North Sea Transition Authority

Appraisal and subsurface characterisation

Carbon Storage Stewardship Expectation 2

September 2025

1. Expectation

The North Sea Transition Authority ('NSTA') expects that Carbon Dioxide Appraisal and Storage Licence ('CS Licence') holders will complete appraisal and site characterisation in a timely and appropriate manner.

This means CS Licence holders should:

1.1 Manage their appraisal activities, including work programme commitments, to ensure they have acquired, reviewed, and analysed the appropriate data and information needed to properly characterise the storage site, complex and surrounding area in accordance with Annex I of EU Directive 2009/31/EC[1] ('**Annex 1**').

1.2 Do this in such a way that fully supports the evaluation of risks to containment, capacity, injectivity and monitorability.

1.3 Do so on a timeline and at a level of detail that enables the project to progress to subsequent phases of the licence without the need for substantial revision or further data acquisition or analysis. The Carbon Storage permit road map in NSTA published guidance[9] outlines the Appraisal Term of a CS Licence, highlighting appraisal and site characterisation activity and other requirements. Under normal circumstances, it is expected that appraisal drilling and seismic acquisition, along with other data gathering, should be completed in the Appraise Phase.

1.4 Develop and maintain structured workplans, agreed with the NSTA, with clear links between the appraisal activities and relevant risks and uncertainties.

2. Reason for the Expectation

2.1 There is a robust regulatory framework in the UK relating to Carbon Capture and Storage ('**CCS**'), including legislation under which the NSTA operates in its role as the licensing and permitting authority for offshore carbon storage. This Expectation supports the NSTA's regulatory role in respect of carbon storage, as established by the Energy Act 2008[2], Energy Act 2023[2] and further elaborated by secondary legislation, including The Storage of Carbon Dioxide (Licensing, etc) Regulations 2010[4] (the '**Storage Regulations**').

2.2 The purpose of appraisal activity and site characterisation is to provide the relevant data and analysis needed to reduce the uncertainty associated with any potential store in order to:

i. provide a reasonable estimate of a prospective store's capacity,

ii. assess whether the prospective store is appropriate for the injection of CO_2 at the proposed rates,

iii. ensure the prospective store is capable of effective permanent containment of the injected CO_2,

iv. demonstrate that, pursuant to regulation 7(1)(a) of the Storage Regulations[4] and Annex 1[1], the storage complex and surrounding area have been sufficiently characterised,

v. enable a full assessment of the risks to containment, capacity and injection and monitorability for inclusion in the Containment Risk Assessment ('**CRA**') (see CS SE 1 (Risk)[5]), and

vi. contribute to optimisation of the Carbon Storage Development Plan ('**CSDP**') and Monitoring Plan ('**MP**').

2.3 The characterisation of a storage site, complex and surrounding area can be a substantial project in and of itself and will likely involve some iterative steps. To deliver projects through each stage of a CS Licence to a permit application, and ultimately to first injection, and on a timescale that meets the UK's net zero targets, it is essential that appraisal activity be planned in appropriate detail. The dependencies between activities should be clearly understood and critical tasks identified. This Expectation sets out the broad steps and best practice required to meet those aims.

2.4 Pursuant to regulation 7(1)(a)[4] of the Storage Regulations and in relation to Annex1[1], this Expectation will:

i. assist CS Licence holders in optimising the development of the three-dimensional static geological earth model required to properly characterise the store and complex in such a way and at such a time that the project can progress through to the Assess Phase and mature a viable development concept

ii. support timely characterisation of the store's dynamic behaviour, sensitivity analysis and risk assessment at an appropriate level of detail and standard to allow the project to progress to Define and, if appropriate, to a storage permit application, and

iii. help identify the monitoring strategy at a stage in the project where the data required for baseline assessment can most optimally be acquired and assessed (see also CS SE 3 (Data)[6]).

3. Delivering the Expectation

A. Strategic behaviours

A.1 All project personnel should be fully aware of applicable legislation, regulatory requirements, and guidance. CS Licence holders should utilise relevant industry standards and best practice where appropriate (e.g. ISO 27914[7,a] and references therein).

