HyNet North West
Hydrogen Pipeline

Delivering clean growth

Cadent
Your Gas Network

Chapter 2

The Project

October 2024

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Contents

2. The Project

2.1 Background to and Need for the Project

2.1.1 The UK Government has set legally binding net-zero carbon dioxide (CO2) emissions targets in response to the global climate emergency. This means that by 2050, any CO_2 emissions to the atmosphere must be offset by equivalent emissions removal.

2.1.2 This Draft Environmental Statement (ES) is for the HyNet North West Hydrogen Pipeline Project ('the Project'). This is an integral part of the wider HyNet North West programme and the associated removal of emissions described in **Chapter 1: Introduction, Section 1.2**. Further information on the legislative and policy drivers for the Project are outlined in **Chapter 4: Legislation and Planning Policy**.

2.1.3 The HyNet North West programme is being developed in stages, as is necessary and appropriate for the commercial deployment of hydrogen technology. The Project comprises one of the elements of the wider HyNet North West programme. The elements of the wider programme include:

- Production of hydrogen by EET Hydrogen, formerly Vertex Hydrogen at the Hydrogen Production Plant (located at Stanlow Refinery);
- Development of Carbon Capture and Storage (CCS) infrastructure for capture, transport and storage of carbon dioxide from the Hydrogen Production Plant (as well as existing and new build industrial facilities) by Liverpool Bay CCS Ltd; and
- Development of a Hydrogen Storage Facility (HSF) by Inovyn at underground storage caverns in Cheshire to allow for fluctuations in demand.

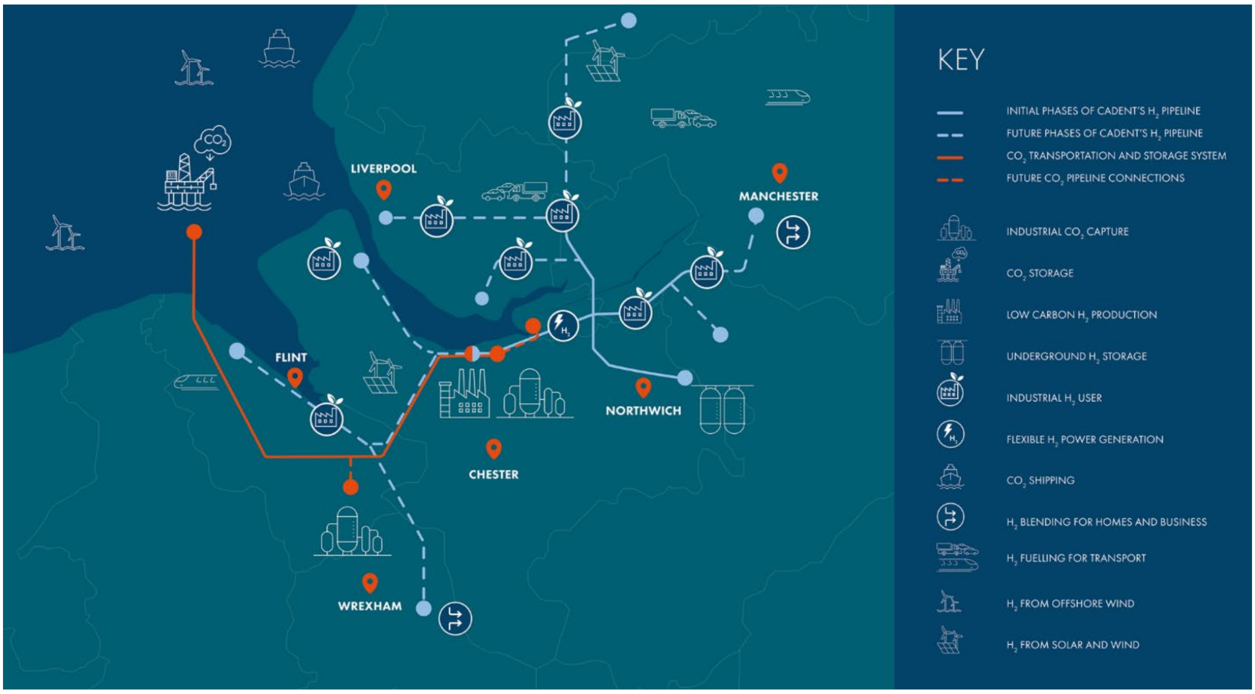
2.1.4 The Project is being designed with foreseeable future phases and usage in mind and the potential to accommodate hydrogen from other sources in the area including sources of blue and green hydrogen.

2.1.5 The key objective of the Project is as follows:

"*The HyNet North West Hydrogen Pipeline project will transport low carbon hydrogen from the EET Hydrogen production site at Stanlow or the Inovyn storage site to identified industrial customers and will provide the opportunity to introduce or convey hydrogen into the existing gas network at Partington and Warburton (the "Customers"). The aim is for the Project to be commissioned in 2030, but it will also be designed with foreseeable future phases, demand and need in mind. In this way, it will support some of the North West's biggest businesses and employers for years to come, helping the region lead the way in the transition to Net Zero Carbon by 2050.*"

2.1.6 **Figure 2.1** illustrates the pipeline element of the Project (labelled 'Initial Phases of Cadent's H_2 Pipeline') in the context of the wider HyNet North West programme. This includes illustration of potential future phases of the wider programme. Further detailed description of the Project is provided in **Section 2.4**

Figure 2.1 Illustration of the wider HyNet North West programme (Source: https://hynet.co.uk/about/)



Note: the figure above is an illustrative representation of the wider HyNet North West programme only. For the HyNet North West Hydrogen Pipeline Project, please refer to **Section 2.4** and the accompanying figures with this Draft ES.

2.2 Consideration of Options and Routeing

Introduction

2.2.1 Schedule 4 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017[1] (the EIA Regulations) states that an ES should include:

"*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.*"

[1] UK Government (2017). Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended). (Online) Available at: https://www.legislation.gov.uk/uksi/2017/572/contents (Accessed June 2024).

2.2.2 **Section 2.2** provides an overview of the options and routes considered, with further detail, including figures, presented in **Appendix 2A: Design Evolution.**

Strategic options

2.2.3 Strategic Options were developed to allow the identification of connection routes between the following defined end points, which the Project needs to connect to:

- Hydrogen Production Plant (at Stanlow Refinery);
- Hydrogen Storage Facility (Inovyn, Northwich);
- ESB Power (Carrington Power Station) and two blending points on the existing Cadent gas network (Partington and Warburton);
- A cluster of industrial operations in St Helens; and
- A number of other industrial customers in the vicinity of the route that wish to be supplied with hydrogen.

2.2.4 Each Strategic Option had both positive and negative considerations; however Strategic Option A was chosen as the most appropriate option on the basis that:

- Strategic Option B and D both involved crossings of the Mersey Estuary with the environmental implications of work within or closer to the Special Protection Area (SPA) and Ramsar designations and the additional cost from longer sections of large diameter pipeline and the difficulty in long distance drilling required to create the pipeline route.
- Strategic Option C would require an additional hub site, which would add complexities and cost to the construction of the development and would require additional land take.

Route Corridor and HAGI Search Area Identification

2.2.5 Within the preferred Strategic Option A, route corridors and Hydrogen Above Ground Infrastructure (HAGI) search areas were developed and evaluated in terms of environmental and engineering considerations. Where no clear preference was identified, all options were retained and taken forward for non-statutory consultation.

Stage 1 Non-statutory Consultation

2.2.6 The non-statutory consultation exercise ran from January to March 2022. A summary of how the feedback from the Stage 1 non-statutory consultation has shaped the development of the Project is described in **Appendix 2A: Design Evolution.**

Preliminary route alignment/preliminary order limits

2.2.7 Following the Stage 1 Non-statutory consultation exercise, the representations received, and ongoing engineering/environmental work allowed the corridors to be refined to provide a more defined corridor, which supported the identification of route alignments within the corridors. HAGI locations were also refined. These route alignments formed the Preliminary Order Limits which were described and assessed with the Preliminary Environmental Information Report (PEIR) published in September 2022. The Preliminary Order Limits were also consulted upon at Stage 2 Statutory Consultation.

Stage 2 Statutory Consultation and Draft Order Limits

2.2.8 Following publication of the PEIR and the Stage 2 Statutory Consultation, which ran from 12 September to 10 November 2022, the design has evolved further to account for consultation feedback and further environmental/engineering work. The changes between the Preliminary Order Limits and the Draft Order Limits considered in this Draft ES are described in **Appendix 2A: Design Evolution.**

2.3 Design Envelope Approach for Draft ES

2.3.1 In order to establish the scope of environmental assessment, the Draft ES adopts a parameter-based design envelope approach, having regard to the Planning Inspectorate's Advice Note Nine (The Planning Inspectorate, 2018[2]). The Final ES will do the same. This approach, known as the 'Rochdale Envelope' Approach, is employed "where the nature of the Proposed Development means that some details of the whole project have not been confirmed" and "flexibility is sought to address uncertainty."

2.3.2 Assessing the Project using this design envelope approach means that the assessment will consider a maximum design scenario which allows flexibility to make design decisions in the future that cannot be finalised at the time of publication of this Draft ES, or for the Development Consent Order (DCO) Application in due course. Defining the design envelope within which changes may occur also allows for the worst-case design scenario to be considered within the technical assessments presented in the Draft ES.

Order limits

2.3.3 **Figure 2.2** (and **Figure 1.1**) illustrate the proposed 'Draft Order Limits', which is the presently anticipated maximum extent of land in which the Project may take place, as well as the key components of the Project. The Draft Order Limits cover the entire area within which development could take place. As well as the permanent features (including the pipeline, HAGIs and Block Valve Installations (BVIs)) these include areas to account for temporary construction works including compounds, accesses and other temporary works including drainage.

[2] The Planning Inspectorate (2018). Advice Note Nine: Rochdale Envelope (Version 3). (Online) Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-nine-rochdale-envelope/ (Accessed July 2024).

2.3.4 At this stage of the project design the Draft Order Limits include optionality for certain infrastructure elements at certain locations, including the route of the pipeline and location of HAGIs (see **Section 2.4** for further details). This is to allow design flexibility for the following reasons:

- to take account of ongoing engineering design;
- to allow for refinement based on the findings of planned geotechnical, topographical, walkover and utility surveys;
- to allow for design changes in light of on-going environmental surveys and assessment; and
- to take account of feedback received during Stage 3 Statutory Consultation, through engagement, including through consultation events with the public, key stakeholder meetings and discussions with landowners.

