New Approaches and Tools for Evaluating LNAPL Mobility

Ian Hers, Golder Associates; Peter Miasek, IOL*; and Mark Malander, ExxonMobil*

Light non-aqueous phase liquid (LNAPL) mobility is a key consideration for management of sites with free-phase LNAPL plumes. New approaches and tools are being developed to evaluate LNAPL mobility, and recent case studies have improved our understanding of LNAPL behaviour. This paper will summarize these recent advances beginning with a description of the conceptual site model for LNAPL distribution and mobility, highlighting the importance of multiphase model and role of capillary forces for constraining LNAPL mobility. In particular, the difference between potential mobility within the core of the LNAPL plume, where there may be varying thicknesses of LNAPL observed in wells, versus the overall stability of the LNAPL body will be contrasted.

Quantitative modeling approaches for screening predictions of potential mobility and software tools such as those developed by the American Petroleum Institute (API) will be described. These include models based on vertical equilibrium and in-well LNAPL thicknesses to predict potential mobility from Darcy's Law and Brooks-Corey type models that predict the LNAPL thickness needed to overcome the pore-entry displacement pressure. The benefits and limitations and appropriate use of these models will be addressed. Since real-world sites are complex, the influence of geology and fluctuating water tables on in-well LNAPL thicknesses and mobility models will be highlighted. The uncertainty associated with the use of in-well LNAPL thicknesses as predictor of LNAPL mobility and emerging approach to use of more direct measurements (bail-down tests, flux measurements) will also be described.

Until recently, the regulatory approach for determining when LNAPL mitigation was required was commonly based on arbitrary and typically small in-well LNAPL thicknesses (i.e., few millimeters). More recent science-based guidance for management of LNAPL is based on a multiple lines-of-evidence approach where LNAPL thickness and recovery data at wells, laboratory data and models are used to assess potential mobility. Recent guidance for evaluating mobility, including those developed for the BC Science Advisory Board for Contaminated Sites, the BC Ministry of Environment and Interstate Technology Regulatory Council (ITRC) will be summarized.

Several brief case studies illustrating key points or how different models or measurement data may be used to evaluate mobility will be described. Data will be used to show variability in in-well LNAPL thicknesses and saturations compared to models, and use of time-series data to evaluate LNAPL plume stability.

…continued on next page

31

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.

'* To be confirmed