HyNet North West

ENVIRONMENTAL STATEMENT (VOLUME II)

Chapter 4 – Consideration of Alternatives

HyNet Carbon Dioxide Pipeline DCO

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulations 5(2)(a)

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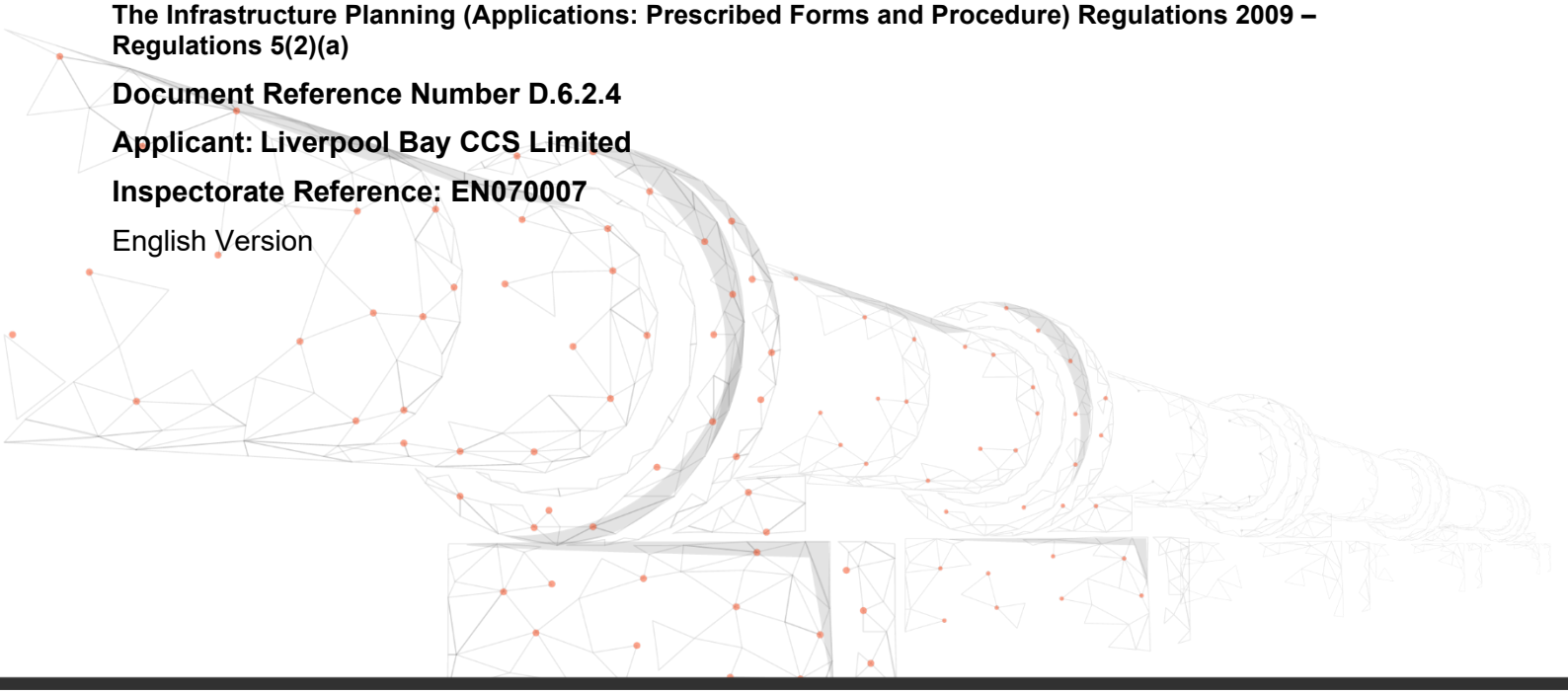

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4.1. INTRODUCTION

4.1.1. This Chapter of the Environmental Statement (ES) sets out the reasonable alternatives that have been considered during the evolution of the DCO Proposed Development and design process as presented in **Chapter 3 - Description of the DCO Proposed Development (Volume II)**.

4.1.2. In this context, the consideration of alternatives and design evolution has been undertaken with the aim of avoiding and/or reducing adverse environmental effects, maintaining operational efficiency and cost-effective design solutions, and consideration of other relevant matters such as available land and planning policy.

4.1.3. The design of the DCO Proposed Development has evolved throughout the Preliminary Design stage, in response to consultation feedback and with reference to the results of surveys and technical studies.

4.1.4. The Rochdale Envelope approach has been used as a basis of assessment for the ES submitted as part of the DCO Application.

4.1.5. Alternatives considered within this chapter include:

- Pipeline routes;
- Pipeline designs;
- Pipeline crossings;
- Above Ground Installations (AGIs) alternative sites;
- Block Valve Stations (BVSs) alternative sites; and
- Construction Compounds.

4.2. REQUIREMENT FOR CONSIDERATION OF ALTERNATIVES

4.2.1. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (DCO EIA Regulations) (**Ref. 4-1**) state that an Environmental Statement (ES) should include *'a description of the reasonable alternatives studied by the applicant, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment'.*

4.2.2. To accord with the DCO EIA Regulations, the following alternatives have been considered for the HyNet Carbon Dioxide Pipeline DCO, to reduce environmental effects of the DCO Proposed Development.

- Do nothing;
- Alternative options; and

- Mitigation by design.

4.3. DO NOTHING ALTERNATIVE

4.3.1. The Do Nothing alternative would mean that following the end of life of the natural gas reserves in the Liverpool Bay Gas Field, the gas pipeline and existing infrastructure would be decommissioned. The DCO Proposed Development which is also a key component of the low carbon hydrogen network in the region would not be progressed. As an integral part of HyNet (the Project), this would mean that carbon emissions from industrial sources in North Wales and the North West of England region would remain unabated.

4.3.2. The Do Nothing alternative would be contrary to the UK's goal to achieve Net-Zero carbon emissions by 2050, the Industrial Decarbonisation Strategy (**Ref 4.2**), the British Energy Security Strategy (**Ref 4.3**) and the UK Hydrogen Strategy (**Ref 4.4**). The Do Nothing scenario represents the current and future baseline which is considered in each of the technical chapters (**Technical Chapter 6 – 19, Volume II**).

4.4. THE NEED FOR THE DCO PROPOSED DEVELOPMENT

4.4.1. The Committee on Climate Change (CCC) have stated that Carbon Capture and Storage (CCS) is a necessity, not an option (**Ref. 4-5**). CCS is fundamental to the decarbonisation of energy intensive industries, such as refineries, chemical and cement plants, and will enable domestic production of low carbon hydrogen from natural gas.

4.4.2. Through proposed updates to National Policy Statement (NPS) EN-1 (**Ref. 4-6**), the UK Government recognises that new CCS infrastructure will be essential to ensuring the transition to a Net-Zero economy and that any realistic alternatives to new CCS infrastructure for delivering Net-Zero by 2050 are limited.

4.4.3. To meet the UK's sixth carbon budget, the Government has outlined an ambition to capture 20-30 $MtCO_2$ per year by 2030 and the CCC have recommended that the first cluster should be operational by 2025, with at least one cluster involving low-carbon hydrogen (**Ref. 4-5**).

4.4.4. As presented in **Chapter 2 - The Project (Volume II)**, the Project is an innovative low carbon and hydrogen energy project that will unlock a low carbon economy for the North West of England and North Wales and put the region at the forefront of the UK's drive to Net-Zero. The importance of the Project has been recognised in the Government's choice in taking forward the project in Track-1 of its Cluster Sequencing process (**Ref. 4-8**).

4.4.5. As an integral part of the Project, the DCO Proposed Development will transport CO_2 captured from greenhouse gas emitting industries in the region and from the new low-carbon hydrogen plant, to storage, contributing to the reduction of

CO_2 in the atmosphere and making a significant contribution to the international, national, and local effort against the climate emergency. The Project has the potential to capture 10 $MtCO_2$ per year by 2030, the equivalent of taking 4 million cars off the road.

