



CARBONI, MARCELLO

Regional Manager, Europe



# INSTALLATION, COMMISSIONING AND OPERATION OF AN INJECTABLE IN SITU PERMEABLE REACTIVE BARRIER TO PREVENT THE ADVECTION OF PER-AND POLYFLUOROALKYL SUBSTANCES AT A EUROPEAN AIRPORT

Marcello Carboni, Jack Shore

PlumeStop and PFAS

# PlumeStop

What is it?

- Liquid activated carbon
- Particle sizes 1 – 2  $\mu\text{m}$
- Suspended as a colloid in a polymer solution
- Distributes widely under low pressure
- Provides extremely fast sorption sites
- Converts underlying geology into purifying filter



**PLUME STOP**  
Liquid Activated Carbon

PlumeStop and PFAS

# Column Study

CAC vs. PAC



Colloidal Activated Carbon



Powdered Activated Carbon  
(PAC)

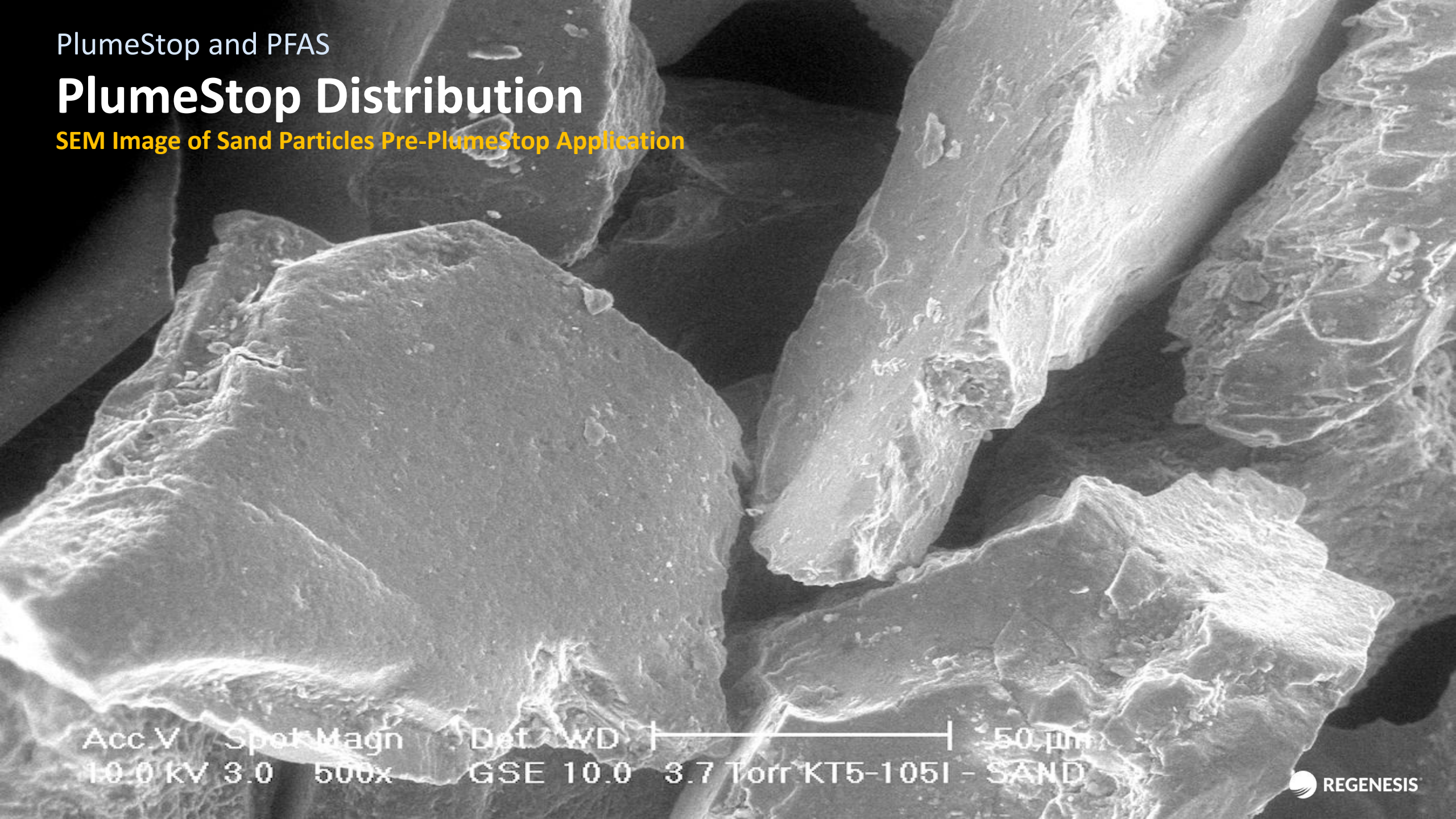
Time Lapse = 12 minutes



PlumeStop and PFAS

# PlumeStop Distribution

SEM Image of Sand Particles Pre-PlumeStop Application



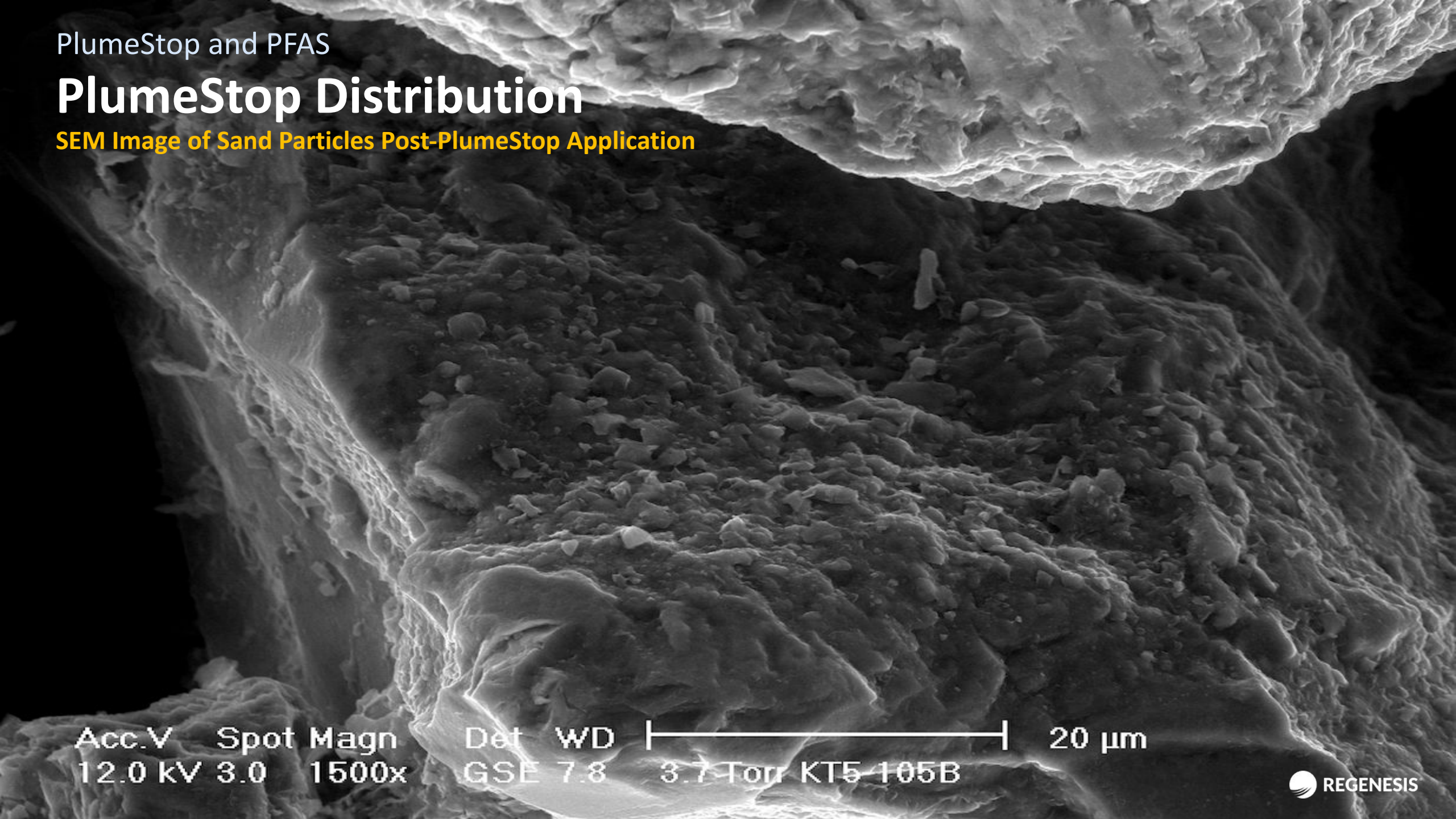
Acc.V Spot Magn Det WD |-----| 50 µm  
10.0 kV 3.0 500x GSE 10.0 3.7 Torr KT5-1051 - SAND



