Ion Science

Introduction

Peter Childs

DATE

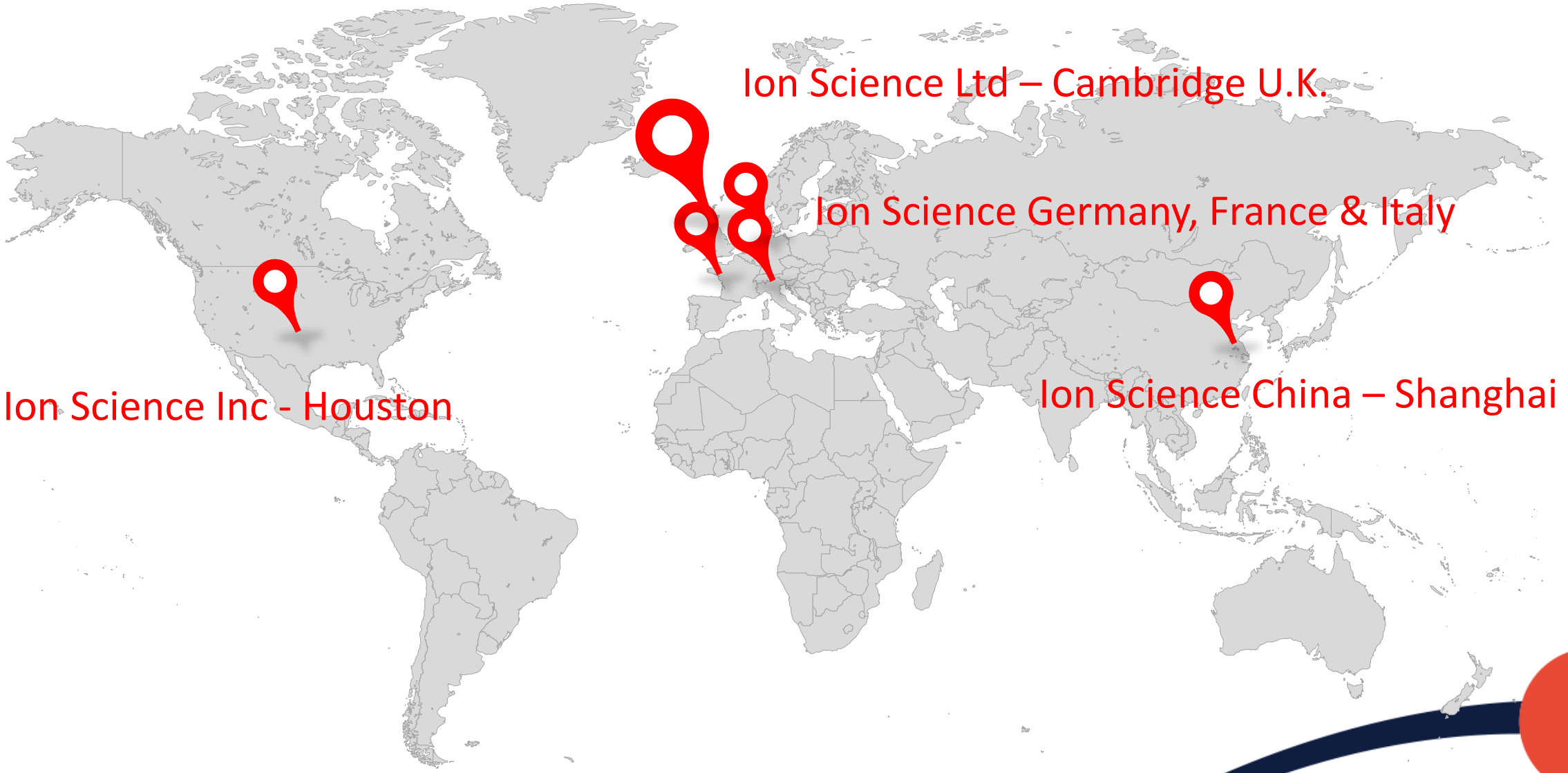
Unrivalled Gas Detection

ionscience.com

Introduction to Ion Science

- Leading manufacturer of PID sensors & Instruments
- Private Company
- Founded in 1989
- Based in Cambridge U.K.
- Group Revenue > £16m
- Employees 120

Global Coverage



ION Science

Continuous Ground Gas Monitoring

Peter Childs

ionscience.com

Unrivalled Gas Detection

Ground Gas risk

The problem

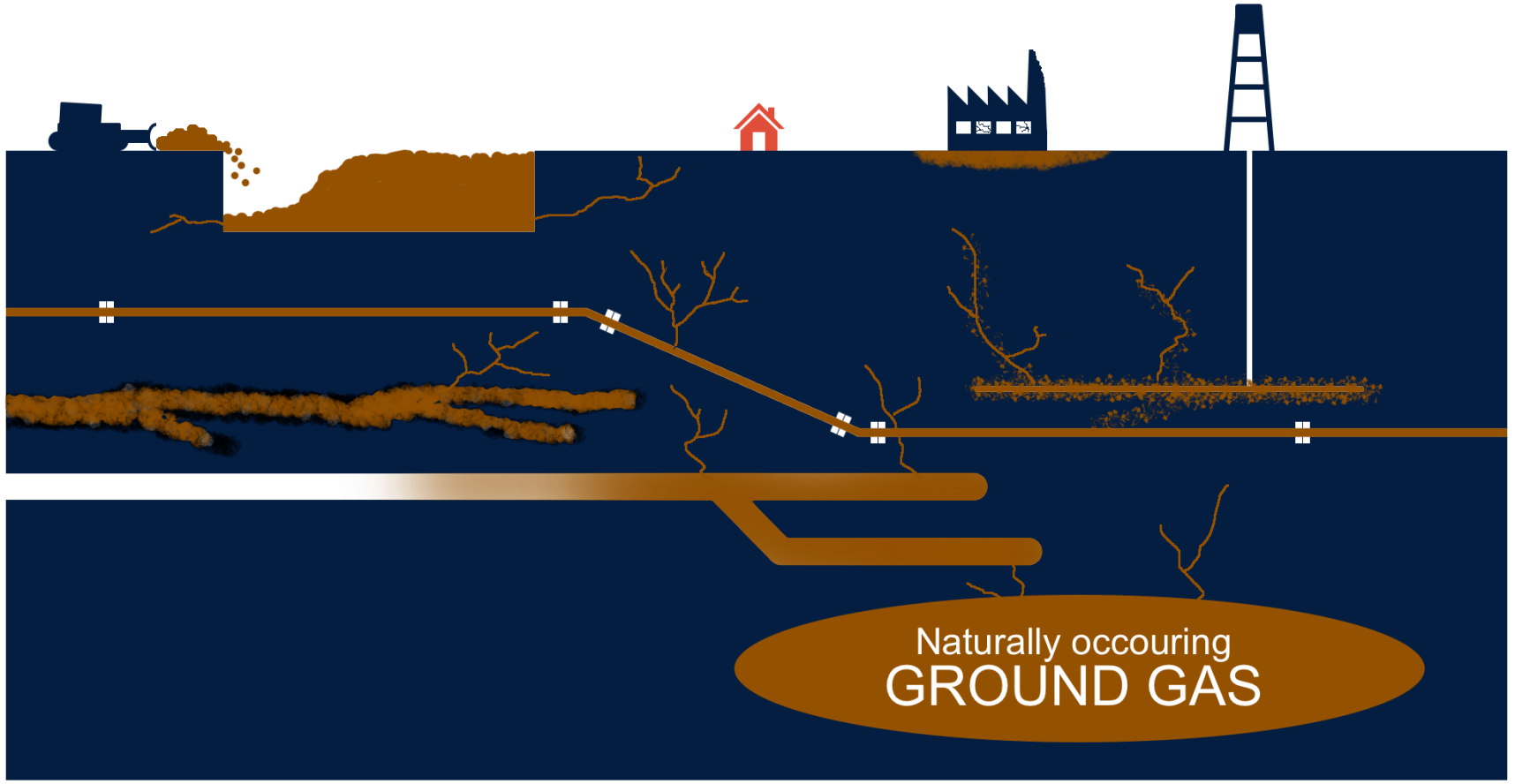
Various hazards can arise depending on the gas released

Soil / Ground Gas risk

The problem

Ground gas can originate from natural and various forms of human activity

- Land fill waste
- Abandoned coal mining
- Shale gas production
- Contaminated land
- Pipeline leaks
- Coal bed methane
- Natural Ground Gas



Abbeystead 1984

- Natural methane from coal seams released into water supply tunnel
- Pushed into valve house by start of water pumping
- Ignition source not known, but visiting group from local community present
- 16 killed by explosion