4.5. PIPELINE ROUTING

INTRODUCTION

4.5.1. There were two main Project objectives used to underpin the framework for developing the Newbuild Carbon Dioxide Pipeline:

- To deliver a pipeline capable of transporting CO_2 from new hydrogen production facilities at Stanlow Manufacturing Complex and other local process emitters to a CO_2 Storage location within Liverpool Bay; and
- To maximise the opportunity to substantially reduce CO_2 emissions from industry within North West England and North Wales - by ensuring any pipeline provides the opportunity for all major emitters to connect.

4.5.2. In meeting the above objectives, the design and location of the Newbuild Carbon Dioxide Pipeline needed to consider the requirements and phasing of the wider Project. This included exploring opportunities to modify existing infrastructure to reduce the need for constructing additional pipelines, which avoids potential environmental impacts and provides programme and cost efficiencies. With this in mind, a section of the existing Connah's Quay to Point of Ayr (PoA) Terminal Pipeline, which is being repurposed to transport CO_2 as part of the DCO Application, will form an integral part of the Project infrastructure. As a result, all of the proposed route corridor options were developed to connect to the existing Connah's Quay to PoA Terminal Pipeline. This section of route is referred to as the Flint Connection to PoA Terminal Pipeline.

PIPELINE SIZE

4.5.3. To determine the most appropriate size and capacity of the Newbuild Carbon Dioxide Pipeline it was necessary to consider the maximum capacity of the overall system that might potentially be required to effectively decarbonise industry in the region. Clearly there is uncertainty in this assessment.

4.5.4. The existing Connah's Quay to PoA Terminal Pipeline has a 24" diameter, providing a maximum capacity of 4.5 $MtCO_2$/yr, while the Project's proposed offshore pipeline from PoA to the Douglas Complex has a maximum capacity of approximately 10 $MtCO_2$/yr in dense phase. Taking into account a range of potential upstream emitter projects that might connect to the DCO Proposed Development and the total capacity of offshore storage, the Project aims to provide system capacity to enable CO_2 transport and storage of 10 $MtCO_2$/yr by 2030. The Project philosophy is to design any new infrastructure to meet this

system capacity, but to only upgrade re-usable existing infrastructure when there is greater demand certainty. This approach minimises cost and risk and allows incremental expansion of the system. The delivery of any future expansion of existing infrastructure will depend on Government policy support for industrial decarbonisation, including the outcome of the Business, Energy and Industrial Strategy (BEIS) Carbon Capture, Usage and Storage (CCUS) cluster sequencing process.

4.5.5. The above approach has resulted in the proposal for a 36" pipeline for the Stanlow AGI to Flint AGI Pipeline as part of the DCO Proposed Development, which provides a capacity of 10 $MtCO_2$/yr for this section and therefore supports the overall Project goal and is consistent with the maximum capacity of the existing offshore pipeline infrastructure in dense phase.

4.5.6. The re-use of the existing Flint Connection to PoA Terminal Pipeline will limit throughput to 4.5 $MtCO_2$/yr. However, this section will not be upgraded as part of the DCO Proposed Development as the cost would not be justified at this stage of development. Any future upgrade between Flint and the PoA Terminal to increase capacity of this section to a maximum of 10 $MtCO_2$/yr would be subject to a separate consenting process as and when demand and understanding of future Government policy provide certainty for the needs case and allow design to be progressed. Similarly, the 20" pipeline from Ince AGI to Stanlow AGI has been sized to provide a capacity of 2.5 $MtCO_2$/yr based on the number of emitters and with consideration of the future capacity requirements for the pipeline.

4.5.7. Safety requirements have dictated the materials to be used in construction, taking into consideration corrosion risk, pressure as well as temperature of the CO_2. Therefore, alternatives with regard materials have not featured in the design development.

PIPELINE ROUTES

4.5.8. In developing the Newbuild Carbon Dioxide Pipeline route corridor options, the following guiding principles were developed:

- To avoid, minimise and manage impacts upon the environment and local amenity;
- To ensure the transportation of the CO_2 is undertaken safely and securely;
- To optimise the potential socio-economic benefits within the region;
- To be technically viable and constructible with minimum disruption; and
- To be cost-effective.

4.5.9. A three-stage appraisal process, as shown in **Diagram 4.1**, was developed to identify the preferred route option for the Newbuild Carbon Dioxide Pipeline being considered as part of the DCO Proposed Development, namely:

- Stage 1: Development and appraisal of strategic corridors;
- Stage 2: Development and appraisal of route options; and
- Stage 3: Refinement of preferred route option and siting.

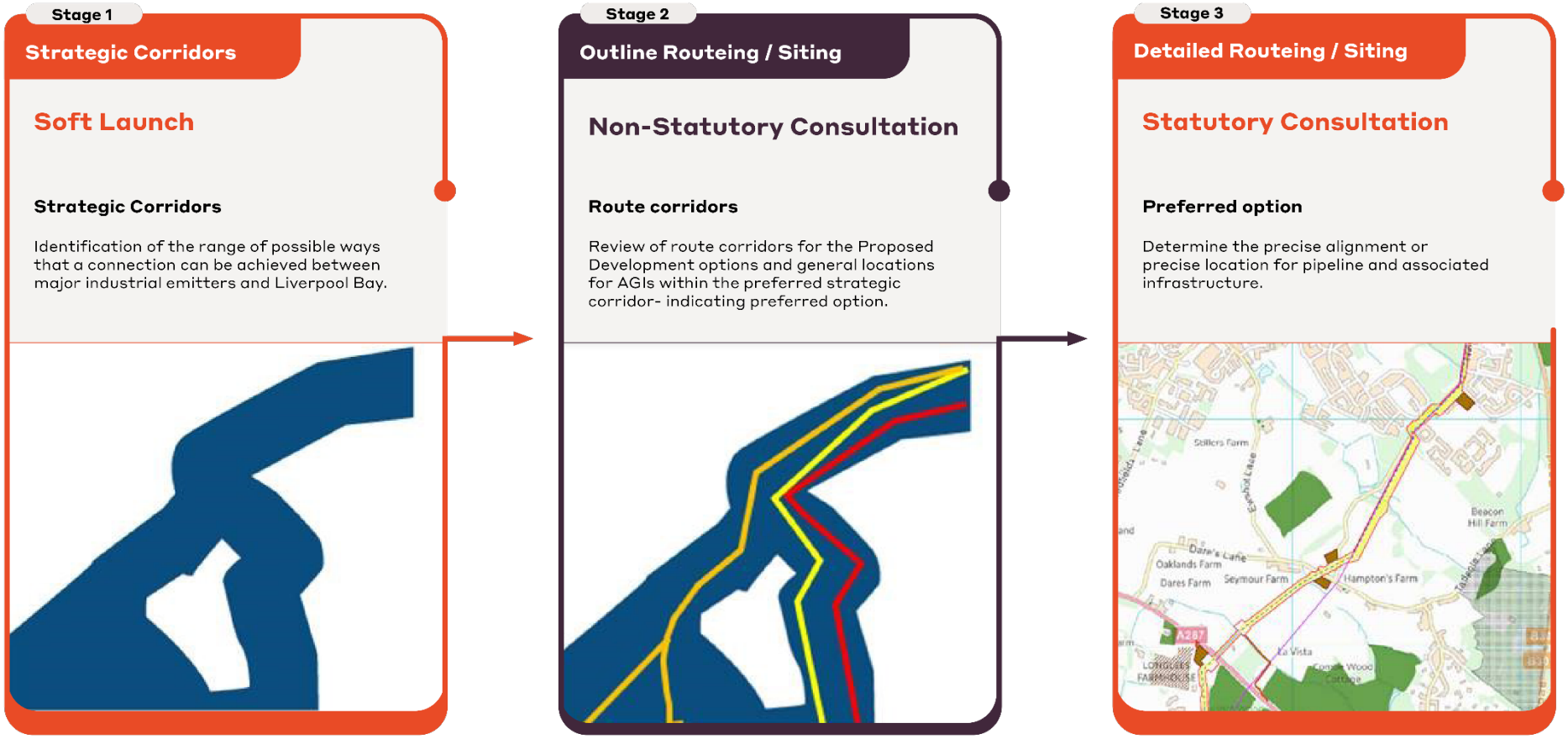

Diagram 4.1: Newbuild Carbon Dioxide Pipeline Options Appraisal Stages and Outputs

4.5.10. The appraisal methodology has drawn on best practice adopted by National Grid in developing new gas and electricity infrastructure (**Ref. 4-9**), intended primarily for major infrastructure projects under the Planning Act (PA) 2008. The National Grid guidance sets out the importance of a robust and transparent process as well as balancing the technical, socio-economic, environmental, and cost considerations when selecting a project option.

