



# 00248 Geoscientific Report

## *The use of ADR as a qualitative geothermal proxy across England*

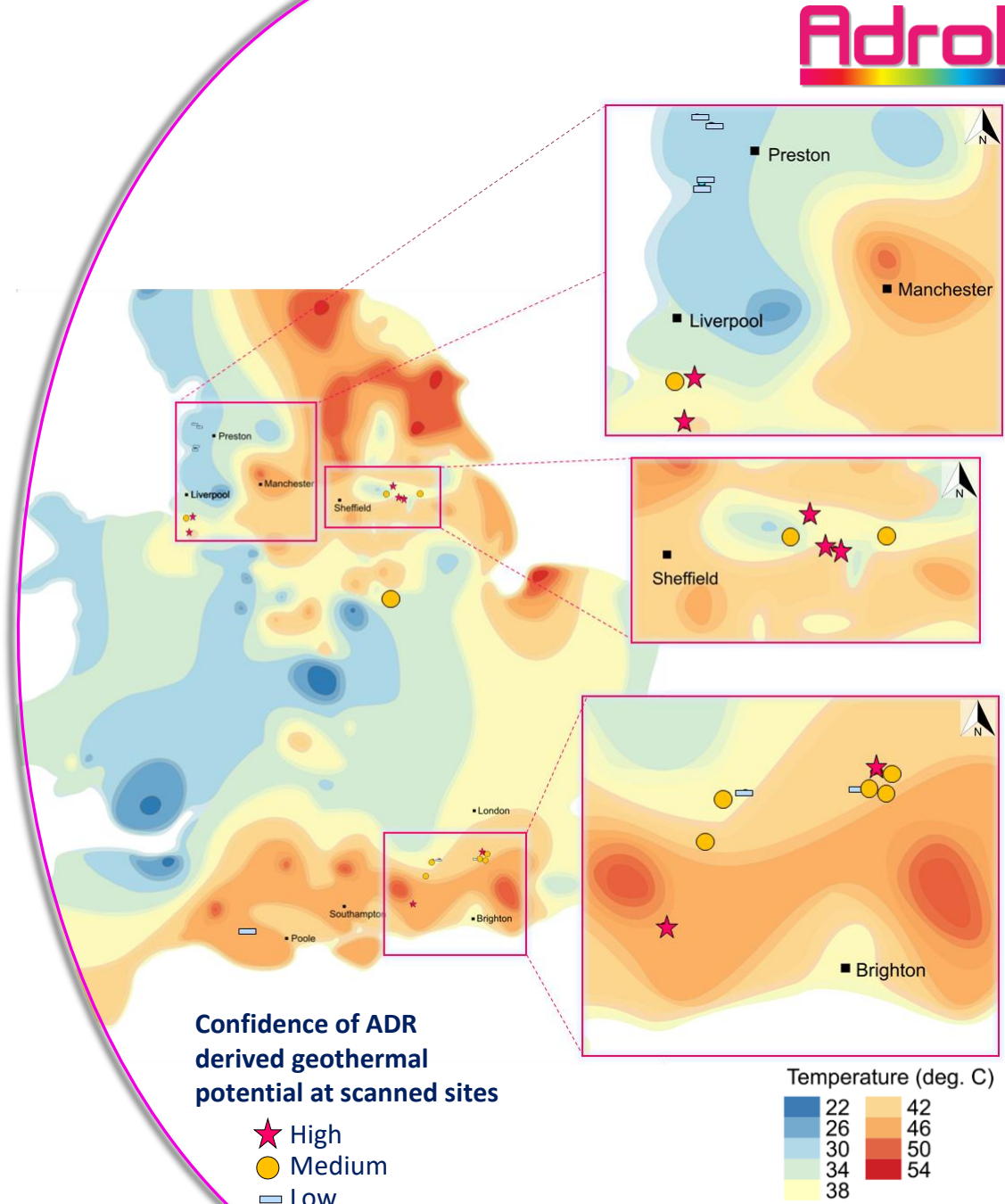
Inhouse Project (ER) for Adrok

11/11/2021

# Executive Summary

- This report describes the results of the November 2021 geoscientific survey completed by Adrok Limited (“Adrok”) in England on behalf of Adrok. The objective of the project is to use Adrok’s stare scan data to identify geothermal potential in onshore oil and gas sites.
- Adrok has prognosed several high confidence targets of high thermal impact at locations where the literature agrees and demonstrates a higher geothermal gradient. Adrok has also found no evidence of thermal anomalies in the locations where the temperatures at depth are not high enough to be considered of geothermal interest.
- Knowing this, we can be confident on marketing this tool for **onshore projects that require the application of a fast analysis technique to assess general geothermal potential across a wide area.**
  - **Benefits:** Fast analysis, distinguishing between minor and major targets, multi-level confidence assessment.
  - **Limitations:** Not quantitative, the depth and width of the troughs are still not directly related to the depth and width of the geothermal reservoir.

**Overall, we believe this report demonstrates that this technology has the potential to be of great use for exploration of onshore geothermal potential at a regional scale.**



\*Map vectorized from Watson et al, 2021. Modelled temperature at 1000m depth.

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## Executive Summary

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1. Conclusions: ADR Geothermal Assessment
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**1) Introduction**  
This is an internal project for Adrok's development of geothermal tools. The project will reprocess 26 V-Bores from projects 00178 (collected in 2017 for

**2) Methods: Stage-Gated Workflows**

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1. Pre-survey
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**3) H1 – Blacon East 1 : From 00178**

Blacon East 1 (E-Gamma)		
Well	Barrel	10m MA*
0.23	0.59	0.75
0.50	0.89	1.00
0.76	1.19	1.30
1.02	1.49	1.60
1.28	1.79	1.90
1.54	2.09	2.20
1.80	2.39	2.50
2.06	2.69	2.80
2.32	2.99	3.10
2.58	3.29	3.40
2.84	3.59	3.70
3.10	3.89	4.00
3.36	4.19	4.30
3.62	4.49	4.60
3.88	4.79	4.90
4.14	5.09	5.20
4.40	5.39	5.50
4.66	5.69	5.80
4.92	5.99	6.10
5.18	6.29	6.40
5.44	6.59	6.70
5.70	6.89	7.00
5.96	7.19	7.30
6.22	7.49	7.60
6.48	7.79	7.90
6.74	8.09	8.20
7.00	8.39	8.50
7.26	8.69	8.80
7.52	8.99	9.10
7.78	9.29	9.40
8.04	9.59	9.70
8.30	9.89	10.00

**4) Discussion: Integration of Results**

**5.1) Conclusions: ADR Geothermal Assessment**

Considering the ADR prognosis into a regional scale

**Executive Summary**

This report describes the results of the November 2021 geoscientific survey completed by Adrok Limited ("Adrok") in England on behalf of Adrok. The objective of the project is to use Adrok's stare scan data to identify geothermal potential in onshore oil and gas sites.

Adrok has prognosed several high confidence targets of high thermal impact at locations where the literature agrees and demonstrates a higher geothermal gradient. Adrok has also found no evidence of thermal anomalies in the locations where the temperatures at depth are not high enough to be considered of geothermal interest.

Overall, we believe this report demonstrates that that this technology has the potential to be of great use for exploration of onshore geothermal potential at a wide regional scale.



# 1) Introduction

This is an internal project for Adrok's development of geothermal tools. The project will reprocess 26 V-Bores from projects 00178 (collected in 2017 for IGAS) and 00209 (collected in 2018 for Cuadrilla and Transgas). We will be using the WARRs that have already been processed and then re-process the E-Gamma for thermal exploration.

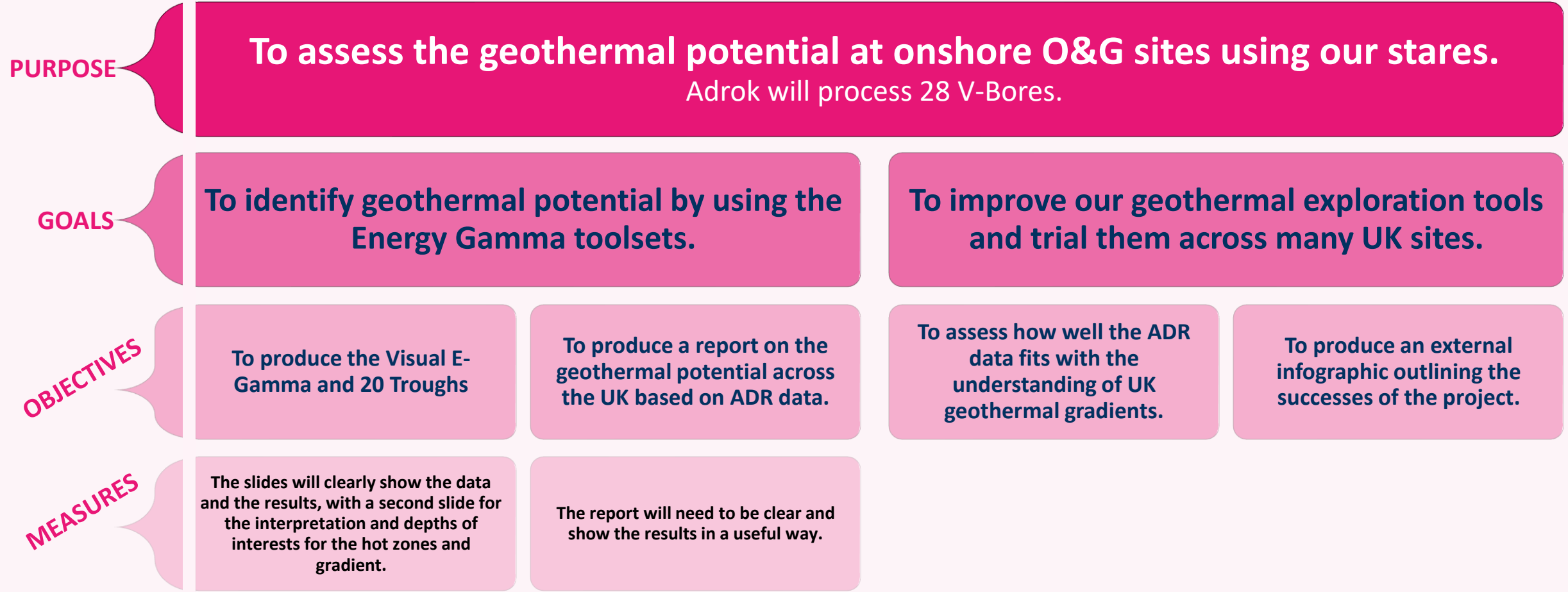
The purpose of the project is:

**To assess the geothermal potential at onshore O&G sites using our stare data.**

This report focuses on showing the identified geothermal potential via the Energy Gamma toolsets, producing Visual E-Gamma graphs and a comparison with the temperature map of the UK at a depth of 1000m from Busby et al, 2011.



# 1) Introduction: Project Purpose



# 1) Introduction: Glossary

Term	Definition
<b>ADR</b>	Atomic Dielectric Resonance. This technology transmits broadband pulses of radio waves between 1 to 100 MHz into the ground and detects the modulated reflections returned from the subsurface structures.
<b>Harmonic Analysis</b>	“Harmonic Analysis” is a widely accepted mathematical method that studies the functions of signals as the superposition of waves. Using Fourier transforms to analyse the “harmonics” the technique is often used for assessing materials in a laboratory setting in the chemical industry. Unique harmonic energy frequency and phase peaks are produced and can be analysed in a number of ways producing a range of parametric statistical tests. Different rock types with different mineral assemblages will exhibit different spectral harmonic relationships over these levels.
<b>Stare</b>	A stationary scan where data collected with both antennae pointing the ground., including Harmonics, and Correlation as input
<b>Training Relationships</b>	These are the relationships between the ADR signal and verified down-hole information. This is they key using ADR for exploration, since once powerful training relationships are defined between the ADR signal and the target lithologies or mineralisation then ADR can be used to target the best are and understand its potential.
<b>WARR</b>	Wide Angle Reflection and Refraction scan to triangulate subsurface depths from the surface ground level. The Transmitting Antenna is moved at ground level along the scan line, away from the stationary Receiving Antenna which is fixed to the start of the scan line. Collected by ADR Scanner at ground level (that produces depth calculations).

# 1) Introduction: Data Collected

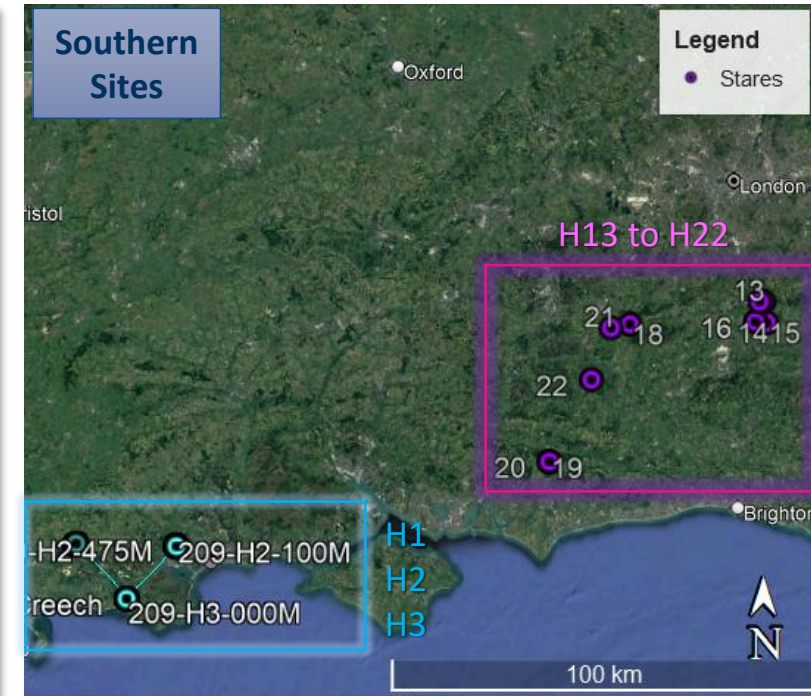
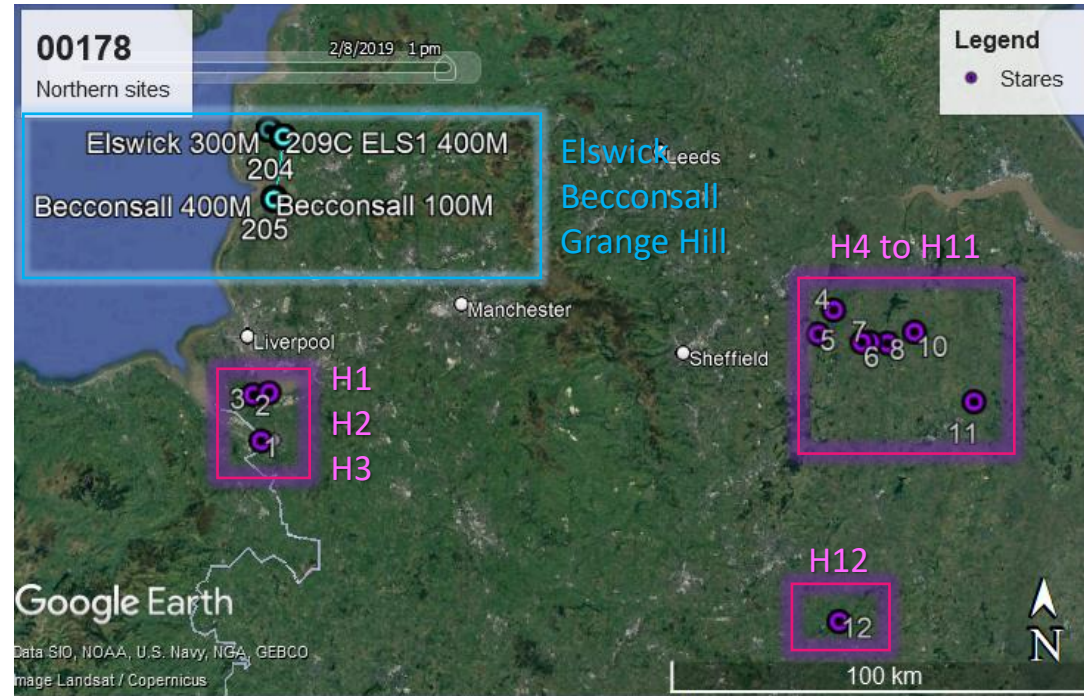
## Mega Deep Stare 00178

1000 traces x20  
 100,000 pixels.  
 100,000ns.  
 1mV.  
 6Tf.  
 1GS/s.  
 TCU06  
 RCU07, Tx & Rx 39:01, TBPC07

## Mega Deep Stare 00209

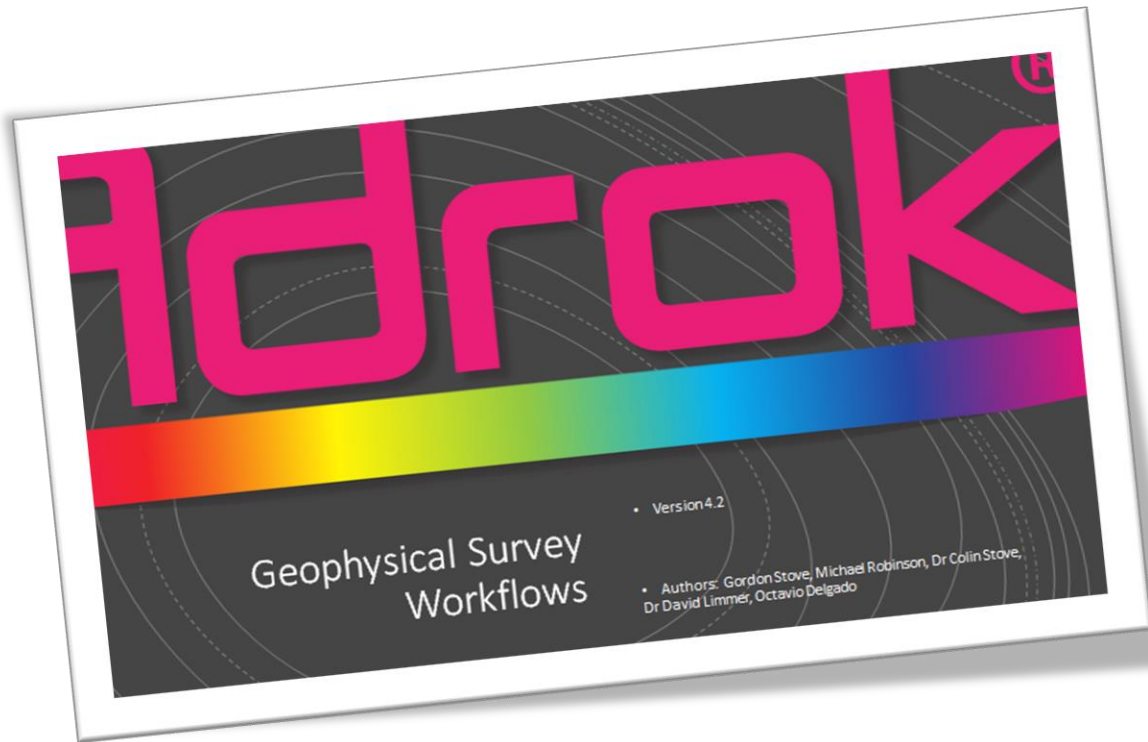
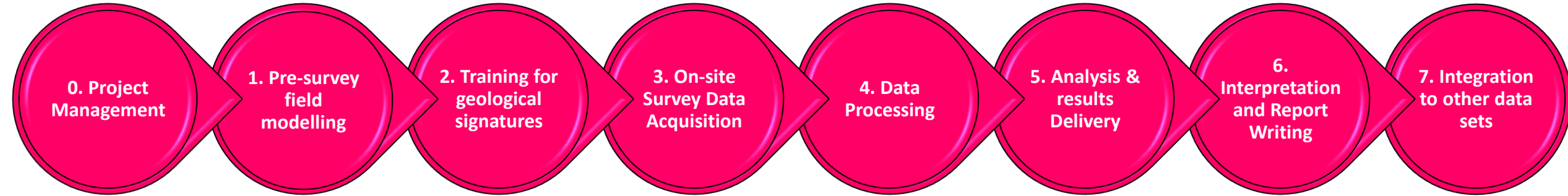
2000 traces x10  
 100,000 pixels.  
 100,000ns.  
 1mV.  
 6Tf.  
 1GS/s.  
 TCU06 at Site 1 (then TCU05 at Sites 2 and 3)  
 RCU07, Tx & Rx 39:01, TBPC08.

## Settings and Location



🌈 A total of 28 Stares are going to be processed in this project.

# 2) Methods: Stage-Gated Workflows



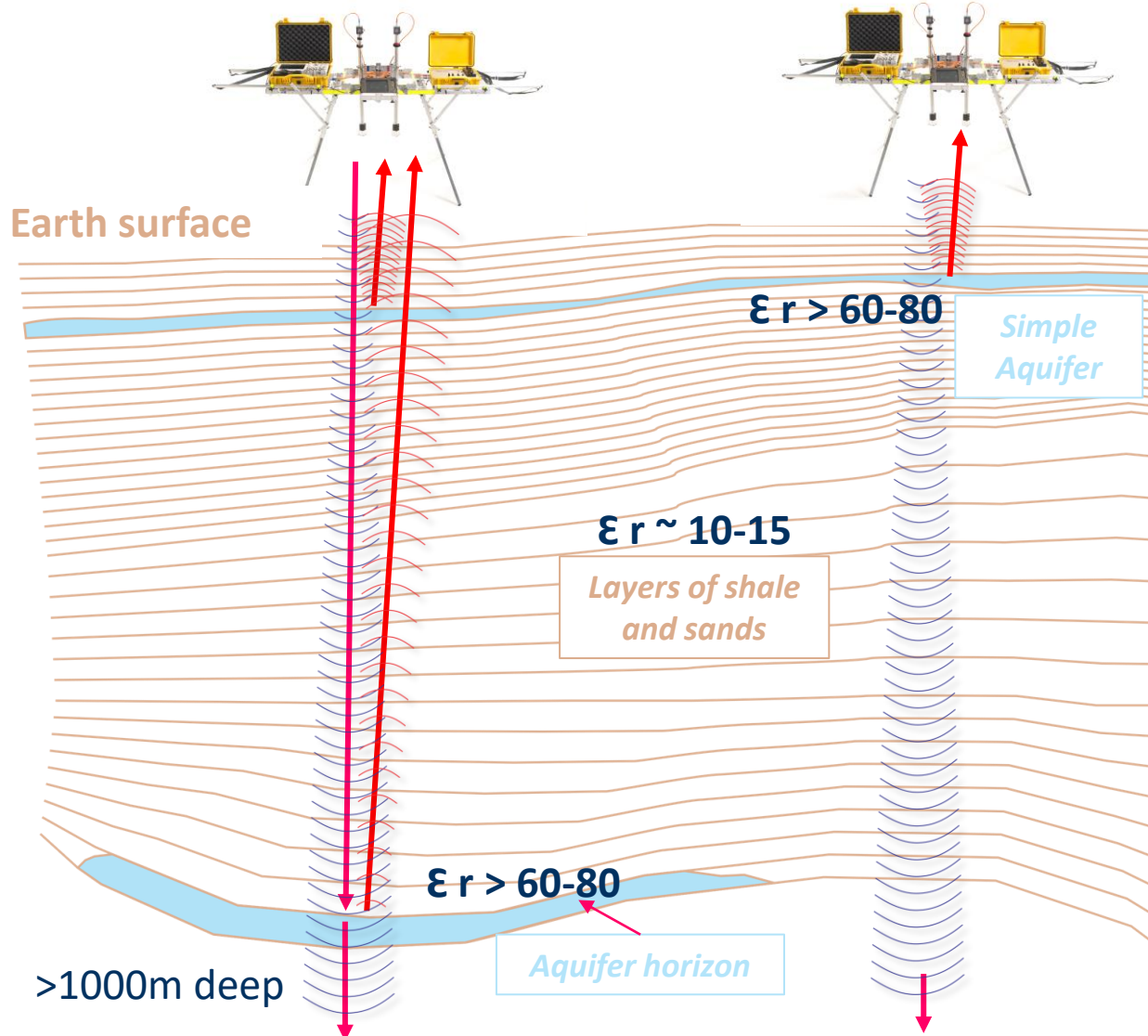
☀ The Geophysical Survey Workflows describe which process will be performed in each stage of the project to ensure quality, repeatability and a successful completion.



