US Army Corps of Engineers®
St. Louis District

Data Summary

NATURAL LEAD-210 AT JANA ELEMENTARY

"Gateway to Excellence"

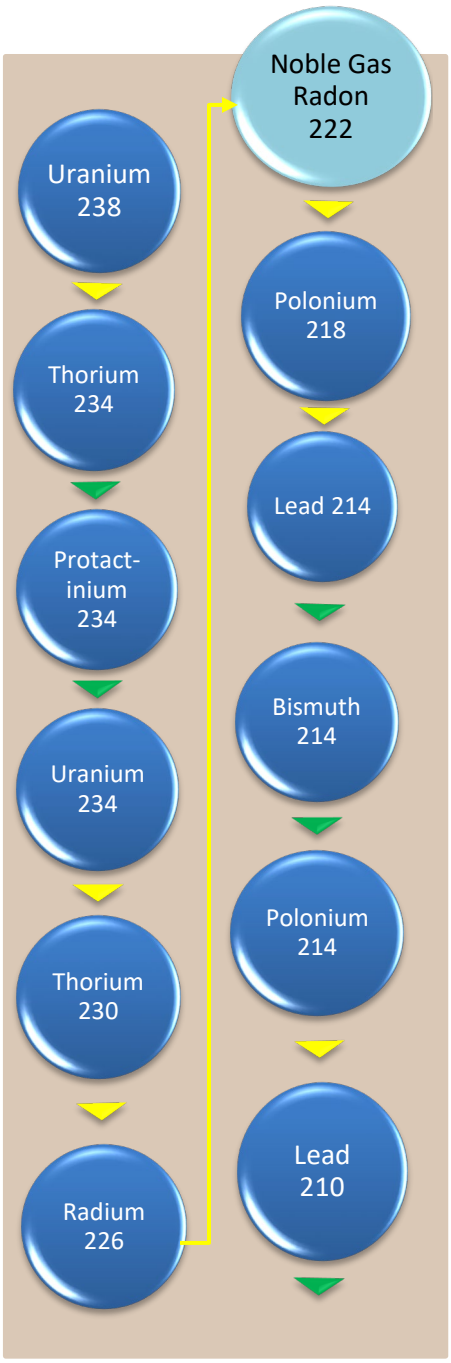

Figure 1 – Natural Uranium-238 Decay Chain through Lead-210, then beta decay to Bismuth-210, then beta decay to Polonium-210 then alpha decay to Lead-206 to complete the decay chain

Lead-210 occurs in nature as part of a decay series shown Figure 1. The yellow arrows identify alpha decay steps and green arrows identify beta decay steps. The brown shading indicates soil because some of the noble gas radon can exit the soil before decaying to polonium-218. **Lead-210 results are within the expected range of background levels and do not pose a health risk. The lead-210 identified at Jana Elementary results from background levels of radon gas decaying to lead-210**, settling on pavement, and rain causing pavement sediment to concentrate at low spots, cracks with grass, or similar features.

The school was well maintained from a cleanliness standpoint, so finding dirty areas was not easy for taking biased swipes. The swipes from 19 locations (example areas shown in Figure 2) were analyzed for alpha and beta radioactivity and for lead-210. No lead-210 was found on those swipes, and alpha and beta radioactivity were consistent with background levels.

Figure 2 – Examples of dirty surfaces where swipes were taken

The results for the swipes are summarized in Table 1. This dataset demonstrates that lead-210 is consistent with background levels.

Table 1. Lead-210 Swipe Summary Results		
Number of Measurements	19	Negative results means that the analyte is either not present or is present at levels less than the laboratory system's background level.
Mean	-0.95	The greatest minimum detectable activity was 1.96.
Maximum	-0.23	Units are pCi per swipe of a 100-cm^2 area.

USACE continued the investigation by sampling the pavement sediment at the locations shown in Figure 3. Locations 1 and 2 have a layer of sediment on the surface of pavement; these samples were collected by scraping the sediment off the pavement. Location 3 is at a drain where sediment about an inch deep was collected from around the edges. The results are provided in Table 2.

The pavement sediment data and swipe results reported in this Data Summary for Jana Elementary demonstrate there are no radiological health risks related to lead-210 on the school property.

