COMMONWEALTH of VIRGINIA

Department of Health

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November 23, 2016

Dr. David Goodfriend, MD, MPH, District Director
Loudon County Health Department
1 Harrison Street, SE
Leesburg, VA 20175

Dear Dr. Goodfriend,

Thank you for sharing Loudon County's independent's review of Hidden Lane Landfill's Final Remedial Investigation Report with the Division of Environmental Epidemiology (DEE). DEE was previously asked by the Agency for Toxic Substances and Disease Registry (ATSDR) to review their public health assessment, Hidden Lane Landfill Public Health Assessment (2009), and determine if recommendations in that document were addressed and to identify additional public health concerns at the landfill. As we discussed, DEE *will use this opportunity to provide comments on Loudoun County's independent review (LCIR) of the remedial investigation (RI) report and ATSDR's request.* Site background and historical information is provided as necessary. In 2009, ATSDR released its health assessment for Hidden Lane Landfill.[1] In that health assessment ATSDR made several recommendations:

1. EPA should ensure proper operation of the carbon filtration systems on private wells, especially if the system has sulfur odor problems. ATSDR recommends EPA work with its contractors to address the sulfur odor problems in certain well treatment systems.
2. ATSDR, EPA, and Loudoun County should work together to encourage residents who have not had their private well tested for contaminants to have the water tested. If the VOC levels in the well water exceed drinking water standards, residents should be informed about the potential hazard of drinking the water without filtering it properly for VOCs.
3. EPA should perform adequate groundwater and soil gas sampling to determine if vapor intrusion into nearby homes is a possibility, and take follow-up actions as necessary.
4. EPA should monitor the potential for physical hazards (fire and methane gas production) to impact nearby residences.

[1] ATSDR Public Health Assessment for Hidden Lane Landfill. April 6, 2009.

5. The following recommendation was made in the text of the document and not found at the end with the other recommendations: *ATSDR recommends that EPA include plans to sample landfill soil and subsurface soil for a full range of contaminants to determine the potential hazard associated with trespasser or recreation exposure at the landfill.*

ATSDR's Region III office asked DEE to determine if recommendations in the health assessment were addressed and to identify additional public health concerns at the landfill. These findings are presented in Attachment A of this letter.

The LCIR report provides a critique of the RI conclusions, lists deficiencies in the RI including data gaps, speculative or incorrect interpretation of data and conclusions, and potential current and future hazards. The report also provides comments on each section of the RI. The LCIR states that there are five issues of immediate concern:

1. Concentrations of trichloroethene (TCE) in tap water (post treatment) have exceeded the maximum contaminant level (MCL) in 20 tap water samples and have exceeded the EPA Risk Based Regional Screening Level (RSL) in 46 tap water samples. The concentration of other volatile organic compounds (vinyl chloride, chloroform and 1,2-dichloroethane) have exceeded RSLs in 244 tap water samples. The EPA should address exposure, notification to residents, and concerns for human health as well as account for failures in the point of entry treatment systems (POETS) at residences.
2. Because metals in groundwater are present at concentrations that exceed RSLs and are not treated by the POETS, the EPA should direct the contractor to immediately begin monitoring consistently for the concentrations of metals in residential wells and in tap water at all residences. It is probable that the risk of exposure to metals in groundwater is underestimated in the human health risk assessment.
3. EPA should release the identification of the residential sampling locations which are redacted in the RI. Redaction of this data is a significant barrier to assessing public health concerns, runs counter to expectations for transparency, and is problematic to a review of the RI.
4. EPA should immediately release the work plan and reports (interim or final) including all data associated with the recently completed vapor intrusion study. Potential exposure pathways and impacts to human health due to TCE vapors were left as an open-ended question in the RI.
5. For the on-going treatability study, the EPA should immediately release the work plan and any interim reports including all data collected to date. Remediation of TCE by enhanced bioremediation is expected to significantly increase concentrations of cis-1,2-dichloroethene and vinyl chloride in groundwater and possibly release naturally-occurring arsenic and other metals from geologic material.

