



ARE GROUND SOURCE ENERGY SYSTEMS CAUSING RISING GROUNDWATER TEMPERATURES IN CENTRAL LONDON?



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OVERVIEW



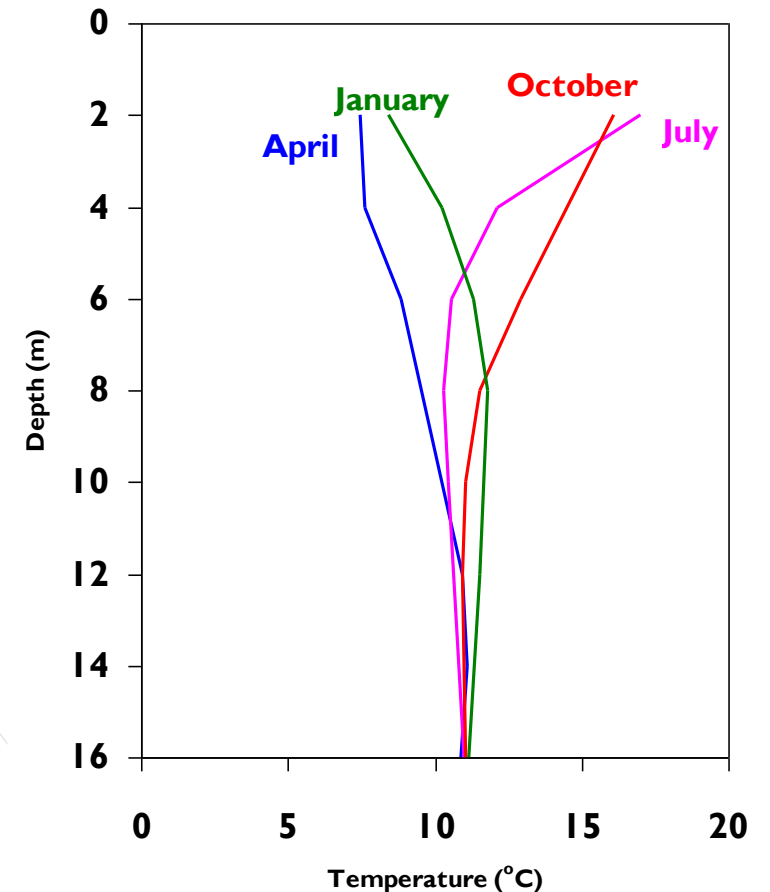
- Ground source energy systems (GSES) in UK
 - Why?
 - What?
- Why is this important?
- GW are temps rising due to GSES - the null hypothesis
- Hypothesis testing – numerical modelling
- Rejecting the null hypothesis
- So, what is actually going on?





