

Emerging contaminants in leachate of old closed landfills

James W. Roy^{1,2}, Victoria Propp^{1,2}, Amila O. de Silva¹, Christine Spencer¹, Susan Brown¹, Sara Catingan¹, and James E. Smith²

¹Water Science and Technology Directorate, Environment and Climate Change Canada

²School of Geography and Earth Sciences, McMaster University

Summary

Many types of contaminants of emerging concern (CECs), including per- and polyfluoroalkyl substances (PFASs), flame retardants, plasticizers (e.g., bisphenol A), pharmaceuticals, and personal care products, have been found in leachate of operating municipal landfills. However, there have been few studies into leachate of old closed landfills (≥ 3 decades since closure), of which there are many thousands across Canada, and these have covered only a select few emerging compounds. Most of these old landfills have no engineered liners or leachate collection systems, and many of them were operational prior to the current stringent environmental regulations, and thus, may pose a greater threat of contamination to nearby wells and surrounding surface water ecosystems. The objective of this study was to assess whether various CECs may be present in leachate-impacted groundwater from old closed municipal landfills at concentrations that may pose an environmental risk. There was a special focus on PFASs because of the extreme environmental persistence of these compounds and current concerns about their effect on human health. Other CECs measured included artificial sweeteners, organophosphorus flame retardants (OPFRs), select pharmaceuticals, bis-phenols, and substituted phenols. In total, 48 samples of leachate-impacted groundwater were collected from 20 closed landfills in Ontario, either from i) pre-existing monitoring wells, ii) leachate collection systems, iii) groundwater discharge zones along surface water bodies, iv) surface seeps, and v) one tile drain (passing under the landfill). Considering the artificial sweetener results, the common presence of saccharin, a known indicator of old landfill leachate, combined with mostly negligible levels of acesulfame, an indicator of modern wastewater, revealed that the groundwater at most sites was strongly influenced by leachate and not cross-contaminated by wastewater sources (which can contain these same CECs). Several landfills, including ones closed in the 1950s and 1960s, had total PFAS ($\Sigma 17$ PFASs) concentrations in a similar range to those previously measured at modern operational landfill sites (i.e., 1000s of ng/L), with a maximum observed here of 12700 ng/L. Notably elevated concentrations of OPFRs and bis-phenol A were also found at some landfills; the select pharmaceuticals and personal care products assessed were all at low concentrations. These findings provide guidance on the types of CECs that may require monitoring in old closed landfills.