**INVESTORS IN PEOPLE™**  
We invest in people Gold



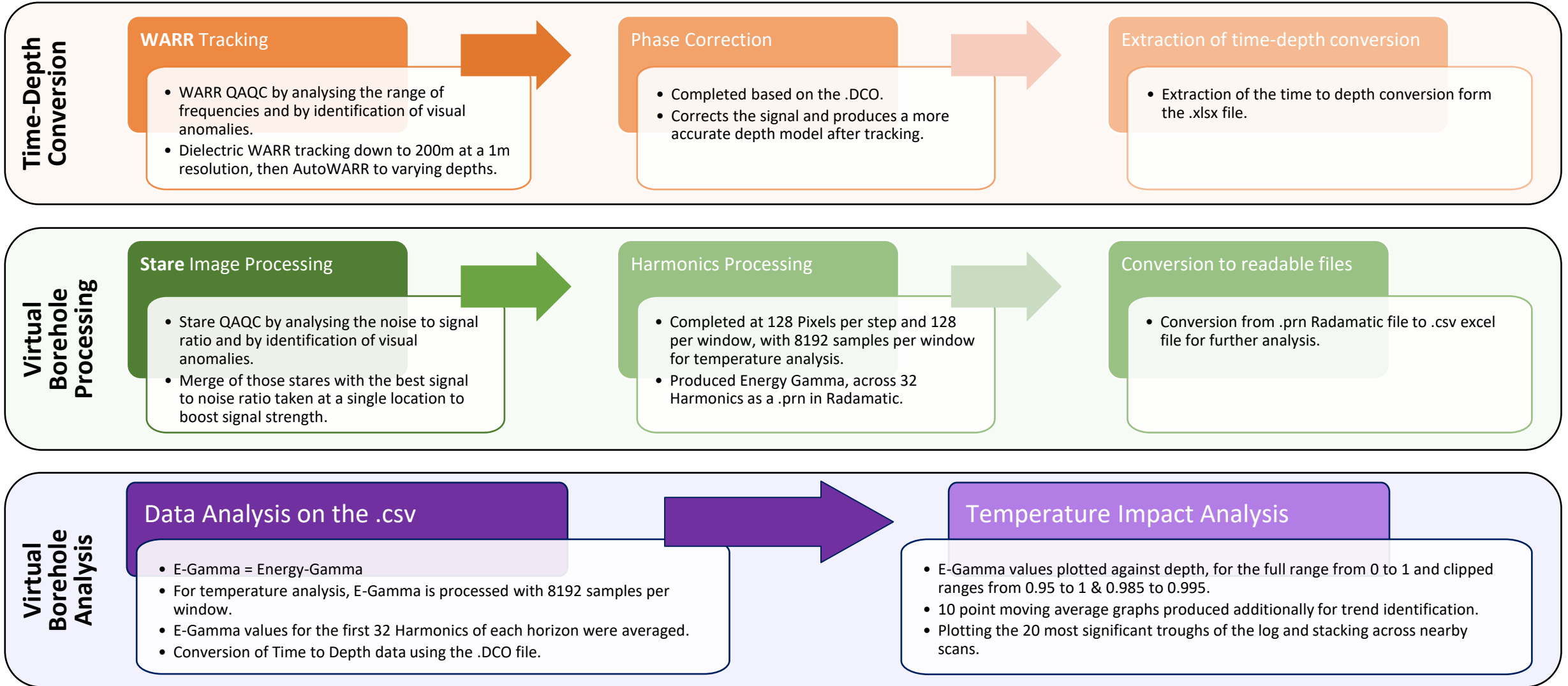
# 2) Methods: Atomic Dielectric Resonance (ADR)



- ☀ Transmits broadband pulses of radio waves between 1 to 100 MHz into the ground.
- ☀ Detects the modulated reflections returned from the subsurface structures.
- ☀ Measures dielectric permittivity ( $\epsilon_r$ ) and conductivity of material.
- ☀ Analyses spectral content of the returns to help classify materials (energy, frequency, phase).
- ☀ Time & frequency domain.
- ☀ Time ranges typically 20,000ns, 40,000ns & 100,000ns. This project used a 10,000ns range.
- ☀ High speed time domain sampling ~5GS/s
- ☀ Stack return signals for improved signal-to-noise 20,000, 100,000.....1million.

# 2) Methods: Processing & Analysis

The flow diagrams below shows a synopsis of Adrok's processing methodology for this project.



# 2) Methods: Averaged E-Gamma Analysis

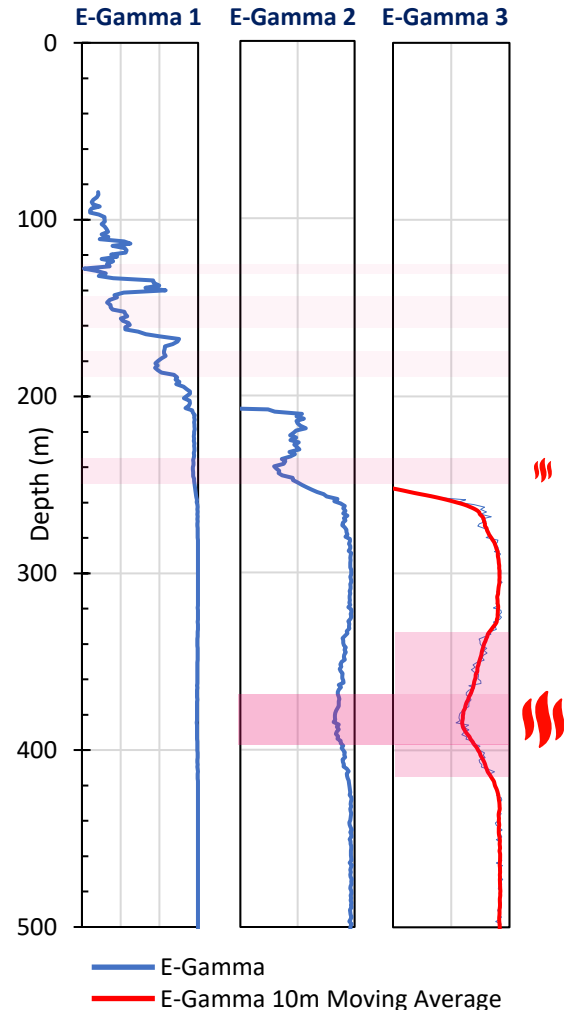
## E-Gamma Moving Average Analysis

### Pros

- V-Bore specific hotspots can be identified.
- Allows for thorough site by site analysis and comparisons.

### Cons

- Visual analysis used if a baseline cannot be established from the training data.
- Cannot estimate temperatures, only identify zones that have high thermal impact.



For each virtual borehole three E-Gamma logs are displayed from left to right.

**E-Gamma 1:** Shows data within values of 0.25 to 1.

**E-Gamma 2:** Shows data within values of 0.95 to 1.

**E-Gamma 3:** Shows data within values of 0.985 to 0.995, also shows the 10m Moving Average in red.

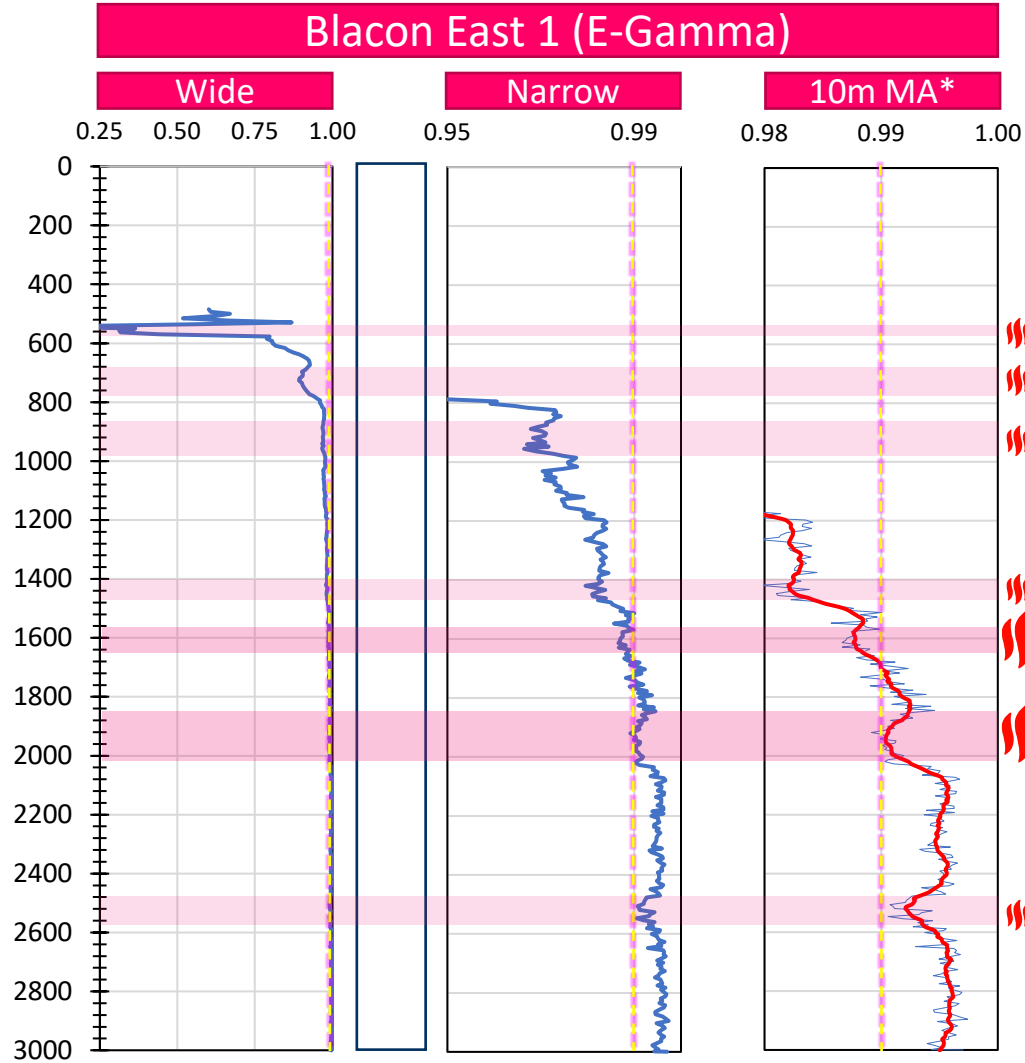
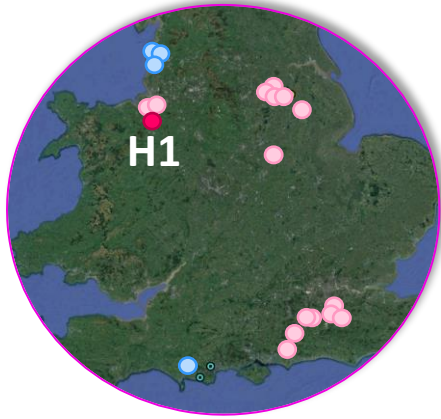
This method of identifying E-Gamma troughs as temperature anomalies is good for targeting hot zones or aquifers, due to the high contrast in temperature with adjacent units. However, the method is not as effective at identifying geothermal gradients.

**“Hot zones” are interpreted when the E-Gamma moving average falls below 0.99. This is where we interpret high temperature.**

Confidence of ADR derived geothermal potential at scanned sites



# 3) H1 – Blacon East 1 : From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

- Target 1:** The strongest thermal impact at the site. Thinner than the following one but more intense. Located at 1560-1640m.
- Target 2:** Wider but weaker target deeper down from the previous one. The trough seems more relevant, but does not consistently trespass the 0.99 baseline. Located at 1840-2010m.

**Minor Targets:**

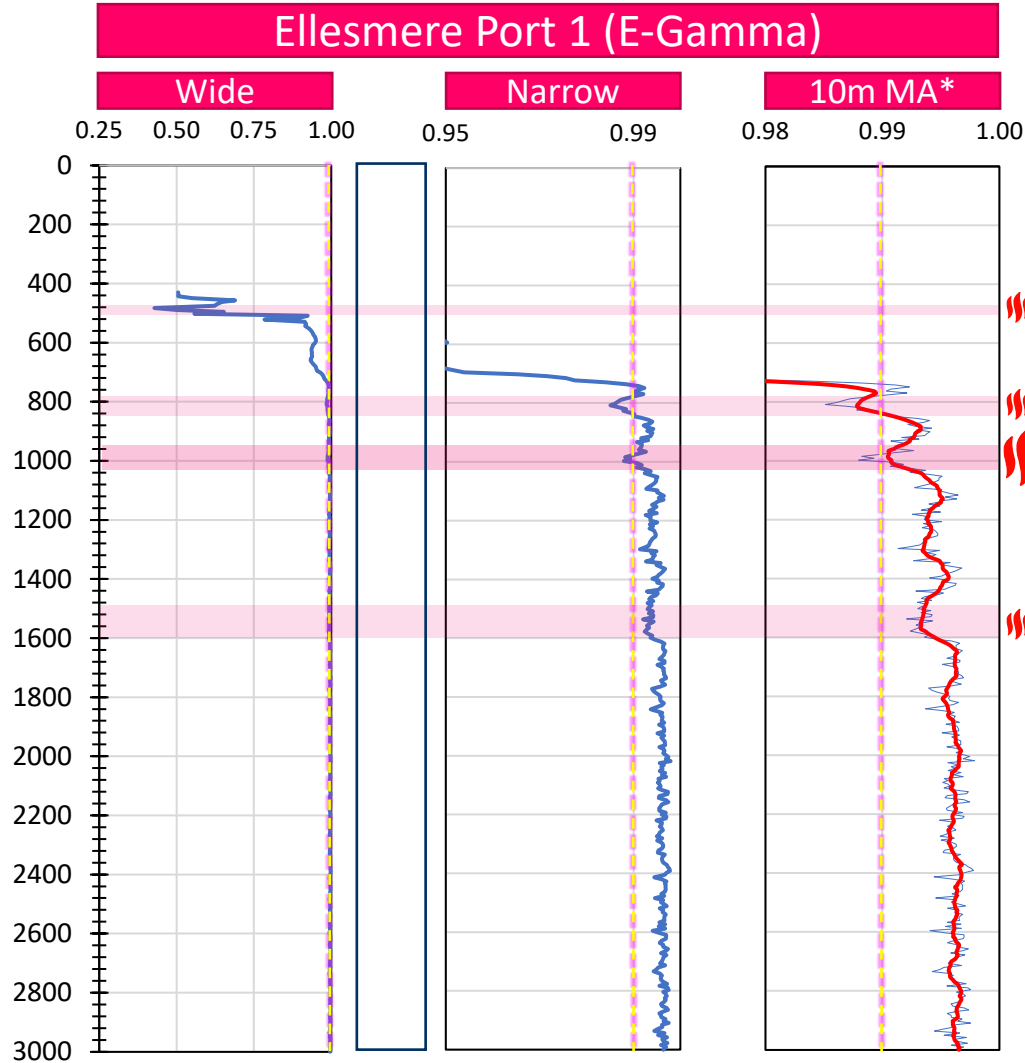
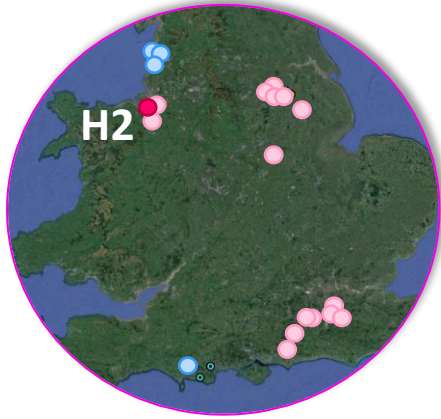
Up to 5 minor targets are found in this site. The first three occur between 560 and 980m. The last occurrence is at 2480-2560m.

**Trend Observations:**

Overall, this site shows **strong indications of thermal impact**, with well defined troughs and peaks. Most of the Energy Gamma readings are above the baseline.

**High Confidence Geothermal Site**  
 — E-Gamma  
 — E-Gamma 10 metres Moving Average\*

# 3) H2 – Ellesmere Port 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

**Target 1:** The strongest thermal impact at the site. The moving average does not quite reach the baseline, but one more intense trough does so, this would be a low confidence target. Located at 960-1040m.

**Minor Targets:**

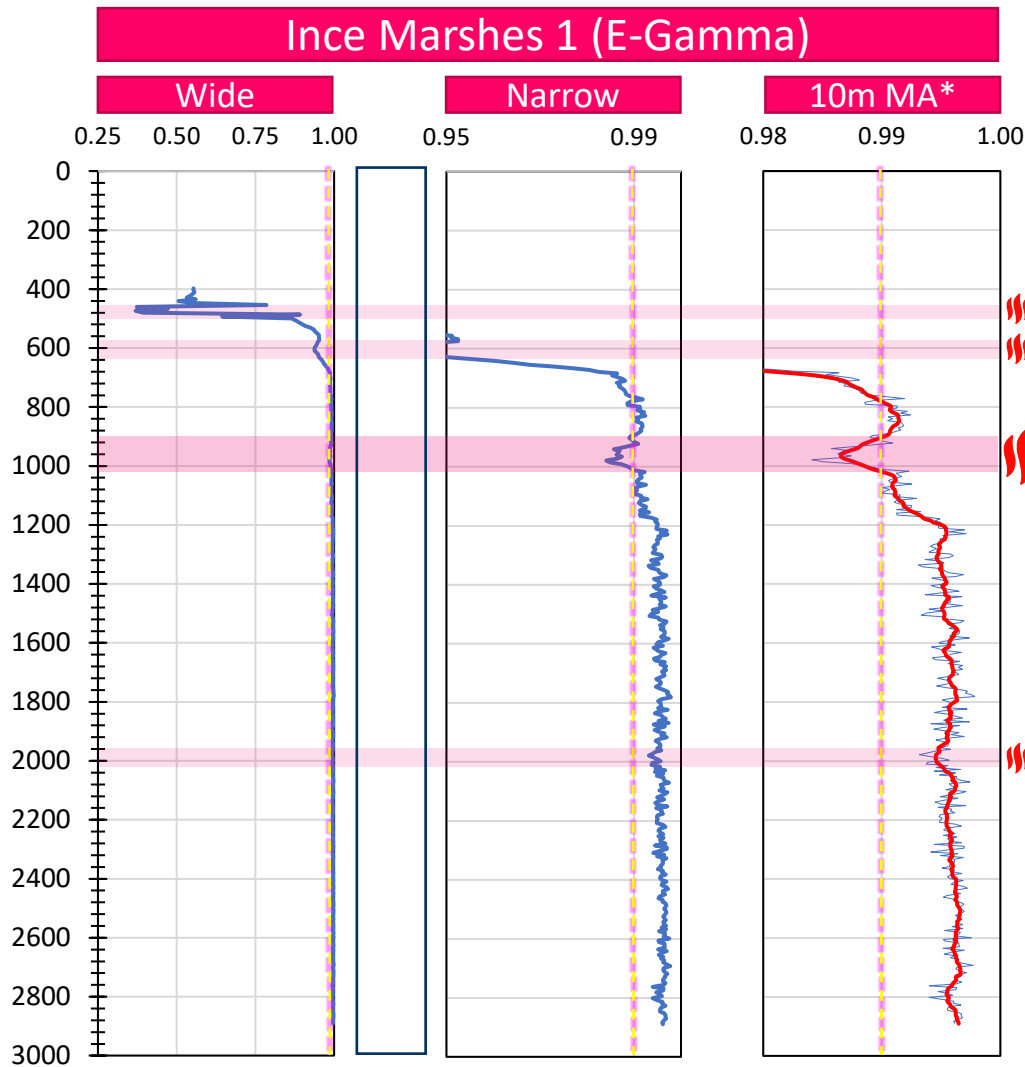
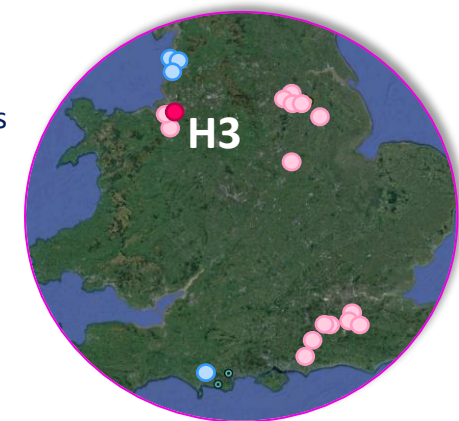
There are three minor targets, at around 500m and at around 800m. The last occurrence is at 1480-1600m.

**Trend Observations:**

Overall, this site shows low indications of thermal impact, with not well defined troughs and peaks. Most of the Energy Gamma readings are above the baseline, and even the major target is very weak.

**Medium Confidence Geothermal Site** — E-Gamma (blue line), E-Gamma 10 metres Moving Average\* (red line)

# 3) H3 – Ince Marshes 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

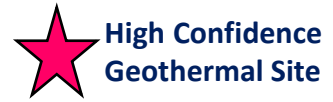
**Target 1:** The strongest thermal impact at the site. The values dip strongly below the 0.99 baseline and it's followed by a smaller trough that reinforces confidence. Located at 440-640m.

