The UK subsurface microbial limits database: a screening tool for safe geological storage

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UK subsurface microbial limits database

Why is microbial activity a concern?

Microbial activity in carbon dioxide (CO_2) or hydrogen (H_2) storage sites has the potential to affect operation through consumption of stored fluids, production of contaminants, blockage of flow paths or microbiologically influenced corrosion.

The database and maps

As part of the NERC-funded MOET (Managing the Offshore Energy Transition) project, a tool has been developed to aid microbial risk assessment at potential storage sites (containing ~800 potential offshore storage units and 35 onshore units) including saline aquifers and oil and gas fields.

Risk rating for a range of environmental parameters were estimated based on a literature review (Table 1).

An overall risk rating for each site was calculated based on temperature, salinity, pH, permeability, porosity values. Risk ratings were displayed on a map of the UK (Figure 1)

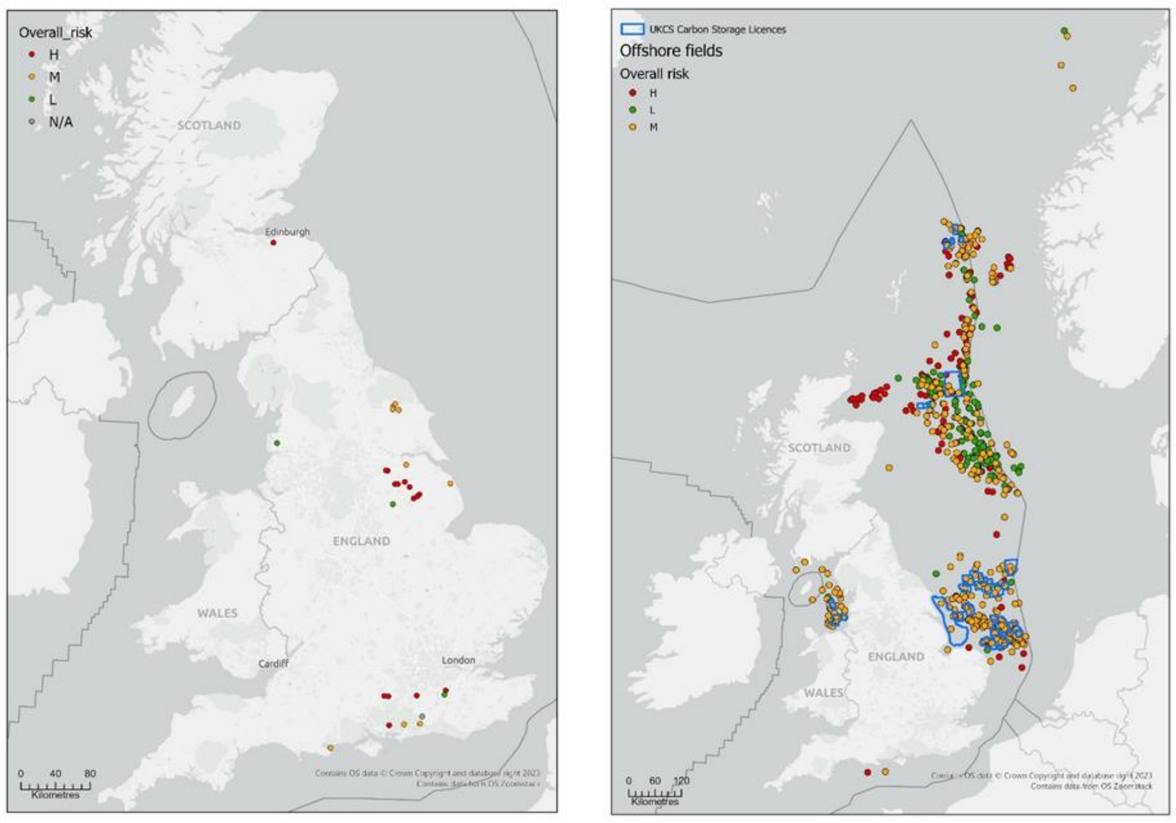


Figure 1. Maps of UK Onshore (left) and Offshore (right) subsurface site locations and their overall risk rating for microbial activity. H=high risk (red), M=medium risk (amber), L=low risk (green), 'N/A'=unrated risk due to insufficient data.

Table 1. Limits used for identifying microbial risks

The lowest risk rating for temperature, salinity, pH permeability, porosity and permeability determines the overall risk.
Pressure and sulphate concentration were not used to determine overall risk ratings

	High risk	Medium risk	Low risk
Temperature (°C)	< 80	80 – 122	> 122
Salinity (mg/L)	< 120,000	120,000 – 520,000	> 520,000
Pressure (MPa)	< 10	> 10	
pH	5 – 9	< 5 9 - 13.2	> 13.2
Permeability (mD)	> 0.1		< 0.1
Porosity (fractional)	> 0.1		< 0.1
Sulphate concentration (mg/L)	> 20	< 20	

Interactive tool

As wells as the maps of overall risk, an interactive tool (Figure 2) to look at specific fields will soon be available through the MOET website

