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ENVIRONMENTAL RESPONSE TEAM – WEST
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To: James Augustyn, Region 5 On-Scene Coordinator, Cleveland, Ohio

From: Donald T. Bussey, CPG, Environmental Response Team, Las Vegas, Nevada
Robert G. Ford, PhD, Office of Research and Development, Cincinnati, Ohio

Re: Potential for Contamination of Ground Water by Landfill Leachate
Countywide Landfill, Stark County, Ohio

Introduction

Presently there are well-founded concerns that the Countywide Landfill's liner may be damaged due either to high temperatures and/or waste slumping/rotation due to exothermic reactions between aluminum dross (accepted as waste) and leachate within the landfill. At the request of OSC James Augustyn the writers travelled to Twinsburg and Columbus, Ohio for briefings by personnel from the Ohio Environmental Protection Agency (OEPA), and to Countywide Landfill in Stark County, Ohio for a briefing by landfill staff and consultants, March 4-6, 2008. Additionally, the writers were present at a briefing conducted by consultants to the Stark, Tuscarawas, and Wayne Counties Waste Management District in Pittsburgh, Pennsylvania March 19, 2008. This memorandum presents the writers' interpretation of the situation with recommendations to clarify sampling procedures for the semiannual detection monitoring program and confirm historical trends in hydrologic conditions in the southwest portion of the detection monitoring well network.

Geologic / Hydrogeologic Setting

The Countywide landfill is underlain by Pennsylvanian-aged sedimentary bedrock of the Allegheny and Pottsville Formations. The following is the location's generalized stratigraphic section:

Mine Spoil	0-80 feet
Allegheny Formation	
Lower Kittanning / #5 Underclay	6 feet
Lawrence Shale	discontinuous
Vanport Limestone	discontinuous
Clarion Shale	80 feet
Putnam Hill Limestone	10 feet

Brookville / #4 Coal

2 feet

Pottsville Formation

Brookville / #4 Underclay

4 feet

Homewood Shale / Sandstone

15-35 feet

coal/underclay/shale/limestone cyclic sequence

123 feet

Massillon Sandstone / Quakertown / Scioto

100-170 feet

Sharon Sandstone / Conglomerate

150-200 feet

There are two mine spoils at the site, one associated with the strip mining of the Lower Kittanning / #5 coal, and the other with the mining of the Brookville / #4 coal. These mine spoils have been designated as Significant Zones of Saturation and predominantly rest on the respective underclays. Recharge is primarily through direct infiltration of precipitation, but where spoils are in contact with buried mining high walls, potential discharge from the high walls may also contribute to recharge. Laboratory vertical permeability tests performed on the underclays indicate very tight (in approximate excess of 10^{-8} cm/sec) vertical permeabilities. Due to the low vertical permeabilities of the underclay, ground-water flow within the mine spoils (where saturated) is primarily horizontal and driven by underclay topography, with discharge along valley walls as seeps and springs.

In general, the Clarion Shale isolates the landfill liner and the Uppermost Aquifer System. Although the upper portion of this unit is comprised of discontinuous siltstones, limestones, coals, and underclays, the Lower Clarion is a consistently tight dark gray shale approximately 15 feet in thickness. Hydraulic conductivity data for the Lower Clarion are in the 10^{-6} to 10^{-8} cm/sec range. Monitoring wells within this unit have been removed from the landfill monitoring program as they typically would not yield enough ground water for sampling. This is the unit which the Stark, Tuscarawas, and Wayne Counties Waste Management District's consultants feel is possibly compromised by bedrock fractures.

The Putnam Hill Limestone and Brookville / #4 Coal, and the Homewood Sandstone / Shale, are the first saturated zones beneath the Lower Clarion Shale meeting the definition of an aquifer system, and are defined as the Uppermost Aquifer System. However, these units are not considered a Regional Aquifer, and no known supply well obtains potable ground water from the units in the vicinity of the landfill. Ground water within these units is confined relative to the footprint of the existing and proposed limits of waste placement. Due to the presence and low hydraulic conductivity of the Brookville / #4 Underclay, ground-water flow within the Putnam Hill Limestone and Brookville / #4 Coal is primarily horizontal.