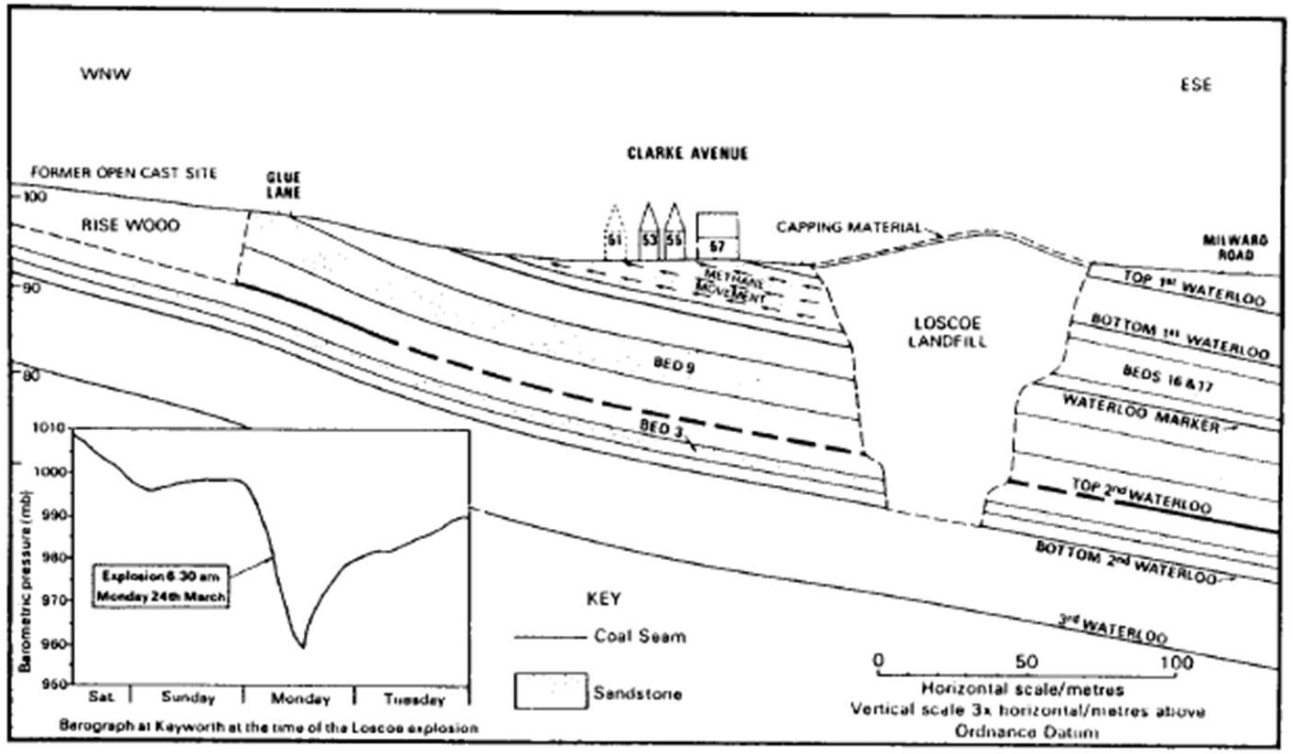
Gas-leak residents win $23.5m payout Brookland Greens Estate

- Hundreds of residents affected by a methane gas leak in Cranbourne will share more than $20 million in compensation paid by Casey Council and the Environment Protection Authority.
- A settlement has been reached in the class action by 750 residents and individual property owners will soon be contacted and told how much of the $23.5 million they will receive.
- In September 2008, hundreds of residents of the estate were forced to evacuate after dangerously high levels of methane gas were detected escaping from a disused landfill site in Cranbourne

Loscoe 1986

House exploded at 6.30 24th March

Loscoe Public Inquiry following House Explosion in 1984



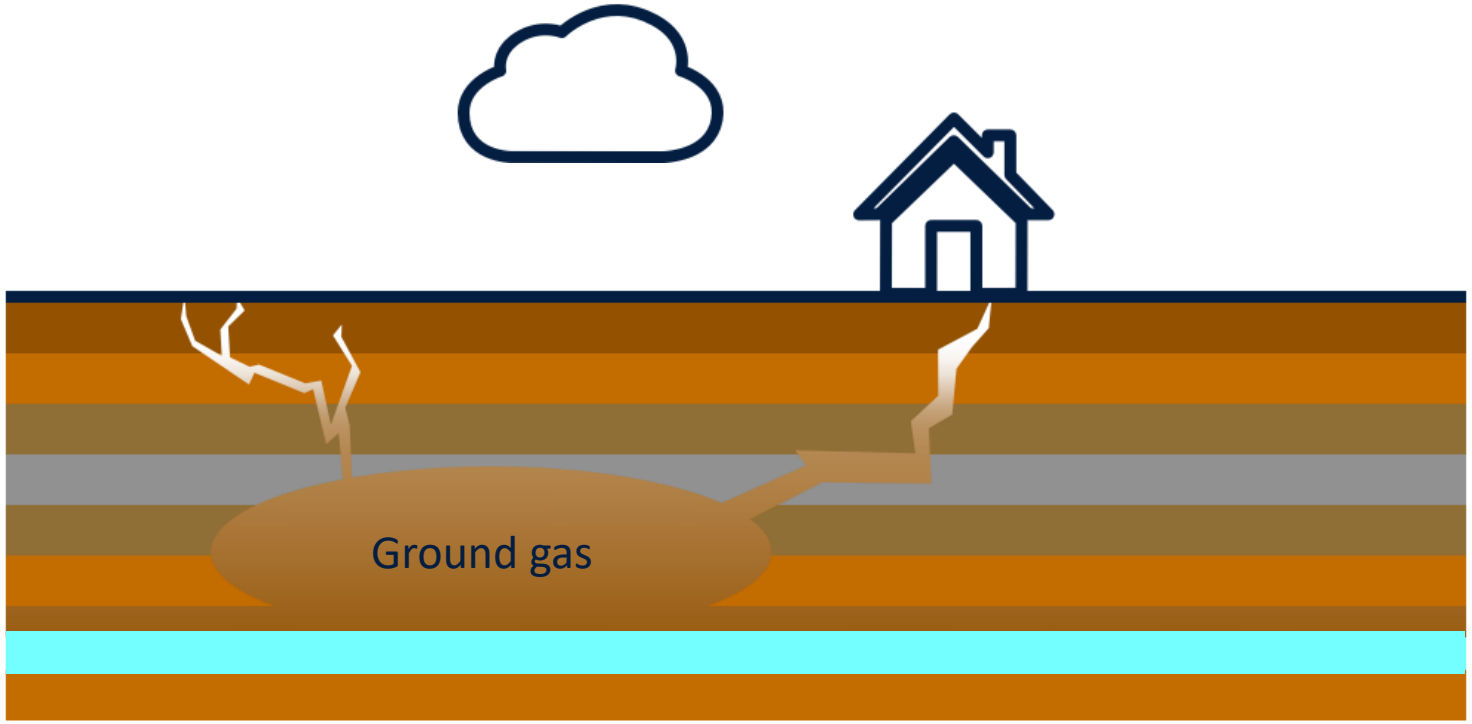
From CIRIA 130, 1995
(construction industry research and information association)

Soil / Ground Gas risk

The problem

Variations in environmental conditions cause variations in the rate gas is emitted. These conditions are:

- Ambient temperature
- Ambient pressure
- Rain and snow
- The water table



Spot check monitoring is therefor likely to miss some/maybe all hazardous events!

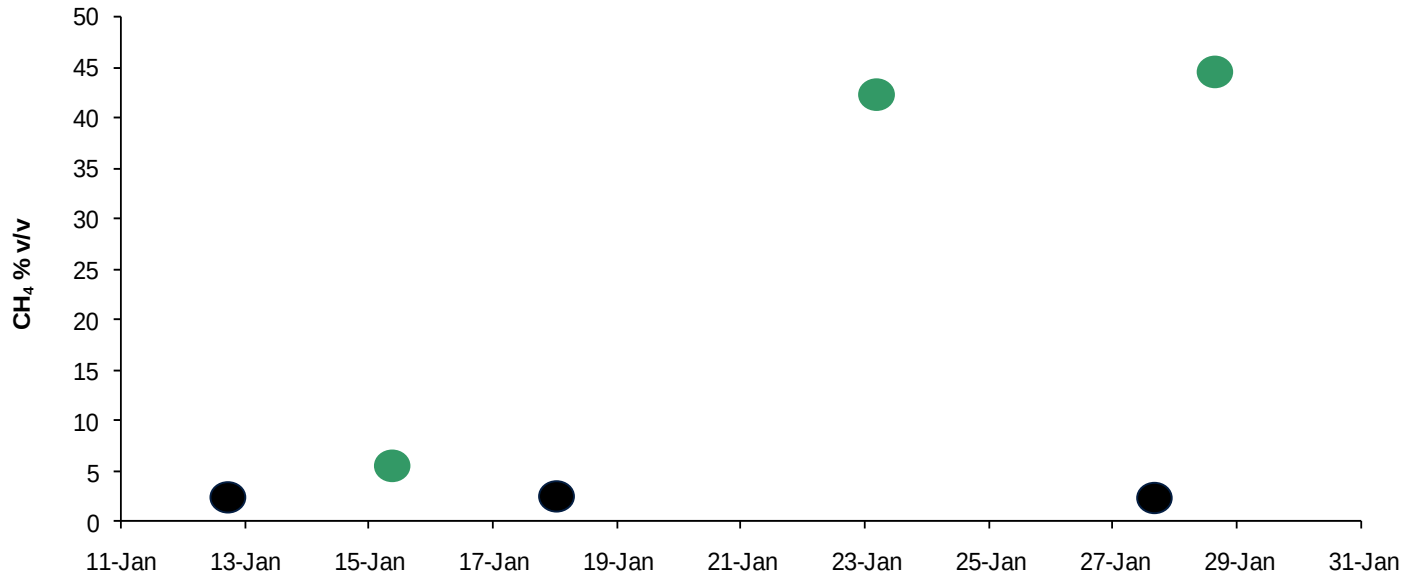
Objectives of ground gas monitoring

- Determine the true subsurface gas regime
- Predict how this may change in the future

Currently achieved by:

Discrete periodic spot measurements of gas concentrations and the gas regime is inferred

Effect of Sampling frequency on observed gas regime



- Spot sampling on these dates show no methane
- Spot sampling on these dates show gas, up to 40% !

