REGENESIS®

Synergistic in situ technologies treat TCE during construction works

A source-zone and boundary-barrier approach to support redevelopment and real estate transaction timelines

Site type:
Commercial-industrial mixed-use redevelopment on a historic industrial site.

Primary contaminants:
Chlorinated solvents: trichloroethene (TCE) and associated daughter products including cis 1,2-dichloroethene (cis-DCE or DCE) and vinyl chloride (VC).

Geology:
Made ground, over mixed sand and alluvial deposits over weathered and fractured sandstone.

Hydrogeology:
Groundwater level ~5.7 m below ground level (BGL). Contamination reported between ~6–16 m BGL in source area, increasing with depth.

Project driver:
Real estate transaction and accelerated redevelopment aimed at discharge of pre occupation planning conditions set by the Environment Agency (EA).

Treatment approach:
Combined ISCR + ERD strategy applied to the source area and plume, with a site-boundary PRB to mitigate offsite migration.

Technologies applied:
S-MicroZVI®, 3-D Microemulsion®, Bio-Dechlor Inoculum Plus®; implementation supported by specialist remediation services and injection via wells.

Summary

A former industrial site at Atlantic Park near Liverpool, UK, required a multi-phase in situ groundwater remediation programme to address trichloroethene (TCE) and associated daughter products. The works were carried out by REGENESIS Remediation Services on behalf of Curtins for their client, Royal London Mutual Insurance Society. The remediation took place alongside active construction works, supporting site redevelopment and a real estate transaction.

The completed remedy combined in situ chemical reduction (ISCR) and enhanced reductive dechlorination (ERD) through injection of the sulfidated, micron-scale, zero valent iron (S-MicroZVI®), 3-D Microemulsion® (3DME), and Bio-Dechlor Inoculum Plus® (BDI+). Treatment comprised a grid injection in the source area, combined with a site-boundary permeable reactive barrier (PRB) to mitigate offsite migration. This approach enabled construction to proceed as planned while the treatment continues in the subsurface. Monitoring of the site is ongoing.

Project background and remedial objective

Atlantic Park is a phased redevelopment of a large, historic industrial site. Site investigations by Curtins had identified groundwater contamination within the Principal Aquifer linked to historical mixed-use industrial activity dating back to 1965. This included a TCE plume extending across much of the site.

Figure 1 Site Redevelopment

Completed redevelopment scheme: mixed industrial and commercial office units with car parking and landscaped areas.

Image credit: Curtins

The planned redevelopment programme consists of a mix of industrial and commercial office units with car parking and landscaped areas. The objective of the remediation was to reduce existing concentrations of TCE and demonstrate ongoing reductions to support regulatory close-out of the site to enable progression of the planned redevelopment, including discharge of pre occupation planning conditions.

Site conditions

Site geology comprises made ground (fine to coarse mixed fill and reworked alluvium) to up to 3.7 m thick, overlying fine to medium sand (Shirdley Hill Sand Formation) up to 2.9 m thick, alluvial deposits up to 3.8 m thick, over weathered to competent weak sandstone bedrock with regular fractures (Sellafield Member / Wilmslow Sandstone Formation). An approximately 30,000 m² chlorinated solvent plume extended roughly 100 m across the site towards the north/northeast property boundary.

The groundwater level in the target treatment zone was reported at ~5.7 m BGL with contamination identified between 6–16 m BGL in source area wells and higher concentrations reported deeper in the interval.

Maximum groundwater concentrations reported in the source area included TCE up to 3,579 µg/L, cis-DCE up to 2,142 µg/L and vinyl chloride up to 932 µg/L. In the downgradient plume near the site boundary, vinyl chloride and DCE concentrations were reported at ~900 µg/L and 700 µg/L, respectively.

Remedial approach

After the remedial options appraisal, Curtins requested a site design from REGENESIS which would treat the source, prevent offsite migration and avoid interruption of the planned construction activities. Working in consultation with Curtins, REGENESIS devised a remediation plan comprising ISCR and ERD, targeting both a defined source-area Target Treatment Zone (TTZ) and a site-boundary permeable reactive barrier (PRB) intended to mitigate offsite plume migration, whilst offering compatibility with ongoing construction works and safe site operations.

