

## **New Perspectives on Horizontal Wells for Assessment and Remediation**

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**Background/Objectives.** Sometimes remediation technologies can be established but not prevalent; however, they can still be subject to the forces of change. In some cases, creative economics can open up new uses, but also process improvements can drive new applications in traditional settings. This is what is happening with the deployment of horizontal wells for site assessment and remediation. In essence, decreasing costs tied to design innovations, as well as strategic shifts which can initiate greater flexibility in deployment, are two factors that have brought about a resurgence of interest in certain styles of horizontal well systems (HWSs). The latter is specifically tied to moving from monolithic single well systems, that are subject to preferential flow path distortions, to segmented, nested well systems.

**Approach/Activities.** Using several case studies, a series of illustrations will be made for how specialized HWSs form a next generation advancement in site assessment and remediation. As one example, horizontal profiling with nested, segmented well systems brings additional accuracy to conceptual site models (CSMs), especially those challenged by access issues. HWSs also provide more directed treatment operations with a unique flexibility for managing both subsurface air and groundwater management, specifically vapor or liquid extraction, air sparging and the delivery of liquid reagents. Also, with horizontal nested, segmented well systems, on a case by case basis, there can be significant economic advantages in their deployment versus vertical well systems, even with exploratory vertical assessments facilitating optimal horizontal well placement.

Horizontal systems can be a supportive process to conventional vertical profiling and high-resolution site characterization (HRSC). In fact, it opens up a new strategic approach that can be called “high resolution contaminant distribution” (HRCD), because flexible horizontal nested, segmented well systems can be used to navigate “up the spine of the plume” providing discretized data sets that illuminate contaminant locations in novel ways. Several case studies will be presented that highlight the advantages of horizontal segmented well systems, that also incorporate nested bundling and miniaturization features into the process. The improved flexibility and the integrity of the data sets that are collected and the ability to deliver reagents with improved precision will be illustrated.

**Results/Lessons Learned.** Several site results will be featured as follows. 1) In terms of assessment, at a naval base a hydrocarbon plume was assumed to be originating from a large storage tank generating prospects of a major engineering effort to demolish, excavate and rebuild the facility. The application of a HWS was able to show the origin of the plume was due to external piping leakage thus generating significant cost relief. 2) In terms of remediation, at an active commercial site with dissolved hydrocarbon contamination, a successful bioremediation protocol was executed with variable sequential applications of reagents using segmented delivery. 3) Also, in another remediation case, a site with special challenges involving extensive LNAPL in a cobble was efficiently addressed with SVE and air sparging. 4) Lastly, in a combined assessment and remediation application, using limited vertical profiling, due to access issues as a guide, horizontal nested, segmented well systems filled in significant data gaps and then allowed for effective treatment of chlorinated hydrocarbons with reagent

injection leading to site closure. Through these four examples, the benefits of horizontal nested, segmented well systems, for assessment and remediation will be presented.