Executive Summary

This report consists of a set of maps contouring the carbon isotope values of production, surface casing vent flow (SCVF) and ground migration gases (GM) in the Western Canada Sedimentary Basin. From regional to mesoscale, these maps document the isotopic composition of n-alkane and carbon dioxide from the whole Western Canada Sedimentary Basin to part of one oil field. Mapped isotopic variability was reported, broadly discussed, and explained, even though a full understanding of such response requires considering other variables suggested as part of future work. These maps are useful tools for Regulators, Industry and the Public to anticipate or predict the source of fugitive gases at any given location. Our results show that most SCVF and GM originates somewhere along the wellbore above the target formation.

In compiling the maps, we made two important discoveries. (1) We observed that contours continuity on the mapped SCVF and GM isotopic values from multiple nearby wells have the same or similar isotope fingerprints, even though the wells are of differing age and drilled by different operators. (2) The maps and current modelled isotopic response can be used by service companies and regulators faced with remediating wells. Their problem well can be placed on these maps and used to predict the source, depth of putative SCVF and GM, thereby improving budgeting and scheduling. Drillers can use the maps to predict likely zones that need special attention or cementing, implementing techniques to prevent future SCVF and GM problems, which in the long term will save monetary resources.

Perhaps a more surprising observation is that the uniformity of failure depths in adjacent wells changes at topographic breaks. The isotope contours tend to follow topography. In most cases, isotope fingerprints of SCVF and GM of wells in valleys are more depleted of ^{13}C, indicating a shallower source for SCVF than in nearby wells on higher ground. The reservoir gas isotopic

fingerprint also constrains such a response. Documentation of the influence of surface topography on the source depth of SCVF has clear economic and engineering implications. Knowing that in any one region, the SCVF in valley wells originates from a different zone than wells on topographic highs will lower the cost of remediation of clusters of wells and should challenge drillers and cementers to avoid SCVF and GM problems in future wells.