Comments on the LCIR and each of these five issues of immediate concern are provided in Attachment B of this letter.

VDH has finished reviewing ATSDR's 2009 Public Health Assessment for Hidden Lane Landfill, Loudon County's independent review report, and EPA's 2015 Final Remedial

Investigation Report for Hidden Lane Landfill. VDH's conclusions and recommendation are below.

CONCLUSIONS

DEE concludes that methane gas levels reported are not a health hazard.

DEE concludes that concentrations of volatile organic compounds reported in the vapor intrusion study conducted in February 2015 are not a health hazard.

DEE concludes that concentrations of volatile organic compounds in tap water samples collected in 2012 and 2014 are not a health hazard.

DEE concludes that average concentration of arsenic in all tap water samples collected in 2014 are a public health hazard because the additional cancer risk slightly exceeds 1 in 10,000.

DEE concludes that contaminants in surface water and sediment are not a health hazard, because there is no ongoing exposure to any of these environmental media.

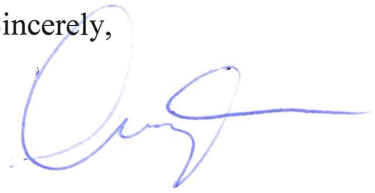
DEE concludes that contaminants below the landfill cap are not a health hazard given the elimination of the exposure pathway.

RECOMMENDATION

DEE recommends that residents using well water for potable use consider treatment options that reduce or eliminate arsenic concentrations in their well water.

I trust that the above information will be of help to you. Should you have any additional questions please contact me by phone at (804)-864-8187 or by email: dwight.flammia@vdh.virginia.gov.

Sincerely,



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Attachment A. Review of ATSDR's 2009 Recommendations

Responses to each of ATSDR's 2009 recommendations are addressed independently below.

Note: Contaminants in the environment can only impact human health if individuals are exposed to them and they are present at sufficient concentrations. Per ATSDR guidance, DEE examines exposure pathways and determines whether the concentration of a contaminant in the environment is of concern.

Evaluation of environmental sample results

DEE uses ATSDR's comparison values (CVs) to evaluate contaminant concentrations in environmental media. CVs are media-specific concentrations used to identify contaminants that require additional evaluation. They are derived using standard default exposure assumptions and are not site-specific. For contaminants detected below their respective CVs, exposure is not anticipated to result in adverse health effects. Concentrations above CVs do not mean adverse health effects occurred or will occur, but that further investigation is needed. Therefore, the CVs should not be used to predict the occurrence of adverse health effects. CVs used to evaluate contaminants at Hidden Lane Landfill Site include ATSDR's environmental media evaluation guide (EMEG) for children and cancer risk evaluation guides (CREGs). EMEGs represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, intermediate or chronic) without experiencing non-cancerous adverse health effects. CREGs are media-specific comparison values used to identify concentrations of cancer-causing substances which are unlikely to result in a significant increase of cancer rates in an exposed population. ATSDR develops CREGs using EPA's cancer slope factor or inhalation unit risk, a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents an estimated risk of one excess cancer cases in an exposed population of one million.

Evaluating exposure pathways

In addition to evaluating the concentrations of contaminants in soil, water, and air, DEE determines if an exposure is taking place. An exposure pathway can be defined by five key elements: a source of contamination (e.g., landfill); an environmental transport medium (e.g., groundwater); a point of exposure (e.g., tap water); route of exposure (e.g., ingestion); and exposed population (e.g., residents). These elements determine to what extent exposures may have occurred, may be occurring, or may occur in the future. All of these five elements need to be present for a pathway to be complete.

Follow-up actions to ATSDR's recommendations numbers 1 & 2 (well water maintenance and testing)

Through correspondence with the Loudon County Health Director DEE learned that homeowners are continually encouraged to have their wells tested privately, but they are not obliged to share results with the local health department. Additionally, EPA has routinely tested approximately 30 wells on a quarterly basis. The local health department has not received any

sulfur complaints directly from homeowners for several years and it appears that the EPA's contractor has been doing a good job at maintaining the systems undergoing monitoring.[2]

DEE evaluated the *treated well water* sampling results from 34 homes sampled in 2013 and 2014. The samples were tested for 31 analytes including trichloroethene, chloroform, 1,1-dichloroethene, 1,1-dichloroethane, and vinyl chloride. There were a total of 208 samples collected. A summary follows.

