Case Study

Elusive Source of Refinery LNAPL Seeps Located

The Problem:

A refinery site utilized LNAP-saturated filter clays as fill material to create an additional land area adjacent to a waterway. After the new coastline was established for the refinery, LNAPL seeps began to discharge at surface locations across the site (see photos below). 20 years of drilling, sampling, monitoring, and remediation attempts failed to identify the source of the seeps and prevent further contamination of the waterway.

The Solution:

Aestus successfully deployed its GeoTrax Survey™ specialty electrical resistivity imaging technology across upland and fill areas without disrupting refinery operations. In addition, marine resistivity surveys were conducted to investigate river sediments and evaluate the hydraulic connection between observed seep areas and potential upland refinery source zones. Given the refinery's coastal setting, integrating both land-based and marine resistivity surveys was essential for accurately evaluating LNAPL migration and validating Aestus' hypotheses regarding the conceptual site model (CSM).

Boring logs, LNAPL thickness measurements, and soil and groundwater analytical data were integrated with GeoTrax Survey™ imagery to generate 2D figures and 3D visualizations using RockWorks® software. These datasets were then evaluated through the 5-Step GeoTrax CSM Plus™ process, enabling detailed analysis of preferential migration pathways and the identification of previously elusive seep source zones and contaminant flow paths.

Results

- ☑ Seeps along the waterway were first observed in 2002, and multiple mitigation efforts were attempted but were unsuccessful
- ☑ Aestus imaged the site in 2021 and provided targeted confirmation drilling locations which were converted to recovery wells that targeted the source of the seeps (deep LNAPL migrating along paleochannels)
- ☑ LNAPL seeps were completely eliminated within 4 years of Aestus' imaging work due to the ability to target the root issues

More Certainty & Optimal Outcomes

Our client needed more certainty in their subsurface data. We integrated existing site data, our GeoTrax Survey™ electrical images, and targeted confirmation drilling data to yield a more complete understanding of the subsurface. This allowed them to:

- ☑ Make better technical/business decisions
- ☑ Have clear roadmap for next steps
- ☑ Achieve project goals faster and cheaper

Aestus

1.888.GEO.TRAX (436.8729) info@aestusllc.com www.aestusllc.com

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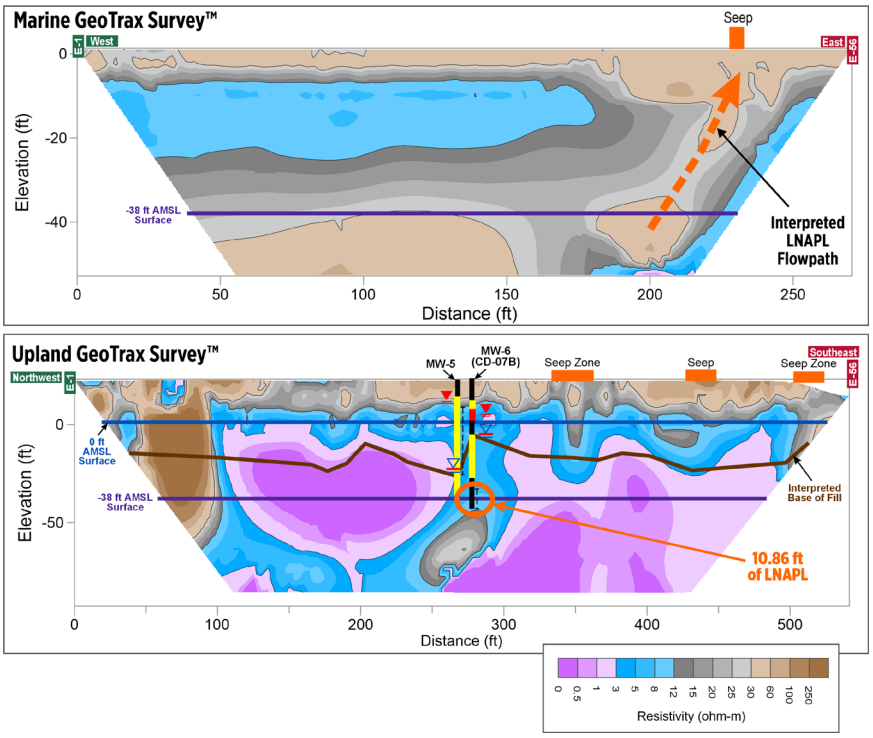
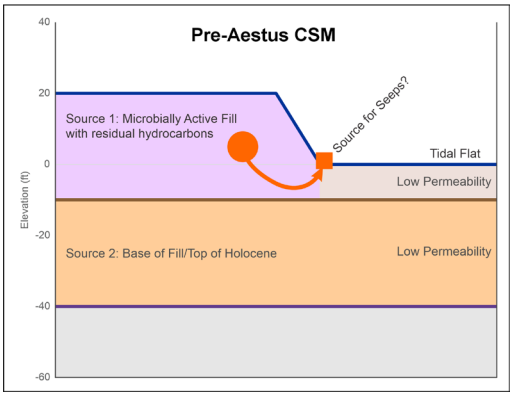
Outcome – Seep Sources and Flowpaths:

