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Managing a Complex Contaminated Site Based on Toxicity Rather Than Individual Compounds

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Background/Objectives. The site associated with this research goes back several decades and as a result of historical operation contains a mixture of herbicide residues, pesticide residues and unidentifiable breakdown daughter products. Unfortunately, it has proven extremely difficult to accurately quantify and identify the contaminant of potential concern. This issue has arisen because the parent chemical compounds may no be longer present in the subsurface due to mixing and degradation. This is further complicated as there is no documentation in existence that can pinpoint what chemical(s) may have been released in the past. Further complicating site management is that the sub-surface of these sites are technosols (soils heavily influenced by human activity) which can include fill, legacy infrastructure, construction debris, as well as coarse aggregate. Thus, developing a conceptual site model that can estimate contaminant distribution, mass and potential pathways can be challenging.

As part of the Sustainable In Situ Remediation Cooperative Alliance (SIRCA), we are developing an assessment approach for our subject site based on toxicity profiling that can be applied as an integrated-effect-based tool for conceptual site models and risk assessment. The aim of this project is to provide site managers with the information required to effectively manage these complex operating sites.

Approach/Activities. Groundwater was sampled from two locations at a 70-year old crop protection chemical blending and packaging facility in Western Canada. One location was considered to be background and one known to be heavily impacted with 2, 4-D DMA; 2, 4-D 2EHE; bentazone; Bromoxynil; CMPP-p; MCPA 2EHE, MCPA DMA based compounds and carrier compounds. Paired soil samples from these locations were also collected. Using groundwater samples, five aquatic toxicity tests using standardized test organisms were performed on dilutions of the impacted well. Soils were then extracted by *in vitro* digestors and hydrophobic and hydrophilic fractions of bioaccessible compounds collected. The groundwater and bioaccessible soil fractions were then assessed for cytotoxicity in mammalian liver and intestinal cell lines, general toxicity, genotoxicity and dioxin-type responses.

Results/Lessons Learned. Groundwater was not acutely toxic to aquatic organisms but was cytotoxic to liver and intestinal cells. In addition, the groundwater likely contains compounds with potential to impact immune, developmental and endocrine pathways in humans. Surprisingly, bioaccessible extracts from the soil caused much lower responses in the intestinal and liver cell lines, as well as the toxicity assays. Thus, it appears, based on a soil ingestion pathway, that the soil may not pose as great a toxicity risk compared to groundwater and future efforts should be directed towards understanding: (i) groundwater pathways in this technosol that might represent a significant risk pathway and (ii) where do the majority of the toxic compounds reside and what remaining exposure pathways exist.