**Minor Targets:**

Up to 3 minor targets are found in this site. The first two occur between 560 and 980m. The last occurrence is around 2000m.

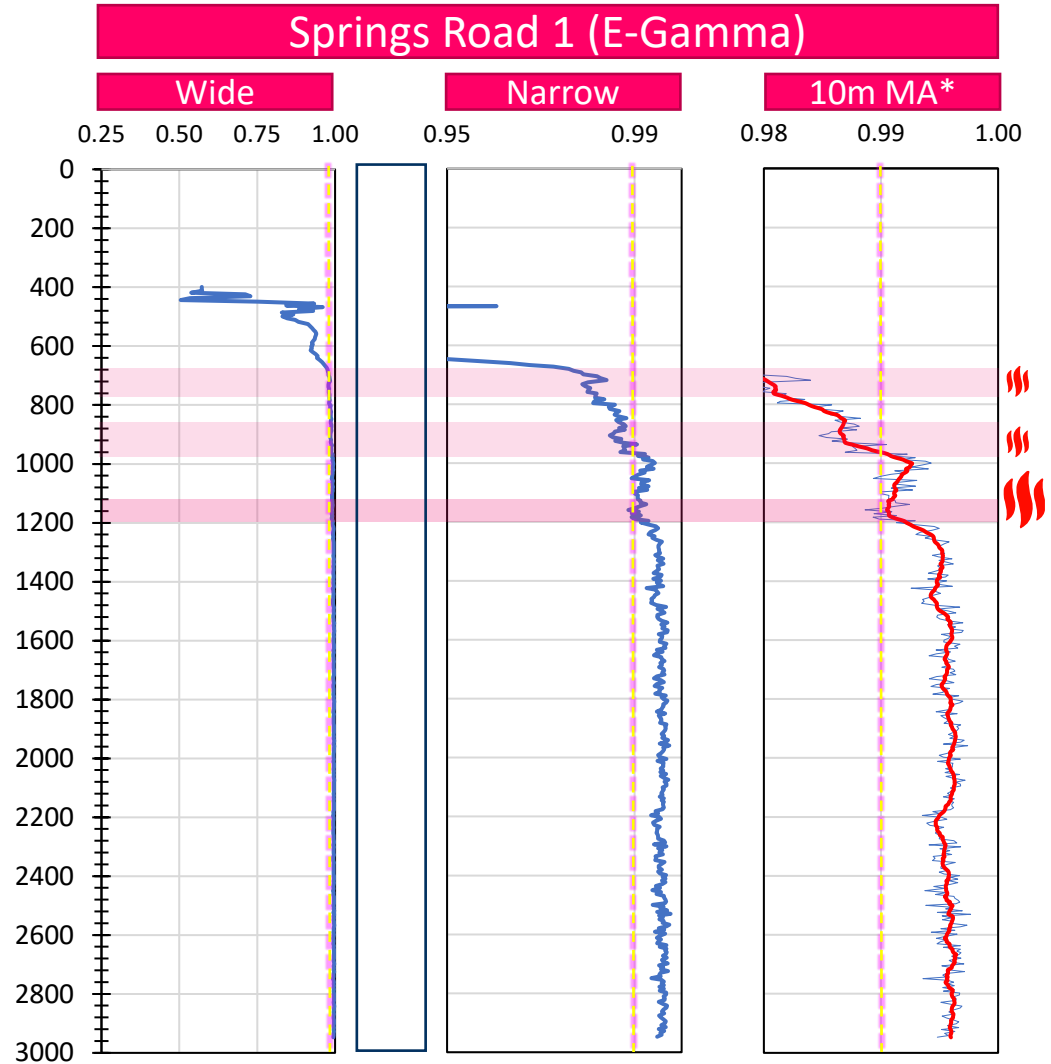
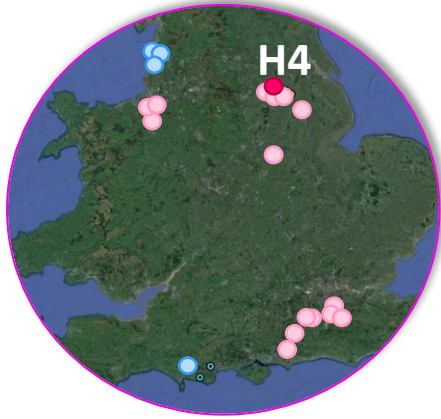
**Trend Observations:**

Overall, this site shows a single strong indication of thermal impact, with a well defined troughs. All of the Energy Gamma readings are above the baseline after 1000m.



— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H4 – Springs Road 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

- Target 1: A thin indicator with the moving average above the baseline but some sparse troughs trespassing below 0.99.

### Minor Targets:

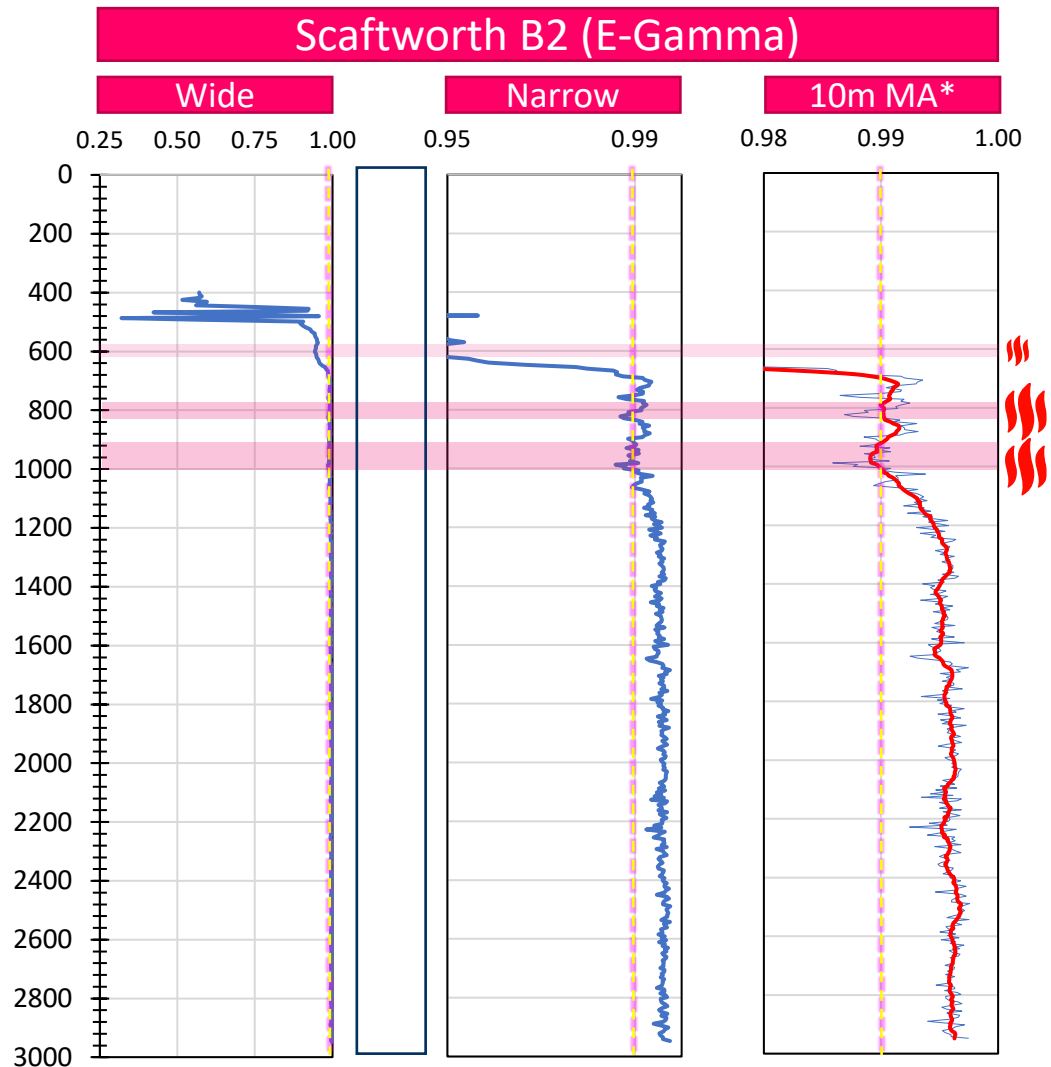
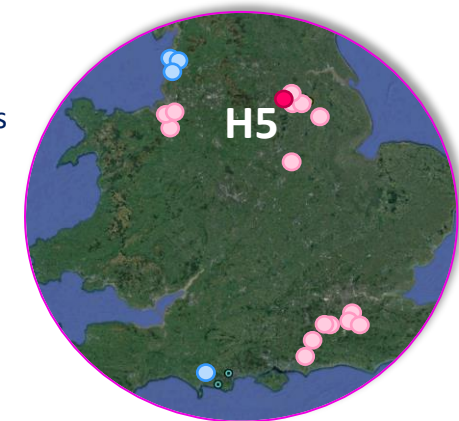
Up to 2 minor targets are found in this site. The first three occur between 680 and 960m..

### Trend Observations:

Overall, this site shows medium indications of thermal impact, with the only indications of thermal impact before 1200m.

**Medium Confidence Geothermal Site**  
 E-Gamma  
 E-Gamma 10 metres Moving Average\*

# 3) H5 – Scaftworth B2: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

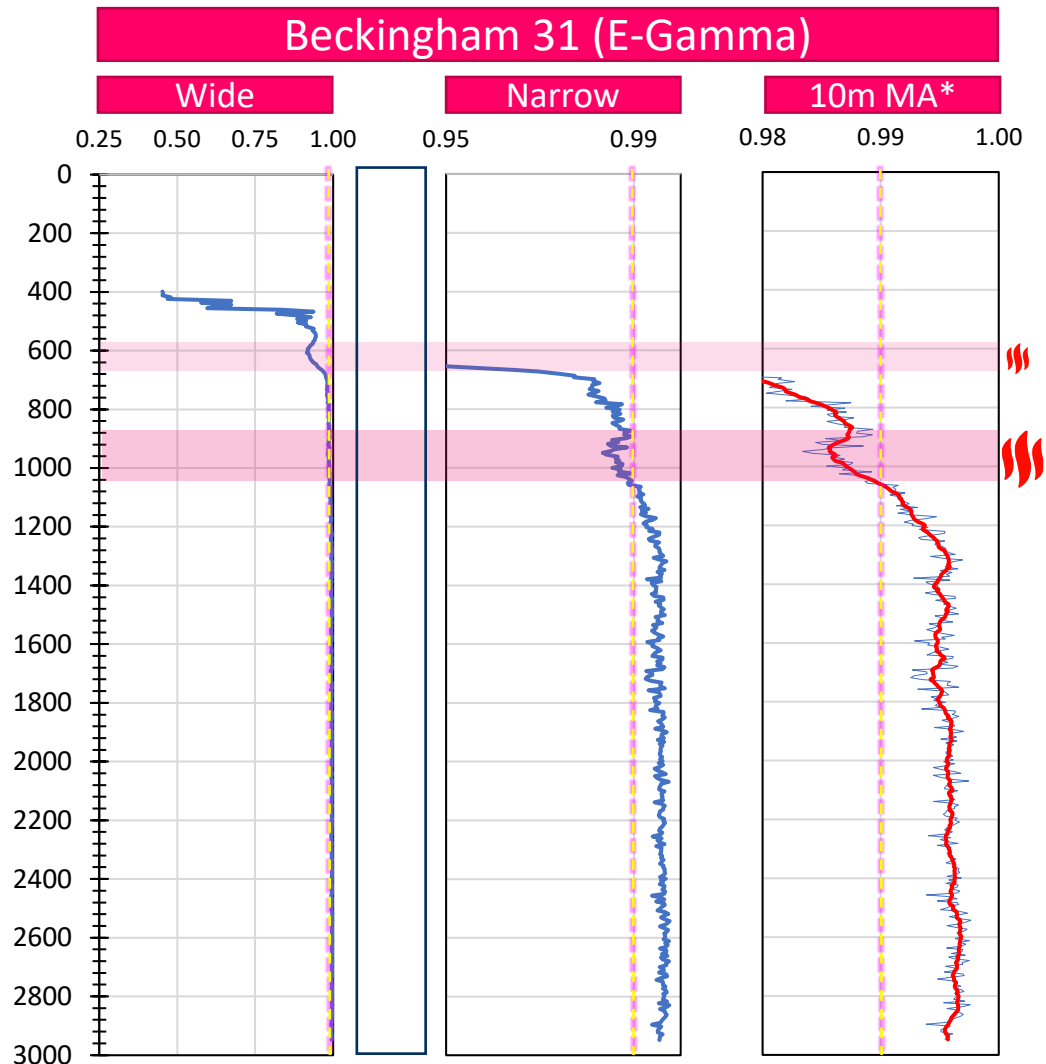
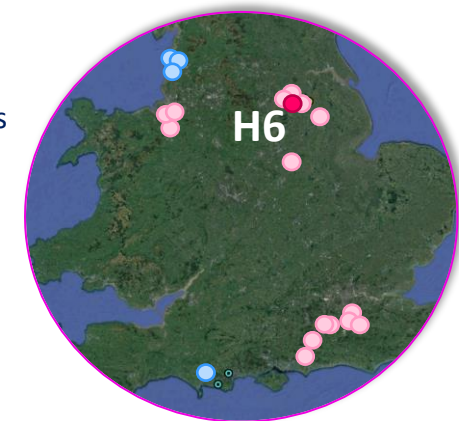
Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- **Major Targets:**
  - **Target 1:** A strong and shallow trough with a small moving average indication. Thinner than the following one and located at 760-840m.
  - **Target 2:** Wider and strongest thermal indicator, with the most intense trough present. Located at 920-1000m.
- **Minor Targets:**
  - Up to one more minor target is found in this site, at 600m.
- **Trend Observations:**
  - Overall, this site shows two indicators above 1000m, but overall not a very strong signature when compared to other sites.

● **Medium Confidence Geothermal Site**
— E-Gamma
 — E-Gamma 10 metres Moving Average\*



# 3) H6 – Beckingham 31: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

- Target 1: The strongest thermal impact at the site. While major, it is located before the signal fully stabilizes, so it may not invoke a lot of confidence. Located at 880-1040m.

### Minor Targets:

- A target at about 600m.

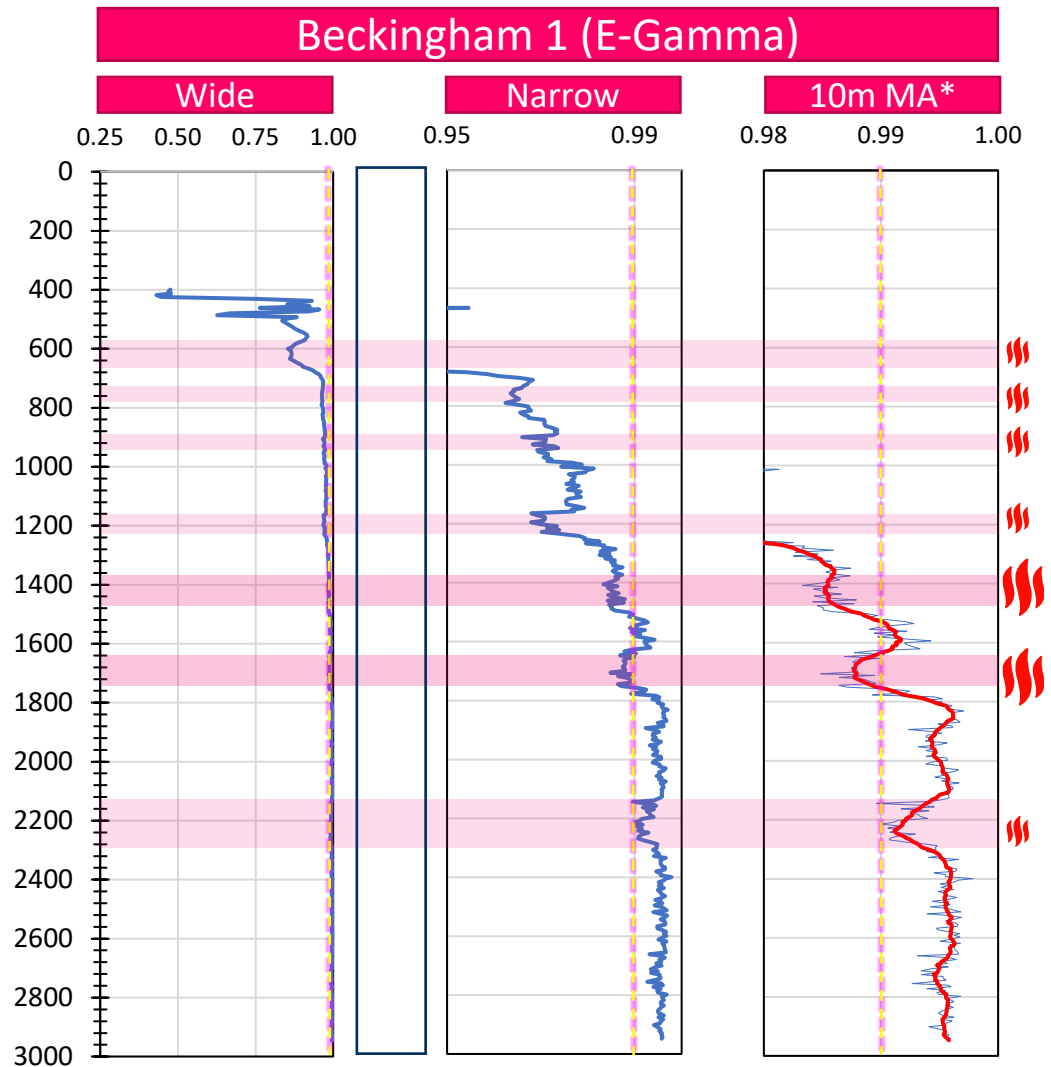
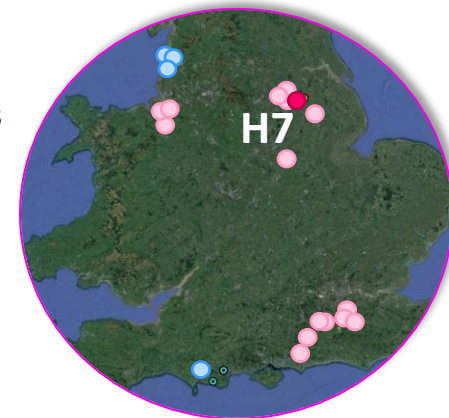
### Trend Observations:

- Overall, this site shows indications of low confidence thermal impact, with a single relevant trough. Most of the Energy Gamma readings are above the baseline.



— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H7 – Beckingham 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

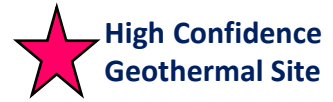
- Target 1:** Relevant thermal impact signal at the site. While major, it is located before the signal fully stabilizes, so it may not invoke a lot of confidence. Located at 1360-1480m.
- Target 2:** Wider and stronger target deeper down from the previous one. The trough seems more relevant and allows more confidence. Located at 1640-1720m.

### Minor Targets:

Up to 5 minor targets are found in this site. The first four occur between 560 and 1220m. The last occurrence is at 2120-2280m and is the strongest one of the minor targets.

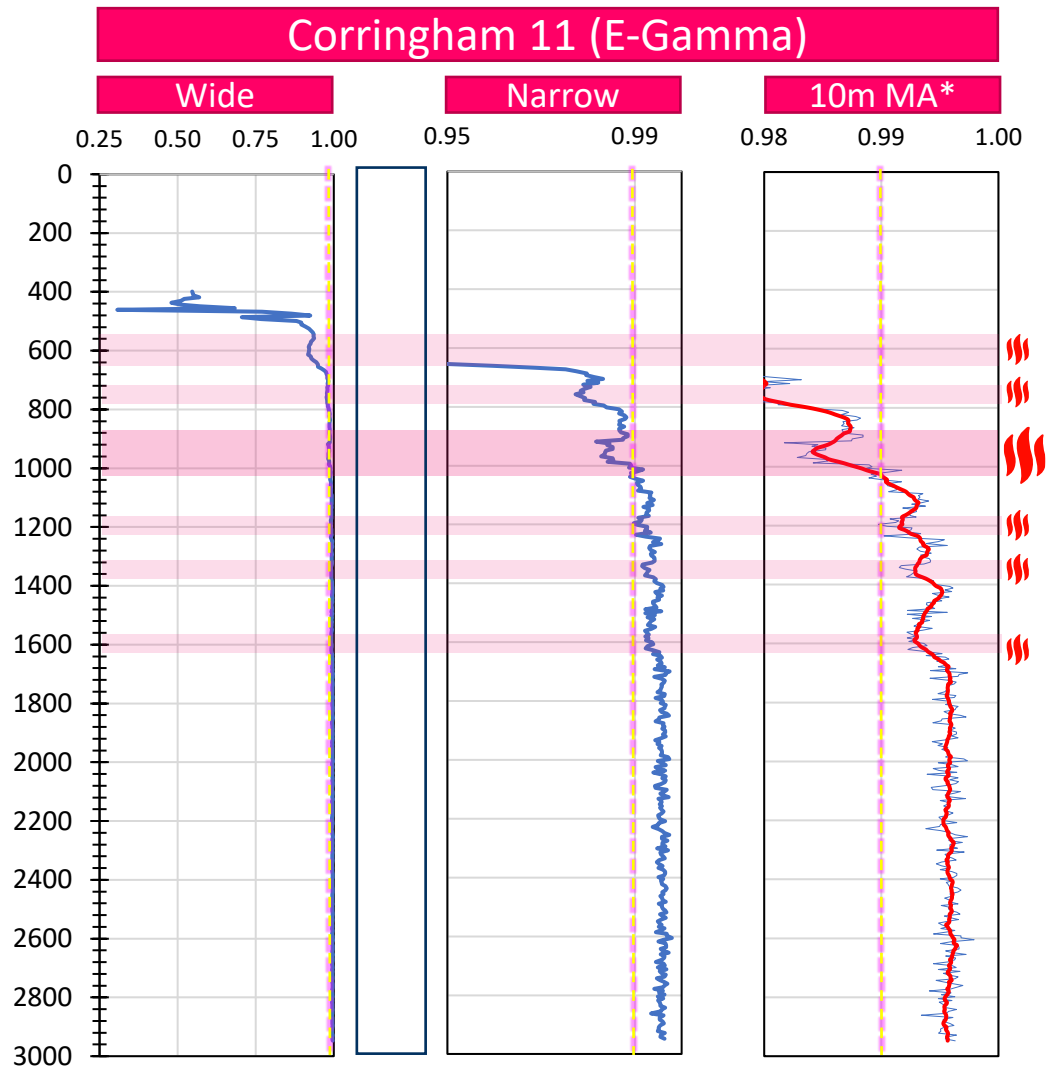
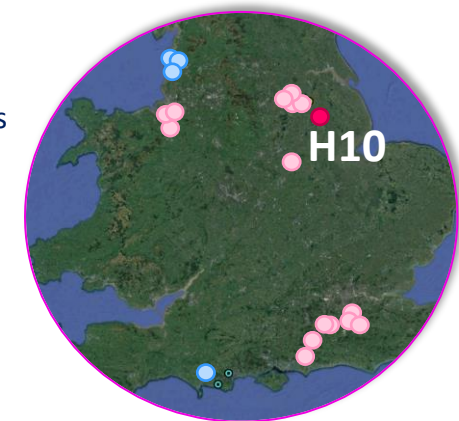
### Trend Observations:

Overall, this site shows strong indications of thermal impact, with well defined troughs and peaks.



— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H10 – Corringham 11: From 00178



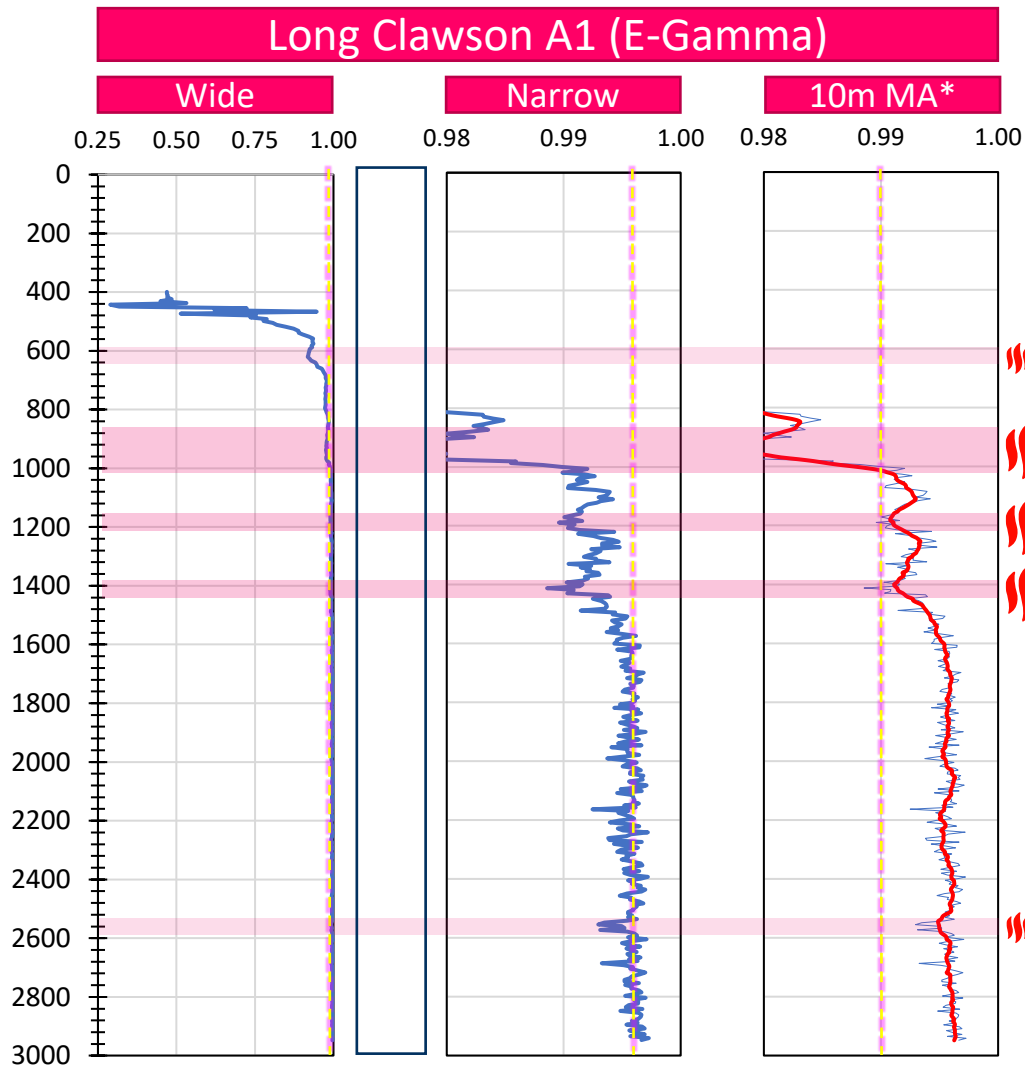
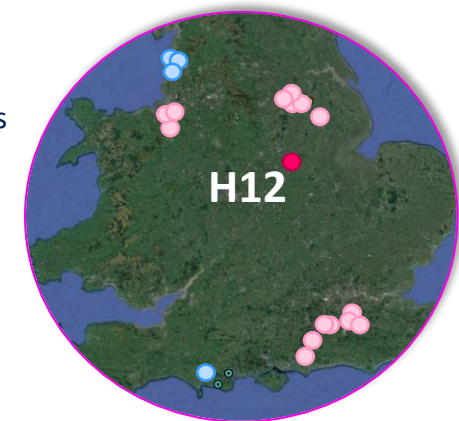
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- **Major Targets:**
  - **Target 1:** The strongest thermal impact at the site. With very intense troughs, but little prior stabilisation. Located at 880-1040m.
- **Minor Targets:**
  - Up to 5 minor targets are found in this site. The first two occur between 550 and 780m. The last three are at 1160-1640m.
- **Trend Observations:**
  - Overall, this site shows moderate indications of thermal impact, with well defined troughs and peaks. Most of the Energy Gamma readings are above the baseline.

● **Medium Confidence Geothermal Site**
— E-Gamma
 — E-Gamma 10 metres Moving Average\*

# 3) H12 – Long Clawson A1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

- Target 1:** Wide and strong target. The trough seems relevant, but does not consistently trespass the 0.99 baseline, losing on some confidence. Located at 840-1020m.
- Target 2:** A thin indicator with the moving average above the baseline but some sparse troughs trespassing below 0.99. Located at 1160-2010m.
- Target 3:** Very similar to Target 2, but with stronger troughs. Located at 1360-1440m.

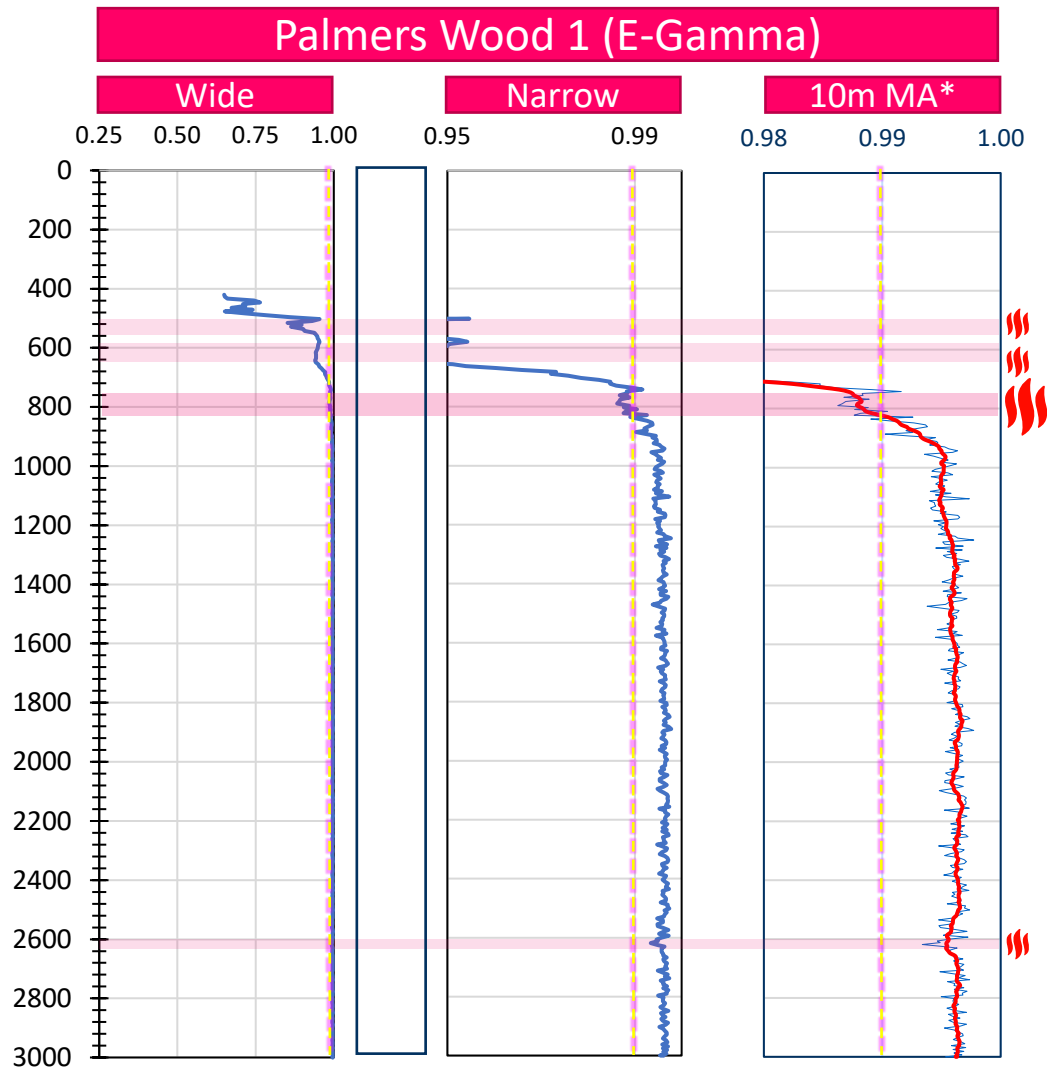
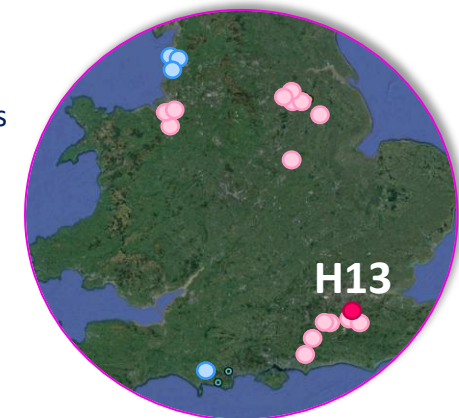
### Minor Targets:

Up to 2 minor targets are found in this site. The first one occurs between 600 and 640m. The last occurrence is at 2560-2600m.

**Trend Observations:** Overall, this site shows moderate indications of thermal impact.

**Medium Confidence Geothermal Site**  
 E-Gamma  
 E-Gamma 10 metres Moving Average\*

# 3) H13 – Palmers Wood 1: From 00178



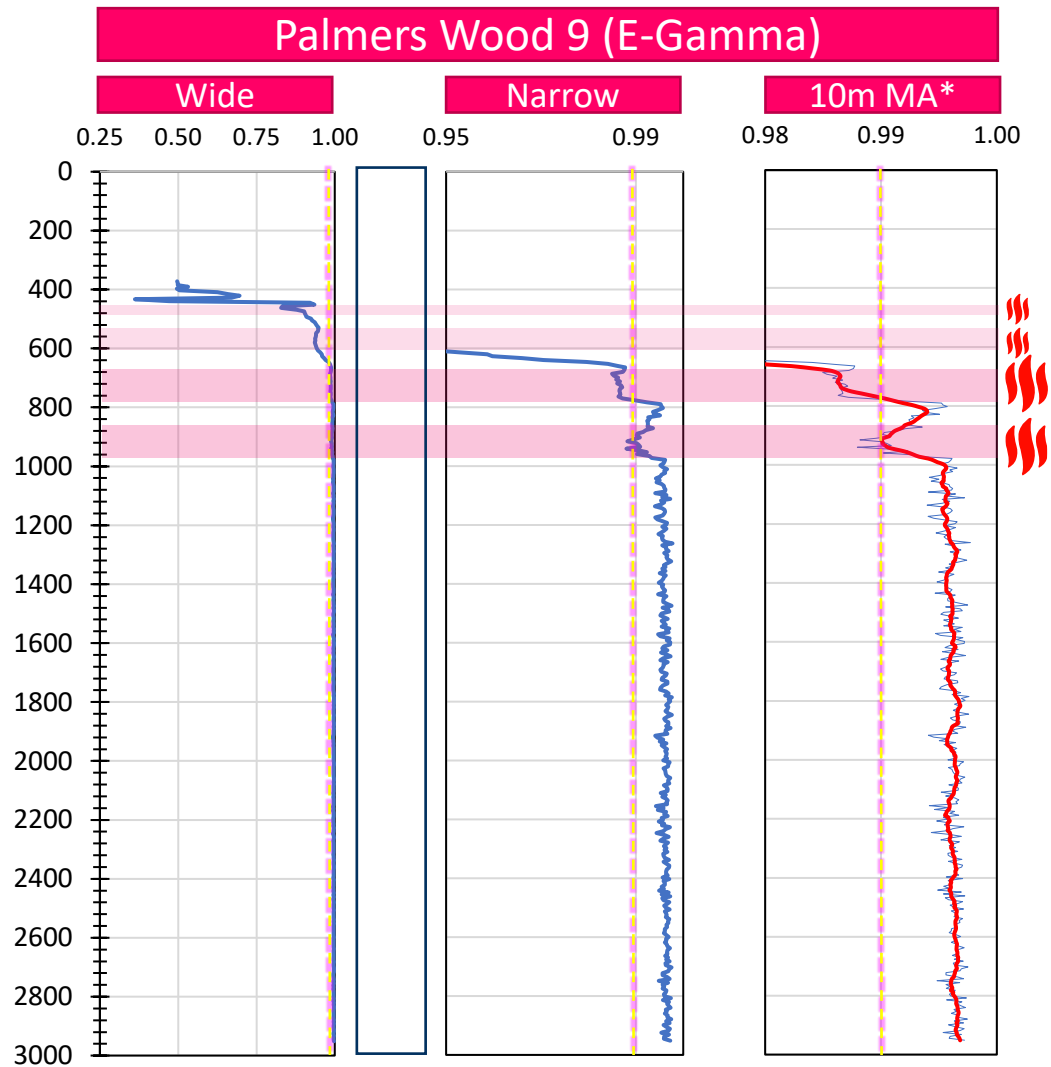
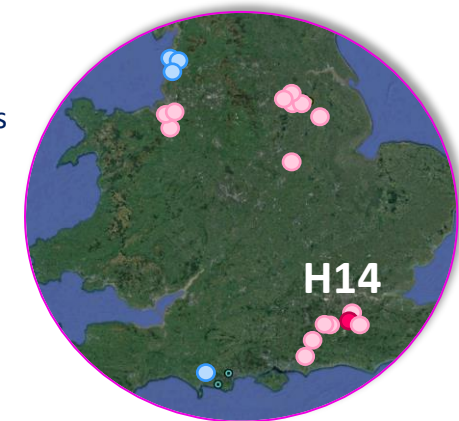
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- **Major Targets:**
  - **Target 1:** The strongest thermal impact at the site. With very intense troughs, but little prior stabilisation. Located at 1560-1640m.
  - **Minor Targets:** Up to 3 minor targets are found in this site. The first two occur between 520 and 640m. The last occurrence is at 2480-2560m.
- **Trend Observations:** Very little thermal impact confidence.

● **Medium Confidence Geothermal Site**
— E-Gamma
 — E-Gamma 10 metres Moving Average\*

# 3) H14 – Palmers Wood 9: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

- Target 1:** With intense troughs, but little prior stabilisation. . Located at 680-880m.
- Target 2:** Wider and stronger target deeper down from the previous one. The troughs are intense, but the moving average does not consistently trespass the 0.99 baseline. Located at 880-960m.

### Minor Targets:

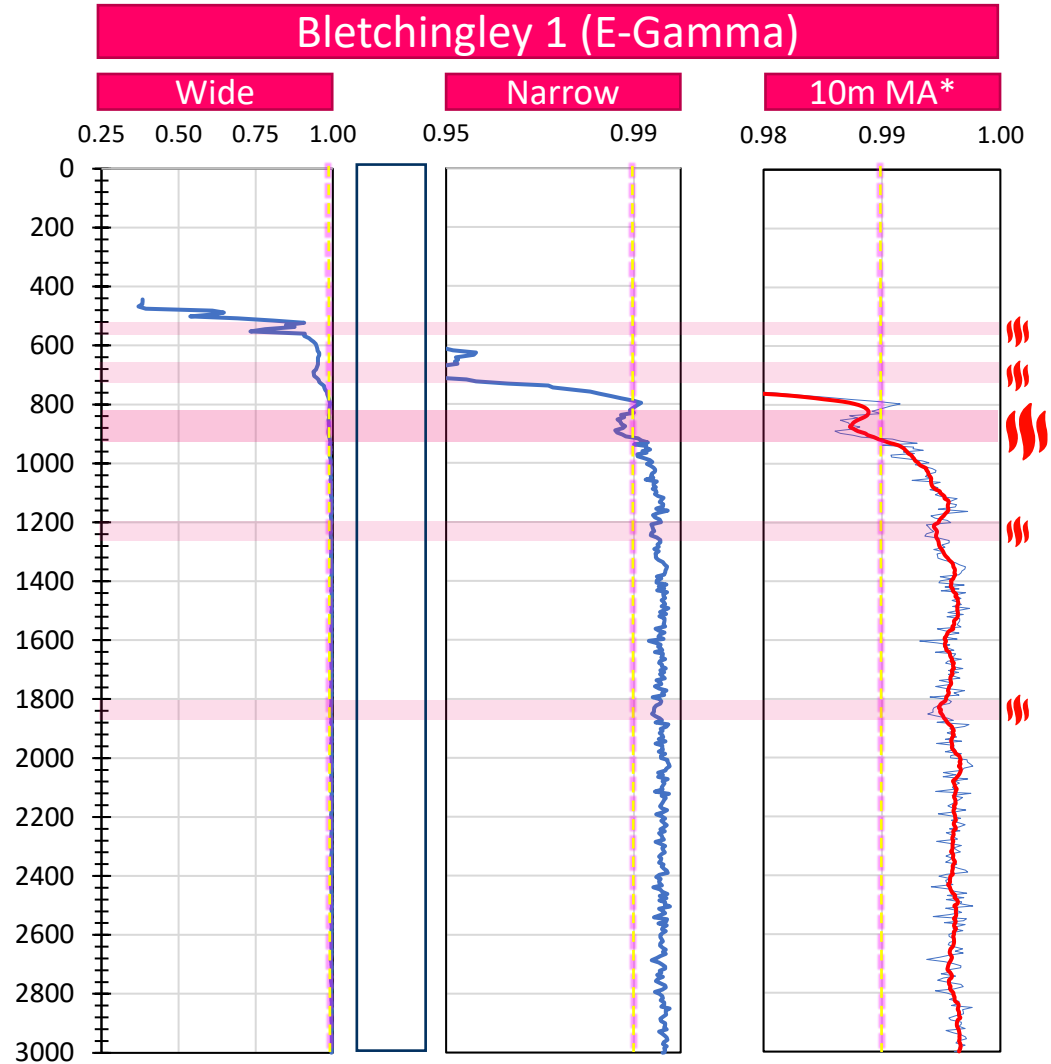
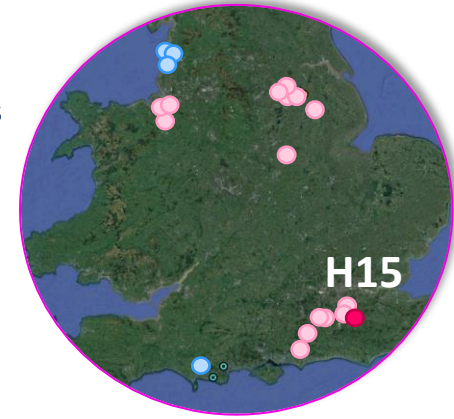
Up to 2 shallow minor targets are found in this site between 440-600m.

### Trend Observations:

Overall, this site shows a single confidence strong indications of thermal impact, with a well defined trough. Most of the Energy Gamma readings are above the baseline.

High Confidence Geothermal Site  
 — E-Gamma  
 — E-Gamma 10 metres Moving Average\*

# 3) H15 – Bletchingley 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

**Target 1:** The strongest thermal impact at the site. While the moving average does not reach the 0.99 stabilization before the trough, the raw data does peak above it. Located at 840-960m.

**Minor Targets:**

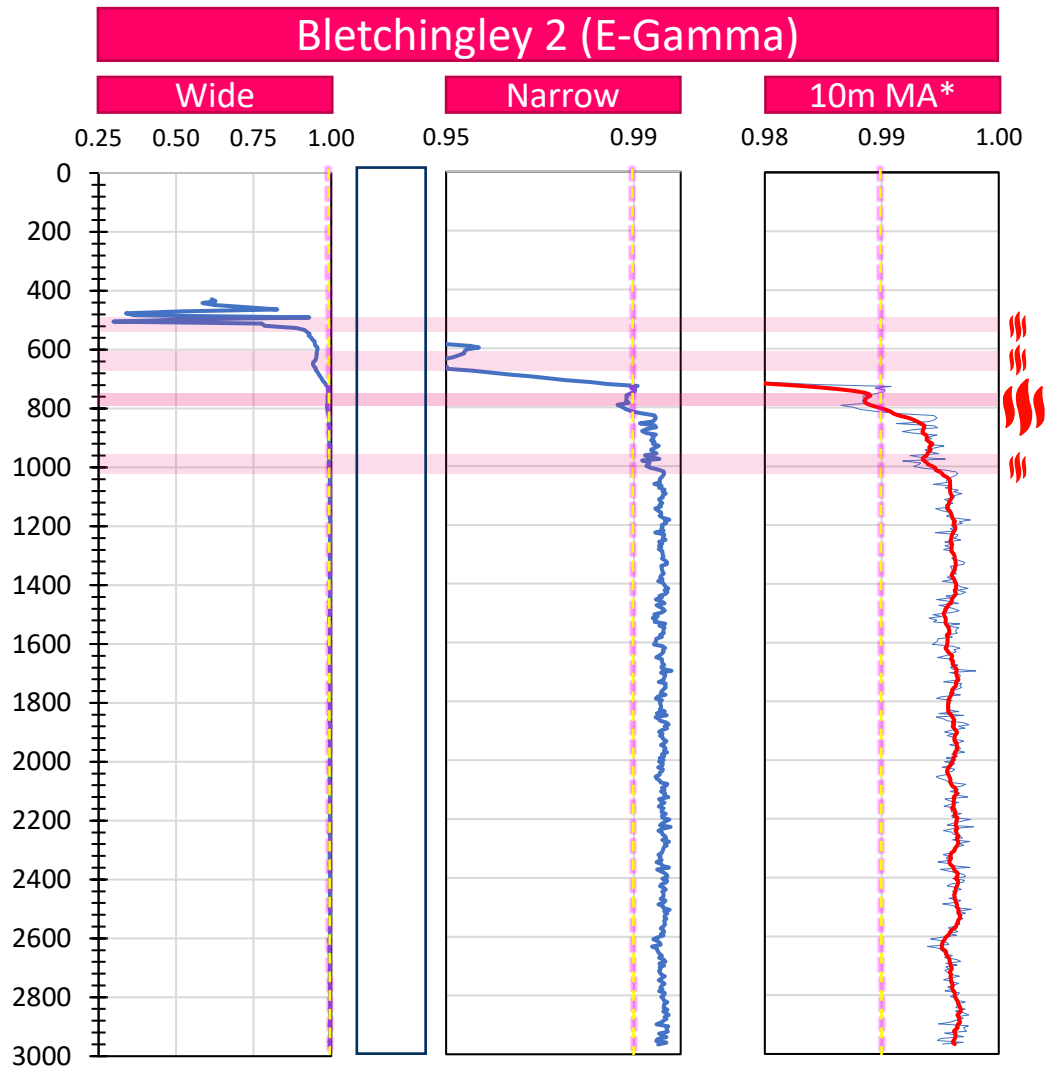
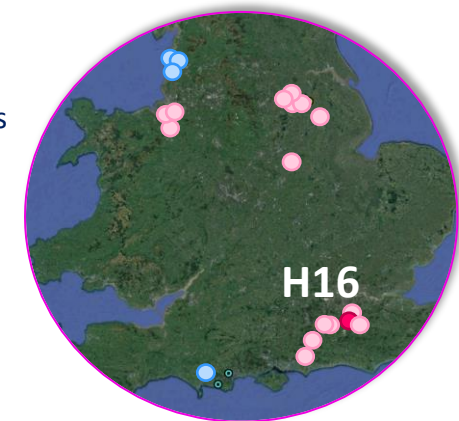
Up to 4 minor targets are found in this site. The first two occur between 560 and 720m. The last occurrences are at 1200-1800m and 1800-1880m.