4.5.11. Having a process in place that enables a coherent and consistent appraisal of potential options to be undertaken allows for 'back-checking' of any options at a later date. The back-checking of options will be triggered if new material information or a material change in circumstances comes to light which warrants a reconsideration of previously discontinued options.

STAGE 1: DEVELOPING CARBON DIOXIDE PIPELINE STRATEGIC CORRIDORS

4.5.12. The Newbuild Carbon Dioxide Pipeline routing was considered in two sections:

- Ince Above Ground Installation (AGI) to Stanlow AGI Pipeline (20"); and
- Stanlow AGI to Flint AGI Pipeline (36").

4.5.13. The Stage 1 appraisal identified four strategic corridors for the newbuild 36" pipeline, please refer to **Figure 4-1 (Volume IV)**. Due to its shorter length and limited corridor options, the newbuild 20" pipeline was not subject to a Stage 1 appraisal.

4.5.14. The first of the four defined strategic corridors was labelled the '**Core**' corridor. This is the broadest of the four corridors on account of being the least geographically constrained. The core corridor runs approximately 13km between Stanlow and the A548 Sealand Road, extending approximately 1km into Wales. It is at this point that the strategic corridors can be seen to split into three more distinct corridors:

- **Northern corridor**: Measuring approximately 8.5km in length, the Northern corridor traversed the northern perimeter of the Deeside Industrial Estate;
- **Central corridor**: Measuring approximately 7.5km in length, the Central corridor ran through an area of open fields adjacent to Garden City and the Airfield Industrial Estate before heading northwards along the western side of the River Dee; and
- **Southern corridor**: Measuring approximately 15km in length, the Southern corridor arced south of Deeside, Queensferry and Connah's Quay.

4.5.15. The widths of the corridors varied, primarily due to the consideration of key geographical constraints to avoid, as far as possible, centres of population and environmental features.

4.5.16. A qualitative appraisal of the three corridors (Northern, Central, and Southern) was undertaken to identify which corridor should be taken forward for further design development. The Core corridor was not subject to the Stage 1 appraisal process on account of there being no significant constraints that would have warranted the division of this corridor into separate corridors.

4.5.17. Any individual corridor was considered as having an advantage over other alternatives if it:

- Was **closer located**, for example, provided more opportunities to connect to existing industrial emitters, would utilise more existing infrastructure, would pass through less complex or urban areas (where possible), and/or minimise land take and the need for compulsory acquisition;
- Would be likely to have **improved environmental outcomes** versus the other options considered by avoiding or having reduced adverse environmental impacts;
- Would provide **social and economic outcomes of greater benefit** compared to the other corridors; and
- Would provide a **stronger business case**, for example, could be installed at reasonable construction and operational cost, with fewer engineering constraints.

4.5.18. The **Northern** and **Central** corridors contained a significant number of constraints and construction risks and a distinct lack of flexibility and opportunities. This posed a significant risk for the detailed routing of the newbuild 36” pipeline and subsequent construction programme.

4.5.19. Overall, the **Southern** corridor was the preferred option for a number of reasons, including:

- Offered the greatest opportunity to connect to other CO_2 emitters, thereby achieving the greatest level of CO_2 reduction within the region;
- Likely to be the least complex to build and safest route to construct on account of having fewer complex crossings;
- More likely to provide route options which have less direct impact upon international and national environmental designations (including the River Dee Estuary); and
- Likely to offer the most cost-effective solution, based on the fact it would be the least complex.

4.5.20. The **Core corridor in combination with the Southern corridor** was taken forward to the Stage 2 Appraisal for the newbuild 36” pipeline.

STAGE 2: DEVELOPING THE CARBON DIOXIDE PIPELINE ROUTE OPTIONS

4.5.21. The Stage 2 appraisal framework was developed using the objectives and guiding principles (as set out in **paragraph 4.5.8**) with each broken down further to include a series of 35 'factors' and associated 'criteria' which allowed for a more detailed qualitative (and part quantitative) appraisal of the strengths and weaknesses of the preferred route in the selected corridors. These are listed in **Appendix 4.1 – Guiding Principles, Factors and Criteria for Options Selection (Volume III).**

4.5.22. The factors and criteria were derived from relevant policy, including, but not limited to: Overarching National Policy Statement for Energy (NPS) 2011 EN-1 (**Ref. 4-7**), Draft National Policy Statement (NPS) EN-1 (**Ref. 4-6**), NPS EN-4 (**Ref. 4-10**), Draft NPS EN-4 (**Ref. 4-11)**, National Planning Policy Framework (NPPF) (**Ref. 4-12**), Planning Policy Wales (**Ref. 4-13**), and the Wales Future Generations Act 2015 (**Ref. 4-14**).

4.5.23. Part 5 of the Draft NPS EN-1 outlines the impacts which must be considered when developing and applying for development consent for a NSIP. These have informed the list of factors identified for the Stage 2 appraisal. The criteria were developed by the Project team to ensure all relevant environmental, social, economic, and engineering factors were considered in the appraisal. The route options were designed to consider:

- The requirement for and potential location of above ground installations at the beginning and end of each section of newbuild pipeline;
- Key environmental designations and environmental features;
- Key planning designations and land use constraints (identified within Local Plans);
- Avoidance of potential engineering constraints (including difficult terrain and complex infrastructure crossings);
- Avoidance of existing major utilities and centres of population;
- Compliance with relevant Health and Safety Executive (HSE) legislation; and
- On-going accessibility and maintenance considerations.

4.5.24. The Stage 2 appraisal was largely a desk-based exercise with information gathered through consultation and early site work used to inform the process where possible.

4.5.25. To ensure a consistent approach was taken when considering each option against the appraisal factors and criteria, the three-tier grading thresholds set out in **Table 4.1** were applied to each criterion.

Table 4.1 - Stage 2 Appraisal Rating System

Grade	Description
Low Risk	Appears likely to be acceptable in terms of the relevant appraisal attributes. Meets policy criteria, land availability, deliverability, cost, and business case criteria. Environmental effects and/or consenting risks may arise but on balance appear likely to be acceptable with mitigation.
Moderate Risk	Policy compliance, land agreements, deliverability, cost, and business case requirements appear to be achievable but may require compromise. Environmental effects and / or consenting risks may arise but appear likely to be acceptable on balance with mitigation.
High Risk	Non-compliance with policy, introduction of likely significant effects, and / or other consenting risks that are likely to remain after mitigation and/or are likely to carry such weight that there may be a risk to obtaining consent. It appears unlikely to be able to meet deliverability and/or cost and business case criteria.

Newbuild 20" CO_2 Pipeline

4.5.26. Three route options were identified for this section of Newbuild Carbon Dioxide Pipeline and considered against the assessment criteria, please refer to **Figure 4.2 (Volume IV)** and **Table 4.2.**

Table 4.2: Ince AGI to Stanlow AGI Pipeline Route Options

Route Option	Description
Northern Route Option	The Northern Option runs westwards from the Ince AGI and wraps around the north of Elton before travelling south, crossing the Ellesmere Port to Warrington railway line, and then running along on the western side of Elton until it crosses the A5117 Chester Road. Following the crossing, it turns further west and then north again before terminating at its end point.
Southern Route Option A	From the proposed location(s) of the Ince AGI, the route heads south of Elton before crossing the Ellesmere Port to Warrington railway line. The route would continue north of the M56 Chester Services (junction 14) before crossing the A5117 Chester Road and heading in a south-westerly direction south of Elton. The route continues west before heading in a north-westerly direction towards Thornton le Moors. The route would cross the B5132 Cryers Lane, before heading northwards to the Stanlow AGI.
Southern Route Option B	From the proposed location(s) of the Ince AGI, the route heads south of Elton before crossing the Ellesmere Port to Warrington railway line. The route would cross the M56 before heading in a south-westerly direction and crossing the A5117 Chester Road. The route would continue west before heading in a north-westerly direction towards Thornton le Moors. The route would cross the B5132 Cryers Lane, before heading northwards to the Stanlow AGI.

