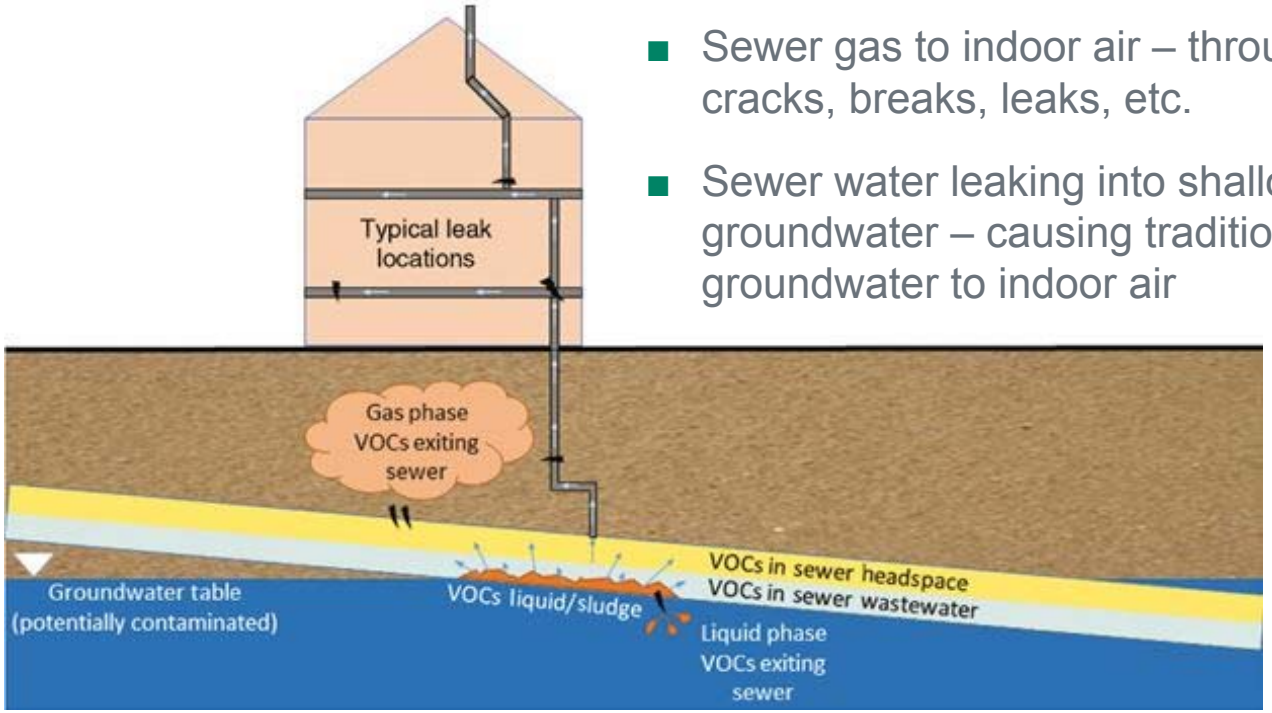
Friedrich, Wallace, 2016



Pennell, 2013

Pathway Understanding

- Impacted media (groundwater, vapor) infiltrating sewer
- Sewer gas to indoor air – through cracks, breaks, leaks, etc.
- Sewer water leaking into shallow groundwater – causing traditional groundwater to indoor air



Pennell, et.al, 2016

Assessment

Desktop

- Impacted media near or intersecting a sewer
- Understand how and where structures are connected to the sewer
- Obtain publicly available information on sewers
- Understand water presence and flow conditions in the sewers
- Permitted discharges to the sewer