Figure 3 – Locations of pavement sediment samples

As shown on the decay chain on the previous page, radon is a noble gas that can exit the soil before decaying to polonium-218. The four radionuclides from polonium-218 to polonium-214 have decay half-lives of days or less, while lead-210 has a half-life of 22 years. In the air, all 5 of these radon-222 decay products will attach to particulates that are always floating in the air. These particulates eventually settle out onto surfaces. This settling process is often uneven, depending on the type of particulate, the material the surface is made of, static electricity, and precipitation.

Table 2. Pavement Sediment Results

	Result	Uncertainty (Error)	Minimum Detectable Concentration
SVP264222/SVP264231 – Location 1 – Grass clump in pavement			
Radium-226 (pCi/g)	1.19	0.53	0.39
Thorium-230 (pCi/g)	0.90	0.34	0.21
Uranium-238 (pCi/g)	0.73	0.29	0.18
Lead-210 (pCi/g)	44.9	6.09	2.41
SVP264223/SVP264232 – Location 2 – Pavement sediment			
Radium-226 (pCi/g)	0.78	0.43	0.41
Thorium-230 (pCi/g)	1.06	0.36	0.12
Uranium-238 (pCi/g)	0.78	0.32	0.14
Lead-210 (pCi/g)	12.7	2.74	2.43
SVP264224/SVP264233 – Location 3 – Edge of drain cover			
Radium-226 (pCi/g)	1.17	0.52	0.25
Thorium-230 (pCi/g)	1.37	0.43	0.13
Uranium-238 (pCi/g)	1.07	0.37	0.20
Lead-210 (pCi/g)	3.56	1.52	1.79

Lead-210 is routinely used as a natural tracer to characterize sedimentation and erosion rates in 50 to 150 studies per year (Mastisoff and Whiting 2011). After settling out, these radionuclides attach to pavement sediment (i.e., surface dirt and dust). In addition, rain washes particulates out of the air, providing another mechanism for these radionuclides to attach to pavement sediment. Rainwater concentrates pavement sediment at low spots, cracks with grass, or similar features; see Figure 4. These natural concentrating processes for pavement sediment have been found to have background lead-210 concentrations as high as 71 pCi/g (Gellis, et al 2020). Thus, the levels of lead-210 in pavement sediment at Jana Elementary are consistent with background levels of radon gas decaying through to lead-210, settling on pavement, and rain causing pavement sediment to concentrate at low spots, cracks with grass, or similar features.

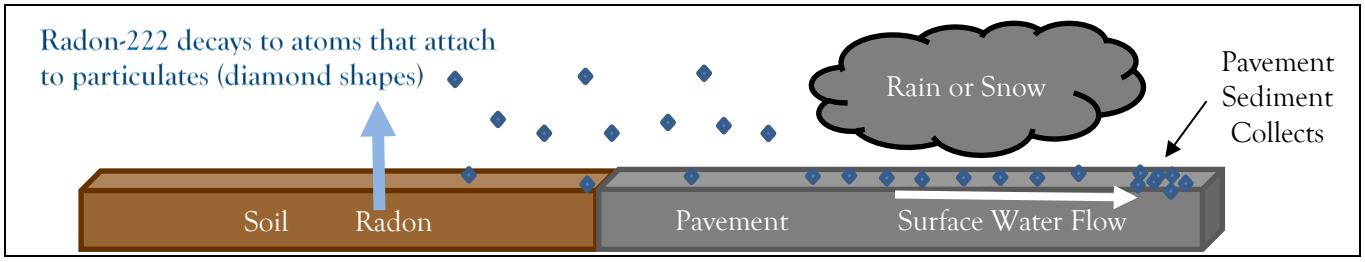

Figure 4 – Natural Background Radon Gaseous Diffusion, Settling, and Concentration in Pavement Sediment

Gellis, et al 2020. A. Gellis, C. Fuller, P. Van Metre, B. Mahler, C. Welty, A. Miller, L. Nibert, Z. Clifton, J. Malen, J. Kemper. "Pavement Alters Delivery of Sediment and Fallout Radionuclides to Urban Streams." J. Hydrol., 588. September 2020.

Mastisoff and Whiting 2011. G. Mastisoff and P Whiting. "Measuring Soil Erosion Rates Using Natural (7Be, 210Pb) and Anthropogenic (137Cs, 239,240Pu) Radionuclides." Handbook of Environmental Isotope Geochemistry (pp.487-519). June 2011.