A.2 CS Licence holders should deliver all appraisal activity, including work programme commitments such as appraisal wells, seismic acquisition and processing, or reprocessing, and studies, in a timely manner to support the characterisation of the storage site, storage complex and surrounding area, and the development of a storage permit application.

A.3 Should the schedule of planned appraisal activity change, CS Licence holders should engage with the NSTA, particularly where this may impact delivery of later milestones.

A.4 The need for additional appraisal activity may be identified as a project progresses. CS Licence holders should ensure that sufficient time is included in plans and schedules to assess results of data acquisition and studies, understand how they might impact existing interpretations and models, and make the relevant updates to models and workplans.

A.5 CS Licence holders should ensure that Appraisal activity is incorporated into the Stakeholder Engagement Plan, in line with CS SE 5 (Stakeholder)[8].

A.6 An appropriate generalised structure for delivering and reporting on site characterisation is laid out in Annex 1[1] under Steps 1, 2, and 3. Following this organised structure through the Appraisal Term to a storage permit application can help navigate review processes (see also Appendix 4 to this Expectation, the NSTA's published Guidance[9], & sections 5.4 through 5.5 of ISO 27914[7]).

B. Appraise Phase: Early appraisal activity

This section is focused on activity largely undertaken in the Appraise Phase (delivering to Annex 1, Step 1: *Data Collection* and Step 2: *Building the three-dimensional static geological earth model*). Early work to understand the dynamic behaviour of the store is also encouraged as it will inform the potential limits of the store and plume extents.

B.1 CS Licence holders should review the uncertainty associated with the proposed storage site and complex and define a work plan for reducing this uncertainty.

B.2 CS Licence holders should make an assessment of the requirement for new seismic data, acquiring appropriate seismic data that is suitable for site characterisation as part of a permit application and baseline for monitoring, should 4D seismic be selected as an appropriate method for monitoring (see CS SE 3 (Data)[6]).

[a] For the avoidance of doubt ISO standards do not override any other statutory obligations

B.3 CS Licence holders should ensure that a legacy well review incorporates all legacy wells, with those wells requiring further investigation clearly identified at this time (see Appendix 1 of this Expectation for further detail).

B.4 An Early Risk Assessment ('**ERA**') should identify risks to the containment, storage capacity, injectivity and monitorability of CO_2, and the uncertainties in defining the proposed storage site and storage complex. The ERA should include a Risk Register containing all identified risks to storage capacity, injectivity, and containment of CO_2 within the storage site and complex ('**Risk Register**').

B.5 To support CS Licence holders in delivering an effective ERA in line with the NSTA's published guidance[9], external independent technical experts should be given sufficient access to project work and data to ensure they can thoroughly review the ERA, ensuring that, among other things, the following points are covered in the review:

i) Methodology: is the risk assessment process comprehensive and is the risk analysis auditable and supported by appropriate technical evidence?

ii) Scope: does the ERA cover all relevant risks? Are further additional risks identified for inclusion?

iii) Dependencies: what risk dependencies exist and what is the link between the risk, residual risk and risk mitigation? Are there clear links with the work programme, data/studies and appraisal objectives? How do these relate to proposed further appraisal activity, the timing of that activity and the risks they address?

iv) Uncertainty and Bias: are areas of uncertainty and bias acknowledged, addressed and minimised?

v) Further Work Plan: does the ERA include a follow-on work plan that will adequately address the identified risks?

B.6 CS Licence holders should identify risk reduction measures including the need for further appraisal, such as data gathering and/or studies, and these should be added to the work plan, scheduled, and agreed with the NSTA.

C. Appraise Phase: Appraisal well activity including injectivity tests

C.1 Appraisal well activity should be executed in a timely manner to allow the incorporation of well results and associated studies (such as petrophysical data and SCAL) into the static and dynamic models by the end of the Appraise Phase.

C.2 CS Licence holders should engage with the NSTA on well investments for any contingent wells as laid out in the licence work programme (see Figure 1 & Appendix 2a).