PlumeStop and PFAS

# PlumeStop Distribution

SEM Image of Sand Particles Post-PlumeStop Application



Acc.V Spot Magn  
12.0 kV 3.0 1500x

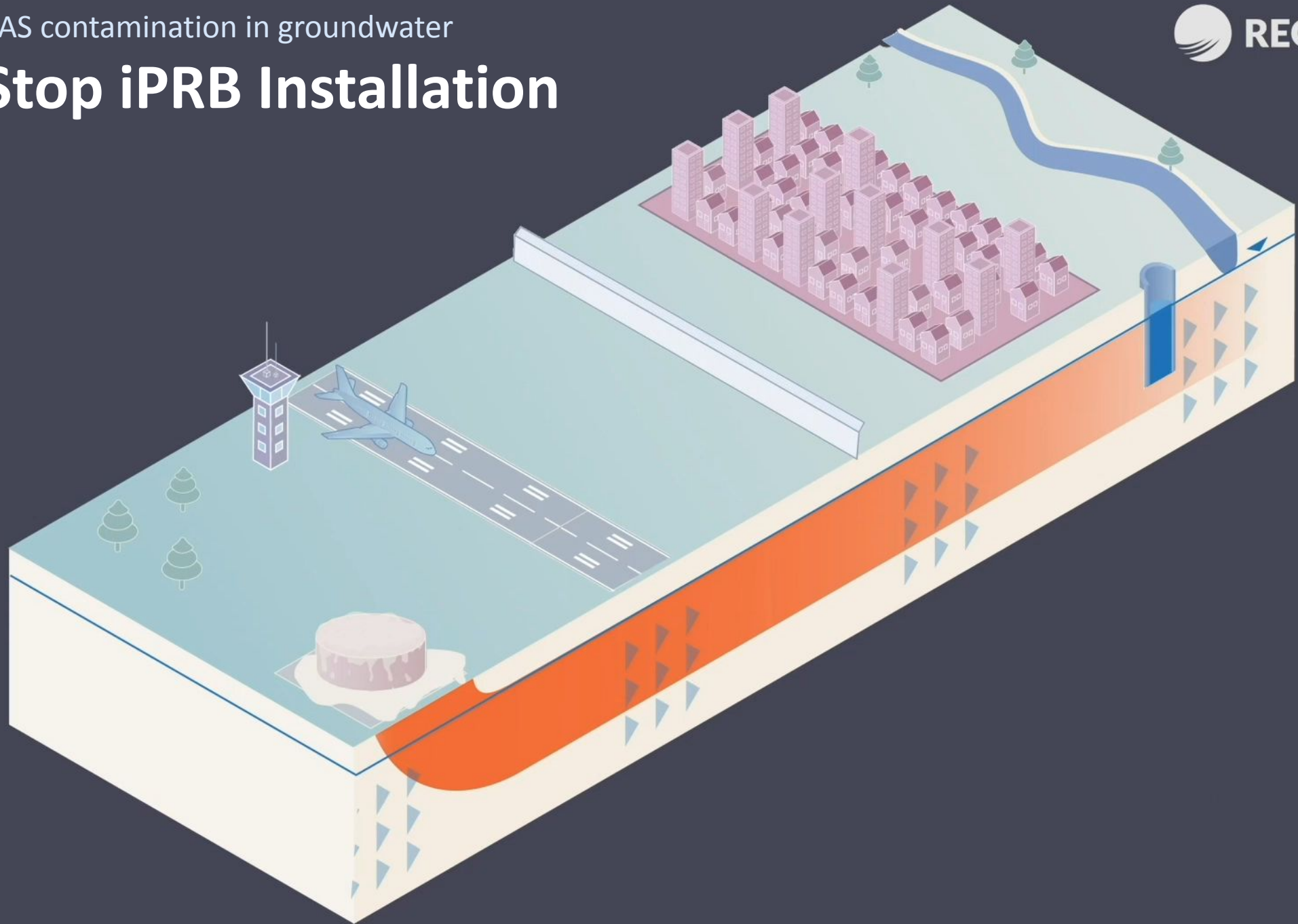
Det WD  
GSE 7.8

3.7 Torr KT5-105B

20  $\mu$ m

Addressing PFAS contamination in groundwater

# PlumeStop iPRB Installation





# PlumeStop: Eliminates Risk of PFAS

- ~~Risk = Hazard x Exposure~~
- PlumeStop binds up PFAS *in situ*
- Eliminates potential for down gradient exposure
- Eliminates the risk



# Capture Efficiency

What happens over time

## Won't the barrier eventually fill up and break through?

- This is an *in situ* stabilisation/sequestration approach
- PFAS do not degrade, so the potential for breakthrough must be part of the design process
- The approach includes: **how to predict, avoid, and prevent breakthrough**
- **Which we can do!**