Source treatment

The source-area TTZ was defined as a ~20 m × 20 m (400 m²) area targeting the highest reported TCE concentrations. Amendments S-MicroZVI, 3-D Microemulsion and BDI+ were applied across a vertical treatment interval of 6–16 m BGL via injection wells installed into the bedrock. A total of 16 injection wells on a grid spacing of 5 m were used for amendment delivery.

Plume treatment at the property boundary

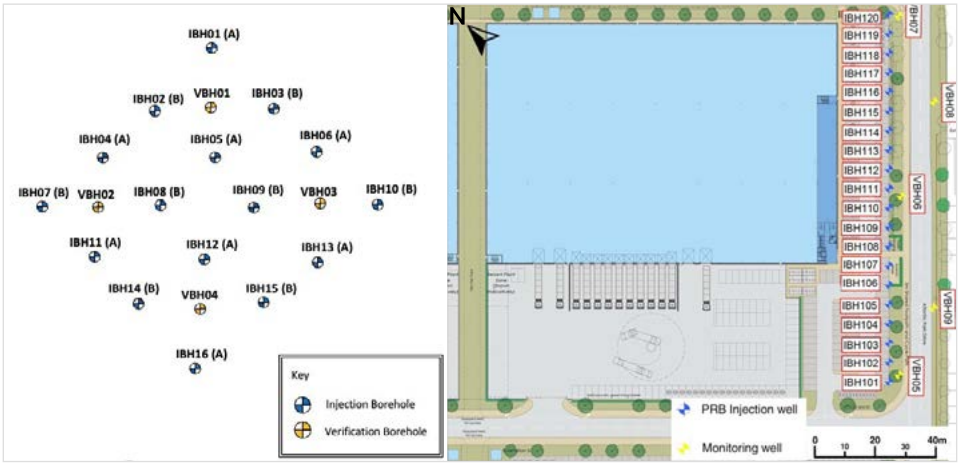
A 100m PRB was installed along the property boundary, targeting 6–16 m BGL, to prevent offsite migration of chlorinated solvents, including daughter compounds vinyl chloride and dichloroethene. The PRB was created by injecting the combined amendments into bedrock injection wells. The application emplaced the amendments into the bedrock fractures to treat contamination advecting through the flowpaths and back-diffusing from the rock matrix.

Figure 2 Remediation injection layout and PRB injection layout

Left: Remediation injection layout schematic of Source TTZ.

Right: Injection layout of the PRB at the site boundary.

Image credits: Curtins, adjusted by REGENESIS



Application

Co-mixing of S-MicroZVI, BDI+ and 3DME prior to injection into wells.

REGENESIS Services field staff managing reagent mixing and injection from inside trailer.

Curtins installed the injection wells and provided site facilities, after which REGENESIS' services team mobilized to site to carry out the injection works. This consisted of two mobilisations: barrier installation followed by the source-zone treatment. The programme was delivered within a three week onsite window alongside active construction activities. The works were completed safely and methodically, producing no increased risk to the workforce or other contractors working on the site.

Source area TTZ Application Details

TTZ footprint:	~20 m × 20 m (400 m²),
TTZ interval:	6–16 m BGL
Injection points:	16 (5 m spacing)
Injection method:	Injection into wells
Amendments:	S-MicroZVI, 3DME, BDI+

Boundary plume PRB treatment

PRB length:	100 m
PRB interval:	6–16 m BGL
Injection points:	20
Injection method:	Injection into wells
Amendments:	S-MicroZVI, 3DME
Re-application:	Estimated every 3–5 years (as required)

Image credit: Curtins

Results

Post-injection monitoring was undertaken by Curtins in both treatment areas, including groundwater sampling and analysis for target contaminants, daughter products, indicators of complete dechlorination (e.g., ethene), and supporting geochemical parameters (e.g., dissolved oxygen, ORP, electrical conductivity).