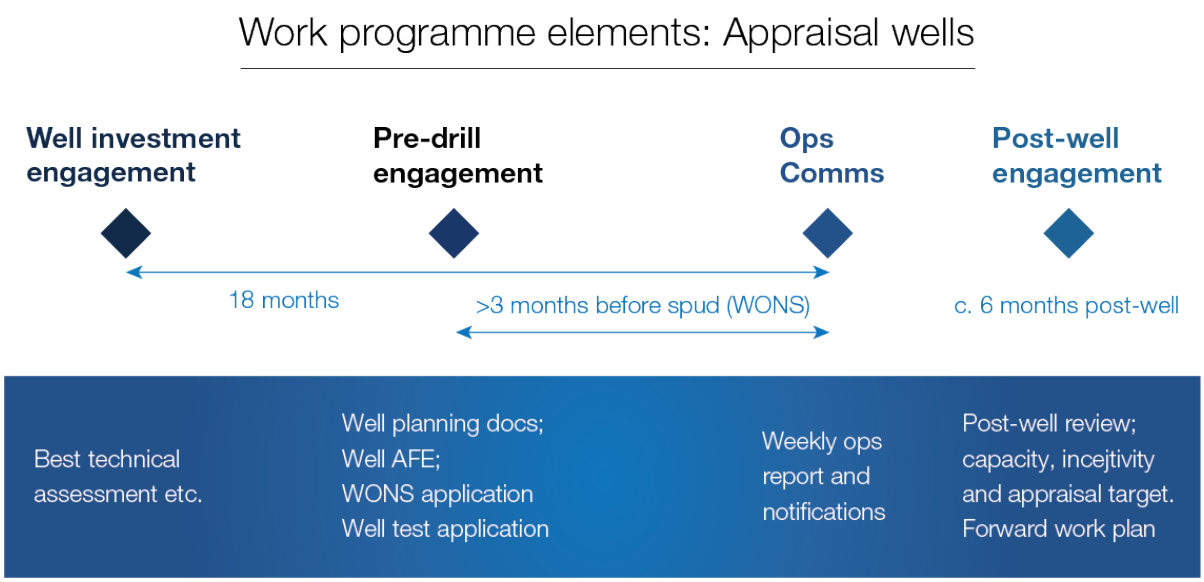
C.3 CS Licence holders should conduct a pre-drill engagement (Appendix 2b) with the NSTA at least three months before applying in Well Operations Notification System ('**WONS**') for consent to drill (or recomplete/test an existing well)

C.4 CS Licence holders should communicate weekly with the NSTA during drilling and well activity (Appendix 2c).

C.5 CS Licence holders should conduct a post-well engagement with the NSTA within six months of well activity concluding (Appendix 2d).

C.6 Appraisal wells drilled to appraise the potential store should be categorised as legacy wells for the purposes of the CRA and risk-assessed to the same standard as a legacy well.

Figure 1: Expected engagements with NSTA for CS appraisal well activity



D. Appraise Phase: Ongoing Appraisal (building the static and dynamic models).

To monitor the evolution of risk and update the risk assessment in the Operational Term and Post-Closure Period, Storage Permit Operators should:

D.1 CS Licence holders should incorporate all relevant appraisal data into a suite of appropriately scaled models to investigate different elements of the dynamic system, for example, regional aquifer models and detailed sector models (Figure 2).

D.2 Preliminary dynamic models, including tools such as box and sector models, should be utilised to forecast dynamic behaviours, test assumptions, and understand the impact of CO2 behaviour against key risks identified in the ERA.

D.3 Dynamic models should investigate plume behaviour and store and hydraulic unit pressures, focusing on critical interactions and potential leakage risks (e.g. spill points; critical wells; legacy hydrocarbon-water contacts; hydraulically connected aquifers).

D.4 Dynamic models must reflect the unique characteristics of the CO_2 in the storage site including temperature, composition, and phase behaviour.