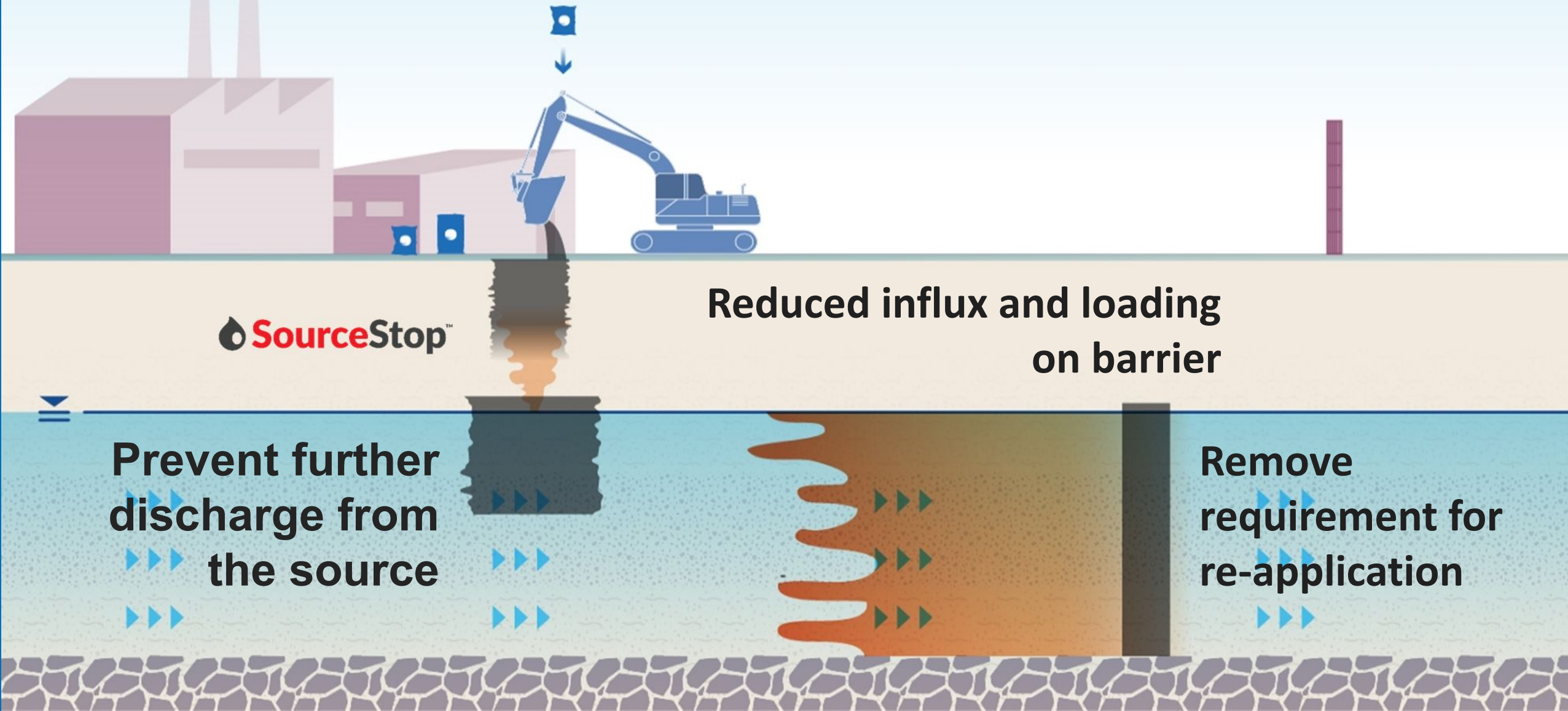




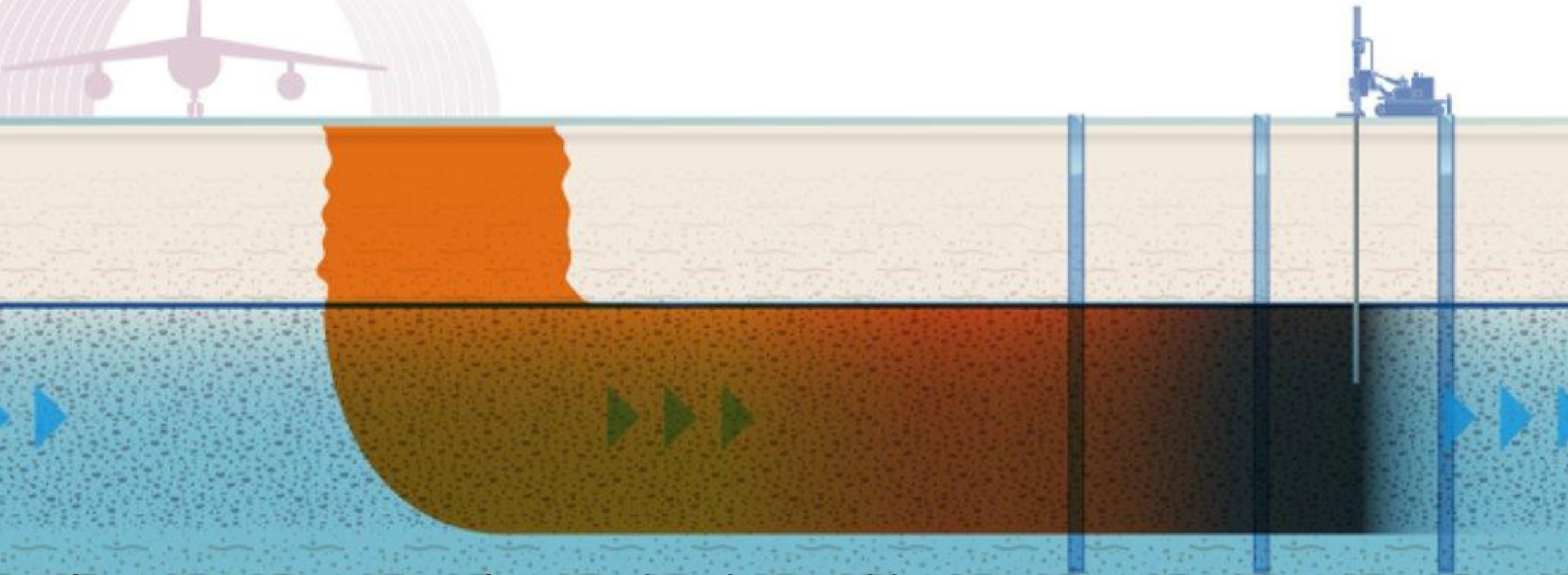




## Treat soil source: *In situ* leachability and infiltration treatment



# Re-application



If source treatment isn't immediately possible  
Maintenance applications can be planned for every 15 - >80 yrs  
With no onsite activities during all this time