2.3.5 In addition to the Draft Order Limits, Limits of Deviation have also been defined. The Limits of Deviation indicate the maximum area of land within which the permanent infrastructure may be located.

2.3.6 Indicative widths of the Order Limits and Limits of Deviation are provided in **Table 2.1** for typical open cut sections of pipeline. As detailed further in **Section 2.5**, limits of deviation will vary due to the requirements of trenchless crossings and HAGIs.

Table 2.1 Indicative Limits of Deviation for pipeline

Pipeline size	Pipeline diameter	Indicative width of Order Limits	Indicative Limits of Deviation
Very large	36 – 42”	104m	60m
Large	24 – 30”	96m	60m
Medium	16 – 18”	80m	50m
Small	6 - 12’’	Within the highway boundary (including verges)	Within the highway boundary (including verges)

2.3.7 The Draft Order Limits that informed this Draft ES were determined by taking into account factors including key connection points to the Hydrogen Production Plant at Stanlow, the Hydrogen Storage Facility, required HAGIs, gas network blending points and the spurs to connect to identified industrial customers.

2.3.8 The design of the Project and Draft Order Limits will be further refined and evolve through the EIA process based on the further information to be collected that is outlined above. This is expected to include narrowing of the Order Limits and application of Limits of Deviation.

2.3.9 It is currently anticipated that the Project as a whole will be included within the Order Limits, including the spurs - smaller pipelines - that form the connections to customers identified as part of the Project - which will be included as 'associated development' (in accordance with the Annex to the Secretary of State's Direction under section 35 of the Planning Act 2008).

2.4 Development Proposals

Introduction

2.4.1 The Project includes the construction, operation and maintenance of approximately 100km of new pipelines to distribute hydrogen to industry, power stations and opportunities for blending with the existing natural gas network in the North West. The pipeline network would connect to a newly constructed Hydrogen Production Plant at the Stanlow site as the source of hydrogen for onward distribution through the network. Future, additional sources of hydrogen for the pipeline network are being considered. A Central Hub connects the four main pipeline corridors. Branching off from each main corridor there would be spurs.

2.4.2 The EIA Scoping Opinion[3] also required that the scenario for decommissioning be considered as part of the Project. See **Section 2.7** for further information.

2.4.3 The pipelines that make up the network would vary in diameter between approximately 6” and 42” dependent on which corridor or spur they create. The two main types of pipe expected to be used are Carbon Steel (CS) and Polyethylene (PE) pipes. The pipeline would be buried along the entire route apart from short sections within secure compounds at locations where HAGIs and BVIs are required. It is currently envisaged that nine HAGIs and two BVIs would be required at points along the network. The description of a typical HAGI and a BVI is provided in **Section 2.4** with further details on operation provided in **Section 2.6**.

2.4.4 The pipeline would be constructed predominantly using open cut techniques. However, where open cut is not practicable trenchless crossing techniques (such as Horizontal Directional Drill (HDD) or micro-tunnelling) will be used at key locations including motorways and major highways, rail, rivers (typically those classed as main rivers, but some may be ordinary watercourses) and canals. These techniques are described in **Section 2.5**.

2.4.5 A Crossing Schedule is provided in **Appendix 2B** and illustrated in **Figure 2.3** which includes the location and grid reference, the type of feature being crossed and the proposed crossing methodology. Note, due to the linear nature of the corridors and spurs on the Project and also the features being crossed, some features may be crossed more than once.

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[3] The Planning Inspectorate (2022). Scoping opinion Proposed: HyNet North West Hydrogen Pipeline Project Case Reference: EN060006. (online) Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN060006/EN060006-000019-EN060006%20-%20Scoping%20Opinion.pdf (Accessed August 2022).

2.4.6 In some locations it has been necessary to retain optionality (e.g. route options for complex trenchless crossing locations). These options will be subject to further analysis and design development through ground investigation, environmental surveys and landowner/stakeholder consultation.

2.4.7 Where optionality remains, these are detailed in the following descriptions. The assessment of optionality is described in the technical chapters of this Draft ES. The optionality will be refined as part of the ongoing design, assessment and consultation process, with the refined design presented in the DCO application and assessed in the accompanying ES.

Central hub HAGI

2.4.8 The Central Hub HAGI is the common connection point on each corridor and would be located approximately 380m from the A553, in an agricultural field that is bound with hedgerows and occasional mature trees. The location is adjacent to an existing area of hardstanding used for plant storage, accessed via an existing hardstanding track.

West corridor

2.4.9 The West Corridor of the Draft Order Limits (**Figure 2.2**, Sheet 1 to 8) is typically characterised by open fields separated by hedgerows and tree lines. The pipeline would be between approximately 1.5km and 2km from the Mersey Estuary SPA and Ramsar at the nearest point. The West Corridor includes eleven or twelve trenchless crossings, depending on the options chosen, as detailed in **Appendix 2B**.

2.4.10 The West Corridor would start at the Hydrogen Production Plant HAGI (HPP HAGI) at Stanlow with the pipeline running approximately 9.7km northeast to the Rocksavage HAGI and then approximately 9.7km southeast to the Central Hub HAGI. The pipeline would be High Pressure and the diameter is anticipated to be 42”.

2.4.11 The HPP HAGI (see **Figure 2.2**, Sheet 1) would be located within the south-easterly extent of the Stanlow site, approximately 30m north of the A5117 and 180m west of Pool Lane.

2.4.12 The Rocksavage HAGI would be located in an area of woodland, on land bound by the M56 to the northwest, the Weaver Navigation to the northeast, the River Weaver to the southwest, and the railway viaduct to the southeast.

North corridor

2.4.13 The North Corridor of the Draft Order Limits (**Figure 2.2**, Sheet 8 to 21) is typically characterised by open fields with hedgerows and tree lines separating them before Sutton Heath, where the route is more typically adjacent to residential areas and proceeds to the more industrial setting around Ravenhead. The North Corridor includes nine trenchless crossings as detailed in **Appendix 2B**. The pipeline diameter on the North Corridor is expected to be between 10” to 18”.

2.4.14 The North Corridor would start at the Central Hub HAGI with the High Pressure pipeline running approximately 9.2km north to the Higher Walton HAGI. There are two options for the location of the Higher Walton HAGI (**Figure 2.2**, Sheet 12); HWH2 located on land north of the Manchester Ship Canal and the southern edge of the Moore Nature Reserve (as presented in the PEIR), or a new HWH8 option in an agricultural field to the south east of the Manchester Ship Canal.

2.4.15 From the Higher Walton HAGI, the corridor runs approximately 9.7km northwest to the Clock Face HAGI. Owing to a new housing allocation in the likely adopted Local Plan and the associated redevelopment of the area immediately to the east of Fiddler's Ferry Power Station the route considered in the PEIR is no longer viable; alternative pipeline routes NP6 and NP7 have therefore been identified and are included in the Draft Order Limits and assessed in this Draft ES (**Figure 2.2**, Sheet 17).

2.4.16 NP6 would proceed in a north-westerly orientation from Moore Nature Reserve, facilitating a trenchless crossing of the River Mersey, canal and railway line before proceeding along the northern edge of Fiddler's Ferry Golf Course and re-joining the route presented in the PEIR, after crossing the A562 via a trenchless technique. NP7 would head westwards across the Golf Course after crossing the River Mersey, canal and railway, utilising the route of an existing ethylene pipeline, before re-joining the route presented in the PEIR north of the A562.

2.4.17 The proposed location for the Clock Face HAGI (**Figure 2.2**, Sheet 19) is in an agricultural field bound by the M62 approximately 20m to the north and the B5419 approximately 30m to the east (both measured to the nearest point).

East corridor

2.4.18 The East Corridor of the Draft Order Limits (**Figure 2.2**, Sheet 8, and 22 to 30) is typically characterised by open fields separated by hedgerows and tree lines and includes eight trenchless crossings as detailed in **Appendix 2B.**

2.4.19 The East Corridor would start at the Central Hub HAGI with the pipeline running approximately 18km northeast to the Warburton HAGI. A BVI is required between the Central Hub HAGI and the Warburton HAGI, located in an agricultural field bound by hedgerows off the A50, west of High Legh.

2.4.20 The Warburton HAGI (**Figure 2.2**, Sheet 28) would be located adjacent to the existing Cadent Above Ground Installation (AGI) facility at Carr Green Lane. The HAGI would be located in a field with existing established hedgerows and trees, to the southeast of the B5160 (Dunham Road). While some of the vegetation may need to be removed temporarily for access and pipeline connection, the majority would be maintained as visual screening. A thicker belt of woodland to the south of the HAGI location would provide visual screening for the TransPennine Trail/Bollin Valley Way.

2.4.21 The pipeline then continues northwards across open fields for approximately 3.8km to the Partington HAGI. There are two options for the location of the Partington HAGI, PH1 located west of the junction of Ashton Road and Townsend Farm Lane on an existing disused brownfield site, west of the HAGI location shown in the PEIR, or a new PH2 option located in an agricultural field to the east (**Figure 2.2**, Sheet 30).

2.4.22 The Warburton and Partington HAGIs would connect to existing Cadent AGI facilities to allow potential Hydrogen Injection Blending (HIB) of the hydrogen supply into the wider gas supply. See information on the spurs in the sections below.

South corridor

2.4.23 The South Corridor of the Draft Order Limits (**Figure 2.2**, Sheet 8, and 31 to 38) would start at the Central Hub HAGI with the pipeline running approximately 17.9km south to the Hydrogen Storage Facility (HSF). The pipeline is expected to be High Pressure and 42” diameter and includes fourteen trenchless crossings as detailed in **Appendix 2B**.

2.4.24 Two options are being considered where the corridor approaches the Trent and Mersey Canal near Bartington; the route considered in the PEIR (now known as SP5) and a new SP6 option which runs slightly further west, passing to the other side of the residential property in this location (**Figure 2.2**, Sheet 31).

2.4.25 A BVI would be required, located in an agricultural field to the north of the A556 (Chester Road) (**Figure 2.2**, Sheet 34).