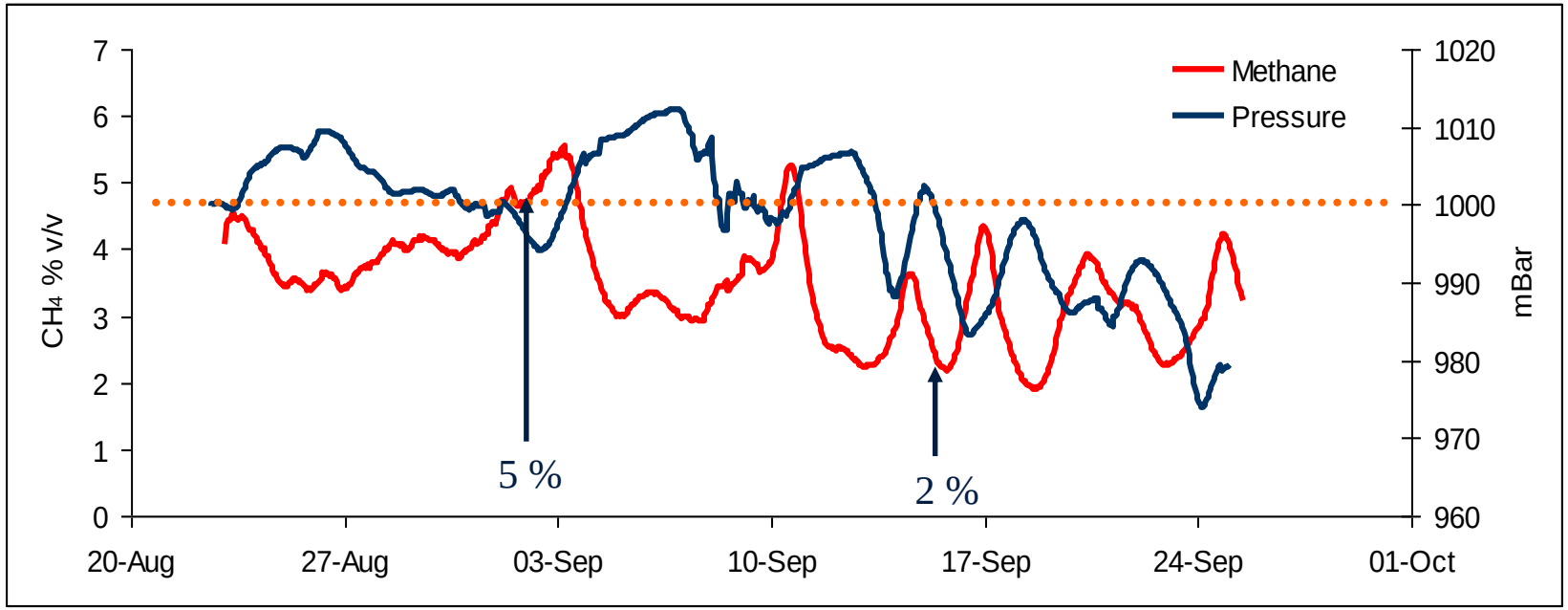
GASCLAM

The world's first continuous, borehole gas monitor

Key features:

- Specifically designed to detect ground gas from boreholes
- Continuously monitors methane, carbon dioxide, oxygen, hydrogen sulfide, VOCs and atmospheric pressure
- Can be deployed for over 3 months
- Intrinsically safe so can be used in explosive environments
- Discrete installation
- Telemetered data from real time reporting

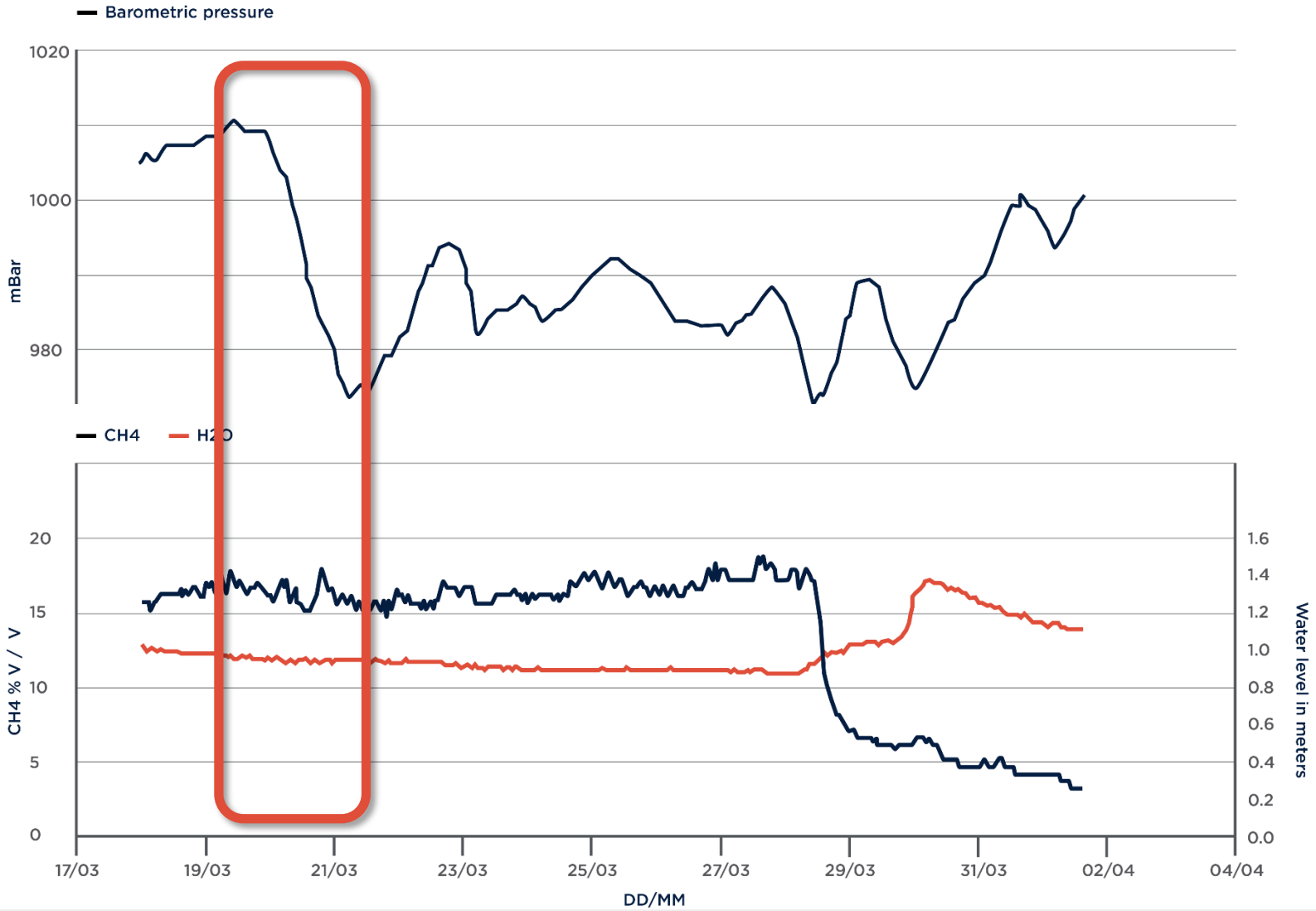
Process responsible for controlling ground gas concentration