“Groundwater containment may be achieved through an **injection of an amendment** that causes the PFAS **to attach onto materials in an aquifer**”



PFAS Team

# Case Study

# Private UK Airport

PFAS pilot trial leads to successful PlumeShield-guaranteed full-scale installation



# Site Features

## Site

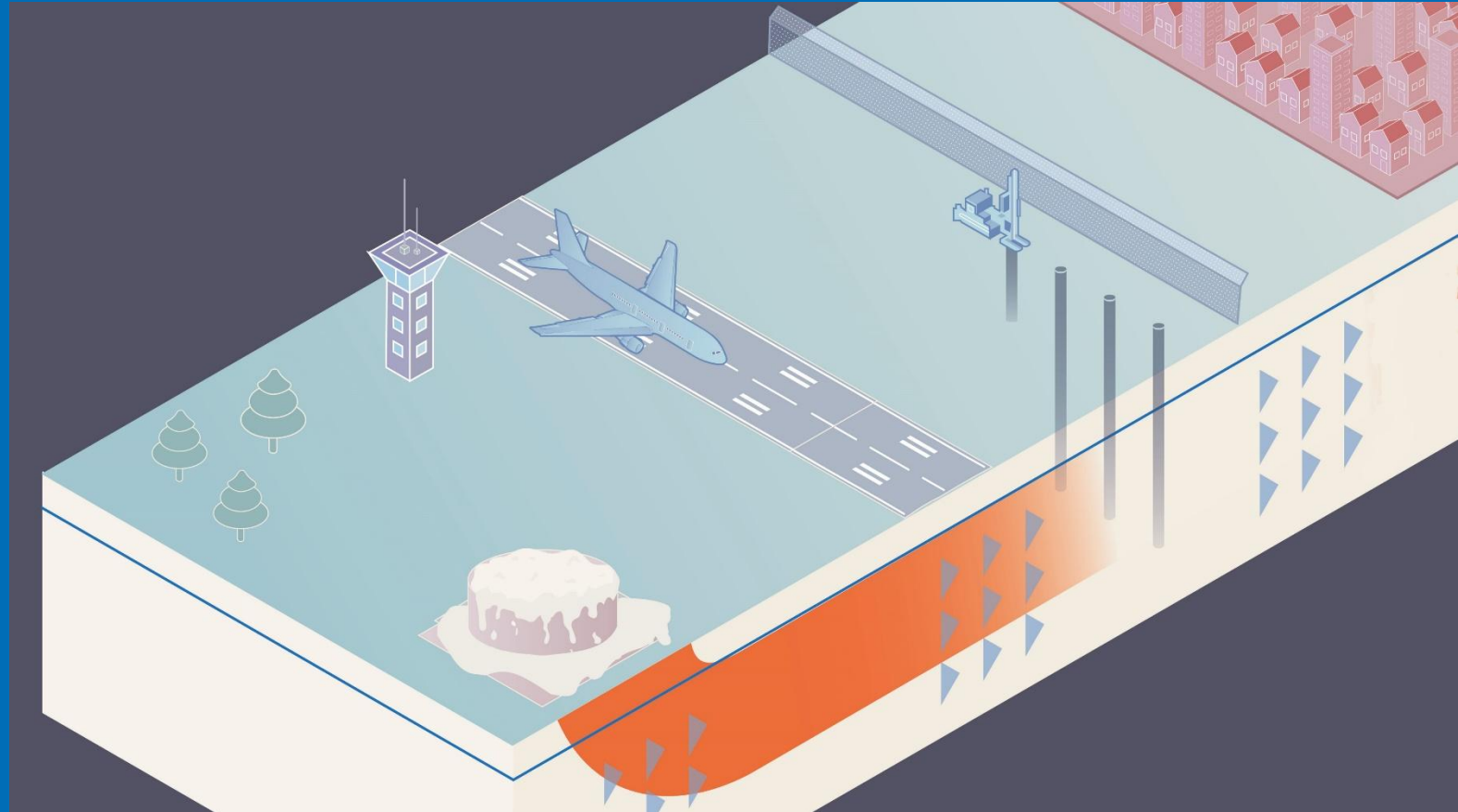
- Fire fighting training area
- Land divestment