2.4.26 The HSF and associated infrastructure are subject to a separate consent application by Inovyn, which is considered as part of the inter-project cumulative effects assessment. It has previously received consent for natural gas storage. The Project considered in this Draft ES involves provision of the pipeline to supply the site with hydrogen, a HAGI and an access road. The HAGI would be located approximately 250m to the east of the A530 in a field currently bounded by hedgerow and mature trees.

Spurs

Runcorn/Rocksavage Spur

2.4.27 The Runcorn/Rocksavage Spur (see **Figure 2.2**, Sheet 5) would start at the Rocksavage HAGI and run north to the Runcorn HAGI. From the Runcorn HAGI it would continue broadly southwest to connect the following customers:

- Intergen (Rocksavage).

2.4.28 The Runcorn/Rocksavage Spur would also facilitate a connection to Inovyn, Runcorn for which the pipeline connection would be provided by the customer.

2.4.29 The Runcorn HAGI would be located on land between the Weaver View (minor road, approximately 100m to the south) and A5126 (approx. 300m to the north).

2.4.30 This Rocksavage HAGI to Runcorn HAGI spur would include approximately 1.3km of 24” diameter pipeline and one trenchless crossing as detailed in **Appendix 2B**.

2.4.31 There would be an approximately 0.4km 24” High Pressure spur from Runcorn HAGI to Intergen (Rocksavage), with no major crossings required.

Warrington Spurs

2.4.32 The Warrington Spur(s) (see **Figure 2.2**, Sheet 12 to 15) would be approximately 6km in length and include two trenchless crossings as detailed in **Appendix 2B**. The spur would start at the Higher Walton HAGI and run northeast with a High Pressure 8” spur to provide connection to the following customers:

- Ingevity, Warrington.

2.4.33 A second spur of 10” diameter Medium Pressure pipeline would remain south of the River Mersey and cross under the railway underpass then proceed as street works along Eastford Road to Morely Common. To reduce interaction with the Trans Pennine Trail and the proposed Warrington Western Link road scheme and minimise effects on the Walton Locks Local Wildlife Site, it is proposed to utilise a trenchless crossing technique in this location rather than open cut north-eastwards from Eastford Lane to the A5060/Gainsborough Road. A trenchless crossing entry compound would be located on part of Morley Common and would exit at either Gainsborough Road or Cranbourne Avenue. From here the route will continue as street works along Gainsborough Avenue (WSp1) or along Cranbourne Avenue (WSp3).

2.4.34 The route would then proceed broadly northeast, crossing the disused Runcorn and Latchford Canal and the A50 and proceed with street works for approximately 4.8km to Novelis.

Clock Face Spur

2.4.35 The Clock Face Spur (see **Figure 2.2**, Sheet 19 to 20) starts at the Clock Face HAGI and runs northeast to connect to the following user:

- NGF Europe Ltd.

2.4.36 This Medium Pressure spur would include approximately 4.8 km of 8” diameter pipeline through areas of fields adjacent to Chapel Lane and continue into the existing industrial area along Lea Green Road. There would be one trenchless crossing as detailed in **Appendix 2B**.

St Helens Spurs

2.4.37 From the Clock Face HAGI, the corridor continues broadly north for 6.4km to connect to the following customers (**Figure 2.2**, Sheet 19 to 21):

- Pilkington UK’s Greengate Works.
- Glass Futures.

2.4.38 The Intermediate Pressure 8” diameter spur to Pilkington UK’s Greengate Works would run along Burtonhead Road to the northwest for approximately 0.25km.

2.4.39 The Intermediate Pressure Glass Futures 8” diameter spur would run along Burtonhead Road with Ravenhead Nature Park to the southwest then turn north and cross the A570 (St Helen’s Linkway) into the Glass Futures site to the north of Sherdley Road Industrial Estate. This would be approximately 0.85km of spur.

Warburton Spur

2.4.40 The Warburton Spur (see **Figure 2.2**, Sheet 28) starts at the Warburton HAGI and runs approximately 0.2km west to connect to the existing Cadent AGI on Carr Green Lane to facilitate Hydrogen Injection Blending (HIB) of the hydrogen supply into the wider gas supply. This spur is expected to be an 8” diameter pipeline. No trenchless crossings are required.

Partington Spur

2.4.41 The Partington Spur(s) (see **Figure 2.2**, Sheet 30) start at the Partington HAGI and connect to the following:

- Partington Cadent AGI.
- Basell Polyolefins.

2.4.42 The Partington Spur would also facilitate a connection to ESB Power, for which the pipeline connection would be provided by the customer.

2.4.43 The High Pressure spur would run northwest to the existing Cadent AGI at Partington and is expected to be approximately 0.3km and up to 8” diameter pipeline. This would facilitate HIB of the hydrogen supply into the wider gas supply.

2.4.44 The High Pressure spur to Basell Polyolefins would run north for approximately 0.4km and is expected to be up to 8" diameter.

Hydrogen Above Ground Installations (HAGIs)

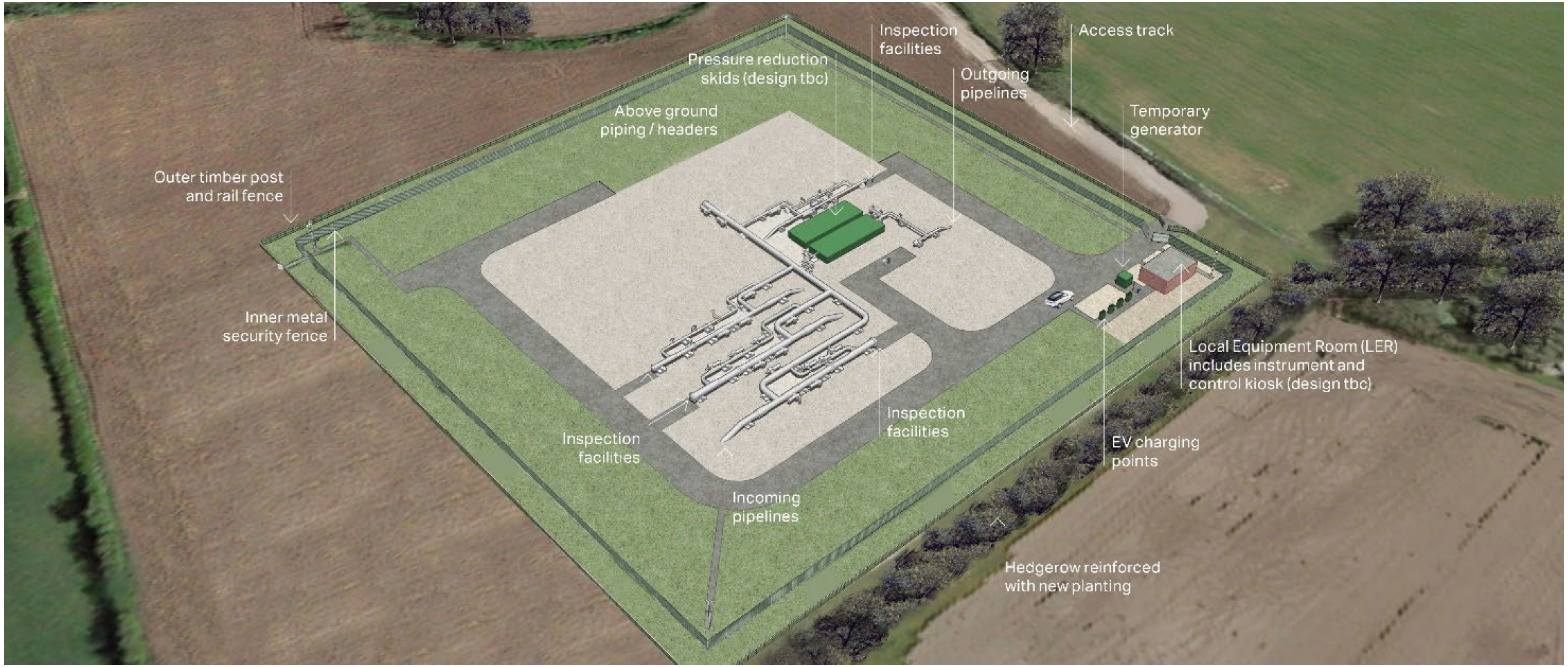
2.4.45 The HAGIs are required to facilitate connections to the network producers, customers and storage and to be able to monitor, operate, maintain and inspect the network during operation.

2.4.46 HAGI sites will include a range of permanent above ground components for which further description is provided under the headings below. The above ground components described will be kept at low level due to the nature of the equipment and to reduce visual impact. This infrastructure would typically be approximately up to 3m in height, subject to final design. Other features including fencing, general telecommunications equipment and lighting may vary as described below. The HAGIs will require connection to the local distribution network operator's (DNO) electrical distribution network and telecommunication systems. The DNO supply will support electric vehicle charging by Cadent maintenance staff visiting the site. In addition to the DNO electrical supply, alternative sources of power including use of renewables are currently under consideration for use on the HAGI site, including hydrogen generators as detailed below. An illustrative layout for a HAGI is provided in **Graphic 2.1** A photo of an example above ground installation as part of the existing gas network is shown in **Graphic 2.2**

HyNet North West Hydrogen Pipeline

Delivering clean growth

Graphic 2.1 Illustrative HAGI layout



Note: The figure illustrates the types of equipment required and the final equipment and layout at each HAGI will vary.

Graphic 2.2 Above Ground Installation Example

2.4.47 The sites would require security fencing, typically 2.4m to 3.6m high with double-leaf access gates for vehicles. Access would be required from the adjacent road network, access tracks or similar. There would also need to be space for maintenance operatives to safely park their vehicle(s) off the highway and open the gates.

2.4.48 The HAGI sites footprint would vary; typically ranging between 0.5ha to 1.5ha.

2.4.49 For the purposes of the environmental assessment in this Draft ES, assessment of HAGI sites up to 2ha have been undertaken to allow for further design development including requirements for access, security, and associated landscaping such as planting or bunds to provide screening. The HAGIs would generally be unlit except during maintenance or potential breakdown/emergency requirements, at which point permanent task lighting mounted on columns (approximately 3-5m high) would be switched on for the duration of the works.