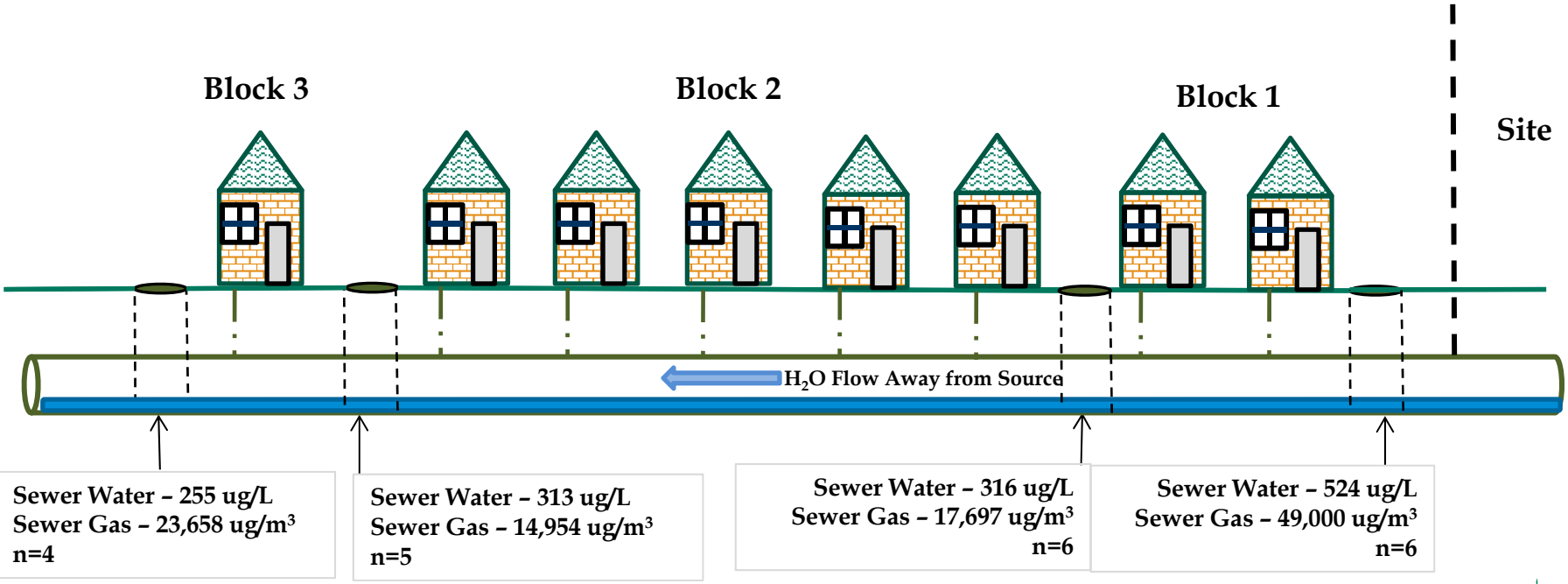
Field

- Sewer video inspections
- Sewer water sampling
- Sewer gas sampling
  - Active / Passive
  - Sample Depth
- Groundwater sampling
- Subslab and indoor air sampling
- “Vapor” testing

