

Remediating 46 Acres of Jet Fuel LNAPL with a Bioventing System: Endpoint Strategy and Regulatory Closure Process

Victor Gamez Grijalva (victor.gamezgrijalva@ch2m.com) and Robert Frank (Jacobs, Phoenix, AZ, USA)
Rob Hinchee (PEC, Perry, UT, USA)

Background/Objectives. A large-scale bioventing system was used to remediate a 46-acre zone of free-product jet fuel (LNAPL) at an aircraft engines manufacturing and testing facility in the southwestern United States (Site). Bioventing was approved by the State regulatory agency in October 2005, and following an intensive permitting process, significant input from multiple stakeholders, and changes to the subsurface conditions (most notably, a dramatic fluctuation in the local water table), construction of the system was completed and startup occurred in May 2009. The system's 77-acre target treatment area encompasses the southern portion of the active manufacturing Site and the northern portion of the adjacent international airport. This presentation provides details on the remedial endpoint strategy evaluation and the process for ultimately achieving regulatory closure from the State.

Approach/Activities. Following over 8 years of operation, the bioventing system had an extremely positive impact on the subsurface. Specifically, operation of the bioventing system:

- Removed over 17 million pounds of petroleum hydrocarbons (and almost 400 pounds of residual chlorinated solvents),
- Reduced methane concentrations in the entire target treatment area to below 1 percent, and increased oxygen concentrations to greater than 5 percent,
- Reduced LNAPL thicknesses in monitoring wells from an average of about 1 foot to non-detect,
- Resulted in the cost per pound of mass removed decreasing from over \$4.00/pound in 2010 to less than \$0.50/pound in 2017.

Following discussion with the Arizona Department of Environmental Quality (ADEQ), it was agreed that Site closure could be obtained using risk-based evaluation methods that incorporated soil samples or shallow soil-gas samples, followed by vadose zone modeling, to determine the cumulative risk remaining in the subsurface after remediation. A combination of historical and new soil samples, along with the collection of new soil-gas samples in the source areas and surrounding vicinity were used to evaluate the remaining cumulative risk at the Site. Soil data were compared directly to Arizona Residential Soil Remediation Levels, and soil-gas data exceeding USEPA's Region 9 Regional Screening Levels were evaluated using the screening level implementation of the Johnson and Ettinger Vapor Intrusion Model (forward calculation) to simulate indoor air concentrations. Results indicated all compounds were below Residential Soil Remediation Levels, and cumulative risk levels were all below 1×10^{-6} . Based on these results, ADEQ approved closure of the entire area of interest, which included 15 separate case file numbers spread out over the eastern portion of the Site.

Results/Lessons Learned. Over the course of 18 years, the investigation, monitoring, and remedial actions, were successful in determining the size of the impacted area and remediating the subsurface following the applicable regulatory standards. In total, over 7,000 gallons of LNAPL were recovered, and over 18 million pounds of petroleum hydrocarbons were removed from the subsurface. This presentation will provide a summary of the BSVE system operation, a discussion of the endpoint strategy, and details regarding the final data evaluation and confirmation that resulted in full site closure.