> TCE was detected in 22 out of 208 samples. The concentrations exceeded the cancer risk comparison value (CREG 0.76 µg/L) in 8 different homes once during the sampling period except for one home that was resampled later the same month. Four of the eight homes exceeded or equaled the non-cancer comparison value (EMEG 5.0 µg/L).
>
> Chloroform was not detected in any of the tap well water samples at concentrations exceeding its health based comparison value (Child EMEG 100 µg/L). Frequency of detection was 86 out of 208 samples.
>
> 1,1-Dichloroethene was not detected in any of the tap well water samples at concentrations exceeding its health based comparison value (Child EMEG 90 µg/L). Frequency of detection was 43 out of 208 samples.
>
> 1,1-Dichloroethane was not detected in any of the tap well water samples at concentrations exceeding the regional screening level (2.4 µg/L). Frequency of detection was 35 out of 208 samples.
>
> The frequency of detection for vinyl chloride was nine out of 208 samples. Eight of the nine results were reported as "analyte presumed to be a blank contamination artifact." The one sample not flagged had a concentration equal to 0.05 µg/L which exceeded its cancer risk comparison value (CREG 0.025 µg/L). None of the samples exceeded the higher non-cancer health based comparison value (Child EMEG 30 µg/L).

Raw and tap water samples were collected from 36 houses in 2014. Out of 83 total samples arsenic was detected in 82 samples. Of those 82 samples, including one duplicate, 41 samples were collected from the tap. The average, lowest, and highest arsenic concentration in all tap water samples reported was 2.25 µg/L, 0.4 µg/L, and 4.2 µg/L, respectively. The concentration of arsenic at the tap exceeded the cancer risk evaluation guideline CREG (0.025 µg/L) and was evaluated further.

Arsenic

Ingesting high doses of arsenic may cause nausea, vomiting, diarrhea, heart and blood vessels disease, and brain damage. Long-term health effects from exposure to low concentrations of arsenic include thickening of the skin, warts, pain in the arms and legs, and "pins and needles" sensation. Children who are exposed to high levels of arsenic have symptoms similar to adults. Ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver,

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[2] Personnel correspondence with Dr. David Goodfriend July 18, 2016.

bladder, and lungs. The Department of Health and Human Services and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer has determined that inorganic arsenic is carcinogenic to humans.[3]

Arsenic levels in groundwater average about 1–2 µg/L, except in some western states with volcanic rock and sulfidic mineral deposits high in arsenic, where arsenic levels up to 3,400 µg/L have been observed. Many communities have high levels of arsenic in their drinking water due to contamination or as a result of the geology of the area. For members of the general population, above-average exposure to arsenic from drinking water is possible in areas of high natural arsenic levels in groundwater or elevated arsenic levels in drinking water due to industrial discharges, pesticide applications, or leaching from hazardous waste facilities.

To determine the increased cancer risk from a lifetime exposure to arsenic in drinking water the concentration was multiplied by the drinking water unit risk ($5x10^{-5}$ per µg/L). Rather than present the increased cancer risk for each house sampled a comparison table with various concentrations is presented below. Acceptable levels of risk used by most state and federal agencies are less than 1 in 10,000. Anything greater than 1 in 10,000 is considered high.

Arsenic concentrations reported in 2014 and calculated risk at different concentrations

Arsenic Concentration (µg/L)	Additional calculated increase cancer risk*	Cancer risk characterized
0.4 – lowest reported in 2014	2 in 100,000	Low
1.0	5 in 100,000	Low/High
2.25 – average reported in 2014	1.1 in 10,000	High
3.0	1.5 in 10,000	High
4.2 – highest reported in 2014	2.1 in 10,000	High
5.0	2.5 in 10,000	High
10.0	5.0 in 10,000	High

*Risk is calculated by multiplying the concentration and the unit risk, $5x10^{-5}$ per µg/L.