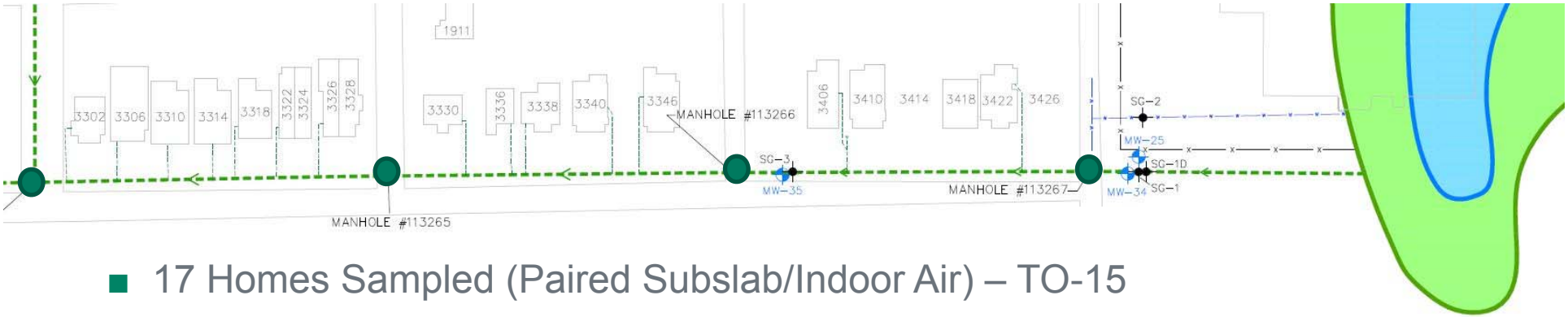
Case Study


TCE > 5 ug/L in groundwater
TCE > 500 ug/L in groundwater
= Combined Sanitary/Storm Sewer
= GW Flow Direction
Manhole

