Comparative Field Studies of Real-Time Soil Screening Techniques for Two Petroleum Hydrocarbon Sites

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Two field studies compare soil screening methodologies using a photoionization detector (PID) and a portable field spectrometer for two petroleum hydrocarbon (PHC) sites during challenging winter conditions.

The first project involves a remedial excavation carried out at Siksika First Nation in Alberta in January 2019. Historical site conditions and environmental data were limited prior to work at the site. Soil borings advanced in 2017 had identified diesel-impacted soils in the vicinity of a former above-ground fuel storage tank. Remedial excavation was recommended to remove the contaminated soil. The excavation was conducted in January 2019. In anticipation of challenging soil field-screening conditions with temperatures ranging from -15°C to -25°C and low-volatility degraded diesel as the contaminant, a comparative field study was initiated. The objective was to evaluate how near-infrared spectroscopy (NIRS) with proprietary machine learning technology by Maapera Analytics could support field decision making and reduce remediation costs in comparison with soil excavation screening using a photoionization detector (PID).

The field study was carried out over one day, in which over fifty soil samples were collected. Each soil sample was analysed in the field using both the NIRS and a PID. Confirmation soil samples were also submitted for laboratory analysis. While the PID did not register a response to any sample during field screening, the NIRS screening showed greater than 20,000 parts per million (ppm) total petroleum hydrocarbons in several samples. These field results were later confirmed by laboratory analysis of duplicate samples. The NIRS technology also provided near real-time visualization of the contaminated areas, enabling precise and timely excavation.

The second study took place in December 2019 during a site investigation of potentially contaminated soil at a former bulk fueling yard north of Fort McMurray, Alberta. Thirty-eight soil borings and four test pits were advanced over a three-day period beneath former fuel tanks, generators, pump islands, and oil storage areas. The objective was to evaluate how the NIRS would compare to the PID for gasoline and diesel-range PHCs where few surface structures or landmarks remained. Challenging field conditions included frozen gravels to 1m depth, temperatures dropping to -28°C with wind and blowing snow, and limited daylight. Over 150 discrete soil samples were collected over three days and field screened using both a PID and NIRS with an additional 50 samples analysed in the laboratory. The PID registered variable responses from 0 to 2,150 ppm, and results were inconsistent with NIRS and laboratory analysis. Although NIRS detected one F1 exceedance, laboratory data showed no BTEX or F1 exceedances. The NIRS and laboratory analyses were generally consistent across the F2 and F3 PHCs, with the NIRS screening identifying over 90% of impacted soils laterally and vertically. However, the NIRS was not effective at identifying the polycyclic aromatic hydrocarbons (PAHs) beneath the former generators.

In these two field studies, using advanced field screening technology enabled effective field-based decision making for efficient remedial excavation, backfilling, and contaminant delineation.

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Ailsa Le May is a partner at EnviroSearch Ltd. With over 25 years of consulting experience in the geosciences industry, she has conducted and managed hundreds of environmental assessment and remediation projects throughout Western and Northern Canada and California. Ms. Le May has worked on contaminated site investigations, remediation system design and construction management, remedial and maintenance dredging, underground storage tank removals, Phase I, II, and III investigations, feasibility studies, and risk-based corrective action plans. Ms. Le May obtained her BSc in Geology from the University of Saskatchewan and her MBA from Golden Gate University in California.