D.5 By the end of the Appraise Phase, before moving to Assess, well integrity assessments should be complete and shared with the NSTA at an agreed time before the site characterisation review. The work should comprise:

i) Results of study work required for well integrity assessment as identified in the ERA.

ii) Outline of the process used to ensure all well bores and data have been assessed.

iii) Outline of methodology for well integrity assessment including standards and criteria used.

iv) Well integrity assessments for each well.

v) Well abandonment plans for wells not yet abandoned.

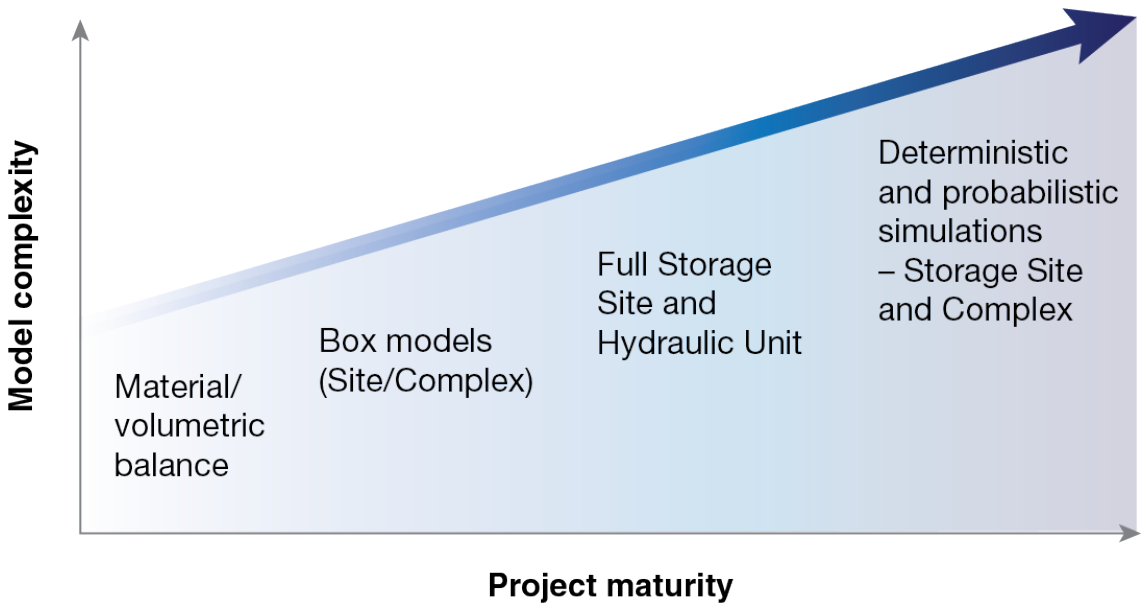
D.6 CS Licence holders should also be able to demonstrate how the well integrity assessments have been used to assess the risk of leakage and how they have been incorporated into the risk register and will be incorporated into the CRA.

D.7 Data collection should be complete by the end of the Appraise Phase. CS Licence holders should avoid, where practicable, data gathering and development of the static model beyond the Appraise Phase of the licence, to avoid excessive subsurface uncertainty being carried forward into the Assess Phase that could potentially impact development of the End Assess requirements and progression into the Define Phase.

D.8 Where, by exception, there is remaining data gathering to be completed, it should be part of the Assess Phase Plan (see Appendix 3) with sufficient time allocated for integration into the final Site Characterisation report, which should be complete by the time of the End Assess Review to support completion of Site Characterisation against the NSTA's published guidance on applications for a carbon storage permit[9].

D.9 At the end of the Appraise Phase, CS Licence work programmes may require an integrated technical report on the site and complex characterisation completed during the Appraise Phase. Suggested contents and structure are provided in Appendix 4

Figure 2: Approach to dynamic modelling vs project maturity and licence phases.



E. Assess Phase: Optimisation of the Full Field Dynamic Model

E.1 The Assess Phase should largely focus on optimisation of storage dynamic behaviour for the proposed development.

E.2 CS Licence holders should further develop the suite of models built in the Appraise Phase to ensure that they represent the full range of uncertainty in the reservoir geology and dynamic behaviours in the proposed storage site, complex and hydraulic unit.

