

A city scale 3D geological model to support ground source heat recovery and storage

James, L.R.⁽¹⁾, Kendall R.S.⁽¹⁾, Patton, A.M.⁽¹⁾ Thorpe, S.⁽²⁾, Farr, G.⁽¹⁾, Boon, D.⁽²⁾, Holden, A.⁽¹⁾

(1) British Geological Survey, Cardiff University, Main Building, Park Place, Cardiff. UK (2) British Geological Survey, Keyworth, Nottingham UK.

1. Introduction

The Cardiff Urban Geo Observatory was established to characterise, monitor and model groundwater and heat flow in a shallow urban aquifer. Mapping showed that shallow ground groundwater temperatures exceeded 15°C, due to effects of the subsurface urban heat island (Farr *et al*, 2017).

A 3D model of the superficial deposits was created to better understand the aquifer dimensions and as a framework for a hydrogeological heat flow model.

2. Creating cross-sections

- 142 cross-sections constructed to form a fence diagram over the most densely populated areas of the city using Geological Surveying and Investigation package (GSI3D) software.
- Geologists interpreted the geological succession using 1269 borehole records and surface geological mapping.
- The model demonstrates the main superficial deposits in Cardiff, which include till, alluvium, tidal flat deposits and glaciofluvial sheet deposits.
- The most significant aquifer for this project are the glaciofluvial sheet deposits, which were deposited in meltwater streams after glacial retreat in the Late Devensian.
- The glaciofluvial deposits, because of their relatively high porosity and permeability are thought to host much of the warmer water beneath the city centre.

3. 3D Model

The construction of the 3D model predicts where these sand and gravel deposits occur beneath the city, indicating the potential for other GSHP systems to be installed in the city, where the heat from the shallow groundwater can be harvested and exploited.