## Contamination

- PFOS (320 ng/L)
- PFOA (6,320 ng/L)

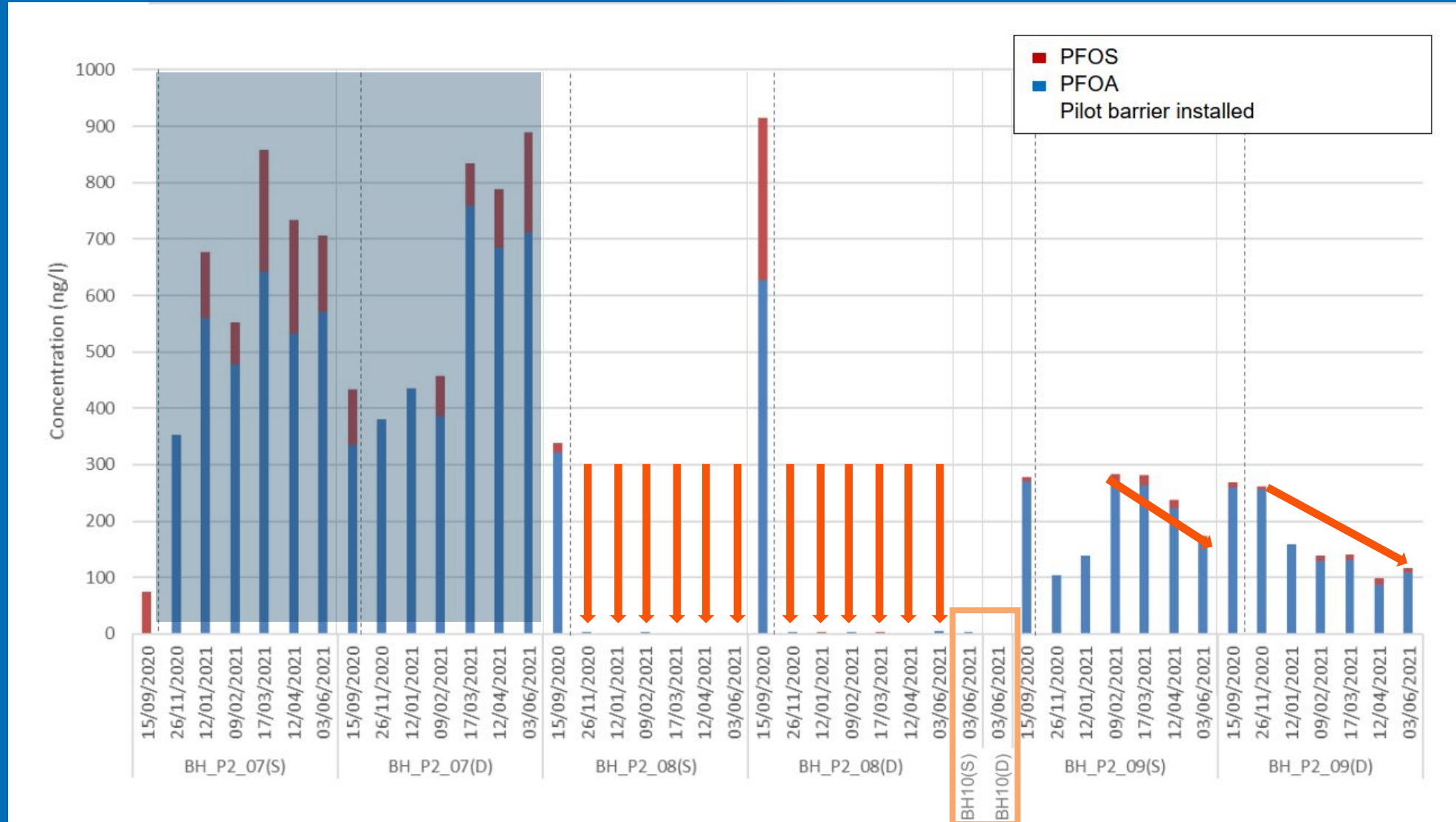
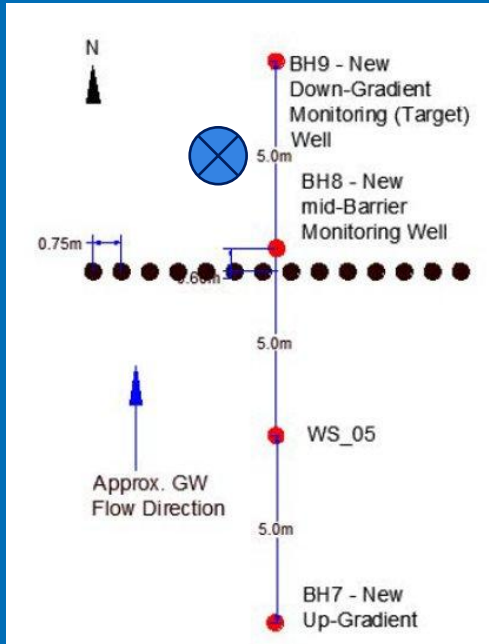
## Formation

- Weathered Chalk
- Higher permeability layers
- Slow and fast-flowing flux zones
- Groundwater at 3m BGL



