Connah's Quay Low Carbon Power

Environmental Statement Volume IV
Appendix 13-E: Hydrogeological Assessment

Planning Inspectorate Reference: EN010166
Document Reference: EN010166/APP/6.4
Planning Act 2008 (as amended)
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 - Regulation 5(2)(a)
Revision 00

August 2025

Prepared for:
Uniper UK Limited

Prepared by:
AECOM Limited

Table of Contents

Tables

1. Hydrogeological Assessment

1.1.1 This supporting document has been produced to provide further assessment associated with dewatering and drawdown during the construction works. This assessment is not a standalone document and should be read in conjunction with the impact assessment in **Environmental Statement (ES) Chapter 13: Water Environment and Flood Risk** (**EN010166/APP/6.2.13**). This hydrogeological assessment is based on the information available at the time of writing, July 2025.

1.2 Excavation design

1.2.1 Design details for earthworks and excavation will be developed during the detailed design stage. At present, specific excavation details are not available, however, it is anticipated that shallow excavations (typically around 1.2 m below ground level m bgl) associated with the pipelines, utilities connections or cut-and-fill are likely to take place within the Main Development Area and Proposed CO_2 Connection Corridor. No deep excavations are anticipated.

1.2.2 A piled foundation may be needed for certain components, e.g. absorber stack, Heat Recovery Steam Generator (HRSG), and turbine hall, which may be constructed using continuous flight auger (CFA) or bored piling techniques. Piling design will also be carried out during detailed design stage and include method statements, informed by a Foundation Works Risk Assessment (FWRA). The requirements for this are set out in the **Framework Construction Environmental Management Plan** (**CEMP**) (**EN010166/APP/6.5**). The FWRA would include soil and groundwater pollution prevention measures. A FWRA must be approved by the local authority following submission, and after engagement with Natural Resources Wales. All piling and penetrative foundation work must comply with the approved method statements in order to prevent contamination of the groundwater and underlying soils.

1.2.3 The assessment is based on the construction details outlined in **Chapter 5: Construction Management and Programme** (**EN010166/APP/6.2.5**).

1.3 Geological summary

1.3.1 Details on geology can be found in **Appendix 13-A: Water Environment Baseline Survey and Methodology Report** (**EN010166/APP/6.4**), **Appendix 14-A: Geo-Environmental Desk Based Assessment** (**EN010166/APP/6.4**) and **Appendix 14-F: Tier 2, Stage 1 Generic Risk Assessment: Soil and Groundwater** (**EN010166/APP/6.4**).

1.3.2 A summary of the geology within the Main Development Area is as follows:

- Made Ground up to 3 m in thickness comprised of: clay, pulverized fuel ash (PFA), clayey sand and gravel and the occasional brick and concrete layers;
- Tidal Flat Deposits up to approximately 20 m bgl comprised of unconsolidated silts, sands and clays; and
- Underlain by the following bedrock formations: Pennine Lower Coal Measures, Gwespyr Sandstone Formation and Etruria Formation.

1.3.3 A summary of the geology within the Proposed CO_2 Connection Corridor is as follows:

- Glaciofluvial Deposits up to 4 m in thickness comprised of sand and gravel;
- Glacial Till up to 15 m in thickness comprised of diamicton; and
- Underlain by Pennine Lower Coal Measures including the Pennine Lower Coal Measures sandstone formation outcrop.

1.3.4 The superficial deposits have been recorded to be greater than the depth of the excavations therefore it is likely the excavations would take place solely within the unconsolidated superficial deposits.

1.4 Hydrogeological summary

1.4.1 Details on hydrogeology can be found in **Appendix 13-A: Water Environment Baseline Survey and Methodology Report** (**EN010166/APP/6.4**).

1.4.2 The bedrock aquifers are unlikely to be intercepted by the excavations and are therefore omitted from the assessment hereafter.

1.4.3 Made Ground is not designated as an aquifer, however, due to the composition, it is likely to still hold and transmit limited water locally and therefore potential to cause groundwater ingress to excavations.

1.4.4 The Tidal Flat Deposits and Glacial Till are designated as Secondary Undifferentiated aquifers. These deposits are heterogenous and are typically comprised of a laterally discontinuous, interbedded layers and lenses of clays, silts and sands.

1.4.5 The glaciofluvial deposits are designated as a Secondary A aquifer and comprised of sands and gravels.

1.4.6 Groundwater flow within the Made Ground and superficial deposits will be through the relatively higher permeability layers (sands and gravels) and would be controlled by their interconnectivity and the presence of the lower permeability layers (clays and silts).

1.4.7 Groundwater level data within the study area is limited. Available groundwater levels indicate groundwater levels to be shallow and within 4 m of the ground surface and groundwater levels recording a tidal fluctuation of approximately 10 cm, see **Appendix 13-A: Water Environment Baseline Survey and Methodology Report** (**EN010166/APP/6.4**).

1.4.8 Three rising head tests were undertaken in the superficial deposits during the 2025 Ground Investigation (GI). The results can be found in **Appendix 13-A: Water Environment Baseline Survey and Methodology Report** (**EN010166/APP/6.4**).

1.4.9 Of the three permeability tests undertaken, two were successful providing the following hydraulic conductivity values: $8.54x10^{-07}$ m/s and $3.56x10^{-06}$ m/s.