Data from a borehole between a house and landfill

Soil / Ground Gas risk

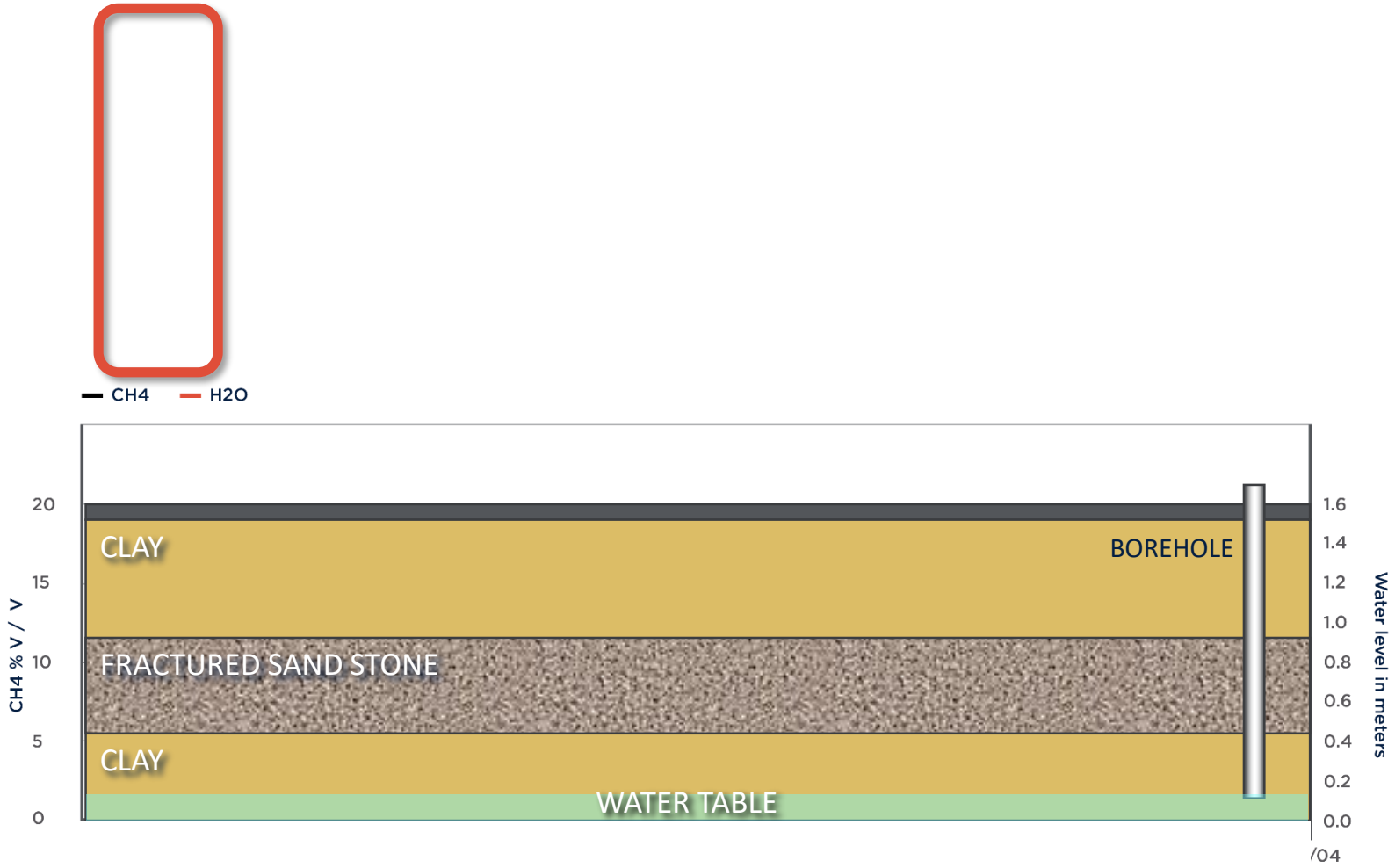
Example data – Closed landfill adjacent to housing



- In this example there is no obvious change in CH4 due to ambient pressure

Soil / Ground Gas risk

Example data – Closed landfill adjacent to housing

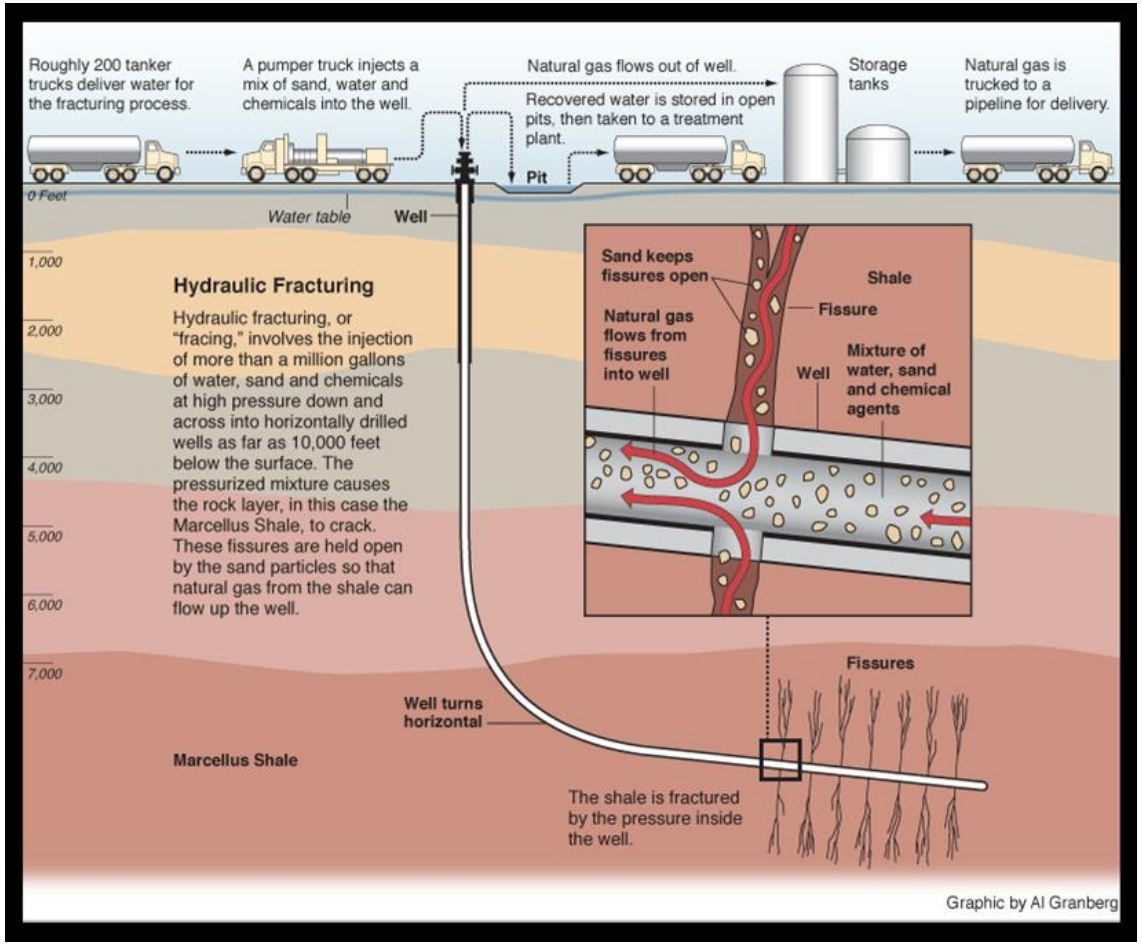


- No obvious change in CH4 as ambient pressure drops
- In this example it is the water table that affects the CH4 level

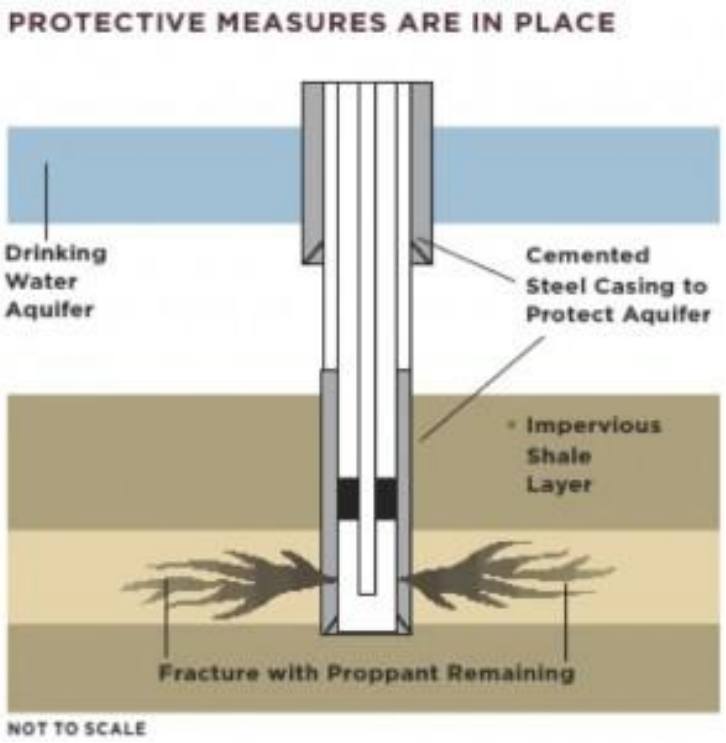
A high profile case – Caudrilla Operations, Blackpool UK - 2012

- Faded glory of a major holiday destination
- Now area of high unemployment
- Underlain by >2000 ft Bowland Shale - Potential for hydrofracking

