HyNet North West Hydrogen Pipeline

Delivering clean growth

Appendix 7B
Preliminary Flood Risk Assessment

September 2022
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1. Introduction

1.1 Context

1.1.1 This preliminary Flood Risk Assessment (pFRA) accompanies **Chapter 7: Water environment**, of the Preliminary Environmental Information Report (PEIR). The PEIR is the written output of the Environmental Impact Assessment (EIA) undertaken to date for HyNet North West Hydrogen Pipeline Project ('the Project') proposed in the North West of England.

1.1.2 The pFRA should also be read in conjunction with the full description of the Project provided in **Chapter 2: The Project**.

1.1.3 The Project is a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008 (the 'Act')[1]. Under Section 31 of the Act, development consent is required for development to the extent that it is or forms part of an NSIP. Development consent is granted by the making of a Development Consent Order (DCO) for which an application may be made under Section 37 of the Act to the Secretary of State (delegated to the Planning Inspectorate (PINS)). The pFRA accompanies the Section 42 statutory consultation materials, ahead of the submission of the DCO application.

1.1.4 The pFRA provides an overview of potential sources of flood risk to the Project from tidal, fluvial, surface water, groundwater and artificial sources. It also considers any potential impacts on flood risk exerted by the Project towards other receptors. The potential impact of climate change on flood risk is considered throughout the assessment.

1.1.5 This preliminary assessment will be further revised and developed in line with emerging design information and feedback from Section 42 consultation to form a full Flood Risk Assessment (FRA) to accompany the subsequent Environmental Statement (ES) which will accompany the DCO application.

1.1.6 This pFRA has been prepared in accordance with the overarching National Policy Statement (NPS) for Energy EN-1[2] and NPS for Gas Supply Infrastructure and Gas and Oil Pipelines EN-4[3]. EN-1 and EN-4 are in the process of being revised

[1]UK Government (2008) The Planning Act 2008. (online) Available at: https://www.legislation.gov.uk/ukpga/2008/29/contents (Accessed August 2022).
[2] Department of Energy and Climate Change (2011). Overarching National Policy Statement for Energy (EN-1). (Online) Available at: https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure (Accessed August 2022).
[3] Department of Energy and Climate Change (2011). National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4). (Online) Available at: https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure (Accessed August 2022).

and at the time of writing both the revised NPS for Energy EN-1[4] and revised National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines[5] are in draft.

1.1.7 Reference has also been made to the National Planning Policy Framework (NPPF)[6] and associated Planning Practice Guidance[7] where relevant for additional guidance regarding flood risk and development, as appropriate. The development of this assessment has also been informed by consultation and engagement with key stakeholders, including the Environment Agency, and the following Lead Local Flood Authorities (LLFAs) which overlap the project area: Cheshire East Council; Cheshire West and Chester Council; Halton Borough Council; St Helens Borough Council; Trafford Council; and Warrington Borough Council.

1.2 Scope

1.2.1 This pFRA accompanies the PEIR, and as such does not provide the final FRA as will be necessary to accompany ES for the DCO application. This pFRA seeks to present preliminary flood risk information, namely a high-level overview of the flood risk baseline, the relevant elements of the Project, and the potential environmental measures that could be embedded within the final design (and / or enacted / implemented during the construction phase). The document has been produced to facilitate comment from stakeholders on the emerging design and therefore influence the FRA that will accompany the DCO application. It also aims to define the scope of any additional detailed assessment required to inform the final FRA and outline drainage strategy submitted with the DCO application.

1.2.2 This pFRA considers the flood risks associated with the construction and operation phases of the Project. Both flood risks to the Project from external sources and flood risks arising from the Project to external receptors are considered. The pFRA covers the Preliminary Order Limits, which is the anticipated maximum extent of

[4] Department for Business Energy & Industrial Strategy (2021). Draft Overarching National Policy Statement for Energy (EN-1). (Online) Available at https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements (Accessed August 2022).
[5] Department for Business Energy & industrial Strategy (2021). Draft National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4). (Online) Available at https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements (Accessed August 2022).
[6] Ministry of Housing, Communities and Local Government (2021). National Planning Policy Framework (updated 20 July 2021). (Online) Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2. (Accessed August 2022).
[7] Ministry of Housing, Communities and Local Government (2021). Planning Practice Guidance on Flood Risk and Coastal Change Framework (updated 20 August 2021). (Online) Available at https://www.gov.uk/guidance/flood-risk-and-coastal-change. (Accessed August 2022).

land in which the Project, including construction works, would take place. The Preliminary Order Limits are also illustrated in **Figure 1.1, Chapter 1**.

1.2.3 This pFRA follows a source-pathway-receptor led approach to the assessment of flood risk. Sources are defined as the source of the flood risk, such as direct rainfall, watercourses, the sea, groundwater or artificial sources. Pathways define the means by which the source of flood risk can impact receptors. A specific combination of sources and pathways is referred to as a flood mechanism, such as tidal overtopping of the sea defences as a result of high tides and storm surge. Receptors comprise those persons or assets that could be vulnerable to the flood mechanisms identified.

1.2.4 With due consideration of the temporary nature of many of the elements of the Project, which are only required during construction of the pipeline, the approach taken in this assessment is considered to be proportionate to the risk and appropriate to the scale, nature and location of the Project.

1.3 Sources of information

1.3.1 Sources of data and information consulted as part of this pFRA are detailed within **Table 1.1**.

Table 1.1 Sources of Data

Data	Source	Purpose
Environment Agency Statutory Main River Map	https://data.gov.uk/	Definition of watercourses, in relation to the development
Flood Map for Planning	https://flood-map-for-planning.service.gov.uk/	For assessment of fluvial and tidal flood risk
Risk of Flooding from Surface Water (RoFSW) Mapping	https://flood-warning-information.service.gov.uk/long-term-flood-risk/map	For assessment of surface water flood risk
Susceptivity to Groundwater Flooding Map (StGWF)	British Geological Survey (BGS)	For assessment of groundwater flood risk
Flood Risk from Reservoirs Mapping	https://flood-warning-information.service.gov.uk/long-term-flood-risk/map	For assessing reservoir flood risk
Geological Mapping	British Geological Survey (BGS) Geology of Britain Viewer: https://mapapps.bgs.ac.uk/geologyofbritain/home.html	Geological Mapping

Data	Source	Purpose
	BGS Onshore GeoIndex: http://mapapps2.bgs.ac.uk/geoindex/home.html BGS Hydrogeological mapping: http://www.largeimages.bgs.ac.uk/iip/hydromaps.html?id=south-downs.jp2 http://www.largeimages.bgs.ac.uk/iip/hydromaps.html?id=england-wales.jp2	
Aquifer Designations	http://www.magic.gov.uk/	To characterise the underlying aquifers and hydrogeology
Soils Mapping	http://www.landis.org.uk/soilscapes/	To characterise the underling soil type
Environment Agency flood model data	Environment Agency modelled flood extents for the various flood models within the Preliminary Order Limits.	For assessment of fluvial and tidal flood risks

1.3.2 At the PEIR stage, all available data has been used to undertake the assessment, but no new, additional modelling has been undertaken. Modelling identified as being required as a result of this pFRA will be completed and included in the final FRA submitted in support of the DCO application. This pFRA has primarily used the Environment Agency's openly available flood maps for fluvial and surface water flood risk, though the Environment Agency have provided some additional modelled flood extents for a number of models in the Preliminary Order Limits including (but not limited to):

- 2019 Lower Weaver;
- 2016 Mersey Estuary;
- 2016 Manchester Ship Canal; and
- 2017 Upper Mersey.

1.4 Flood event probability and flood zone definition

1.4.1 Throughout this report, the terminology 'Annual Exceedance Probability' (AEP) is used to describe the magnitude and likelihood of a flood event occurring. AEP

expresses the probability of a flood occurring in any given year. For example, what can sometimes be referred to as a '1 in 100 year flood event', is a flood with a 1 in 100 or 1% probability of occurring in any given year. Use of the AEP terminology makes it clearer that there is a probability of this magnitude of flooding occurring in any one year, not just once every 100 years.

1.4.2 **Table 1.2** is provided to clarify the use of the AEP terminology as well a description of the Flood Zone definitions as set out in the NPPF (MHCLG, 2021a) and its associated PPG (MHCLG, 2021b) on Flood Risk and Coastal Change, and which are shown on the Environment Agency's Flood Map for Planning.

Table 1.2 Flood Zone definitions and associated annual exceedance probability

Flood Zones	AEP	Flood Zone Definition
Flood Zone 1: Low probability	<0.1% AEP of river or sea flooding	Land with less than 1 in 1,000 probability of flooding from rivers or the sea, in any given year.
Flood Zone 2: Medium probability	1% - 0.1% AEP of river flooding 0.5% – 0.1% AEP of sea flooding	Land with between a 1 in 100 and 1 in 1,000 of river flooding; or land having between a 1 in 200 and 1 in 1,000 probability of sea flooding.
Flood Zone 3a: High Probability	>1% AEP of river flooding >0.5% AEP of sea flooding	Land having a 1 in 100 or greater probability of river flooding in any year; or Land having a 1 in 200 probability or greater of sea flooding in any year.
Flood Zone 3b: Functional Floodplain	The 5% AEP (or 1 in 20 annual probability) event is often used to help define Flood Zone 3b, the 'functional floodplain', but is not part of the definition	This zone comprises land where water has to flow or be stored in times of flood. Local Planning Authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

1.4.3 **Table 1.3** provides a summary of flood risk category definitions used in the Environment Agency's Risk of Flooding from Surface Water (RoFSW) mapping, which differ from those used to describe fluvial and tidal Flood Zones.

Table 1.3 Surface water flood risk category definitions and associated annual exceedance probability

Probability of flooding	AEP	Definition
Very low risk	<0.1% AEP of surface water flooding	Land with less than 1 in 1,000 probability of flooding from surface water, in any given year.
Low risk	0.1 – 1% AEP of surface water flooding	Land with between 1 in 1,000 and 1 in 100 probability of flooding from surface water, in any given year.
Medium risk	1 – 3.3% AEP of surface water flooding	Land with between 1 in 100 and 1 in 30 probability of flooding from surface water, in any given year.
High risk	>3.3% AEP of surface water flooding	Land with more than 1 in 30 probability of flooding from surface water, in any given year.

1.5 Structure of pFRA

1.5.1 The remainder of this pFRA is structured as follows:

- **Section 2** establishes the planning policy context for the assessment;
- **Section 3** provides an overview of the relevant characteristics of the Preliminary Order Limits and a description of the Project;
- **Section 4** comprises a screening assessment to consider the potential risk from all sources of flooding prevailing across the Preliminary Order Limits;
- **Section 5** presents an initial assessment of flood risks associated with the Project;
- **Section 6** specifies potential flood risk management measures that could be available to address the potential risks identified in **Section 5**;
- **Section 7** sets out how the specific planning requirements have been / will be addressed in the final FRA, including the Sequential and Exception Tests; and
- **Section 8** presents a summary and concluding comments.

2. Planning Policy Context and Requirements

2.1 Introduction

2.1.1 The purpose of this section is to identify the key planning policy documents that define the scope of this pFRA. This section concludes by summarising the flood risk requirements applicable to this pFRA. The section is structured in a hierarchical order, from national policy down to local guidance.

2.2 National Policies and Guidance

2.2.1 The Project is defined as a Nationally Significant Infrastructure Project (NSIP) under Section 14(1)(f) of the Act[1] .Therefore, a DCO is required to authorise the Project.

2.2.2 The Act[1]requires that DCO applications must be determined in line with the requirements of the relevant NPSs which provide the overarching principles relevant to major energy infrastructure and the policies against which applications for NSIPs should be determined.

2.2.3 In a hierarchical context, the FRA will be prepared in accordance with the Act[1], NPS EN-1[2], which sets out planning policy with regard to NSIPs in the energy sector, and NPS EN-4[3], which covers gas supply and storage. Reference will also be made to NPPF[6] and its associated PPG[7] as set out in the next section.

National Policy Statement (NPS) for Energy (EN-1)

Overarching NPS for Energy (EN-1)

2.2.4 NPSs set out government planning policy for NSIPs in England and Wales. The Overarching NPS for Energy (EN-1) [2] establishes national policy for energy infrastructure and have effect on the decisions by the Secretary of State for Business, Energy and Industrial Strategy (BEIS) on applications for energy developments that fall within the scope of the NPSs.

2.2.5 In September 2021, the Draft NPS EN-1[4] was published for consultation but has yet to be finalised. The relevant paragraphs of the Draft NPS EN-1 have been outlined in **Table 2.1** alongside the current EN-1 requirements.