E.3 The impact of pressure on the wider hydraulically connected area, beyond the site and complex should be identified and implications considered.

E.4 Where the storage complex may be in pressure communication with one or more licensed storage sites (potential or permitted) or where pressure communication may impact other relevant stakeholders, CS Licence holders should collaborate with all stakeholders to develop appropriate analytical tools that integrate all available shared data to allow for understanding of the pressure and fluid interactions between projects (see CS SE 5 (Stakeholder)[8]).

E.5 A full well integrity assessment should be completed, and CS Licence holders should demonstrate, using dynamic models, the interaction of the CO_2 plume and pressure front with legacy wells. Where well remediation may be required, this should also be included in the full well integrity assessment at this stage.

E.6 The Storage Site and Complex Characterisation Report delivered at End Assess will be a matured version of the Site Characterisation Review Report delivered at End Appraise Report; the overall structure and contents should be largely similar (it will form one of the documents submitted as part of a permit application).

4. Demonstrating Delivery

Information obtained from various sources and engagements between the NSTA and licensees will help inform the NSTA of the extent to which they may be delivering against this Expectation. These may include, but not be limited to:

4.1 Reporting

The NSTA collects a range of data from CS Licence holders as part of the annual reporting in accordance with paragraph 3 of Schedule 2 of the Storage Regulations and may request additional information or reports (for example using the powers in s112 of the Energy Act 2023). Information may be collected in accordance with any other applicable regulations or guidance.

4.2 Stewardship Engagement Meetings

The NSTA will engage with CS Licence holders during the lifecycle of a project. For any meeting, the NSTA may suggest an agenda to focus on issues that present the greatest stewardship

impact, and the agenda will be based on data received, any applicable benchmarking, and delivery against this Expectation.

4.3 Sharing with Industry

CS Licence holders are encouraged to share examples of best practice and lessons learned with industry, through active participation at forums such as conferences, industry-convened workgroups, taskforces, and publications such as academic journals. The NSTA may, on occasion, convene or co-convene events and participation is strongly encouraged to demonstrate delivery of this Expectation.

4.4 Meeting of Licence Commitments

The NSTA may track progress against meeting of licence commitments through Stewardship Engagement meetings. If the NSTA does not consider sufficient progress is being made, it may engage with the relevant parties to understand the situation. Licensees are expected to proactively manage and track progress in meeting licence commitment and permit conditions.

4.5 Documentation

Formal documentation should be delivered to a high standard at all stages. Reports should be integrated and summarise work in a concise manner without overly relying on appendices. Maps and sections should be full-page and utilise scientific colourmaps to aid visualisation. The organisation of the documents should follow published NSTA guidance, noting there may be future updates to guidance.

5. References

1 *Annex 1 of EU Directive 2009/31/EC on the geological storage of carbon dioxide*

2 *Energy Act 2008*

3 *Energy Act 2023*

4 *The Storage of Carbon Dioxide (Licensing, etc) Regulations 2010*

5 *Carbon Storage Stewardship Expectation 1 – Risk assessment*

6 *Carbon Storage Stewardship Expectation 3 – Data acquisition and use for appraisal and monitoring*

7 *ISO 27914:2017 Carbon dioxide capture, transportation and geological storage – Geological storage.*

8 *Carbon Storage Stewardship Expectation 5 – Stakeholder engagement.*

9 *NSTA Guidance on Applications for a Carbon Storage Permit.*

10 *Well Decommissioning for CO_2 Storage Guidelines, OEUK*

11 *OGA Strategy*

Appendix 1: ERA Legacy Well Assessments

For the purposes of these assessments, legacy wells include any well within the proposed storage site or complex or licensed area and any well outside these areas that might see CO_2, a pressure increase or brine movement due to the storage development.

Legacy wells include wells that are still to be abandoned, including post-permit. Wells still to be abandoned should be assessed to determine if their current mechanical status will make it difficult to abandon them to the OEUK guideline requirements. In cases where a development is likely to have more wells drilled prior to Cessation of Production ('**COP**'), with the agreement of the NSTA, open wellbores with no significant issues (e.g. sustained casing pressure) may not need to be assessed at this stage, however associated sidetracks with open wellbores are required to be assessed.