HydroFracking



HydroFracking - issues

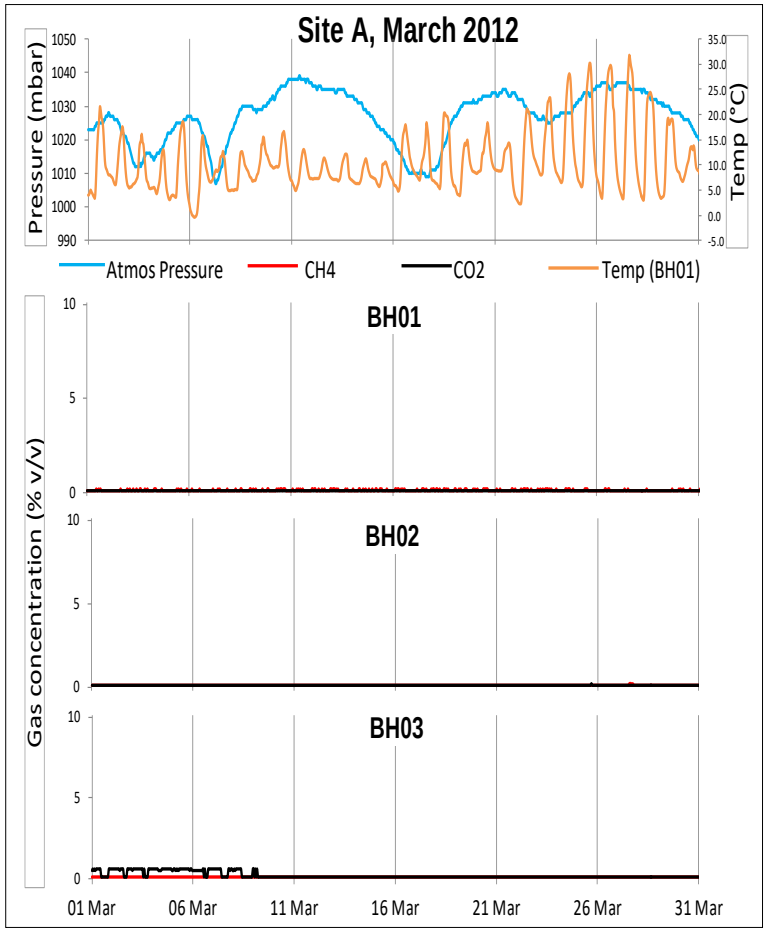


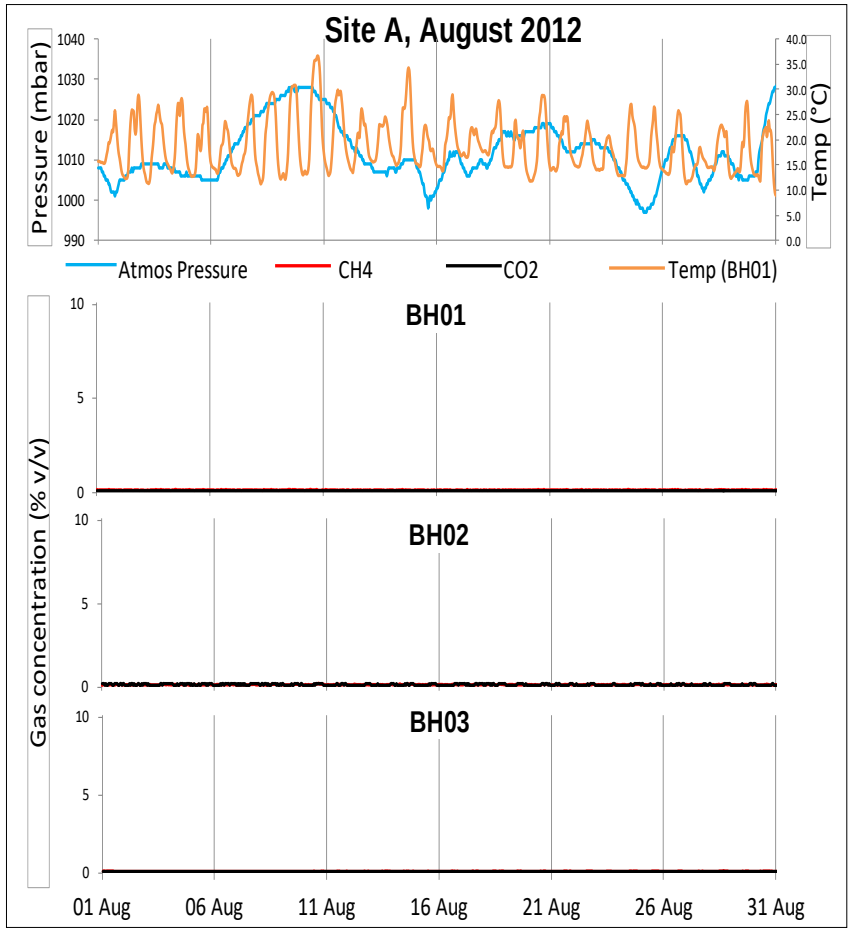
Benzene has been used in frack fluids – if methane can escape so can benzene!

Cuadrilla Case Study - Blackpool

- The sites are close to Blackpool, surrounding towns and farms
- Therefore operations are under particular close scrutiny by local residents, politicians and regulators
- Cuadrilla have adopted best practice in managing and drilling fracking operations in close liaison with regulators
- However, the need to win over and maintain public opinion by going beyond current best practice has been an important element of their approach.
- This includes high quality continuous monitoring of ground-gas in the near surface soils at their well pad sites before, during and after fracking

Establishing baseline data





Cuadrilla installed a network of 21 GasClams to monitor their current exploration sites

- Mark Miller, CEO of Cuadrilla, said: “The monitoring device will allow us to collect background gas levels and compare them between before, during and after our operations.

  Continuing with our open and transparent communications with the community, we will make this data available to the public and include this on the Cuadrilla website.”

2018 – Hydraulic fracturing can now go ahead based on solid understanding of the site
Continuous monitoring is a condition

Hierarchy of Cost-Benefits

Unmanned data Collection

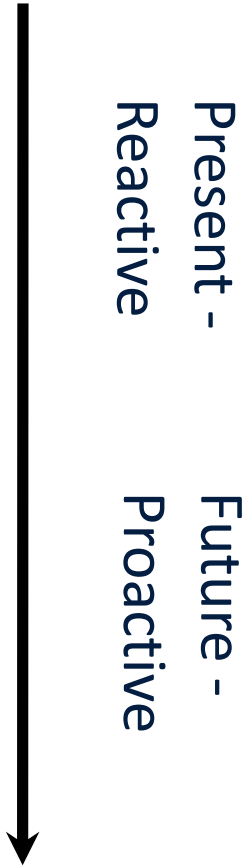
Efficiency savings in meeting existing legislative requirements

Reduced uncertainty about gas regime

Pre and Post development condition monitoring with telemetry

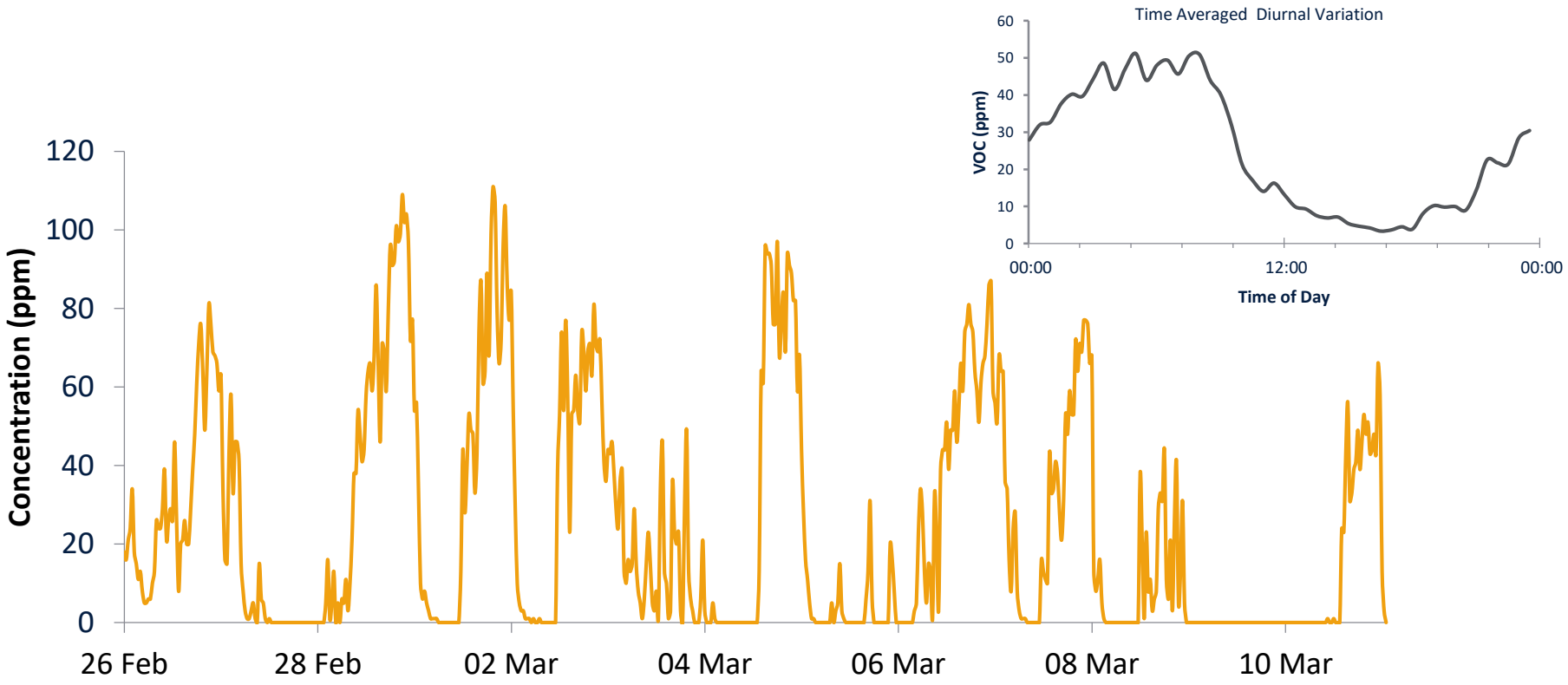
Design appropriate remediation measures

Demonstration of low risk by monitoring rather than as a consequence of remedial engineering