2.2.6 The 'minimum requirements for FRAs' are set out in paragraph 5.7.5 of EN-1 and 5.8.7 of the draft EN-1. In addition to these there are a number of other references to flood risk made throughout the NPS.

Table 2.1 EN-1 and Draft 2021 EN-1 minimum FRA requirements

EN-1 Minimum FRA Requirements	
Policy	EN-1 and Draft 2021 EN-1: The development proposal should be in line with any relevant national and local flood risk management strategies.
Scope of FRA	EN-1 and Draft 2021 EN-1: Be proportionate to the risk and appropriate to the scale, nature and location of the project.
Assessment	EN-1 and Draft 2021EN-1: Consider the risk of flooding arising from the project in addition to the risk of flooding to the project.
Climate change	EN-1 and Draft 2021 EN-1: Take the impacts of climate change into account, across a range of climate scenarios, clearly stating the development lifetime over which the assessment has been made.
Climate change	EN-1: As a minimum, the applicant should consider the emissions scenario that the Independent Committee on Climate Change suggests the world is currently most closely following – and the 10%, 50% and 90% estimate ranges. These results should be considered alongside relevant research which is based on the climate change projections *Draft 2021 EN-1: Applicants should assess the impacts on and from their proposed energy project across a range of climate change scenarios, in line with appropriate expert advice and guidance available at the time. Applicants should be able to demonstrate that proposals have a high level of climate resilience built-in from the outset. They should also be able to demonstrate how proposals can be adapted over their predicted lifetimes to remain resilient to a credible maximum climate change scenario. These results should be considered alongside relevant research which is based on the climate change projections*
Approach	EN-1 and Draft 2021 EN-1: Be undertaken by competent people, as early as possible in the process of preparing the proposal.
Baseline	EN-1 and Draft 2021 EN-1: Be supported by appropriate data and information, including historical information on previous events.
Vulnerability and safe access	EN-1 and Draft 2021 EN-1: Consider the vulnerability of those using the site, including arrangements for safe access.
Assessment	EN-1: Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made.

EN-1 Minimum FRA Requirements

	Draft 2021 EN-1: Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and include information on flood likelihood, speed-of-onset, depth, velocity, hazard and duration.
Assessment	*Draft 2021 EN-1:* Identify and secure opportunities to reduce the causes and impacts of flooding overall, making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management.
Assessment	EN-1 and Draft 2021 EN-1: Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes.
Assessment	EN-1: Consider if there is a need to be safe and remain operational during a worst-case flood event over the development's lifetime. *Draft 2021 EN-1: Detail those measures that will be included to ensure the development will be safe and remain operational during a flooding event throughout the development's lifetime without increasing flood risk elsewhere*
Assessment	EN-1: Where necessary, the development should be appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development (paragraph 5.7.9). *Draft 2021 EN-1: the project is designed and constructed to remain safe and operational during its lifetime, without increasing flood risk elsewhere (subject to the exceptions set out in 5.8.18). The project includes safe access and escape routes where required, as part of an agreed emergency plan, and that any residual risk can be safely managed over the lifetime of the development (paragraph 5.8.11)*
Residual risks	EN-1 and Draft 2021 EN-1: Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project.
Functional floodplain	EN-1 and Draft 2021 EN-1: The development should not result in a net loss of functional floodplain storage or impede water flows (within Flood Zone 3b)
Flood risk management infrastructure	EN-1 and Draft 2021 EN-1: Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure.

EN-1 Minimum FRA Requirements	
Flood warning and evacuation plan	EN-1: Flood warning and evacuation plans should be in place for those areas at an identified risk of flooding. The applicant should take advice from the emergency services when producing an evacuation plan for a manned energy project as part of the FRA. Any emergency planning documents, flood warning and evacuation procedures that are required should be identified in the FRA *Draft 2021 EN-1: The applicant should take advice from the local authority planning team, emergency services and, where appropriate, from local resilience forum when producing an evacuation plan for a manned energy project as part of the FRA*
Surface water runoff	EN-1 and Draft 2021 EN-1: Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems.
Drainage and Sustainable Drainage Systems (SuDS)	EN-1: The applicant should give priority to the use of SuDS and make provision for their adoption and maintenance (paragraphs 5.7.9 and 5.7.10). *Draft 2021 EN-1: Sustainable drainage systems (SuDs) (as required in the next paragraph on National Standards) are to be used in the design unless there is clear evidence that their use would be inappropriate (paragraphs 5.8.11 and 5.8.12).*
Drainage and SuDS	EN-1 and Draft 2021 EN-1: For construction work which has drainage implications, approval for the project's drainage system will form part of the DCO issued by PINS. The proposed drainage system should comply with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010 (paragraph 5.7.10 of EN-1 and paragraph 5.8.12 of Draft EN-1).
Drainage and SuDS	EN-1 and Draft 2021 EN-1: Site layout and surface water drainage systems should be designed to cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without any adverse impacts (paragraph 5.7.20 of EN-1 and paragraph 5.8.22 of Draft EN-1).
Drainage and SuDS	EN-1: The volumes and peak flow rates of surface water leaving the site should be no greater than the rates prior to the Project unless specific off-site arrangements are made and result in the same net effect (paragraph 5.7.21). *Draft 2021 EN-1: The surface water drainage arrangements must also account for the predicted impacts of climate change throughout the developments lifetime, on volumes and peak flow rates (paragraph 5.8.23).*
Sequential Test	EN-1: The Sequential Test and sequential approach should be applied.

EN-1 Minimum FRA Requirements	
	Draft 2021 EN-1: The Sequential Test and sequential approach should be applied. If essential energy infrastructure has to be located in such areas for operational reasons, they should only be consented if the development will not result in a net loss of floodplain storage and will not impede water flows.
Exception Test	EN-1: The Exception Test, where necessary, should be applied.

National Policy Statement (NPS) for Oil and Gas Supply and Storage (EN-4)

2.2.7 The NPS for Oil and Gas Supply and Storage (EN-4) (DECC, 2011b) establishes national policy for certain energy infrastructure and have effect on the decisions by the Secretary of State for BEIS on applications for energy developments that fall within the scope of the Act.

2.2.8 In September 2021, the Draft NPS EN-4 (DBEIS, 2021b) was published for consultation, but has yet to be finalised.

2.2.9 Sections of EN-4 and Draft 2021 EN-4 that are relevant to this assessment are as follows:

- Section 2.2 of EN-4 and Section 2.2 of Draft 2021 EN-4 Climate change adaptation refers to flood risk, stating that applicants should set out how the proposal will be resilient to increased risk of flooding.
- Section 2.22 of EN-4 and 2.22 of Draft 2021 EN-4 on Gas and Oil Pipelines Impacts: Water Quality and Resources states that in the case of aquifer storage the applicant should assess the impact of the displacement of groundwater with respect to its potential interference with groundwater flow pathways and flood risk.
- Section 2.22.6 of EN-4 and Section 2.22.6 of Draft 2021 EN- 4 refer to the use of sustainable drainage systems to control runoff as part of mitigation measures.

National Planning Policy Framework

2.2.10 The NPPF[6] acts as guidance for local planning authorities and decision makers, both in drawing up plans and making decisions about planning applications. This is supported by Planning Practice Guidance[7].

2.2.11 Although the NPPF and the associated Planning Practice Guidance are not directly applicable to NSIP developments, they do provide additional relevant guidance on a range of issues, including the definition of flood zones, development vulnerability classifications, compatibility of development types and flood zones, and appropriate allowances for the effects of climate change.

2.2.12 The NPPF sets out requirements for FRA for new developments and describes how the Sequential (Paragraph 161 and 162) and Exception Tests (Paragraph 163

and 164) should be applied, depending on the Flood Zone that the Project is located in, and its Flood Vulnerability classification. Paragraph 164 states that, *'To pass the exception test it should be demonstrated that:*

- *a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*
- *b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'*

2.2.13 Paragraph 167 of the NPPF requires that new development should not increase flood risk elsewhere, and that opportunities should be sought to reduce flood risk, where possible. Paragraph 167 states *'…Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*

- *a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- *b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
- *c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*
- *d) any residual risk can be safely managed; and*
- *e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.'*

2.2.14 Paragraph 169 of the NPPF states *'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:*

- *a) take account of advice from the lead local flood authority;*
- *b) have appropriate proposed minimum operational standards;*
- *c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- *d) where possible, provide multifunctional benefits.'*

2.2.15 There is a presumption for the use of sustainable drainage systems (SuDS) within any development, except in rare instances that it can be demonstrated that SuDS principles cannot be feasibly incorporated within a development, as agreed with the planning authority.

Climate Change Policy for FRA

2.2.16 National Policy Statement EN-1 and National Policy Statement EN-4 gives advice on accounting for climate change, to the effect that developments should be resilient and adaptive to the latest climate change projections. EN-1 and Draft 2021 EN-1 both state that the most up to date UK climate projections should be

used in the assessment of climate change effects on flood risk over the development lifetime.

2.2.17 Current Environment Agency Flood Risk Assessments: climate change allowances guidance[8] will be used to determine appropriate climate change allowances to determine future flood hazard for the FRA. The climate change allowances in the latest version of this guidance are based on the UKCP18 Climate Projections. Relevant allowances for the Project location are summarised in **Table 2.1** to **Table 2.4.**

2.2.18 The Environment Agency guidance provides climate change allowances for extreme rainfall and river flows by individual operational management catchment. The Project crosses three Environment Agency Management Catchments which are listed below (from north to south). The climate change allowance relevant to the Management Catchments listed below are set out in **Table 2.2** for river flows and **Table 2.3** for rainfall.

- Lower Mersey;
- Upper Mersey; and
- Weaver Gowy.

[8] Environment Agency (2022) Flood Risk Assessments: climate change allowances guidance. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances (Accessed August 2022).

Table 2.2 Climate change allowances – peak river flow allowances

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Peak river flows – Lower Mersey Management Catchment			
Upper end	32%	55%	90%
Higher central	22%	35%	57%
Central	18%	27%	44%
Peak river flows – Upper Mersey Management Catchment			
Upper end	27%	51%	85%
Higher central	17%	31%	53%
Central	13%	22%	41%
Peak river flows – Weaver Gowy Management Catchment			
Upper end	36%	64%	106%
Higher central	24%	40%	67%
Central	19%	30%	52%

(Based on a 1981 – 2000 baseline)

Table 2.3 Climate change allowances – peak rainfall allowances

Allowance category	Total potential change anticipated for the '2050s' (to 2060)	Total potential change anticipated for the '2070s' (2061 to 2125)
Peak rainfall – Lower Mersey Management Catchment – 3.33% AEP		
Upper end	35%	40%
Central	20%	30%
Peak rainfall – Lower Mersey Management Catchment – 1% AEP		
Upper end	40%	45%
Central	25%	30%
Peak rainfall – Upper Mersey Management Catchment – 3.33% AEP		
Upper end	35%	40%

Allowance category	Total potential change anticipated for the '2050s' (to 2060)	Total potential change anticipated for the '2070s' (2061 to 2125)
Central	20%	30%
Peak rainfall – Upper Mersey Management Catchment – 1% AEP		
Upper end	40%	45%
Central	25%	30%
Peak rainfall – Weaver Gowy Management Catchment – 3.3% AEP		
Upper end	35%	40%
Central	20%	25%
Peak rainfall – Weaver Gowy Management Catchment – 1% AEP		
Upper end	40%	45%
Central	25%	30%

(Based on a 1981 – 2000 baseline)

2.2.19 The Project is classified as essential infrastructure, therefore the guidance[8] states that for essential infrastructure in Flood Zones 2 or 3 the higher central allowance should be applied to river flows.

2.2.20 Additionally, as the Project is classed as a NSIP, the Environment Agency guidance[9] suggests sensitivity testing any design using a 'credible maximum' future scenario. For river flows, this corresponds to the 2080s upper end allowance.

2.2.21 The design life of the pipeline and HAGIs is 40 years but it is anticipated that the actual life of the pipeline could extend well over 40 years depending on its condition, as over time parts are likely to be refurbished or replaced through.

2.2.22 For the FRA it is assumed the lifetime of the development is not expected to extend beyond 2100. When considering surface water flooding, any development with a lifetime up to 2100 must be designed to be safe and ensure no increase in flood risk elsewhere for the Central rainfall allowance in the 1% AEP event. There is no requirement to assess a credible maximum surface water event.

2.2.23 Future uplifts in sea level are specified regionally. Those for North West England are detailed in **Table 2.4**. FRAs must assess both upper end and higher central when considering future tidal flood risk.

[9] Environment Agency (2022b) Flood Risk Assessments: climate change allowances guidance. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#credible-maximum-scenarios (Accessed August 2022).

