SMART Remediation

Vapor Intrusion Through Sewers: Investigation and Mitigation

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VAPOUR INTRUSION THROUGH SEWERS: INVESTIGATION AND MITIGATION

Nicholas Head, MESc, P.Geo (ON)

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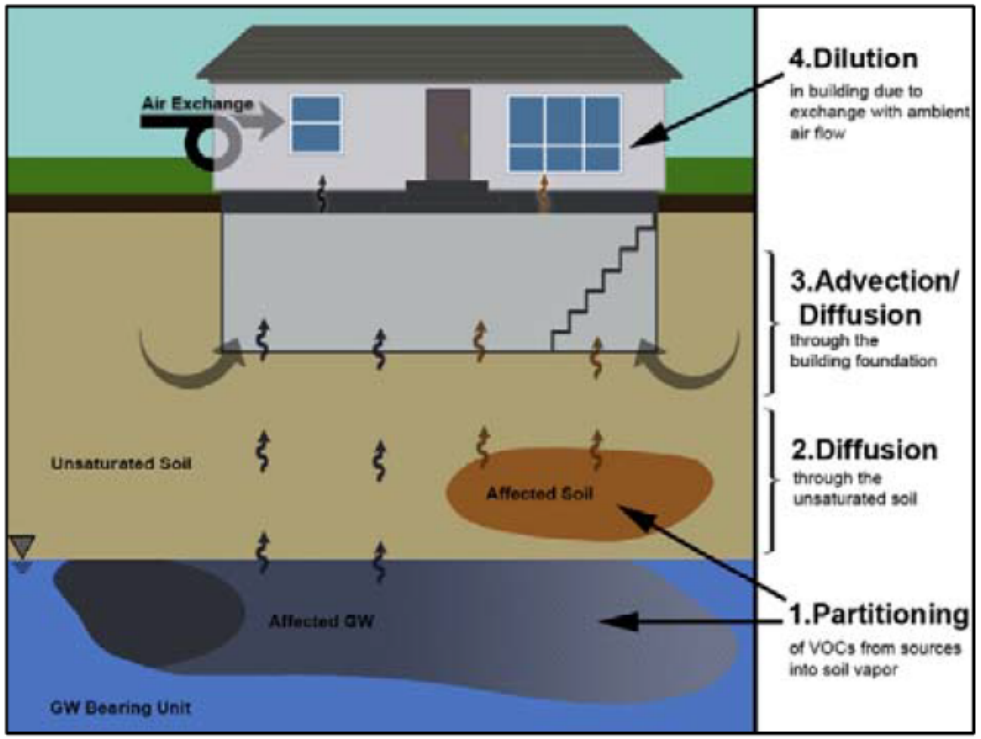
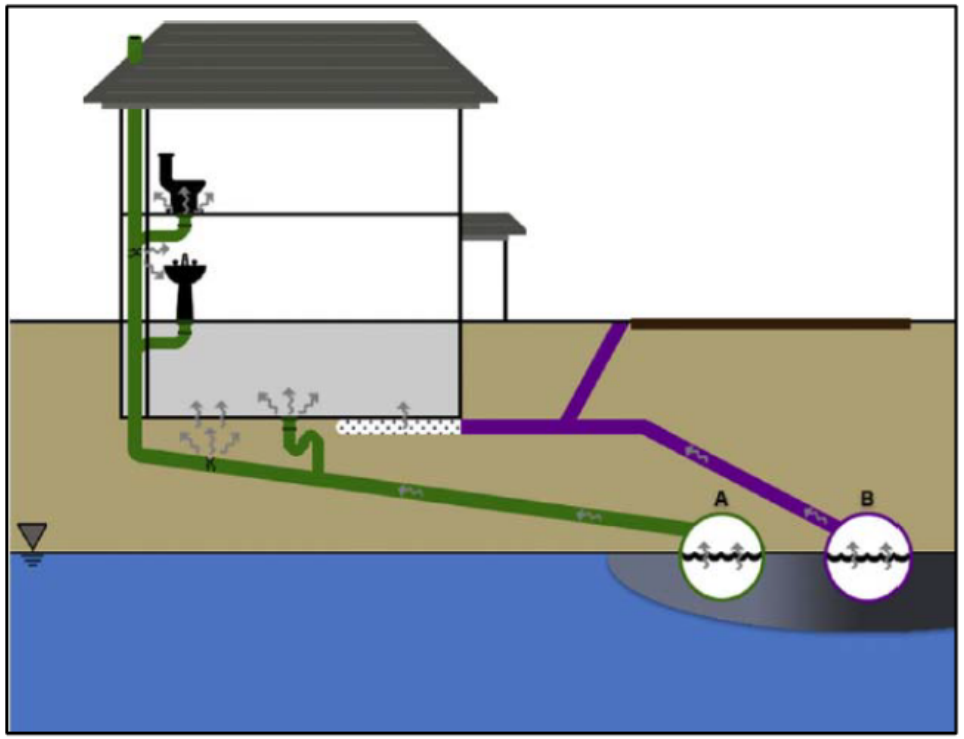
SMART Remediation | 8 Feb 2024