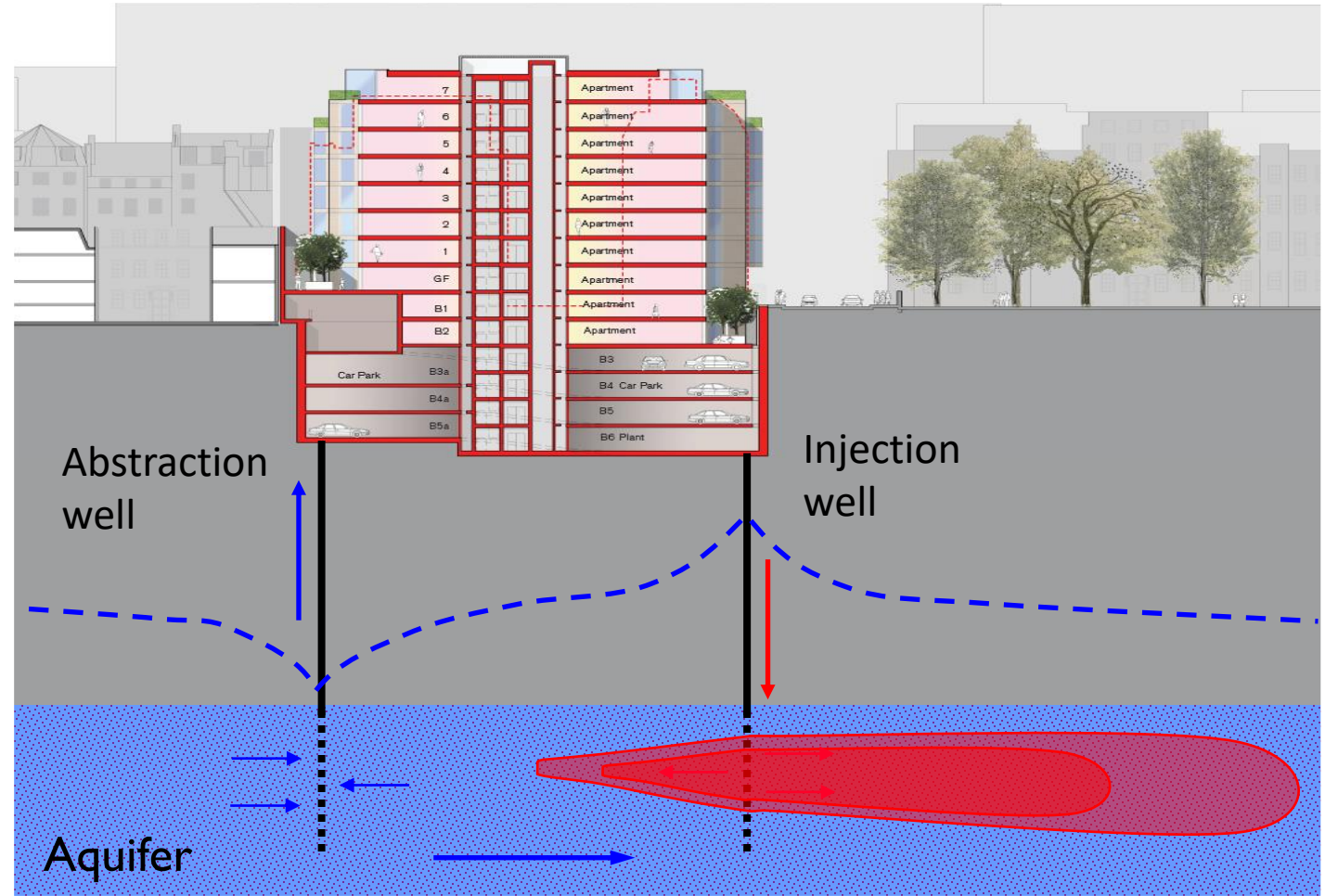
WHY GROUND SOURCE ENERGY SYSTEMS?

- Commitment to GHG reductions
- Decarbonisation of building heating
- GSES efficiency > ASHP efficiency
 - Temperature stabilises with depth
 - Ground temperature > air temperature in winter
 - Ground temperature < air temperature in summer





OPEN LOOP CONCEPT

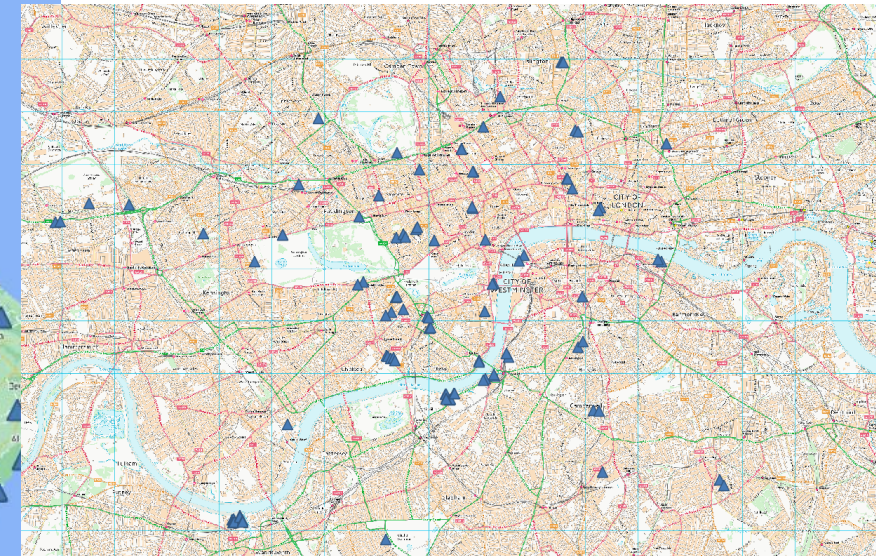


Natural groundwater flow



GROUND SOURCE ENERGY SYSTEMS IN THE UK

- KSL do a range of studies
- Large number installed in the UK
- ~ 45 installed in Central London
- What impact might this have on groundwater temperatures?