As part of the ERA, for all existing wells, among other deliverables, the Licensee should:

i) Identify all legacy wells that could affect the project (in tabular form and displayed on relevant maps that also show the proposed storage site and complex).

ii) Where a well has been sidetracked, assess all legs of the wells independently (including leak paths between adjacent bores).

iii) Demonstrate data availability per well in both map and tabular form.
- Where data is not available, detail what steps have been taken to obtain that data, and the impact of the missing information on the integrity and risk assessment for the well.
- Any data that should have been reported and disclosed but is not available within the National Data Repository ('**NDR**') should be requested via the NDR through a missing data request prior to the finalisation and submission of the ERA.
- Any data used in the assessment that is not in the NDR should be added to the NDR (if not the current data owner for this data seek the advice of NSTA).

iv) Actively engage with petroleum licensees[b] whose non-decommissioned wells (i.e. any well that does not have a mechanical status of AB3) may affect a storage project.
- Notify Petroleum Licensees of wells potentially affecting a storage project and advise them what formations require isolation for the storage project (noting petroleum licence holder's obligations in para 15 & 22 of the OGA Strategy[11]).
- Engage the NSTA if issues arise.

[b] i.e. the holder or a petroleum licence in accordance with s3 of the Petroleum Act 1998

v) Provide an initial risk assessment of each well based on the integrity assessments. The OEUK Guidelines[10] contain an efficient method of conducting the assessment. Licences with many wells can be managed by grouping up the assessment of the wells by risk, for example:

(1) Wells with no likely issues

(2) Wells that do not fully meet the OEUK guidelines but have been risk assessed as acceptable

(3) Wells that are high risk/have inadequate barriers in place/sufficient data is not available and therefore cannot be allowed to contact CO_2 in their current condition.

The analysis should be linked to the Risk Register containing all identified risks to storage capacity, injectivity, and containment of CO_2 within the storage site and complex highlighting key areas and risks where further risk analysis is required.

vi) Provide a work plan to address remaining required assessments and studies.

vii) Provide plumbing diagrams for the wells and their abandonment detail, including illustrating the Minimum Safe Abandonment Depth, against the proposed storage site and complex.

Appendix 2: Well Delivery engagements:

Appendix 2a: Well Investment engagement:

The well investment engagement should include as a minimum:

a. technical evaluation of storage sites including seismic and geological interpretation,

b. a summary of data quality, suitability, and availability,

c. a risk assessment summary including injectivity, capacity, and containment,

d. chance of success and capacity assessment,

e. conceptual exploration, appraisal and development scenarios, and

f. cashflow or business model inputs, where applicable

With the following included where there is a positive recommendation to drill the well:

g. the proposed well location, trajectory, and total depth ('TD') criteria

h. appraisal rationale and well objectives

j. plans for data gathering (e.g. coring, injection testing, logging)

k. planned timings of well operations

l. abandonment plans

m. a post-well analysis programme, and

n. plans for information and sample reporting in line with any applicable legislation.

Any injection test proposals should include:

o. objectives of the well test

p. proposed injection fluid and an analysis of the suitability of that fluid to achieve the objectives

r. test programme and how that will meet the specific objectives, including any decision points and alternate test scenarios

s. well test reservoir modelling demonstrating the expected outcomes and pressure behaviour

Appendix 2b Pre-Drill engagement:

A pre-drill engagement is an opportunity to check in with the NSTA prior to submitting an application to drill and/or conduct a well test. The following are useful in this context (the well proposal and basis of design should contain most relevant information):

a. **Confirmation that licence commitments are being met including TD criteria**
b. **Selection of bottom hole location(s)**
c. **Geological prognosis**
d. **Drilling hazards including site survey analysis and pore pressure prediction**
e. **Rationale for data acquisition programmes**
f. **Rationale for key operational decision-making (e.g., decision trees)**
g. **Confirmation of material to be submitted to WONS, and**
h. **A communication plan to cover communications with the NSTA on well operations**