Follow-up actions to ATSDR's recommendation number 3 (vapor intrusion)

Vapor intrusion study

A vapor intrusion (VI) study was conducted in February 2015.

Sub-slab soil gas samples

All sub-slab soil gas samples collected using Tedlar® bag were analyzed onsite for vinyl chloride (VC), 1,1-dichloroethene (1,1-DCE), trans-1,2-dichloroethene (trans- 1,2-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), TCE, and tetrachloroethene (PCE). A reporting limit (RL) of 0.50 parts per billion by volume (ppbv) for all target compounds, except for VC at 5 ppbv, was required.

[3] ATSDR 2007. Toxicological Profile for Arsenic. U.S. Department of Health and Human Services, Atlanta, GA.

Results

Of the 11 installed sub-slab soil gas probes, 10 samples were collected in Tedlar® bags and analyzed on-site in the EPA's mobile laboratory by GC/MS. VC, 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE, and TCE were not detected in any of the analyzed samples. The highest concentration of PCE detected is as follows: sample number (#) 52838/Unit 011 SS at 0.54 ppbv (3.7 $\mu g/m^3$).

Air samples

Air samples were collected from the crawl space of seven units and a first floor location from one unit. Two outdoor ambient air samples were collected at locations adjacent to two units. All samples were collected in SUMMA canisters The requested target compounds of concern were: VCL, 1,1-DCE, trans- 1,2-DCE, cis-1,2-DCE, TCE, and PCE. A reporting limit (RL) of 30 parts per trillion by volume (pptv) was required for all target compounds.

Results

Ten air samples and one trip blank were collected on 2 February 2015 and 3 February 2015 using SUMMA® canisters. VC, 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE, and TCE were not detected in any of the analyzed samples. The highest concentrations of PCE detected were as follows: sample # 52810/Unit 001 CS at 0.014 ppbv (0.095 µg/m3) and sample # 52819/Unit 019 Amb at 0.014 ppbv (0.094 $\mu g/m^3$).

Real-time indoor air samples

Real-time indoor air monitoring was conducted at one residential unit by SERAS personnel using the ECA Trace Atmospheric Gas Analyzer (TAGA) mass spectrometer/mass spectrometer (MS/MS) located in the EPA's mobile laboratory.

Results

The TAGA MS/MS system was used to survey the indoor air of a residential unit. The real-time air monitoring was used to determine the impact of the subsurface gas plume, if any, to indoor air quality. During the survey, a one-minute average was measured in various room areas, locations, and floor drains. Of the unit surveyed, the average concentrations of TCE and PCE were not detected above their quantitation limits at any of the monitoring locations.

Only PCE was reported as detected in the air and it was compared with its cancer and non-cancer CV (CREG CV is 3.8 $\mu g/m^3$ and Chronic EMEG is 270 $\mu g/m^3$). The sub-slab concentration (3.7 $\mu g/m^3$) is not indicative of what is in the house. In general, an attenuation factor is used to estimate the indoor air concentration when sub-slab concentrations are collected. Finally, the

sub-slab concentration was less than the CREG and EMEG, therefore further evaluation of this result is not warranted.

Follow-up to ATSDR's recommendation number 4 (landfill gas)

Subsurface methane gas monitoring has occurred semi-annually since 2008 at a total of 22 locations along the east and west side of the landfill. Detections of methane above the detection limit (0.3% by volume) were reported in two samples collected in 2011 and in one sample collected in 2012. The maximum detection was 1.7% by volume. None of the samples exceeded the lower explosion limit (5% by volume). Hidden Lane Landfill has not received any waste since 1984. Methane production at landfills goes through phases and based on the age and recent methane concentrations detected it appears that the landfill is in the last phase of methane production.[4]

Follow-up to ATSDR's recommendation number 5 (landfill soil and subsoil testing)

The RI states that soil sampling was conducted previously in 2005 and 2007 with the majority of the samples collected from the perimeter of the landfill, therefore, a soil investigation was not part of the RI. DEE is not aware of any soil sampling results taken from the landfill. In August 2016 EPA and its contractor told DEE that there was evidence from visual identification that recreational/trespassers frequent the landfill. This was evident by all-terrain vehicle tracks, horse tracks, signs of hunting, and people walking their dog. DEE was also provided a copy of the July and October 2013 landfill cap evaluation reports.