**Trend Observations:**

Overall, this site shows poor indications of thermal impact.

**Medium Confidence Geothermal Site** — E-Gamma (blue line), E-Gamma 10 metres Moving Average\* (red line)

# 3) H16 – Bletchingley 2: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

- Target 1:** The strongest thermal impact at the site. However, the moving average does not reach the 0.99 stabilization before the troughs, reducing the confidence on this target. Located at 760-800m.

**Minor Targets:**

Up to 3 minor targets are found in this site. The first two occur between 550 and 680m. The last occurrence is at 960-1000m.

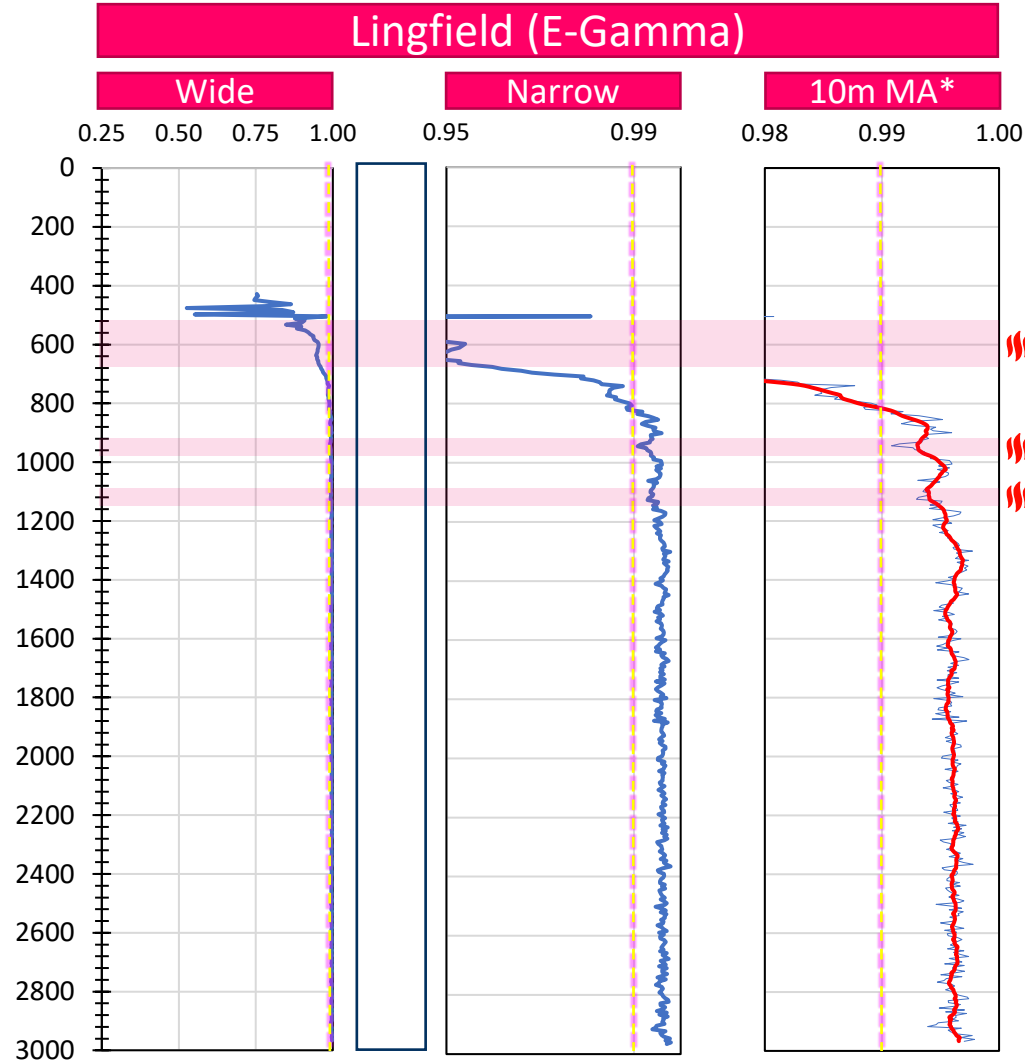
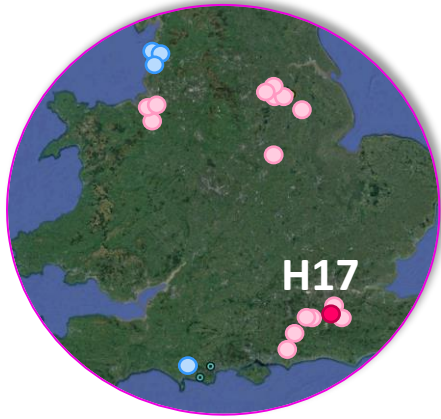
**Trend Observations:**

Overall, this site shows poor and low confidence indications of thermal impact, with poorly defined troughs and peaks. Most of the Energy Gamma readings are above the baseline.

**Medium Confidence Geothermal Site** — E-Gamma (blue line), E-Gamma 10 metres Moving Average\* (red line)



# 3) H17 – Lingfield: From 00178



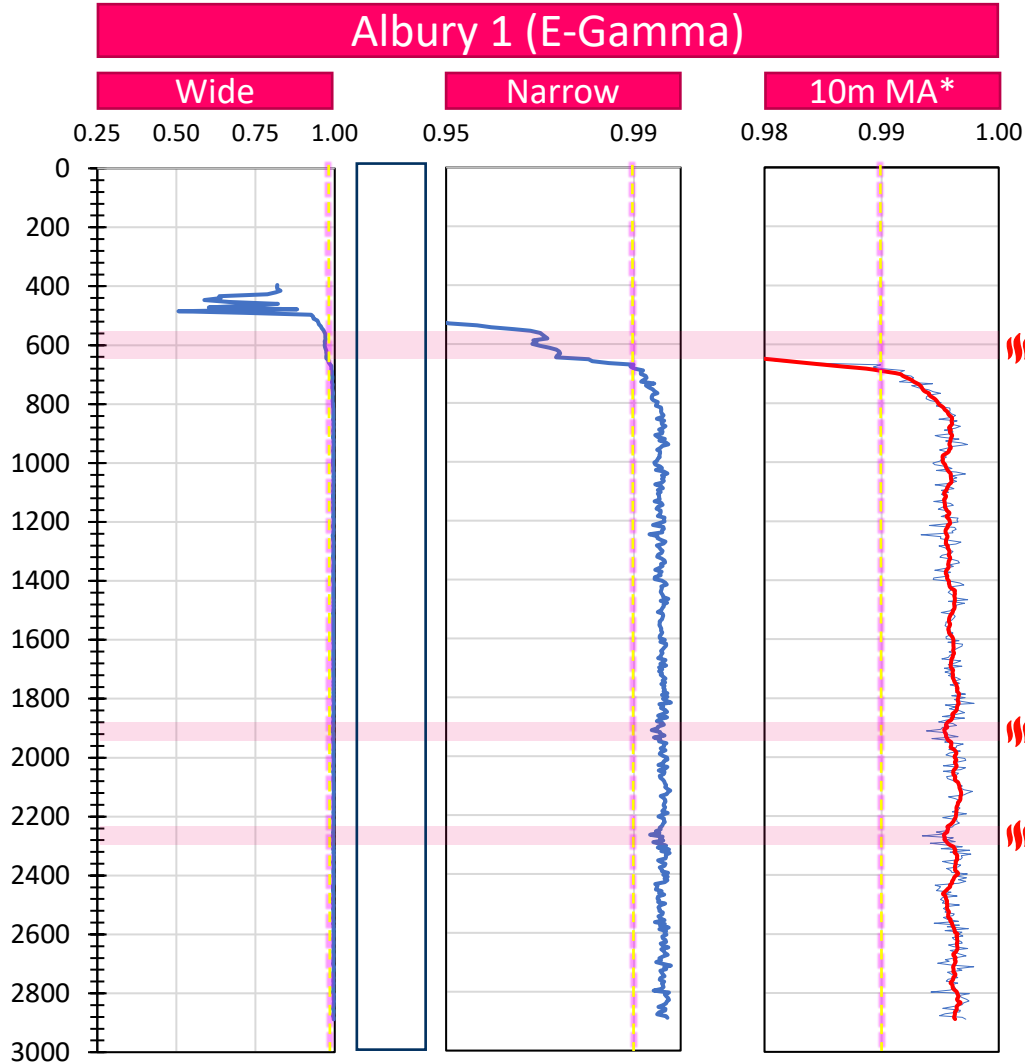
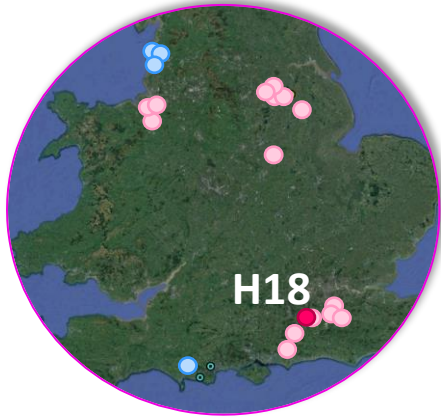
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** Up to 3 minor targets are found in this site. The first one is quite wide, and appears way before the stabilization point of the signal at 520-680m. The last two are between 920-1180m.
- Trend Observations:** Overall, this site shows very weak indications of thermal impact, with badly defined troughs and peaks. Most of the Energy Gamma readings are above the baseline.

**Low Confidence Geothermal Site**  
— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H18 – Albury 1: From 00178



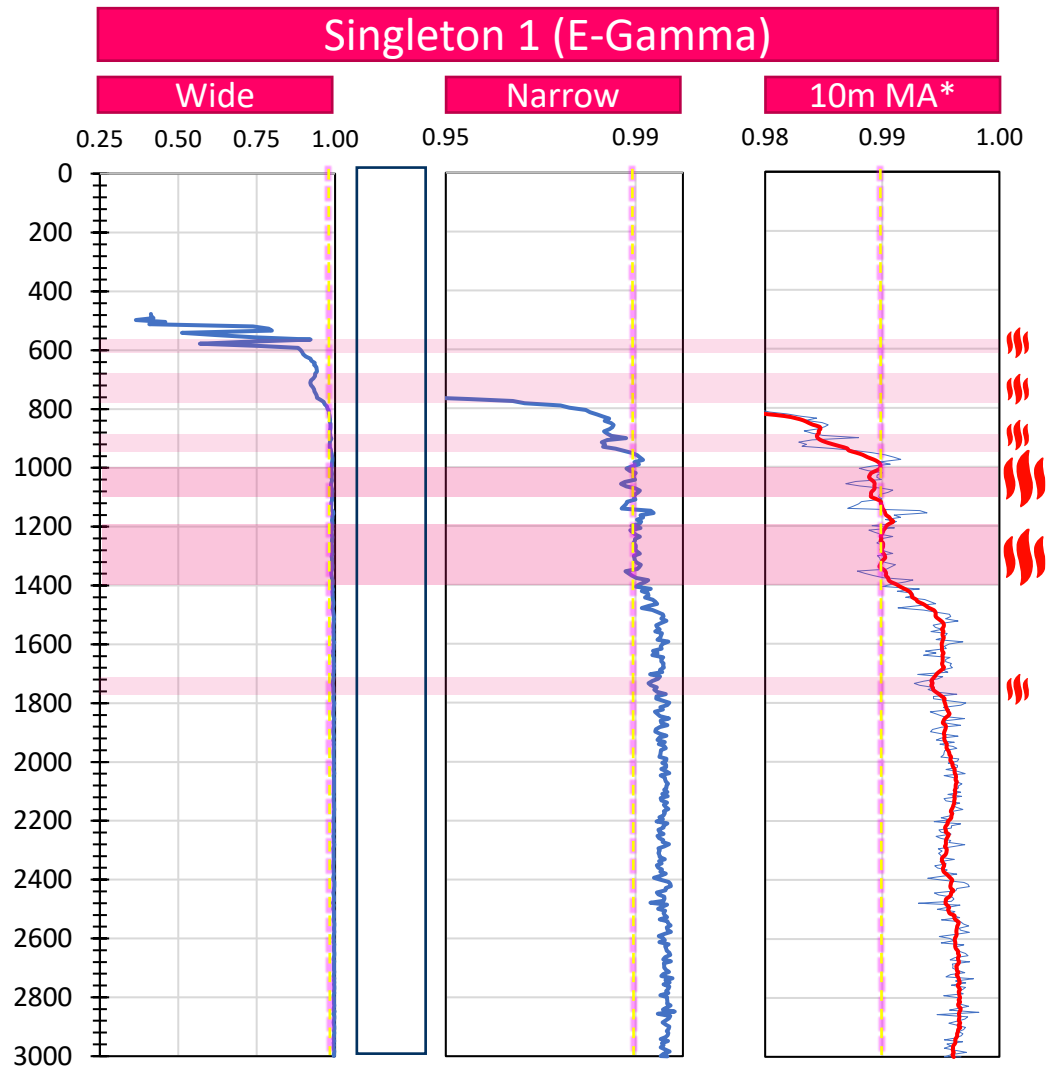
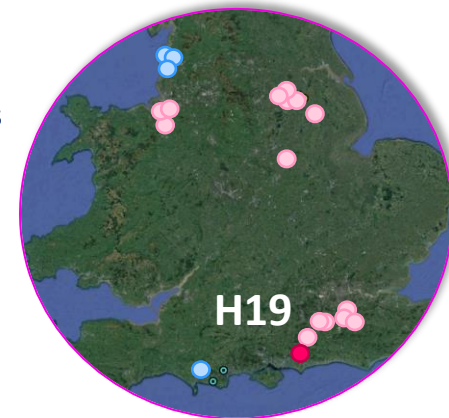
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** Up to 3 minor targets are found in this site. The first occurs at 560-640m, the deeper ones are at 1880-1920m and at 2240-2280m.
- Trend Observations:** There are only minor targets, this is not a prospective location.

**Low Confidence Geothermal Site**  
 E-Gamma  
 E-Gamma 10 metres Moving Average\*

# 3) H19 – Singleton 1: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

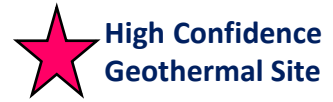
- Target 1:** The first thermal impact at the site. Thinner than the following one and with similar features. Located at 1000-1080m.
- Target 2:** Very wide trough with strong moving average indicators accompanying the collection of raw data troughs. Located at 1200-1400m.

### Minor Targets:

Up to 4 minor targets are found in this site. The first three occur between 560 and 960m. The last occurrence is at 1720-1760m.

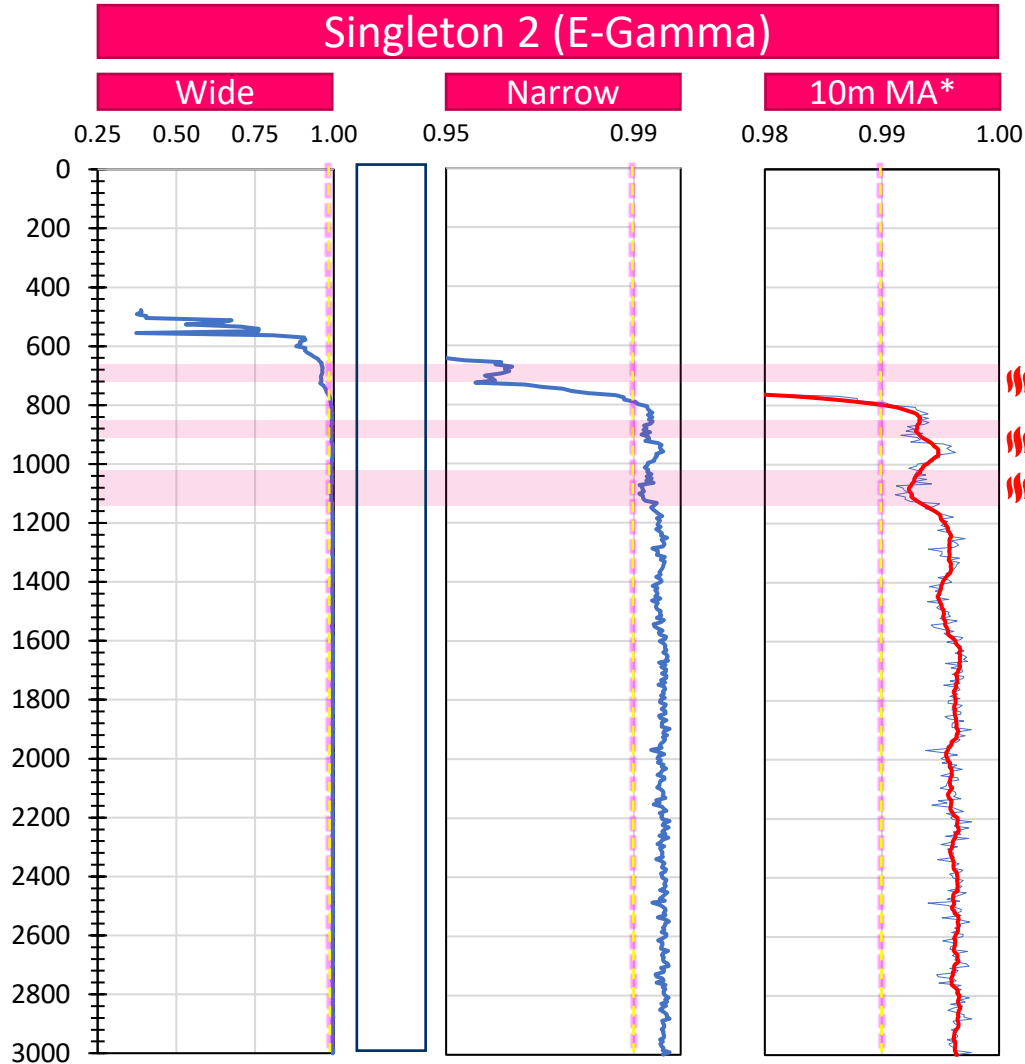
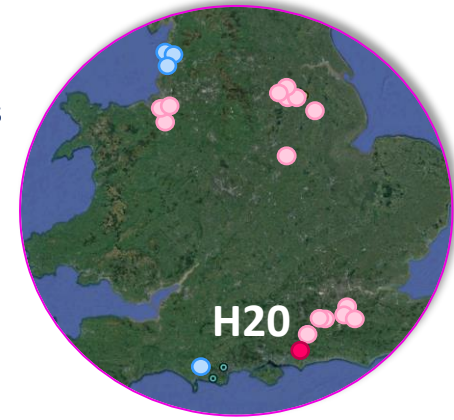
### Trend Observations:

Overall, this site shows strong indications of thermal impact, with well defined troughs and peaks. Most of the Energy Gamma readings are above the baseline. The indicators are confident but not too intense.



— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H2O – Singleton 2: From 00178



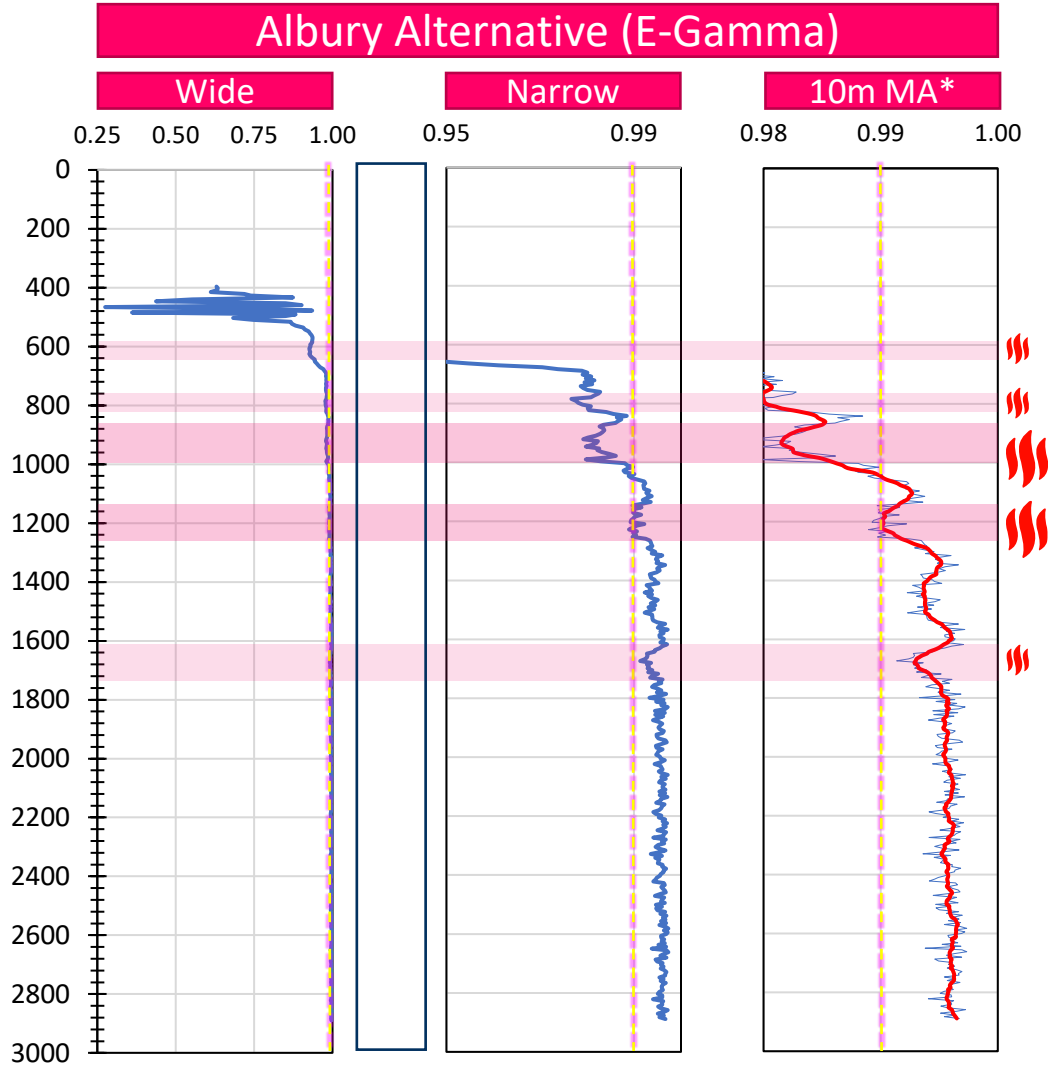
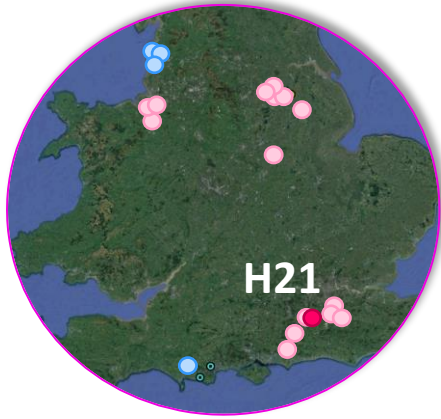
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** Up to 3 minor targets are found in this site. The first occurs at 680-720m, the deeper ones are at 840-880m and at 1000-1160m.
- Trend Observations:** There are only minor targets, this is not a prospective location.

**Low Confidence Geothermal Site**  
— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 3) H21 – Albury Alternative: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

**Major Targets:**

- Target 1:** The strongest thermal impact at the site. However, the moving average does not reach the 0.99 stabilization before the troughs, reducing the confidence on this target. Located at 880-1000m.
- Target 2:** Weaker target deeper down from the previous one. The trough seems more relevant, but does not consistently trespass the 0.99 baseline. Located at 1160-1250m.

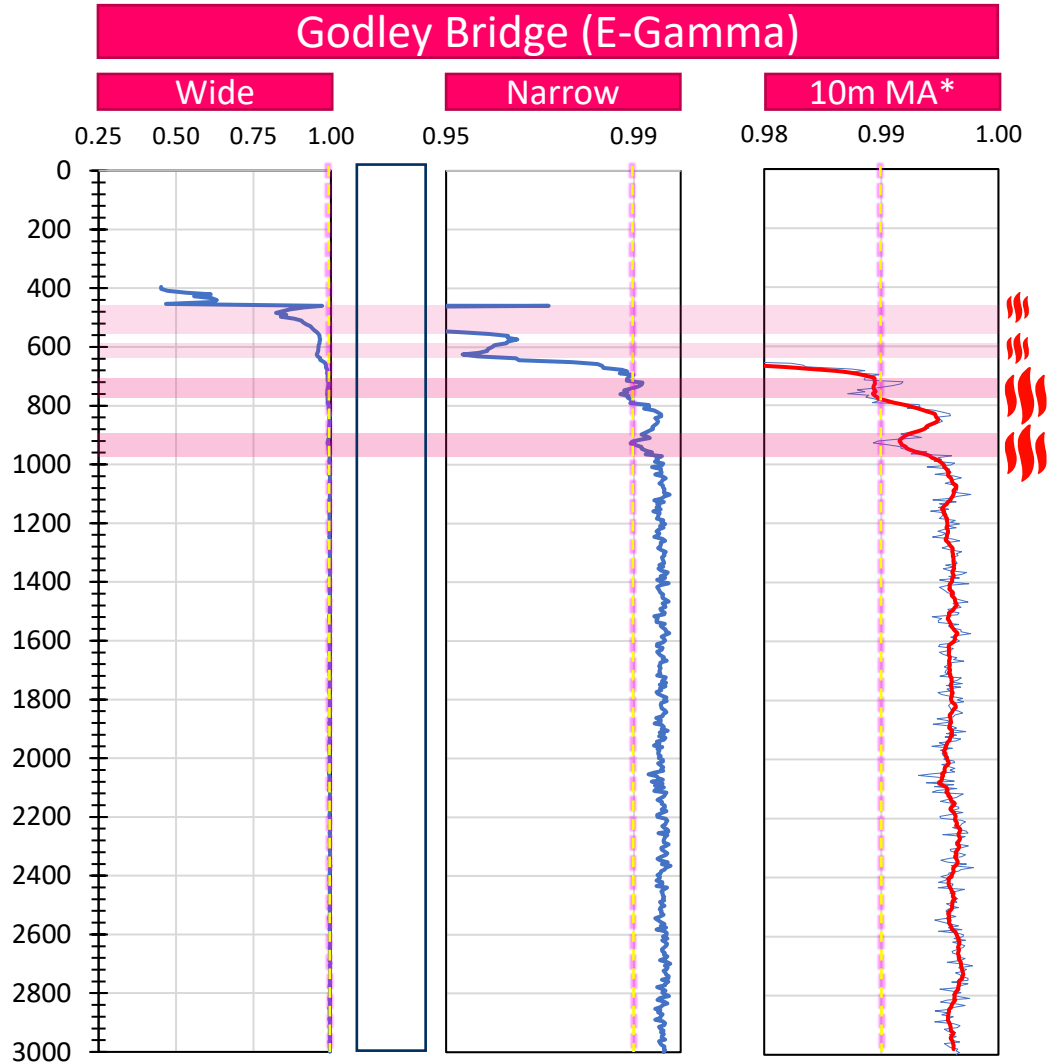
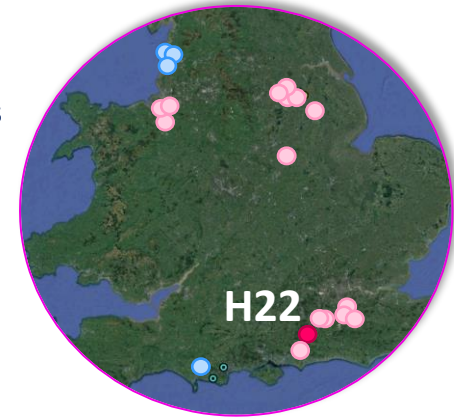
**Minor Targets:**

Up to 2 minor targets are found in this site. The first two occur between 600 and 800m. The last occurrence is at 1600-1720m.

**Trend Observations:** Overall, this site shows moderate indications of thermal impact, with well defined troughs and peaks.

**Medium Confidence Geothermal Site** — E-Gamma (blue line), E-Gamma 10 metres Moving Average\* (red line)

# 3) H22 – Godley Bridge: From 00178



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

### Major Targets:

- Target 1:** The strongest thermal impact at the site. Thinner than the following one but more intense, However, the moving average does not reach the 0.99 stabilization before the troughs, reducing the confidence on this target. Located at 720-760m.
- Target 2:** Wider but weaker target deeper down from the previous one. The trough seems more relevant, but the moving average does not consistently trespass the 0.99 baseline. Located at 880-960m.

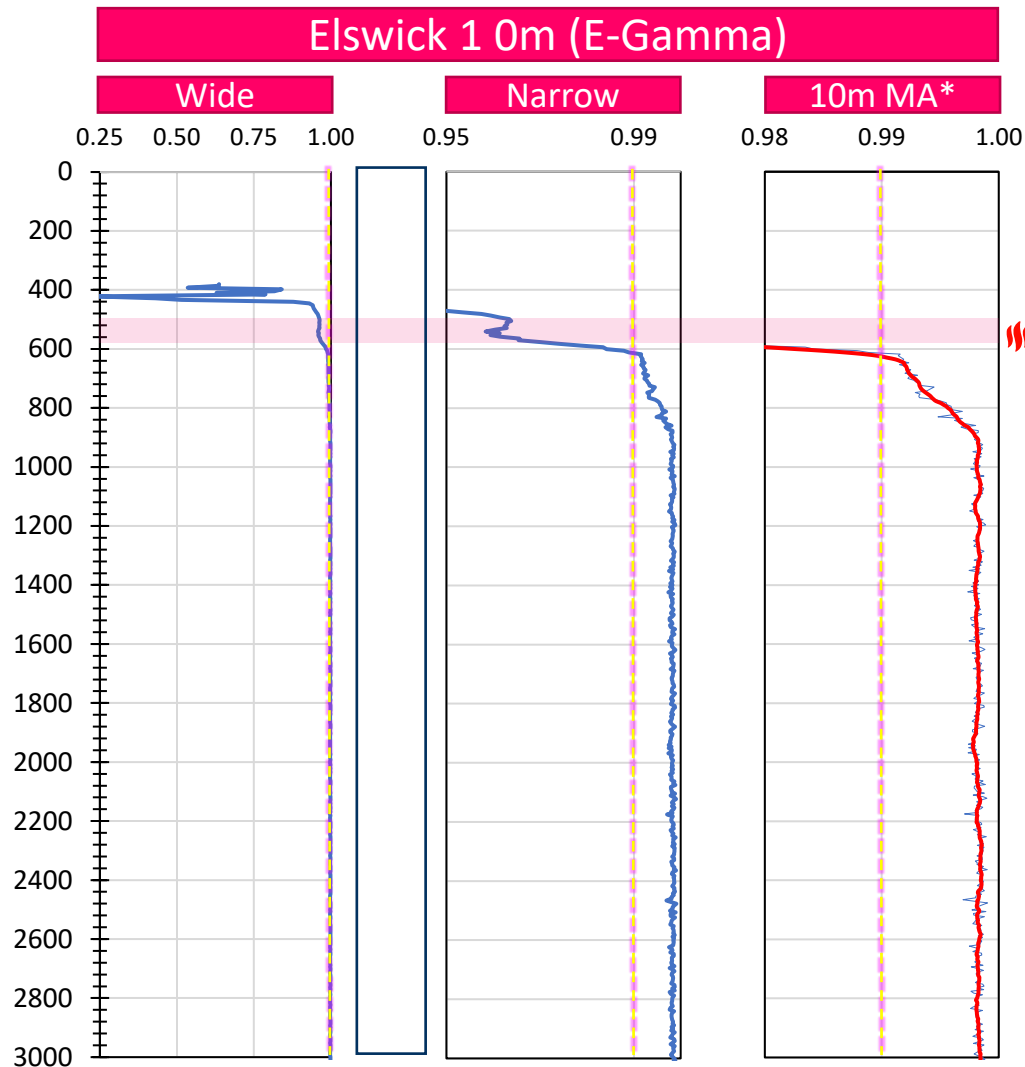
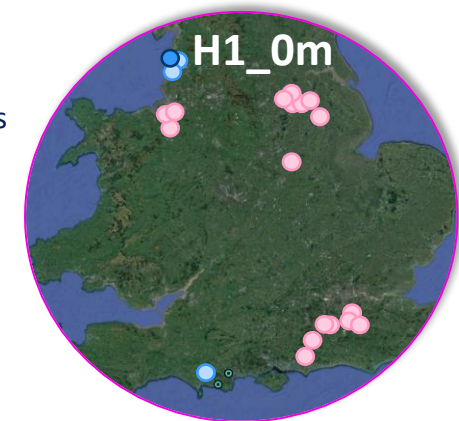
### Minor Targets:

Up to 2 minor targets are found in this site between 480-640m

**Trend Observations:** Overall, this site shows poor to moderate indications of thermal impact, with well defined troughs and peaks.

**Medium Confidence Geothermal Site** — E-Gamma (blue line), E-Gamma 10 metres Moving Average\* (red line)

# 3) H1 @ 0M – Elswick 1: From 00209-C

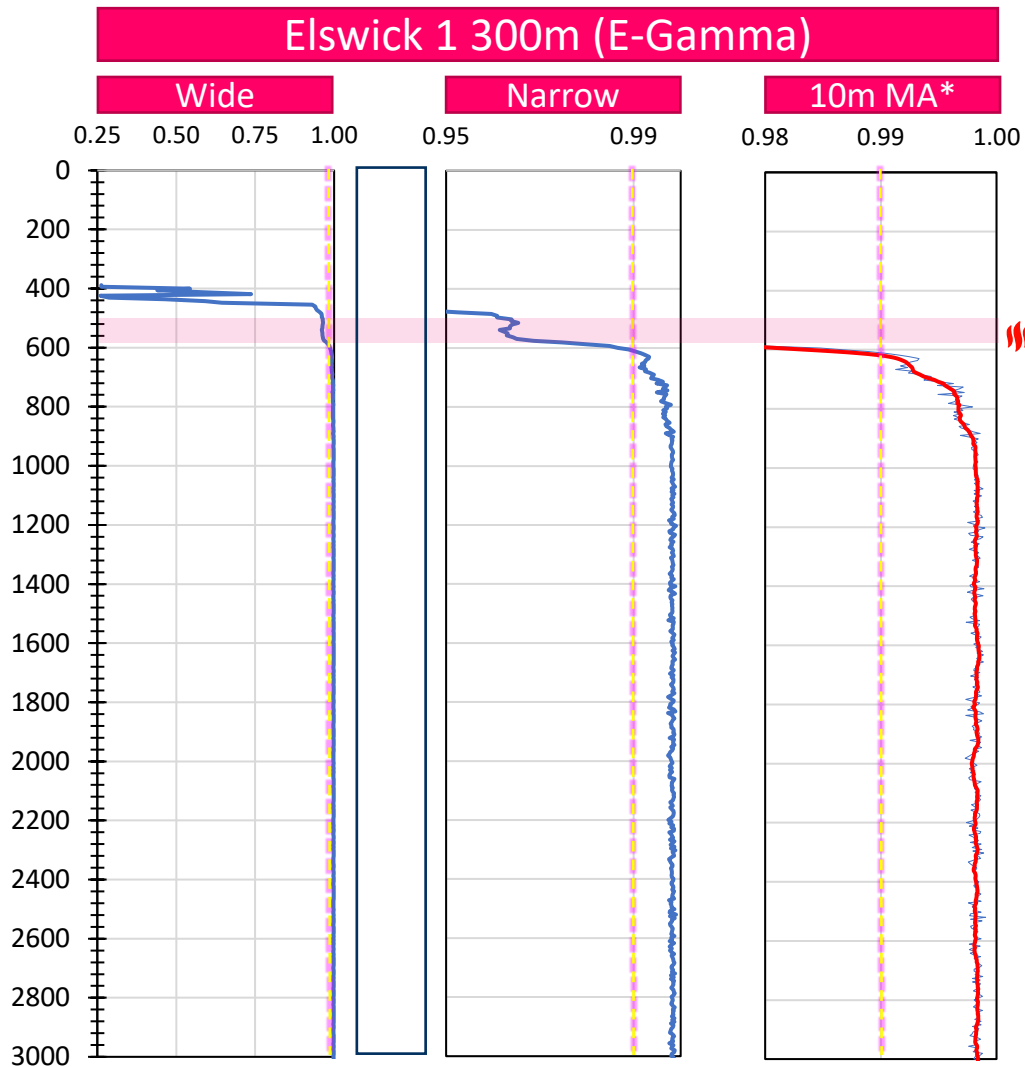
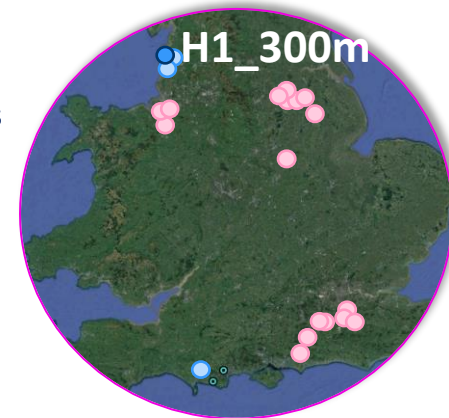


The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** The single target appears before signal stabilisation and is weak, located at 520-600m.
- Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.

# 3) H1 @ 300M – Elswick 1: From 00209-C



The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

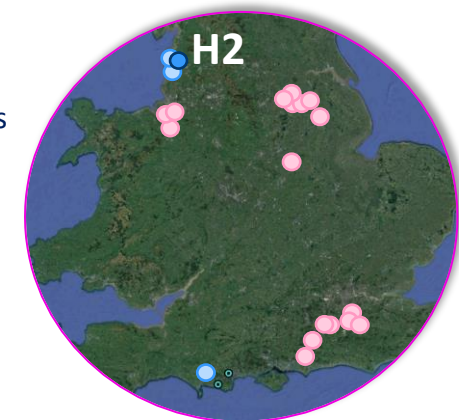
Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** The single target appears before signal stabilisation and is weak, located at 520-600m.
- Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.

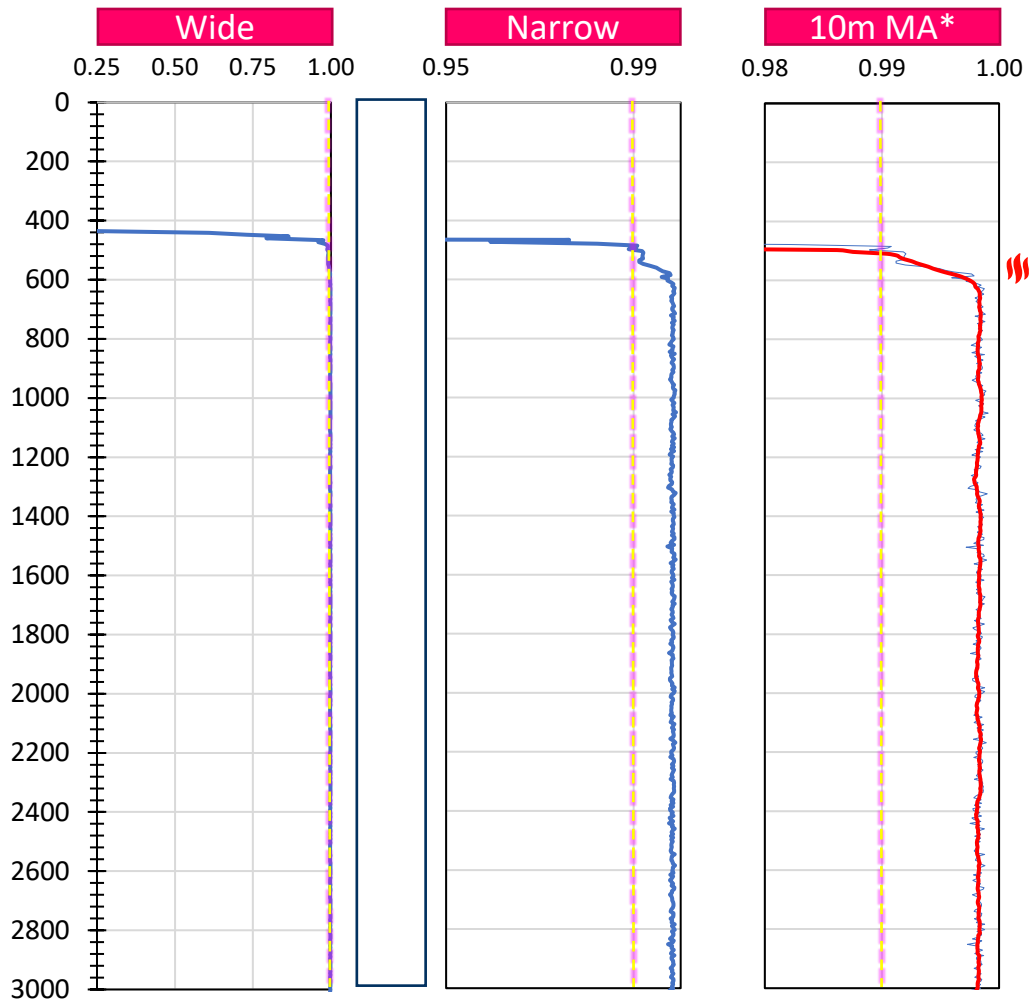
**Low Confidence Geothermal Site**  
— E-Gamma  
— E-Gamma 10 metres Moving Average\*



# 3) H2 @ 100M – Beconsall: From 00209-C



## Beconsall 100m (E-Gamma)



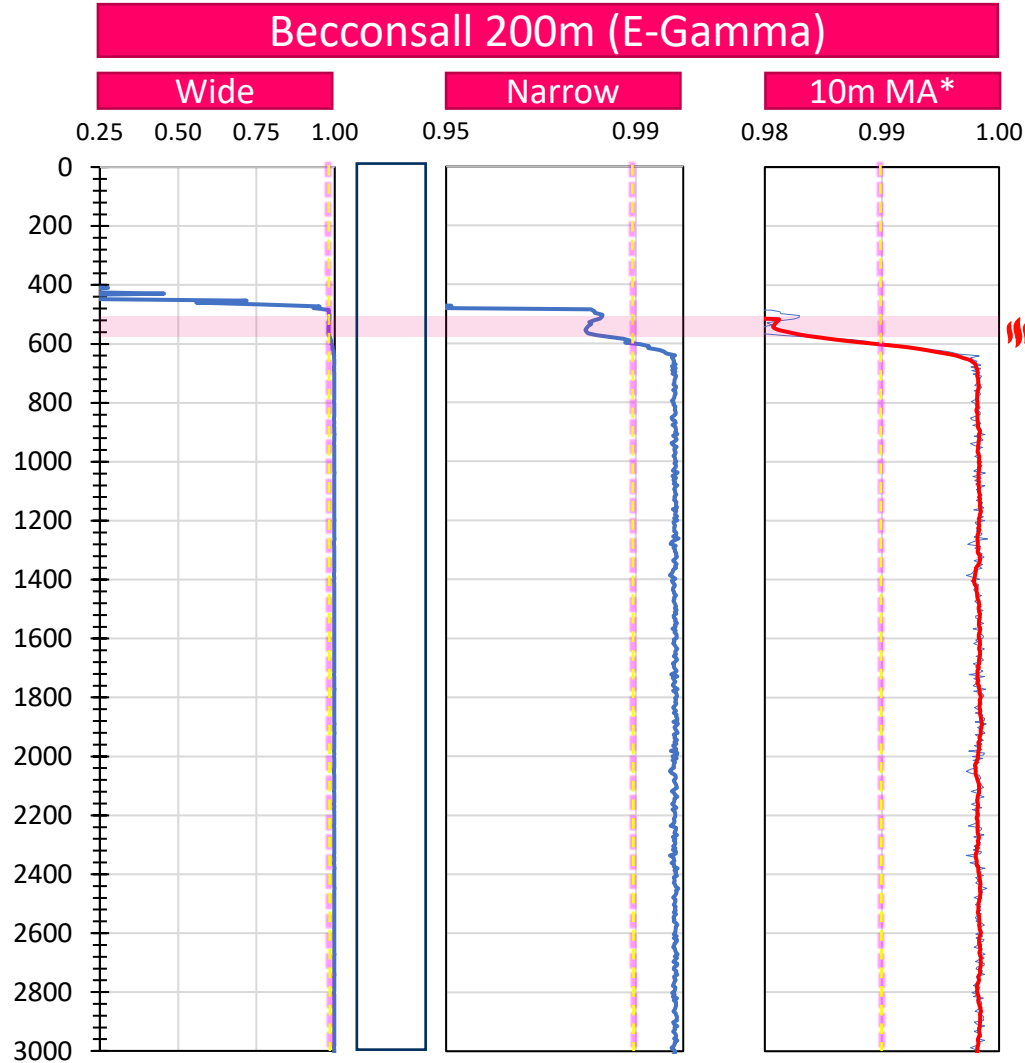
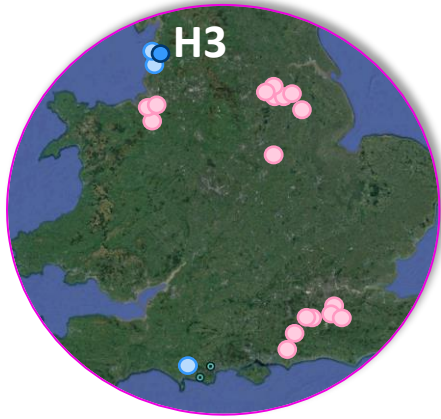
Low Confidence Geothermal Site
— E-Gamma  
— E-Gamma 10 metres Moving Average\*

The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:**  
No minor targets.
- Trend Observations:**  
No indications whatsoever.