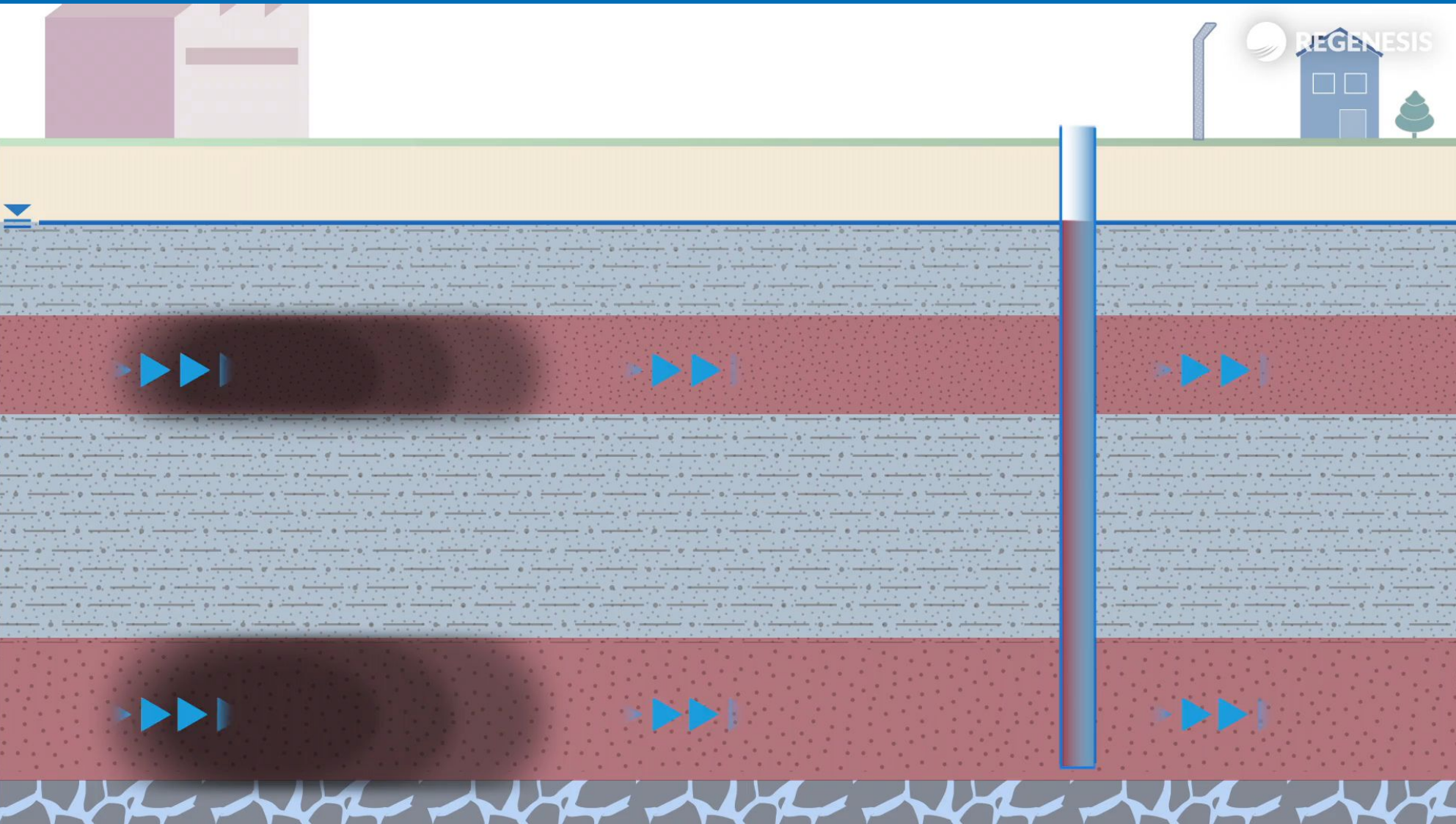


# PlumeStop Pilot Installation – Summary



# Case Study – Private UK Airport

## Updated CSM



Higher contaminant loading (WS5)  
Greater back diffusion  
Slow Flux  
Greater noise

Lower concentrations  
Less back diffusion  
Faster flux  
Down gradient effect clearer

# PlumeStop Pilot Installation – Concluded

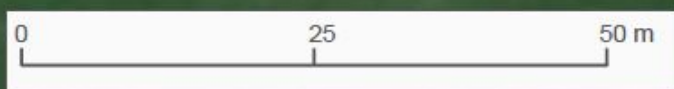
- 0.5m and 2.5m down gradient of the barrier we are seeing a >99% reduction in PFOA/PFOS (<0.1ug/L)
  - **Barrier is working**
- **Clear evidence of reducing concentrations**  
5m downgradient in deeper well (BH09 (D))
  - Faster flowing flux zone
  - Wave of cleaner water arriving sooner
- **Robust results** that allow to:
  - **Move to Full-Scale Installation**





# Full Scale Implementation

- 277 meters long
- 3 to 11m BGL
- Installation works: 4 months (March-June 2022)
- Commissioning works: August 2022 to Feb 2023
- Placement validation
- Performance validation
- 3<sup>rd</sup> Party Validation and Verification
- Warrantied solution