The regional aquifers of southern Stark County include the Massillon Sandstone and Sharon Sandstone units (listed in the generalized stratigraphic section above), and the glacially derived sand and gravel outwash deposits located in buried stream valleys (locally Sandy Creek and the Tuscarawas River). The vast majority of the bedrock potable supply wells within a three mile radius of the Countywide Landfill utilize the Massillon and Sharon Sandstones as the primary water resource, with wells yielding up to 25 gpm, including public supply wells at the Bearcreek

Campground and Amphitheater, the USACE well at Bolivar Dam, and the on-site Countywide Landfill well. Within a four mile radius of the landfill buried sand and gravel valley aquifers are utilized for the Village of Bolivar and the community of Wilkshire Hills public water supplies, with wells yielding between 100 and 500 gpm.

Existing Monitoring Well Network / Sampling and Analyses Program

Based on review of the “Ground-Water Monitoring Plan for Countywide Recycling and Disposal Facility, Stark County, Ohio” (February 2008, Revision 5; hereafter referred to as the “Countywide GW Monitoring Plan”), the existing and proposed monitoring well network is adequate for the detection of potential releases of leachate to the underlying aquifer system. The sampling and analysis programs are also appropriate for the detection of potential leachate releases, including the protocol for well purging prior to sampling. The list of analytical parameters includes a sufficient number of chemical constituents that can be used to uniquely identify leachate relative to other potential sources of water sampled within existing and proposed screened intervals in the aquifer system.

As previously indicated, there are two areas where clarification of procedural details and confirmation studies are recommended. Two specific items are listed separately below with suggested paths forward:

- 1) As shown in Figures 8 and 8a of the Countywide GW Monitoring Plan, the portion of the Uppermost Aquifer System being monitored adjacent to the southwest limit of waste placement is not fully intercepted by a continuous confining unit. Currently, this portion of the aquifer system is monitored using wells MW-104B (completed in Homewood Sandstone / Shale Zone) and MW-16AR (completed across Clarion Shale – Putnam Hill Limestone – Brookville No. 4 Coal units) with supplemental ground-water chemical data being derived from the UD-5D underdrain (see Table 1 in Countywide GW Monitoring Plan). Verbal communication with Ohio EPA staff indicates that historical data from older well completions within mine spoils in the vicinity of the UD-5D underdrain has previously indicated dry conditions. Since the underdrain system does not provide water level data for this portion of the Uppermost Aquifer System, it is recommended that confirmation of the absence of a significant zone of saturation be conducted in mine spoils at an approximate location mid-way between the linear distance separating monitoring wells MW-104B and MW-16AR. In addition, it is recommended that construction details of the UD-5D underdrain and other monitored underdrain systems be documented within the Countywide GW Monitoring Plan in order to clarify the potential source(s) of water withdrawn from this type of sampling device.
- 2) As described in Section 4.3 of the Countywide GW Monitoring Plan, wells sampled under the monitoring program are outfitted with either a dedicated Well Wizard bladder pump or a dedicated PVC or Teflon bailer. Verbal communication with Ohio EPA staff indicates that dedicated bailers are used only for low-yield wells where continuous pumping is not feasible. It is recommended that a table be included in the Countywide GW Monitoring Plan that

documents what ground-water collection device is used for each of the detection monitoring wells along with documentation of the technical rationale for use of a bailer system.