# 3) H3 @ 200M – Becconsall: From 00209-C

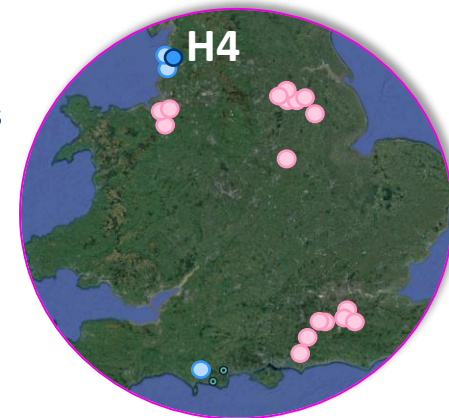


The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

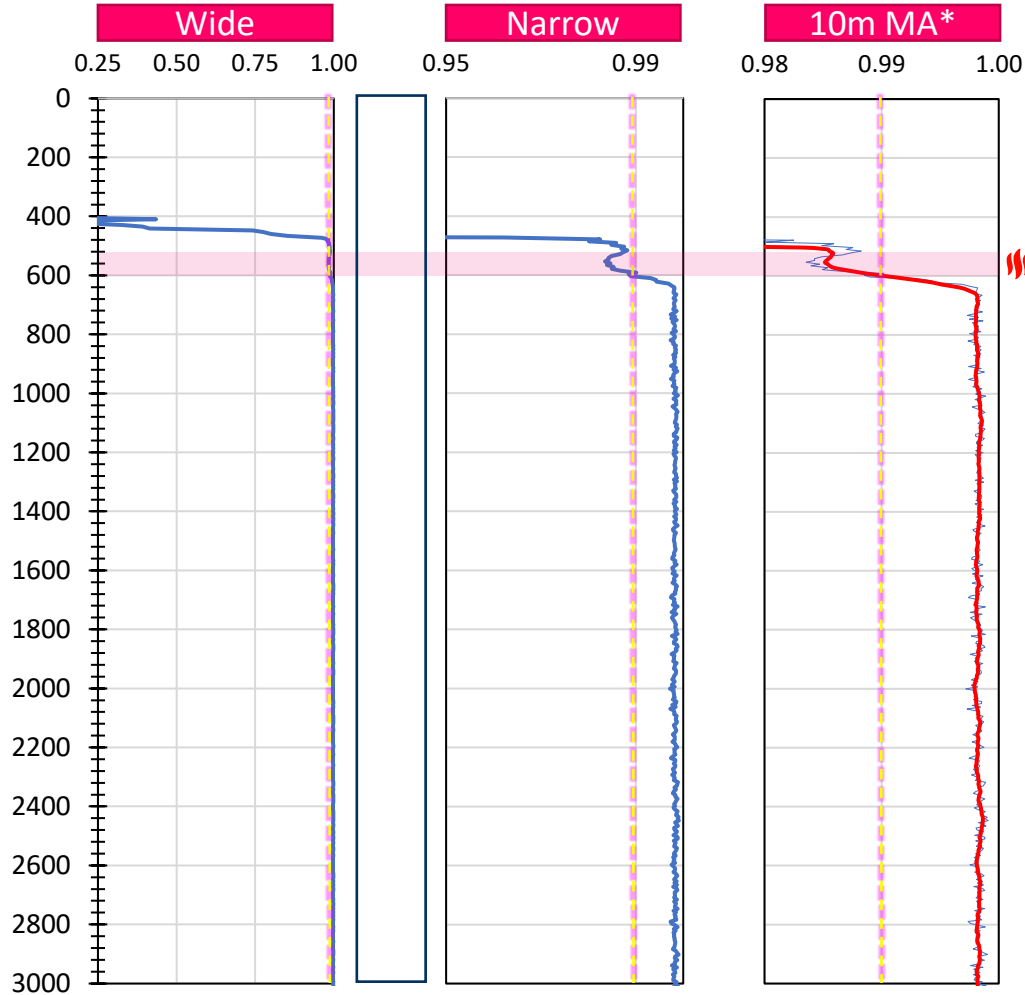
Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** The single target appears before signal stabilisation and is weak, located at 520-560m.
- Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.

# 3) H4 @ 300M – Becconsall: From 00209-C



## Becconsall 300m(E-Gamma)



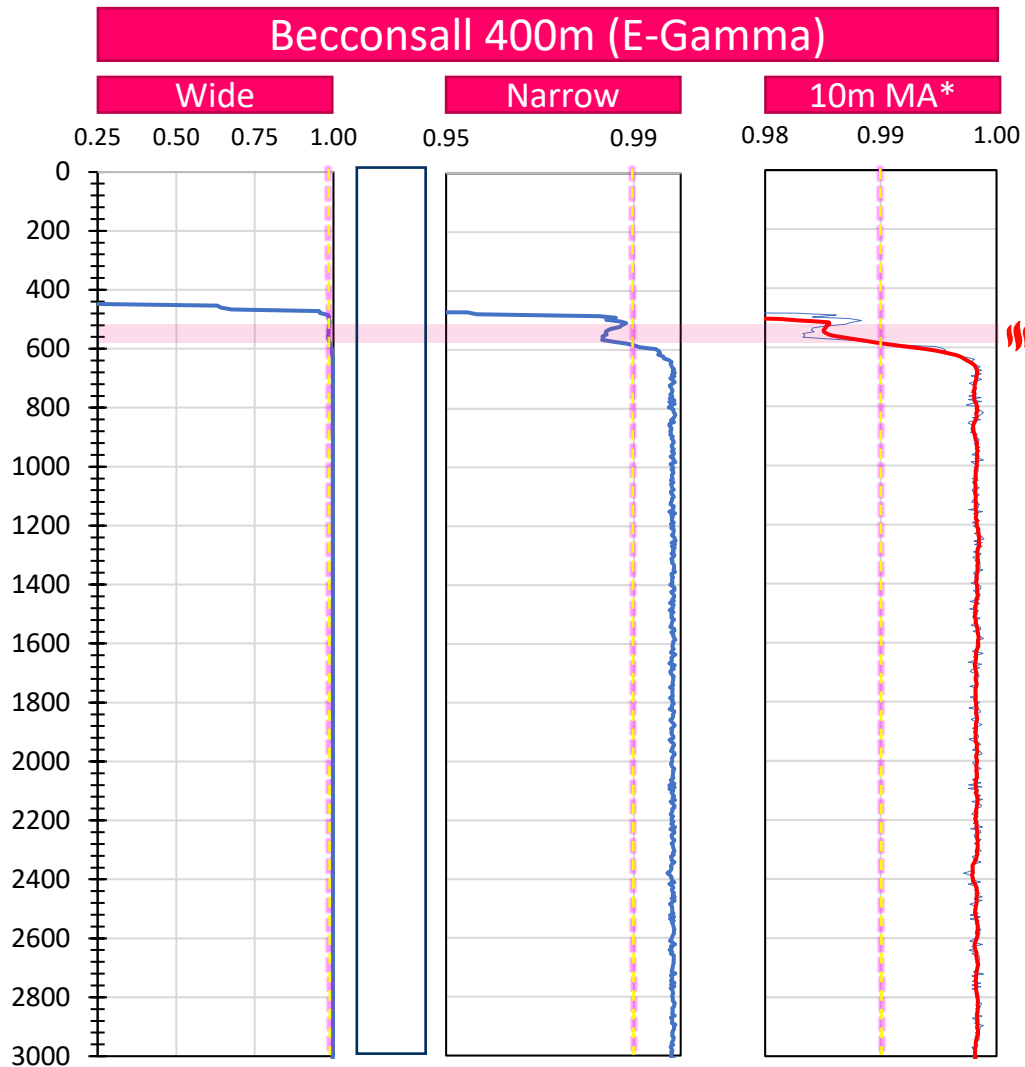
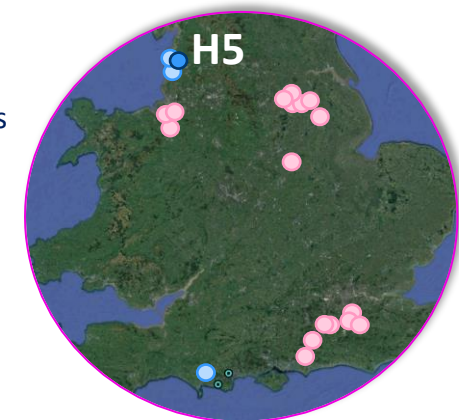
Low Confidence Geothermal Site  
— E-Gamma  
— E-Gamma 10 metres Moving Average\*

The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- **No Major Targets:** This log does not show any major targets below the relevant baseline.
- **Minor Targets:** The single target appears before signal stabilisation and is weak, located at 520-600m.
- **Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.

# 3) H5 @ 400M – Becconsall: From 00209-C



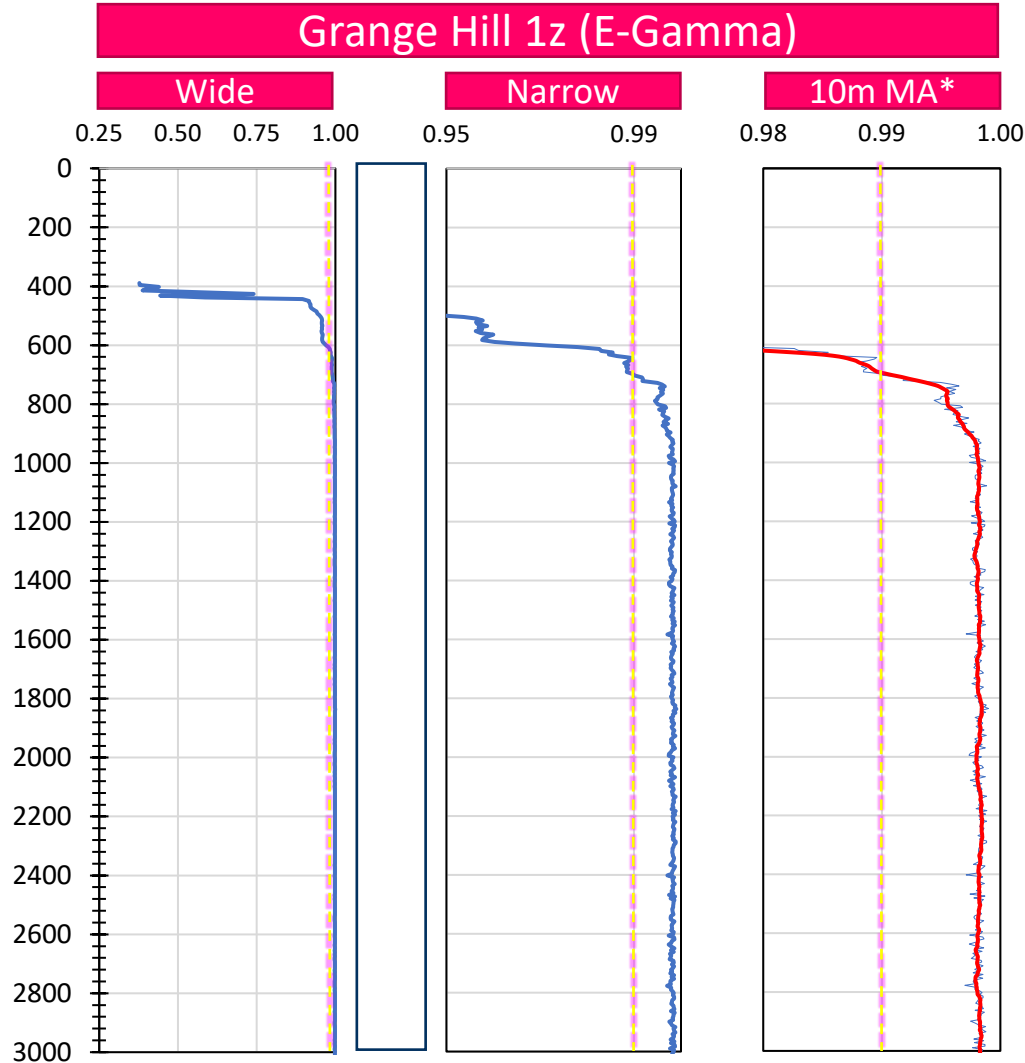
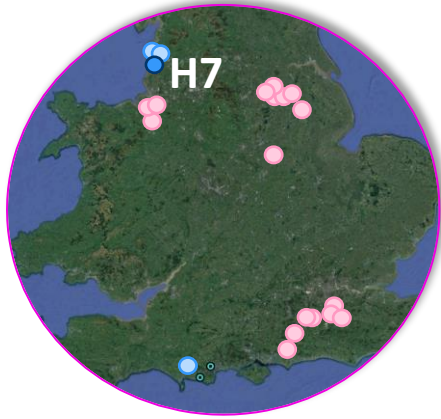
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** The single target appears before signal stabilisation and is weak, located at 520-560m.
- Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.




Low Confidence Geothermal Site  
 E-Gamma  
 E-Gamma 10 metres Moving Average\*




# 3) H7 – Grange Hill 1z: From 00209-C



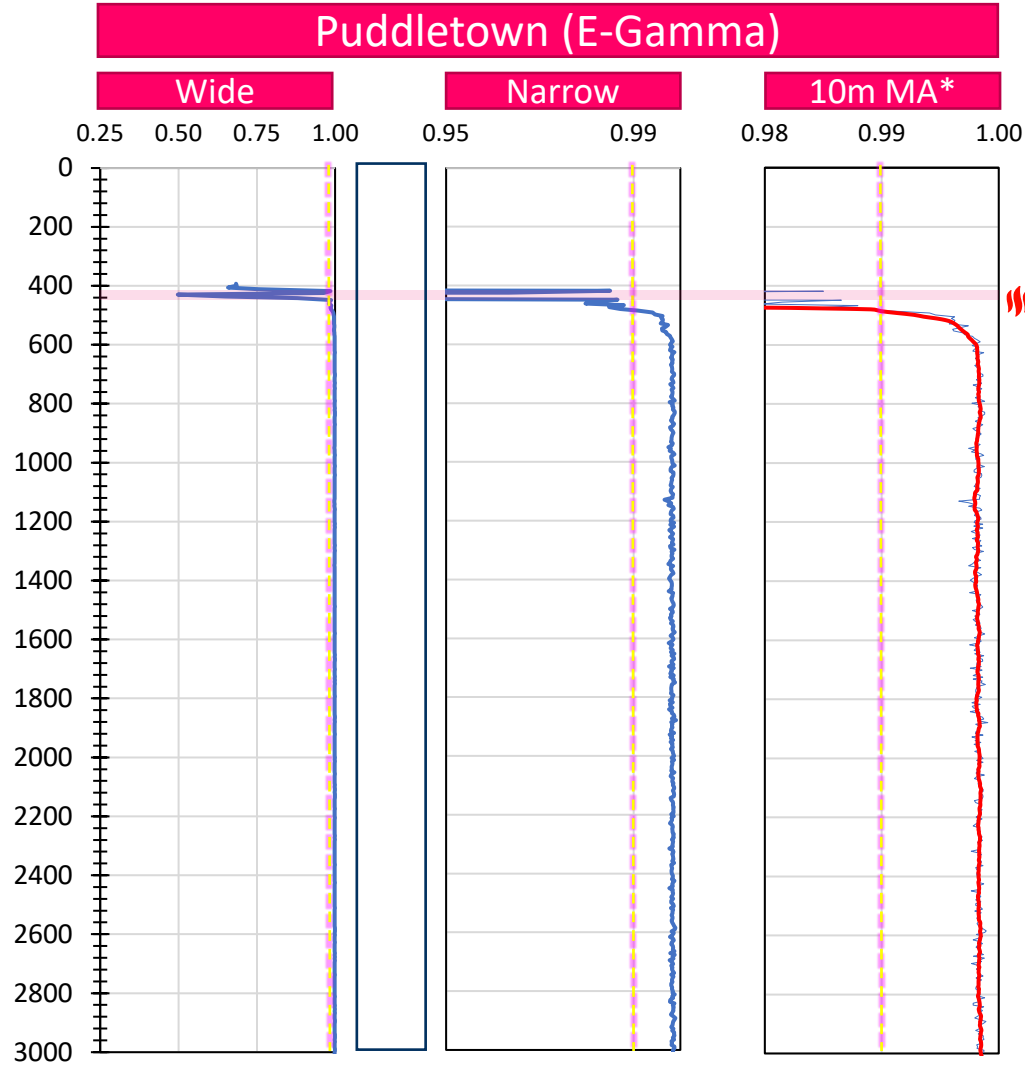
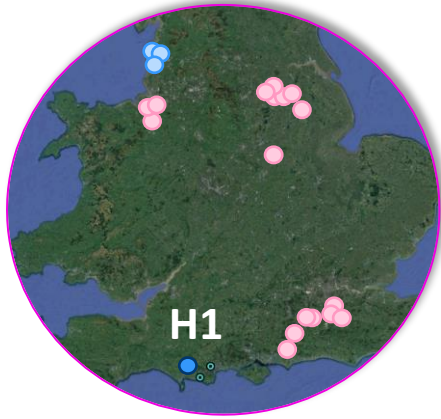
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

-  **No Major Targets:** This log does not show any major targets below the relevant baseline.
-  **Minor Targets:**  
No minor targets.
-  **Trend Observations:**  
No indications whatsoever.

 **Low Confidence Geothermal Site**       E-Gamma       E-Gamma 10 metres Moving Average\*

# 3) H1 – Puddletown: From 00209-T



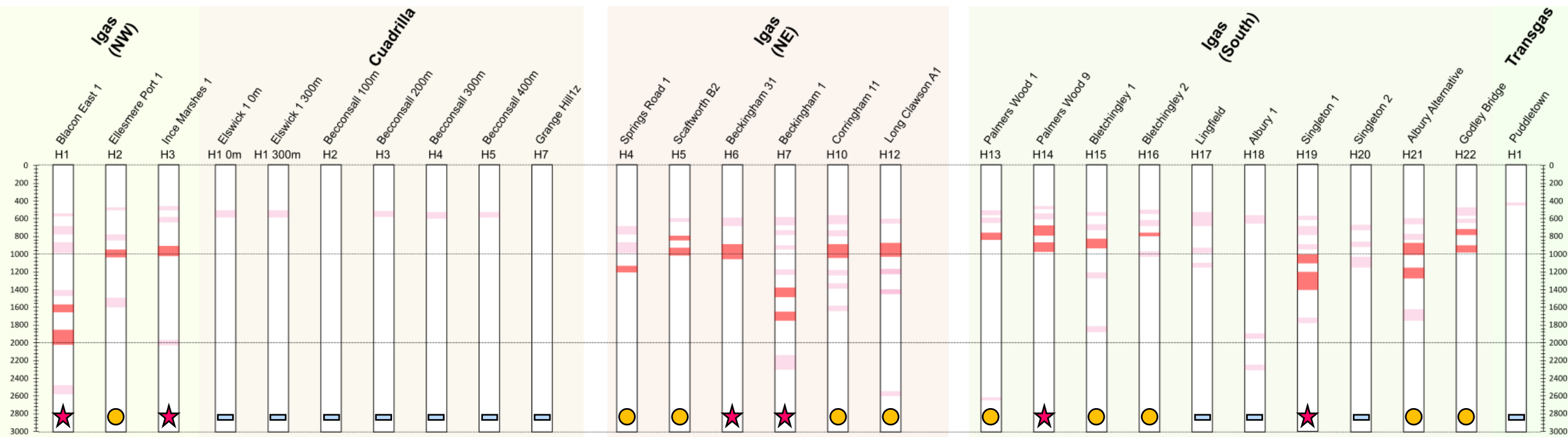
The three graphs in the slide show the same dataset at increased levels of detail. As the signal travel deeper, we need to look at smaller variations within.

Any areas with outstanding troughs may be indicative of locally increased temperature. We are most interested in the spots where the signal approaches 0.99 after passing it for the first time.

- No Major Targets:** This log does not show any major targets below the relevant baseline.
- Minor Targets:** The single target appears before signal stabilisation and is weak, located at 400-440m.
- Trend Observations:** There is only a single low-confidence minor target, this is not a prospective location.