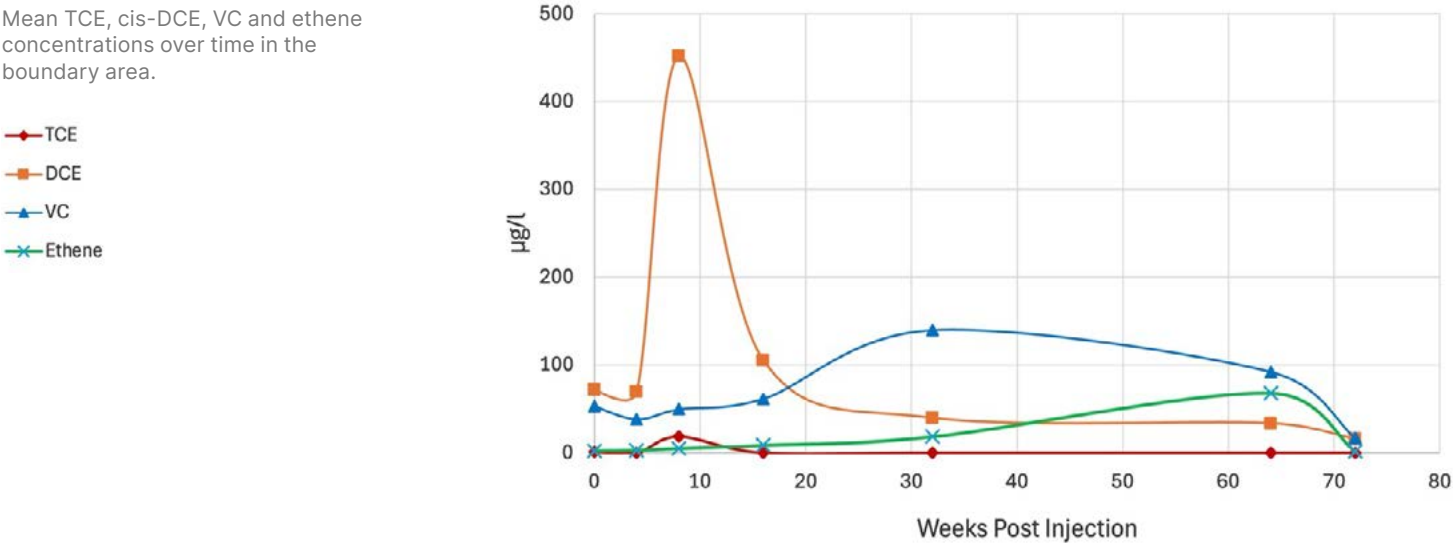
Source-area performance monitoring was limited to 15 weeks due to onsite construction activities; however, the available data suggest an early response to treatment. Week 4 represents the first monitoring event in which all five performance wells were sampled. From week 4 to week 15, average TCE concentrations across the five wells decreased approximately 40% with modest average decreases in cis-DCE and VC.

Monitoring of the boundary PRB showed a clear reduction in chlorinated ethene concentrations over time. Following early post-injection variability, resulting from a temporary increase in cis-DCE at BH07, concentrations declined substantially through week 72. By the end of the monitoring period, summed chlorinated ethene concentrations in the key boundary wells were reduced to low levels, demonstrating the efficacy of the PRB in treating the downgradient plume and mitigating offsite migration.

Ethene generation observed in the monitoring dataset provides further evidence of reductive dechlorination within the treatment zone.

Figure 3 CVOC concentrations over time

Mean TCE, cis-DCE, VC and ethene concentrations over time in the boundary area.



Conclusion

Following an 18-month groundwater monitoring period, ongoing degradation of the contamination has been demonstrated, showing measurable environmental betterment. This synergistic in situ approach has resulted in regulatory discharge of the pre-occupation planning conditions, allowing construction to proceed uninterrupted, as planned, and without reliance on long-term above-ground treatment systems.