2.2.24 Again, given the Project is classed as an NSIP, a maximum credible sensitivity test applying the H++ scenario of 1.9m for the total sea level rise to 2100 would be required to demonstrate the resilience of infrastructure to tidal flooding over its lifetime.

Table 2.4 Climate change allowances – sea level (North West)

Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Upper end	5.7 (200)	9.9 (297)	14.2 (426)	16.3 (489)	1.41
Higher central	4.5 (158)	7.3 (219)	10 (300)	11.2 (336)	1.01

2.3 Local Planning Policy

2.3.1 The Project traverses the areas of six local planning authorities (LPAs), Cheshire East Council, Cheshire West and Cheshire Council, Halton Borough Council, St Helens Borough Council, Trafford Council and Warrington Borough Council. Although, as an NSIP, the Project is not subject to LPA consent, LPAs are Statutory Consultees in the DCO process, and the Secretary of State may consider local planning policy to be relevant to the examination process. Local planning policies of relevance to flood risk and the Project are summarised below. Local planning policies should be aligned with the requirements of NPPF at national level, and this has generally been found to be the case.

Cheshire East Council

2.3.2 Cheshire East Council Local Plan Strategy (2017), Policy SE13 (Flood Risk and Water Management) requires all developments at risk of flooding should be supported by an appropriate Flood Risk Assessment (FRA) to reduce the risk of flooding taking into account the impacts of Climate Change in line with the Cheshire East Strategic Flood Risk Assessment (SFRA). In addition, improvements to the current surface water drainage network are sought and to be designed to manage surface water. This should include appropriate SuDS and must not result in an increase in runoff. Developments should enhance and protects surface and ground water quality and comply with the Water Framework Directive in ensuring with suitable mitigation measures are in place.

Cheshire West and Chester Council

2.3.3 Cheshire West and Chester Adopted Development Plan (2015), Policy ENV1 (Flood Risk and Water Management) seeks to reduce flood risk and to protect and enhance water quality through an appropriate FRA, mitigation and designed to reduce surface water run-off rates to include the implementation of SuDS.

Halton Borough Council

2.3.4 Halton Borough Council Core Strategy (2013), Policy CS19 (Sustainable Development and Climate Change) requires development to incorporate appropriate climate change resilience including passive design features, conservation measures, and the management of surface water run-off. Policy CS23 (Managing Pollution and Risk) requires management of flood risk and not to exacerbate existing levels of flood risk nor place residents or property at risk.

St Helens Borough Council

2.3.5 St Helens Local Plan Core Strategy (2012), Policy CP 1 (Ensuring Quality Development in St Helens) seeks to avoid adding to the causes and sources of flood risk and ensuring no adverse impact on other sites. Where this cannot be achieved, but there is an overriding need for the development and a suitable alternative site cannot be identified, protection from the risk of flooding, through the use of SuDS and/or other appropriate measures and/or flood defences will be required.

Trafford Council

2.3.6 Trafford Local Plan: Core Strategy (2012), Policy L5 (Climate Change) states that any development that has potential to cause adverse pollution of water or ground will not be permitted unless it includes mitigation measures. The Council will also control development in areas at risk of flooding considering the level of risk, requiring an appropriate FRA at the planning application stage. In addition, surface water run-off should be reduced through the use of appropriate SuDS based on mapping within the Council's SFRA.

Warrington Borough Council

2.3.7 Warrington Borough Council Local Plan Core Strategy (2014) Policy QE 4 (Flood Risk) outlines the requirements to manage surface water run-off, to ensure that flood risk is not increased, the use of SuDS, floodplain compensatory storage and safe design within development proposals. Any development identified as at intermediate and high risk of surface water flooding (greater than 0.5 hectares) should be supported by a site-specific FRA, which considers information in Warrington's SFRA and preliminary Flood Risk Assessment (pFRA).

2.4 Other relevant plans and consenting requirements

2.4.1 A number of bodies with responsibility for management and regulation of the water environment have produced plans that are of relevance to this assessment. These bodies also have responsibilities for the regulation of activities in and around watercourses that could affect flood risk. Within the Preliminary Order Limits, these

include the Environment Agency and LLFAs[10]. Relevant plans produced by these bodies and their consenting powers are summarised below.

Environment Agency

2.4.2 The Environment Agency is the lead statutory body with responsibility for protection of the water environment. It is also responsible for flood defence and drainage for Main Rivers (Main River is a statutory designation which is usually applied to larger watercourses) and estuarine and coastal areas. The Environment Agency has produced regional management plans and policies for the water environment; the key documents of relevance to this FRA are:

- Lower Mersey Catchment Flood Management Plan (CFMP);
- Upper Mersey Catchment Flood Management Plan; and
- Weaver Gowy Catchment Flood Management Plan.

2.4.3 **Table 2.5** shows the relevant sub-areas and policies for each CMFP. The Preliminary Order Limits span five policy areas, as defined within the plans, as follows:

- Policy 2 – "*areas of low to moderate flood risk where we [the Environment Agency] can generally reduce existing flood risk management actions.*"
- Policy 4 – *"areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change."*
- Policy 5 – *"areas of moderate to high flood risk where we can generally take further action to reduce flood risk."*
- Policy 6 – *"areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits."*

[10] Internal Drainage Boards (IBDs) are responsible for maintaining drainage networks in low-lying agricultural areas of many parts of England and Wales. They produce management plans, and exercise Ordinary Watercourse Consenting powers for their operational areas. However, there are no IDBs in the Preliminary Order Limits for the Project, so they are not discussed further in this document.

Table 2.5 Catchment Flood Management Plan sub-areas and policies

Catchment Flood Management Plan	Sub-area	Policy Option
Upper Mersey	Bollin	4
	Lower Sinderland	5
Mersey Estuary	Warrington (Lower Sankey, Padgate and Woolston)	5
	Middle Mersey Estuary	4
	Widnes and Penketh	2
	St Helens	2
Weaver Gowy	Frodsham and Runcorn	4
	Northwich	5
	Stanlow	4
	Rural Areas	6

2.4.4 The Environment Agency is a Statutory Consultee in the DCO process and is also responsible for regulating engineering works liable to affect Main Rivers through the issuing of Flood Risk Activities Permits (FRAPs). Any works within 8m of a Main River banktop (or 8m of the landward side of a flood defence structure or culvert), increasing to 16m for a tidal Main River, would require FRAP to be applied for from the Environment Agency.

Lead Local Flood Authorities (LLFAs)

2.4.5 LLFAs were defined as risk management authorities under the Flood and Water Management Act 2010 (FWMA, 2010). They are responsible for the management of local flood risk (i.e. all other flood risk except that from Main Rivers and the sea). This is done though the process of developing Preliminary Flood Risk Assessments (pFRAs) and Local Flood Risk Management Strategies (LFRMS). LLFAs are also responsible for regulating engineering works likely to affect Ordinary Watercourses through issuing Ordinary Watercourse Consents (OWCs) outside of IDB areas. Ordinary watercourses are all streams, drains, ditches and passages through which water flows that are not classified by the Environment Agency as a Main River.

2.4.6 The Preliminary Order Limits traverses six LLFA areas, which align with the LPA areas outlined above: Cheshire East Council, Cheshire West and Cheshire Council, Halton Borough Council, St Helens Metropolitan Borough Council, Trafford Council and Warrington Borough Council. A summary of relevant assessments and guidance produced by each of the LLFAs is provided below.

OWCs would need to be applied for any works in and around Ordinary Watercourses within the standoff distances specified by the individual LLFAs.

2.4.7 Five of the six LLFAs which the Preliminary Order Limits traverses are part of the Cheshire and Mid-Mersey (CMM) sub-regional LLFA working group which agrees to follow the same principles in producing each individual LFRMS with the aim of ensuring a catchment wide approach. The catchment partners in the CMM group are Cheshire East Council, Cheshire West and Chester Council, Halton Borough Council, St Helens Metropolitan Borough Council and Warrington Borough Council.

Cheshire East Council

2.4.8 Cheshire East Council's LFRMS was published in 2017, building on the high-level findings of the PRFA (2011) and SFRA (2013). The LFRMS provides principles for managing flood risk within Cheshire East. Cheshire East requires OWC for any structure, permanent or temporary, within 8m of an Ordinary Watercourse.

Cheshire West and Chester Council

2.4.9 The Cheshire West and Chester Council LFRMS (2016) indicates key sources of flooding, including from the Rivers Weaver and Dane and surface water runoff. The SFRA (2016) also indicates that surface water flooding is a risk in the region in areas with flat terrain.

2.4.10 Cheshire West and Chester Council have produced guidance from Ordinary Watercourse consenting which requires OWC for any structure, permanent or temporary, within 8m of a watercourse.

Halton Borough Council

2.4.11 The Halton Borough Council LFRMS (2015) details the sources of flood risk in the borough, including fluvial, surface water and canals. The SFRA (2011) also discusses the residual risks associated with the canals present in the Borough. No information on OWC is available from Halton Borough Council.

St Helens Borough Council

2.4.12 The St Helens Borough Council LFRMS (2014) details the potential flood risk in the Borough and the effect of climate change on future flood risk. The position of St Helens at the top of the Mersey sub-catchment means that the fluvial flood risk is generally low. The pFRA (2017) identifies surface water flooding as a major source of flood risk in the Borough.

Trafford Council

2.4.13 Trafford Council are responsible for local flood risk management within their region, which involves developing and maintaining a strategy for the management of local flood risk. The LFRMS (2014) details the various sources of flood risk including surface water, groundwater, fluvial and canal. The SFRA (2011) highlights that surface water poses the most significant risk in the region.

2.4.14 Trafford Council uses the North West SuDS Pro-forma states that if development proposals are within 8m of the top of the banks of an Ordinary Watercourse, or makes changes to such a watercourse, then a consent or permit may be required in addition to planning permission.

Warrington Borough Council

2.4.15 Warrington Borough Council LFRMS (2017) sets out their position in relation to managing, regulating and coordinating the local flood risk, including flooding from other sources, including surface water, groundwater and the sewer network. The SFRA (2011) highlights that the River Mersey and its tributaries that run through the borough are the primary source of flood risk. Tidal flooding is also highlighted as a risk due to the tidal influence on the River Mersey extending to Howley Weir in Warrington.

2.5 Other technical guidance

SuDS guidance

CIRIA SuDS manual (C753)

2.5.1 The CIRIA SuDS (C753) is the most up-to-date industry standard containing revised principles and technical advice for the planning, design, construction, management, and maintenance of effective SuDS. The drainage systems for new developments should be designed to align with the SuDS manual.

DEFRA Non-statutory technical standards for sustainable drainage systems, 2015

2.5.2 The Non-Statutory Technical Standards for Sustainable Drainage Systems is a national guidance document that provides a set of standards to be applied when designing SuDS systems for new developments. Standards include controls on peak flow and volume of run-off, and flood risk internal to the development and downstream. These comprise a common national set of basic standards for England, which are used as the basis of more specific local guidance prepared by individual LLFAs, as discussed below.

Lead Local Flood Authority surface water drainage advice

2.5.3 Each LLFA produces guidance with regards to their requirements for drainage design and runoff estimation which are all principally based upon the non-statutory guidance set out above. They each set out and promote the same drainage hierarchy as follows:

- Prevention of runoff by good site design and reduction of impermeable areas.
- Source Control: Dealing with water where and when it falls (e.g. infiltration techniques).
- Site Control: Management of water in the local area (e.g. swales, detention basins).

- Regional Control: Management of runoff from sites (e.g. balancing ponds, wetlands).

2.5.4 The methods used to discharge surface water should be prioritised in the following order: infiltration to ground; watercourse; and combined/surface water sewer.

2.5.5 Local SuDS standards and drainage requirements for each of the LLFAs affected by the Project are summarised in **Table 2.6**.

Table 2.6 Local SuDS standards

	Cheshire East	Cheshire West and Chester	Halton*	St Helens*	Trafford	Warrington
Consider connections to highways and drains	Consent is needed as well as consent from the owner of the drain or sewer pipes.	No, unless solely water from highway gullies	N/A	N/A	Not Specified	Consult the Highways Authority if SuDS would impact on adopted public highways or discharge surface water to highways and drainage systems.
Minimum Brownfield Discharge Rate reduction	Reduction in rates in line with the non-Statutory Technical Standards for Sustainable Drainage Systems (2015)	30%	N/A	N/A	Must be designed to greenfield site rates	Existing brownfield rates will be taken into consideration.
Greenfield Discharge Rate to be used	Greenfield or less (% betterment not specified)	IH124	N/A	N/A	Greenfield or less	Greenfield or less.