Landfill cap 2013 investigation summary

In July, 17 holes via auger were attempted. The thickness of the clay on the southwest and northeast sides was observed to be greater than 3 at two locations. Fifteen other hand auger attempts met with refusal due to stones, rocks, and cobbles within the clay cap. Locations were determined based on access due to landfill being heavily vegetated.

In October, EPA requested that the 15 locations where refusal was encountered in July be re-evaluated. In summary the report states that the landfill cap appears to consist of silt and some clay at an observed thickness of 2 feet.

After discussions with EPA, its contractor, and DEQ the vegetation, groundcover, and landfill cap are preventing contact with any contaminants in landfill soil two feet below the top surface of the cap. Exposure to any contaminants below the landfill cap is eliminated because one of the key elements (point of exposure) is not present.

[4] http://www.atsdr.cdc.gov/HAC/landfill/html/intro.html accessed July 2016.

Attachment B. Evaluation of Loudon County Independent Review

Five issues of immediate concern

The review states that there are five issues of immediate concerns. Each concern is listed followed by a response:

Issue number 1 - Concentrations of trichloroethene (TCE) in tap water (post treatment) have exceeded the maximum contaminant level (MCL) in 20 tap water samples and have exceeded the EPA Risk Based Regional Screening Level (RSL) in 46 tap water samples. The concentration of other volatile organic compounds (vinyl chloride, chloroform and 1,2-dichloroethane) have exceeded RSLs in 244 tap water samples. The EPA address exposure, notification to residents, and concerns for human health as well as account for failures in the point of entry treatment systems (POETS) at residences.

Response - Addressed above where well water maintenance and testing is discussed.

Issue number 2 – Because metals in groundwater were present at concentrations that exceed RSLs and are not treated by the POETS, the EPA should direct the contractor to immediately begin monitoring consistently for the concentrations of metals in residential wells and in tap water at all residences. It is probable that the risk of exposure to metals in groundwater is underestimated in the human health risk assessment.

Response - Addressed above where well water maintenance and testing is discussed.

Issue number 3 - EPA should release the identification of the residential sampling locations which are redacted in the RI. Redaction of this data is a significant barrier to assessing public health concerns, runs counter to expectations for transparency, and is problematic to a review of the RI.

Response - DEE also prefers data that is not redacted and in some large reports redacted data slows the process - especially for those who are used to receiving non-redacted data. However, it has never been a significant barrier to assessing public health.

Issue number 4 – EPA should immediately release the work plan and reports (interim or final) including all data associated with the recently completed vapor intrusion study. Potential exposure pathways and impacts to human health due to TCE vapors were left as an open-ended question in the RI.

Response - DEE received a copy of the VI study and DEE's findings are discussed above under vapor intrusion.

Issue number 5 – For the on-going treatability study, the EPA should immediately release the work plan and any interim reports including all data collected to date. Remediation of TCE by enhanced bioremediation is expected to significantly increase concentrations of cis-1,2-

dichloroethene and vinyl chloride in groundwater and possibly release naturally-occurring arsenic and other metals from geologic material.

Response - DEQ should be asked to comment on this issue of immediate concern.

LCIR critique of the nine conclusions and two recommendations

The LCIR provides responses and recommendations, if applicable, to each conclusion and recommendation in the RI. Most of the LCIR is directed towards data gaps identified. Below are the nine conclusions and two recommendations made in the report followed by DEE's response. Most have already been addressed earlier in the document.