Appendix 2c Well operations reporting:

CS Licence holders should send the NSTA copies of weekly well operations/drilling reports (and on specific request, daily well operations/drilling reports), plus the following information as applicable:

a. **Notification of spud**
b. **Notification on reaching top reservoir**
c. **Notification on reaching TD and, where relevant, reach agreement with the NSTA that well commitments have been met**
d. **Initial draft analysis of the reservoir and its fluid content**
e. **Draft log interpretation (e.g., CPI) as soon as available, and**
f. **Notification of any major deviations from the well plan.**

Appendix 2d: Post-well evaluations:

Post well evaluations should include a review of:

a. **Well execution and performance against appraisal targets**
b. **Updated mapping (if substantially impacted by the well results)**
c. **Petrophysical evaluation of the well**
d. **Fluid and sample analyses**
e. **Well data impact on areas such as capacity, containment and injectivity**
f. **A forward work plan including the incorporation of results into the characterisation of the site and complex and any specialist studies, and**
g. **Status of well information and samples reporting to the NSTA.**

Appendix 3: Assess Phase Plan

The Assess Phase Plan should include:

a) **A Gantt chart showing the project workstreams and technical studies required to meet the requirements at End Assess as set out in the NSTA's published Guidance[9], any CS Licence work programme deliverables, and other key project gates or phases.**

b) **For each workstream and technical study, provide:**

   i) **Brief scope of work**

   ii) **Schedule and resources required**

c) **Collaboration plans with other CS Licence holders (or other stakeholders) whose developments may be in pressure communication with the proposed storage site and complex and outline a plan to develop analytical tools suitable for understanding the pressure interactions between the projects.**

Appendix 4: Site Characterisation Review Report (End Appraise Phase)

Licence work programmes may require an integrated report, clearly setting out how the work completed has met the requirements for Site and Complex characterisation with a summary of the conclusions organised by topic.

- Technical reports and other supporting information should be summarised and referenced or, if essential to the conclusions, be included in the document as appendices.
- The goal of the report structure is to avoid the requirement to move between sections of the document to evaluate whether the relevant requirements have been met.
- The view is that if suitable document structure and contents are established as early as possible, it will reduce the revision requirements at draft storage permit application stage.
- The below list of suggested contents **is not exhaustive and omits some level of detail normally attributed to subsections and/or certain specific studies**. Further sections should be included, as required, on a case-by-case basis. In particular, reference should be made to risks identified in the ERA and the data/studies that were identified as mitigations of those risks, along with any dependencies.
- The general layout of the contents reflects the requirements in Annex 1[1] ('CRITERIA FOR THE CHARACTERISATION AND ASSESSMENT OF THE POTENTIAL STORAGE COMPLEX AND SURROUNDING AREA REFERRED TO IN ARTICLE 4(3)') – it is useful to broadly follow this format because it forms the basis of the work required for site characterisation in a Carbon Storage Permit Application.
- For any section, please include an adequate summary reflecting the maturity of the

technical work. Where work has not been completed, please indicate whether there is outstanding work planned, justification for it not yet being complete, and a rationale for the planned completion of that work.

- For critical issues leading to a decision to cease further work or proposed determination/ surrender of the licence, please include as a minimum a clear rationale with supporting evidence.
- This template is for the report due at the end of the Appraise Phase (Site Characterisation Review Report) only.
- Any subsequent Site Characterisation reporting should develop the material provided in the Site and Complex Characterisation Review Report. The general format can be carried through to Permit Application.