	Cheshire East	Cheshire West and Chester	Halton*	St Helens*	Trafford	Warrington
Climate Change Allowance	Not specified	Environment Agency climate change rainfall intensity allowance	N/A	N/A	40%	20% allowance on rainfall intensity for non-residential developments.
Urban Creep Allowance	Not specified	10%	N/A	N/A	10%	<=25 (dwellings/ha)10% 30 (dwellings/ha) 8% 35 (dwellings/ha) 6% 45 (dwellings/ha) 4% >=50 (dwellings/ha)2% Flats and Apartments0%
Identified Special Areas of Drainage	Development proposals for critical drainage areas must address and mitigate known risks in the area	All development in designated Critical Drainage Areas (CDAs) would be required to incorporate measures to alleviate surface water flood risk through the layout and form	N/A	N/A	Developments in a CDA must submit a Site-Specific FRA Sustainable Drainage Strategy and a Sustainable Drainage Strategy Pro	Recommended that within critical drainage areas a reduction of 50% in surface water discharge rates from new development on brownfield sites and a reduction to greenfield rates on

	Cheshire East	Cheshire West and Chester	Halton*	St Helens*	Trafford	Warrington
		of the development, including the appropriate application of SuDS to intercept and attenuate overland flow and drained water.			Forma in the planning application.	all other development sites is achieved
Local SuDS Guidance	All developments in Cheshire East are required to have SuDS.	Consider biodiversity, and water quality benefits into SuDS design.	N/A	N/A	N/A	SuDS to be designed so that they are easy to maintain and minimise risk of blockage. Demonstrate how pollutants are prevented or controlled by SuDS scheme Follow principles of the SuDS Management Train

* Local SuDS guidance for Halton and St. Helens has not yet been made available.

2.6 Summary of Design Standards for Assessment

2.6.1 Design standards for flood protection measures for flood vulnerable critical elements of project infrastructure are specified in **Table 2.7** in line with NPPF PPG[7] Environment Agency climate change guidance for FRA[8].

2.6.2 Use of the fluvial 1% AEP event and the 0.5% AEP tidal event as the design standard for flood protection measures is specified in the NPPF PPG. The latest Environment Agency climate change guidance makes it clear that assessment of surface water flood risks should be assessed up to the 1% AEP event.

2.6.3 Given the short construction period proposed for the pipeline, it has been agreed in principle with the Environment Agency[11] that construction phase elements are to be assessed using the present day flood risk estimates only, with no allowance for climate change.

2.6.4 With regards to allowances for future climate change for flood protection and drainage during the operational phase of the Project, these have been based on the current guidance provided by the Environment Agency for FRA, assuming the lifetime of the infrastructure does not extend beyond 2100.

2.6.5 It is also recognised that NPS EN-1 and Environment Agency guidance on climate change advise that further assessment should be made of residual risks to this type of infrastructure associated with 'credible maximum' events beyond the required design standard. For fluvial flood risk the 1% AEP plus Upper End allowance for climate change will be assessed; and for tidal flood risk the Upper End and H++ allowance for climate change will be assessed as credible maxima events. There is no requirement to assess a credible maximum event for surface water flood risk.

Table 2.7 Design Standards for Assessment

Development phase	Source of flooding	Design standard
Construction	Tidal	0.5% AEP (present day)
	Fluvial	1% AEP (present day)
	Surface Water	1% AEP (present day)
Operation	Tidal	0.5% AEP (higher central allowance up to 2095)
	Fluvial	1% AEP (higher central allowance for the '2080s')
	Surface Water	1% AEP (higher central allowance for the '2070s')

[11] As agreed during a meeting with the Environment Agency on 13/06/2022. Minuted in 807733-WOOD-IA-CE-RP-LPA-616047

2.6.6 If permanent development in the floodplain can't be avoided, it may be necessary to provide floodplain storage compensation. The requirement for floodplain compensation storage will be assessed using the fluvial defended 1% AEP event plus the higher central climate change allowance.

3. Site Characteristics

3.1 Study Area and Location

3.1.1 The Project is located in the North West of England in the area between Stanlow, St Helen's, Partington and Northwich and consists of four corridors: West Corridor; North Corridor; East Corridor and South Corridor.

3.1.2 The West Corridor extends from the Stanlow Refinery north-east to Rocksavage, crossing the River Weaver and Weaver Navigation, then south-east through Aston before crossing the Trent and Mersey Canal and joining the Central Hub north of the A553 (Northwich Road).

3.1.3 The North Corridor extends from the Central Hub north crossing the M56, Bridgewater Canal, Manchester Ship Canal, then north-west across the River Mersey between Widnes and Warrington and then broadly north to Ravenhead, St Helen's.

3.1.4 The East Corridor extends from the Central Hub broadly east crossing the M6, M56, up to Partington

3.1.5 The South Corridor extends from the Central Hub broadly south crossing the Trent and Mersey Canal and Weaver Navigation and then around Northwich to the west finishing east of the A530 at the Stublach Gas Storage Plant.

3.1.6 This pFRA assess the flood risks within the Preliminary Order Limits. Preliminary Order Limits has been defined for the Project as described in **Section 7.4** of **Chapter 7: Water Environment**. A detailed description of the characteristics of the Preliminary Order Limits is given within **Section 7.6** of **Chapter 7** and is briefly summarised below.

3.2 Land use

3.2.1 Land within the Preliminary Order Limits is predominantly rural and land use is characterised by open fields with hedgerows and tree lines. However, it also includes some industrial areas and runs adjacent to some residential areas. The Preliminary Order Limits also crosses several significant transport infrastructure features including major roads and railway lines, in addition to minor roads and access routes.

3.3 Climate

1.1.1 The average annual total rainfall is 729mm, based on the Hawarden Airport[12] climate station, this is lower than the average for the North West of England. The

[12] Met Office (2022). Hawarden (Flintshire) UK climate averages. (online) Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcmys019j. (Accessed 16 May 2022).

average monthly rainfall is 61mm, with the highest levels of rainfall observed in October (76.24mm) the lowest levels observed in March (48.22mm). The Woodford (Greater Manchester) climate station, located to the east of the Study Area, has higher average annual rainfall (868mm) than the Hawarden Airport climate station, located west of the Study Area.

3.4 Topography

3.4.1 Topography ranges from 5mAOD to 70mAOD, with the lowest lying land located in areas adjacent to the Mersey Estuary, lower River Mersey, Weaver Navigation and Manchester Ship Canal in the western of part of the Preliminary Order Limits.

3.5 Geology, hydrogeology and soils

3.5.1 The Study Area lies upon dominant Triassic bedrock geology consisting of sandstone, mudstone, siltstone and conglomerates with some coal formation in the north.

3.5.2 These bedrock formations are obscured, in the majority of locations by superficial deposits of till, sand, gravel, alluvium and some isolated pockets of peat along the East Corridor. The alluvium is associated with the route of the River Weaver and River Mersey. Overlying soils are a mix of wet loamy and clayey soils and free-draining sandy soils with some pockets of peat soils

3.5.3 Sections of the West, North and East Corridors are underlain by principal bedrock Aquifers, the remainder of the Study Area is underlain by secondary bedrock aquifers. In addition, large parts of the Study Area are also underlain by secondary superficial aquifers.

3.6 Hydrological setting

3.6.1 The Project is located across three Environment Agency management catchments: Weaver Gowy; Lower Mersey; and Upper Mersey. As a result, there is potential for the Project to interact with major Main Rivers, including the River Mersey, River Weaver, Weaver Navigation, and Manchester Ship Canal, as well as numerous smaller Main Rivers, tributaries and agricultural drains.

3.6.2 Whilst in most parts of England the Main Rivers tends to be confined only to larger watercourses, there are a large number of Main Rivers within the Preliminary Order Limits, many of which are actually very small minor watercourses. This is the legacy of the different approach that was historically taken to water level management in low-lying agricultural areas in the North West compared to the rest of England. Instead of establishing IDBs, small watercourses in rural areas were designated as Main Rivers ('en-mained') to bring water level management under the responsibility of the Environment Agency and predecessor bodies.

3.7 Flood Defence Assets

3.7.1 There are Environment Agency maintained flood defence assets located along sections of the River Weaver at its downstream reach, the River Mersey through Warrington and along the Mersey Estuary coastline.

3.7.2 Those flood defence assets along the River Weaver directly interact with the Project around Rocksavage where there is a flood defence asset located on the left bank of the River Weaver and an area benefiting from defences stretching from Stanlow to Rocksavage.

3.7.3 Those flood defence assets along the River Mersey result in areas benefiting from defences through Warrington, some of which intersect with the Preliminary Order Limits.

3.8 Project Description

Overview

3.8.1 A summary of the different elements of the Project are provided below, however, a more detailed Project description is provided in **Chapter 2: The Project**. For PEIR optionality remains for various elements such as HAGIs and Block Valves, as described in **Chapter 2: The Project.**

3.8.2 The Project includes the construction and operation of up to 125km of new pipelines to distribute hydrogen to industry, power stations and for blending with the existing natural gas network in North West England. The pipeline network would connect to a newly constructed Hydrogen Production Plant at the Vertex Stanlow site as the source of hydrogen for onward distribution through the network. A Central Hub Hydrogen Above Ground Installation (HAGI) connects the four main pipeline corridors. Branching off from each main corridor there would be spurs - smaller pipelines - that form the connections to users identified as part of the Project.

3.8.3 The pipelines that make up the network would vary in diameter between approximately 8” and 42”, dependent on which corridor or spur they are on. The pipeline would be buried along the entire route apart from short sections within secure compounds at locations where HAGIs and Block Valves are required. It is currently envisaged that ten HAGIs and two Block Valves would be required at points along the network.

3.8.4 The pipeline, HAGIs and Block Valves make up the permanent operational infrastructure associated with the Project. During construction there would be other temporary activities and infrastructure associated with the Project including:

- Pipe laying;
- Pipeline crossing works;
- Material storage areas;
- Trenchless crossing compounds;

- HAGI and Block Valve construction compounds; and
- Temporary access routes with watercourse crossings.

3.8.5 These will all be assessed as part of the FRA.

Vulnerability classification

3.8.6 As set out in **Section 2**, the NPPF[6] and the associated PPG[7] provide guidance on vulnerability classifications for development types, based on their use/function and the compatibility of development with flood zones. A matrix is provided in **Table 3.1** that applies the NPPF flood risk vulnerability to the various elements of the Project and their compatibility with the Flood Zones. The Project is defined as 'essential infrastructure' as such is compatible with Flood Zone 1 and 2 and in Flood Zone 3a and 3b if it passes the Exception Test. As the permanent development is classed as essential infrastructure construction activities have in turn been classified as essential infrastructure, with the exception of pipeline watercourse crossings which are classified as 'water compatible' due to the nature of construction techniques used.

Table 3.1 Application of the flood risk vulnerability and Flood Zone 'compatibility' matrix to the Project

Project type	Flood risk vulnerability classification	Flood Zone(s)	Flood risk vulnerability and flood zone 'compatibility'
Construction			
Pipeline crossings	Water compatible	1, 2 and 3	✓
Pipe laying	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
Material storage locations	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
Trenchless crossing compounds	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
HAGI temporary compounds	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
Temporary access routes	Essential infrastructure	1, 2 and 3	✓

Project type	Flood risk vulnerability classification	Flood Zone(s)	Flood risk vulnerability and flood zone 'compatibility'
			Exception Test required within FZ3
Operation			
Pipeline	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
HAGIs	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3
Block Valves	Essential infrastructure	1, 2 and 3	✓ Exception Test required within FZ3

4. Flood Risk Screening

4.1 Introduction

4.1.1 The flood risk screening has been split into two parts. Firstly, a screening of all potential sources of flood hazard in terms of source, pathway and receptor. For a source to be scoped in a receptor must be identified. The presence of a source is initially screened in **Section 4.** Following the screening a more detailed assessment is provided in **Section 5** which assesses the flood risk to and from the specific elements of the Project. Where necessary, appropriate flood risk management measures will be set out in **Section 6** to address the identified risks. **Chapter 7: Water Environment, Section 7.6.2** provides further discussion of the baseline flood risk across the Preliminary Order Limits.

Screening Approach

4.1.2 The aim of this initial screening assessment is to identify which sources of flooding pose a risk to and from the Project, both during construction and to those elements of permanent operational infrastructure. The screening assessment has been carried out by assessing those sources of data identified in **Table 1.1**, **Section 4.2** and **Section 4.3** and where they intersect with the proposed project construction and operational development infrastructure.

4.1.3 The data used in the screening assessment does not include an allowance for future climate change, however the screening assessment of sources of risk has been undertaken with future increases as a consequence of climate change in mind.