2.4.50 Some of the customer connections will require a small amount of equipment to manage the pipeline connection appropriately. The area required for such connections will be <0.1ha and equipment will be less than 3m high. The equipment required will be within the customers land, usually close to other industrial infrastructure and on brownfield land. The equipment area is usually known as a ‘pigging compound’ and these areas are included within the Draft Order Limits. Work is ongoing to assess the requirement for these facilities at each customer site, however they have been included in the Draft ES in case they are a requirement of the Project’s operations going forward.

Pressure Reduction Units

2.4.51 Pressure Reduction Units (PRU) are included within the HAGI footprints and used to control the flow or pressure off the network for end users, and consists of above ground components including pipework. Above ground pipework (for PRUs as well as metering and inspection facilities) will vary in diameter with the maximum piping sizes approximately the same diameter as the adjacent buried pipeline, but many of the associated pipes would be much smaller.

2.4.52 A typical PRU will be skid mounted i.e., mounted to a frame at the point of manufacture and delivered to site for connection.

Metering facilities

2.4.53 Metering facilities are required for volume measurements of the hydrogen gas flow for control and fiscal purposes, they will be located inside the HPP and HSF HAGIs. As with a PRU, these consist of above ground pipework and components and can be skid-mounted. The facilities are installed above ground along a 15m section of pipeline and measure approximately 4m wide and up to 2.5m in height.

Inspection facilities

2.4.54 Inspection facilities support future In-Line Inspection (ILI) of the pipeline network. The ILI is undertaken by passing a device known as a ‘pig’ or Inline Inspection Tool through the pipeline which is propelled by the flowing gas without interruption to the gas supply. The facilities include above ground pipework from which to launch and receive the pig as well as operating equipment including valves. Inspection facilities will be located inside the HAGIs.

Instrumentation and Control Local Equipment Rooms (LERs)

2.4.55 Instrumentation and Control (I&C) LERs, to be located within the HAGI and BVI compounds, will house the equipment that monitors key parameters (including the flow, pressure and temperature). Field instrumentation located on pipework will connect to the equipment in the kiosk with these signals being sent to the Energy Control Centre (ECC) via satellite link or similar. The electrical distribution board(s) and uninterruptible power supply (UPS) are to also be housed within the LER.

2.4.56 The LERs are typically prefabricated Glass Reinforced Plastic (GRP) units of approximately 2.4m height placed on a concrete base that is cast in situ.

Hydrogen Generators

2.4.57 Alternative sources of energy supply are being considered by the Applicant, including the use of Hydrogen Power Units (HPU). HPU technology provides an opportunity to further utilise hydrogen on site to power the HAGI, by converting hydrogen into electrical energy. This energy can then be used to support on-site EV charging units and power for the control systems within the HAGI. The use of on site HPU’s could be an alternative to the electrical supply from the Grid or to reduce the electrical drain from the grid by supporting the EV charging. Permanent and any temporary HPUs would be sited within the footprint of the HAGI compound. Use of the HPU would not however remove the DNO connections from the Project design but could significantly reduce the required load from the Grid.

Block Valve Installations (BVIs)

2.4.58 These sites are separate facilities to the HAGIs and would be housed in a compound less than 0.5ha in size, with fencing approximately 2.4m high, an access track, facilities for turning vehicles. and an access gate. Access would be required for maintenance vehicles, typically Light Goods Vehicles (LGV).

2.4.59 The main valve will be in-line with the buried pipeline. The bypass and bypass valves will be buried with extended stems for valve operation. The valve actuator would also extend a short height (approximately 1.5m) above ground. The valves will be operated locally for which the necessary equipment on site will be housed in an I&CLER (similar to those described above).

2.4.60 Two BVIs are required as part of the Project; the Sworton Heath BVI would be located on the East Corridor, and the Hartford BVI would be located on the South Corridor.

Cathodic Protection

2.4.61 A Cathodic Protection (CP) system will be required as part of the pipeline system. This protects the pipeline from corrosion by imposing a small electrical current, which inhibits the electrochemical process of corrosion. This requires the placement of Transformer Rectifier (TR) units and groundbeds at strategic locations around the network. These would typically be included within the HAGI sites with the required electrical supplies. The CP system will have signals connected to the telecommunication system within the HAGI LER. CP monitoring points would be installed at regular intervals along the pipeline (approximately every 1 - 2km). These are housed within marker posts typically at selected road crossings and field boundaries and do not require any other above ground infrastructure such as a compound or kiosk.

Marker Posts

2.4.62 Markers would also be required at crossings and field boundaries. CP posts and marker posts are small posts and approximately 1m high. Aerial markers are required (to assist in ease of route identification) during aerial surveys of the pipeline and are typically 2m high and made of plastic.

Fibre Optics

2.4.63 Fibre optic cabling would be required along the length of the pipeline route. It is anticipated that a conduit for the fibre optic cable would be buried at the same time as the pipeline, within the same trench. The fibre optic cable would then be installed by blowing it through the ducting. Chambers are required for this process, at spacings of between 2 and 3km depending on the equipment used. These chambers are only needed for the cable installation and have no use during operation unless there is ever a need to replace the fibre optic cable. It is therefore likely that these chambers would be buried below ground at locations indicated with a maker post. Generally, above ground manholes are not anticipated to be required, although there may be a requirement for junction boxes either side of trenchless crossing sections. Above ground splice boxes may also be required at major crossings. These would be housed within marker posts or buried chambers.

2.5 Construction

2.5.1 The following section provides an overview of the typical form and sequencing of construction for both the pipeline and HAGIs. The pipeline would predominantly be constructed by the open cut installation technique. A range of options are identified for the trenchless crossings and are described in **Section 2.5, paragraph 2.5.50** to **2.5.65**.

2.5.2 The proposed pipeline network would be a multi-diameter pipeline transportation network and as such each section would have a specific working width. For a 42” pipeline the working width would be expected to be up to 36m. **Table 2.2** provides an indicative working width for each diameter of pipeline.

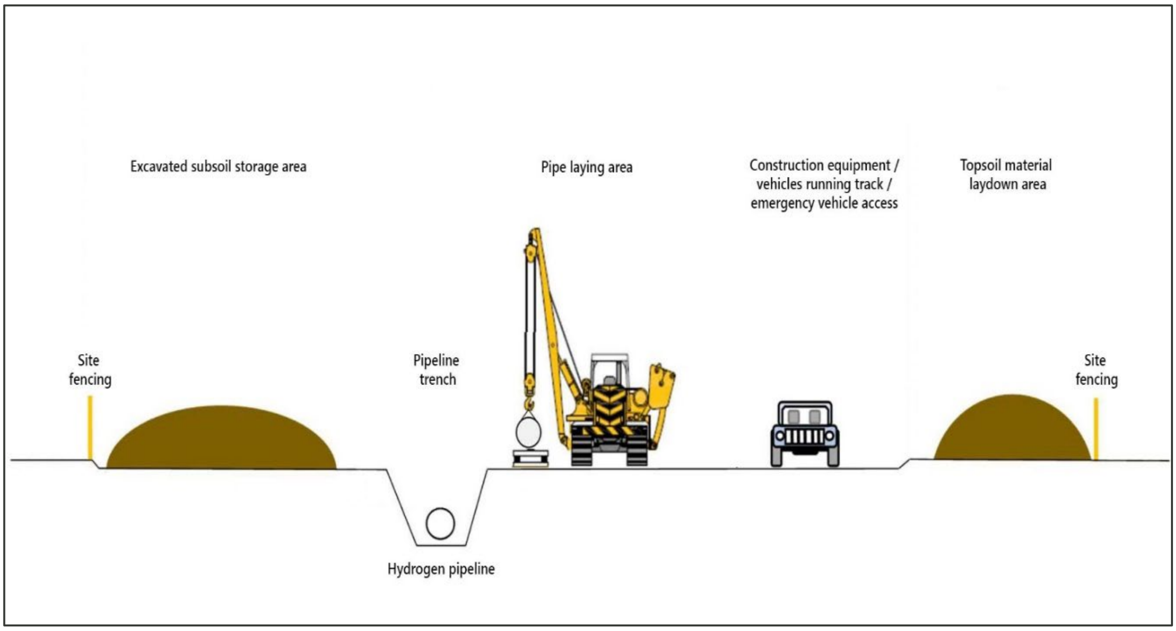
Table 2.2 Indicative working widths for different pipeline diameters

Pipeline diameter range (inches)	Typical construction working widths (m)
36 – 42”	36
24 – 30”	28
16 – 20”	22
4 - 14’’*	Within Highway boundary*

* Note: Exceptions to this are the West and North Corridor spurs, which vary from 8-10” diameter pipeline and would generally use the working width applicable for 16-20” if routed cross country

2.5.3 The working width is divided into work, transport and laydown areas. It typically comprises topsoil and subsoil laydown areas, the trench area, pipe string and construction equipment area and a running track for through access of construction related personnel. A typical cross-section is shown in **Graphic 2.3.**

Graphic 2.3 Typical layout of a working width for pipe laying



2.5.4 A wider working width, known as a box out section, will be required e.g., at crossings including trenchless crossings, where the pipeline route changes direction and before / after sections of narrowed working width. This is to facilitate safe working, additional spoil storage and equipment laydown.

2.5.5 Temporary construction site accesses have also been identified across the Project and are shown in **Figure 2.2**. There are three categories of access routes, one for all construction traffic including plant and Heavy Goods Vehicles (HGVs), those that are limited to use by Light Goods Vehicles (LGVs) only and ‘Light Construction Access’ where a reduced number of HGV vehicles are expected. Third party assets that are unable to be crossed by construction traffic e.g. ‘block points’ are also identified at major highways and navigable canals.

2.5.6 The Draft Order Limits have also been developed to include areas for temporary construction equipment, pipe and other material storage (‘temporary construction compounds’) along the corridors. These include sections of pipe of approximately 12 – 18m in length and are typically stacked on sand berms up to a maximum of 4m high.

Construction phasing and indicative timescales

2.5.7 Construction is expected to commence in Q1 2027 ready for commissioning Q1 2030. The Project would be operational by Q2 2030.

2.5.8 Pipelines are constructed within the pipeline “spread” or temporary working width which is a corridor of land extending along the route. Pipe laying can be likened to a production line with successive activities moving along the spread. Activities include site preparation, pipeline stringing, welding, inspection, laying and testing. Once complete, reinstatement would be undertaken across the temporary working width.