Former Petrol Station site

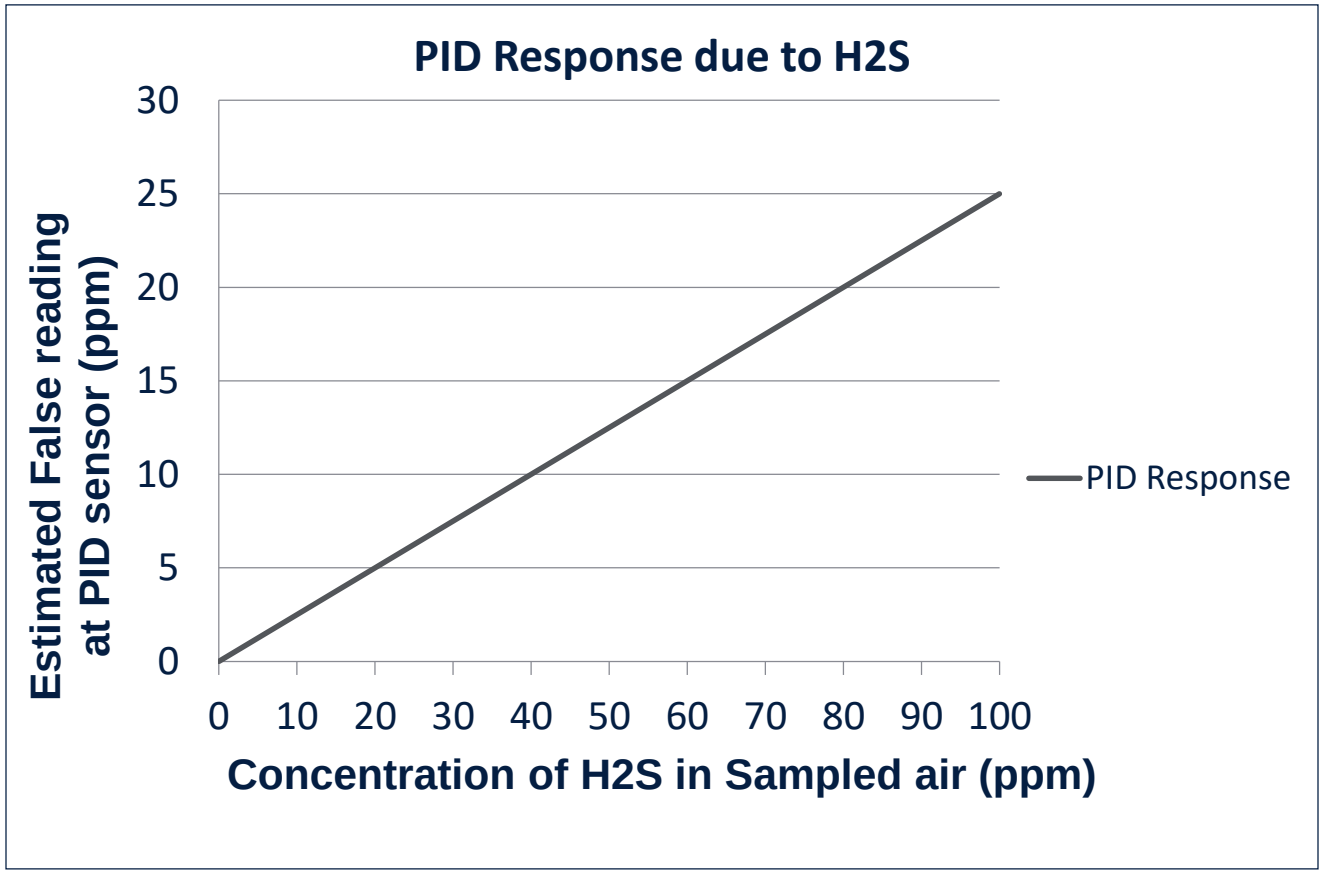
House Adjacent to Petrol Station



Water treatment facility

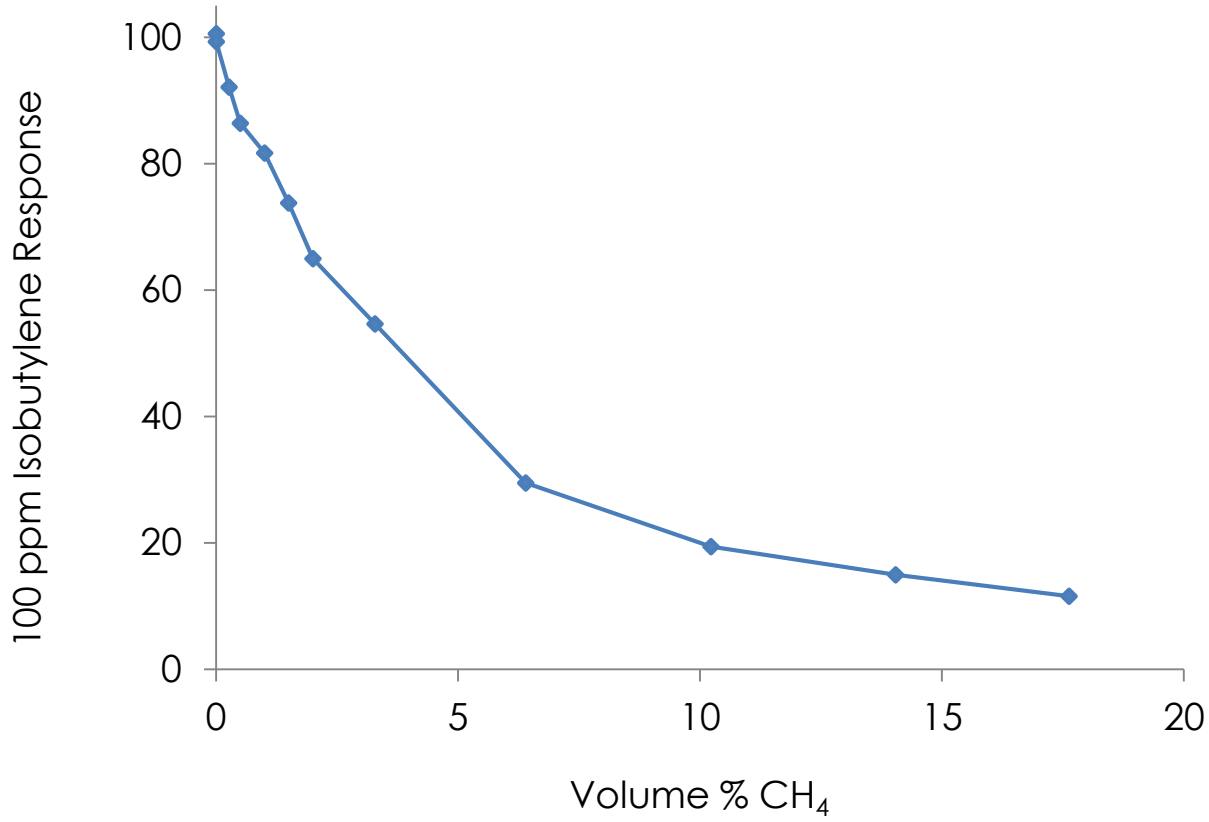
- Treats water for 1.5 Million people
- Suspicions that industry is illegally discharging waste
- PID has been employed to monitor for discharge
- However;
- Methane and H2S will affect a PID reading – but if there affects are understood and the are monitored using different sensor then a ‘true’ VOC reading can be obtained

Effect of H2S on VOC's reading



PID sensors will response to H2S with response factor of approx. 4

Effect of Methane



Due to these Phenomena if PID is used to monitor VOC's H_2S and CH_4 must be measured