4.2 Flood risk datasets

4.2.1 The following sections describe the key sources of flood risk data that have been used in the screening.

Fluvial and Tidal Flood Risk

4.2.2 The Environment Agency's (Environment Agency) Flood Map for Planning (FMfP) has been used in the screening as it provides an indication of the likelihood of flooding from fluvial/ tidal sources and the location of flood defences. Flood Zones 1 to 3 indicate a Low, Medium, and High likelihood of flooding respectively, as defined in **Table 1.2**. Flood Zones and locations of defences are shown on **Figure 7.7** which accompanies **Chapter 7: Water Environment** (any area not highlighted/coloured blue on these maps is Flood Zone 1).

4.2.3 To understand fluvial and tidal flood risk in more detail hydraulic models can be used to understand factors such as depth, water level, velocity and hazard as well as time of inundation and time to peak. The Environment Agency holds a number of existing hydraulic models across the Preliminary Order Limits. These more

detailed modelling results will be used to inform the FRA accompanying the DCO application.

Surface Water Flood Risk

4.2.4 The Environment Agency's Risk of Flooding from Surface Water (RoFfSW) Map has been used to provide an understanding of likely surface water flow paths and areas of surface water ponding/flooding for the 3.33%, 1% and 0.1% AEP. The dataset also contains some depth banding to provide an indication as to how deep water could get in these areas of ponding and along identified flow paths but for this initial screening assessment only the extents have been used. The RoFfSW mapping is shown on **Figure 7.8** which accompanies **Chapter 7: Water Environment.**

Groundwater Flood Risk

4.2.5 The British Geological Society (BGS) Areas Susceptibility to Groundwater Flooding (AStGWF) map provides a regional understanding of the likelihood that groundwater flooding (defined by the BGS as "*defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded*").

4.2.6 The map is split into four categories:

- Category A: Limited potential for groundwater flooding to occur based on rock type and estimated groundwater level during periods of extended intense rainfall;
- Category B: Potential for groundwater flooding of property situated below ground level;
- Category C: Potential for groundwater flooding to occur at surface; and
- Elsewhere: Not considered to be prone to groundwater flooding.

4.2.7 Categories A to C are based on rock type and estimated groundwater level during periods of extended intense rainfall. The 'Elsewhere' category is based solely on rock type.

4.2.8 Where a development falls within Category B or C it is recommended that an investigation occurs in to whether groundwater emergence is known to have occurred in the past and/or ensure measures are put in place as part of any development to reduce the impact of groundwater flooding.

Artificial Sources

4.2.9 The Environment Agency's Reservoir Flood Maps (RFM) show where water may go in the unlikely event of a dam or reservoir failure. The Reservoir Flood Maps include two scenarios: a 'dry-day' and a 'wet-day'. The 'dry-day' scenario is defined as "*the flooding that would occur if the dam or reservoir failed when rivers are at normal levels*". The 'wet day' scenario assesses "*how much worse the*

flooding might be if a river is already experiencing an extreme natural flood". For this screening assessment both scenarios were used.

4.2.10 The nature of sewer flooding means there are no mapping datasets available to inform an assessment so historic data showing hotspot areas prone to historic flooding are used.

4.2.11 At this stage there is no known mapping or data regarding the potential flood risk associated with a failure of the canal network. Therefore, topographic information is reviewed to understand whether the residual risk is likely.

4.3 Historic Flooding

4.3.1 The Environment Agency Recorded Flood Outlines show a number of historic flood events in the Preliminary Order Limits, notably through Warrington, Northwich and Acton Bridge. The majority of these recorded historic events fall outside of the Preliminary Order Limits with the exception of the flood events in Acton Bridge in 2019 and 2021 associated with the River Weaver, and one near Higher Walton in 1990 associated with the River Mersey.

4.3.2 Given the rural nature of the land use within the Preliminary Order Limits it is likely there have been other incidents of localised flooding associated with intense rainfall and minor watercourses over the years but due to the lack of receptors these have not been recorded.

4.3.3 As discussed in **Chapter 7: Water Environment, Section 7.6.2** surface water is a risk across the Preliminary Order Limits, but no specific hot spots of historic flooding have been identified. Equally no historic reports are available for groundwater or artificial sources. With the exception of sewer flooding, which is highlighted to be of high risk in St Helen's Town Centre.

4.4 Screening of all potential sources of flood risk

4.4.1 **Table 4.1** provides an initial screening of all potential sources of flood risk across the Project area. The data sources used to undertake this baseline screening exercise are detailed in **Section 4.2.**

Table 4.1 Screening of all potential sources of flood risk

Source of flooding	Risk posed	Potential connection to the Project area	Screened in?
Tidal	Medium risk	The Environment Agency's FMfP indicates the pipeline in the West Corridor runs parallel to the Mersey Estuary and crosses the River Weaver and Weaver Navigation within the tidal limit.	Yes

Source of flooding	Risk posed	Potential connection to the Project area	Screened in?
		The North Corridor crosses the River Mersey downstream of the tidal limit, which is at Howley Weir in Warrington. There are tidal flood defences in place to protect against a 0.5% AEP present day tidal flood event. However, in the future the standard of protection of these is likely to decrease with climate change. Areas of the pipeline, HAGIs and associated construction activities intersect with areas of tidal flood risk. The risk to the Project's permanent infrastructure and construction from tidal flooding is discussed further in **Section 5**.	
Fluvial	High risk	The Environment Agency's FMfP indicates the primary source of flood risk to the Project is from fluvial sources. The Project is within the River Mersey catchment and traverses several major Main Rivers including the River Weaver, Weaver Navigation, Manchester Ship Canal and the River Mersey as well as a large number of other smaller watercourses and their associated areas of Flood Zones 2 and 3. Areas of the pipeline, HAGIs and associated construction activities intersect with areas of fluvial flood risk. Those watercourses which pose a risk to the Project permanent infrastructure and construction are discussed further in **Section 5.**	Yes
Surface water run-on	Medium risk	The Environment Agency's RoFfSW Map shows a risk of flooding from surface water run-on and ponding across the Preliminary Order Limits for a range of events from high risk to very low risk. The majority of areas are shown to be at very low risk of surface water flooding. However, there are some locations of ponding or flow paths which coincide with existing watercourses and drainage ditches. Some of these areas	Yes

Source of flooding	Risk posed	Potential connection to the Project area	Screened in?
		of surface water risk are also within fluvial Flood Zones. Areas of the pipeline, HAGIs and associated construction activities intersect with areas of surface water flood risk. The risk to the Project's permanent infrastructure and construction from surface water run-on is discussed further in **Section 5.**	
Groundwater	High	The BGS's AStGWF maps indicate the Preliminary Order Limits contain a number of areas where there is potential for groundwater flooding to occur as a result of extended periods of intense rainfall. Additionally, there are a number of other areas where there is a potential risk of groundwater flooding for below ground construction activities. These areas of potential groundwater emergence generally coincide with watercourse valley floors, productive superficial deposits and soils. Areas of the pipeline, HAGIs, Block Valves and associated construction activities intersect with areas susceptible to groundwater flood risk. The risk posed by groundwater flooding is discussed further in **Section 5**.	Yes
Artificial - Reservoir	Low risk	The Environment Agency's RFM shows that the main River Mersey and River Weaver could convey floodwater originating from the failure of upstream reservoirs. In a 'dry' scenario, where river flows are typical at the time of reservoir failure the risk of flooding from reservoir extents are generally smaller than the fluvial Flood Zones. Only in a 'wet' scenario, where a river is in flood at the time of reservoir failure do the risk of flooding from reservoir extents in some places exceed the Flood Zone 2 extent. These reservoirs are highly managed, so the overall risk of failure is very low and highly dependent on the river flow	Yes – as part of fluvial.

Source of flooding	Risk posed	Potential connection to the Project area	Screened in?
		condition. Therefore, mitigation against this residual risk would be commensurate with mitigation against an extreme fluvial food risk and will be addressed under fluvial flood risk.	
Artificial - Sewer	Negligible	A review of the SFRAs for the Preliminary Order Limits determines that there are no concentrated areas of high sewer flood risk within the Preliminary Order Limits, except for the St. Helens Town Centre in the North Corridor that has been identified as an area at high risk of sewer flooding due to a high number of recorded sewer flooding incidents relative to the surrounding areas. Above ground permanent infrastructure is predominantly proposed in rural (greenfield) or industrial (brownfield) area, with the exception of a HAGI in the commercial/industrial area of St Helens to the south of the town centre. Also, no areas of permanent above ground infrastructure coincide with known areas of known sewer flooding and the Project would not require integration into any existing sewer networks. Therefore, the risk posed by sewer flooding is considered to be negligible. In the event that sewer flooding occurs it is anticipated that the flood would follow the natural topography of the landscape and accumulate in low-lying areas, therefore patterns would be similar to that associated with surface water flooding. **The risk of sewer flooding is not considered further in this pFRA.**	No
Artificial - Canal	Low risk	Five canals are present within the Preliminary Order Limits: Bridgewater Canal, Manchester Ship Canal, Sankey Canal, Trent and Mersey Canal, and Weaver Navigation. Canals and their associated structures are highly maintained a regulated to maintain a constant water volume so do not pose a	Yes, as a residual risk

Source of flooding	Risk posed	Potential connection to the Project area	Screened in?
		risk of flooding the event of a storm event. They do however pose a residual risk as a consequence of a breach if the canal is impounded and raised above ground. For the permanent above ground infrastructure, located near a canal, the FRA submitted with the DCO application will include an assessment of the residual risk of canal breach if necessary. **Chapter 7: Section 7.6.2** contains further details of canals in the Preliminary Order Limits.	

5. Assessment of Flood Risk

5.1 Introduction

5.1.1 The potential sources of flood risk within the Preliminary Order Limits have been summarised in **Section 4**. This section assesses specific flood risk to receptors associated with the Project. This will include the flood risk posed to and from operational and construction phase infrastructure as well as potential flood risks to third-party receptors as a consequence of the Project. Appropriate flood risk management measures are specified to address the identified risks in **Section 6**, most of which have been incorporated into the design of the Project through the embedded environmental measures specified in **Chapter 7: Water Environment**.

5.2 Construction Phase

Pipe laying

5.2.1 The laying of the main pipeline would traverse areas of flood risk and existing floodplains. The pipeline would be buried and therefore an element of excavation is required to lay the pipeline. The pipeline routing has been optimised to avoid areas of flood risk wherever possible, but by its nature it is inevitable that there would be some locations where it intersects with areas of flood risk.

5.2.2 The West Corridor flows through a significant expanse of defended floodplain of the Mersey Estuary and associated unnamed main river channels. It then traverses the River Weaver floodplain and some smaller Main Rivers.

5.2.3 The North Corridor flows through significant expanses of floodplain associated with the River Mersey and Manchester Ship Canal and some smaller Main Rivers.

5.2.4 The East Corridor flows through significant expanses of floodplain associated with River Bollin and some smaller Main Rivers.

5.2.5 The South Corridor flows through significant expanses of floodplain associated with River Weaver, Weaver Navigation and some smaller Main Rivers.

5.2.6 There would also be pockets at higher risk of surface water flooding and groundwater flooding.

5.2.7 The excavated route would be reinstated to ensure no change in topography and therefore no change in floodplain storage or conveyance. So, risk from the pipe laying would be low. Risk to the pipe laying of flooding throughout the construction would be managed through embedded environmental measures discussed further in **Section 6**.

5.2.8 Where the pipeline crosses a watercourse is discussed later in this section.

Material Storage Areas

5.2.9 A number of potential material storage areas have been identified as part of the PEIR. Of these:

- Two are located in Flood Zone 3;
- One is located in Flood Zone 2;
- Eight sites are at risk of groundwater flooding in the event of prolonged intense rainfall;
- Ten sites intersect with a surface water flow path;
- Over twenty sites are potentially at risk of surface water ponding on site; and
- No sites are within 16m of a main river so a FRAP would not be required.

5.2.10 Material storage areas are where lengths of pipe to construct the pipeline would be stored for a short time period during construction. In terms of flood risk the greatest risk is to those sites within a fluvial or tidal flood zone or those which intersect with a surface water flow route. In the event that these are activated then there would be a risk that lengths of pipe being stored there could be washed away, or that they could interrupt existing flow paths.

5.2.11 If pipe is stored in an area of undefended Flood Zone there is also a risk that it could displace floodplain storage and make risk worse elsewhere. One particular location coincides with the floodplain of the River Weaver in Acton Bridge which is in an area of historic flood risk.

5.2.12 It is noted that for some material storage areas where they do interact with the flood zones it is not the entire material storage area, and through sequential planning of the site it could be possible to avoid the areas of highest risk. This will be considered in the FRA for DCO submission following further refinement in the Project design.