Finally, it is indicated in Table 3 of the Countywide GW Monitoring Plan that existing wells MW-17A, MW-23A, MW-33 and MW-34 are scheduled for decommissioning following establishment of background conditions for newly installed wells (MW-105A, MW-101A, MW-102 & MW-103, and MW-102A & MW-103A). It is recommended that decisions on decommissioning of these wells be deferred until completion of work to assess the integrity of the liner system underneath the southern portion of the landfill. While these wells may appear to duplicate screened depths covered by the newly installed wells, they represent screened positions of the aquifer that would prove useful into the future to confirm and support observations at the wells positioned closer to the limits of waste placement. It does not seem necessary at this time to include these wells within the proposed semiannual detection monitoring program. However, it does seem premature to potentially decommission these wells prior to completion of the final analysis from the landfill liner integrity study with concurrence from all parties.

Potential for Contamination of Local Public Ground-water Supply Wells by Landfill Leachate

The Bearcreek Campground and Amphitheater wells, the USACE well at Bolivar Dam, and the on-site Countywide Landfill well all obtain ground water primarily from the regional bedrock aquifer of the Massillon and/or Sharon Sandstones. At the Bearcreek Campground and Amphitheater locations, ground-water flow within the regional bedrock aquifer is from the northwest towards the southeast, indicating ground water obtained from these wells is hydraulically upgradient of the Countywide landfill. Ground-water flow direction within the regional bedrock aquifer at the USACE well at Bolivar Dam and at the location of the Countywide well is not known. However, these wells are deep (in excess of 300 feet and 400 feet, respectively), and obtain water from a zone hydrogeologically isolated by the Lower Clarion Shale and several underclays which restrict vertical ground-water flow resulting in shallow ground-water discharge as surface seeps and springs. In addition, the USACE well at Bolivar Dam is on the opposite side of the Sandy Creek buried valley aquifer than Countywide.

The Village of Bolivar and the community of Wilkshire Hills public supply well fields obtain ground water from the Tuscarawas River and Sandy Creek buried valley aquifers, respectively. At Bolivar, ground-water flow within the sand and gravel aquifer mimics the flow of the Tuscarawas River, flowing west to east. Therefore ground water withdrawn from the Village's wells originates upgradient of the Countywide landfill. Likewise, at Wilkshire Hills, ground-water flow mimics the flow of Sandy Creek, from east to west. Ground water withdrawn from the Wilkshire wells therefore also originates upgradient from Countywide.

Based upon the above discussion, ground water potable public supply wells in the vicinity of the Countywide landfill should not be affected by leachate migration from the landfill due to a breach in the landfill's liner. The landfill's monitoring well network and sampling and analysis plan will allow for detection of a leachate release within the Significant Zone of Saturation and

Uppermost Aquifer System with sufficient warning for the release to be addressed. Additionally, at the present time no leachate detections have been made in ground-water samples from the potable supply wells and this sampling should continue.

Potential for Contamination of Regional Aquifer by Landfill Leachate

For many of the reasons listed above, there is no possibility for contamination of local public ground-water supply wells by leachate originating from the Countywide landfill due to potential liner failure. The regional bedrock aquifer and the buried valley outwash aquifers also are protected. The Lower Clarion Shale, several underclays, and an additional 200 feet of cyclothems between the Uppermost Aquifer System (not utilized locally as a potable ground-water source) protect the regional aquifers. The landfill monitoring well network, and the sampling and analysis plan, is generally sufficient and will provide timely notice of any leachate outbreak for employment of mitigation measures.

A concern in some quarters is that there is evidence to suggest significant bedrock fracturing which might compromise the tightness of the Isolation Zone (Lower Clarion Share) and perhaps the underclays. Evidence cited is an apparent surface water drainage pattern locally surrounding Countywide which appears to trend approximately east to west. Lineations such as this can be indicative of bedrock fracture patterns. However, when examined in a larger scale, the overall drainage pattern is dendritic. The local east-west drainage patterns seen east and west of Countywide are more likely due to incisement by massive volumes of glacial melt water runoff at the location of the terminus of glaciation. Additionally, the fact that groundwater in the Putnam Hill Limestone and Brookville / #4 Coal, and the Homewood Shale / Sandstone units is confined, attests to the tightness of the Isolation Zone.