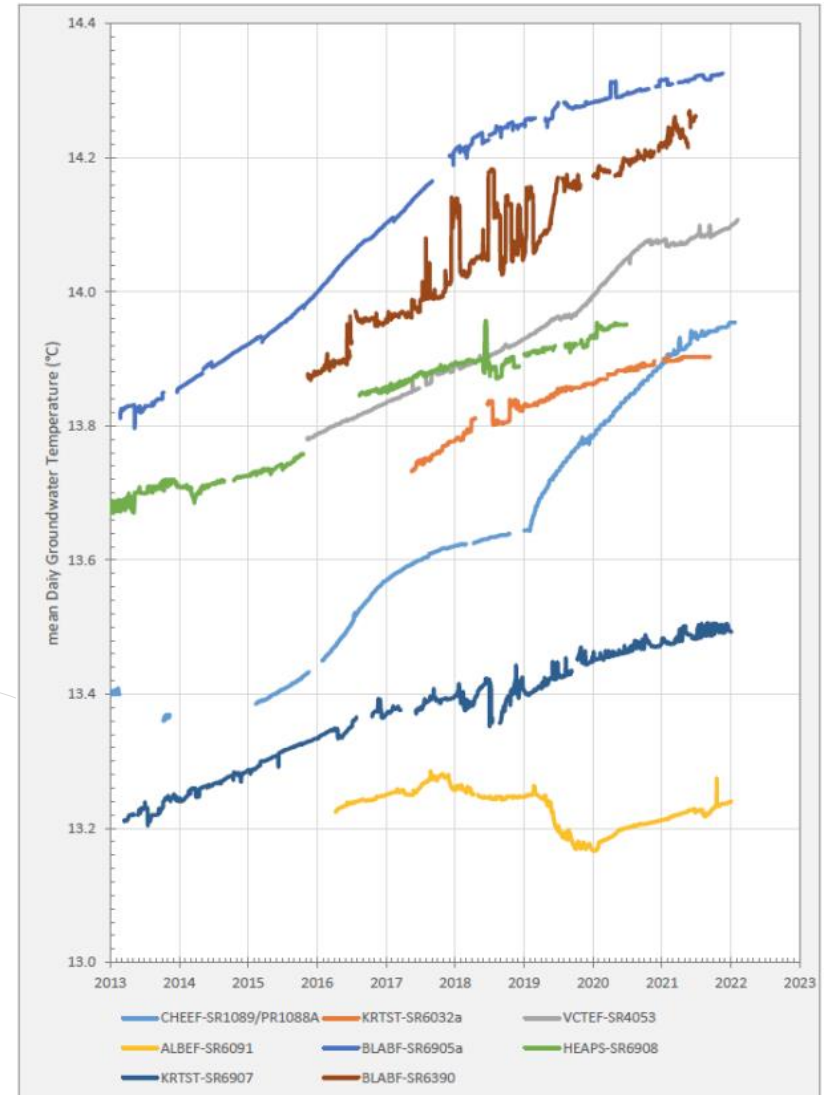




HYPOTHESIS TESTING

- Evidence of elevated GW temperatures
 - GSES investigation by KSL
 - Environment Agency (EA) 2022 report
- Use hypothesis testing
- Null hypothesis:

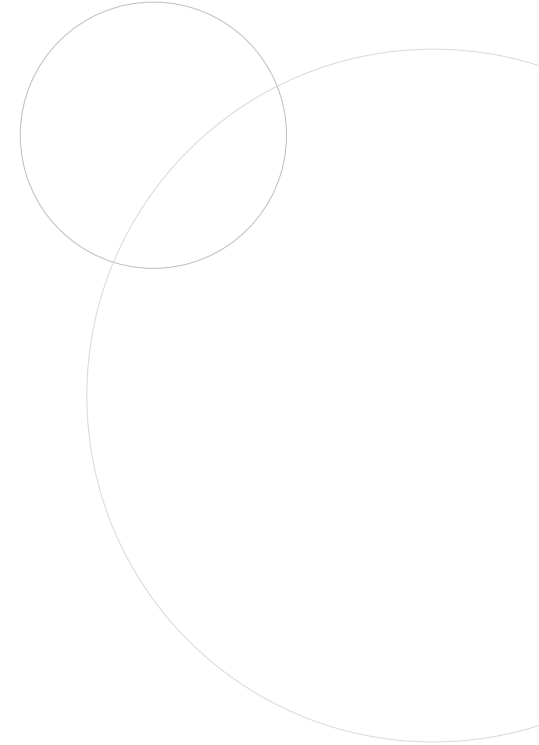
Groundwater temperatures are rising in Central London due to ground source energy systems





WHY IS THIS IMPORTANT?

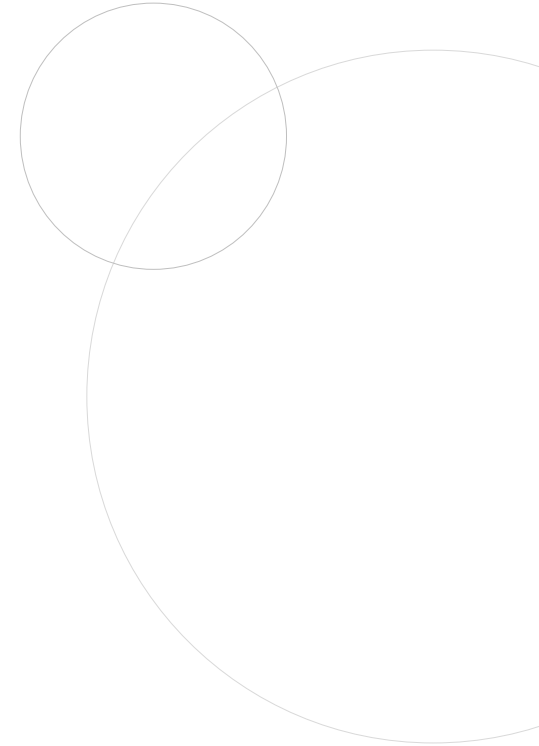
- EA assumed correlation = causation
- Advising not to use aquifer
- Outcomes:
 - Reduce use of the aquifer
 - A valuable low CO₂ energy source
 - Mismanagement of resource
 - Disservice to environment and people
 - Climate change action & solutions