5.2.13 The material storage areas will be reviewed and assessed in more detail prior to the submission of the DCO application, and opportunities will be sought to relocate those locations deemed to be at risk or which could impact flood risk elsewhere. The FRA submitted with the DCO application will assess information on more frequent fluvial or surface water flood events where available as these will have a greater likelihood of occurring during the short construction time frame. Where necessary appropriate mitigation measures would be embedded in design consistent with the scale of risk, potential receptors and the length of time the pipe would be in situ.

Pipeline watercourse crossings

5.2.14 The pipeline route traverses a number of watercourses along its length resulting in 130 watercourse crossing locations. The pipeline would be buried and where there is a requirement to cross watercourse the following construction techniques are proposed:

- Open cut;

- Micro-tunnel (trenchless);
- Auger Bore (trenchless); and
- Horizontal Directional Drilling (HDD) (trenchless).

Chapter 2: The Project contains more detail on what is involved for each of these techniques.

5.2.15 The majority (104) of pipeline watercourse crossings (at smaller watercourses) are proposed to be constructed using the open cut trenched technique, which would involve isolation of the watercourse at the crossing location with fluming or over pumping during pipeline installation and re-instatement following completion of works. The open cut technique is proposed for smaller watercourses (brooks, ditches, streams, drains).

5.2.16 Auger bore, micro-tunnel and HDD are all trenchless techniques and are proposed for where larger watercourses are to be crossed.

5.2.17 Given the large number of minor watercourses of Main Rivers in the region, the majority of pipeline crossings will require a FRAP.

5.2.18 Due to the fact the crossings are of watercourses the construction of these would be inherently at risk of flooding but the construction period for each crossing is short (2-3 days) and therefore the risk of a flood coinciding with this is minimal, construction would be timed to heed any flood warnings.

Trenchless crossing compounds

5.2.19 A large number ,116, of trenchless compounds have been proposed at this stage to support the construction of pipeline crossings of watercourses, roads and utilities.

5.2.20 Several (22) crossing compounds intersect with Flood Zone 3, and six with Flood Zone 2. One is located in Acton Bridge on the left bank of the River Weaver in an area where historic flooding has been experienced. The boundaries of 12 sites are within 8m of a non-tidal Main River or 16m tidal Main River and may therefore need to be accompanied by a FRAP. By the nature of the fact that trenchless crossings are being used to cross watercourses it may not be possible to site compounds outside of the floodplain, especially of the large rivers in the Preliminary Order Limits (e.g. River Weaver; River Mersey). Wherever possible opportunities will be sought to relocate or sequentially design those compounds at locations deemed to be at risk or which could impact flood risk elsewhere.

5.2.21 Around 50% of the compounds have some element of surface water flood risk associated with them, although this is generally minor areas of ponding across the sites. Five compounds have large areas of the site at risk of surface water flooding even in a 3.33% AEP event, and 17 compound locations have surface water flow paths associated with them that would need to be maintained. Several, 33, compounds are in areas with a risk of groundwater flooding in a period of extensive intense rainfall.

5.2.22 Where fluvial and surface water flood risks have been identified they do not necessarily cover the entire site as such it may be possible to sequentially plan

any temporary compound to manage this risk to ensure no loss of storage or interruption to conveyance pathways, and thereby minimise impacts on external receptors. The trenchless crossings would be in place for a short time period, so where sources of flood risk can't be avoided, the timing of construction would be between March and September so it occurs at a time of year with less risk of flooding.

5.2.23 The FRA for the DCO application will assess these areas in more detail, including assessing any available flood risk information from more frequent events given the short time period most of these compounds would be in place. Where necessary appropriate mitigation measures will be embedded in design consistent with the scale of risk, potential receptors and the length of time the compound would be in situ.

Temporary access routes

5.2.24 To facilitate construction of the pipeline and the transportation of equipment materials and personnel a network of access routes has been proposed within the Preliminary Order Limits.

5.2.25 Where possible these access routes make use of the existing road network. But in some areas new temporary access routes would need to be constructed.

5.2.26 Where new temporary access routes are proposed to be constructed some would need to cross watercourses, requiring temporary bridges or culverts to be installed.

5.2.27 Currently the proposed plans indicate the need to cross 26 watercourses designated as Main Rivers. Clear span bridges would be provided for larger and/or more environmentally sensitive watercourses to avoid any loss of floodplain storage or conveyance to ensure no change in the capacity of the watercourse and no change in flood risk. These new access routes are generally through rural areas so receptors are minimal with the exception of agricultural land. A FRAP will be prepared to accompany each location.

5.2.28 The FRA for the DCO application will assess these areas in more detail, including assessing flood risk from more frequent events given the short time period most of these compounds would be in place.

HAGI Temporary Compounds

5.2.29 A number of potential HAGI temporary construction compounds have been proposed to support the construction of the HAGI options listed in **Table 5.2**. The temporary construction compounds proposed at this stage are within the Preliminary Order Limits and also include construction areas for some alternative HAGI location options described in **Table 5.3**.

5.2.30 A summary of flood risk posed to these temporary construction compounds is provided in **Table 5.1**.

5.2.31 Five construction compounds intersect with Flood Zone 3, these are the compounds associated with the following HAGIs and their various options:

- Rocksavage HAGI (Option 1);
- Rocksavage HAGI (Option 2);
- Higher Walton HAGI;
- Hydrogen Production Plant (HPP) HAGI; and
- Hydrogen Storage Facility HAGI.

5.2.32 The construction compound associated with Hydrogen Storage Facility and Rocksavage HAGIs also have a risk of groundwater flooding in the event of prolonged intense rainfall. Clock Face and Warburton HAGIs have potential for groundwater flooding of development below ground level.

5.2.33 All, with the exception of those compounds associated with Hydrogen Storage Facility, Partington and Runcorn HAGIs, have some element of surface water flood risk across the site. The majority are minor areas of ponding. However, two compounds associated with Central Hub and HPP HAGIs have surface water flow paths through the site which will need to be considered.

5.2.34 The FRA for the DCO application will assess these areas in more detail, including assessing flood risk from more frequent events, given the short time period most of these compounds would be in place. Opportunities will be sought to relocate or sequentially design, those locations deemed to be at risk or which could impact flood risk elsewhere. Where necessary appropriate mitigation measures will be embedded in design consistent with the scale of risk, potential receptors and the length of time the compound would be in situ.

Table 5.1 Flood Risk Overview – HAGI Temporary Construction Compound

Compound ID	Associated HAGI	Flood zone	Watercourse	FRAP required*	Surface water flooding	Reservoir inundation	Groundwater flooding
1	Clock Face	1	No	No	Ponding north east3.33% AEP	No	Potential for groundwater flooding of development below ground level
6	Hydrogen Storage Facility	3	Puddinglake Brook	Yes	No	No	Potential for groundwater flooding to occur at surface
11	Central Hub Option 1	1	No	No	Flowpath and ponding through site	No	Not considered to be prone to groundwater flooding
12	Central Hub Option 2	1	No	No	Minor ponding in east.	No	Not considered to be prone to groundwater flooding
13	Rocksavage Option 2	3	River Weaver	No	Flowpath south minor ponding	Yes – but only when river in Flood**	Not considered to be prone to groundwater flooding
14	Rocksavage Option 1	3 (defended)	River Weaver Mersey Estuary	Yes	Minor ponding 0.1% AEP	Yes – but only when river in Flood	Potential for groundwater flooding to occur at surface

Compound ID	Associated HAGI	Flood zone	Watercourse	FRAP required*	Surface water flooding	Reservoir inundation	Groundwater flooding
15	Runcorn	1	Weaver Navigation	No	Minor ponding 0.1% AEP	No	Not considered to be prone to groundwater flooding
16	Runcorn	1	Weaver Navigation	No	No	No	Not considered to be prone to groundwater flooding
17	HPP	3	Unnamed River Gowy catchment	Yes	Flowpath through site	No	Limited potential for groundwater flooding to occur
18	HPP	1	No	No	No	No	Limited potential for groundwater flooding to occur
19	Higher Walton Option 1	3	Manchester Ship Canal	No	Ponding in site	Yes – but only when river in Flood	Limited potential for groundwater flooding to occur
20	Higher Walton Option2	1	Manchester Ship Canal	Yes	Ponding in site	Yes – but only when river in Flood	Limited potential for groundwater flooding to occur
21	Clock Face	1	No	No	Ponding northwest corner	No	Potential for groundwater flooding of development below ground level

Compound ID	Associated HAGI	Flood zone	Watercourse	FRAP required*	Surface water flooding	Reservoir inundation	Groundwater flooding
24	Warburton	1	No	No	Minor ponding 0.1% AEP	No	Potential for groundwater flooding of development below ground level
25	Warburton	1	No	No	Minor ponding 0.1% AEP	No	Potential for groundwater flooding of development below ground level
26	Partington	1	No	No	No	No	Not considered to be prone to groundwater flooding
27	Central Hub	1	No	No	Minor ponding 0.1% AEP	No	Not considered to be prone to groundwater flooding

*A FRAP is required for any development within 16m of a tidal watercourse or 8m of a non-tidal watercourse. For this screening anything <10m from a non-tidal watercourse has been highlighted as potentially needing a FRAP.
**The Environment Agency publish two reservoir inundation maps – one ‘dry’ assuming normal flow in the river and one ‘wet’ assuming high river flows.

5.3 Operational Phase

Pipeline

5.3.1 The pipeline would be buried for its entire length, apart from short sections within secure compounds at locations where HAGIs and Block Valves are required, and therefore not be at risk from fluvial, tidal, surface water or artificial sources of flood risk. It would also not increase the risk of flooding from these sources to third party receptors as there would be no above ground sections of pipeline and therefore no displacement of floodplain storage.

5.3.2 The flood risk associated with the operational pipeline is limited to risks associated with the interruption of groundwater flow paths. The pipeline would be at low risk from groundwater itself, but through potentially interrupting a groundwater flow path it could result in an increase in groundwater emergence and flooding elsewhere without appropriate mitigation.

5.3.3 The target excavation depth of the pipeline would be on average a 2.5m to 3m deep trench. However, it may be a greater depth particularly where the pipeline is 42” in diameter, and where the pipeline passes beneath services and other crossings it may be 4m to 6m deep, with HDD crossings being up to 15m deep.

5.3.4 Therefore, the risk of this occurring is greatest in those areas where the pipeline would run through perched water tables or superficial aquifers.

5.3.5 Measures to mitigate this risk are discussed in **Section 6.2**.

5.3.6 Flood risks associated with the construction of the pipeline are discussed further in **Section 5.2**.

Pipeline crossings

5.3.7 The pipeline is to be buried for its entire length, this includes where the pipeline route crosses watercourses. Therefore, all watercourse crossings would traverse the watercourses below the existing bed level to ensure no impact on the conveyance capacity of the watercourse and therefore no impact of flood risk to third party receptors.

5.3.8 Flood risks associated with the construction of the pipeline crossings are discussed further in **Section 5.2**.

HAGIs and Block Valves

HAGIs

5.3.9 Ten HAGIs and two Block Valves make up the permanent above ground elements of the Project.

5.3.10 **Table 5.2** provides an overview of the flood risk associated with the ten HAGI locations, whilst **Table 5.3** provides an overview of the flood risk associated with an additional four HAGI location options. It highlights the flood risk present at the

HAGI location and indicates where a FRAP would be required as a consequence of proximity to a Main River or flood defence.

5.3.11 Seven of the ten HAGIs listed in **Table 5.2** are sited in Flood Zone 1. Runcorn HAGI and Hydrogen Storage Facility HAGI are both in Flood Zone 1 but close to the edge of the existing Flood Zone 2 or 3.

5.3.12 Of these seven HAGIs, all, with the exception of Hydrogen Storage Facility HAGI, have small, localised areas of surface water flooding within their boundary. The Hydrogen Storage Facility HAGI, however, may be susceptible to groundwater flooding following prolonged intense rainfall. Warburton, Clock Face and St Helens HAGI have potential for groundwater flooding of infrastructure below ground level. Groundwater flooding is unlikely to adversely impact the operational development, providing appropriate drainage is provided, but could be an issue for construction if excavation of the ground is required (discussed further in **Section 5.2**).

5.3.13 The Hydrogen Storage Facility HAGI location is also very close to the edge of the existing Flood Zone 2/3 of the Puddinglake Brook and therefore with climate change could potentially be at risk of flooding. This will be investigated in detail as part of the FRA submitted with the DCO application.