OVERVIEW – PREFERENTIAL PATHWAY OF SEWERS

CONVENTIONAL (STANDARD) VI

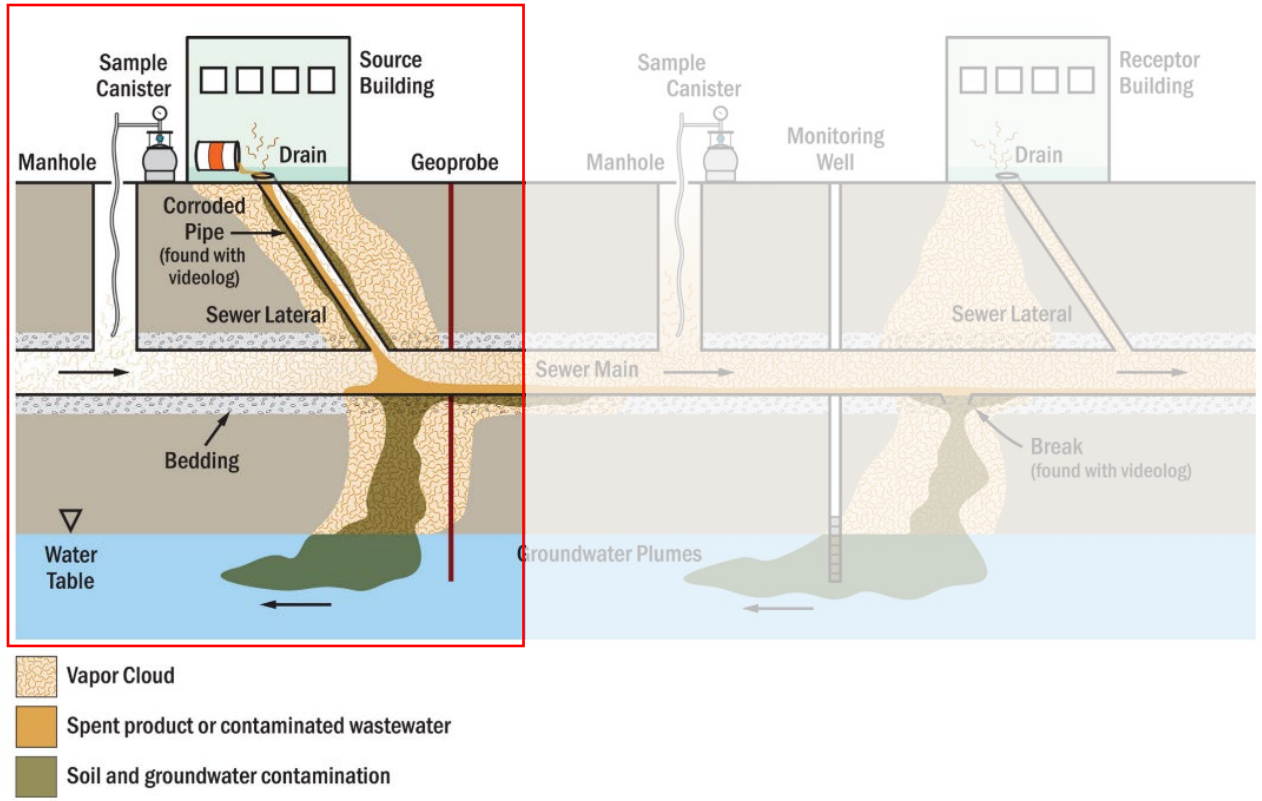


SEWER/UTILITY TUNNEL VI



Note: Figures from McHugh et al. (2017)

OVERVIEW – PREFERENTIAL PATHWAY OF SEWERS

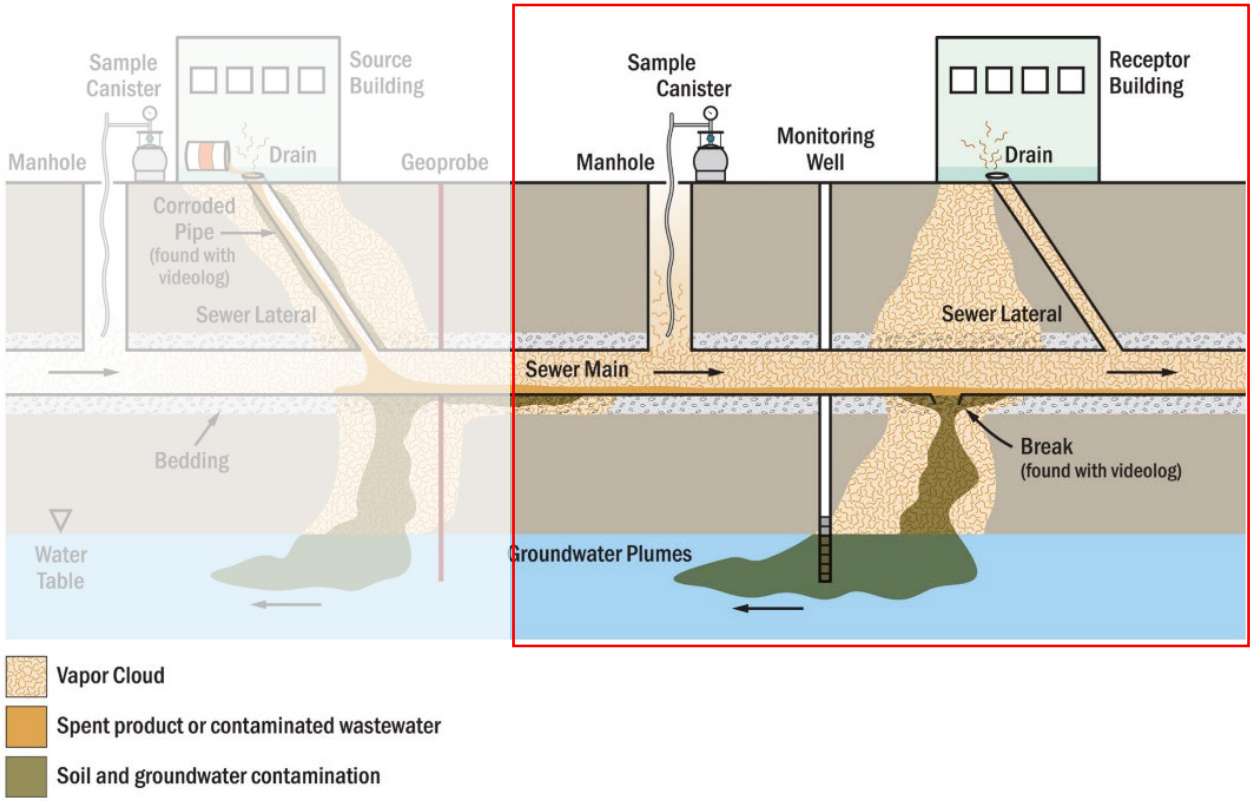


Source: Guidance for Documenting the Investigation of Human-made Preferential Pathway Including Utility Corridors, Wisconsin DNR, 2021. Publication RR-649

Contaminant Migration into Sewer Systems:

- Waste discharge into drains and service laterals
- Vapour migration into utility corridors
- Groundwater intrusion of sewers below the water table

OVERVIEW – PREFERENTIAL PATHWAY OF SEWERS



Source: Guidance for Documenting the Investigation of Human-made Preferential Pathway Including Utility Corridors, Wisconsin DNR, 2021. Publication RR-649

Preferential Pathway for Vapour Intrusion:

- Service laterals and drains (p-traps not functioning)
- Migration through utility corridors to below slab

