



Successful Soil & Groundwater Remediation Technique

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SITE BACKGROUND



Initial Incident & History

- Tanks and pipelines were replaced during 1996/1997 following reported defects in the infrastructures.
- The home owner, states hydrocarbon contamination was noted in the soil that was excavated during the construction of the other rental houses (borders with the site) in the yard
- The home owner and construction team did not report their observations to Engen at that time and therefore the soil was disposed of as general waste.
- There complaint of hydrocarbon smell in the house
- Pressure tests conducted showed no defects in the USTs and pipelines, after complaint

Assessments, Remediation and Monitoring Events

- Hydrocarbon contamination assessment, decommissioning of equipment, house restorations and remedial work (**incl. dig & dump and pump & treat**) was completed.
- Validation groundwater sampling and MNA (monitored natural attenuation)
- Installation of ten oxidant injection wells and sampling prior to ISCO.
- Oxidant (sodium persulfate) injection in Jan, Feb and Mar followed by ISCO efficiency monitoring in June
- ISCO efficiency monitoring
- ISCO efficiency monitoring and close out.

TIMELINES FOR ASSESSMENT, REMEDIATION AND EFFICIENCY MONITORING TO CLOSE OUT

Term ^a	Task ^a	Date ^a	Status ^a
December 2011 to August ²⁰²⁰ (Pre-ISCO) ^a	• → Initial Site Assessment (on and off-site) ^a	October ²⁰¹¹ to December ²⁰¹¹ ^a	Completed ^a
	• → Decommissioning of fuel equipment ^a	June ²⁰¹³ to July ²⁰¹³ ^a	Completed ^a
	• → P&T and Groundwater monitoring ^a	2014 to July ²⁰²⁰ ^a	Completed ^a
ISCO remediation phase (November ²⁰²⁰ to May ²⁰²⁴) ^a	• → Installation of ten oxidant injection wells ^a	9 to 11 November ²⁰²⁰ ^a	Completed ^a
	• → Sampling prior to injection of oxidant ^a	30 th November ²⁰²⁰ ^a	Completed ^a
	• → Injection of oxidants (a total of 1 ⁷⁵⁰ kg of sodium persulfate) over a period of three months ^a	28 th January ²⁰²¹ ^a	
		25 th February ²⁰²¹ ^a	
		25 th March ²⁰²¹ ^a	Completed ^a
	• → ISCO remediation efficiency/validation groundwater monitoring ^a	28 th June ²⁰²¹ ^a	
		20 th September ²⁰²¹ ^a	
		27 th June ²⁰²² ^a	
		03 rd June ²⁰²³ ^a	
	• → Final ISCO remediation efficiency/validation groundwater monitoring ^a	8 th March ²⁰²⁴ ^a	Completed ^a

DISCUSSION OF RESULTS

“DIG & DUMP REMEDIATION DURING UST REMOVAL”

- 3 x 23 000 ℓ and 1 x 46 000 ℓ USTs were decommissioned.
- Contaminated soil (from UST and canopy areas) with a volume of ~930tons was disposed of safely.
- **Additional 580tons of soil was excavated at the canopy footprint area for safe disposal.**
- To enhance attenuation, the solid product (*infested with Bacterial, Fungal and Yeast isolates*) was blended with import soil material during backfilling of the UST excavation.
- For future monitoring, Pit Observation Wells (POW) were installed in the former excavation during the backfilling process.
- Seepage was detected at 1.6mbgl and the average depth to GW was measured at 1.955mbgl.
- Besides hydrocarbon sheen, no measurable LNAPL was found within the excavation.



DISCUSSION OF RESULTS

“PUMP AND TREAT SYSTEM “(LINKED TO CUT-OFF TRENCH)

A cut-off trench was installed on the down-gradient end of the UST excavation.

A sump (equipped with a pump) was linked with the cut-off trench to drain the trench.

The contaminated GW from the trench channelled via the aboveground separator and treated using the air-stripper prior to its disposal into the local sewer system.

No LNAPL was found within the sump.

GW samples were taken from the sump and/or separator and from the outlet of the separator to verify treatment efficiency prior to disposal.

Based on the GW samples taken prior to and post treatment, the *airstripper* was effective in terms of treating/lessening the dissolved phase hydrocarbons.



DISCUSSION OF RESULTS

TRACE TEST, ISCO REMEDIATION AND CLOSE-OUT

Given:

That the trench did not show signs of overflowing over the years; and

The need to fast track remediation close-out (*even though continual decreasing trend on HC was evident in the monitoring wells*);

the P&T system was switched off to facilitate the ISCO remediation.