Sewer Gas/Water Sampling Events

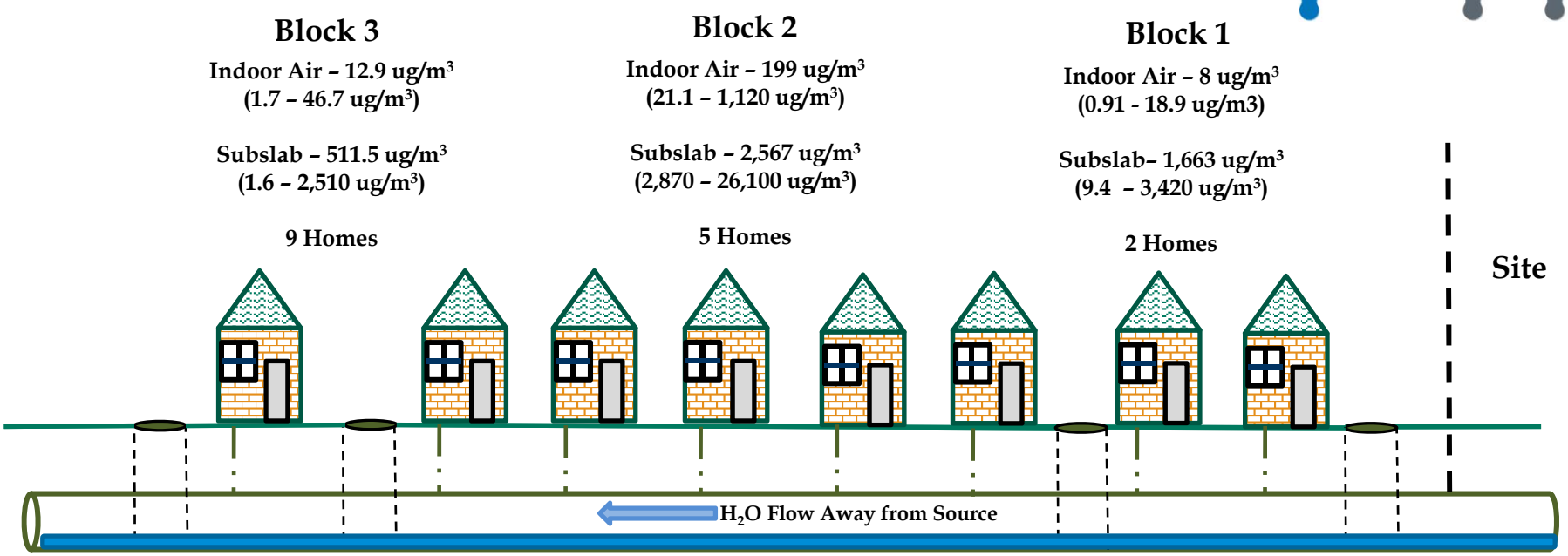


Residential Sampling Overview



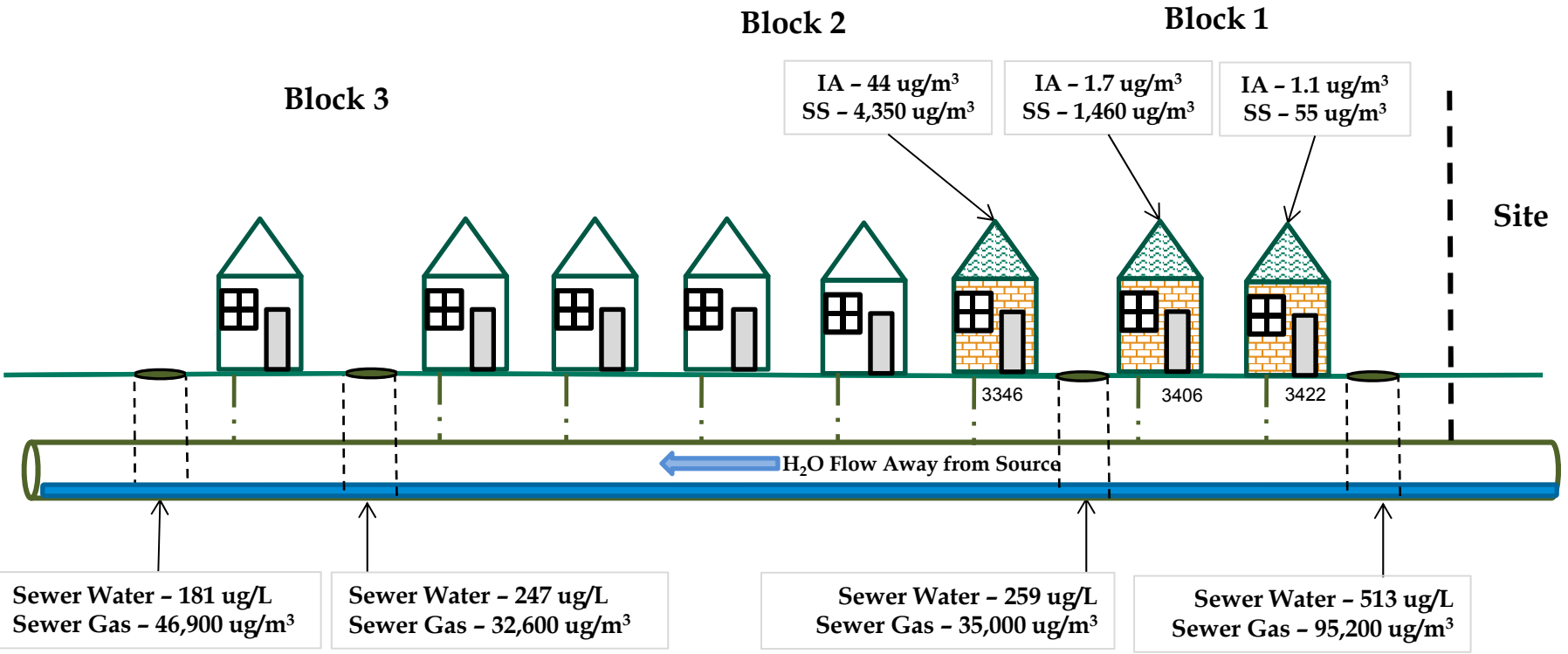
- 17 Homes Sampled (Paired Subslab/Indoor Air) – TO-15
  - 13 Homes > Residential IASL (TCE)
  - Of the 13 Homes > RIASL, 10 Homes > Residential Subslab SL (TCE)