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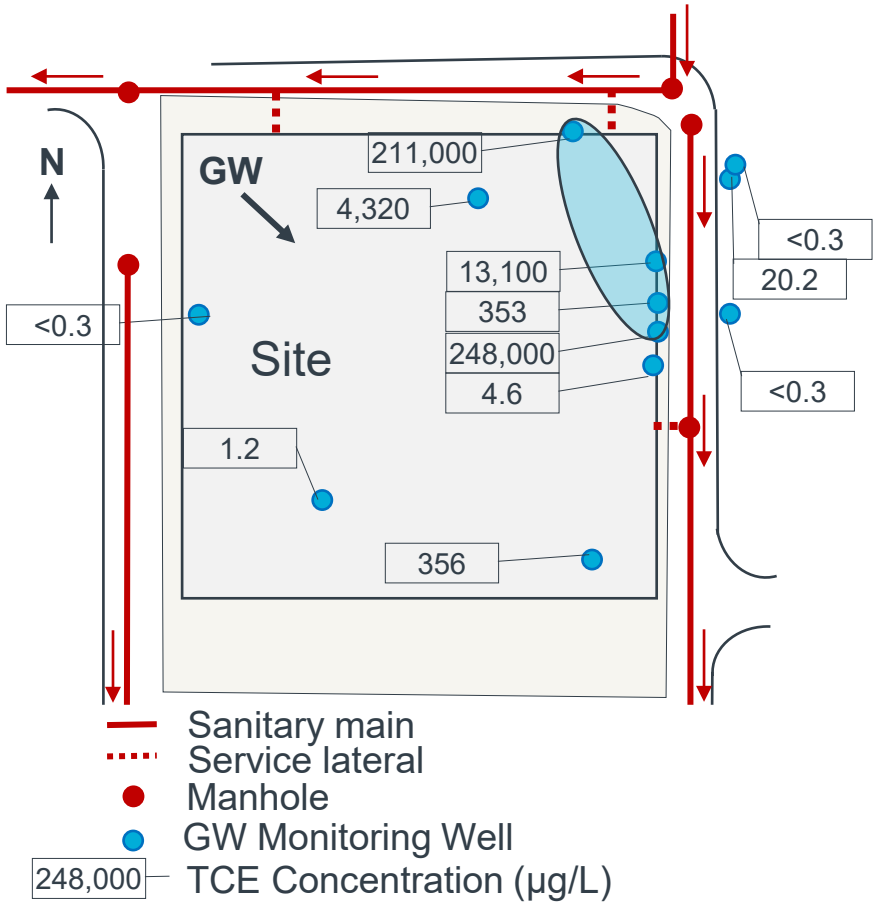
CASE STUDY

Sewer Venting System to Mitigate Preferential Pathway of Sanitary Sewers

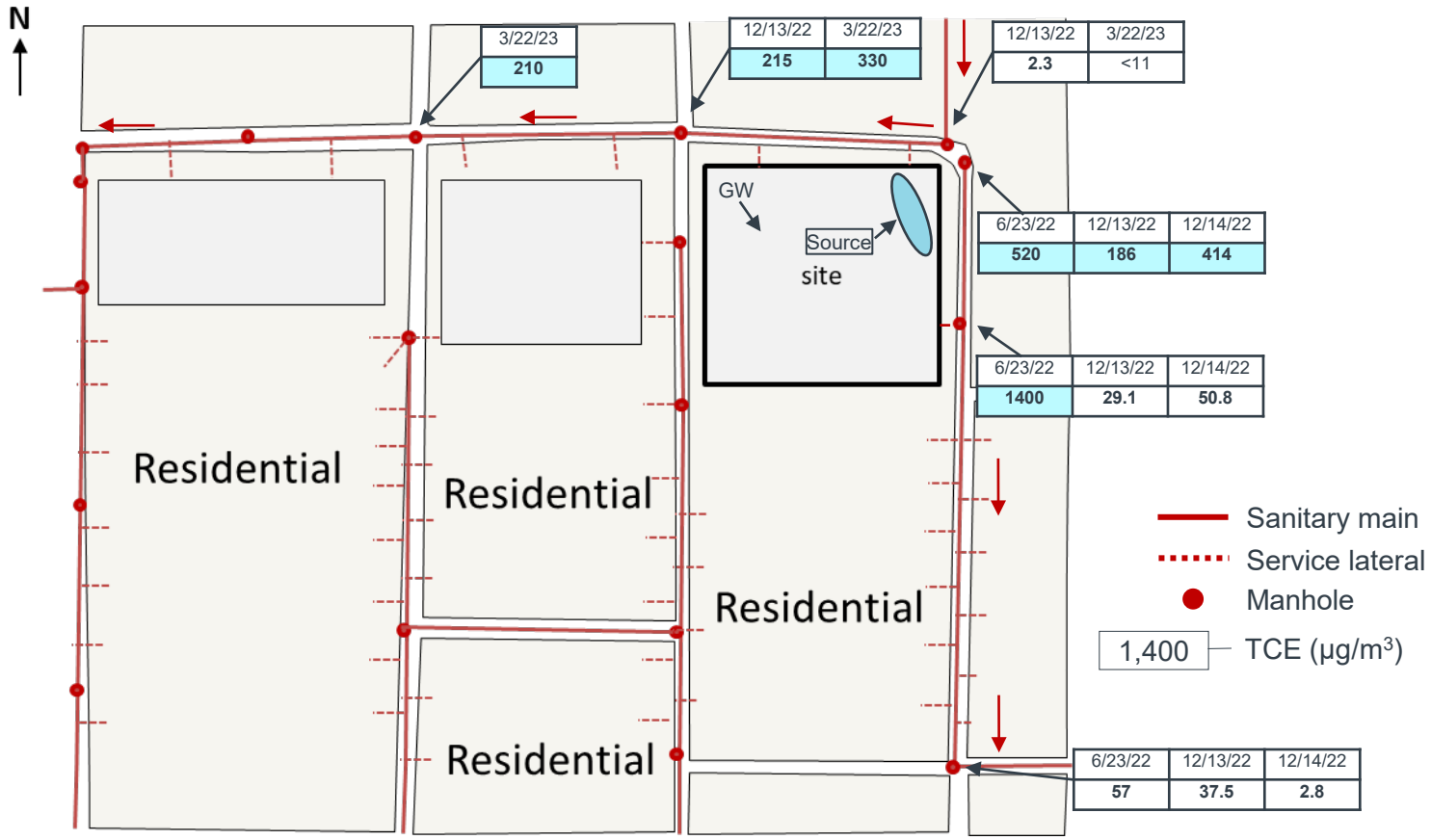
CASE STUDY – SITE DETAILS



Site Details:

- TCE in groundwater up to 248,000 µg/L
- Groundwater flow direction to southeast
- Existing sub-slab depressurization system
- Sanitary sewer mains to north, east, and west
  - Multiple service laterals from site building
- Surrounding property use
  - Industrial/commercial (north)
  - Residential (south, east, and west)

