

CENSUS qPCR

Actionable Data for Evaluating MNA

PROJECT SUMMARY



- Although decreasing, groundwater BTEX concentrations fluctuated considerably at a petroleum impacted site undergoing MNA.
- Site managers needed an additional line of evidence to demonstrate BTEX biodegradation under existing conditions to support continuing MNA.
- [CENSUS qPCR](#) demonstrated that concentrations of functional genes (BSS, ABC) in pathways for anaerobic BTEX biodegradation were substantially greater in impacted monitoring wells than in background wells suggesting growth of anaerobic BTEX degraders within the dissolved plume.
- Based on multiple lines of evidence (decreasing BTEX concentrations and increased concentrations of catabolic genes in impacted wells), MNA continued as the treatment strategy.

PROJECT CHALLENGE



A petroleum pipeline release in a remote area had gone undiscovered for a number of years. Groundwater was impacted with benzene, toluene, ethylbenzene, and xylenes (BTEX). Groundwater monitoring results since discovery and site assessment suggested that BTEX concentrations were decreasing. However, contaminant concentrations and geochemical conditions exhibited considerable variability. Site managers needed additional lines of evidence to evaluate monitored natural attenuation (MNA) as the management strategy.

SAMPLING AND ANALYSIS



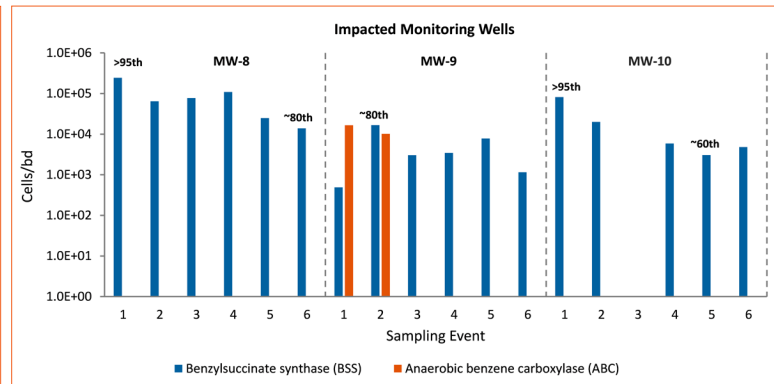
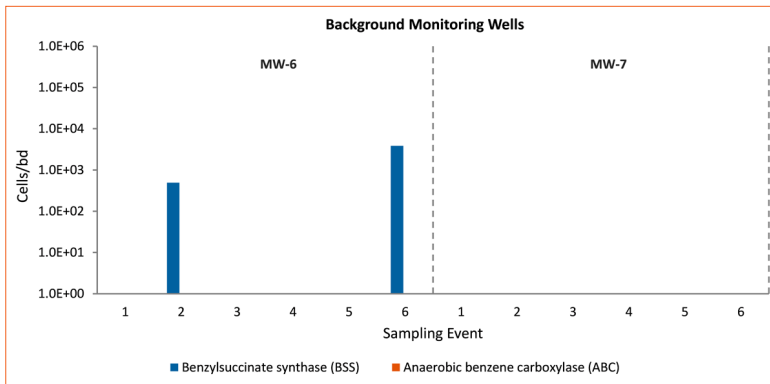
CENSUS qPCR quantification of BSS and ABC genes was incorporated into routine monitoring of plume and background wells to evaluate BTEX biodegradation potential and the feasibility of continuing MNA. Benzylsuccinate synthase (BSS) initiates anaerobic biodegradation of toluene, ethylbenzene and xylenes. Although additional pathways are likely, the only characterized pathway for anaerobic benzene biodegradation is initiated by anaerobic benzene carboxylase (ABC).

During on-going groundwater monitoring, Bio-Traps® were submitted for CENSUS qPCR analysis from two background wells (MW-6 and MW-7) and three BTEX impacted wells (MW-8, MW-9, and MW-10).

MNA EVALUATION



Comparison of CENSUS qPCR results for background wells (MW-6, MW-7) to impacted wells (MW-8, MW-9, MW-10) indicated growth of anaerobic BTEX degraders within the dissolved plume.



- BSS genes for anaerobic toluene biodegradation were only detected in one of the background wells (MW-6) and only during two of the six sampling events. Conversely, BSS genes were detected in all BTEX impacted wells (MW-8, MW-9, and MW-10) during all but one sampling event.
- Moreover, concentrations of BSS genes in impacted wells were high. Using the Microbial Insights Database, BSS concentrations in MW-8 were greater than observed in 80% to 95% of samples submitted from sites worldwide. At MW-9 and MW-10, BSS gene concentrations were “above average”, ranging between the 60th and 95th percentiles.
- Finally, ABC genes for anaerobic benzene biodegradation were occasionally detected in impacted monitoring well MW-9 at high concentrations.

Overall, CENSUS qPCR results indicated growth anaerobic BTEX degraders within the dissolved plume and provided a supporting line of evidence for biodegradation under existing site conditions

Decision: MNA continued based on the converging lines of chemical, geochemical, and microbiological evidence. Concentrations of targeted functional genes involved in anaerobic BTEX biodegradation ranged from above average to very high using the Microbial Insights Database and were orders of magnitude greater in the dissolved plume compared to background locations.

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KEY BENEFITS



- **Actionable:** Along with contaminant trends and geochemistry, microbiological evidence of BTEX biodegradation was a key factor in continuing MNA.
- **Saved Money:** Enhanced remediation options were not necessary.

LAB LOCATIONS



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Microbial Insights Canada, c/o EBPI

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