Average TCE Concentrations



Contemporaneous Sampling

Low Volume Steady State (9/2/15) TCE Concentrations



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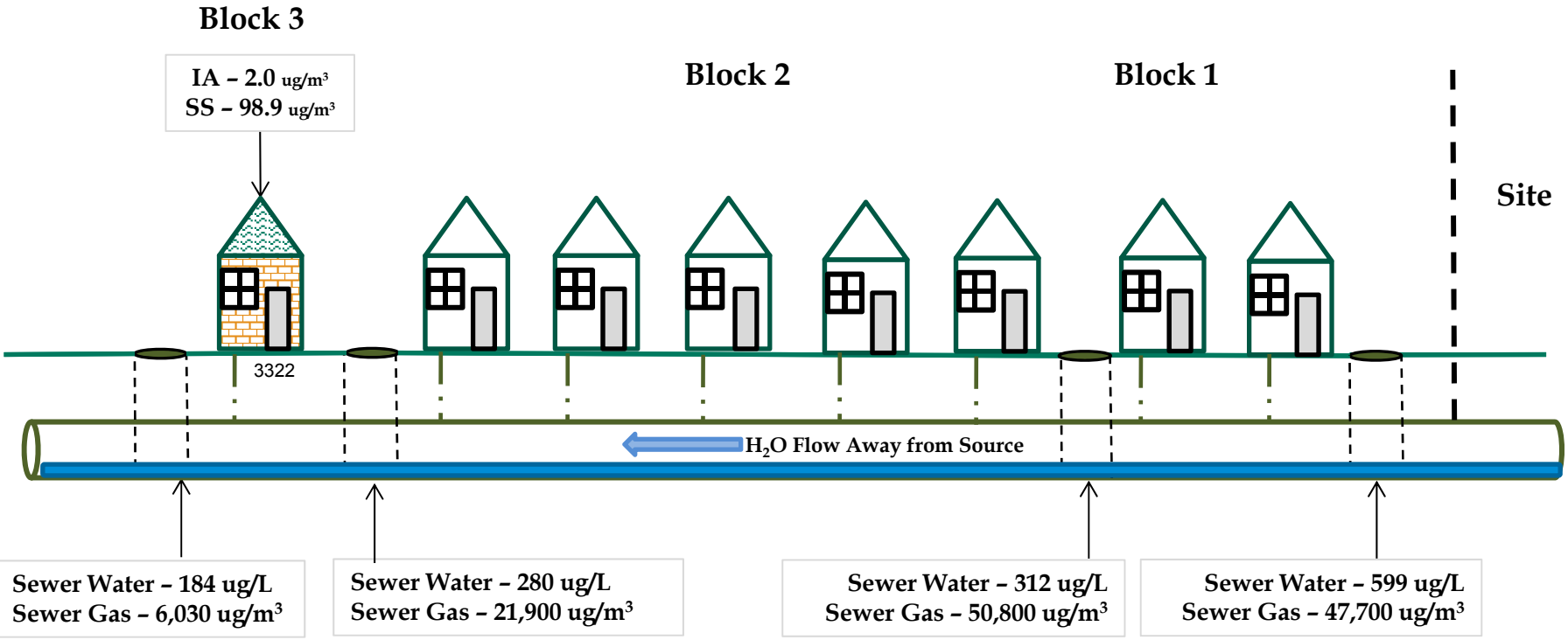
Contemporaneous Sampling

