

QuantArray®-Chlor

Actionable Data for
Remedy Selection



PROJECT SUMMARY



- Site managers were considering monitored natural attenuation (MNA), biostimulation with electron donor injection, and bioaugmentation as remediation strategies at a chlorinated solvent site.
- During site assessment, *Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, and other halorespiring bacteria were present in the dissolved plume but at concentrations less than the 10^4 cells/mL generally needed for effective rates of reductive dechlorination.
- Thus, electron donor injection was selected as the remediation strategy and bioaugmentation was not necessary - saving money.
- To see how QuantArray®-Chlor was a key component of performance monitoring after electron donor injection, please see QuantArray-Chlor: Actionable Data for Performance Monitoring.

PROJECT CHALLENGE



Groundwater at a former chemical manufacturing facility was impacted by tetrachloroethene (PCE) and trichloroethene (TCE) as well as 1,1,2-trichloroethane (TCA) and 1,2-dichloroethane (DCA). Geochemical conditions were mildly anaerobic but with relatively high dissolved sulfate. Daughter products cis-dichloroethene (*cis*-DCE) and vinyl chloride were detected in the source area suggesting that reductive dechlorination had occurred at least to a limited degree.

SAMPLING AND ANALYSIS



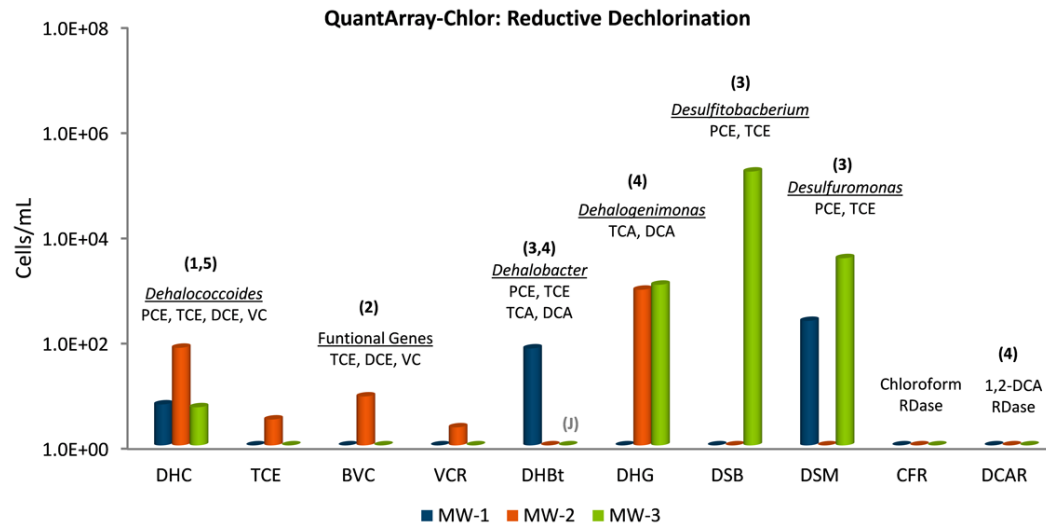
QuantArray-Chlor was performed for selected monitoring wells to quantify a broad spectrum of halorespiring bacteria and reductive dehalogenase genes to answer the following questions:

- Is complete reductive dechlorination of all site contaminants and daughter products likely?
- Is electron donor injection (biostimulation) or bioaugmentation needed?

REMEDY SELECTION



During site assessment, a diverse group of halorespiring bacteria including *Dehalococcoides* were present in the dissolved plume, but at concentrations less than the 10^4 cells/mL generally needed for effective rates of reductive dechlorination.



- (1) *Dehalococcoides* (DHC) were detected in groundwater samples from each monitoring well, indicating the presence of halorespiring bacteria capable of complete reductive dechlorination of PCE and TCE to ethene.
- (2) Moreover, vinyl chloride reductase genes (BVC and VCR) were detected at low concentrations at MW-2, further confirming the potential for reductive dechlorination of vinyl chloride to ethene.
- (3) In addition to *Dehalococcoides*, a diverse group of halorespiring bacteria capable of reductive dechlorination of PCE and TCE to *cis*-DCE (*Dehalobacter*, *Desulfitobacterium*, and *Desulfuromonas*) were also detected consistent with historical groundwater monitoring.
- (4) *Dehalobacter* or *Dehalogenimonas* spp. were also detected in samples from each monitoring well. Although 1,2-DCA reductase genes (DCAR) were not detected, *Dehalobacter* and *Dehalogenimonas* spp. at low concentrations indicated at least the potential for dichloroelimination of TCA and DCA.
- (5) While detected, *Dehalococcoides* concentrations (10^0 to 10^1 cells/mL) under existing conditions were substantially lower than the 10^4 cells/mL threshold concentration for generally effective rates of reductive dechlorination.

Decision: Biostimulation. A broad spectrum of halorespiring bacteria including *Dehalococcoides*, *Dehalobacter*, and *Dehalogenimonas* were detected during site assessment. With *Dehalococcoides* detected at low concentrations at each sampling location, bioaugmentation was not needed and electron donor injection alone should stimulate growth of these key halorespiring bacteria.

KEY BENEFITS



As a component of remedy selection and performance evaluation, QuantArray-Chlor was a critical line of evidence that directly impacted site management decisions.

- **Actionable:** A deciding factor in selecting biostimulation as the treatment strategy. As shown in the follow-up case study QuantArray-Chlor: Actionable Data for Performance Monitoring, QuantArray-Chlor was also an important line of evidence in evaluating the effectiveness of electron donor injection at this site.
- **Saved Money:** Indicated that bioaugmentation was not necessary.
- **Comprehensive & Cost-Effective:** QuantArray-Chlor includes quantification of a broad spectrum of key halo-respiring bacteria and functional genes responsible for anaerobic biodegradation of the mixture of chlorinated ethenes and ethanes present at the site in a single analysis.
- **Conclusive:** Although present at low concentrations, the detection of *Dehalococcoides* along with other halo-respiring bacteria was a conclusive line of evidence supporting biostimulation as the remedy and provided a baseline to evaluate the effectiveness of electron donor injection.

LAB LOCATIONS



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