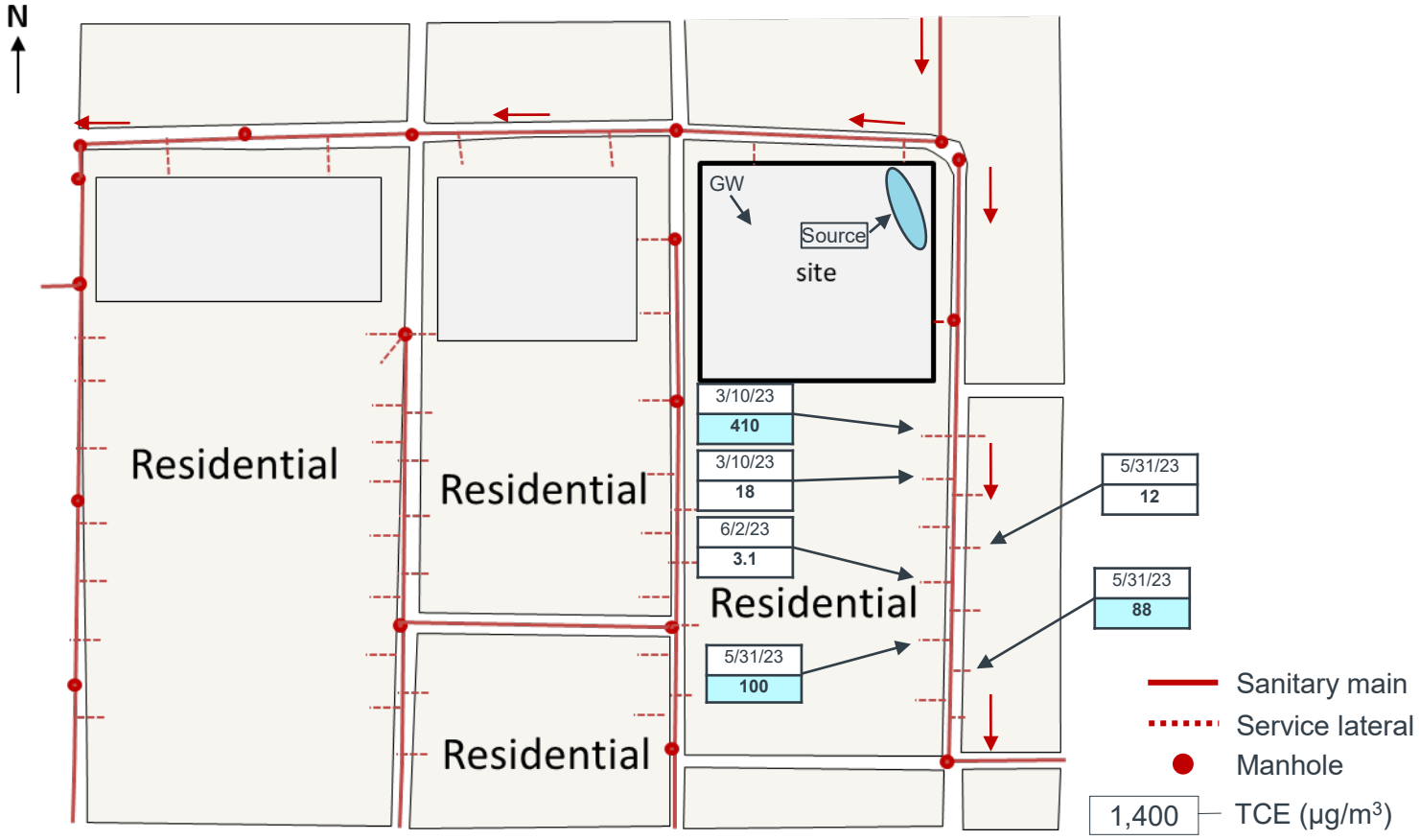
CASE STUDY – SANITARY MANHOLE RESULTS



Sanitary Manhole Sampling:

- Manholes sampled from east and north sanitary mains
- Exceedances of sanitary sewer gas screening level (70 µg/m^3)
- Data indicate sanitary mains acting as preferential pathway

CASE STUDY – RESIDENTIAL CLEANOUT RESULTS



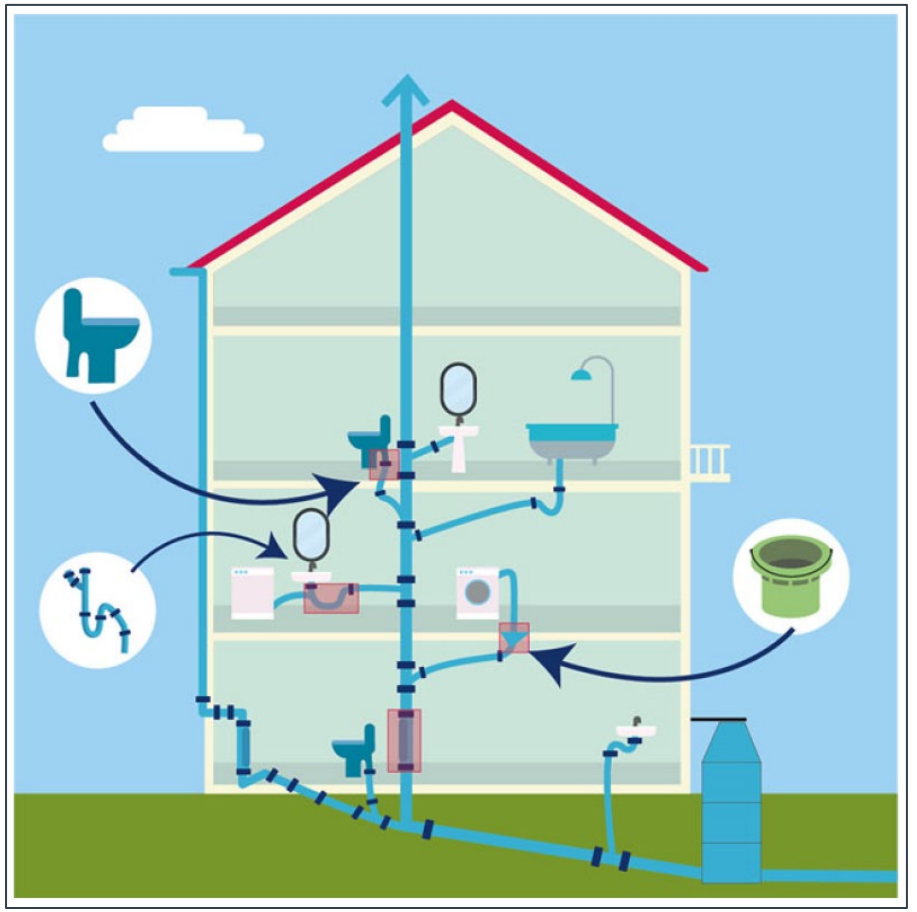
Residential Cleanout Sampling:

- Sewer cleanouts sampled from service laterals
- Exceedances of sanitary sewer gas screening level (70 µg/m^3)
- Data indicate potential VI risk from service laterals

CASE STUDY – MITIGATION MEASURES

Options for Remediation/Mitigation of Sewer Gas Pathway:

- Removing contaminant source
- Lining or replacement of sewer pipes
- Sealing the plumbing system in the buildings
- Passive venting of manholes
- **Active venting of sewer system***

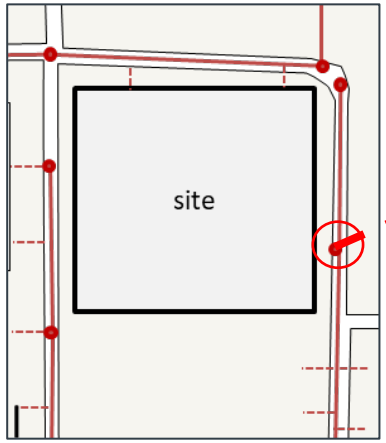


Source: Nielsen and Hvidberg 2017

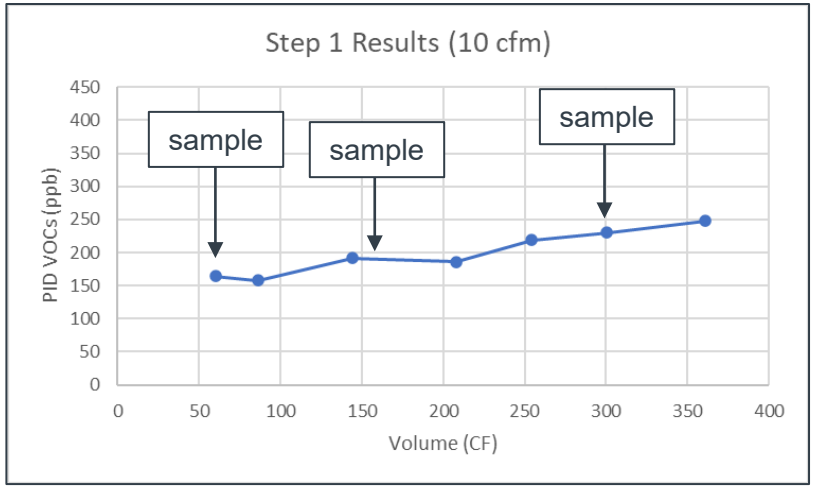
CASE STUDY – PILOT TEST

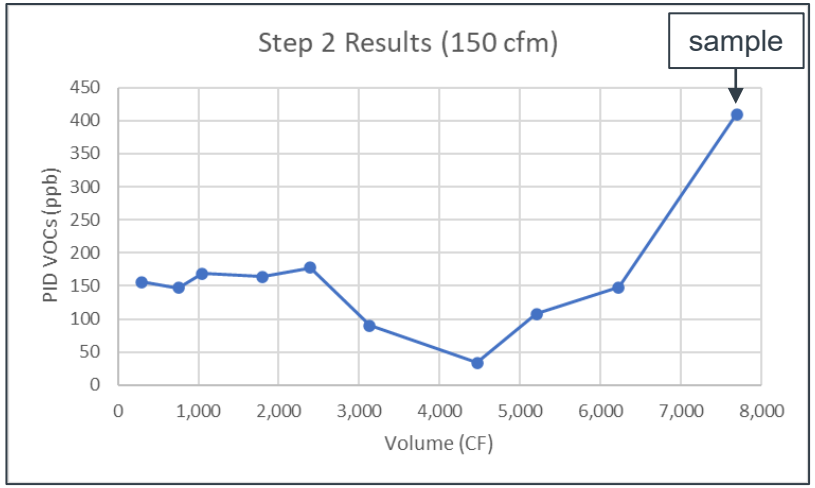
Pilot Test:

- Completed at manhole located along east sanitary main
- Investigate TCE distribution and mass flux of sanitary main
- Support design of sewer venting system