5.3.14 The Runcorn HAGI is similarly close to the floodplain of the Weaver Navigation. As the Weaver Navigation is controlled to maintain sufficient water levels for navigation it is assumed that this management would continue and therefore the Runcorn HAGI location would remain in Flood Zone 1 in the future, notwithstanding potential climate change impacts.

5.3.15 Irrespective of the nature and extent of flood risk from external sources to each HAGI and Block Valve site, outline drainage strategies will be developed for all sites to support the FRA submitted with the DCO application, detailing how drainage would be provided at each site to ensure that surface water runoff from impermeable surfaces does not increase flood risk elsewhere. These drainage strategies will make allowance for future climate change on extreme rainfall in line with the latest Environment Agency guidance (as summarised in **Table 2.3**) and will incorporate appropriate SuDS elements (discussed further in **Section 6.2**).

Table 5.2 Flood Risk Overview - HAGIs (alternative options assessed in Table 5.3)

HAGI Location	Flood Zone	Watercourse catchment	NPPF compatible	Distance to nearest Main River/flood defences	FRAP required*	Surface Water Flooding	Reservoir Inundation	Groundwater flooding	Comments
Runcorn HAGI	1	Weaver Navigation	Yes	30m	No	Minor ponding 0.1% AEP	No	Not considered to be prone to groundwater flooding	Mapping indicates a minor watercourse stops north of site. Currently unknown if it sinks or is culverted under site.
Central Hub HAGI (Option 1)	1	Whitely Brook	Yes	>500m	No	Minor ponding 0.1% AEP	No	Not considered to be prone to groundwater flooding	
Hydrogen Storage Facility HAGI	1	Puddinglake Brook	Yes	30m	No	No	No	Potential for groundwater flooding to occur at surface	Site close to edge of flood zone. Unclear at this stage if the site is at risk for a future climate change event.
Warburton HAGI	1	River Bollin Tributary	Yes	>375m	No	Ponding NE corner 3.33% AEP	No	Potential for groundwater flooding of development below ground level	
HPP HAGI	3 (Fluvial)	Unnamed Watercourse (Gowy Catchment)	If Exception Test is passed	<10m	Yes	Ponding SW corner 3.33% AEP	No	Limited potential for groundwater flooding to occur	
Rocksavage HAGI (Option 1)	3 (Fluvial) 3 (Tidal)	River Weaver Mersey Estuary	If Exception Test is passed	<10m	Yes	No	Yes – but only when river in flood**	Potential for groundwater flooding to occur at surface	Tidally defended to present day 0.5% AEP
Partington HAGI	1	Manchester Ship Canal	Yes	>1km	No	Minor ponding 0.1% AEP	No	Not considered to be prone to groundwater flooding	
Clock Face HAGI	1	Whittle Brook	Yes	>750m	No	Ponding North side 3.33% AEP	No	Potential for groundwater flooding of development below ground level	
Higher Walton HAGI (Option 1)	3 (Fluvial) 3 (Fluvial & Tidal)	Manchester Ship Canal River Mersey	If Exception Test is passed	<10m >800m	Yes	Ponding 3.33% AEP	No	Limited potential for groundwater flooding to occur	Majority of site within a ‘dry island’ with some encroachment on flood zones.

HAGI Location	Flood Zone	Watercourse catchment	NPPF compatible	Distance to nearest Main River/flood defences	FRAP required*	Surface Water Flooding	Reservoir Inundation	Groundwater flooding	Comments
St Helens HAGI	1	Windle Brook	Yes	>400m	No	Ponding in east 3.33% AEP	No	Potential for groundwater flooding of development below ground level	

*A FRAP is required for any development within 16m of a tidal watercourse or 8m of a non-tidal watercourse. For this screening anything <10m from a non-tidal watercourse has been highlighted as potentially needing a FRAP.
**The Environment Agency publish two reservoir inundation maps – one 'dry' assuming normal flow in the river and one 'wet' assuming high river flows.

5.3.16 Rocksavage (Option 1), HPP and Higher Walton (Option 1) HAGI locations all intersect with Flood Zone 3. In line with EN-1 (DECC, 2011a) and NPPF (MHCLG, 2021a) these HAGIs will need to pass the Sequential and Exception Test and be designed and constructed to remain safe and operational during its lifetime, without increasing flood risk elsewhere as they are classed as essential infrastructure.

Rocksavage

5.3.17 Rocksavage HAGI (Option 1) is located in Flood Zone 3 and is the most complex HAGI location in terms of flood risk. The River Weaver is directly north-east of the site and a tributary of the River Weaver, which looks to be part for a wider network of land drains that have been classified as Main River, flows to the east. The south-east corner of the HAGI boundary is within 16m of the designated tidal Main River and, as such, a FRAP will be required.

5.3.18 Rocksavage HAGI (Option 1) is within the undefended flood extent (Flood Zone 3) of the River Weaver and the Mersey Estuary. However, it is located in an Area Benefiting from Defences (ABD), so is at residual risk of flooding. Flood defences are located along the nearby banks of the River Weaver and associated tributary as well as the Mersey Estuary.

5.3.19 A more detailed interrogation of the results of the modelling undertaken by the Environment Agency for the Mersey Estuary 2016 study indicates that the site is defended against a 0.5% AEP tidal event but that, in the future with climate change and associated sea level rise, the standard of protection offered by these defences is likely to reduce, resulting in the site being at risk of future tidal flooding.

5.3.20 Modelling undertaken by the Environment Agency for the Lower River Weaver in 2019 assessed the impact of climate change on fluvial flood risk by modelling up to a 70% increase in river flows. Even with this increase in flow the existing defences were not exceeded and the site remained dry.

5.3.21 The climate change allowances applied for these existing modelling studies are different to the recent Environment Agency guidance outlined in **Table 2.2** and **Table 2.4**. As a consequence, further modelling analysis will be undertaken to inform the FRA submitted with the DCO application to fully understand the impacts of future climate change and residual risk to this HAGI location and establish whether floodplain compensation would be required.

5.3.22 Current Environment Agency guidance[8] on indicates that floodplain storage compensation would be required to offset any loss of floodplain storage in the fluvial defended 1% AEP event including an allowance (higher central in this case) for climate change.

5.3.23 Given the fact the Project is an NSIP, a maximum credible scenario will be investigated for fluvial and tidal to ensure the resilience of the HAGI in line with the design standards detailed in **Section 2.6**.

5.3.24 Rocksavage HAGI (Option 1) would not be at risk from surface water flooding but it is in an area with a potential for groundwater flooding during periods of extended intense rainfall. However, it is likely that any groundwater emergence could be

satisfactorily mitigated through provision of appropriate drainage. Likewise, changes to surface water runoff rates and pathways as a result of the development of the HAGI will be addressed as part of an on-site outline drainage strategy.

HPP

5.3.25 The southwest corner of the proposed HPP HAGI location is shown to be at risk of flooding from fluvial sources. The site is within the flood extent of an unnamed Main River within the River Gowy catchment. Although this watercourse is a designated Main River, it is quite small, with a catchment area of approximately 4.05km^2 upstream of the proposed HAGI location.

5.3.26 It is understood that no detailed modelling exists of this watercourse, with the existing flood zones being based on broadscale modelling. Therefore, for the FRA submitted with the DCO application detailed 1D-2D hydraulic modelling will need to be undertaken to more accurately define the flood risk from this watercourse, and to be able to evaluate the impact of future climate change on this flood risk. This will require the procurement of detailed channel survey data.

5.3.27 Further detailed analysis will better define the flood extents and establish whether floodplain compensation would be required. Current Environment Agency guidance on indicates that floodplain storage compensation would be required to offset any loss of floodplain storage in the 1% AEP event including the higher central allowance for climate change. Given the fact the Project is an NSIP, a maximum credible scenario will be investigated to ensure the resilience of the HAGI.

5.3.28 The south-west corner of the HAGI site is also prone to surface water flooding. However, the surface water flood extent coincides with the existing floodplain so, through mitigating against the fluvial flood risk, it is likely the surface water flood risk to the site would also be mitigated. Changes to surface water runoff rates and pathways as a result of the development of the HAGI will be addressed as part of an on-site outline drainage strategy.

5.3.29 HPP HAGI is proposed in an area of limited potential for groundwater flooding, therefore groundwater flooding is unlikely to be an issue.

Higher Walton

5.3.30 Higher Walton HAGI (Option 1) site is predominantly in Flood Zone 1 with just the northwest corner intersecting with Flood Zone 3. However, it is located within a ‘dry island’ surrounded by the Flood Zone 2/3 associated with the River Mersey in the north, east and west, and the Flood Zone 2/3 associated with the Manchester Ship Canal in the south.

5.3.31 Further detailed modelling analysis will be undertaken to support the FRA for the DCO application to further understand whether the source of risk is the River Mersey or Manchester Ship Canal, determine how the risk to the site would increase with future climate change and establish whether floodplain compensation would be required should ground raising at the site be required to mitigate flood risk. Current Environment Agency guidance on indicates that

floodplain storage compensation would be required to offset any loss of floodplain storage in the 1% AEP event including the higher central an allowance for climate change. Given the fact the Project is an NSIP a maximum credible scenario will be investigated to ensure the resilience of the HAGI.

5.3.32 In the east and west of the HAGI location there is some potential for surface water ponding, but a low risk of flooding from groundwater. Changes to surface water runoff rates and pathways as a result of the development of the HAGI will be addressed as part of an on-site Outline Drainage Strategy.

Additional HAGI location options

5.3.33 As well as the ten HAGI location options discussed in **Table 5.2** there are an additional four alternative location options: two additional options for Rocksavage; one additional option for Central Hub; and one additional option Higher Walton. A summary of the flood risk to these additional HAGI location options is provided in **Table 5.3**.

5.3.34 The two additional options for Rocksavage are both located in Flood Zone 1 with no risk of surface water or groundwater flooding. In purely flood risk terms, therefore, the alternative Rocksavage HAGI locations would be preferred over the current preferred option. However, siting of a HAGI at Rocksavage is contingent on a number of other constraints, in addition to flood risk. Should the Rocksavage Option 1 be selected as the final location for the DCO application, information on these other constraints would be provided as part of the evidence submitted for application of the Sequential Test (as discussed further in **Section 7**).

5.3.35 Both options for the Central Hub are in Flood Zone 1, and therefore are equally acceptable in flood risk terms, with no requirement to provide further evidence to support Sequential Test application.

5.3.36 The Higher Walton Option 2 is adjacent to the Manchester Ship Canal and slightly encroaches into the floodplain and Flood Zones 2 and 3. Additionally there is some isolated risk of surface water flooding. The risk of groundwater flooding is low. Therefore, in flood risk terms, the Option 2 location does not appear to an improvement over the current preferred location. Evidence to support application of the Sequential Test will need to be provided whichever of the two locations is selected for the DCO application.

Table 5.3 Flood Risk Overview – HAGIs Alternative Options

HAGI Location	Flood Zone	Watercourse catchment	NPPF compatible	Distance to nearest Main River/flood defences	FRAP required*	Surface Water Flooding	Reservoir Inundation	Groundwater flooding	Comments
Rocksavage HAGI (Option 2)	1	River Weaver	Yes	>175m	No	No	Yes – but only when river in Flood**	Not considered to be prone to groundwater flooding	Site located within a 'dry island'
Central Hub HAGI (Option 2)	1	Whitely Brook	Yes	>500m	No	No	No	Not considered to be prone to groundwater flooding	
Higher Walton HAGI (Option 2)	3 (Fluvial) 1	Manchester Ship Canal River Mersey	If Exception Test is passed Yes	<10m >400m	Yes	Ponding 3.33% AEP in centre	Edge of site long the Canal	Limited potential for groundwater flooding to occur	Majority of site within a 'dry island' with some encroachment on flood zones.
Rocksavage HAGI (Option 3)	1	River Weaver	Yes	>175m	No	No	Yes – but only when river in Flood	Not considered to be prone to groundwater flooding	Site located within a 'dry island'

*A FRAP is required for any development within 16m of a tidal watercourse or 8m of a non-tidal watercourse. For this screening anything <10m from a non-tidal watercourse has been highlighted as potentially needing a FRAP.
**The Environment Agency publish two reservoir inundation maps – one 'dry' assuming normal flow in the river and one 'wet' assuming high river flows.

Block Valves

5.3.37 Block Valves are proposed on the East Corridor (currently three options) and South Corridor (currently five options).

5.3.38 All Block Valve options are in Flood Zone 1 and more then 16m away from a Main River. Only one of the location options (EBV1) along the East Corridor is at risk of surface water flooding, with up to a third of the location being within a significant area of surface water flooding. One location option along the East Corridor has the potential for groundwater flooding (EBV1), three along the South Corridor have potential for groundwater flooding of development below ground level (SBV1, SBV2 and SBV5) which would need to be considered during construction. Any changes to surface water runoff rates and pathways as part for the development will be addressed as part of an on-site Outline Drainage Strategy.

