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How Sewers Were Designed, Maintained and Located: Insights for Vapor Intrusion (VI) Projects

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Background/Objectives. All vapor intrusion (VI) investigations now require evaluation of the role of utilities (including sanitary sewers, storm sewers and backfill around pipes) serving as potential atypical preferential pathways for the transport of VOCs from the subsurface to indoor air. While there are several well-documented case studies of this occurring, existing regulatory agency guidance provides little detailed technical information on how to evaluate this pathway. VI practitioners have not had a concise summary of what they "need to know" about wastewater collection systems. Thus, since almost all buildings are served by sewers, this analysis is often uninformative or inconclusive. It has recently been suggested that atypical preferential pathways most "important" for vapor intrusion will have certain common characteristics, such as lack of resistance to advective flow and connectivity to a strong source of volatile organics.

Approach/Activities. Through a database analysis of 15 or more documented VI cases involving atypical utility preferential pathways it was determined that sanitary sewers are the single most common utility atypical preferential pathway. VI practitioners need to understand sewer system design and condition features on a neighborhood scale relevant to preferential transport as well as at the building envelope. A literature review of sewer design and construction practices was used to develop more detailed guidance for project teams. The guidance will also provide recommendations for accessing available information sources on local utilities as well as approaches for visual identification in the field, including the available technologies used in the field of conveyance system management to locate and evaluate the condition of sewers.

Results/Lessons Learned. One of the major goals in conveyance system management is to limit the inflow and infiltration (I/I) of water into sanitary sewers especially during wet weather. These locations of inflow and infiltration can also act as a preferential pathway for VOCs in aqueous or gas forms to enter and exit the conveyance line during other seasons. In this presentation we will describe the strengths and weaknesses of the major I/I evaluation technologies such as video inspection, smoke testing, liquid tracer tests and ultrasonic tests. VI practitioners often need to determine if a sewer line is deep enough to intersect with a VOC source zone. Standard locator services do not provide depth information. Minimum sewer design depths are dictated by cover requirements to bear traffic load and resistance to freezing. However VI practitioners may not realize that larger receiving pipes can often be over 20-ft below ground surface as they are located below all pipes discharging into their system (and other utilities) to prevent reverse flow and to optimize gravity flow. This presentation will suggest methods to estimate depth both through logical inference and instrumental techniques. Numerous instrumental technologies have been developed to fill the gaps in historical written/GIS records regarding utility locations to meet the needs of infrastructure developers. This presentation will describe the VI relevant applications of electrical resistivity, ground penetrating radar, magnetic and acoustic locating techniques.

Valuable knowledge of gas flow in sewers has also been developed for control of odor issues but may be unfamiliar to VI practitioners. For example, slope changes, siphons and the condition of designed air relief features can influence the flow of gasses out of sewer systems.