#### 4 No. Validation wells

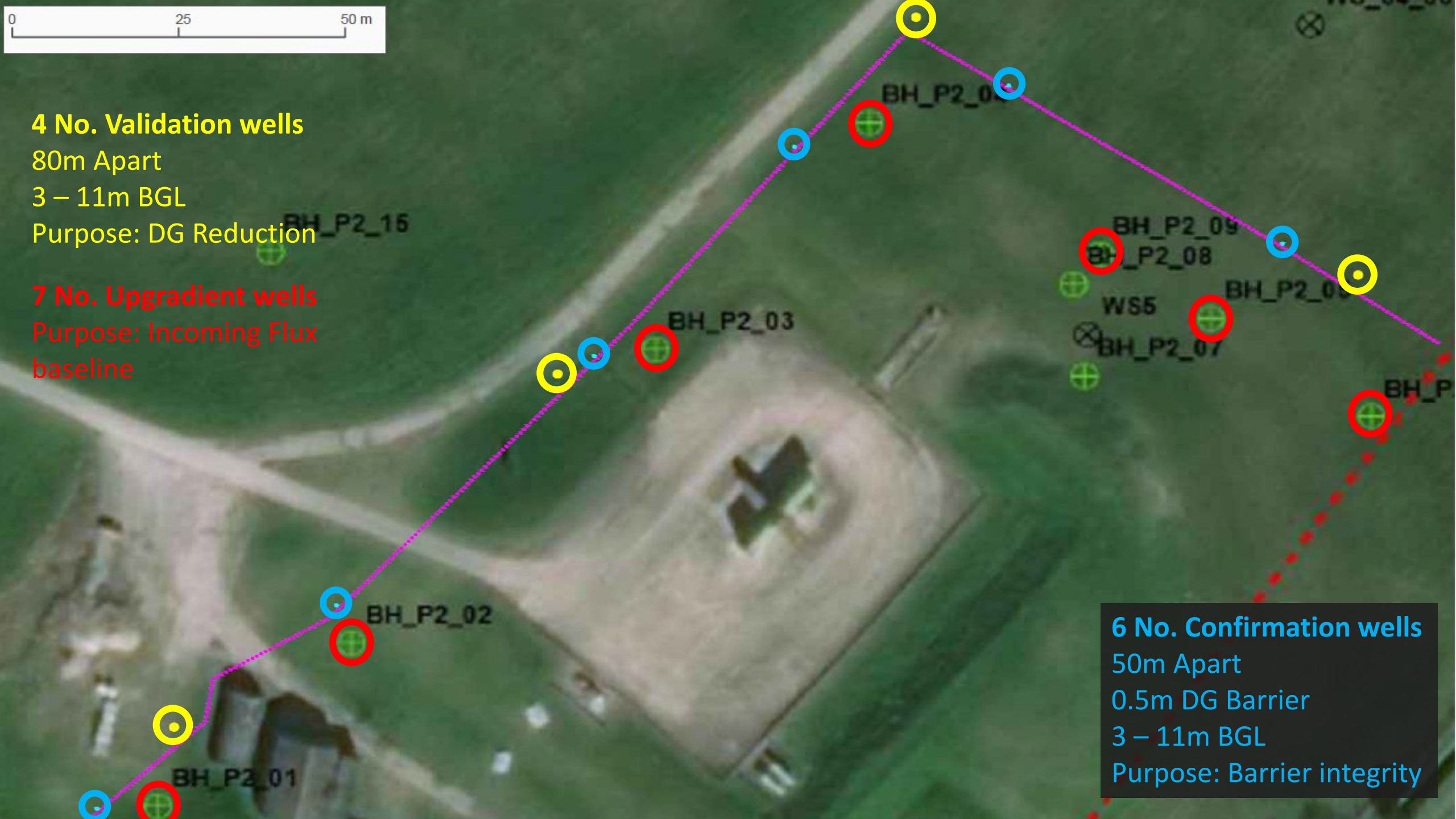
80m Apart

3 – 11m BGL

Purpose: DG Reduction

#### 7 No. Upgradient wells

Purpose: Incoming Flux  
baseline



#### 6 No. Confirmation wells

50m Apart

0.5m DG Barrier

3 – 11m BGL

Purpose: Barrier integrity



Case Study – Private UK Airport

# Installation activities





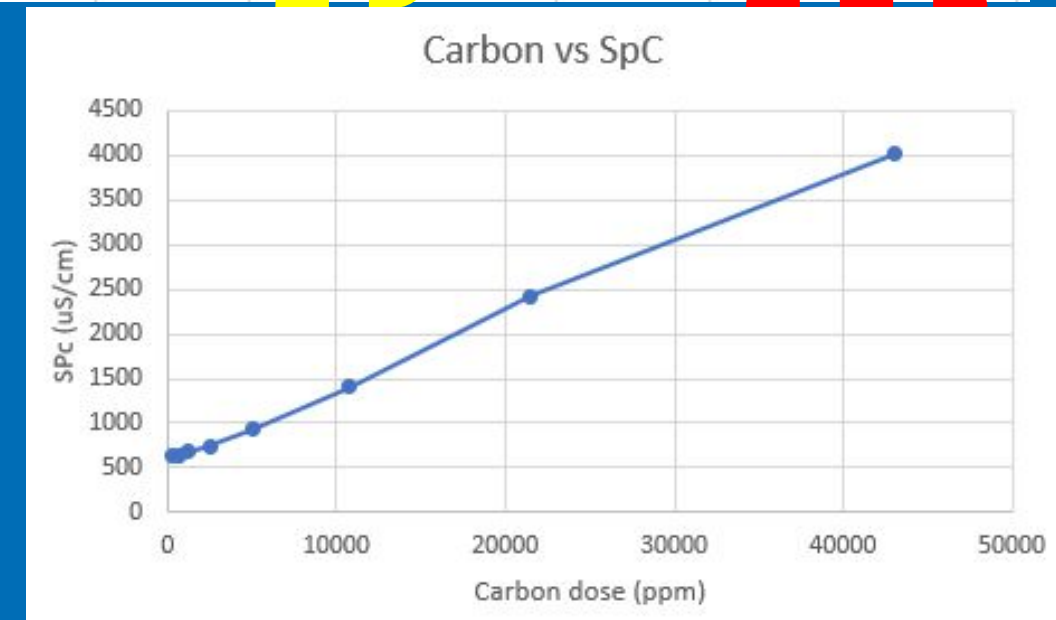
# Installation confirmation methods



# Placement Validation: Secondary lines of evidence

- Turbidity
- Electrical conductivity

Carbon concentration PPM	Temp C	Do %	SPc uS/cm	pH	ORP mV	FNU	NTU
0 (clean water)	14.3	57.3	579	8.04	195	48.25	48.25
43000	15.4	12	4018	9.81	139.8	-2.99	-2.99
21500	15.1	20.2	2423	9.67	134	-3.11	-3.11
10750	14.9	49.3	1408	9.34	150	-3.12	-3.12
5000	15.1	64	924	8.81	171	-2.98	-2.98
2500	15.1	82	745	8.34	189	-2.38	-2.38
1250	15.8	88	674	7.98	195	1.92	1.92
625	16.1	93.2	638	7.74	205	15.5	15.5
312.5	16.2	95.7	626	7.61	206	22	22