6. Flood Risk Management

6.1.1 This section sets out the embedded environmental measures and Outline Drainage Strategy design principles that are to be incorporated/embedded into the Project to ensure that flood risk impacts to and from the Project are minimised and appropriately managed during the construction and operational phases. At this stage of the Project no detailed design has been undertaken for any aspect of the proposed measures discussed below, rather this PFRA sets out the design standards that would be adopted by the Project.

6.1.2 For all temporary works, the final FRA forming part of the DCO submission will set out the parameters for both watercourse crossings and drainage management measures for construction. These will be incorporated into the outline Code of Construction Practice (CoCP) to be developed for the DCO application. However, construction contractors would be required to specify the detail of these measures in relevant FRAP/discharge of DCO requirements documents post-grant of the DCO.

6.1.3 Embedded environmental measures to address flood risks identified in **Section 5.2** for the construction phase are presented in **Table 6.1;** those to address the risks identified in **Section 5.3** for the operation phase are presented in **Table 6.2**.

6.1.4 All measures proposed follow the outline principles presented in **Section 7.7** of **Chapter 7: Water Environment** and are taken from the list of embedded environmental measures in **Table 7.16** of this chapter**.** The Embedded Measure ID is included in the tables in this chapter**.** Any changes to the design between statutory consultation and the DCO submission will be reassessed as part of the final FRA. There is potential scope to refine the design and positioning of above ground infrastructure and construction areas through the DCO process.

Table 6.1 Construction embedded environmental measures

Construction Element	Flood Risk	Mitigation	Embedded Measure ID
All	All	Preferential siting of construction infrastructure and activities to minimise flood risk and impacts on sensitive receptors and wherever possible maintain necessary stand-off distance from the edge of a watercourse or defence.	C-22 C-9
	All	Follow a CoCP*	C-1
	All	Identification of construction activities in flood risk areas and preparation of a Flood Emergency Response Plan	C-23

Construction Element	Flood Risk	Mitigation	Embedded Measure ID
	Surface water run-off	Drainage and Water Management Plan to support CoCP.	C-2
	Fluvial, groundwater, surface water	Timing of works in known areas of flood risk to heed any flood warnings.	C-3
	Fluvial/Tidal	FRAP produced for all works within 16m of a tidal Main River and 8m of a non-tidal Main River.	C-9
Material storage areas	Fluvial, tidal, surface water	Sequential approach to storage of pipes across site to avoid areas of high flood risk and conveyance routes.	C-22
Pipeline Crossings	Fluvial	Watercourse Crossing Plan will be developed to support the CoCP to incorporate embedded mitigation.	C-25
	Fluvial	All pipeline crossings of major watercourses to be trenchless, with no temporary construction access crossing (including where flood defences present).	C-26
	Fluvial	Timing of in-channel open cut crossings to avoid wettest time of year or when a flood warning is predicted.	C-27
Trenchless Crossing compounds	All	Minimise raised structures in floodplains, and mitigate impacts where unavoidable through appropriate alignment, leaving gaps and cross-drainage	C-24
	Fluvial, tidal, surface water	Sequential approach to positioning of compound infrastructure to avoid areas of high flood risk and conveyance routes.	C-22
Temporary Access Routes	Fluvial	Design temporary haul road access crossings to minimise impacts on flood storage and conveyance	D-4 C-28

Construction Element	Flood Risk	Mitigation	Embedded Measure ID
HAGI construction Compounds	All	Minimise raised structures in floodplains, and mitigate impacts where unavoidable through appropriate alignment, leaving gaps and cross-drainage	C-24 D-3
	Fluvial, tidal, surface water	Sequential approach to positioning of compound infrastructure to avoid areas of high flood risk and conveyance routes.	C-22

*The construction works would follow a Construction Code of Practice (CoCP) to be implemented via a Construction Environmental Management Plan (CEMP), which would cover the management of surface water drainage and flood risk mitigation, throughout the duration of the construction works. An Outline Drainage and Water Management Plan document will be produced for the DCO application to summarise the key methods by which surface water and dewatered groundwater would be managed to avoid flood risk and protect the water quality of receiving water bodies during construction. This will support the outline CoCP.

Table 6.2 Operational embedded environmental measures

Project Element	Flood Risk	Mitigation	Embedded Measure ID
All	All	Optimisation of routing, including location of permanent above ground infrastructure to avoid flood risk areas as far as possible	D-1 D-2
Pipeline	Groundwater	Mitigate impacts to sub-surface flow routes where unavoidable through appropriate alignment and positioning the clay water barriers/mitigation and cross-drainage.	D-5
	Fluvial, Surface water	Pipeline is underground, so minimal surface water and flood risk impacts once built	D-1
HAGI	All sources	Preferential siting of permanent infrastructure to minimise flood risk and impacts on sensitive receptors	D-2
	Fluvial/Tidal	Development of flood protection measures and associated floodplain compensation (if required).	D-3
	Surface Water run-off	Development of Outline Drainage Strategy	D-3

Project Element	Flood Risk	Mitigation	Embedded Measure ID
Block Valve	All sources	Preferential siting of permanent infrastructure to minimise flood risk and impacts on sensitive receptors	D-2
	Surface Water run-off	Development of Outline Drainage Strategy	D-3

These are the proposed management measures for the preliminary design based on the assessment of risk in **Section 5**.

6.2 Drainage Strategies

6.2.1 Within the FRA submitted with the DCO application it will be necessary to understand the surface water and foul water drainage implications; and flood risk associated with the proposed works. Drainage strategies will be developed for the permanent above ground infrastructure: HAGIs and Block Valves.

6.2.2 Each of the HAGI and Block Valve compound sites have different site characteristics and will therefore be assessed individually to establish preferred drainage solutions to ensure no increase in run off from the sites.

6.2.3 Drainage strategies will adhere to the LLFA requirements on runoff rates and follow the principles of the SuDS hierarchy. All drainage strategies submitted with the DCO application will be in outline but will be quantified to allow for a robust assessment. Detailed drainage strategy design would be undertaken as part of the discharge of requirements should the DCO be granted.

6.2.4 For construction elements of the Project, each element will be assessed on a case-by-case basis, taking into consideration the duration of construction, risks and vulnerability of potential receptors. For the FRA submitted with the DCO application, an Outline Drainage and Water Management Plan will be developed for the construction phase of the Project. This will set out the principles and parameters to be followed for construction drainage. The development of the detailed Drainage and Water Management Plan would be secured by via DCO requirement and would be the responsibility of the construction contractor.

7. Project Specific Planning Policy Requirements

7.1 The Sequential Test

7.1.1 The primary routeing objective for a pipeline is to join up the supply points with the demand points, in this case connecting the Hydrogen Production Facility with the Hydrogen Storage Facility and connecting both of these with the agreed customers and potential off-take points.

7.1.2 Flood Zones 2 and 3 were identified from Environment Agency flood map for planning data and used in the mapping exercise to identify the most appropriate corridors between these points, with a preference to avoid areas of flood risk wherever possible. The corridors were wide areas of search within which the pipeline route would be located.

7.1.3 In some locations the requirements of the project design along with consideration of other environmental and engineering constraints has meant that it was not possible to avoid development in an area of flood risk. Therefore, some construction activity would have to occur within Flood Zones. More detailed routeing work within the corridors was then undertaken to try and avoid the flood zones if possible or to minimise the extent of flood zone affected.

7.1.4 At this stage of the Project, there remains some optionality in the Preliminary Order Limits as work continues to identify and avoid potential constraints and consider how the Project will manage them. This includes consideration of flood risk.

7.1.5 Information from the associated routing studies will be provided within the FRA submitted with the DCO application to support the final Sequential Test, once the operational and construction infrastructure locations have been finalised.

7.2 The Sequential Approach

7.2.1 Where flood zones cannot be avoided there may be an opportunity to sequential design areas of development so as to avoid the highest areas of flood risk across a development area, for example a construction compound. This can be done to avoid placing infrastructure in the most at risk locations across a site and maintain drainage pathways.

7.3 The Exception Test

7.3.1 The requirements of the Exception Test were set out in **Section 2**, along with the flood risk vulnerability and flood zone ‘compatibility’ matrix in **Table 3.1**, which confirmed that the Exception Test needs to be passed for the infrastructure elements of the Project located in Flood Zone 3a and 3b.

Wider Sustainability Benefits

7.3.2 Part 1 of the Exception Test requires the Project to provide wider sustainability benefits to the community that outweigh flood risk. As stated in NPS EN-1, this would include the benefits (including need) related to the infrastructure.

7.3.3 The Project would make a significant contribution to delivering critical energy infrastructure for the UK and reducing wider carbon emissions in accordance with National Policy.

Flood Risk

7.3.4 Part 2 of the Exception Test requires that the Project would be safe, without increasing flood risk elsewhere (subject to the exception below) and, where possible, would reduce flood risk overall. 'Essential infrastructure' in Flood Zone 3a should also be designed and constructed to remain operational and safe in times of flood.

7.3.5 Evidence will be provided within the FRA submitted with the DCO application to support the Exception Test application.

7.4 Functional Floodplain

7.4.1 Functional floodplain is defined as land where water has to flow or be stored in times of flood. As described in **Table 1.2** the functional floodplain (Flood Zone 3b) is often defined using the 5% AEP event.

7.4.2 For the FRA submitted with the DCO application the modelled 20% AEP flood extent will be used, where such data exists. But in lieu of the 20% AEP flood extent being available it is proposed to apply the 1% AEP flood extent (Flood Zone 3) as a proxy for the functional floodplain.

7.4.3 As the permanent operational infrastructure is classified as essential infrastructure there is no differentiation in planning policy as the Exception Test needs to be passed if the development in either Flood Zone 3a or 3b.

8. Summary and Conclusions

8.1 Summary

8.1.1 As the Project is classified as an NSIP, the pFRA has been carried out in accordance with NPS EN-1, which details planning policy in regard to NSIPs in the energy sector, and the NPPF plus associated PPG where relevant, for additional guidance regarding flood risk and development.

8.1.2 This pFRA considers the flood risks associated with the permanent operational infrastructure associated with the proposed pipeline as well as the construction elements.

8.1.3 Flood risks associated with tidal, fluvial, groundwater and surface water sources have been identified during the construction and operation phase of the Project.

8.1.4 The flood risk management standards, including the appropriate climate change uplifts to be applied, for operational phase elements of the Project were set out in **Section 2**. During both the phases of the Project there would potentially be an increase in impermeable area, which result in greater surface water runoff. To manage the increased runoff from these areas, drainage strategies will be developed to ensure there is no increase in flood risk elsewhere.

8.2 Conclusions

8.2.1 Overall, the permanent operational infrastructure associated with the Project (pipeline, HAGIs (with the exception of Rocksavage, Higher Walton, Hydrogen Storage Facility and HPP), and Block Valves) are not considered to be at risk of significant flooding. Through the preparation of robust drainage strategies and implementation of SuDS measures, where required, the operational infrastructure is not indicated as posing an increased risk of flooding to third party receptors. Additionally, with appropriate mitigation measures to manage groundwater flowpaths along the pipeline route, the operational pipeline is not indicated as posing an increased risk of flooding to third party receptors.

8.2.2 It is noted from this pFRA that four HAGI locations could potentially be at risk of flooding in the future. Further assessment, potentially including additional hydraulic modelling, is required to establish any design and mitigation requirements for the Rocksavage, Higher Walton, Hydrogen Storage Facility and HPP HAGIs prior to completion of the final FRA.

8.2.3 The siting of permanent infrastructure and construction activities will also be subject to further review to try wherever possible to remove locations from significant areas of flood risk. Where relocation is not possible appropriate mitigation would be put in place. Flood risk and drainage mitigation measures associated with construction will be set out in principle with the final FRA. The design details of these measures would be developed as part of the discharge of requirement, should the DCO be granted.

8.2.4 Drainage strategies and design of flood mitigation measures associated with the permanent operational infrastructure will be submitted in outline as part of DCO application but will be quantified to allow for robust assessment. Detailed drainage strategy and flood mitigation design would be developed as part of the discharge of requirement, should the DCO be granted.

8.2.5 The flood mitigation measures detailed in **Section 6** are likely to be sufficient in mitigating the risks associated with the Project, during construction and operation. However, as noted above, further flood risk assessment and design development work is required to address flood risk issues identified at some locations and demonstrate policy compliant drainage strategies for all permanent infrastructure. This work will be completed within the FRA submitted with the DCO application.