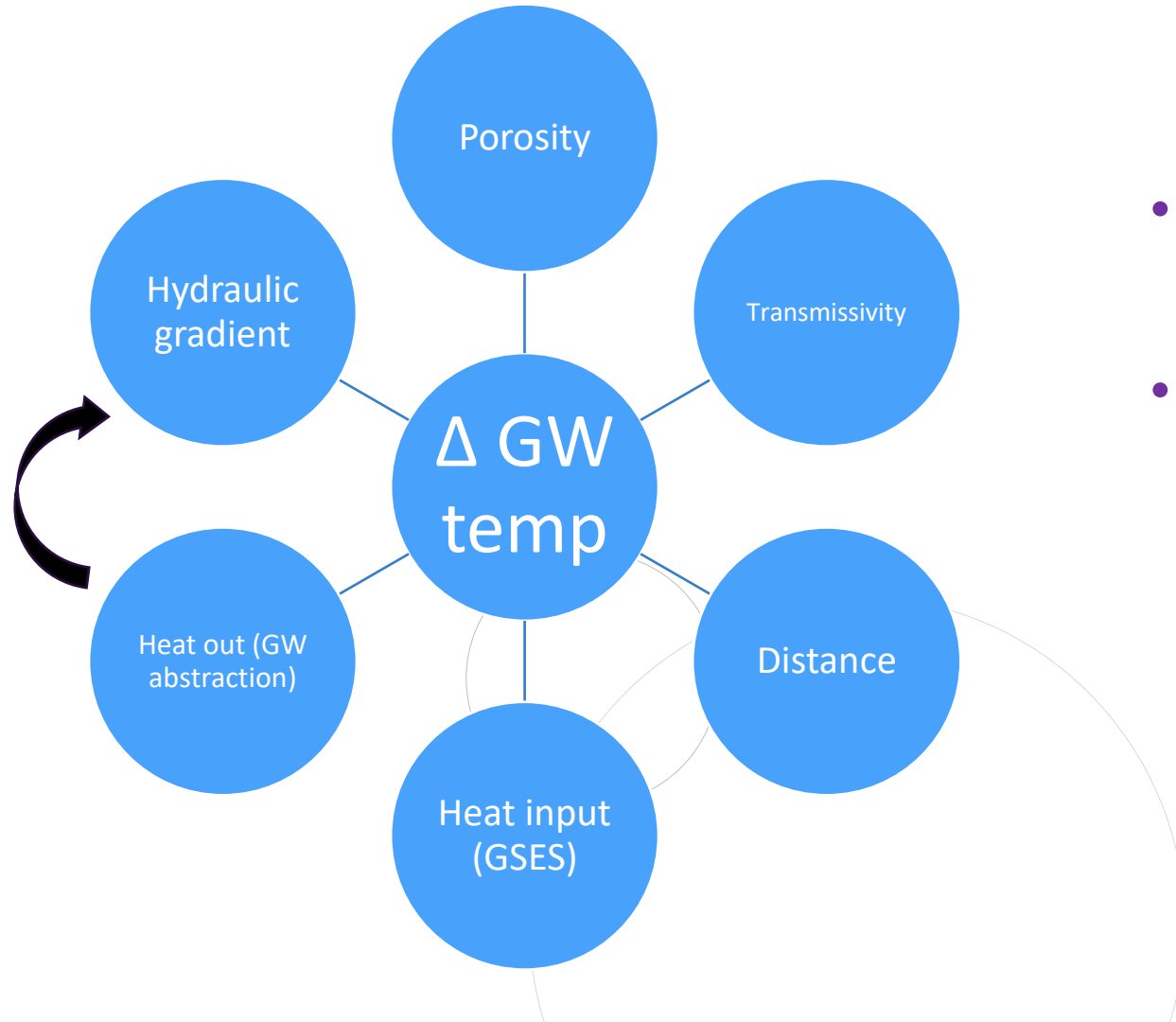
METHODOLOGY OVERVIEW

- Analysed & modelled:
 - GW temperature data
 - GWL data
 - Measured abstraction & heat discharge data
- 3D numerical modelling using FeFlow
- Correlation analysis
- Compared observational data with modelled results





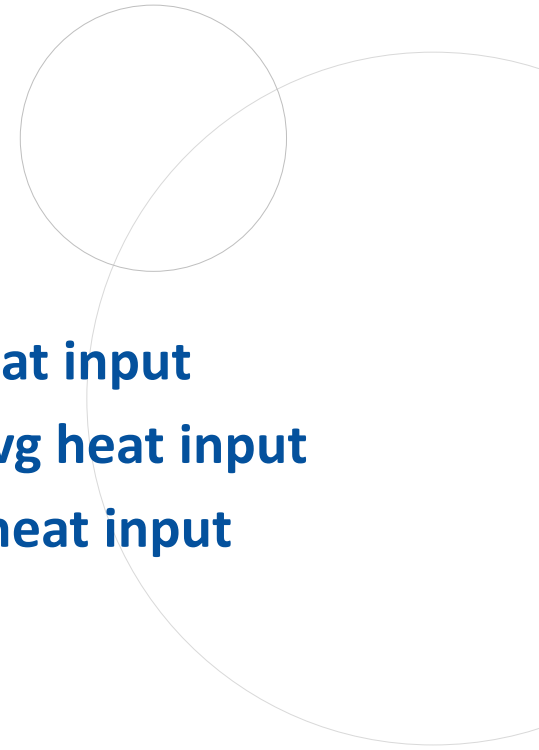
METHODOLOGY



- Analysed data
- Inputs into the numerical model



METHODOLOGY



- 3D numerical modelling scenarios:
 - High heat discharge + low abstraction = **high heat input**
 - Middle heat discharge + middle abstraction = **avg heat input**
 - Low heat discharge + high abstraction = **lower heat input**
 - Transmissivity range
 - 10-year simulations