Low Volume Steady State (8/10/16) TCE Concentrations



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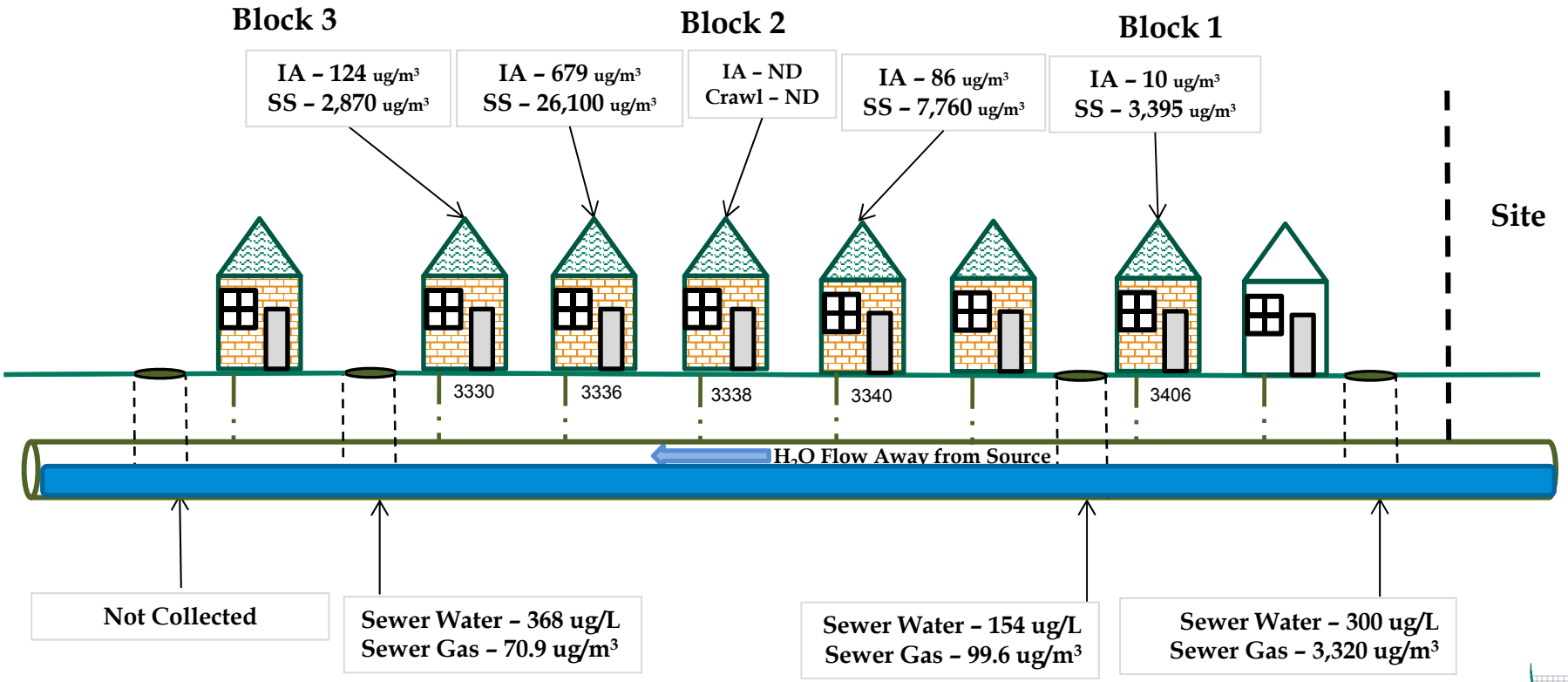
Contemporaneous Sampling

High Volume (1/14/16) - TCE



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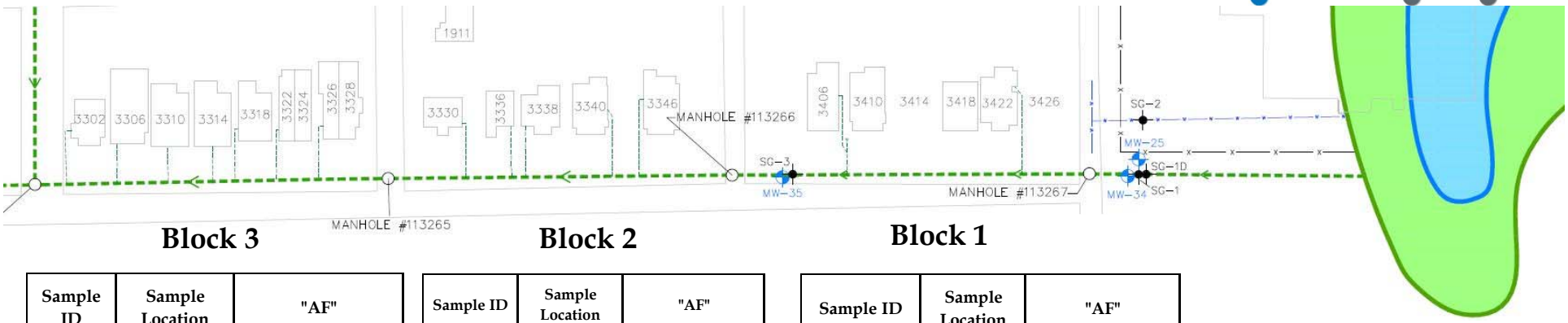
"Attenuation Factors"