2.5.9 Pipeline construction is generally focused on the spring and summer months (March to September) with an aim to reduce impacts on agricultural land. Based on the current programme, survey and early works will take place in 2025 and 2026 followed by two pipelaying seasons in 2027 and 2028. Some crossings, reinstatement works and pre-commissioning will continue into 2029. The works for crossings and pipelines in the streets may occur outside the typical pipelaying season and throughout the year. The Applicant will work with consultees e.g., Statutory Nature Conservation Bodies (SNCBs) to determine the timing of sensitive works. It is expected that each corridor would take 12-18 months to construct, with works focused on a geographical area for a shorter period of time, as below.

2.5.10 Once a section is prepared the installation of fabricated sections can typically advance at 150m – 350m per day depending on diameter and local conditions. In more congested areas, and when pipe diameter and weights are larger, progress is slower and the advance may be only tens of metres per day.

2.5.11 Independent construction crews would work on the main pipeline spread plus road, rail and watercourse crossings. Work crews would be located at several locations at any one time and move forward as the work progresses across the section they are working on. Equally at times during the construction period there would be no active work at particular locations. Each crew would typically have 30 persons and the total workforce would be up to 1,000 personnel split across all project spreads.

2.5.12 Different plant and vehicles are required according to the activities of pipe laying, making trenchless crossings, HAGI or BVI construction and temporary construction compounds. These will include plant of varying height such as mobile telescopic and crawler cranes, 360 tracked excavators and side booms for pipelaying. Use of larger equipment such as cranes would be temporary and generally short-term dependent on the task, plant suitability and availability. **Chapter 10: Noise and Vibration** provides indicative information on plant associated with the construction.

2.5.13 Construction of a HAGI typically takes from six to twelve months and may be in progress at any point during the year, subject to any local constraints. Construction of BVIs would typically take up to four months.

2.5.14 Standard construction working hours would be 10 hours per day (08:00 to 18:00) from Monday to Saturday, with no works on Sundays or Bank Holidays. There may be the need for some extended working hours, for instance, night working to minimise traffic disruption at road crossings, but this would be subject to agreement with the Local Planning Authority.

2.5.15 There would be the need for continuous (24-hour) working for some activities, due to the need to work continuously on specific construction activities and reduce impacts on third party assets/ statutory undertakers. Such activities include:

- Tunnelling and Horizontal Directional Drilling;
- Pipe pulling at trenchless crossings; and
- Pipeline testing.

2.5.16 A number of works would be expected to occur in parallel, however, the exact phasing of the works has yet to be determined. Further details of the construction programme and phasing will be developed for the final ES.

Pipeline construction

Construction site preparation

2.5.17 Following survey of the construction site, including utilities and Unexploded Ordnance (UXO) checks, work would commence to prepare the pipeline corridor. This would include any installation of site fencing, the type of which would be determined based on key factors including security and land use. For example, demarcation fencing may be used in arable fields or where livestock is present, stock fencing appropriate to the type of livestock e.g., cattle, sheep, deer etc. Where the surrounding land is publicly accessible, then requirements would be enhanced for safety and security e.g., 2.4m Heras fencing or similar.

2.5.18 Safe crossing points would be implemented e.g., where a Public Right of Way (PRoW) crosses the working width. Where necessary, a temporary closure and diversion will be put in place and signage provided. An Outline Public Rights of Way Management Plan (OPRoWMP) will be developed for submission with the application for development consent, detailing the locations of crossings, closures /diversions and the proposed method for their implementation. A draft version of this document is provided in **Appendix 11B**.

2.5.19 The accesses and the need for improvements at these points e.g., visibility splays, bell mouths and widening will be subject to further design and consultation with the appropriate Highways Authority, the outcome of which along with the results of further environmental surveys will inform the required assessments in the EIA. Construction access points are discussed further in the Draft Construction Traffic Management Plan (**Appendix 11A**). Where an access point is required along a PRoW, the OPRoWMP will consider options including creation of a temporary shared route with users.

2.5.20 Once access is achieved from the highway, the access track would be based on the particular terrain conditions on the access route. This would vary from stripping the topsoil to allow vehicles to run on the subsoil, limited grading (if required), and use of track mats or overlaying crushed stone on a geotextile membrane (floating roads).

2.5.21 Site clearance including hedgerow and tree removal (outside the bird nesting season) and localised re-grading would take place. Earthworks would be limited due to the generally gentle undulation of the terrain. Some levelling or cut and fill works may be required on a limited number of steep slopes or banks. Benching (terracing) may be required in a small number of locations where side slopes exist. The earthworks are not expected to require large amounts of import. Some limited export and disposal of excavated material may be required, in relation to trenchless crossings and HAGI construction sites or export of material from the site. All suitable excavated materials would be reused in reinstatement and restoration of ground levels (see Reinstatement in **paragraph 2.5.34** to **2.5.36**). It is envisaged that running track access stabilisation will be required in areas that are soft, wet, boggy and in peat areas (if necessary). Stable accesses will be made either by use of installed track matting, floating road or with use of imported aggregates is expected in wet / boggy areas and at some temporary access locations. Track matting and floating roads are typically placed directly over topsoil to avoid stripping or may be used directly on subsoil following stripping if subsoil is unstable. The exact stabilisation method will be determined, as required, based on location specific soil conditions.

2.5.22 The requirements for clearance would be location specific but during the development of the Project a key consideration would be to retain and protect sensitive areas, including habitats and vegetation, where practicable.

2.5.23 Topsoil would be stripped across the required working area and stored at the edge of the works in accordance with industry best practice, to protect topsoil integrity for future reuse during reinstatement. The topsoil bunds would typically be in the order of 2m in height though may be higher subject to ensuring there is no excessive soil compaction and visibility restrictions. Topsoil bunds would be sited to avoid risk of top soil loss and impeding areas of surface water flow and gaps left between bunds to avoid waterlogging.

2.5.24 Other activities likely to be required during site preparation include:

- Site signage, service protection and other site safety requirements;
- Establishment of temporary facilities for site personnel;
- Establishing site environmental management requirements e.g., tree protection fencing and other site-specific pre-commencement activities;
- Development of temporary site drainage, sediment management and any necessary temporary watercourse crossings; and
- Creation of temporary accesses along the working width including opening field boundaries along the route.

Fabrication

2.5.25 Line pipes would be brought to site and stored in stacks prior to deployment along the pipeline route, before being transported to their final location along the route, where they would be placed on wooden supports or skids adjacent to the line of the trench. This process is known as pipe stringing. This process is known as pipe stringing.

2.5.26 Where necessary changes in horizontal direction and vertical profiling would be undertaken by employing cold bending. This would require mobilisation of associated plant on site.

2.5.27 For general cross country construction line pipes would be lifted onto skids and the pipes welded to form a continuous string. A range of welding techniques for CS pipes, including automatic, semi-automatic and manual welding techniques, would be employed along the route. All CS welded joints would be tested by Non-Destructive Test procedures. Once tested an anti-corrosion coating would be applied to the welded joints of steel pipes. Jointing of PE pipes would be undertaken using Butt Fusion or Electrofusion fittings. Mainlaying techniques may be required in congested areas and in streetworks sections where the pipe is fabricated within or directly above the trench. Mainlaying typically comprises lowering of single or double jointed pipe sections directly into the trench where they are welded together in ‘bell holes’ or welding of supported pipes above the trench, avoiding the additional width required for a pipe stringing/ fabrication area. Mainlaying is typically supported by a pipe fabrication/ storage area within a construction compound where single or double joints can be transported in from.

Trenching

2.5.28 The pipe trench would generally be dug using mechanical excavators or trenching machines, which would normally straddle the trench. The depth and width would vary with pipeline diameter but would allow a minimum reinstated cover of 1.2m over the top of the pipeline. The subsoil material excavated would be stored separately from the topsoil to avoid mixing.

2.5.29 Dewatering of trenches may be required e.g., in the event that groundwater is present. Groundwater monitoring is to take place as part of ground investigation. The method of dewatering will be dependent on the ground conditions; however it is likely to include the use of mobile pumps.

Pipe laying

2.5.30 Welded pipe sections would be carefully lifted and lowered into the trench in a continuous operation using side booms, excavators or cranes dependent on the size of the pipeline. PE pipes may be lifted into position using lighter lifting equipment or may be pulled into the trench using a winch and rollers or pulled into the ground using trenchless methods. PE pipe may come to site in coils allowing much longer lengths of pipe without joints being necessary.

2.5.31 The pipe would generally be laid on bedding material and covered in padding material. This would typically be soft fill from excavated materials and would serve to protect and minimise movement of the pipe. Backfilling would be undertaken using subsoil from the temporary storage areas.

Testing

2.5.32 The internal bore of the pipeline would be cleaned using devices known as pigs which travel along the length of a pipeline test. The pipeline will be hydrostatically pressure tested, using a local water source, agreed and permitted by the Environment Agency and appropriate local authority as required. Disposal of test water would also be undertaken in accordance with the permit.

2.5.33 The pipeline would be further inspected by inspection equipment to ensure it is free of defects e.g., unacceptable dents, flat spots or areas of ovality. Final end to end drying and dew point testing would be undertaken.

Reinstatement

2.5.34 Reinstatement of the working area would be undertaken typically including regrading, subsoil ripping to relieve compaction and removal of debris. Topsoil would be reinstated to the former depth.

2.5.35 Where possible, previous land uses would be re-established e.g., agricultural areas and fencing established in accordance with agreements with landowners and in consideration of the necessary easements. Areas of landscaping and required habitat reinstatement, including tree and hedgerow planting, would be implemented through a landscaping scheme that would be prepared and delivered in accordance with a requirement of the DCO.

2.5.36 Drainage altered during construction would be reinstated and where necessary, new drainage would be laid. All temporary materials such as bog mats, road fill, temporary culverts and geotextile membrane will be removed during the reinstatement works.

Crossing techniques

2.5.37 A Crossing Schedule has been developed to inform the assessment as part of the draft ES and is provided in **Appendix 2B** and **Figure 2.3**. The Crossing Schedule will be updated as necessary and be provided as part of the application for development consent and the draft DCO. A description of open cut installation and trenchless crossing techniques are provided below.

