KAFB BFFS
ST-106/SS-111

EPA Region 6 Comments ENTERED 12/30/2020

WORK PLAN FOR SHALLOW SOIL VAPOR SAMPLING, BULK FUELS FACILITY, SOLID WASTE MANAGEMENT UNITS ST-106/SS-111, NOVEMBER 2019
KIRTLAND AIR FORCE BASE, NEW MEXICO
EPA ID# NM9570024423

General Comments:

1) **EPA concurs with NMEDs recommendation that KAFB develop a VI Conceptual Site Model (CSM) to guide further evaluation of the VI pathway. EPA recommends completing the CSM before making final risk management decisions for any given site.**

Vapor migration in the subsurface, through building foundations, and within buildings is complex and influenced by many natural and human-caused factors. These factors include climate (e.g., temperature, pressure, precipitation), building conditions (e.g., foundation type and status, age, size), and heating, ventilation, and air conditioning (HVAC) operation. The combination of these factors can result in significant spatial and temporal variability in subsurface and indoor air vapor concentrations. EPA considers the development of a robust CSM (updated as new information becomes available) essential to understanding and evaluating the VI pathway and should be used to guide the collection of additional data, i.e. multiple-lines-of-evidence (MLE) needed to determine if the pathway is incomplete or complete. MLE are particularly important for supporting "no-further-action" decisions regarding the VI pathway (i.e., pathway incomplete determinations) to reduce the chance of reaching a false-negative conclusion (i.e., concluding vapor intrusion does not pose unacceptable human health risk, when it actually poses an unacceptable human health risk). Collecting and weighing MLE can also help avoid reaching a false-positive conclusion (i.e., concluding vapor intrusion poses an unacceptable human health risk, when it does not).

Subsurface vapors can be drawn into indoor air principally through two routes: 1) vapors can migrate through the soil and enter buildings through openings in the foundation or 2) vapors can migrate through subsurface preferential pathways to openings in the foundation and into indoor air.

The conventional/basic CSM that has most commonly been used at VI sites involves the transport of VOCs from the subsurface source through soil toward the building, vapor entry into the building, and contaminant mixing with indoor air. Overall, vapor transport in the subsurface is controlled by contaminant partitioning, diffusion (transport from high to low concentration), and advection (transport from high to low pressure) (USEPA, 2012a). Diffusion typically dominates the transport of vapor phase contaminants from the subsurface source toward a building or ground surface. Vapors near the building can be transported by both diffusion and advection into indoor air via cracks or other openings. Advection resulting from negative indoor air pressure relative to the subsurface immediately adjacent to the building typically dominates transport of vapors into indoor air (USEPA, 2015a). Building heating, ventilation, and air conditioning (HVAC) operations (e.g., stack effects from heating/air conditioning) and weather conditions (e.g., barometric pressure, wind, and temperature) can affect the pressurization of a building. EPA typically recommends initial concentration- or distance-based screening to evaluate whether VI may be a concern, supported by an MLE investigation approach for sites that do not screen out. MLEs should be used to reduce the considerable uncertainty associated with the spatial and temporal variability of COCs in groundwater, soil gas, and indoor air to provide a more comprehensive understanding of the VI pathway and to increase confidence in making site management decisions regarding VI. Lines of evidence may be weighted differently for each site and building, depending on their characteristics and quality. Distance-based screening is generally applied under this CSM based on the lateral or vertical distance between the edge of the subsurface VOC source and the bottom of the building foundation. If the building is closer to the source than the screening distance, then further evaluation of VI is recommended. A distance of 100 feet is typically used for both lateral and vertical screening and is supported by modeling and observations at other VI sites when significant surface covers are not present, under the assumption that preferential vapor migration routes are absent. Concentration based screening is also used under this CSM where the maximum VOC concentrations in groundwater or soil gas are compared to VI screening levels (VISLs) to determine if further evaluation is needed. Screening concentrations have been developed by regulatory authorities using an attenuation factor (AF) approach (USEPA, 2015a). The AF is an inverse measure of the overall decrease in concentration due to attenuation mechanisms that occur as vapors migrate from the subsurface into a building. The greater the attenuation, the smaller the value of the AF (USEPA, 2012b; USEPA, 2015a). Concentrations of VOCs in subslab soil gas, exterior soil gas, or deeper soil gas or groundwater can be used to estimate indoor air concentrations.

The conventional/basic CSM, however, does not account for VOC migration through preferential pathways, which may occur over much greater distances. This scenario also may result in higher vapor concentrations inside the building or structure than would be expected based on advection or diffusion of vapors into the structure. EPA recommends that buildings with significant preferential migration routes be evaluated closely. AFs in such situations typically do not apply.

