

## Interaction of Collected Water and Soil Within Remediation Excavation in Central Alberta

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Earthen pits are a by-product of past operational practices at a number of oil and gas sites in Alberta. Contaminants, such as hydrocarbons, metals, and salts, from these pits can leach into the environment creating issues with soil and water. In an effort to mitigate the negative effects of these pits, remediation excavations are often undertaken, removing soil for treatment and creating potential areas for water to accumulate. Many of these excavations remain open for more than one field season, while remediation activities are completed, and are consequently open during precipitation (rain and snow) events. The accumulated water in these excavations have to be classified and disposed as "leachate" because it has the potential to be in contact with contaminated soil on the base and walls of the excavation. In most instances the collected water does not contain contaminants of concern and there are no apparent relationships between soil contaminant concentrations and what was present in the collected water. Alternative uses and reuse of this water would be beneficial for a variety of applications and would lead to more effective use of this valuable water resource.

Relationships dealing with soil and water interactions within these excavations were investigated based on typical oil and gas sites in Alberta. Three methods were utilized to determine if relationships existed between the contaminants in the soil and the collected water. These methods included; mathematical calculations based on Fickian equations, numerical modelling using MODFLOW, and case study data from various sites in central Alberta, each representing a range of conditions typically found in Alberta. Worst case scenarios were used for all conditions. Chloride was used as indicator for other potential contaminants due to its conservative nature, in terms of transfer from the soil to the collected water (i.e. the most likely parameter or contaminant to transfer from contaminated soil to collected water within the excavation). Based on an average excavation surface area of 310 m<sup>2</sup> the Fickian equations predicted the maximum amount of chloride that would transfer from the soil to the collected water by dispersion ranged from 36-73 mg L<sup>-1</sup>. Using

MODFLOW, the average predicted concentration was <5 mg L<sup>-1</sup>. Field case study sites had an average chloride concentration of <70 mg L<sup>-1</sup> in the collected water.

These concentrations are all less than the Health Canada (2006) aesthetic guideline (250 mg L<sup>-1</sup>) for chloride in drinking water. Various other scenarios for contaminant type and concentration, soil type, and volumes were also investigated, with similar results and conclusions. In Alberta, based on soil, water, and contaminant information, and for typical contact times encountered, little transfer, if any, of contaminants from soil to collected water within excavations occurs. Collected water from these excavation pits represents a valuable resource that should not be removed from the watershed by downhole disposal. Reuse of this water should be promoted in the oil and gas industry.

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Jan Quinlan has a M.Sc. in Environmental Management from Royal Roads University ('07) and a B.Sc. in Environmental Sciences from the University of Alberta ('00). Her graduate research focused on soil-water interactions at oil and gas sites within Central Alberta. She has over 8 years experience with WorleyParsons Komex, with experience in site investigations, remediation activities, environmental impact assessments, and liability assessment. Jan is a professional member of the Alberta Institute of Agrologists. She is also a proud new mom.