Site Characterisation Review Report – example Table of Contents

Abbreviations

1 Executive Summary

2 Structure of Site Characterisation [*identifies where the different guidance points and* ***requirements from Annex 1*** *have been addressed in the documentation. A table containing a line for each item in Annex 1, the relevant section(s) of the report that cover that item and the status of the work (completed/incomplete)*]

3 Overview [*Note this section will also be included other stand-alone documents such as the "Carbon Storage Development Plan" in the final permit application*]

- Project
- Project Governance
- T&S System Description
- Shipping
- Other Users of the Site
- Base Case Development

4 Store Definition

- Storage Site and Complex Definition [*including underburden and any key characteristics, may reference section 8*]
- Storage Constraints [*understanding of how containment risks may limit CO_2 injected and/ or injection location to ensure no significant risk of leakage – summarise each limit (table and map)*]

5 Geotechnical Database

- Well Data
- Core and Log Data [*incl. SCAL etc.*]
- Mineralogical Data [*incl. XRD, thin section/modal analysis etc.*]
- Seismic Data
- Pressure and Temperature Data
- Geomechanical Data
- Production Data
- Hydrocarbon and Brine Samples
- CO_2 Properties for Injection
- Seismicity

6 Regional Context [*in as much detail as is required to contextualise the regional permeability architecture and extent of potentially connected hydraulic units*]

- Regional Geology and Basin Evolution
- Regional Stratigraphy

7 Seismic Interpretation

- Seismic processing
- Seismic to well tie
- Seismic resolution
- Horizon interpretation
- Reservoir pinch-out uncertainty
- Fault Interpretation
- Regional Aquifer Seismic Interpretation
- Depth Conversion
- Overburden Features

8 Geological Description [*Each section should include, where relevant, details on sedimentology, petrography, diagenesis, faulting and fractures, etc.*]

- Overburden
- Storage Interval(s)
- Underburden
- Storage Complex [possible geological pathways through which pressure, CO_2 or formation fluids could move out of the Storage Formation; aquifer connectivity; permeability architecture]
- Hydraulic Unit(s)

9 Rock & Fluid Properties

- Petrophysical Evaluation of Storage Site & Complex
- Formation Pressure

- Formation fluid PVT analysis [*phase behaviour of injected CO_2*]
- Relative Permeability analysis
- Geochemical Fingerprinting & Charge History

10 Legacy Well Assessment [*The legacy well assessment section should be a summary of the key findings of the well integrity study*]

- Well Integrity Summary
- Unconfirmed Isolations
- Individual well abandonment diagrams and conclusions
- Summary of Well Integrity and ongoing/future work

11 Storage Complex and Hydraulic Unit Modelling [*The introduction should outline the modelling philosophy i.e. summarise the multiscale modelling at differing scales employed to resolve specific questions. Each step should include a demonstration that uncertainties have been appropriately captured. It is accepted that dynamic modelling will be* ***optimised*** *through Assess as the development concept is further defined, but the basic building blocks and framework for the site and complex dynamic model should be* ***in place by End Appraise***]

- Static Modelling and Uncertainty [*to include a detailed description of the three-dimensional static geological earth model, or a set of such models, of the candidate storage complex, including the caprock and the hydraulically connected areas and fluids. Where models at different scales have been used to adequately address site risks, describe these. Where multiple models have been required to assess different processes, these should be included*].
- Dynamic Analytic, Material Balance, and Box Models used to understand key uncertainties
- Sector, Storage Site and Complex, and Hydraulic Unit Modelling including uncertainty analysis
- Geomechanical Models & Analysis [*to model the effects of pressure and temperature and fluid/rock compositional changes to the stress state of the site and complex and surrounding area. To include mechanical damage and induced tensile or shear failure of unfaulted reservoir or caprock; reactivation of faults within the reservoir, caprock or overburden; thermal fracturing; hydraulic fracturing; formation strength at the base of the P&A plugs; etc*]
- Geochemical Models [*of storage unit and complex including caprock*]
- Well Performance Models

13 Forward Plan

14 References

15 Appendix 1 – Updated Risk Register [*note this section will evolve into the Containment Risk Assessment document. Please refer to the NSTA's published Guidance on applications for a carbon storage permit*[9].

Appendix 2 etc. [*technical supporting material as appropriate*]

North Sea Transition Authority

The North Sea Transition Authority is the business name for the Oil and Gas Authority, a limited company registered in England and Wales with registered number 09666504 and VAT registered number 249433979.
Our registered office is at 50 Broadway, London, England, SW1H 0DB.