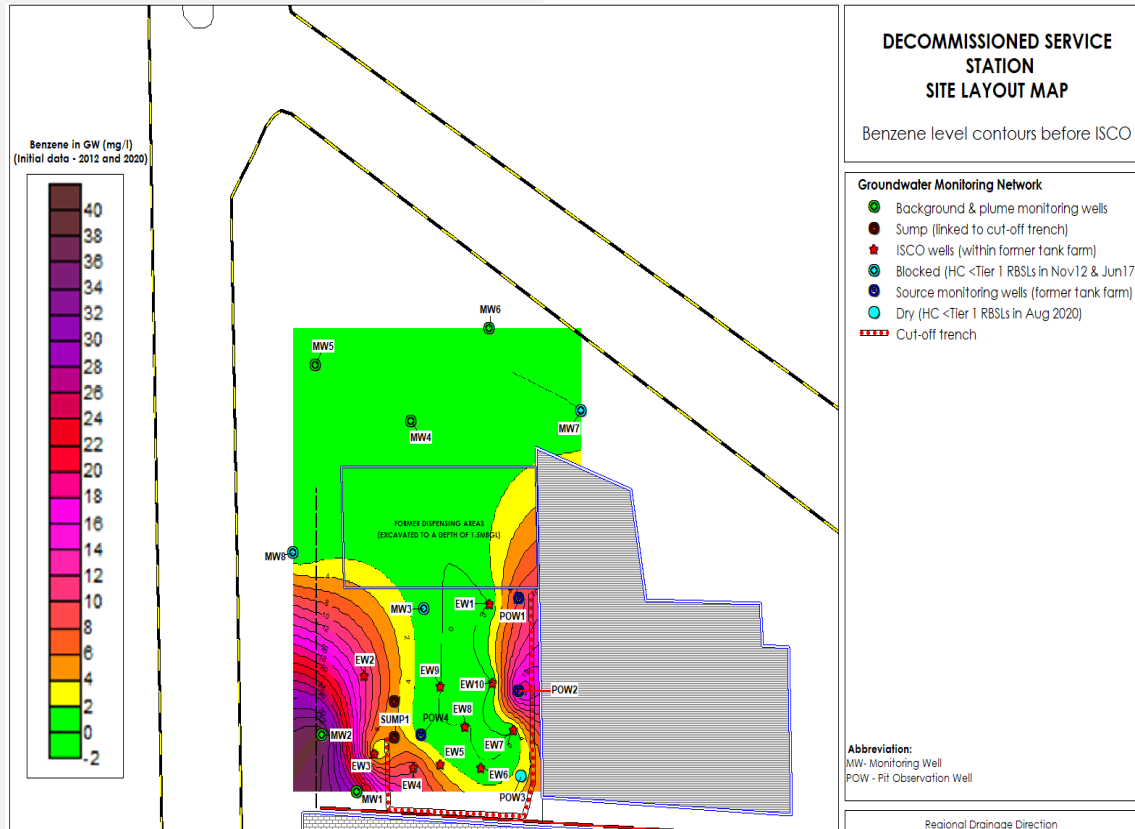
To trace the connectivity of the monitoring wells at the former tank farm (compacted) area, 2000 litres of dyed bacterial liquid was injected in MW1, MW2, POW1, POW3 and POW4

The dyed bacterial liquid was not injected in POW2 in order to use it to check if the liquid moved laterally over time post injection and also to assess the change in the hydrocarbon levels based on the known background levels.

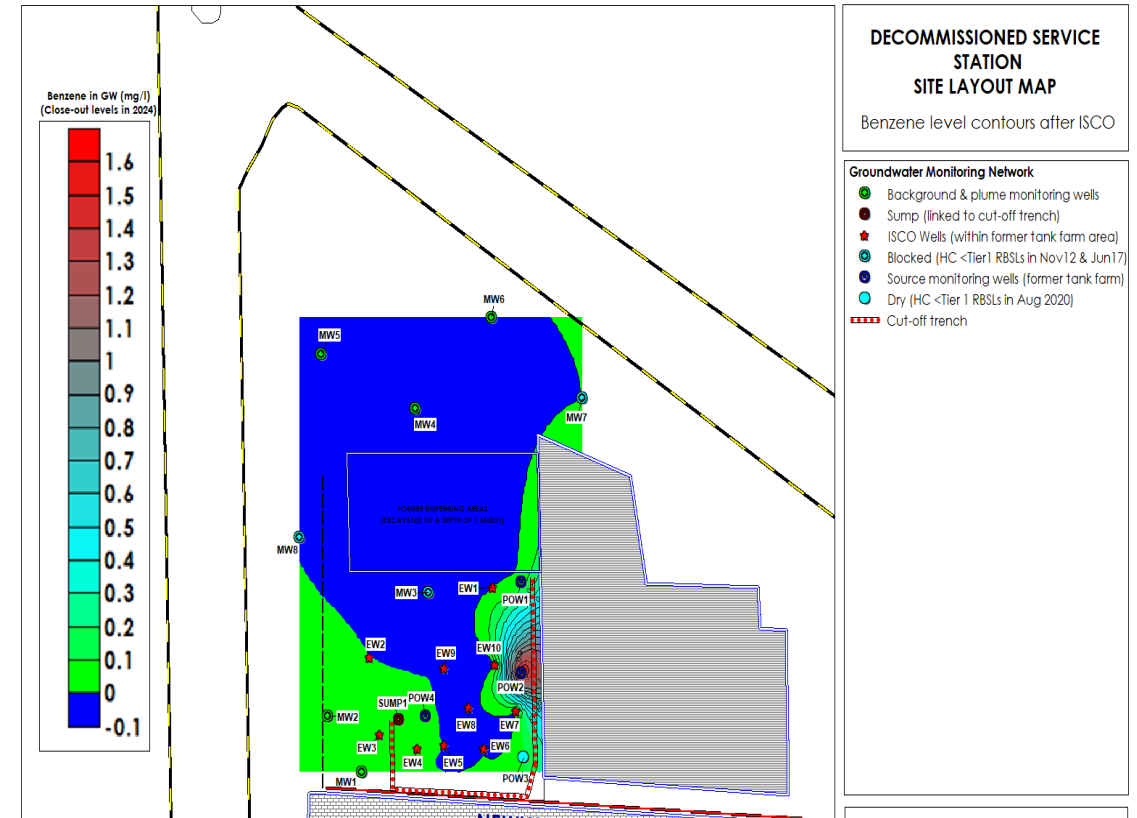
Well ID	Volume of BioBlue (litres)	Location
POW1	750	Former tank excavation
POW2	0	
POW3	750	
POW4	400	
MW1	50	In-situ soil, down-gradient of the former filler and UST positions.
MW2	50	



SITE LAYOUT MAP



Initial Benzene Levels



Final Benzene levels



Thank you