4.5.27. The Stage 2 appraisal of the three route options, when considering environmental and planning designations and constraints, identified that there was no major differences between the scoring of each option. The Northern Route Option contains a larger section passing through either coastal and floodplain grazing marsh and deciduous woodland and is also within 1km of the Mersey Estuary Special Protection Area (SPA) / Ramsar site. Southern Route Option A runs in close proximity to a Scheduled Monument (Moated Site, fishpond and connecting channel, Elton).

4.5.28. The Stage 2 appraisal of the three route options, when considering engineering, HSE, and maintenance criteria, identified that the Northern Route Option would require a complex crossing of the Ellesmere Port to Warrington railway line. In addition, the Northern Route Option would run in close proximity to an existing 132kV overhead line and residential properties. Therefore, based on the engineering and HSE constraints associated with the Northern Route Option, the Stage 2 appraisal concluded that only Southern Route Option A and Southern Route Option B should be taken forward and presented to the public during the Non-Statutory Consultation period in Summer 2021 and subject to further investigation.

4.5.29. Southern Route Option A and Southern Route Option B were considered as part of the EIA Scoping process, please refer to **Appendix 1.1 – EIA Scoping Report (Volume III).** In addition, both options were presented to members of the public during the Non-Statutory Consultation period.

4.5.30. It was concluded that, due to fewer complex infrastructure crossings and the requirement for a shorter length of pipeline, **Southern Route Option A** is the preferred route option and has been considered in greater detail as part of the Stage 3 design process.

Newbuild 36" CO_2 pipeline

4.5.31. Following the Stage 1 appraisal of the potential route corridors for the Stanlow AGI to Flint AGI Pipeline, nine route options were identified within the Core and Southern corridors and considered against the assessment criteria, please refer to **Figure 4.2 (Volume IV)** and **Table 4.3**.

Table 4.3: Stanlow AGI to Flint AGI Pipeline Route Options

Route Option	Description
Option A	Option A exits the Stanlow Manufacturing Complex and heads west through the Gowy Local Wildlife Site (LWS), crossing the Shropshire Union Canal, M56 and M53 before continuing south of Dunkirk and Saughall. The route passes to the north of Sealand before continuing south where it crosses the River Dee in a south-westerly direction between Hawarden Airport and Deeside. The route continues in a westerly direction to the south of Ewloe and north of Buckley where it crosses the A55 Chester Southerly Bypass. Heading west of Northop Hall, the route continues north to its termination near Connah's Quay (east of Oakenholt). Option A is approximately 33.5km in length.
Option B	Option B exits the Stanlow Manufacturing Complex moving west and crosses the Gowy LWS and Shropshire Union Canal. Once the route crosses the M53, it continues west passing through Dunkirk towards Shotwick, before crossing the A494 Bypass Road and passing to the East of Deeside Industrial Park. The route crosses the River Dee between Hawarden Airport and Deeside before continuing in a north-westerly direction into Deeside, crossing the A550 Gladstone Way then passing to the south of Ewloe. The route then crosses the A55 Chester Southerly Bypass and A55 North Wales Expressway before passing to the south of Northop Hall. The route then continues north to its termination near Connah's Quay (east of Oakenholt). Option B is approximately 37km in length.
Option C	Option C follows the same alignment as Option B up to the point where Option B heads east of Ewloe. At this point, Option C heads north of Ewloe, crossing the A494 Aston Expressway before heading north of Ewloe Green. Option C re-joins Option B to the west of Ewloe Green before passing to the south of Northop Hall. The route then continues north to its termination near Connah's Quay (east of Oakenholt). This route is approximately 36km in length.

Route Option	Description
Option D	Option D exits the Stanlow Manufacturing Complex and heads south crossing the M56, before heading in a south-westerly direction north of Picton. The route then crosses the M53, Shropshire Union Canal, and A41 Liverpool Road north of Chester. The route crosses the River Dee between Hawarden Airport and Deeside before following the same alignment as Option C. Option D is approximately 35km in length.
Option E	Option E exits the Stanlow Manufacturing Complex following the same alignment as D, F and G before deviating west through agricultural land at Wervin. Option E passes north of Backford and north of Saughall, then re-joins Option D, F and G between Sealand and the River Dee. The route then continues north but takes a straighter, more northern alignment towards its termination near Connah's Quay (east of Oakenholt). Option E is approximately 35km in length.
Option F	Option F passes south out of the Stanlow Manufacturing Complex, moving in a south west direction, south of Backford and then north of Mollington, passing through predominantly agricultural land. However, Option F crosses the Gowy LWS at the site's narrowest point. Once Option F has passed west of Northop Hall, the route takes a straighter, more northern alignment towards its termination near Connah's Quay (east of Oakenholt). This route is approximately 34km in length.
Option G	Option G largely follows the same alignment as Option F. Once Option G has passed west of Northop Hall, the route takes a more northerly alignment towards its termination south of Flint (adjacent to Allt-Goch Lane). This route is approximately 34km in length.
Option H	Option H exits the Stanlow Manufacturing Complex to the west and crosses the Gowy LWS and Shropshire Union Canal. The route continues west crossing the M53 and A41 Liverpool Road before heading south and crossing the M56. The route then passes to the south of Dunkirk before continuing west and crosses the A494 Bypass Road

Route Option	Description
	between the Deeside Industrial Park and Garden City. The route crosses the River Dee towards Shotton, where it then continues in a north-westerly direction which broadly follows the route of the North Wales Coast railway line. The route terminates north of Connah's Quay (east of Oakenholt). This route is approximately 26km in length.
Option I	Option I follows in the direction of Option B and C between the Stanlow Manufacturing Complex and the River Dee, However, Option I crosses the M53 at a more northern point and continues West, passing north west of Saughall and Sealand before joining the same route as Options D, E, F and G south of the River Dee crossing. Option I passes to the north of Ewloe and south of Northop Hall before following a similar alignment to Option F north towards Connah's Quay. This route is approximately 36km in length.

4.5.32. The Stage 2 appraisal considered each of the nine route options against the criteria developed by the Project team. The appraisal identified a number of critical constraints which allowed the Project team to undertake a comparative assessment and make an informed decision of which route options should be take forward for further investigation. The key constraints identified included (but were not limited to):

- Environmentally sensitive sites, including:
  - The River Dee and Bala Lake Special Area of Conservation (SAC) / River Dee Site of Special Scientific Interest (SSSI): All proposed routes would cross both designations, the appraisal considered the requirement for trenchless crossings to reduce impacts on any qualifying features;
  - Deeside and Buckley Newt Sites SAC: Option A and Option B head south of Ewloe and would therefore pass through or in close proximity to this designation. All other options pass in close proximity to the SAC which is north-west of Ewloe;
  - Buckley Clay Pits and Commons SSSI: Option A and Option B head south of Ewloe and would therefore pass through or in close proximity to this designation;
  - Connah's Quay Ponds and Woodlands SSSI: Options C-I would pass in close proximity to this designation north-west of Ewloe;
  - Maes Y Grug SSSI: Option A would pass through this designation;

  - Local Wildlife Sites (LWS) (England and Wales): A number of the proposed routes pass through LWSs given their abundance and, in some cases, linear spatial coverage;
  - Areas of Ancient Woodland: In particular, Ancient Woodland to the west and south of Ewloe, and south of Northop. The commitment to avoid direct impacts to areas of Ancient Woodland requires trenchless crossings where Options pass through these Sites.;
  - Conservation Areas: Most notably; Thornton-le-Moors, Chester Canal, and Oakenholt Hall. A number of Options pass through or in close proximity to Conservation Areas;
  - Permitted Waste Sites and Historic Landfill Sites; and
  - Known Heritage Assets: Avoiding known heritage assets (including Scheduled Monuments and Listed Buildings) to prevent any direct impacts and reduce indirect impacts on setting.
- The location for crossing the River Dee: Particular consideration around existing infrastructure, proposed alterations to the strategic highway near Connah's Quay, and associated environmental designations (see above); and
- The number of complex infrastructure crossings in the rural and urban environment (including highways, rail, and watercourses) and the requirement for trenchless crossing techniques.