RESULTS

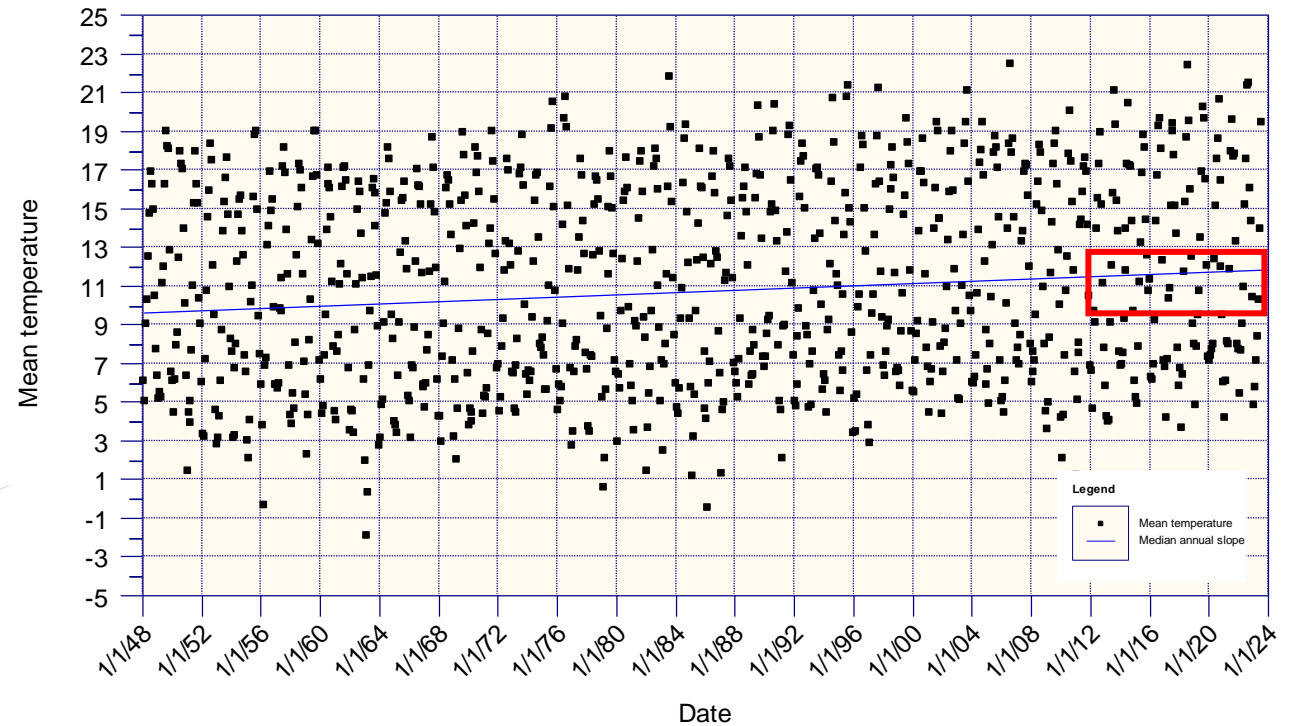
- No evidence that rising groundwater temperatures in Central London relate to GSES heat rejection
- Reject the null hypothesis

~~Groundwater temperatures are rising in Central London due to ground source energy systems~~



FUTURE WORK

- Assumptions
- Redo the modelling with more data from third-party schemes (underway)
- What is causing groundwater temperatures to rise?
 - Climate change
 - Reduced abstraction & recovering GWLs





ACKNOWLEDGMENTS

- Thank you to Zeb Etheridge & Iain Howley
- Any questions?

