



## **Downtown Urban Setting Former Dry Cleaner Site Remediation Using Direct Injection of EHC®**

**Site:** Waterfront Medieval Town Center, The Netherlands

**Solution Provider:** Groundwater Technology B.V., Rotterdam, The Netherlands



# **ADVENTUS**

*Solid Technology, Superior Value, Proven Results*

**PROJECT CASE STUDY  
SERIES**



## Summary: Remediating underneath a 16th century shop downtown urban setting

A 16th century historic women's fashion boutique on the waterfront in a medieval town centre in The Netherlands sits on environmentally impaired property. The impacts originate from a former dry cleaner at the premises. The Constituents of Interest (COI)—PCE and TCE—slowly degrade to DCE, VC, and ethene (Table 1). However, the premises are sold and the new investor wants to terminate 'perpetual' monitoring.

**EHC®**

The Original Injectable ISCR Reagent  
for Groundwater Applications



**Figure 1: This historic waterfront shopping district was impacted by a dry cleaning tenant.**



Constituents of Interest (COI)	Concentrations
Perchloroethene (PCE)	7800 µg/l
Trichloroethene (TCE)	13000 µg/l
Cis-1,2,dichloroethene (DCE)	16000 µg/l
Vinylchloride (VC)	5600 µg/l

**Table 1: COI Profile**

## The Issue

A thorough assessment led the former consultant to conclude that there was no cost-effective remedial solution for this site. The soil consists mainly of silt, clay and some peat, retarding COI migration.

Monitored Natural Attenuation (MNA) was deemed sufficient for this case and accepted by the regulators. A back-up scenario was available in case of unexpected COI migration.

The client, a real estate investor, preferred to terminate the need for perpetual monitoring and was willing to invest a premium in a final remedial solution. However, active measures were required to achieve this goal.

Effective *in situ* remediation is not always a simple task:

1. The subsoil is very sensitive to subsidence (wet clay & peat). The premises, like all other buildings in the area, are not based on firm foundations such as pilings. Subsidence is likely to damage the property.
2. Pump & Treat is virtually impossible, and in view of the low permeability, probably would not affect COI migration.

3. The area is densely built-up and many cables, lines, pipes, ducts and sewers are present in the subsoil. Visiting customers must not be hindered by remediation activities.

4. The area is a popular recreational-shopping area with fashionable boutiques, cafés, bars, restaurants, and summer boating.

## The Solution

Groundwater Technology assessed available data and concluded that natural attenuation will not sufficiently reduce source zone COI concentrations. An alternative remedial solution for this complex case was developed. The solution was based on combining three techniques:

1. *In Situ* Chemical Reduction (ISCR) was selected as the most optimal approach for the source zones, where the highest COI concentrations were found. EHC® was injected to significantly reduce COI concentrations.
2. For the other areas, enhanced natural (anaerobic) attenuation was selected, supported by the injection of a suitable substrate, to create and maintain a strongly anoxic environment, which facilitates the degradation of chlorinated hydrocarbons.
3. Soil stabilizing agents were selected that would greatly reduce the soil's permeability, if necessary. The result would be that groundwater could not migrate, eliminating relocation of COIs.



## The Results

**Direct injection.** In the first round, Groundwater Technology injected a balanced mixture of substrate and zero-valent iron (EHC®). Active agents are pumped into the ground through a pressurized injector system. The high injection pressure effectively disperses the slurried mixture.

The amendment used in the first injection-event consisted of a mix of micro-scale ZVI, substrate and fertilizer to chemically convert

COI	Start	3 months	6 months
Perchloroethene	7800 µg/l	0,14 µg/l	0,16 µg/l
Trichloroethene	13000 µg/l	< 0,6 µg/l	< 0,6 µg/l
Cis-1,2,dichloroethene	16000 µg/l	37 µg/l	0,71 µg/l
Vinylchloride	5600 µg/l	33 µg/l	17 µg/l

**Table 2: COI concentrations following EHC ISCR treatment**

the COI's into harmless compounds, as well as enhance natural attenuation. Performance monitoring has shown excellent COI reduction in a timely manner. (Table 2.)

### Project data:

Setting: Historic downtown area  
 Solution Provider: Groundwater Technology, B.V.  
 Activity on site: 1 week  
 Passive monitoring: 2 years on a semi-annual basis  
 Costs: € 37.000 to € 60.000 \*  
 Status: Ongoing

Contaminants:  
 Type: Chlorinated ethenes  
 Volume: < 1.000 m3 soil volume  
 Maximum depth: 7 m-grade  
 Initial concentration: > 10.000 ug/l (CIS)  
 Remediation goal: Stable situation, no monitoring

### \* The Project Costs

The € 60.000 projection includes a second EHC injection event and reduced soil permeability. Costs for the project to-date are a mere € 37.000. Based on future monitoring, it is likely that additional costs will not be incurred.