4.5.33. The Stage 2 appraisal concluded that Option G and Option I performed most favourably from an environmental, health and safety and engineering perspective and should be taken forward for further investigation. Both route options were considered as part of the EIA Scoping process, please refer to **Appendix 1.1 – EIA Scoping Report (Volume III)**. In addition, both options were presented to members of the public during the Non-Statutory Consultation period.

4.5.34. The comments received during the Non-Statutory Consultation Period detailed in the Consultation Report (**Document Reference D.5.1**) were taken on board and further engineering appraisals which considered constructability, safety, environmental impact, and cost assessments were undertaken. These concluded that Option G performed better than Option I for the following key reasons:

- Less engineering complexity, particularly in relation to highway and river crossings, and avoiding the need for a tunnel underneath a water treatment plant at Queensferry;
- Fewer potential impacts on key environmental and planning designations;

- Avoids any potential impacts on proposals for expanding the A494 Aston Expressway near Queensferry;
- Lower construction safety risk associated with reduced engineering complexity; and
- A lower cost option.

4.5.35. **Option G** is therefore the preferred route option and has been taken forward as part of the Stage 3 design process.

STAGE 3: REFINEMENT OF THE CARBON DIOXIDE PIPELINE ROUTE OPTIONS AND SITING

4.5.36. Following the conclusions of the Stage 2 Appraisal, the design of the Newbuild Carbon Dioxide Pipeline both 20” and 36” (and associated infrastructure) and the infrastructure associated with the repurposing of the existing Flint Connection to PoA Terminal Pipeline have been progressed as part of the Stage 3 process.

4.5.37. A 100m corridor was applied to the preferred route to enable more detailed consideration of specific planning, land use, environmental and social criteria and to identify engineering, cost and constructability issues. The 35 factors as mentioned in **paragraph 4.5.21** were applied to allow further route optimisation.

4.5.38. Small variations to the preferred route options have been investigated, building on feedback from the Non-Statutory Consultation (Summer 2021) and Statutory Consultation (Spring 2022), engagement with landowners during targeted consultation exercises, engagement with statutory consultees, and further environmental and technical surveys. Reason for variations to the pipeline routing include (but is not limited to):

- Determining the preferred location for connecting to the existing Flint Connection to PoA Terminal Pipeline;
- The avoidance of existing water utilities near Mollington;
- Consideration of existing or proposed buried services, geotechnical or topographical constraints including mine-shafts;
- Reducing loss of waterbodies and mature vegetation including trees and woodland habitat and routing the pipeline to coincide with existing gaps in hedgerows;
- Reducing impacts on watercourses and existing infrastructure; and
- Where route optimization options are limited, alternative construction methods have been considered. This includes using a trenchless crossing technique at certain crossings, to avoid impacting and/or disturbing features such as roads, railways and watercourses.

4.5.39. As a result of environmental and engineering surveys and consultation with the public and statutory organisations, alternative construction methods have also been considered at certain locations. This has led to the proposal to use trenchless pipeline construction methods at locations such as at pinch points where there is limited access or where there would be significant disruption to environmental receptors or existing assets. Locations where trenchless crossing methods would be used are set out in **Appendix 3.1 - Table of Trenchless Crossings (Volume III)**.

4.5.40. The overall pipeline route has been split into seven sections for ease of reference. Optimisation has occurred through all six sections associated with the new pipeline. The seventh section is associated with the existing Connah's Quay to PoA Terminal Pipeline, which is being repurposed to transport CO_2. Due to potential conflicts with existing planning allocations three options were developed in the area north of Ewloe Green (Section 5), to the north, south and through the centre of the Ewloe residential developments as shown in **Figure 4-3 (Volume IV)**. These routes were subject to assessment and comparison in terms of environmental effects, engineering and cost.

4.5.41. The Ewloe north alternative compared less favourably in environmental, planning, land and safety terms compared to the south and central options. The Ewloe south alternative had the lowest ecological impacts as it is the furthest from Deeside and Buckley Newt SAC (European designated site) and Connah's Quay Ponds and Woodlands SSSI (Nationally designated site). It was also preferred by Flintshire County Council as it would avoid direct impacts on the Sea View and Aston Wetland Local Wildlife Sites (LWS) and associated peat deposits; however it had the lowest score for engineering constructability and it also impacts on all the planned developments. The Ewloe central alternative had the second highest environmental score. It minimises impacts to the three planned residential developments as such is an inherently safer design and scored highest in terms of engineering/cost so is the best option for construction viability. As such, the Ewloe central alternative was taken forward as the preferred option.

PIPELINE CROSSINGS

Infrastructure

4.5.42. Trenchless techniques will be used to install the Newbuild Carbon Dioxide Pipeline under complex existing infrastructure such as railways, major roads and identified sensitive receptors such as Ancient Woodland. The locations where trenchless techniques will be used is provided in **Appendix 3.1 - Table of Trenchless Crossings (Volume III).** Trenchless options include Horizontal Directional Drilling, Guided and Unguided Auger Bore, Pipe-jacking and Micro-tunnelling, the preferred option at each location will be determined during detailed design. Further details of these construction methods are provided in **Chapter 3 – Description of the DCO Proposed Development (Volume II)**.

4.5.43. Open cut trench techniques will be used to cross existing infrastructure where there are specific issues preventing the use of trenchless techniques, typically

where there would be insufficient space for entrance and exit pits required to install the pipeline via trenchless methods.

Shropshire Union Canal (Section 2)

4.5.44. Following Non-Statutory Consultation on the pipeline route in Summer 2021, further technical studies and design reviews were undertaken and two alternative routes were developed at Caughall that cross the Shropshire Union Canal. The North and South alternatives were presented during Statutory Consultation in Spring 2022 and are shown in **Figure 4-4 (Volume IV)**.

4.5.45. Both routes would require a number of complex crossings including existing pipelines. The North Alternative would have a greater impact on the Chester Zoo biodiversity site.

4.5.46. The Statutory Consultation Response from the Cheshire Wildlife Trust was taken into consideration and the South Alternative, which crosses fewer minor watercourses and avoids two parcels of woodland, was selected as the preferred option. The South Alternative has been optimised as a result of design development and input from surveys and has been moved slightly further south as shown in the route alignment in **Figure 4-4 (Volume IV)**. The Shropshire Union Canal is proposed to be crossed via trenchless construction method, due to the environmental sensitivities of the watercourse, as was also noted in Statutory Consultation responses.

Mollington Railway Crossing (Section 3)

4.5.47. Following Non-Statutory Consultation in Summer 2021, further studies identified trunk water mains at Mollington which would restrict space for construction of the Newbuild Carbon Dioxide Pipeline. As such an alternative route option further south near Station Road at Lea-by-Backford was developed which provides an easier crossing of these watermains. The North Alternative has a more constrained working area and would require the pipeline to be buried much deeper as the railway is in a cutting in this location. The two alternatives presented during Statutory Consultation in Spring 2022 for the Chester and Birkenhead Railway line crossing at Mollington, are shown in **Figure 4-5 (Volume IV)**.

4.5.48. Fewer hedgerows would be impacted by the Mollington South Alternative and the deciduous woodland would be avoided through the use of trenchless crossing techniques. However, the Mollington South Alternative would result in the loss of river habitat and would require mitigation.

4.5.49. Preference for the South Alternative was identified by Cheshire Wildlife Trust following the Statutory Consultation, as this route would avoid direct impacts to the Lea by Backford Railway Cutting Local Wildlife Site. Both routes have potential for construction noise and air quality impacts to St Oswalds CE Aided Primary School, however, it would be possible to mitigate by undertaking works within the school holidays.