Block 3

Sample ID	Sample Location	"AF"
3322	Basement	0.0002
	Main Floor	0.0001

Block 2

Sample ID	Sample Location	"AF"
3330	Basement	1.5
	Main Floor	1.4
3336	Basement	13.1
	Main Floor	2.8
3338*	Crawlspace	0.005
	Main Floor	0.005
3340	Basement	1.2
	Main Floor	0.9
	2nd Floor	0.9
3346	Basement	0.002
	Main Floor	0.0006
	2nd Floor	0.0008

Block 1

Sample ID	Sample Location	"AF"
3406	Basement	0.00004
	Main Floor	0.00002
	Basement	0.006
	Main Floor	0.006
3422	Basement	0.00002
	Main Floor	0.00001

High Volume Sewer Water Presence	
Alpha Range	0.005 to 13.14
Average Alpha	1.99

Low Volume Sewer Water Presence	
Alpha Range	0.00001 to 0.002
Average Alpha	0.0005

Results

- Receptor Focused Mitigation
- Vapor Testing/Plumbing Corrections (Floor Drains, Wax Rings, Piping, etc.)

- Air Purifying Units (Granular Activated Carbon Included)
- Subslab / Submembrane Depressurization Systems

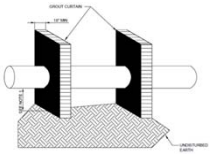
Mitigation of 5 Homes

	Pre-Mitigation TCE (ug/m^3)	First/Primary Mitigation Method	Post-Mitigation TCE (ug/m^3)	Second Mitigation Method	Post-Mitigation TCE (ug/m^3)	Final Mitigation Percent Reduction
3406 - Main	10.1	Plumbing Correction	0.91			91.0
3406 - Basement	9.7		1.0			89.7
3346 - 2nd Floor	28.6	SSD	25.5	Plumbing Correction	5.3	81.5
3346 - Main	21.1		29.5		1.8	91.5
3346 - Basement	81.9		83.8		20.3	75.2
3340 - 2nd Floor	75	SSD*	5.6			92.5
3340 - Main	79.2		9.3			88.3
3340 - Basement	105		20.6			80.4
3336 - Main	237	SSD & Plumbing Correction	4.0			98.3
3336 - Basement	1,120		5.0			99.6
3330 - Main	117	SSD*	2.7			97.7
3330 - Basement	130		3.1			97.6

Sewer Relocation & Abandonment

= Existing Sewer
= Sewer Plugged and Abandoned
= New Sewer (Re-Route)

Post-Abandonment/Reroute sewer water/sewer gas sampling location



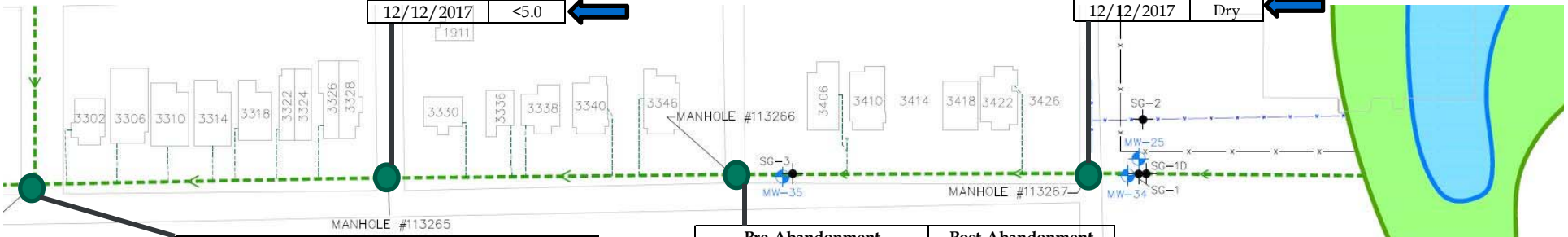
Post Abandonment TCE Results

Pre-Abandonment		Post-Abandonment	
MH-113265	TCE	**MH-113265**	TCE
Sewer Gas Average (ug/m^3)		Sewer Gas (ug/m^3)	
2014-2016	**14,954**	7/17/2017	**121.0**
		10/11/2017	**6.4**
		12/12/2017	**2.1**