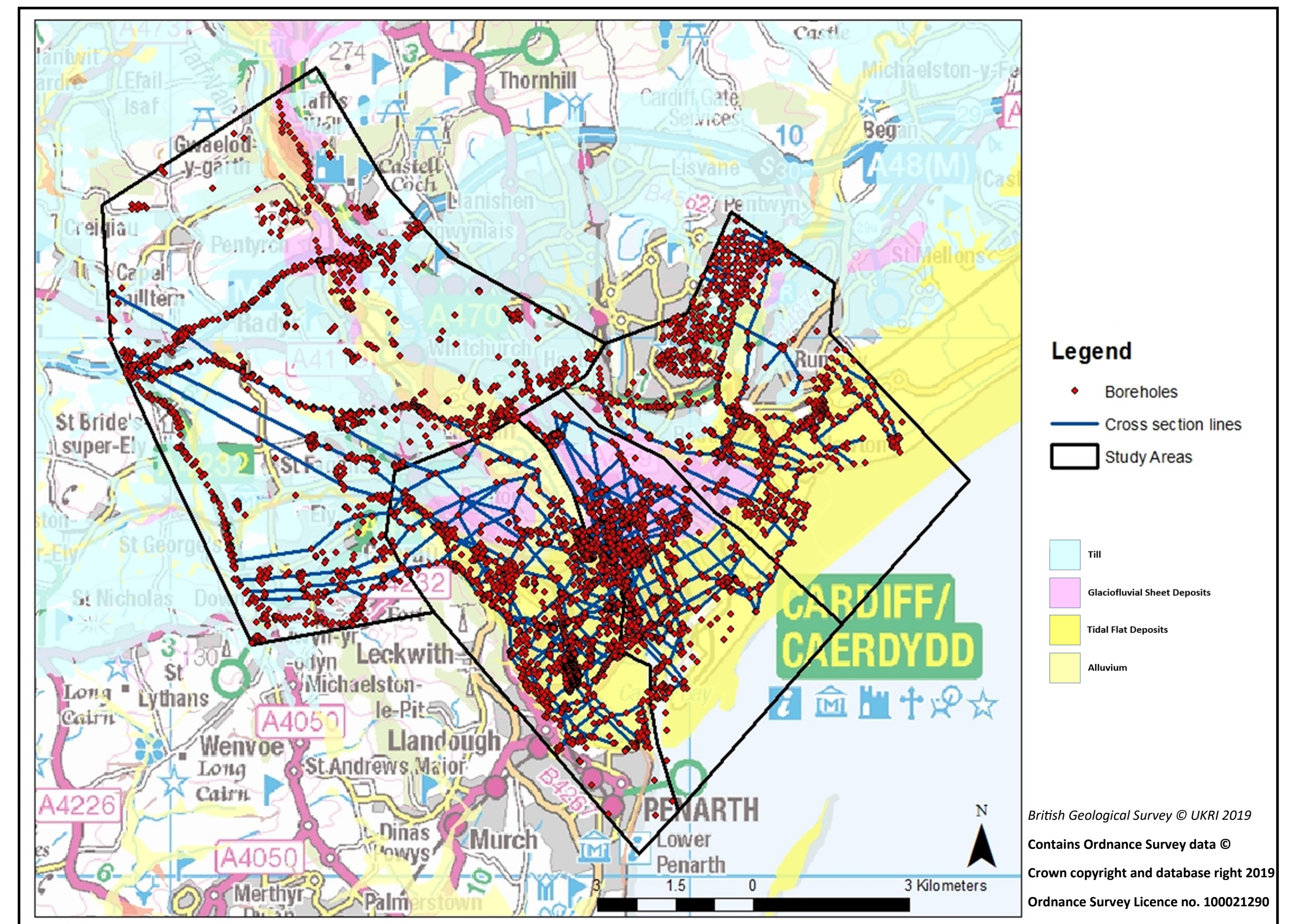


Figure 1: Map showing cross section lines and borehole positions in the study area