4.5.50. The Mollington South Alternative performed slightly better than the North Alternative on environment, planning and land criteria, however, the North Alternative is slightly further away from some heritage designations such as Listed Buildings and Chester Canal Conservation Area. The North Alternative would also be preferred for impact on designated water sites.

4.5.51. The South Alternative was taken forward as the preferred option and modified to provide perpendicular crossings of existing buried utilities and Station Road.

Watercourses

4.5.52. There are three major water crossings along the Stanlow AGI to Flint AGI Pipeline (River Gowy, River Dee and Shropshire Union Canal). These would be crossed using trenchless techniques. Suitable crossing methods for each watercourse were evaluated, with topography and existing infrastructure being key considerations for selection of the preferred construction method.

4.5.53. Minor water crossings will be completed by open-cut trench methods unless there are specific considerations that require otherwise.

Alltami Brook (Section 5)

4.5.54. Alltami Brook located between Ewloe Green and Northop Hall (Section 5), lies within a small valley lined with trees on both sides for most of its length.

4.5.55. Two route options were assessed to cross the brook. These route options were presented during Statutory Consultation in Spring 2022 and are shown in **Figure 4-6 (Volume IV)**. The North Alternative is located in an area of historic coal mining which would present construction risks. The South Alternative is a shorter route and would result in reduced habitat loss compared to the North Alternative and was preferred by the Cheshire Wildlife Trust as it would reduce impacts to the Brook Park Farm Local Wildlife Site. The South Alternative is further from residential properties but would cross the brook in an area with steeper topography as well as potentially in an area of historic landfill (however, potential impacts associated with management of material arisings can be mitigated). Due to the reduced impacts to residential and ecological receptors (Habitats of Principal Importance and LWS), the South Alternative was taken forward as the preferred option.

4.5.56. Alternative methods considered for crossing Alltami Brook include:

- Open trench with temporary diversion of flow. This would require significant temporary works to allow construction equipment and materials to be transported into the gorge. It would require excavating to the depth of the gorge, crossing underneath the brook and coming back up the other side. Micro siting and other construction measures would be needed to optimise the route on the north-west side to avoid or reduce tree loss. Following installation of the pipeline the brook would be returned to its original hydraulic conditions, with no long-term change to flow.
- Trenchless (HDD or Auger Bore). The HDD would have to be designed to a depth of 20 metres to ensure passing under the brook to achieve the required bend radius of the proposed pipeline. The Auger Bore method would require tree removal to install deep entrance pits through shallow bedrock. Due to the high risk of encountering: historical coal workings; polluted mine water; and variable material within the landfill, the trenchless option was considered high risk and potentially high cost.
- Buried pipeline over a culvert. This involves the construction of an approximately 5m long concrete culvert across the stream and routing the pipeline over it. This would involve shallow trenching either side of the brook. The culvert would have a more significant permanent environment impact, both visually and to the public footpath along the gorge, which would need to be modified to cross over the pipeline.
- Pipeline Bridge. Piers would be required on the sides of the gorge to support the pipeline, leaving the stream unaffected by construction. However,

sizeable excavation would be required for the supports, resulting in tree loss and visual impacts. As the only exposed section of pipeline along the route, routine inspections would be required to ensure the integrity of the supports and pipeline. The exposed pipeline section would also present a greater risk for safety, due to the proximity to residences and the Northop Hall Country House Hotel and wedding venue, located off the B5125 and footpath adjacent to the brook. Permanent safety fencing would need to be installed, monitored and maintained to prevent trespass, vandalism and associated safety risks due to the height of the drop from the suspended pipeline into the gorge.

- Local rerouting. Rerouting to the north would present an increased risk of encountering historical mine shafts with more potential ecological impacts. There is little margin to go south due to the A55 which runs parallel to the pipeline route. Re-routing across the existing A55 culvert (via trenchless crossing or pipe bridge) would require works within the existing road embankment. Works within the road embankment have the potential to result in settlement affecting the stability of the road and would require closure of the eastbound A55 for an extended period during construction. Re-routing further south to cross the brook immediately downstream of the A55 culvert would require rerouting of nearby high voltage overhead lines.

4.5.57. Rerouting south of the A55 is not considered a viable option due to the presence of Ancient Woodland and a clay quarry. Avoiding Alltami is not a feasible option for the pipeline route and the trenchless options were considered high risk and high cost due to the presence of coal workings, rugged topography and potential to encounter polluted mine-water. The open trench method, whilst having significant construction impacts, would avoid the long-term public safety risk and visual impacts associated with a pipeline bridge and would result in minimal long term changes to flow associated with the installation of a culvert. As such the open trench method of construction is considered the preferred option for crossing Alltami Brook. Whilst this will have significant temporary impacts on the watercourse, mitigation measures have been developed to minimise impacts through reducing overall working width and width of the trench, as well as micrositing to the least sensitive section of the riverbed as outlined in **Table 48** and detailed in the **Register of Environmental Actions and Commitments (REAC) (Document Reference: D.6.5.1).**

4.6. ABOVE GROUND INSTALLATIONS (AGI) – ALTERNATIVE SITES

4.6.1. The location of each AGI is largely dictated by its ability to maximise opportunities for connecting into upstream emitters. The size of each AGI is driven by the infrastructure requirements (for example, number of pipeline connections). In terms of design of individual AGIs, the route of the pipeline dictates the location of the pig traps and the location of the incoming connections determines the location of the manifolds. Local conditions such as land use and visual impacts, presence of existing utilities and access were also considered during design which evolved to minimise identified impacts. Further details of the AGI design are provided in **Chapter 3 – Description of the DCO Proposed Development (Volume II)**.

4.6.2. Four AGIs are proposed along the Newbuild Carbon Dioxide Pipeline route. The justification for the location of the AGIs including alternatives considered is provided in **Table 4.4**. These options also review locations for 6m wide permanent access tracks to the AGIs considering length, location, sensitive receptors and safety.

Table 4.4: AGI Alternatives Considered

AGI	Consideration of Alternatives
Ince	Three options have been identified for location of the AGI, taking into consideration potential future CO_2 connections. A north option in agricultural land to the north of Marsh Lane, a central option in the overflow carpark to the south of Marsh Lane opposite the Ince Bio Power station, and a south option in agricultural land to the south of CF Fertilisers UK. These options, which were developed with consideration of existing utilities and future development in the locality, are shown in **Figure 4-7 (Volume IV)**. None of the three options had any particular advantage in terms of likely environmental impacts and all three locations are technically feasible. As such minimising disruption to stakeholders has been the key factor in determining a preferred option. The north option has the potential to disrupt existing planning conditions and construction of the Protos Phase 2 & 3 development, the central option would reduce available space for vehicle movements within the parking area in this location. The south option was considered to have the least disruption to

AGI	Consideration of Alternatives
	existing site activities and Protos during the construction, but would require longer pipelines across CF Fertilisers land. The south option would have the least disruption to existing facilities and future construction activities associated with Protos. It would also enable future potential industrial emitters within the Protos development site to connect following closure of CF Fertilisers. As such, this option has been taken forward as the preferred option.
Stanlow	In 2021 the Applicant conducted a review to determine options for the location and orientation of the AGI proposed within the existing Essar Manufacturing Complex at Stanlow. This was undertaken to optimise the location with due consideration of AGIs for the future Natural Gas (CADENT) and Hydrogen (Essar). PEL/Essar provided a land allocation within the Essar complex for an integrated HyNet Project. The siting of the AGI needs to allow space for future expansion and flexibility for future emitters. The area allocated for siting the AGIs is shaded in **Figure 4-8 (Volume IV).** Due to the industrial setting, health and safety and access were key considerations. Locating the AGI within the centre of the allocated area would position the AGI between the two other proposed AGIs (CADENT and Essar) and would prevent future expansion to the east and west. It would require the incoming pipeline to cross buried power cables and raw water mains. The preliminary routing of the pipeline corridor into the AGI would be located in close proximity to the traveller camp located to the south of the A5117, which is seen as a risk in terms of gaining consent as well as complications for installation. Locating the AGI in the western section of the allocated area would allow a direct approach into the refinery property and would be easier to construct as it would be closer to the temporary construction compound and laydown areas. The location of the AGI has been adjusted north following input on the likely siting of the AGI associated with the natural gas CADENT proposal, with the pipelines routed to maximise distance from the traveller camp.

