

An Integrated Model for Design of Soil Vapour Intrusion Mitigation Systems

Ian Hers, Gabriele DiMarco and Graeme Miller, Golder Associates

A risk management approach and engineering controls are increasingly being considered for addressing sites with volatile hydrocarbon impacts, but there is little guidance or models for design of sub-building ventilation systems or assessment of the reduction in vapour intrusion into the building achieved by engineering controls. The need for such models is not just related to volatile chemicals associated with anthropogenic sources of contamination, but also for methane produced at sites where filling has occurred or where there are peat, marsh or other organic deposits. This paper will describe two integrated models that enable both the prediction of soil gas venting and vapour intrusion into a building with engineering controls.

The venting mitigation design tool is a model that integrates soil gas venting within a soil layer below a building slab and flow through a piping system, and which also enables consideration of different active venting systems (blowers, wind turbines). This model is comprehensive in that it combines pressure driven soil gas flow in soil with civil engineering design for frictional losses along a piping system. The vapour mitigation design tool enables specification of components based on desired venting efficiency (pore flushings). This tool to our knowledge is unique and provides a designer a quantitative basis for design and opportunities for optimization, which is of potential significant benefit. The vapour intrusion model is a semi-analytical model that is a modification of the Johnson and Ettinger one-dimensional model that enables the influence of a venting layer and barrier to be simulated. The venting layer influence on vapour intrusion is dependent on the pore flushings from the venting mitigation tool.

The model is applied to design of vapour mitigation system for large commercial development. The venting efficiency and pore flushings for a wind turbine and active blower system is compared. The venting efficiencies, are in turn, input into the modified Johnson and Ettinger model, and show that for some mitigation designs, there is only a small decrease in the vapour intrusion attenuation factor, and that either greater venting efficiency or barrier layer is required to significantly reduce vapour intrusion. The model simulations illustrate how useful insight on potential mitigation effectiveness is derived through the use of the model.

Ian Hers, P.Eng., Ph.D.

Ian Hers is a senior consultant and Associate of Golder Associates located in Vancouver, B.C., Canada with 20 years professional experience, and is the vapour intrusion practice leader for Golder Associates. He directs and provides technical support for projects involving environmental site assessment, human health risk assessment, and remediation of contaminated sites. Much of his work over the past ten years has been on issues for light nonaqueous phase liquid (LNAPL) mobility and recovery and assessment and management of soil vapour intrusion. This work has including a number of large and complex LNAPL and vapour intrusion projects at sites in Canada, US, Europe and Australia.

Dr. Hers had an integral role in developing LNAPL training for Interstate Technical Regulatory Council “*An Improved Understanding of LNAPL Behavior in the Subsurface*”, and is one of three course instructors for this training. He has also developed LNAPL guidance and best practice manuals for BC Ministry of Environment and and ExxonMobil.

He has developed vapour intrusion guidance for numerous regulatory agencies, completed comprehensive field-based research programs evaluating vapor intrusion processes, has developed new screening and numerical

models for this pathway, and has evaluated field data and model predictions for vapor intrusion from numerous sites. He has helped author guidance for USEPA, Health Canada, British Columbia Ministry of Environment, Alberta Environment, Ontario Ministry of Environment, Canadian Atlantic Provinces and United Kingdom (CLEA review of models) and served on a number of technical advisory panels (CCME, USEPA, New Jersey, Michigan, other state agencies). He has conducted research projects for several regulatory agencies and industry groups in Canada and the U.S. including Health Canada, the Canadian Petroleum Producers Institute, Science Advisory Board for Contaminated Sites in British Columbia, the Electric Power Research Institute (EPRI), New Jersey Department and Shell Global and has published over 15 technical papers on vapour intrusion issues.

Dr. Hers holds a Ph.D. in Civil Engineering (University of British Columbia), is on the Board of Directors of the Science Advisory Board for Contaminated Sites in British Columbia, is a member of the roster of professional experts in British Columbia, and is a part-time instructor at the University of British Columbia and British Columbia Institute of Technology where he gives lectures on chemical fate and transport for risk assessment and site remediation technologies.