Pre-Abandonment		Post-Abandonment	
Sewer Water Average (ug/L)		Sewer Water (ug/L)	
2014-2016	**312.6**	7/17/2017	<5.0
		10/11/2017	<5.0
		12/12/2017	<5.0

Pre-Abandonment		Post-Abandonment	
MH-113267	TCE	**MH-113267**	TCE
Sewer Gas Average (ug/m^3)		Sewer Gas (ug/m^3)	
2014-2016	**49,000**	7/17/2017	**69.7**
		10/11/2017	**52.0**
		12/12/2017	**1.1**

Pre-Abandonment		Post-Abandonment	
Sewer Water Average (ug/L)		Sewer Water (ug/L)	
2014-2016	**551**	7/17/2017	Dry
		10/11/2017	Dry
		12/12/2017	Dry



Pre-Abandonment		Post-Abandonment	
MH-113264	TCE	**MH-113264**	TCE
Sewer Gas Average (ug/m^3)		Sewer Gas (ug/m^3)	
2014-2016	**23,658**	7/17/2017	**41.9**
		10/11/2017	**1.3**
		12/12/2017	**1.5**

Sewer Water Average (ug/L)		Sewer Water (ug/L)	
2014-2016	**255**	7/17/2017	<5.0
		10/11/2017	<5.0
		12/12/2017	<5.0

Pre-Abandonment		Post-Abandonment	
MH-113266	TCE	**MH-113266**	TCE
Sewer Gas Average (ug/m^3)		Sewer Gas (ug/m^3)	
2014-2016	**17,697**	7/17/2017	**47.1**
		10/11/2017	**3.9**
		12/12/2017	**2.1**

Pre-Abandonment		Post-Abandonment	
Sewer Water Average (ug/L)		Sewer Water (ug/L)	
2014-2016	**304**	7/17/2017	<5.0
		10/11/2017	Dry
		12/12/2017	Dry

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Conclusion

- 17 Homes sampled along sole source sewer to IA migration pathway
  - 13 Homes (76%) > Residential IASL
  - 10 Homes (59%) > Residential SSSL
- Highly variable "attenuation" factors (10^{2} to 10^{-5})
  - Low Volume "AFs" – 10^{-3} to 10^{-5}
  - High Volume "AFs" – 10^{2} to 10^{-3}
  - "AFs" > 1 may reflect flux of sewer gas into structures
- Multiple approaches may be needed for receptor mitigation
- Approach for source-based mitigation should aim to restrict impacts from entering sewer
- Comprehensive research needed for regulatory guidance

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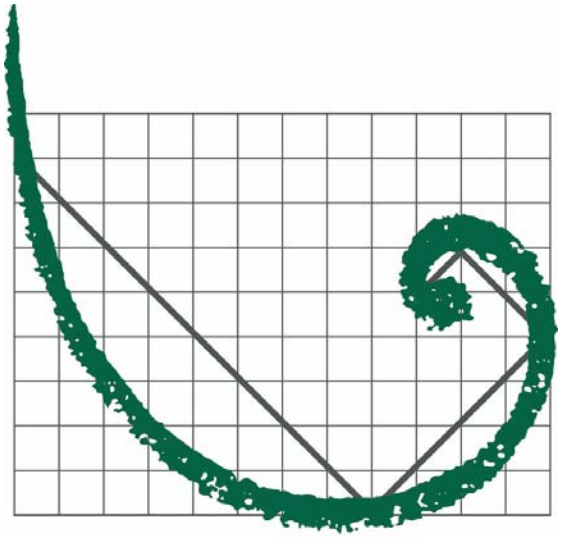
Conference on Remediation of Chlorinated and Recalcitrant Compounds

April 8-12, 2018 | Palm Springs, CA

Thank you!



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