AGI	Consideration of Alternatives
Northop Hall	The Northop Hall AGI options are shown in **Figure 4-9 (Volume IV)**. Originally Northop Hall was identified as a BVS, which was required to allow segmentation of the pipeline. However, it also provided a convenient location for the connection to future emitters and the requirement for above ground equipment and pipework in this location transitioned it into an AGI. Option 1, in fields north of Magazine Lane, was identified early in the preliminary design phase. However, this provided challenges for connection of future emitters. The identification of a potential future housing development triggered a high-level review of options for the pipeline south of the A55 and further from residential development. This simplified the connection for future emitters but added two trenchless crossings and increased pipeline length by approximately 300m and also impacted on Ancient Woodland. Therefore, locations to the south of the A55 were discounted. A further option (Option 2), was developed, located just south of the B5125 and the Highfield Hall Wedding Venue which provides an easier connection for potential future pipeline connections from other emitters, as such was selected as the preferred option. Following Statutory Consultation, the landowner requested the location of the AGI was reviewed to avoid severance and reduced productivity of the field. Alternative locations to the west were considered, however this would result in potential impacts upon the setting of the Grade II Listed Highfield Hall, while moving to the south risks impacting woodland, surface water bodies or an area of Ancient Woodland and to the east risks impacting local residents. Therefore, design development resulted in micrositing of Option 2 by positioning the AGI nearer to the field boundary.
Flint	Three options were considered for location of the Flint AGI. These are shown in **Figure 4-10 (Volume IV)**. Following confirmation of the preferred route for the 36” Newbuild Carbon Dioxide Pipeline, further design work was undertaken to determine where the end of the pipeline should connect to the existing natural gas pipeline at Flint. Three spurs were included to provide flexibility for the location of the AGI.

AGI	Consideration of Alternatives
	The West Option and associated spur avoids an Ancient Woodland, but would have a direct impact on Flint Mountain SSSI and passes through Crown Land and within 250m of a Scheduled Monument (Bryn y Cwm Mound & Bailey Castle). The spur for the Central Option passes north towards a connection close to Coed Onn Road/Allt-Goch Lane. This option avoids residential areas and designated ecological sites, but does pass in proximity to agricultural buildings and close to an area of Ancient Woodland. The East Option spur passes in a north-east direction to a connection close to Leadbrook Drive. The option avoids direct impacts to national or local ecology or landscape designations, but crosses an area of Ancient Woodland, and passes within 1km of Oakenholt Hall Conservation Area and three Grade II listed building. The Central Option is preferred as it is located further away from the Scheduled Monument, does not impact on designated ecological sites and does not impact on Crown Land and residential areas. The location has been adjusted south to minimise impacts to farmland.

4.7. BLOCK VALVE STATIONS (BVS) – ALTERNATIVE SITES

4.7.1. Block Valve Stations (BVSs) are required to be located along the length of the Carbon Dioxide Pipeline, as described in **Chapter 3: Description of the DCO Proposed Development** (**Volume II)**.

4.7.2. The number of and location of BVSs is a function of the volume of CO_2 that could be released, its rate of release, and the way in which it disperses.

4.7.3. The identification of the number and location of BVSs is based on an 'As Low As Reasonably Possible' (ALARP) approach, whereby any potential health and safety risks are reduced to ALARP and is based on topography, population density, ease of access and CO_2 dispersion characteristics.

4.7.4. Being heavier than air CO_2 will tend to pool, (until it is dispersed by, for example, air movement by wind). Elevated CO_2 can affect human behaviour, in lower concentrations (1-2% concentration in air) it can cause an increase in the rate of breathing, cause headaches and tiredness. In higher concentrations (>5%), exposure can lead to more severe symptoms, unconsciousness and death from asphyxiation. Locating BVSs near residential areas or other areas where people might congregate that are at the bottom of a hill or slope, will provide a potential situation in which a leak of CO_2 could present a hazard if the concentrations were high enough. Similarly prevailing wind direction will have an influence on the risk posed by CO_2, whereby instead of dispersing the CO_2, the wind blows it towards residences and other sensitive receptors.

4.7.5. **Table 4.5** provides details of the alternatives and justification for the three BVSs proposed along the pipeline route between Stanlow AGI and Flint AGI Pipeline. Three further BVSs located along the existing Flint Connection to Point of Ayr Terminal Pipeline are detailed in **Table 4.6**. These have also been assessed within **Chapter 4 – Consideration of Alternatives (Volume II)** for the **TCPA Proposed Development ES (Document Reference: T.4)**.

4.7.6. The potential locations for BVSs also took into consideration options for the 3m wide permanent access tracks required and considered length, location, sensitive receptors and safety.

4.7.7. Details of the BVS design is provided in **Chapter 3 – Description of the DCO Proposed Development (Volume II).**

Table 4.5: BVS Alternatives Considered (Stanlow AGI to Flint AGI Pipeline)

BVS	Consideration of Alternatives
Rock Bank	Only one location along the pipeline route has been considered for location of the Rock Bank BVS. This site in context to the surrounding land use and topography is shown in **Figure 4-11 (Volume IV).** The site selection considered the local topography, ease of access from Chorlton Lane with micrositing undertaken to minimise construction impacts on hedgerows and conflict with existing overhead lines as can be seen in **Figure 4-11 (Volume IV).**
Mollington	Options considered for location of the Mollington BVS are shown in **Figure 4-12 (Volume IV).** Option 1, located within a field north of Mollington Court, on the pipeline route was originally identified as a potential location for the BVS. However, forward visibility for vehicular access/egress of the site from the existing field access on Townfield Lane was poor and an alternate option (Option 2) was developed, with access from Overwood Lane. Option 2 was identified as the preferred option as it has safer access. Further adjustments were made to minimise land take by locating Option 2 in the south-west corner of the field.
Aston Hill	The two options considered for location of the Aston Hill BVS are shown in **Figure 4-13 (Volume IV).** Initially Option 1 was identified for the BVS. However, the topographic survey showed that the land rose sharply up to the railway line in this location which would require significant earth movement to prepare the site for construction. In addition, there is a well utilised PRoW running through the field which would need to be permanently diverted. Option 2 is located slightly to the west and further from Overlea Drive. Although the pipeline still cuts through the field and there is a temporary PRoW diversion required, the duration for disruption to users is shorter. The area where Option 2 is located is relatively flat in comparison to Option 1, so due to the benefits for construction and PRoW disruption Option 2 was selected as the preferred location for the Aston Hill AGI. The pipeline route in this location did originally run through the centre of the field, but was adjusted south east, closer to Overlea Drive as the Aston Lea

BVS	Consideration of Alternatives
	Care Home to the north west was considered a sensitive population centre under Land Use Planning.

Table 4.6: BVS alternatives considered (Flint Connection to PoA Terminal Pipeline)

BVS	Consideration of Alternatives
Coed-y-Cra	A location for a BVS at Coed-y-Cra was identified and presented during the Statutory Consultation in Spring 2022. Following technical review of the BVS locations it was identified that a fourth BVS would not be required and due to the proximity to the Cornist Lane BVS and the Flint AGI, the Coed-y-Cra BVS has since been removed from both the DCO Proposed Development and TCPA Proposed Development.
Cornist Lane	Topography and existing development limited the options available along the pipeline in this location. One area along the pipeline route was considered for the BVS. Locating the BVS in a flat, accessible field, maximising separation from the overhead line that cuts through the southern corner of the field was the priority for the BVS at Cornist Lane. These features are shown in **Figure 4-14 (Volume IV)**. The BVS is located such that the BVS and associated pipeline is 40m from the overhead line to avoid interference with the pipeline cathodic protection.
Pentre Halkyn	Options considered for location of the Pentre Halkyn BVS are shown in **Figure 4-15 (Volume IV).** The three locations include: Beyn-y-Grug. This was the first location identified during design of the DCO Proposed Development. The site is located on farmland midway between Babell and Pentre Halkyn, however, this was considered too close to an occupied building and due to potential health and safety risks further options were investigated to the east and west. East of Beyn-y-Grug. This east option had greater visual impacts and the BVS and the associated access track would result in making a portion of the field unfarmable as such was rejected. West of Beyn-y-Grug. The west option was located further from local residences, had better access and could be installed along the field boundary reducing the impact on farmland, as such the western option was chosen as the preferred option.