The VI preferential pathway CSM evaluates pathways for VI via specific migration routes that support higher contaminant transport, into a building compared to transport through bulk soil. EPA and others define a preferential pathway for VI investigations as all high-capacity transport pathways for vapors from the subsurface source to the building foundation or into the building (USEPA, 2015a). Examples of preferential pathways are bedrock fractures, sand lenses, dry wells, rodent tunnels, vapor pathways inside conduits (e.g., sanitary sewers, storm drains, utility tunnels-corridors, fiber optic cable housing, etc.), and engineered backfill material along conduits. More specifically, a utility tunnel-corridor (also referred to as a services tunnel, services trench, services vault, or cable vault) is a passage built underground or above ground to carry utility lines such as electricity, water, and sewer pipes. Utility tunnels are often installed at large military facilities, industrial plants and other large institutions such as universities, hospitals, research labs, etc. Vapor conduits such as these provide little to no resistance to vapor flow. For example, vapors can flow through the pipes of the sanitary sewer, utility conduits, or other drains or conduits and if they penetrate the building foundation, the preferential pathway can also serve as a potential vapor entry point. Sewer VI is a term used when vapor-forming chemicals enter sewer pipes that run through contaminated soil or groundwater. Once inside a sewer, vapors can move through the pipes and escape through cracks or openings, under or inside a building. Some of the traditional ways to test for vapor intrusion could potentially miss vapor-forming chemicals moving through sewer pipes. Public and facility records may be useful sources of information about utility and sewer locations, which may provide maps, "as built diagrams," or construction specifications. Depending upon the CSM, sampling of vapors within the utility corridor (or within a sewer, if present) may be warranted to characterize vapor migration in the subsurface.

2) **Shallow soil gas sampling should be conducted adjacent to the VA hospital and at certain homes in the Siesta Hills subdivision before the pathway should be excluded from further consideration.**

The document Conceptual Model Scenarios for the Vapor Intrusion Pathway (EPA 2012b) provides simplified simulation examples to show graphically how several of the subsurface and building-specific factors work together to determine the distribution of VOCs in the subsurface and the indoor air concentration relative to a source concentration. It provides a theoretical framework with which to draw inferences about and better understand the complex vapor fate and transport conditions typically encountered at actual, non-idealized contaminated sites. Following are several of the general observations made from these simplified simulation examples, and may be useful when considering the VI pathway at the site:

- The horizontal and vertical distance over which vapors may migrate in the subsurface depends on the source concentration, source depth, soil matrix properties (e.g., porosity and moisture content), and time since the contaminant release to the environment occurred.

- Vapor concentrations, including oxygen, in the vadose zone (i.e., soil gas concentrations) may not be uniform in sub-slab soil gas or in soil gas at similar depths exterior to the building of interest. Therefore, soil gas concentrations at exterior locations (i.e., outside a building's footprint) may be substantially different from the concentration underneath the building (e.g., the sub-slab concentration), depending on site-specific conditions and the location and depth of the exterior soil gas sample.

- Simulations assuming an idealized, constructed ground cover suggest that shallow soil gas concentrations can be greater under low-permeability ground covers (e.g., asphalt) than under soil open to the atmosphere.

EPA generally recommends that soil gas surveys collect soil gas samples at multiple locations and depth intervals between the vapor source and building(s) (potential "receptors"). As a result, the soil gas survey may include samples collected immediately outside the building ("exterior soil gas") at various depths or several depth intervals, as well as immediately beneath it (e.g., sub-slab soil gas sampling). If any shallow soil gas samples are collected, EPA recommends they be collected as close as possible to the building and at depths below the respective building foundation and no less than five feet below ground surface, depending on site-specific conditions. The goal is to locate the soil gas concentrations outside the building footprint that best represent conditions immediately below the building. Less attenuation is expected beneath buildings with a slab (e.g., slab-on-grade or basement) due to the slab capping effect, which is a result of a concrete slab acting as a barrier or cap limiting the downward flow of ambient air and the upward venting of contaminated soil gas. Where crawl spaces are present, crawl space air sampling may also be conducted.

To ensure that the sampling data will meet the site-specific data quality needs, EPA recommends that the sampling and analytical methods selected be capable of obtaining reliable analytical detections of concentrations less than project-appropriate, risk-based screening levels (e.g., VISLs). Towards that end, EPA recommends that, as part of establishing site-specific data quality objectives (DQOs), the planning and data collection team(s) consult with a laboratory skilled in the analysis of air and soil gas samples and choose sampling and analytical methods capable of routinely attaining the desired detection sensitivity for each medium. Several rounds of sampling are recommended to develop an understanding of temporal variability to ensure that final risk management decisions are based upon a consideration of a reasonable maximum vapor intrusion condition.