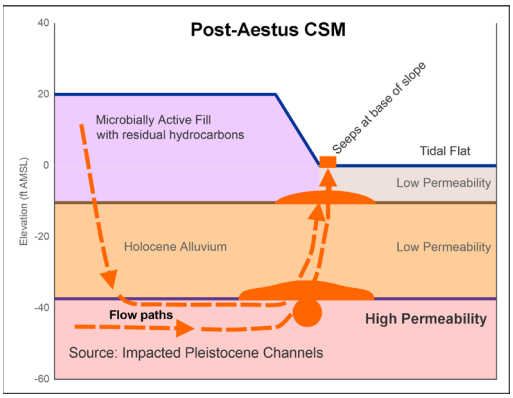
Preferential flow paths originating within the deeper coarse-grained alluvium (illustrated by the orange pathway in the graphic to the right) were identified in both the land-based and marine GeoTrax Survey™ images. A targeted confirmation drilling program conducted by Aestus' client subsequently verified the presence of LNAPL at depths deeper than previously sampled—more than 10 feet below the static groundwater table measured in monitoring wells.

Specifically, the GeoTrax Survey™ imagery revealed previously unknown paleochannels at depth that act as preferential migration pathways. Confirmation wells installed within these features encountered up to approximately 11 feet of LNAPL, validating the interpretations derived from the GeoTrax Survey™ data. The upland GeoTrax Survey™ image to the right shows the targeted well intercepting the upgradient LNAPL flow path, where 10.86 feet of LNAPL was measured.



Outcome – Significant Improvement to CSM:





Prior to Aestus' involvement, the CSM had been developed using more than 20 years of largely untargeted drilling and sampling data; the source of the seep was believed to be the LNAPL-saturated filter clays used to build up the made land (see the lower left image below). This approach was based on the assumption that LNAPL migration would primarily occur at or near the static groundwater table. However, the historical data lacked the density necessary to accurately identify the true sources of the observed surface seeps.

Integration of GeoTrax Survey™ ultra-high-density continuous imaging data with existing site data refined the CSM and clarified contaminant migration pathways. The analysis showed upland LNAPL impacts were diving, migrating laterally at depth through coarser-grained materials, and then rising to discharge into the adjacent river, which explained the surface seeps observed along the shoreline and why previous mitigation attempts were too shallow to impact the source of the seep (see the lower left image). The GeoTrax Survey™ images clarified the CSM and allowed for accurate targeting and pumping of the seep sources that resulted in the seeps completely ceasing within 4 years of imaging.

In Aestus' experience at similar upland/waterway LNAPL seep sites, the groundwater flow nets at land-water body interfaces are almost always more complex than initially thought. Borings/wells are typically unable to fully characterize these environments while our GeoTrax Survey™ images have proven invaluable for their ability to accurately map these complex flow paths.

You Deserve More Certainty in your Subsurface Data

Aestus