Open cut

2.5.38 Open cut installation involves the excavation of a trench across the feature to be crossed and the installation of the pipeline in the trench. A trench for the largest diameter pipe may be approximately 2.5m deep while crossings of features such as streams may require excavations of approximately 4 – 5m deep. This method is typically used for minor roads, tracks, streams and ditches. The features on the Project that would be expected to be installed using open cut techniques are outlined in the Crossing Schedule in **Appendix 2B**.

2.5.39 Note, open cut installation may also be used for third party utilities, the details of which would be subject to agreement with the utility providers.

2.5.40 At each crossing point it is necessary to install the pipeline beneath the feature being crossed and provide a means of crossing for construction plant and vehicles.

2.5.41 Open cut installation at minor roads would typically involve the following stages:

- Implementation of traffic control measures (subject to agreement with the Highways Authority) to ensure safety and minimise disruption. Works would be undertaken in as short a timeframe as possible, typically five days or less.
- Identification of services and protection as required.
- Cutting of the road surface at the trench edges using a road saw.
- Excavation of the trench to the required depth.
- Installation of temporary access covers to maintain traffic flow, where necessary.
- Installation of the pipe or a construction sleeve for installation of the pipeline at a later data.
- Backfilling of the trench and resurfacing undertaken in accordance with the requirements of the Highways Authority.

2.5.42 Construction plant and vehicles must be able to cross from one side of a road for onward access to the route. This involves tracking major plant across the road for which traffic control measures and service protection would be undertaken as above. The road surface would be protected using rubber matting or similar, or by use of a temporary sacrificial tarmac surface. Measures would be put in place to ensure the highway is clear of debris and any restoration works would be subject to agreement with the highway authority.

2.5.43 The crossing point would be required for the duration of the construction period within the particular section. However, the crossing point would only be in operation when it is necessary to transfer plant or vehicles across. The highway would otherwise remain open to the public as normal for the majority of the time a crossing is in place.

2.5.44 Open cut installation of watercourses would typically be undertaken by one of two methods, either by fluming or damming and subject to the required consents. Fluming would typically include the following stages:

- Steel or plastic pipe is installed along the bed such that the water flows unimpeded through the flume. These would be sized to ensure that the total flow capacity includes any anticipated increase in flow due to wet weather plus a factor of safety.
- Excavation of a trench beneath the flume and the pipeline inserted beneath.
- Backfilling of the trench and removal of the temporary flume.
- Reinstatement of the feature crossed to pre-construction condition.

2.5.45 Damming would typically include the following stages:

- Damming at the proposed crossing location through installation of steel trench sheets, aggregate/sand bags or similar.
- Transfer of flowing water from upstream to downstream using pumps and hoses. Pumps and hoses would be suitably sized to ensure that the total flow capacity includes anticipated increase in flow due to wet weather plus a factor of safety. Note, this may not be necessary in drainage ditches where water flows in either direction.
- Excavation of the trench through the temporarily dammed area and installation of the pipeline.
- Backfilling of the trench and removal of the temporary dam.
- Reinstatement of the feature crossed to pre-construction condition

Note: a combination of pumping for flow transfer and fluming may also be used.

2.5.46 To maintain access either side of these features, temporary crossing points would be required subject to agreement with the appropriate authorities. This would typically include bridging where larger spans are required, or fluming for smaller features. Bridging would typically be used on features including rivers, larger streams/ ditches (note, this is for access only and the pipeline may still be installed using a trenchless crossing method). Bridging of navigable canals is not proposed.

2.5.47 For flumed temporary crossing points, these would include sizing and laying of a steel or plastic pipe as described above. To complete the installation of the crossing, a combination of geotextile and fill (e.g., stone, excavated materials) and/or bog mats would provide the surface for plant and vehicles to move over. At the end of construction, the materials and pipe would be removed and reinstatement undertaken to pre-construction condition.

2.5.48 There would also be the need for crossings of numerous hedgerows on the Project. Crossings of hedgerows would be undertaken in a manner to minimise the working width as far as possible and therefore minimise the impact on hedgerows across the Project. A typical crossing for a 42” pipeline would involve approximately 5m for pipe laying and approximately 4m for plant crossings as opposed to the standard 36m working width, this would vary for smaller diameter pipelines. For further measures to mitigate impacts at hedgerow crossings, please refer to **Chapter 5: Biodiversity, Section 5.7.**

Trenchless crossing techniques

2.5.49 There are a number of methods by which trenchless crossings would be undertaken, the choice of which is determined by a number of factors including the feature being crossed, agreements with third parties regarding asset protection, ground conditions and the length/depth of the crossing. It is not possible to determine which method would be used at each trenchless crossing prior to the establishment of these factors and appointment of the Contractor(s) to undertake the works.

2.5.50 Each trenchless crossing technique is characterised by the need for establishment of an entry and exit site. Temporary construction compounds will be required at entry and exit sites to support crossing construction activities. In order to assess a reasonable worst case, the typical footprint for each type of crossing has been established. **Table 2.3** provides these parameters as well as the proposed maximum vertical LoD for each technique. Further information on how each topic has undertaken a reasonable worst-case assessment is provided in the topic **Chapters 5 to 18**.

Table 2.3 Typical parameters for trenchless crossing techniques

Trenchless crossing technique	Footprint entry site (ha)	Footprint exit site (ha)	Maximum Vertical Limit of Deviation (m)
HDD	0.3	0.2	60m
Auger bore (guided and unguided)	0.1	0.1	40m
Micro-tunnel	1	0.4	40m
Direct pipe	1	0.4	60m

2.5.51 The layout and equipment at each trenchless crossing temporary construction compound varies and would include site fencing such as Heras fencing (or other types between 2.4m to 3.6m high depending on security requirements) and lighting to support 24hr activities as required. Temporary construction compounds at crossings include areas for pit / shaft construction, excavated materials, soil processing plant, settlement pits (as required), drilling mud/ slurry processing, storage of materials and equipment, drilling rigs and ancillary equipment, generators, security and welfare facilities, temporary office, car parking, fuelling area, waste disposal etc. Equipment heights will vary but are typically expected to range between 1m and 4m. Some larger equipment individual elements including storage tanks and cranes are likely to be required during the works.

2.5.52 The length of time a trenchless crossing site would be in use varies depending on the technique, complexity, depth and length of crossing. This may vary between one to six months. Some continuous (24 hour) working may be required as defined in **paragraph 2.5.15**.

Horizontal Directional Drilling (HDD)

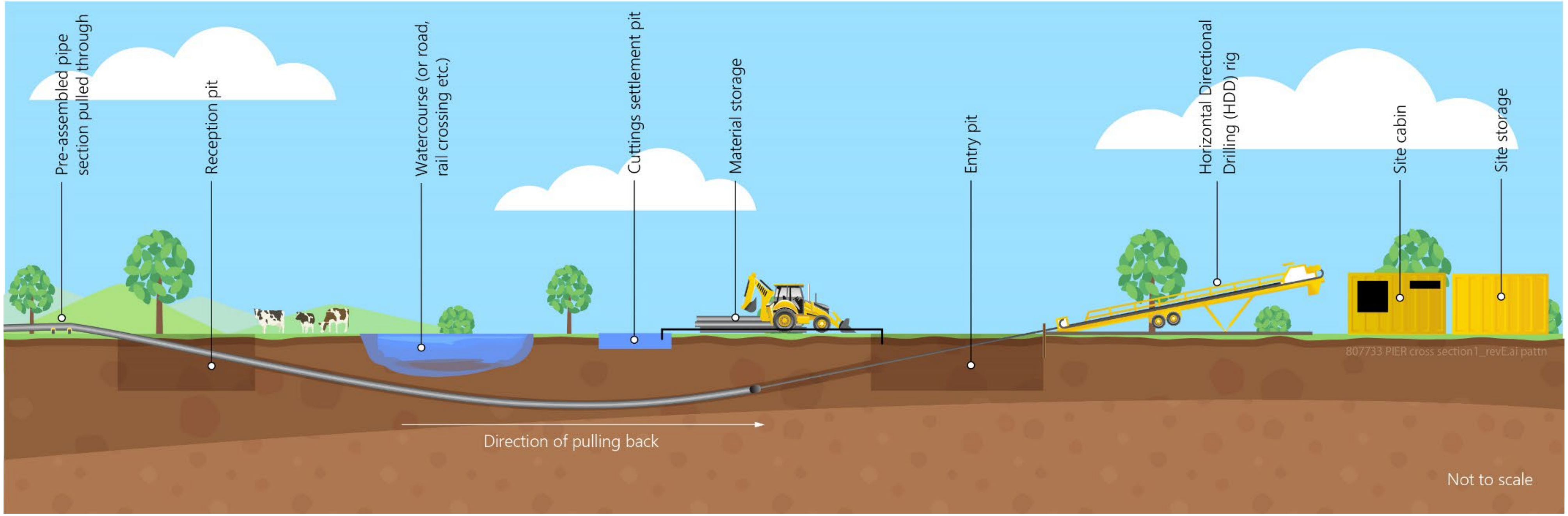
2.5.53 The HDD technique is typically used on longer trenchless crossings. HDD requires creation of an entry and exit pit on either side of the feature to be crossed and guiding a pilot hole along a pre-determined profile beneath the obstacle. **Graphic 2.4** provides an illustrative example of an HDD site set-up. The depth of the drilled profile can be set to minimise risk to the obstacle being crossed and maximise protection of the pipeline.

2.5.54 Once the pilot hole is complete the bore is enlarged in stages using reamers (drill heads) in soft ground or hole openers in hard ground to a diameter approximately 1.5 times greater than the diameter of the pipeline to be installed.

2.5.55 Excavation takes place by rotating a cutting head at the front of the drill string and pumping drilling fluid from the surface, through the drill string, to the cutting head. During drilling, the bore is supported by drilling fluid which also performs functions such as drill bit cooling, lubrication and as a transport medium for the removal of drill cuttings. Settlement pits are used for the separation of excavated materials and recycling of the drilling fluid.

2.5.56 When the bore has been enlarged to the required diameter the pipeline is pulled through using the drilling rig. A stringing site that is equivalent to the length of the HDD crossing is required to fabricate the product pipeline in a single length allowing the installation operation to be completed without interruption.