Remedial Investigation Conclusion - Methane gas generation and migration is not a concern at the landfill.

Response - Discussed above

Remedial Investigation Conclusion - The estimated volume of TCE was calculated to be between 2.7 and 67.9 gallons. This volume estimate was calculated from the TCE mass present in the dissolved-phase, and does not take into account the sorbed mass within the Balls Bluff Siltstone. Some TCE is present in the bedrock as evidenced by continued dissolved TCE emanating from the RI-14 area. As identified in the CSM, TCE DNAPL likely migrated from the landfill downward into the fractures of the Balls Bluff Siltstone. Subsequently, TCE DNAPL that migrated into fractured bedrock has dissolved over time into groundwater, creating a dissolved-phase plume. Observed low concentrations of TCE in the fractured bedrock source area indicate that DNAPL is no longer present, and only a sorbed source of TCE remains within or adjacent to specific bedrock fractures

Response - DEE defers to DEQ for a response.

Remedial Investigation Conclusion - TCE in groundwater is the COPC at HLLF; the RI found no evidence that TCE has migrated into media other than groundwater within the overburden soil and fractured bedrock.

Response - TCE and arsenic are a chemical of concern in the groundwater. DEE defers to DEQ regarding migration of TCE into other media. TCE and arsenic concentrations in tap water are discussed above.

Remedial Investigation Conclusion - Risks to ecological receptors from analytes present in surface media at HLLF are not expected.

Response - DEE defers to DEQ for a response.

Remedial Investigation Conclusion - Risks to human receptors from analytes present in surface media and groundwater at HLLF, other than TCE, are not expected.

Arsenic present in the groundwater is a risk to human receptors. See discussion above regarding arsenic in groundwater.

DEE reviewed the surface water and sediment results for public health implications. There is no reason to believe that anyone would come into contact with contaminants in surface water and sediment on a continuous daily basis; therefore, screening the results using CVs developed for continuous exposures (e.g., CREG and EMEG) are not always appropriate. Also, dose calculations based on actual exposures are needed to further evaluate any health impact. A site visit or further discussions would help determine if an exposure to contaminants in surface water and sediment is occurring before assessing any health impact. It should be noted that arsenic was found in surface water samples at concentrations similar to what is found in the groundwater.

Remedial Investigation Conclusion - A TCE groundwater plume is present at HLLF and has impacted groundwater quality to the extent that exposure to groundwater poses the potential for unacceptable health risks to residential human receptors.

Response - Discussed above.

Remedial Investigation Conclusion - The existing POETS are sufficiently preventing exposure above regulatory standards for those residences with potable water wells and concentrations of TCE in untreated water that are greater than the MCL.

Response - There are occasional TCE exceedances. The risk presented in 2013 and 2014 are minimized so one could argue that the treatments systems are sufficient, however not perfect. The arsenic is not above the MCL but it is above the CREG. See discussion above.

Remedial Investigation Conclusion - Migration of TCE in groundwater is occurring and is controlled by flow in fractured bedrock.

Response - DEE defers to DEQ for a response.

Remedial Investigation Conclusion - Vertical flow paths with downward gradients along fractures intersect the zone of highest TCE concentrations (in RI-14). Upward gradients prevalent near the Potomac River have resulted in upward discharge of the plume.

Response - DEE defers to DEQ for a response.

Remedial Investigation Recommendation - A Feasibility Study is recommended to identify possible remedial alternatives that could prevent exposure to groundwater with concentrations of TCE that are above regulatory standards.

Response - DEE defers to DEQ for a response.

Remedial Investigation Recommendation - A vapor intrusion study would be needed to determine whether or not vapor migration is a complete or incomplete exposure pathway for human health receptors.

Response - See discussion above regarding VI.

The remainder of the LCIR is a section-by-section review and critique of the RI. Comments on this section-by-section review would not add beyond those already made by DEE. Also, DEE is aware that there have been on-going discussions since the release of the LCIR between EPA, DEQ, and Loudon County and that many of the concerns in the LCIR have been addressed.