

OR/19/052 Appendix 3b - Array 2 Borehole descriptions

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Kingdon, A, Fellgett, M W, and Spence, M J. 2019. UKGEOS Cheshire Energy Research Field Site - Science infrastructure. *British Geological Survey Internal Report*, OR/19/052. *Contributors*: Midgley, J, Elsome, J W, Dearden, R A, Chapman, C, Burke, S P, Hough, E, Luckett, R R, and Bianchi, M.

Table 10 Array 2 Summary borehole metadata and planned sampling.

Array 2: Seismic Baseline

Scientific Objective:	Seismic monitoring network that detects very small earthquakes (-0.6 to -1.0 Magnitude)
No of Sites	10 sites each with 1 borehole (some co-located with Array 1)
Expected Lithostratigraphy at TD	Sherwood Sandstone Group (Triassic)
Boreholes per site	1 per site: 7 x 200 m deep, 3 x 300 m
Casing Installed	PVC casing
Expected end use	Seismometers/sensors installed in boreholes then sealed
Samples available during drilling	Drill cutting collected sporadically
Cored Boreholes	4 x 200 m boreholes also cored
Geophysical logs	3 x 300 m, 7 x 200 m boreholes: Gamma-Ray - Caliper (Borehole diameter)
Geomicrobiology sampling	Standard geomicrobiology sampling protocol: 1 sample per 10 m of core in cored boreholes
Gas testing during drilling	Boreholes not equipped for gas testing
Fluid testing during drilling	None planned
Fluid Testing Post Drilling	None planned
Pump Testing	None planned
Permanently installed equipment	10 seismometers installed in boreholes then sealed, 3 x DAS fibre optics

The purpose of the proposed seismic array is to establish a new seismic monitoring network which will allow researchers to get an improved understanding of the seismic activity within the Cheshire Energy Field Research Site (CERFS) area. These data will form the natural baseline against which future seismic activity will be compared and contrasted.

Monitoring components of array 2

The baseline seismic monitoring array will consist of 13 seismic sensors in 10 boreholes with an average spacing of 1 km, along with three strings of fibre optic cables configured for distributed acoustic sensing (DAS). These are distributed across a 4 km by 4 km area, centred on the proposed zone of subsurface anthropogenic activities in the Ince Marshes area, and the defining geological structure of the area. An additional seismometer will be installed at the base of the 'Deep Well' (Array 03). The components parts of the array are:

- 3 boreholes, each with a planned total depth (TD) of 300 metres dependent on drilling conditions. Each borehole will be instrumented with two seismometers, one at 200 metres and one at 300 metres depth. All of these 300 metre boreholes will have fibre optic cables installed on the outside of the casing, which will be used for Distributed Acoustic Sensing (DAS) applications.

- 7 boreholes, each with a planned total depth of 200 metre dependent on drilling conditions, instrumented with one seismometer at 200 metre.
- 1 seismometer to be installed at the base of the Array 3 1200 metre deep borehole.

Each seismometer (Guralp Radian broadband) will record 3-component acceleration data at 1000 Hz. This data will be transmitted in real time using Guralp's GCF protocol to be archived at the BGS. Complimentary metadata will be maintained as part of the archive. The installed fibre optic cables will provide the facilities for future DAS measurements/interrogation to take place. The DAS unit will be supplied externally, and will not be installed on site.

Table 11 Array 2 List of borehole codes and site locations (Cored borehole in Bold).

Location	200 m	300 m	Cored
SITE D	TH0204		
SITE E		TH0215	
SITE F	TH0218		
SITE H	TH0202		Yes
SITE I	TH0209		Yes
SITE J		TH0210	
SITE K	TH0212		Yes
SITE L		TH0214	
SITE M	TH0216		Yes
SITE N	TH0220		

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