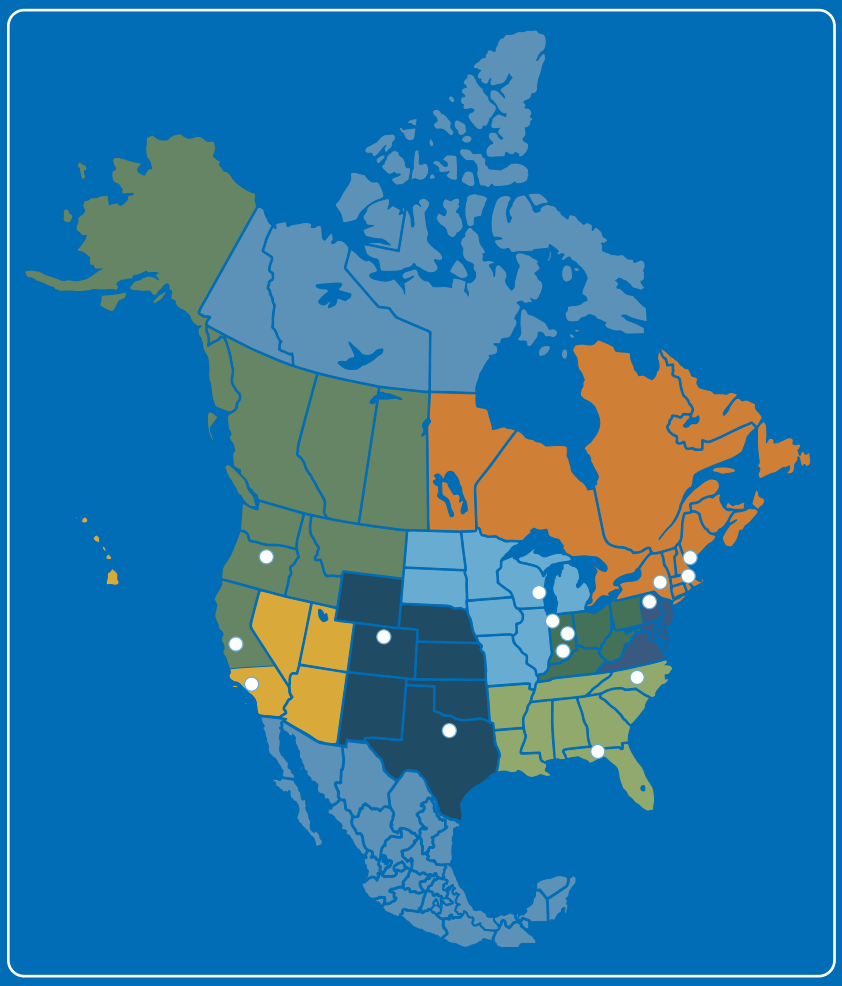
Project reference

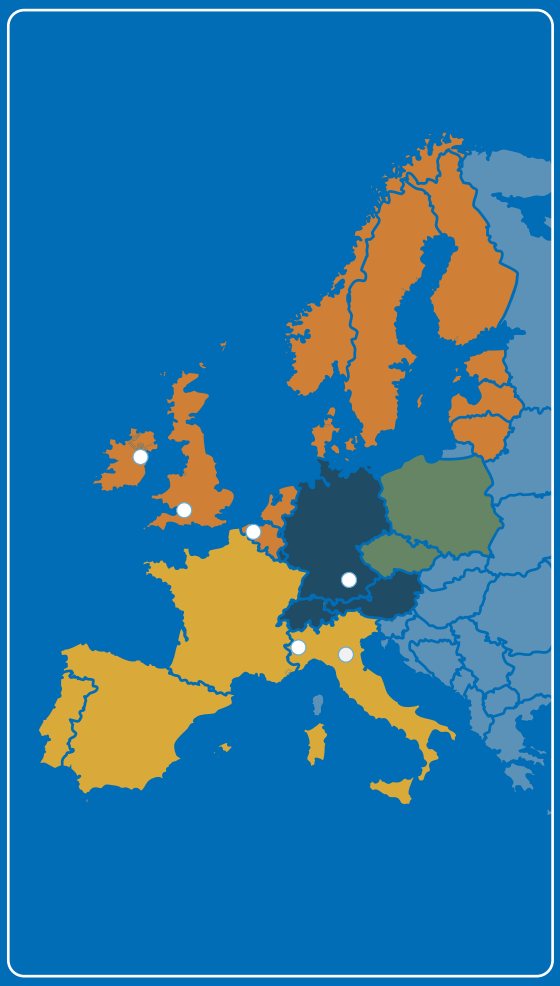
Niall Farnworth
Principal Geo-Environmental Engineer, Curtins Consulting
Niall.farnworth@curtins.com

Image credit: Curtins

Have a challenge? Let's solve it together.

Contact us today to discuss your specific needs.





Global Headquarters

1011 Calle Sombra
San Clemente, CA 92673 USA

Ph: (949) 366-8000
Fax: (949) 366-8090

Europe

Bath, United Kingdom
Ph: +44 (0) 1225 61 81 61

Dublin, Ireland
Ph: +353 (0) 1 853 7384

Torino, Italia
Ph: +39 338 4694021

Ieper, België
Ph: +32 (0)498 57 26 90

© 2026 All rights reserved. S-MicroZVI, 3-D Microemulsion, Bio-Dechlor Inoculum Plus, and REGENESIS are registered trademarks of REGENESIS Bioremediation Products. All other trademarks are property of their respective owners.

REGENESIS®
www.REGENESIS.com