1.5 Assessment

1.5.1 The drawdown radius (the Radius of Influence (ROI)) is defined as the maximum area within which the drawdowns can be detected. Schiardt's equation has been used to calculate the ROI (CIRIA C750).

Schiardt equation:

$$R_0 = Cs\sqrt{K}$$

Whereby:

R_o = Radius of influence

C= constant factor

s= drawdown

K= hydraulic conductivity

1.5.2 The input to Schiardt's equation can be found in **Table 1** and is based on the following:

- site-specific hydraulic conductivity values obtained during the 2025 GI for Main Development Area;
- literature values for hydraulic conductivity ranges for Glacial Till and Glaciofluvial deposits along the Proposed CO_2 Connection Corridor;
- the anticipated depth of the excavation being greater than 1.2 m. Calculations have been undertaken for two scenarios:
  - shallow scenario at 2 m (1.5 m deep excavation plus 0.5 m drawdown below the base); and
  - deeper scenario at 2.5 m (2 m deep excavation plus 0.5 m drawdown below the base); and
- assumed saturated aquifer thickness with groundwater level at ground surface.

Table 1: Input Parameters

Parameter	units	value	Justification
s	m	2	Shallow scenario (1.5 m deep excavation plus 0.5 m drawdown below the base).
		2.5	Deeper scenario (2 m deep excavation plus 0.5 m drawdown below the base).
C	-	3000	Constant factor (CIRIA C750).
k	m/s	$8.54x10^{-07}$	Minimum site-specific conductivity from 2025 GI within the Main Development Area.
		$3.56x10^{-06}$	Maximum site-specific conductivity from 2025 GI within the Main Development Area.
		$2\ x10^{-09}$	lower range literature value for Till and silt (Domenico and Schwartz 1990) Proposed CO_2 Connection Corridor.
		$2\ x10^{-07}$	mid-range literature value for Till and silt and lower end for sand (Domenico and Schwartz 1990) Proposed CO_2 Connection Corridor.
		$2\ x10^{-05}$	upper range literature value for fine to medium sands (Domenico and Schwartz 1990) Proposed CO_2 Connection Corridor.

ROI results

1.5.3 The calculated ROI can be found in **Table 2**.

Table 2: ROI Results

Excavation	Minimum ROI (m)	Average ROI (m)	Maximum ROI (m)
1.5 m deep excavation			
Proposed CO_2 Connection Corridor	0	3	27
Natural gas connection within the Main Development Area	6	n/a	11
2 m deep excavation			
Proposed CO_2 Connection Corridor	0	3	34

Natural gas connection within the Main Development Area	7	n/a	14

Impact Assessment

1.5.4 The impact assessment associated with drawdown and dewatering can be found in **Chapter 13: Water Environment and Flood Risk** (**EN010166/APP/6.2.13**).

Assessment summary

1.5.5 Proposed CO_2 Connection Corridor excavation and dewatering summary:

- the maximum ROI calculated for the Proposed CO_2 Connection Corridor is 34 m from the proposed excavation based on hydraulic conductivity for fine to medium sands to represent the glaciofluvial deposits as worst-case scenario. This assumes a maximum excavation of 2 m;
- glaciofluvial deposits outcrop on the very edge of the Proposed CO_2 Connection Corridor boundary and it is likely the pipeline would not be installed within these deposits but instead be installed within the lower permeability Till and Tidal Flat Deposits which would significantly reduce the ROI;
- the extent of the ROI would be controlled by the lateral extent and the connectivity of the more permeable deposits;
- water abstracted from the superficial deposits along the Proposed CO_2 Connection Corridor is likely to be fresh groundwater and recharged by infiltration of precipitation. It is unlikely, due to the shallow excavation depth, distance to the River Dee (over 450 m at its closest point), and the density of brackish/saline water, that brackish/saline water would be abstracted/drawn in during the dewatering process; and
- receptors within the ROI could potentially receive an impact from the dewatering undertaken for construction of the pipeline. However, this impact is likely to be temporary and of short-duration and therefore not considered to be significant.

1.5.6 The natural gas connection excavation and dewatering within the Main Development Area summary:

- the maximum ROI calculated for the natural gas connection within the Main Development Area is 14 m from the proposed excavation based on site specific hydraulic conductivity data. This also assumes a maximum excavation depth of 2 m;
- the extent of the ROI would be controlled by the lateral extent and the connectivity of the more permeable deposits;
- groundwater levels within the superficial deposits underlying the Main Development Area are typically within 4 m of the ground surface and show varied response to tidal fluctuations ranging from <2 cm up to c.10

cm. Although the superficial deposits are likely to be in hydraulic continuity with the River Dee, the shallow groundwater encountered during excavation is likely to be recharged by infiltration of precipitation and flow of fresh groundwater from up hydraulic gradient; and

- receptors within the ROI could potentially receive an impact from the dewatering undertaken for construction of the natural gas connection however, this impact is likely to be temporary and of short-duration and therefore not considered to be significant.

References

Ref 1. Domenico, P.A. and F.W. Schwartz, 1990. *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

Ref 2. CIRIA C750, 2016, Groundwater control: design and practice, second edition.