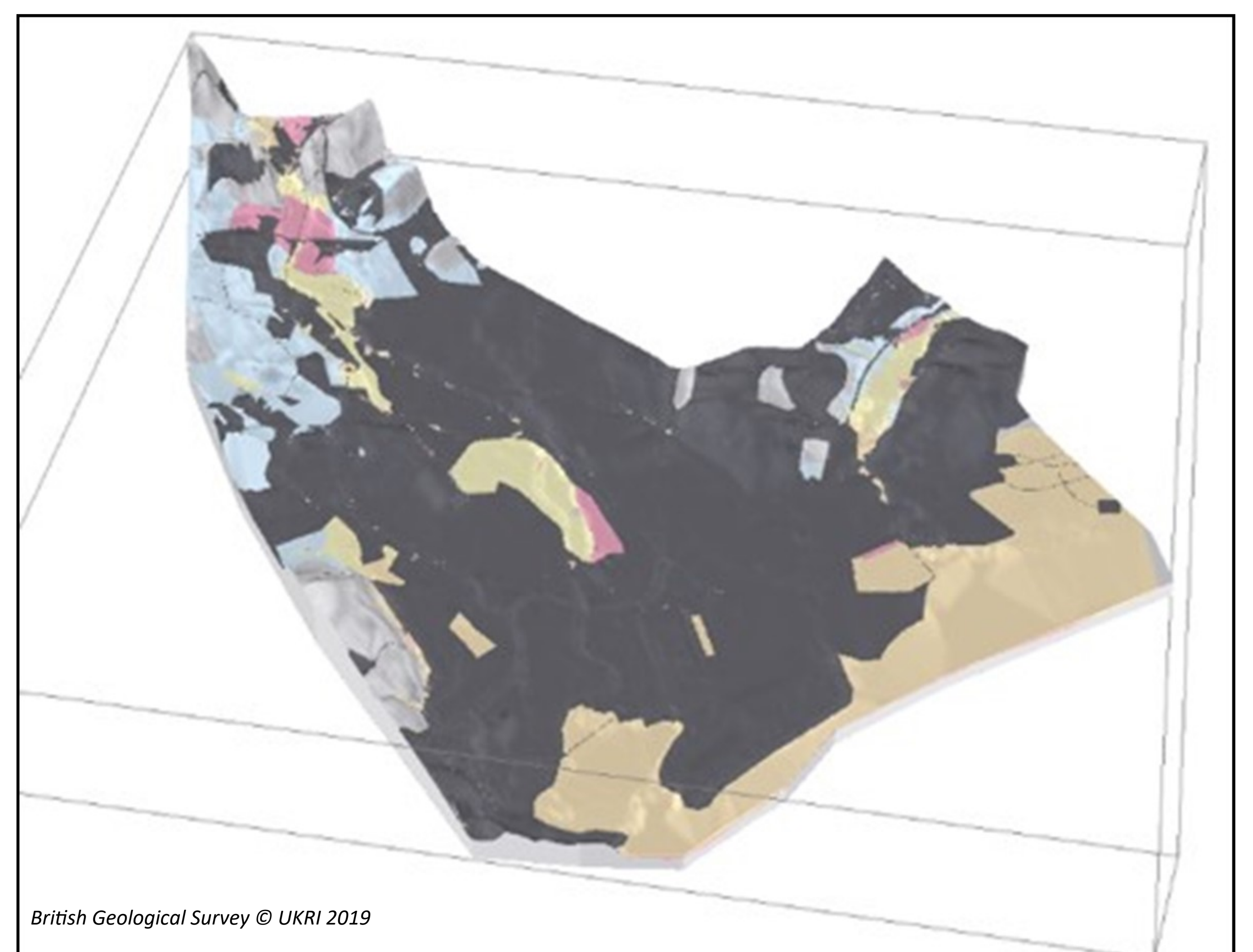


Figure 2: View of the Cardiff Superficial 3D Model looking across harbour to the north.