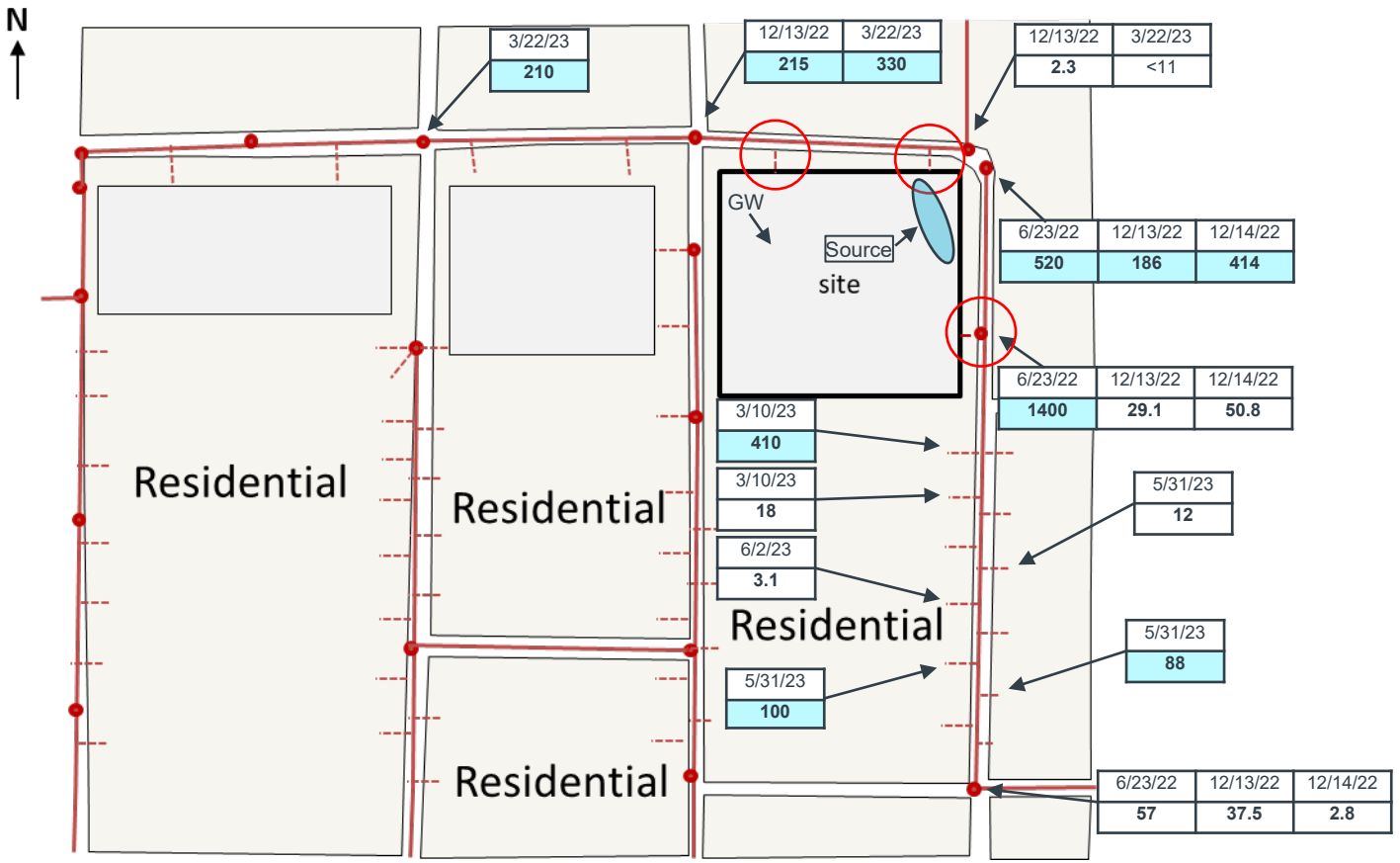
CASE STUDY – PILOT TEST





Purge Volume (CF)	60	160	300	8,000
TCE ($\mu g/m^3$)	185	194	361	189
cDCE ($\mu g/m^3$)	53.2	55.3	107	36.6
VC ($\mu g/m^3$)	1.5	1.8	3.1	1.7

CASE STUDY – SEWER VENTING SYSTEM



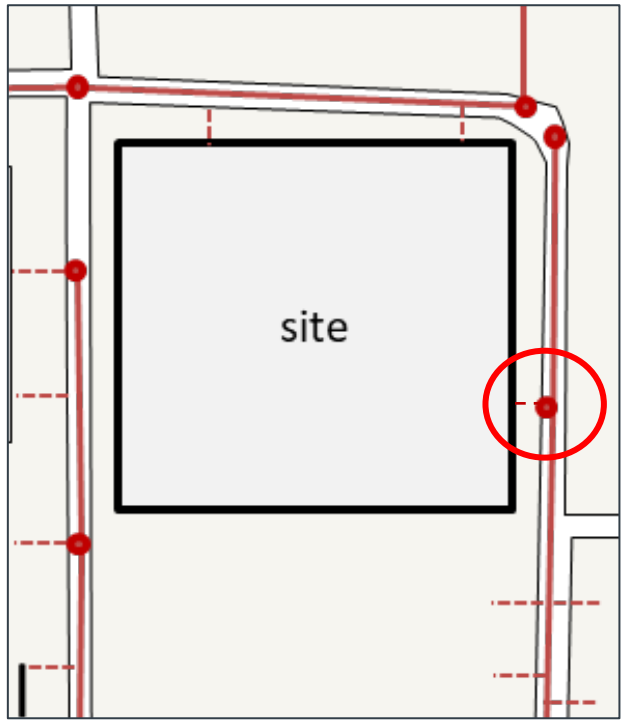
Sewer Venting System:

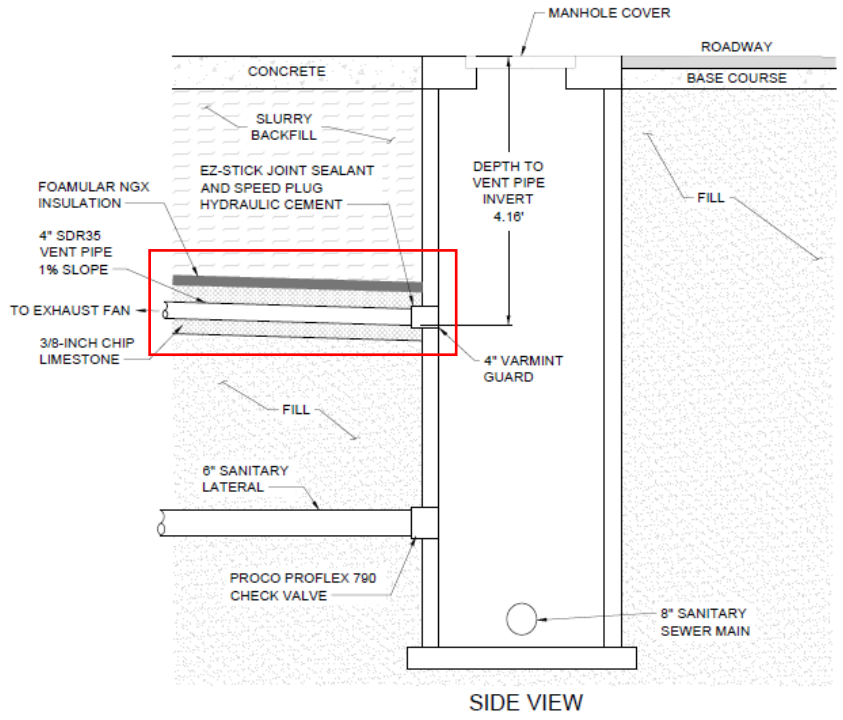
- Extraction points – 1x manhole and 2x sewer cleanouts
- Ventilate east and north sanitary mains

Sanitary main
Service lateral
Manhole
Extraction point
1,400 TCE (µg/m³)