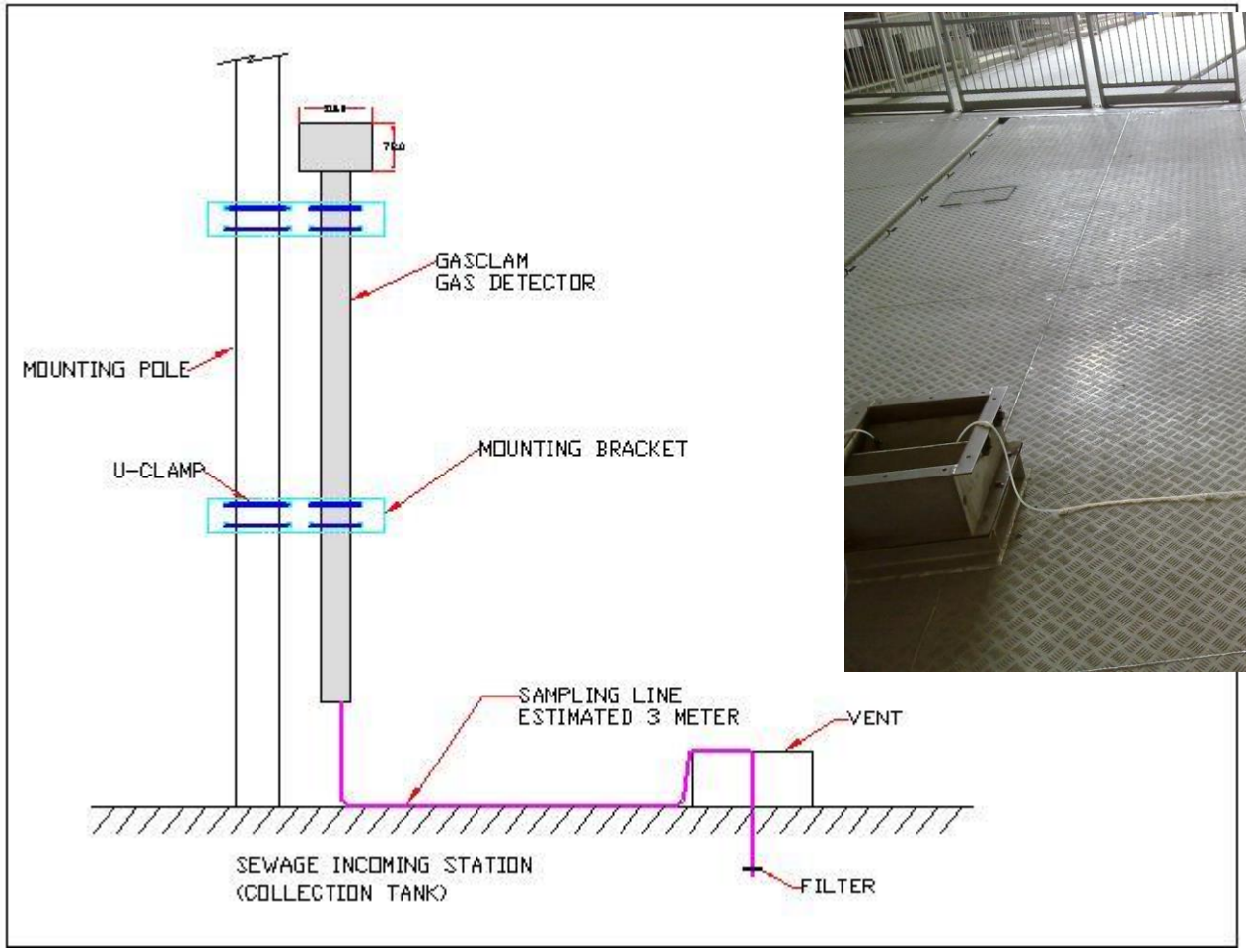
This will:

i) Validate the PID result – Prevent false positive and negatives

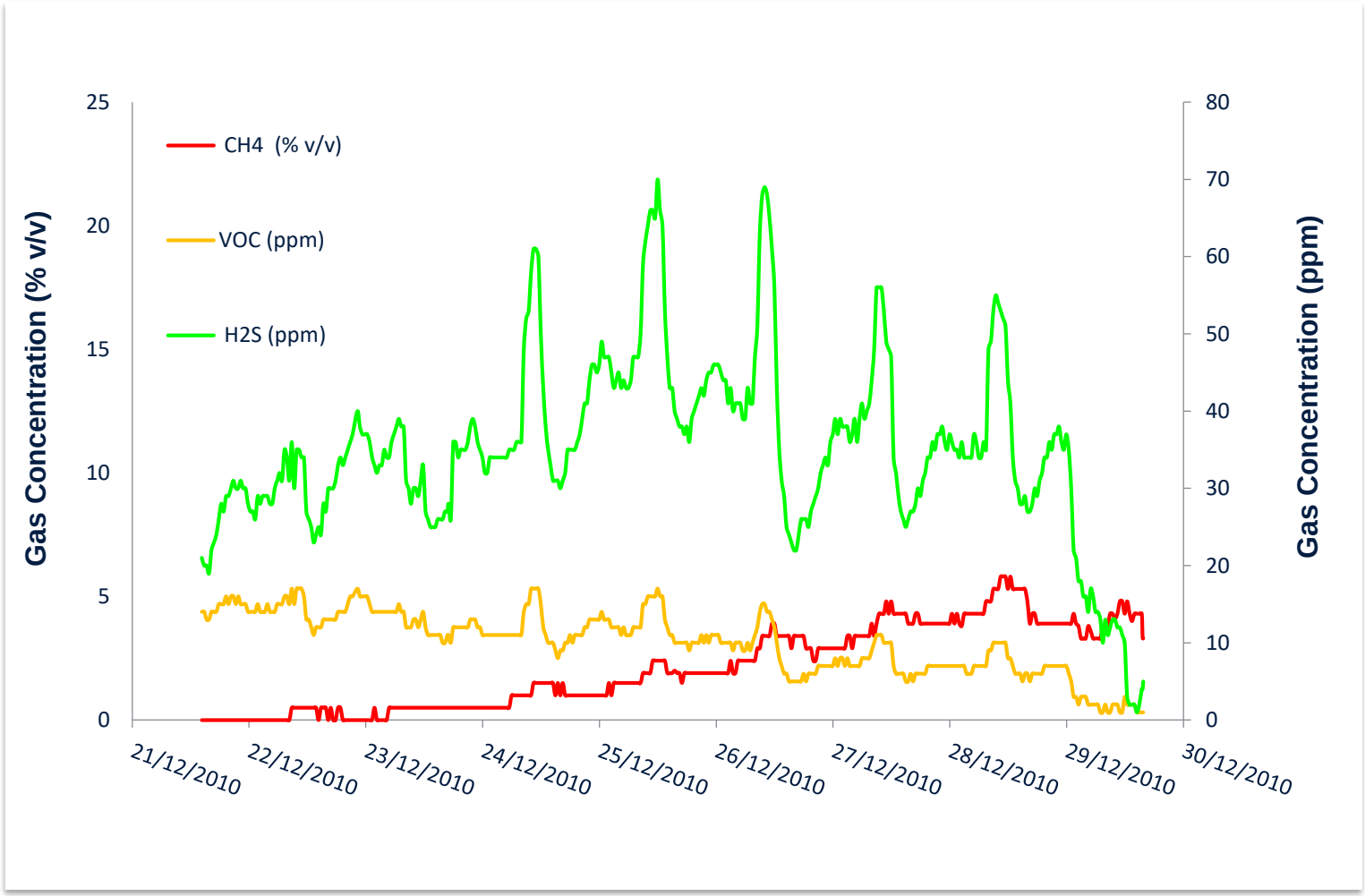
ii) Allow significantly improved calculation of true VOC concentration if H2S and CH4 are present