Graphic 2.4 Illustrative HDD set-up



Auger Boring

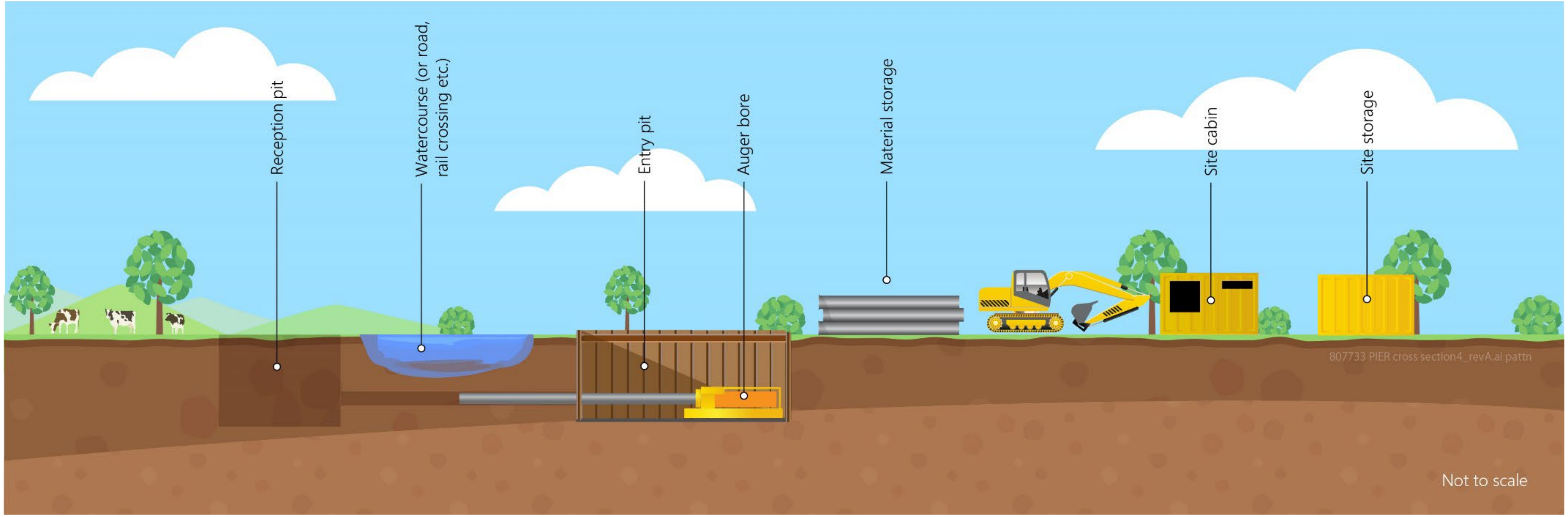
2.5.57 Auger bores are typically used for shorter trenchless crossings. The auger bore process requires the establishment of a drive reception pit and boring the hole under the feature to be crossed. **Graphic 2.5** provides an illustrative image of an unguided auger-bore set-up. The pipeline can be simultaneously installed in the bored hole as excavation takes place (uncased). Alternatively, a sacrificial pipe (steel or concrete) the same diameter as the pipeline is installed in the bored hole (cased) as excavation takes place, which is later displaced after the bored hole has been completed.

2.5.58 Excavation takes place by rotating a cutting head at the front of the pipe as it is pushed into the ground. Excavated material is removed from inside the pipe back to the drive pit by helical-wound auger flights inside the pipe.

2.5.59 Following reception of the auger, the cutting head is removed and the pipe is welded and pushed through to the reception pit.

2.5.60 Auger bores can be unguided or guided, each method generally follows the same excavation and pipe installation principles but guided auger boring uses more accurate guidance systems as conditions and the particular crossing may require.

Graphic 2.5 Illustrative unguided auger bore set-up



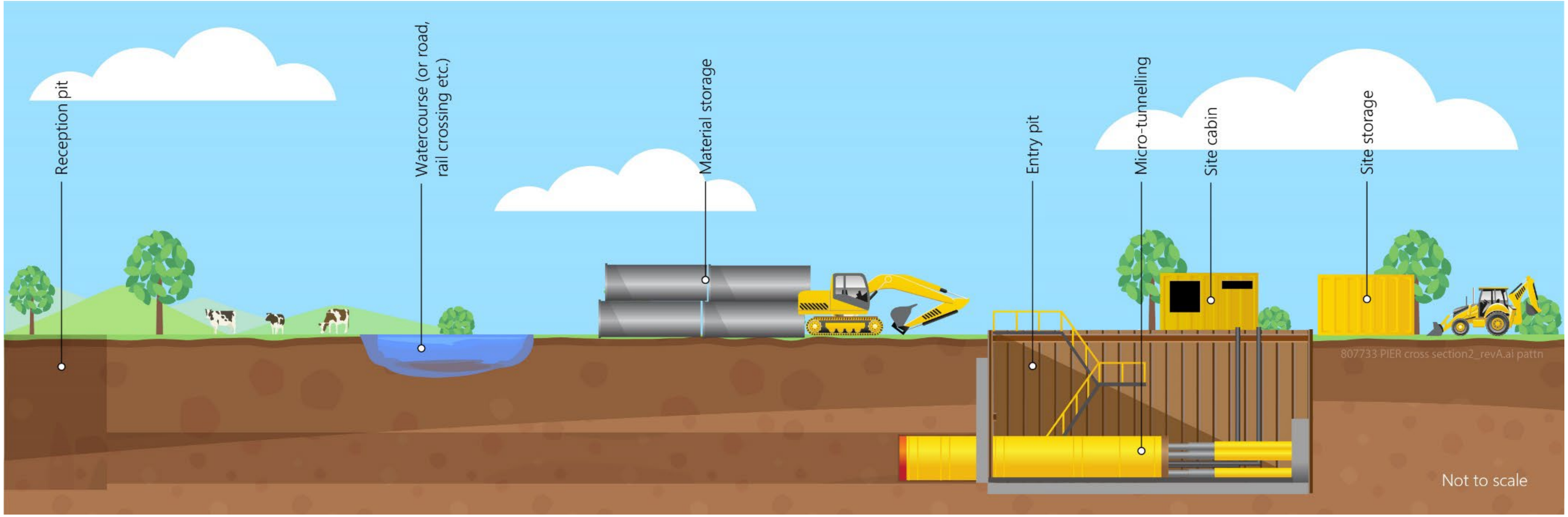
Micro-tunnelling

2.5.61 Micro-tunnelling can be used for short and longer crossings but generally requires a larger footprint including installation of drive and reception pits or shafts. A cutting tool/machine provides the mechanical excavation, generally controlled remotely from an above ground compound. **Graphic 2.6** provides an illustrative example of a micro-tunnelling site set-up. There are a range of open and closed face tools/machines including: boring, earth pressure balance and pressurised slurry for use in the appropriate ground conditions. Excavated spoil is transported back to the surface at the drive shaft site for disposal.

2.5.62 A pre-cast concrete pipe is driven in behind the cutting machine using a hydraulic ram or jack placed within the drive shaft. A typical profile arrangement has a shaft at one end and a tunnel profile long radius at the other where the pipe exits and transitions to normal cover.

2.5.63 The pipes are then welded into a string pipe and gradually pushed or pulled into the casing or, where space is limited, the pipe may be welded at the base of a shaft. Following pipeline installation inside the tunnel, the remaining void between the tunnel and installed pipeline is typically filled with cementitious grout.

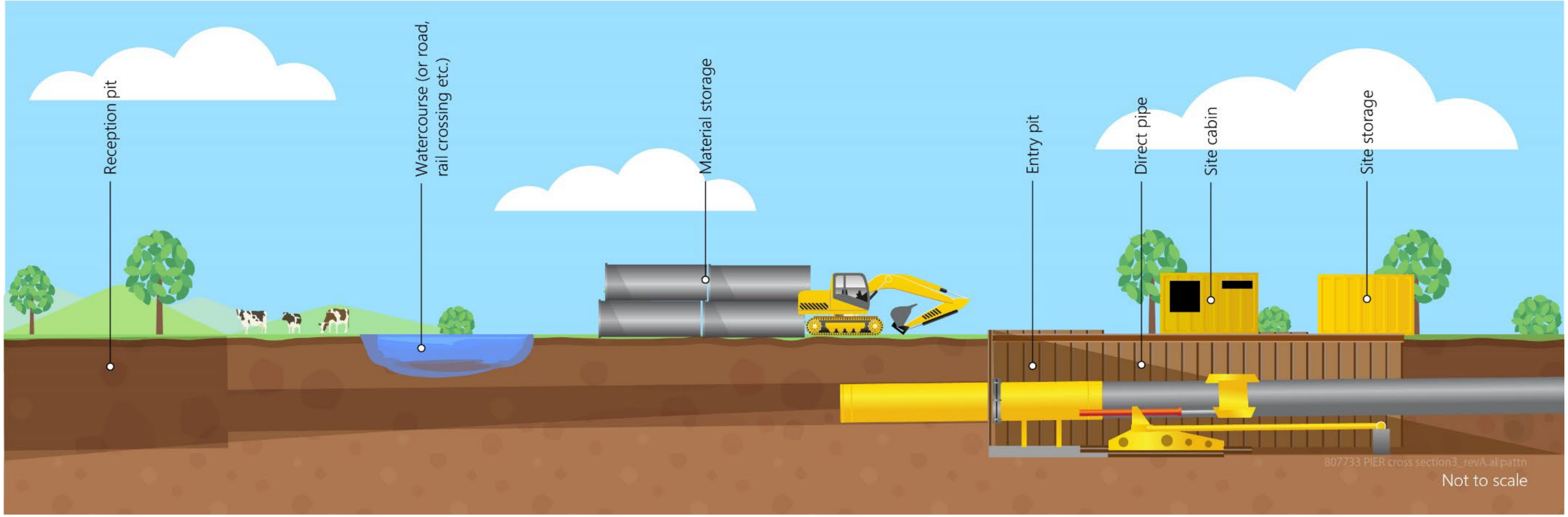
Graphic 2.6 Illustrative micro-tunnelling site set-up



Direct Pipe

2.5.64 Direct pipe can be applied to short and longer trenchless crossings. This technique is similar in its method and set up as described for micro-tunnelling. However, the pipeline is installed directly into the ground behind the cutting machine, rather than being installed inside a completed tunnel. **Graphic 2.7** provides an illustrative example of a direct pipe site set-up.