Users can look up risk ratings for individual sites of interest to identify which environmental variables affect the risk of microbial activity occurring

A risk statement is produced for each risk rating describing the expected impact on microbial activity

Available data on gas compositions from the site are also reported

The database and interactive tool can be used as part of a screening process when planning hydrogen or carbon dioxide storage to assess the likelihood of microbial activity

It also highlights those sites where further data or research is required to reduce any uncertainties about the potential for microbial activity before planning storage activities

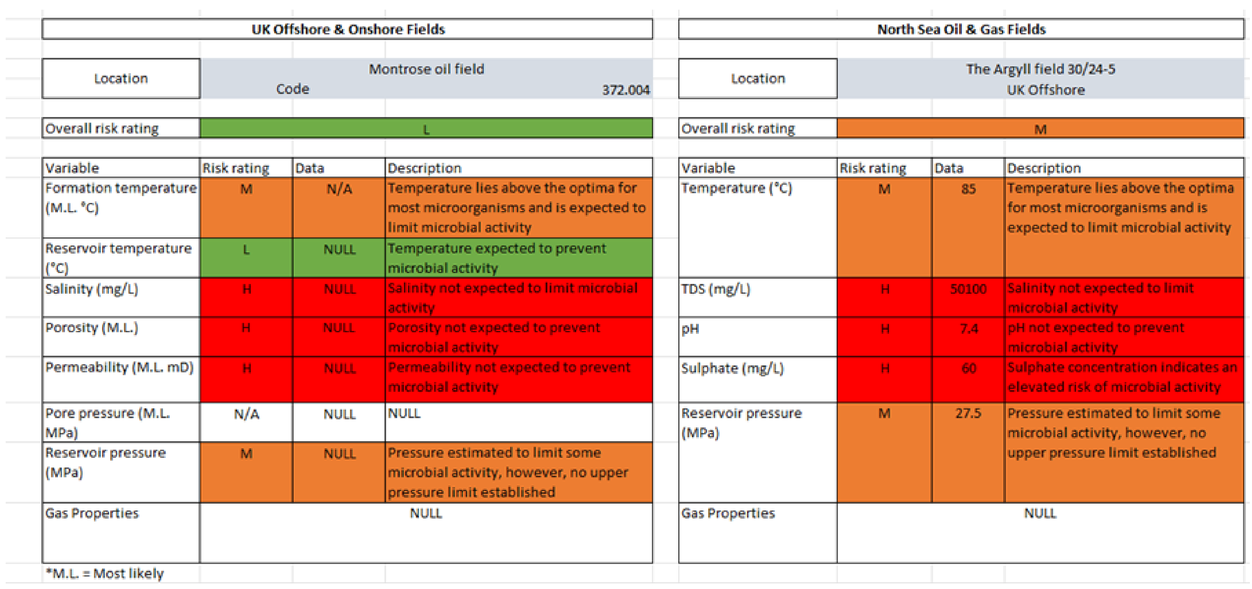
Database summary

~57% of the onshore units and ~12% offshore units were rated as having a high risk of microbial activity

~9% of onshore and ~23% offshore units were rated as having a low risk of microbial activity

Further investigation is recommended for the remaining units to fully assess the likelihood of significant microbial activity occurring

Together, this provides useful information for preliminary assessments of microbial risks and the suitability of specific sites for H_2 and CO_2 storage



UK Offshore & Onshore Fields

Location	Montrose oil field
Code	372.004
Overall risk rating	L

Variable	Risk rating	Data	Description
Formation temperature (M.L. °C)	M	N/A	Temperature lies above the optima for most microorganisms and is expected to limit microbial activity
Reservoir temperature (°C)	L	NULL	Temperature expected to prevent microbial activity
Salinity (mg/L)	H	NULL	Salinity not expected to limit microbial activity
Porosity (M.L.)	H	NULL	Porosity not expected to prevent microbial activity
Permeability (M.L. mD)	H	NULL	Permeability not expected to prevent microbial activity
Pore pressure (M.L. MPa)	N/A	NULL	NULL
Reservoir pressure (MPa)	M	NULL	Pressure estimated to limit some microbial activity, however, no upper pressure limit established
Gas Properties	NULL		

*M.L. = Most likely

North Sea Oil & Gas Fields

Location	The Argyll field 30/24-5 UK Offshore
Overall risk rating	M

Variable	Risk rating	Data	Description
Temperature (°C)	M	85	Temperature lies above the optima for most microorganisms and is expected to limit microbial activity
TDS (mg/L)	H	50100	Salinity not expected to limit microbial activity
pH	H	7.4	pH not expected to prevent microbial activity
Sulphate (mg/L)	H	60	Sulphate concentration indicates an elevated risk of microbial activity
Reservoir pressure (MPa)	M	27.5	Pressure estimated to limit some microbial activity, however, no upper pressure limit established
Gas Properties	NULL		

Figure 2. Prototype of interactive tool for interrogating database for individual sites

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MOET website: www.projectmoet.org

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