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Ryan Nakken
Clark Pacific
1980 South River Road
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Subject: Evaluation of Data Collected By Grayland Environmental Consulting Services

Dear Mr. Nakken:

I, Paul Rosenfeld, Ph.D., received a Doctoral Degree Chemistry from the University of Washington with my thesis focus on Soil Science, Soil Chemistry, and the incorporation of biosolids with wood ash from paper mills, a material that can be very similar to precipitated calcium carbonate ("PCC"). I have worked and published in peer reviewed journals focusing on various forms of organic waste such as biosolids (and horse manure), as well as highly combusted wood ash which has similar properties to PCC found on the Clark Pacific Property. I am currently the Senior Environmental Scientist at Soil Water Air Protection Enterprise (SWAPE) and have taught at the University of California, Los Angeles School of Public Health for many years.

Site Background

The Clark Pacific facility, located in Woodland, CA, began its production of architectural and structural precast concrete panels in 2008, partnering with architects and contractors in various structural projects. Ms. Brenda Cedarblade, owner of Historic Nelson Ranch in Woodland, retained Grayland Environmental Consulting Services ("Grayland") to evaluate a variety of chemicals on her property. This letter will focus on only a few of the parameters evaluated by Grayland, including calcium carbonate, chromium, ammonia and pH.

Calcium Carbonate

Calcium is one of nature's most basic elements, but it rarely exists in its pure elemental and reactive form. Because of this, calcium is often found as calcium carbonate ("$CaCO_3$"), which is the primary component of limestone and lime dust. The samples obtained by Grayland showed that $CaCO_3$ was detected in soil at ~1,350 mg/kg and in dust at ~7,000 mg/kg (Grayland, 2012). These numbers were obtained using the U.S. Environmental Protection Agency's ("U.S. EPA") method 310.1 for alkalinity, in which an unaltered sample of soil or dust was mixed with water to form a solution and then titrated to a pH of 4.5. The volume of the resulting solution was then used in a series of formulas to calculate the alkalinity. In Grayland's report, alkalinity was synonymous with the concentration of calcium carbonate.

After considering stoichiometry, the concentration of calcium (in the form of Ca^{2+}) is actually ~40% of that of calcium carbonate. Therefore, the calcium concentration in the Woodland soil turns out to be ~540 mg/kg and ~2,800 in the dust. This stoichiometric analysis was completed so that comparisons could be made between these Ca^{2+} concentrations and the background Ca^{2+} concentrations in Sacramento and U.S. soils.

In 2009, an article was published by Allan Fulton, a farm advisor in Tehama County, CA, and Roland D. Meyer, a soils specialist, in which they discuss the levels of different soil nutrients like calcium, magnesium, and sulfur. They found that the background level for Ca^{2+} in soils in the Sacramento Valley ranges between ~1,000 and ~10,000 mg/kg (Fulton, 2009). By definition, the background level is the concentration of the chemical that is found naturally in the environment, without any external sources from industry pollution. Fulton and Meyer obtained these results using the saturated paste extract method, which brings the soil sample to the point of saturation and then extracts the soil solution by vacuum through a filter paper. The constituents of the soil solution are then analyzed using spectrophotometers. The concentration of calcium obtained by Grayland falls below this range for Sacramento soils.

According to Garrison Sposito in “The Chemistry of Soils,” the natural level for calcium in U.S. soils is ~24,000 mg/kg (Sposito, 1989). This concentration refers to samples taken approximately 0.2 meters beneath the land surface in uncontaminated mineral soils in the conterminous United States. The calcium concentration found on Ms. Cedarblade's property was also below this background concentration for U.S. soils (1989).

It is also important to note that $CaCO_3$ is utilized in daily applications. Precipitated calcium carbonate (“PCC”) is often used as a fertilizer and soil conditioner to raise the pH of acidic soils in agricultural applications. In the dairy industry, PCCs are used to prevent mastitis, an infection of the breast caused by common bacteria. They are also utilized as combustion emission controls in the power generation industry (California Regional Water Board, 2012).

Moreover, calcium carbonate is commonly used in drinking water distribution systems as a protective layer against pipe corrosion and the leaching of lead into water (Hong, 2008). According to a study completed in 2008, a system called the calcium carbonate precipitation potential control process uses an algorithm for corrosion prevention of pipelines. Another way to prevent pipeline corrosion is by purposely increasing the pH, hardness, and alkalinity of the water with limestone filters (Frycklund, 1999). The use of limestone filters reduces the amount of transport and handling of toxic chemicals in the water treatment and distribution processes. These facts confirm that calcium carbonate is an important component in these distribution systems and a common trace element in drinking water in general.