**Low Confidence Geothermal Site**  
— E-Gamma  
— E-Gamma 10 metres Moving Average\*

# 4.1) Discussion: Integration of Results



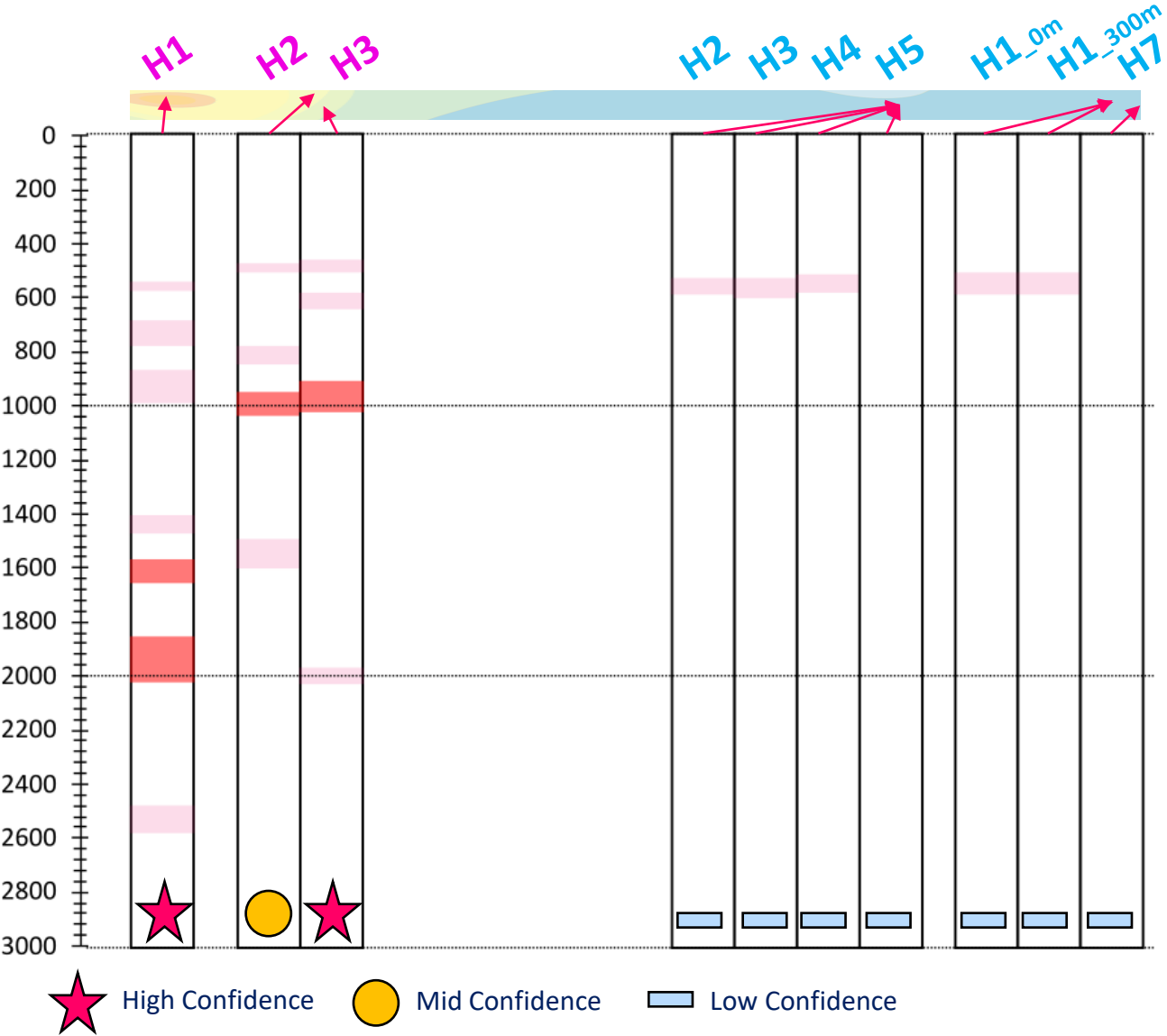
This section of the report will be integrating all the sites analysed with the data and model from Busby et al, 2011 and providing a comparison between the areas of high temperature at 1000m depth, to the geothermal potential derived from ADR readings. This will be presented with a vectorized version of the Watson et al, 2021 maps derived from the Busby et al 2011 models.

The panel above summarizes the targets found at each site, with brighter red for targets that meet the baseline, and more transparent red for very low confidence targets. Each site also has a mark (star, circle or bar) that indicates the overall geothermal confidence level.

**Confidence of ADR derived geothermal potential at scanned sites**

- High Confidence
- Mid Confidence
- Low Confidence

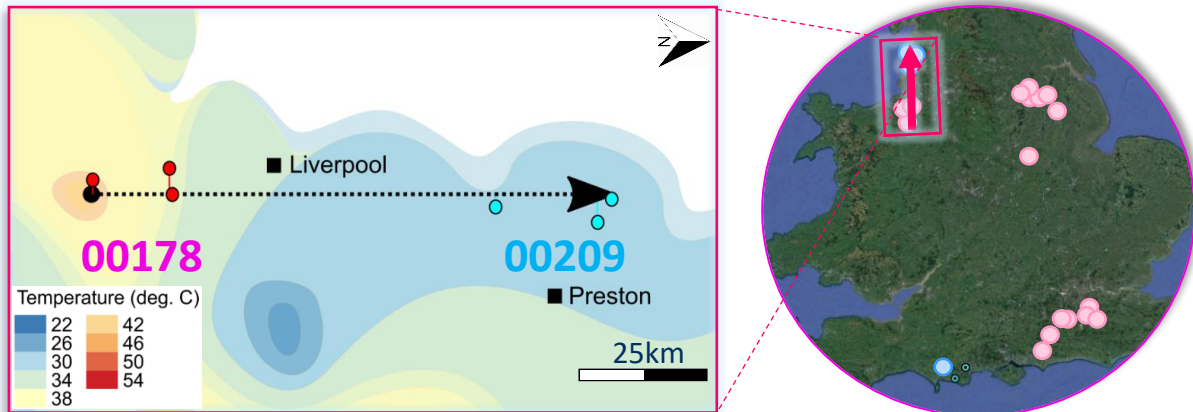
# 4.1) Discussion: North West Panel



This is a panel cross-section in NW England, from the south of Liverpool to north of Preston. It shows how the Energy Gamma derived temperature prognosis changes northward in a trend that decreases in both intensity of the energy indicators, and confidence.

The prognosis closely matches the validation provided by the Busby et al, 2011 geothermal maps as shown in the vectorized version of the Watson et al, 2021 maps.

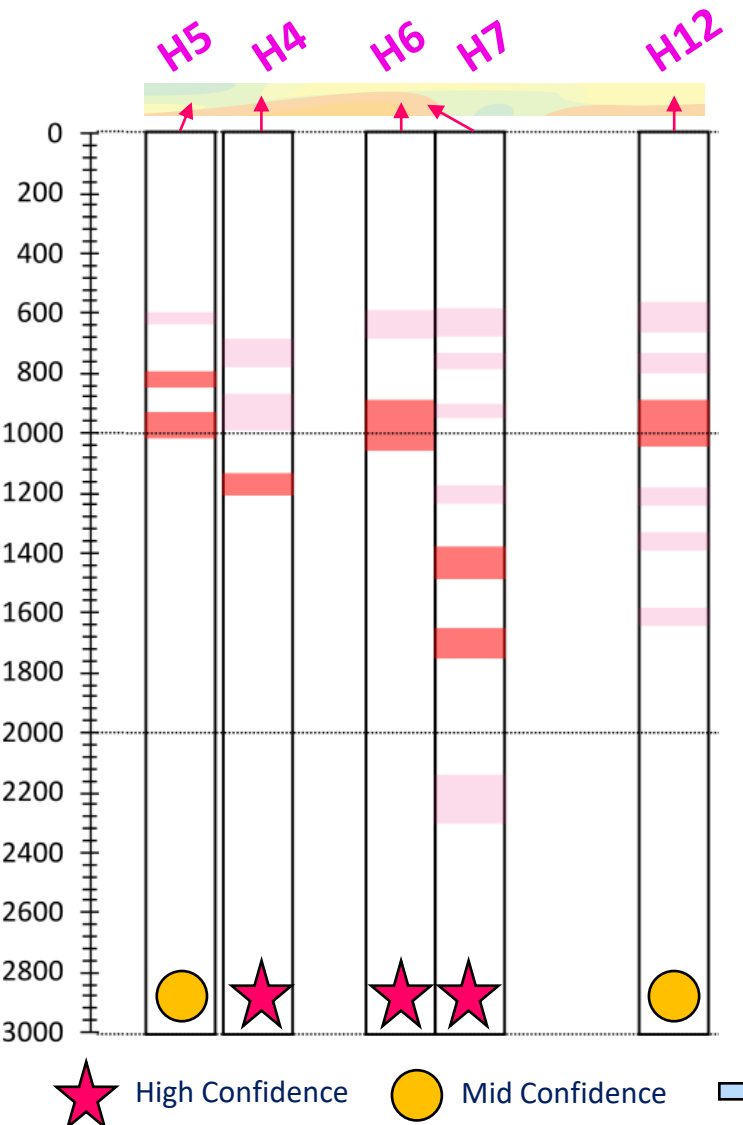
H1 is indeed the highest confidence and best position for geothermal potential in this area, both based on ADR prognosis and the map, while the 00209 sites are located in a relatively colder area.



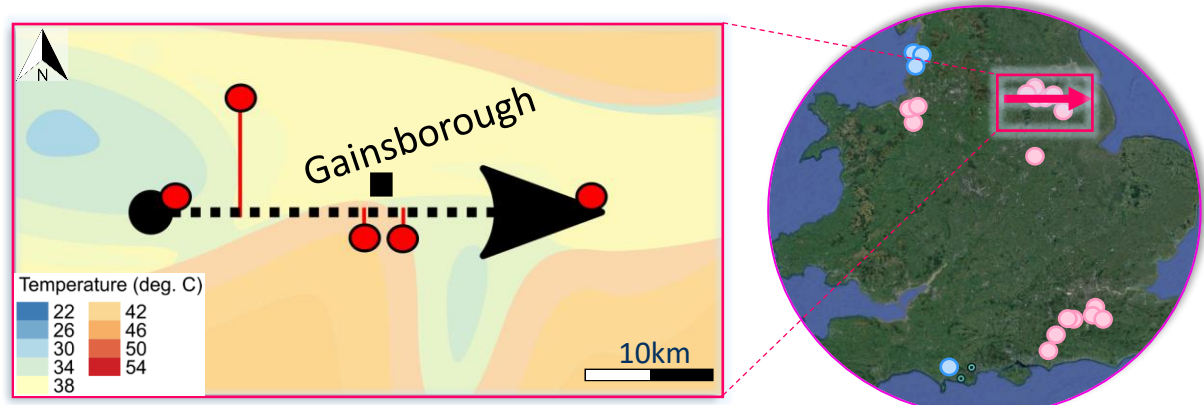
\*Map vectorized from Watson et al, 2021



# 4.1) Discussion: North East Panel

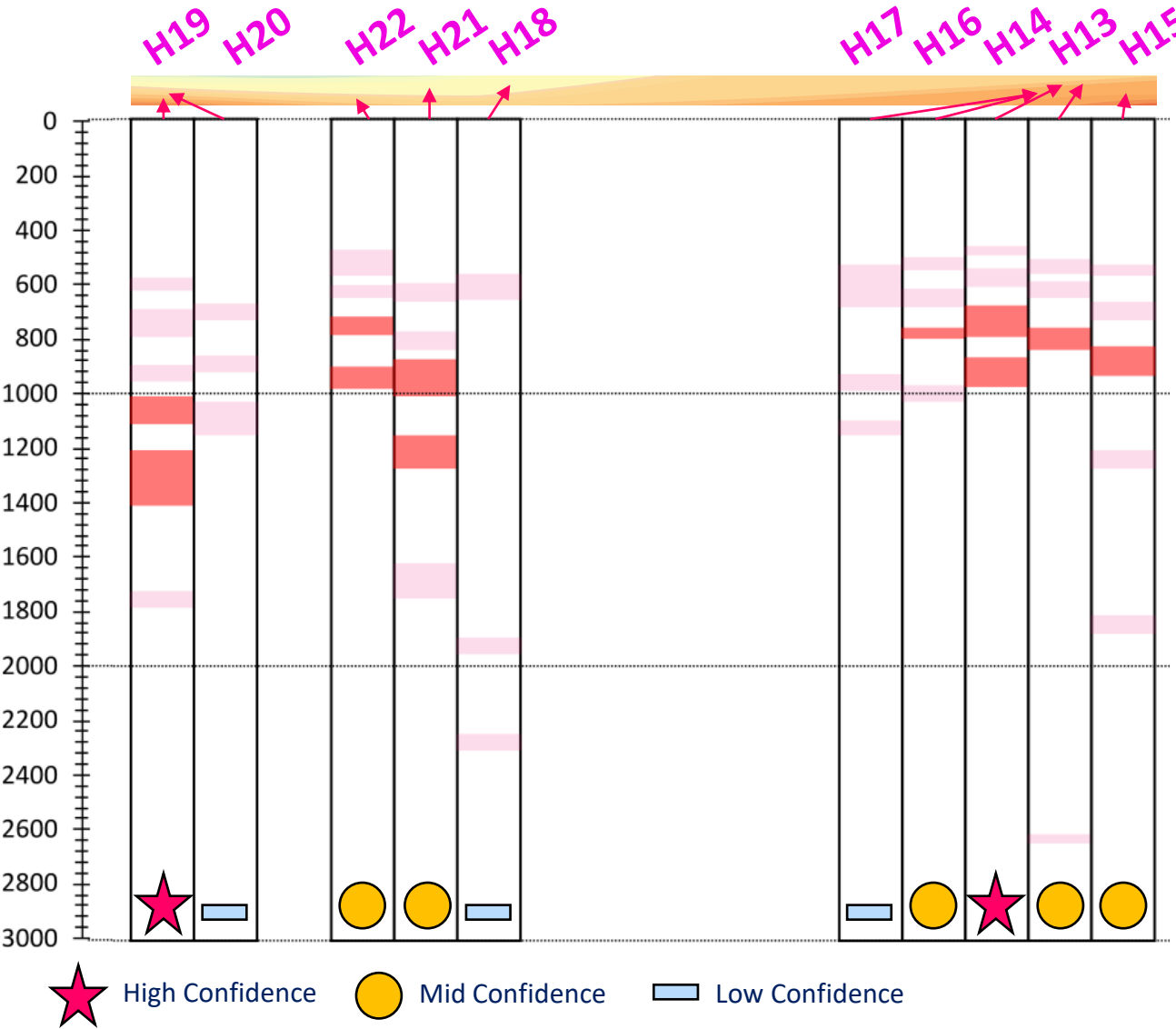


- 🌈 This is a panel cross-section in NE England, around Gainsborough. It shows how the Energy Gamma derived temperature prognosis changes eastwards.
- 🌈 Firstly, the ADR results show medium confidence, but then as it approaches Gainsborough, located in a thermal high, the confidence increases. On the easternmost site, the confidence reduces again. That location is not far away from a thermal low.
- 🌈 The prognosis closely matches the validation provided by the Busby et al, 2011 geothermal maps, as shown in the vectorized version of the Watson et al, 2021 maps.

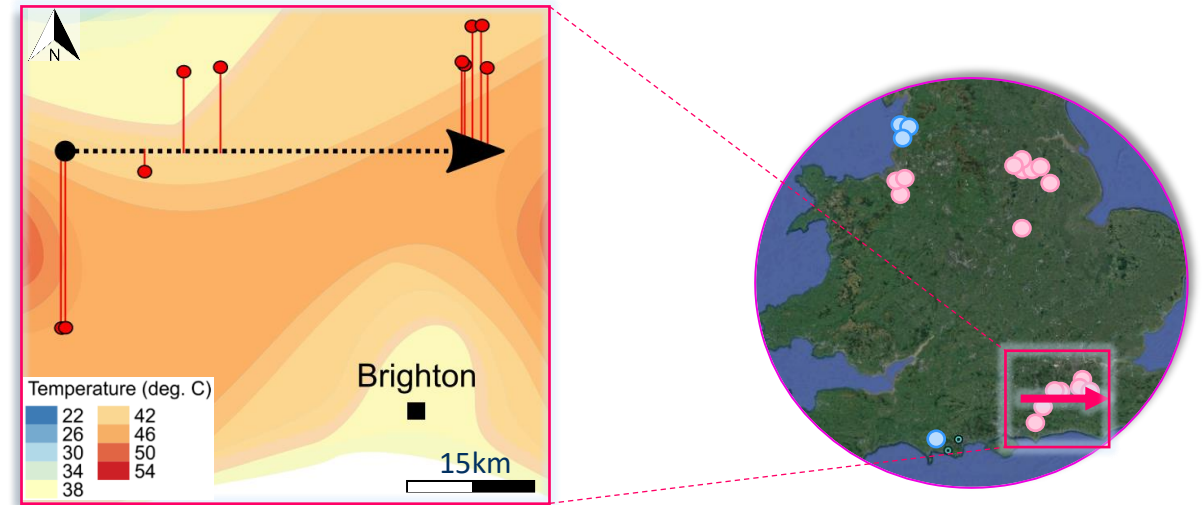


\*Map vectorized from Watson et al, 2021

# 4.2) Discussion: South England Panel



- ☀ This is a panel cross-section in SE England, north of Brighton. It shows how the Energy Gamma derived temperature prognosis changes eastwards.
- ☀ The location with highest confidence and greatest thermal prognosis is H19, and it's close to the thermal high in the model. H22 to H18 are closer to a northern thermal low, and have lower confidence in the ADR interpretation. For the western sites, as the sites approach a western thermal high, the confidence and thermal impact grow as well.
- ☀ The prognosis closely matches the validation provided by the Busby et al, 2011 geothermal maps, as shown in the vectorized version of the Watson et al, 2021 maps.

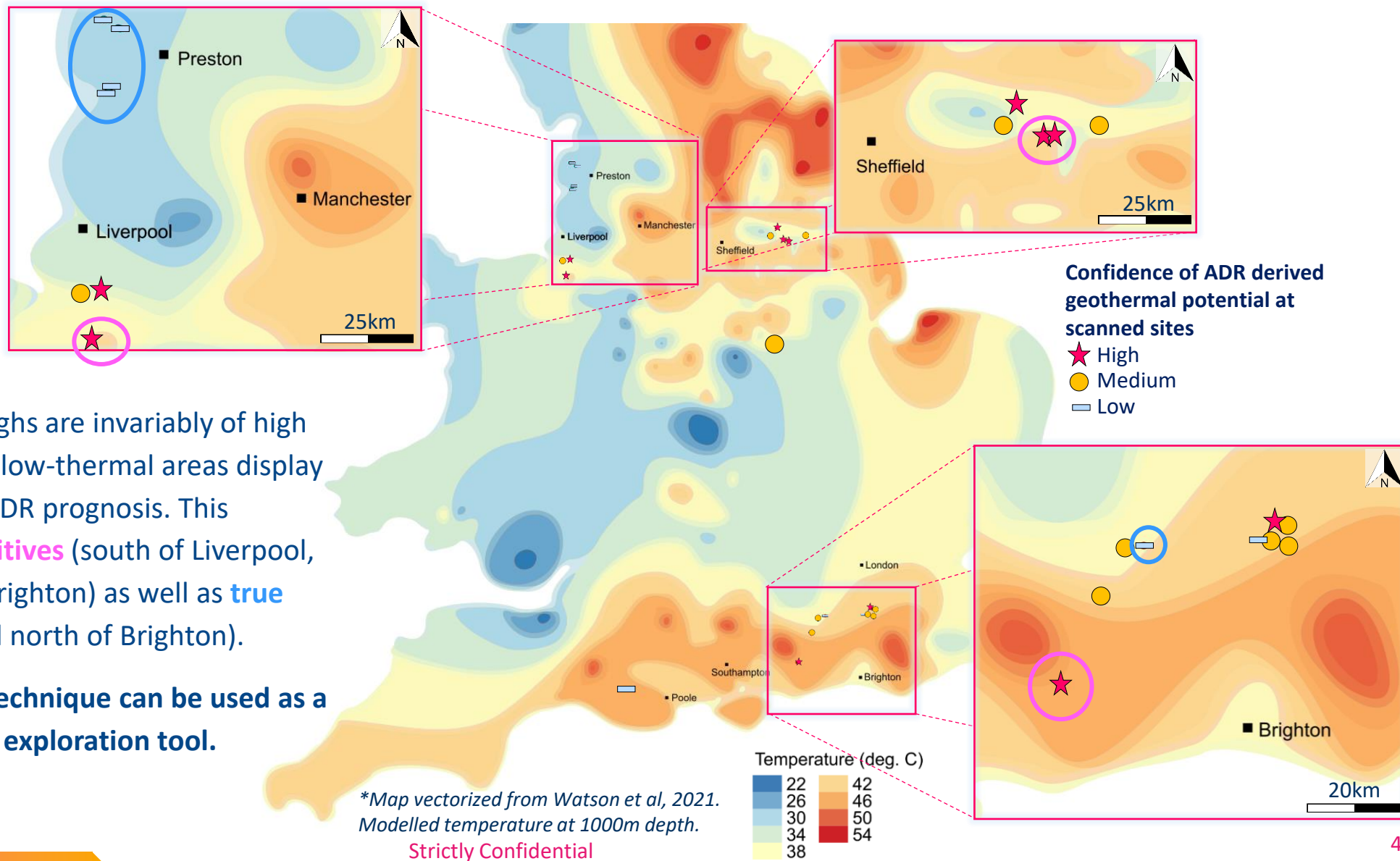


# 5.1) Conclusions: ADR Geothermal Assessment

Considering the ADR prognosis into a regional scale in context with the thermal model at 1000m depth (Watson et al, 2021), we can see strong correlation.

Sites near the thermal highs are invariably of high confidence, while sites in blue low-thermal areas display much less confidence on the ADR prognosis. This provides examples of **true positives** (south of Liverpool, west of Sheffield and east of Brighton) as well as **true negatives** (around Preston and north of Brighton).

**The ADR thermal prognosis technique can be used as a regional geothermal exploration tool.**



## 5.2) Further Actions: How to market this?

🌈 These results confirm that the Energy Gamma attribute of the ADR signal can be used as a qualitative proxy of geothermal potential. There are two aspects to this prediction:

**1) Thermal Impact:** Provides an indication of the depths at which the thermal impact is detected in the signal and its intensity. This depends on factors such as: Minimum value of the trough in the un-averaged E-Gamma log, general values for the moving average E-Gamma, width of the trough and amount of sub-troughs within it.

**2) Confidence in Prognosis:** Provides an indication of how confidently the signal is ascertaining the thermal impact. This depends on factors such as: Stabilisation level of E-Gamma, behaviour of the moving average or width of the trough.

🌈 Knowing this, we can be confident on marketing this tool for **onshore projects that require the application of a fast analysis technique to assess general geothermal potential across a wide area.**

- **Benefits:** Fast analysis, distinguishing between minor and major targets, multi-level confidence assessment.
- **Limitations:** Not quantitative, the depth and width of the troughs are still not directly related to the depth and width of the geothermal reservoir. As of now, unable to pick gentle geothermal gradients.