## Contact

Adventus Europe GmbH  
 Sitz der Gesellschaft/company's seat:  
 Duisburger Strasse 69-73, 46049  
 Oberhausen, Germany  
 Amtsgericht/district court: Duisburg HRB

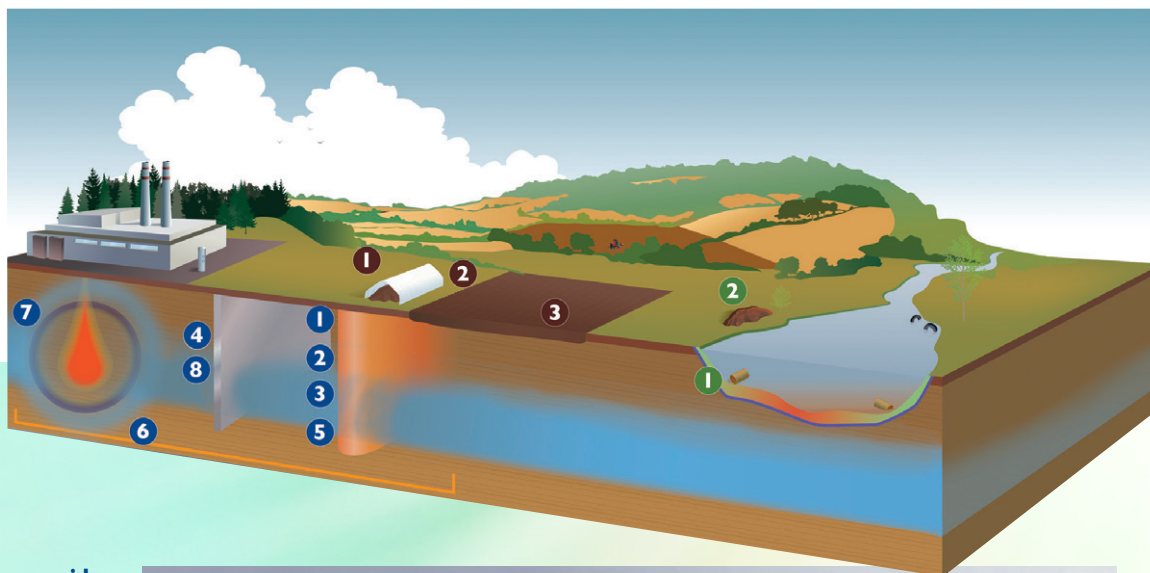
22561

Tel: (+49) 0208 85005-35

Fax: (+49) 0208 85005-980

Sales & Service Mobile: (+43) 664.180.3060

www.ADVENTUS.eu



The Adventus Group provides the environmental remediation industry with a portfolio of innovative proprietary Soil, Sediment, and Groundwater remediation solutions and other technologies shown here. Contact us today to arrange a complementary Technology Transfer Session, or Site Evaluation.

### Groundwater

#### *In Situ Chemical Reduction (ISCR) Technologies*

- 1 EHC® injectable controlled release carbon plus ZVI
- 2 EHC®-L injectable concentrated, buffered, microemulsion
- 3 EHC®-M injectable immobilization of heavy metals
- 4 ZVI PRBs patent holding innovators

#### *Other Groundwater Solutions*

- 5 EHC-0™ injectable controlled release oxygen compound with nutrients
- 6 mGCW™ reactive groundwater circulation wells
- 7 ISGS™ *In Situ* Geochemical Stabilization for source zones / flux reduction
- 8 ZVI-Clay *In Situ* treatment of DNAPL source zones

- A-SOX™ anaerobic biodegradation in ground water wells
- O-SOX™ aerobic biodegradation in ground water wells
- HolePlug+™ reactive sealant
- Modeling Services for optimization of remedial designs and strategies

### Soil

#### *In Situ, Ex Situ, Land Farming and Soil Vapor Pathway Technologies*

- 1 DARAMEND®
- 2 DARAMEND®-M
- 3 TERRAMEND®

### Sediment

#### *In Situ Capping and Treatment Technologies*

- 1 AquaBlok+™
- 2 DARAMEND®

The Adventus Group provides a growing portfolio of leading environmental remediation technologies, including patented products, and is best known for leadership in the area of in situ chemical reduction (ISCR) with the EHC® family of products. Adventus pioneered ISCR in the early 90's to effectively and economically treat soil and groundwater contaminated with a wide variety of organic constituents and/or metals amenable to biological and chemical reduction. Other Adventus products are also used to address problems that require oxidation processes and contaminant flux management. We support site owners, consultants, regulators, and others by providing unbiased design, and selection of the most cost-effective remediation strategies. Adventus has a world-wide presence and a strong record of sharing its achievements across more than 500 technical abstracts and publications.