BVS	Consideration of Alternatives
Babell	Only one location was considered for the Babell BVS within flat agricultural land accessed via a track off Racecourse Lane to the west. This is shown in **Figure 4-16 (Volume IV).** This location was identified during the initial analysis. The location was chosen as it minimises land take and maximises distance from the overhead line in the field to the north. As impacts could be minimised through micrositing, no further options were considered.

4.8. CONSTRUCTION COMPOUND ALTERNATIVES

4.8.1. Temporary infrastructure required to facilitate the construction of the DCO Proposed Development is described in **Chapter 3 - Description of the DCO Proposed Development (Volume II)** and includes:

- Construction Compounds (Centralised, Trenchless Crossing and Localised);
- Additional working areas, including equipment yards, groundwater storage and treatment areas; and
- Temporary access tracks to the construction compounds and working areas.

4.8.2. The construction compounds and working areas need to be adjacent to the work front and will be distributed along the pipeline route. Centralised Compounds will be larger and house workshops and warehouses, with the Localised Compounds being located near the major crossings, AGIs and BVSs.

4.8.3. Areas of high environmental and social sensitivity have been avoided and compounds located to minimise effects on receptors where practicable.

4.8.4. The siting of the localised compounds has been refined during development of design and during consideration of construction methods. Options for localised compounds are restricted as they need to be in close proximity to the working front that they service. They will be smaller and may not be in place for the entire construction period, as such the alternatives considered in this section focus on the main Centralised Compounds.

4.8.5. The locations of the Centralised Compounds were identified in the PEIR. The location and design of some of these have been refined following Statutory Consultation and in conjunction with the landowners. The changes from the PEIR are detailed in **Table 4.7.**

Table 4.7: Centralised Construction Compounds Evolution

Centralised Compound Identified in PEIR	Construction Design Evolution
Two compounds approximately 200 metres apart between Ince and Stanlow AGIs were identified in the PEIR. The western compound was located along Old Cryers Lane off Cryers Lane and the eastern compound adjacent to Hill View Way (A5117) and New Dairy Farm.	Reduced to one Centralised Compound at Stanlow following Statutory Consultation. The western Centralised Compound was optimised and has been designed in consultation with the landowner and moved south further away from sensitive receptors at Elton Green and a Scheduled Monument and now extends further south than that shown in the PEIR. The preferred location and other areas considered at Stanlow are shown in **Figure 4-17 (Volume IV).**
Picton Lane Compound.	No significant design changes from the PEIR.
Chorlton Lane Compound.	No significant design changes from the PEIR.
Sealand Road Compound.	No significant design changes from the PEIR. This compound is a back-up compound and would be used as an alternative if Wood Farm could not be used.
No compound identified in this location in the PEIR. A compound site at Wood Farm was identified following completion of Statutory Consultation.	Addition of a compound on the east side of the Dee Estuary at Wood Farm following the completion of Statutory Consultation as shown in **Figure 3-2 DCO Proposed Development (Volume IV)**. This is located in an area of existing hardstand and is accessed from Deeside Lane. It provides an alternative to the Sealand Road Compound which would not be used if Wood Farm Compound is taken forward.
River Dee Compound	No significant design changes from the PEIR.

Centralised Compound Identified in PEIR	Construction Design Evolution
Shotton Lane Compound.	No significant design changes from the PEIR.
Northop Hall Compound.	The compound in the vicinity of Northop Hall was located off Starkey Lane, just north of Northop Brook as shown in **Figure 4-18 (Volume IV)**. Due to difficult vehicle access off Starkey Road the compound in this area was moved further south east, within open fields accessed from Village Road (B5125).

4.8.6. Details of the facilities to be included in the compounds and likely layout is provided in **Chapter 3 – Description of the DCO Proposed Development (Volume II)**.

4.9. MITIGATION BY DESIGN

4.9.1. This section summarises the embedded and good practice mitigation intended to reduce potential environmental impacts that are included within the design and documentation for the DCO Application.

EMBEDDED MITIGATION

4.9.2. Consideration has been given to the potential environmental effects for which embedded mitigation is required. This includes route-wide design measures and more specific design measures associated with the development of the pipeline route and associated infrastructure.

4.9.3. A summary of embedded mitigation is provided in **Table 4.8.**

Table 4.8: Embedded Mitigation

Embedded Mitigation	Purpose
Design route alignment and/or construction methods to avoid direct impacts to areas of existing classified Ancient Woodland (**D-BD-008** of the **REAC, Document Reference: D.6.5.1**).	To avoid loss of existing classified Ancient Woodland in England and Wales.
Design route alignment to avoid high value habitats wherever possible. However, it has not been possible to avoid all high value habitats along the pipeline route. Where losses have been unavoidable, habitats that will not be permanently lost during construction are to be reinstated upon completion of the works (**D-BD-016, D-BD-053, D-BD-055, D-BD-062**) of the **REAC, Document Reference: D.6.5.1**).	To reduce permanent biodiversity loss.
To utilise existing field access points, where available and practicable (**D-LV-030**) of the **REAC, Document Reference: D.6.5.1**).	To reduce the need for loss of existing vegetation
Where new temporary construction accesses are required in existing hedgerows, the width to be lost will be kept to the minimum practicable and will not exceed 15m (**D-LV-030**) of the **REAC, Document Reference: D.6.5.1**).	To reduce the need for loss of existing vegetation
At Alltami Brook, the working width for this open cut crossing would be reduced to 16m. Within this length of the watercourse there would be removal of riparian vegetation and temporary culverting of the watercourse. The maximum width of the trench would be 4m, which is the length of the watercourse which would have the permanent loss of bedrock riverbed (**D-WR-063**) of the **REAC, Document Reference: D.6.5.1**).	To reduce the effects on bedrock riverbed at Alltami Brook

Embedded Mitigation	Purpose
Trenchless construction techniques are to be used for all crossings of trunk roads, motorways, railways, and major waterways (including the River Dee and Shropshire Union Canal) (**D-PD-001**) of the **REAC, Document Reference: D.6.5.1**).	To reduce disruption and avoid the need for closures resulting in major effects on users of the local highway network and communities.
The principles of inherent safe design have been incorporated into the design of the pipeline as per relevant industry codes of practice and standards and the requirements of the Pipeline Safety Regulations 1996 (**D-CA-001)** of the **REAC, Document Reference: D.6.5.1**).	To avoid potential effects on sensitive environmental receptors
Inclusion of remotely operated valves to allow isolation of sections of the pipeline if required (**D-CA-002**) of the **REAC, Document Reference: D.6.5.1**).	To avoid potential effects on sensitive environmental receptors
24-hour remote monitoring of pipeline operation to detect leaks and enable remote shut down of the pipeline if required (**D-CA-003**) of the **REAC, Document Reference: D.6.5.1**).	To avoid potential effects on sensitive environmental receptors

4.9.4. The mitigation measures identified through the design and assessment process have been incorporated into the **REAC** (**Document reference: D.6.5.1).**

4.10. REFERENCES

- **Ref. 4-1**: The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/572/contents/made.
- **Ref. 4.2**: HM Government (2021) industrial Decarbonisation Strategy. Available at:
- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/970229/Industrial_Decarbonisation_Strategy_March_2021.pdf
- **Ref. 4.3**: HM Government (2022) British Energy Security Strategy. Available at:

- https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy
- **Ref. 4.4**: HM Government (2021) UK Hydrogen Strategy. Available at:
- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf
- **Ref. 4-5**: Net-Zero: The UK's contribution to stopping global warming, Committee on Climate Change (May 2019). Available at: [redacted].
- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf
- **Ref 4.6**: Draft Overarching National Policy Statement for Energy (EN-1), Department for Business, Energy, and Industrial Strategy (September 2021). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015233/en-1-draft-for-consultation.pdf.
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