Graphic 2.7 Illustrative direct pipe site set-up



Temporary construction compounds

2.5.65 Temporary construction compounds would be established to support the construction of the pipeline and HAGIs. The Draft Order Limits include areas identified for temporary construction compounds, which are located at various locations along the pipeline ROW, and adjacent to the HAGI sites. BVI Site construction areas fall within areas allocated for the wider trenchless crossing compounds and are therefore not discussed separately. See **Table 2.3** / **Section 2.5.51** for temporary construction compounds at trenchless crossing sites.

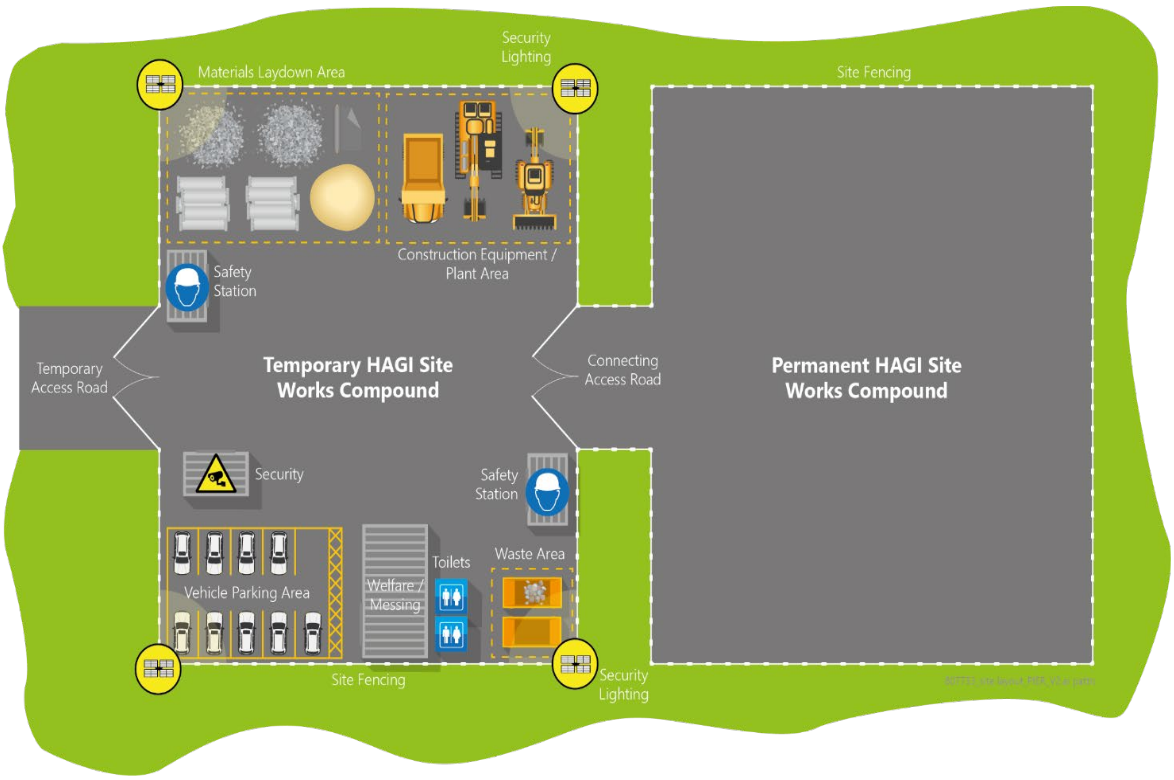
2.5.66 All temporary construction compounds will have a temporary drain system installed that will prevent any construction waste or pollution from entering watercourses or the mains sewerage system. Locations at high risk of chemical spillage will have dedicated bund systems put in place, where the spillage will be drained to a suitable containment vessel and treated offsite.

2.5.67 The temporary construction compounds would typically include:

- Secure fencing between 2.4m to 3.6m high and access for plant, vehicles and personnel.
- Hard surfacing and drainage, using Sustainable Drainage Systems (SuDS).
- Temporary connections to utilities.
- Welfare facilities up to two storeys (approximately 6m).
- Car parking, construction vehicle/plant storage and associated fuelling areas.
- Storage for pipes in stacks, equipment and materials including piping bulks, valves and fittings, E&I equipment, aggregates, track matting, pre-cast concrete slabs, supports, marker posts, signage etc.
- Lighting for the safety of personnel working during the hours of darkness (typically winter months), in the form of task lighting (erected temporarily for a specific task) or lighting maintained for the duration of the use of the compounds. This lighting would only be used whilst work is in progress. Lighting for security purposes may be required and it may be necessary for this to be on for extended periods. Lighting would be installed such that light spill outside the compound near residents and ecological receptors is limited e.g., through considering the height of the columns, lux levels and use of shields etc.

2.5.68 An illustrative temporary construction compound layout for a HAGI site is shown in **Graphic 2.8** below.

Graphic 2.8 Illustrative compound layout



2.5.69 Once the pipeline has been constructed and reinstated, the temporary construction compounds themselves will be decommissioned and land reinstated to its former condition. Landscaping would be implemented through a landscaping scheme that would be prepared and delivered in accordance with the DCO. Draft landscaping proposals are discussed in the Outline Landscape and Ecological Management Plan provided alongside this Draft ES.

Above ground infrastructure

2.5.70 Sizes of temporary construction compounds will vary depending on site specific location and available workspace. The temporary construction compound area would be adequate to accommodate all requirements described in the compound description above. The construction site for a HAGI would typically include the necessary temporary construction compound area to be co-located for maximum convenience. HAGI construction compounds as a minimum require a site not smaller than the permanent works site and may be larger depending on site specific arrangements and are expected to be up to approximately 3ha. Pipeline temporary construction compounds/ material storage areas are typically larger (up to 10ha) as they are required to accommodate large volumes of line pipe as well as accommodation of construction equipment and associated activities.

2.5.71 The typical site construction sequence would include:

- Site preparation, including typical activities for pipeline construction described above;

- Earthworks and civils, including establishment of concrete bases for permanent equipment;
- Installation of mechanical equipment and laying and connection of pipes;
- Installation of electrics, I&C and associated kiosk; and
- Testing and commissioning.

2.5.72 Reinstatement of temporary accesses, working areas and landscaping would be undertaken in accordance with a landscape scheme, prepared in accordance with the DCO.

2.6 Operation and Maintenance

2.6.1 The HAGIs would generally be monitored and operated remotely from an Energy Control Centre located off-site. The HAGIs will be operational continuously (24 hours a day). The frequency of periodic maintenance undertaken on-site has yet to be determined but would typically include the following for telemetered sites:

- Planned periods of maintenance every 6 months with a duration of up to 2 days.
- Pipeline inspection operations requiring ten personnel for approximately one week and undertaken every 1 to 5 years, subject to further development for hydrogen pipelines. Inspection operations involve an internal examination of the pipe undertaken by a “pig”, an inline inspection tool, which travels inside the pipeline from one HAGI to the next.
- Infrequent breakdown or urgent visits with access on a 24/7 basis if required.

2.6.2 Pipeline surveillance is undertaken by helicopter, drone and/or vantage surveys so access onto private land is not normally required. This would look for activities such as construction in proximity to the pipeline or potential visible issues such as disturbance to the land. Aerial surveys are typically undertaken every two weeks, but frequency will be determined during further design development and engagement with the Health and Safety Executive. There are some infrequent maintenance surveys (every 2 to 7 years) which may be required and would require access on foot (line walking) over the route of the pipeline, but do not require excavation or other intrusive activities. Landowners would be contacted to make arrangements for this work.

2.6.3 As described above, the inspection of the pipelines is undertaken internally from the inspection facilities at HAGIs with limited access to the buried pipeline route. It is anticipated that no pipeline maintenance would be required where excavation of the pipeline is required unless a defect is identified.

2.7 Decommissioning

2.7.1 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 ongoing monitoring of pipeline integrity and routine maintenance and upgrading where required. It is reasonably expected that a statutory framework will be developed and agreed prior to any decommissioning. Similarly, technology and best practice would develop and provide new ways to undertake the process.

2.7.2 Decommissioning of the Project would likely involve removing the hydrogen and leaving the pipeline in situ thus avoiding removal and associated potential environmental effects. This would typically involve plugging the pipeline at intervals and stabilisation of major crossings including rail, road and watercourse crossings by grout filling where required. All above ground facilities including HAGIs and BVIs would be removed. The sequence of decommissioning these elements would be the reverse of the construction sequence (as described in **Section 2.5**) and would likely involve the application of similar construction plant and methods. All materials removed would be reused or recycled where possible or disposed of in accordance with relevant waste disposal requirements. Land would then be restored to its former use.

2.7.3 At the appropriate point in time a Decommissioning Plan will be developed by the Undertaker. The Decommissioning Plan will be a live document which is updated and refined as appropriate. The Plan would address the relevant statutory requirements at the time, any extant commitments with landowners/statutory authorities and take account of any developed technology and good practice at the time of decommissioning.

Above ground infrastructure

2.7.4 It is envisaged that HAGIs and BVIs would be removed by reversing the methods used for installation, with similar levels and types of equipment involved. Temporary decommissioning accesses may be required alongside compounds for the storage of equipment. HAGIs would be disconnected from the local electrical distribution and telecommunication systems, following which all electrical components would be removed. At this point the site buildings and mechanical equipment would be dismantled, disconnected and removed from the HAGI site. For HAGIs and BVIs, pipework would be removed to surface where it would be backfilled and capped.

2.7.5 Reinstatement of temporary accesses, compounds and landscaping would be undertaken in accordance with a landscape scheme, which would be defined in the decommissioning plan.

2.7.6 The decommissioning of the HAGIs is anticipated to take the same amount of time as construction (6 to 12 months), although this is indicative and may vary.

Crossings

2.7.7 It is envisaged that rail, road and watercourse crossings would be backfilled with grout if stabilisation is required and left in situ, the land above would be reinstated to pre-construction conditions.

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