The following data will demonstrate the importance of this

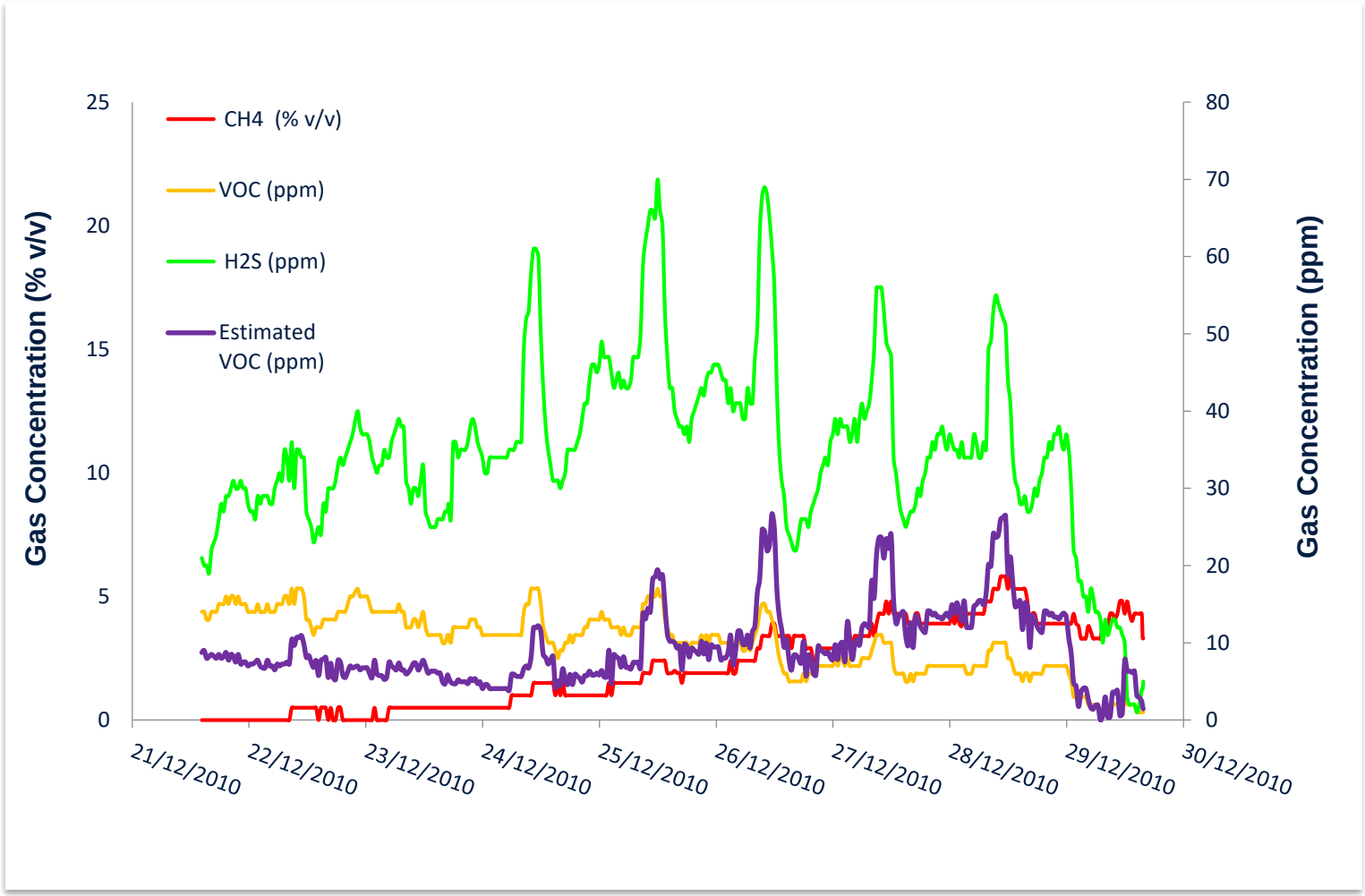
Installation at Site

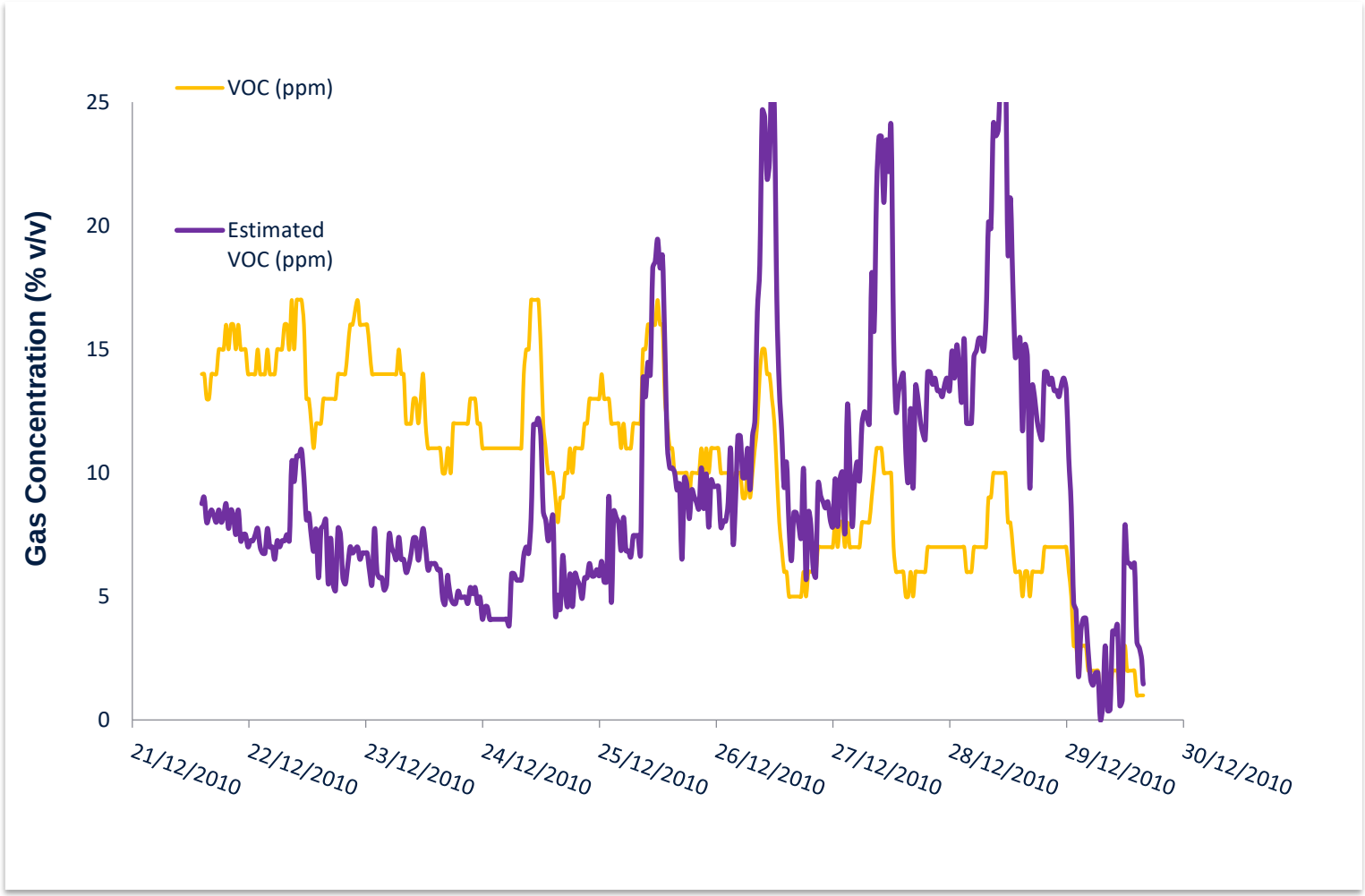


Raw data


CH4 (% v/v)
VOC (ppm)
H2S (ppm)
Gas Concentration (% v/v)
Gas Concentration (ppm)
25
20
15
10
5
0
80
70
60
50
40
30
20
10
0
21/12/2010
22/12/2010
23/12/2010
24/12/2010
25/12/2010
26/12/2010
27/12/2010
28/12/2010
29/12/2010
30/12/2010

Processed data




VOC (ppm)
Estimated VOC (ppm)
Gas Concentration (% v/v)
25
20
15
10
5
0
21/12/2010
22/12/2010
23/12/2010
24/12/2010
25/12/2010
26/12/2010
27/12/2010
28/12/2010
29/12/2010
30/12/2010

Monitoring Summary

- H_2S and CH_4 are present in the waste water (makes sense as both gases are produced by anaerobic bacteria)
- PID reading will be affected by these
- By understanding how these gasses affect PID reading it is possible to estimate real VOC concentration
- Without this PID reading is meaningless

This allows

- To prevent Health hazards and ensure personal safety!
- Allow optimization of water treatment!
- Indentify if industry is illegally discharging waste water!

Any Questions?

GASCLAM

Specifications 1/2

GAS	TECHNOLOGY	RANGE	RESOLUTION	ACCURACY
CO_2	Infrared	0-100%	1% above 50% 0.5% below 50%	+/- 2% FSD
CO_2	Infrared	0-5%	-	-
CH_4	Infrared	0-100%	1% above 50% 0.5% below 50%	+/- 2% FSD
CH_4		0-5%	-	-
O_2	Electrochemical	0-5%	0.1%	+/-5% of reading +/-1 digit
CO*	Electrochemical	0-2000ppm	1ppm	<+/-3ppm at 0 +/- 5% at 250ppm +/-10% full scale
H_2S*	Electrochemical	0-100ppm	1ppm	+/-1 ppm at 0 +/- 2% at 100ppm
VOC*	PID	0-4000ppm	1ppm	+/-5% ppm at 0 +/- 2% at 100ppm
DUAL CO/H2S				
CO	Electrochemical	0-500ppm	1ppm	<+/-3 ppm at 0 +/- 3% at 250ppm
H_2S	Electrochemical	0-200ppm	1ppm	<+/-1 ppm at 0 +/- 2% at 100ppm

GASCLAM

Specifications 2/2

Battery	Lithium ion	non-rechargeable	Typical battery life	3 months
	Alkaline cells	non-rechargeable	-	1 month
	Nickel metal hydride	Rechargeable	-	3 weeks
Case material		High quality stainless steel		
Weight		7.5kg (16.8lbs)		
Dimensions		Length	90cm (35.4in)	
		Borehole tube length	83cm (32.6in)	
		Head diameter	11cm (4.3in)	
		Borehole tube diameter	4.7cm (1.85in)	
Ingress protection		IP68 (continuous submersion)		
Operating temperature		-20°C to +50°C (-4°F to 122°F)		
Approvals		EMC, ATEX 0105 X CE Ex II 2G Ex d ib (ib) IIB T4 IECEx Ex d ib (ib) IIB T4 Gb CSA C (US & Canadian approvals) Class 1, Zone 1 (A)Ex d di IIB T4 (Certification pending: Due Jan 2019)		
Patents		European and world-wide patented		

Air-Met Scientific

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