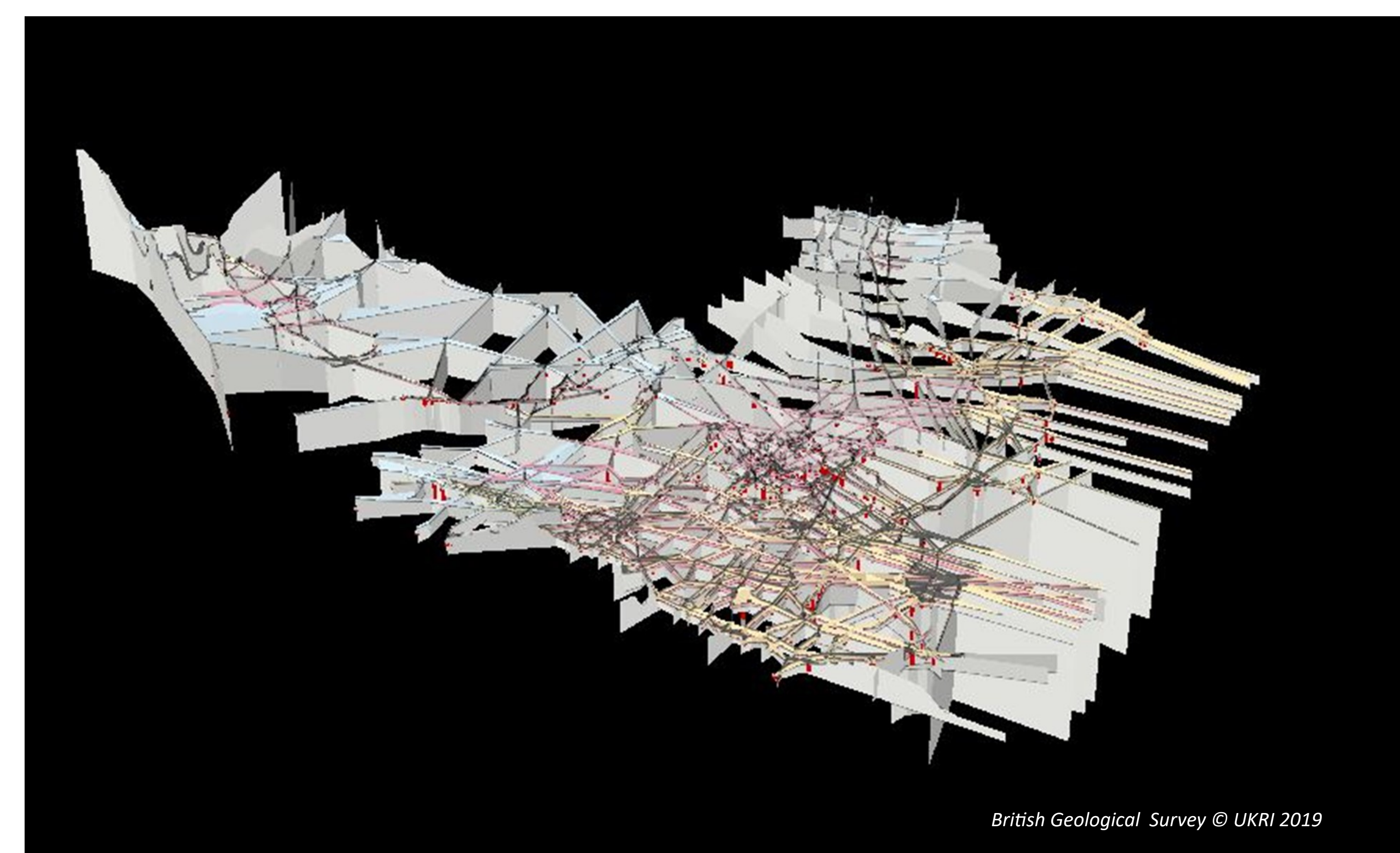


Figure 4: Fence diagram of cross sections across the study area

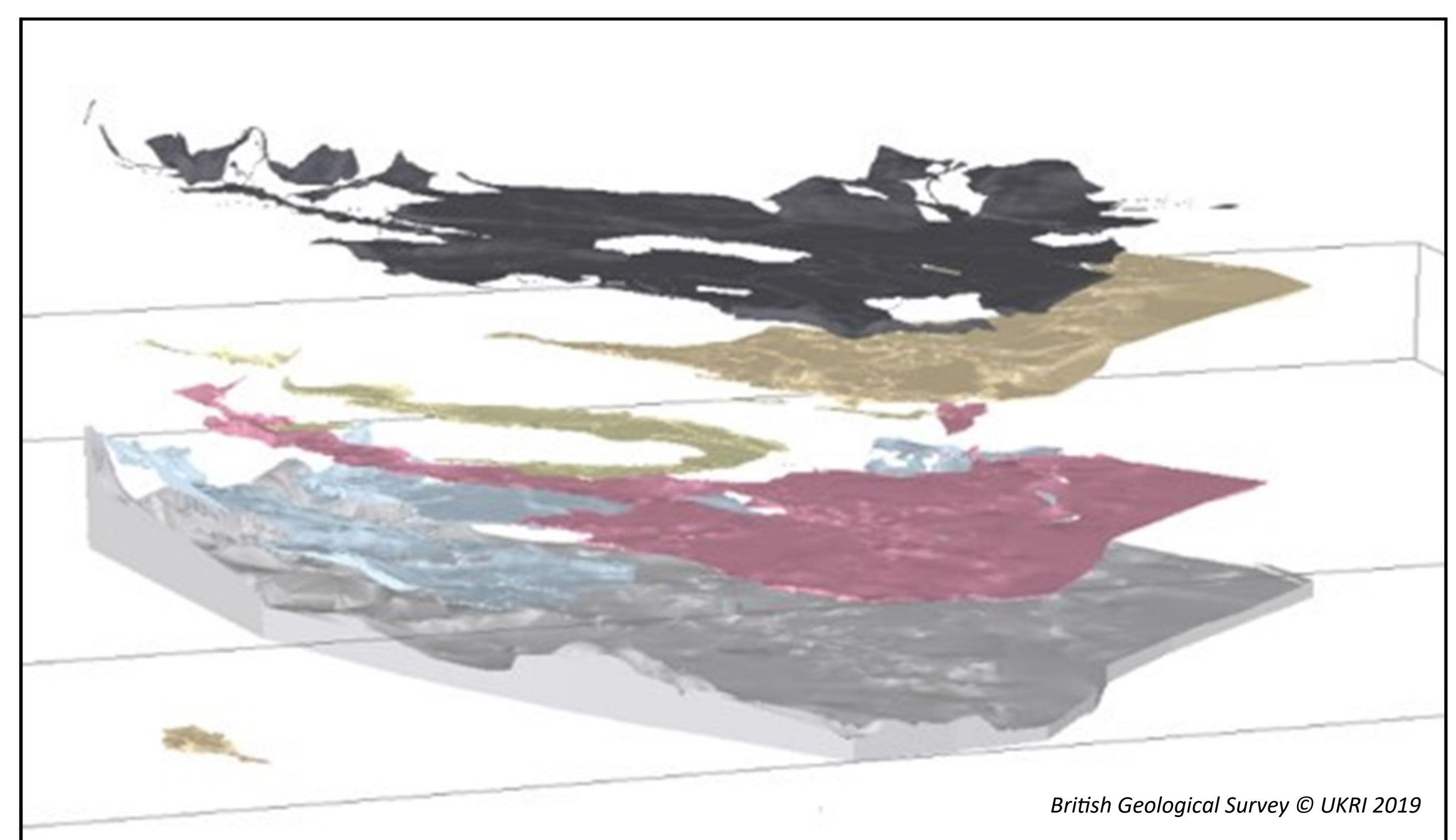


Figure 3: View of the exploded modelled units, viewed from the southwest corner looking eastwards.