<u>Chromium</u>

Grayland found the concentration of chromium to be ~5.0 mg/kg, using the U.S. EPA’s method 6010B. However, Grayland did not specify whether this was total chromium, hexavalent chromium ("Chromium VI"), or trivalent chromium ("Chromium III"). Moreover, the U.S. EPA's Regional Screening Level November 2011 table does not provide the residential soil screening level ("RSL") for total Chromium (EPA, 2011). The EPA does consider Chromium VI to be toxic. Given the data provided by Grayland, it is impossible to determine which type of chromium was present at the site and to make any conclusion based on the data.

<u>Ammonia</u>

Ammonia is a compound made up of nitrogen and hydrogen that is distinctive by its pungent smell. It is common to find ammonia in the building blocks of many pharmaceuticals and in everyday products like food and cleaners. For example, Windex, a common household cleaner, contains between ~10,000 and ~30,000 mg/kg of ammonia (Diversey, 2012).

The level of ammonia in the Woodland area was measured to be ~17.2 mg/kg in soil and ~407 mg/kg in dust (Grayland, 2012). Both of these levels are low compared to levels in household cleaning products like Windex.

Considering the fact that Ms. Cedarblade owns a horse ranch, it is very likely that the horses on her property contributed to the presence of ammonia in the soil and dust. On a daily basis, a 1,000 pound horse produces ~37 pounds of feces and ~2.4 gallons of urine, an amount of waste production that is second only to cows (Extension, 2011). Assuming that 2.4 gallons of urine is equivalent to ~50 pounds, just four horses can produce up to ~160,000 pounds of manure and wet bedding per year. By that logic, 250 horses will produce ~40 million pounds of waste per year.

Horse feces contain approximately ~1-2% of nitrogen, while urine can contain a much higher percentage (Washington State; Water and Rivers Commission, 2002). Because horse urine and feces create anaerobic conditions, certain types of bacteria are allowed to carry out a chemical reaction that transforms nitrogen into ammonia. As a result, the levels of ammonia produced by horses alone are substantial. A study conducted in the U.K. concluded that a horse can produce ~74 pounds of ammonia each year (Dragosits, 2000).

These extensive amounts of waste and chemicals are a cause for concern for the health of humans and other animals. Horse manure contains parasites that can become lodged inside the guts, lungs, liver or other organs of horses. One parasite in particular is Salmonella enteritidis ("Salmonella") (Hinckley, 1992). Salmonella is a common pathogenic serotype in infected horses. It is able to spread throughout the environment, reaching other animals and humans. Ammonia fumes are capable of irritating the horses' respiratory passages and affecting their breathing in areas of poor ventilation (McIlwraith, 2011). Sometimes, horses are unable to remove mucus from their lungs properly, leading to an increased risk of bacterial pneumonia (Art, 2002). Although humans are not confined to these small, poorly ventilated spaces as often, humans' breathing can still be adversely affected while working with horses. Some workers have reported experiencing bronchial obstruction, allergic inflammation, eye and nasal irritation, shortness of breath, dry cough, and wheezing. (Elfman, 2009; Christiani, 2009).

Sources of ammonia from horse urine and manure can have a significant impact on the environment as well. It is possible for nitrogen in horse waste to accumulate and be transported in runoff to local waterways. This may lead to eutrophication, a process in which the deposited nitrogen increases the growth of algae blooms. When these algae blooms die, oxygen is consumed to decompose their remains and is no longer available for aquatic life (Shere, 2012).

pH

Grayland detected the pH in the soil to be ~8.4 and in dust to be ~7.6. In their "Guidelines for Drinking-water Quality," the World Health Organization ("WHO") concludes that the optimum and safe pH level in water ranges between ~6.5 and ~9.5 (WHO, 2012). These standards were established after considering the effects on humans and on corrosion of metals at lower and higher pHs. Moreover, the U.S. EPA sets its maximum secondary pH standards at a range of ~6.5 to ~8.5 (EPA, 2012). The U.S. EPA does not list pH as a primary water quality standard that threatens human health. Instead, pH is on its list of secondary water quality standards. The chemicals on this list are not considered a threat to human health and are tested only on a voluntary basis. The levels detected near Ms. Cedarblade's property are within both of these ranges. Therefore, these levels in soil and dust are considered to be the normal and safe levels in drinking water.

Conclusion

SWAPE has conducted this preliminary assessment of chemicals evaluated by Grayland (calcium carbonate, chromium, ammonia, and pH.) After applying stochiometry, it was determined that calcium carbonate was detected at levels below background concentrations for calcium in the Woodland area. Calcium carbonate is also commonly used in pipes of drinking water distribution systems and as fertilizer in agricultural circumstances. Chromium, on the other hand, could not be adequately assessed due to the lack of specificity in the data. Ammonia is also low compared to levels in common products, but it is important to recognize the potential impact that Ms. Cedarblade's horses have on ammonia concentrations. Horses are a significant source of ammonia that likely contributed to its detection as reported by Grayland (2012). The pH levels found in the soil and dust samples fall into the range of safe drinking water standards set by both the U.S. EPA and WHO.

Paul Rosenfeld Ph.D.

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