# Performance Validation: Early results

- All wells = ND
- MDL > STL
- Centrifugation

## MR2 (Installation #2)

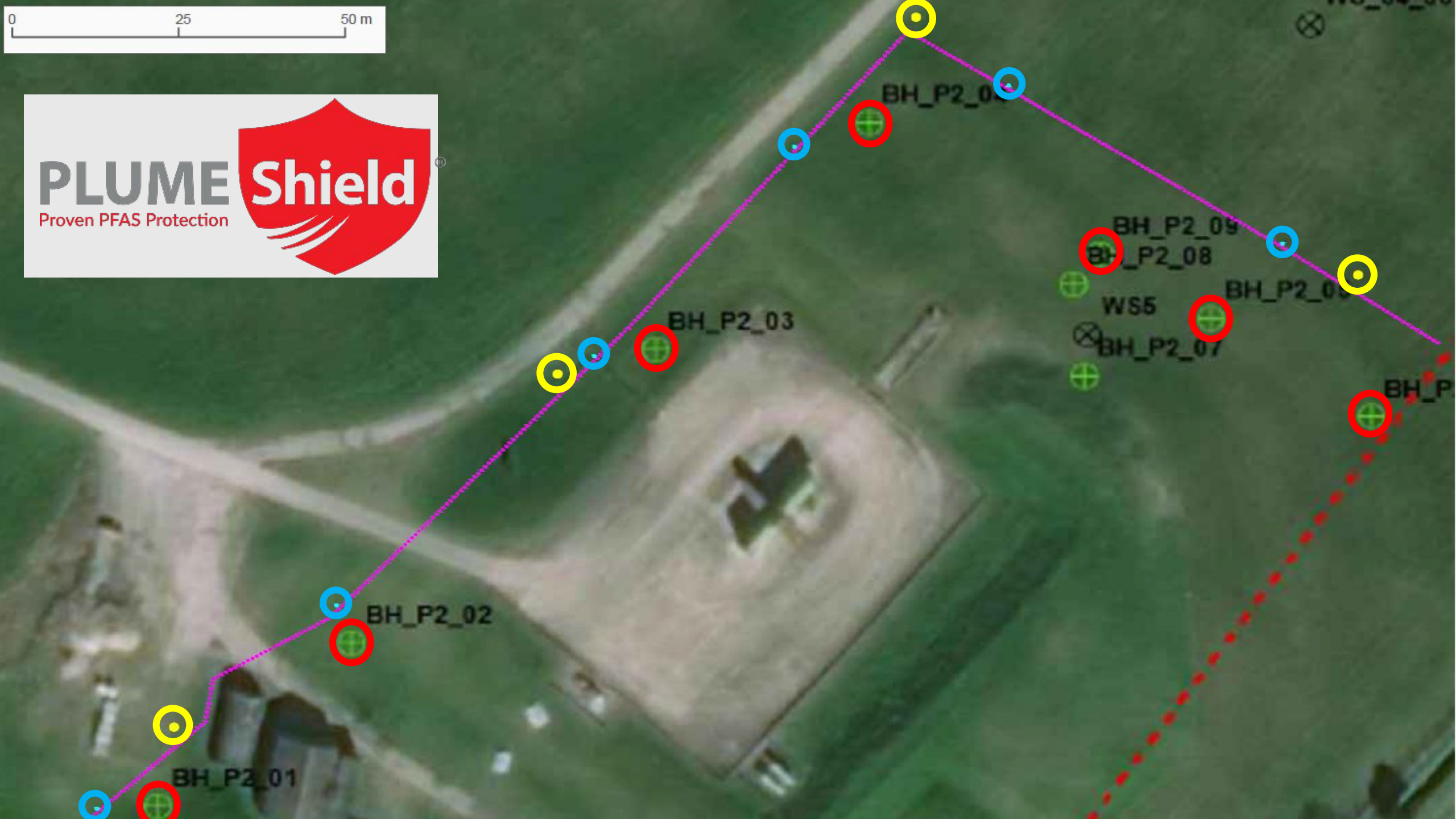
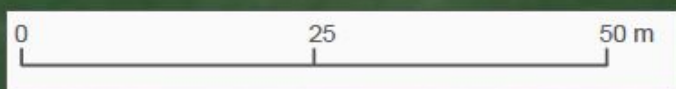
Sampled Date: 31/05/2022

Concentration: (<Detection limit) ng/L

compound	BH_VH_C1	BH_VH_C2	BH_VH_C4
PFOA	<65	<113	<350
Linear PFOS	<65	<65	<65
Branched PFOS	<65	<65	<65
Total PFOS	<65	<65	<65

STL = 100





# PlumeShield

PlumeShield guarantees our advanced PFAS remediation system eliminates the environmental risk of PFAS in groundwater

- **Guaranteed price:**
  - Time, product and injections included
- **Guaranteed effectiveness:**
  - Balance of payment due when barrier meets performance criteria
- **Guaranteed performance:**
  - Minimum 10-year PlumeShield warranty



# Summary

- REGENESIS offers a **suite of remediation technologies** for soil and groundwater
- Colloidal Activated Carbon is a **proven technology**
- PlumeStop eliminates the **risk of PFAS** in groundwater
- **Cost-effective** strategies
- **Guaranteed** approach







# THANK YOU FOR YOUR ATTENTION

Marcello Carboni

[mcarboni@regenesi.com](mailto:mcarboni@regenesi.com)

<https://regenesi.com/eur/>