CASE STUDY – SEWER VENTING SYSTEM

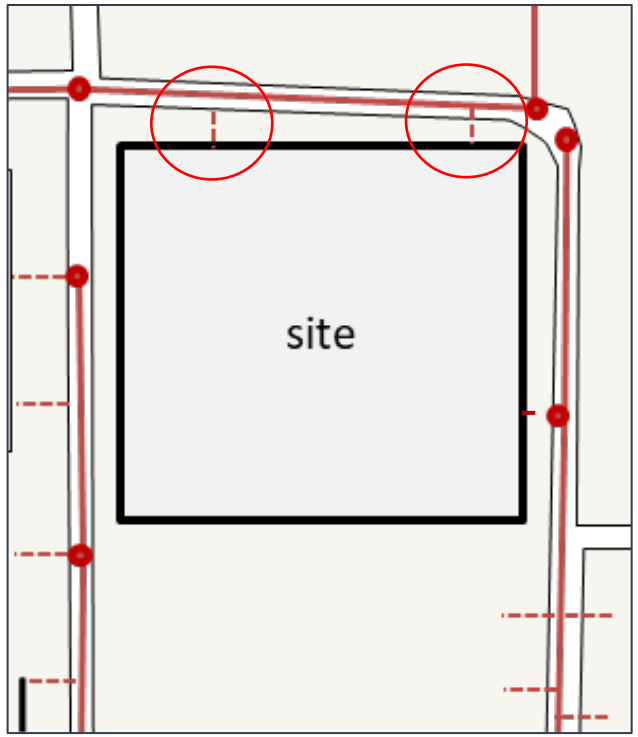
Manhole Extraction Point

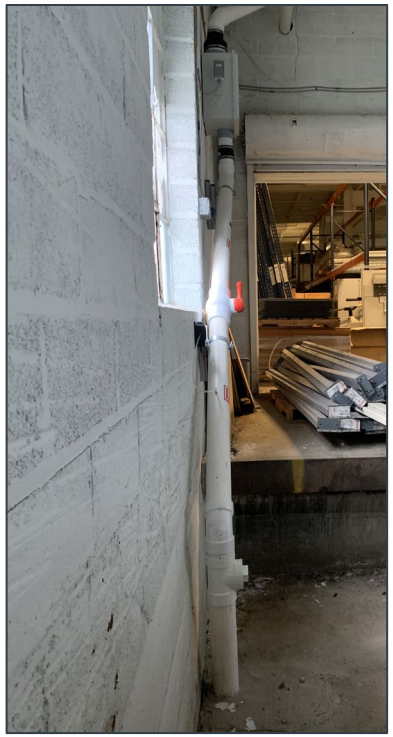




CASE STUDY – SEWER VENTING SYSTEM

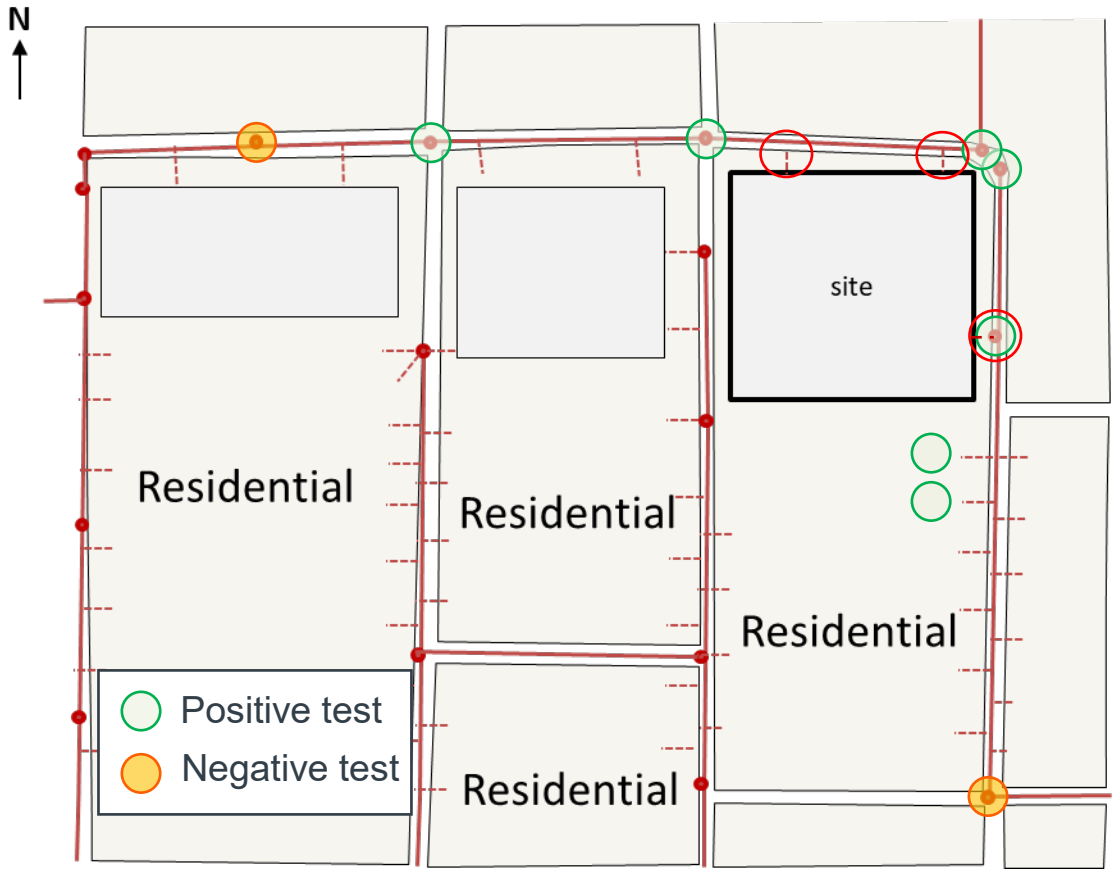
Sewer Cleanout Extraction Points

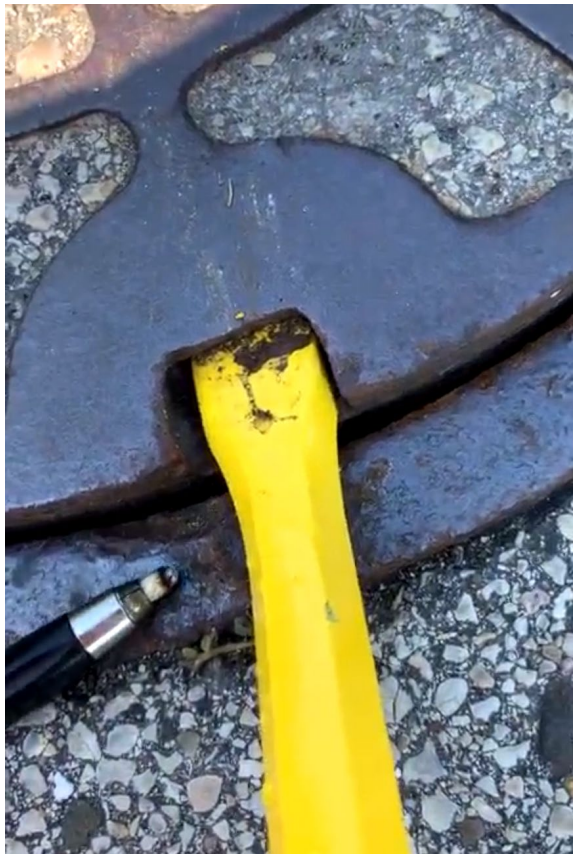




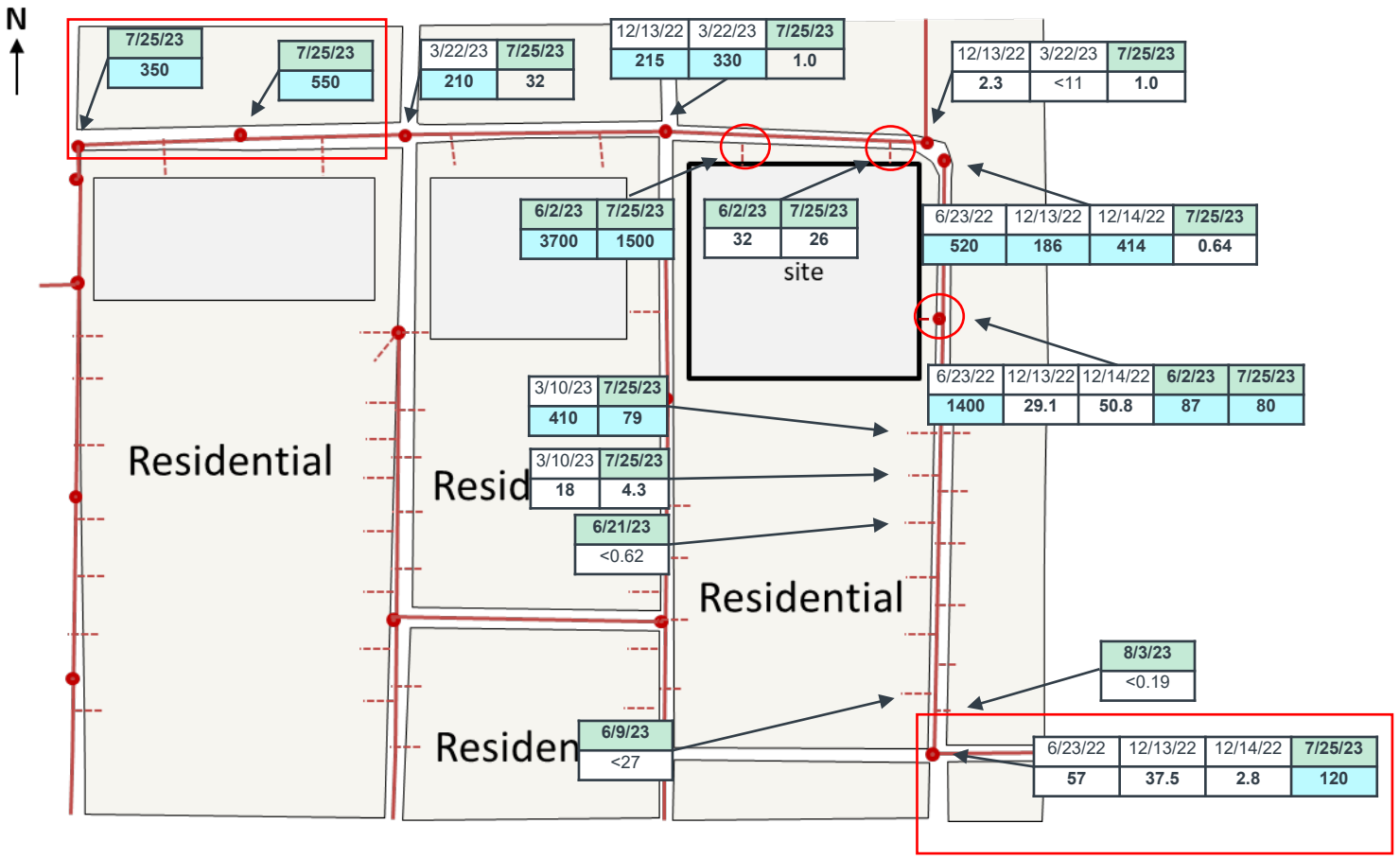
*Photos of NW location

CASE STUDY – SEWER VENTING SYSTEM PERFORMANCE





CASE STUDY – SEWER VENTING SYSTEM PERFORMANCE



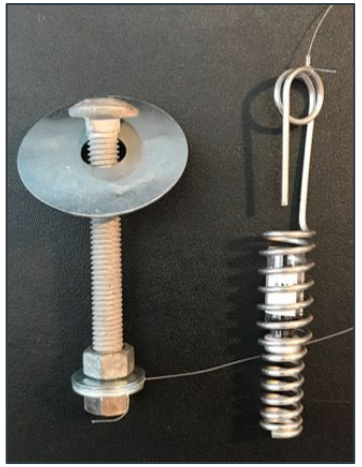
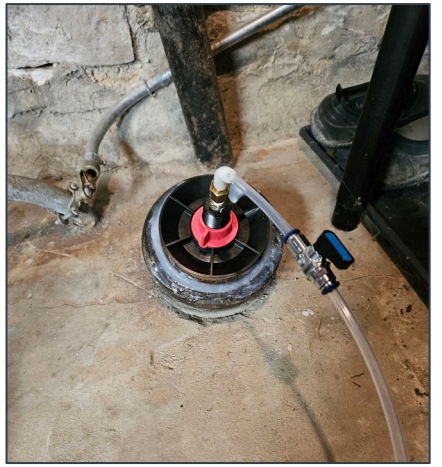
Performance Sampling of Sewer Venting System:

- Reduced concentrations at extraction points and most manholes
- Elevated concentrations in further extent of east and north sanitary mains
- Reduced concentrations in residential cleanouts

CASE STUDY - NEXT STEPS

- Additional sampling of manholes located along east and north sanitary mains
- Additional residential sampling of sewer cleanouts and indoor air during heating season
  - To include residential buildings located along the north sanitary main
- Evaluate impact of seasonal groundwater levels and sampling methodology (active vs passive) on sewer vapour concentrations
  - Active (Summa canister) and passive (Waterloo Membrane Sampler™)



CONCLUSIONS

- The preferential pathway of sewer systems can be an important aspect when developing a conceptual site model for vapour intrusion
  - Investigation and mitigation methods will be different from conventional vapour intrusion
  - Disregarding this pathway could lead to improper characterization and inadequate or unnecessary mitigation
- Active sewer venting systems are readily implementable and can be effective in mitigating the preferential pathway of sewer systems

Geosyntec consultants

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