Is there an environmental benefit from remediation of a contaminated site? Combined assessments of the risk reduction and life cycle impact of remediation

A comparative life cycle assessment is presented for four different management options for a trichloroethene-contaminated site with a contaminant source zone located in a fractured clay till. The compared options are (i) long-term monitoring (ii) in-situ enhanced reductive dechlorination (ERD), (iii) in-situ chemical oxidation (ISCO) with permanganate and (iv) long-term monitoring combined with treatment by activated carbon at the nearby waterworks. The life cycle assessment included evaluation of both primary and secondary environmental impacts. The primary impacts are the local human toxic impacts due to contaminant leaching into groundwater that is used for drinking water, whereas the secondary environmental impacts are related to remediation activities such as monitoring, drilling and construction of wells and use of remedial amendments. The primary impacts for the compared scenarios were determined by a numerical risk assessment and remedial performance model, which predicted the contaminant mass discharge over time at a point of compliance in the aquifer and at the waterworks. The combined assessment of risk reduction and life cycle impacts showed that all management options result in higher environmental impacts than they remediate, in terms of person equivalents and assuming equal weighting of all impacts. The ERD and long-term monitoring were the scenarios with the lowest secondary life cycle impacts and are therefore the preferred alternatives. However, if activated carbon treatment at the waterworks is required in the long-term monitoring scenario, then it becomes unfavorable because of large secondary impacts. ERD is favorable due to its low secondary impacts, but only if leaching of vinyl chloride to the groundwater aquifer can be avoided. Remediation with ISCO caused the highest secondary impacts and cannot be recommended for the site.

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