Medworth Energy from Waste
Combined Heat and Power Facility

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June 2022

Combined Heat and Power Assessment

Regulation reference: The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)

We inspire with energy.

Executive Summary

Medworth CHP Limited (the Applicant) is applying to the Secretary of State for a Development Consent Order (DCO) to construct operate and maintain an Energy from Waste (EfW) Combined Heat and Power (CHP) Facility on the industrial estate in Wisbech, Cambridgeshire. Together with associated Grid Connection, CHP Connection, Water Connections, and Temporary Construction Compound (TCC), these works are the Proposed Development.

Assuming a design Net Calorific Value (NCV) of 10.9 MJ/kg, the EfW CHP Facility will process approximately 523,500 tonnes per annum (at the design capacity of 33.2 tph, assuming 7,884 hours availability). The EfW CHP Facility will have a gross electrical output of 60 MWe, (design when operating in fully condensing mode), and a parasitic load of 5 MWe with the balance exported to the local electricity grid. Therefore, the EfW CHP Facility will export approximately 55 MWe in full condensing mode.

The EfW CHP Facility will have the capacity to export a maximum of 50 MWth of heat to the nearby industrial heat users, subject to technical and economic feasibility, and subject to requirements of the heat consumers and confirmed during detailed design stage.

The Environment Agency (EA) Combined Heat and Power (CHP) Ready Guidance, titled '*CHP Ready Guidance for Combustion and Energy from Waste Power Plants*' (the CHP-ready Guidance) requires Best Available Techniques (BAT) to be demonstrated by maximising the energy efficiency of a plant.

The heat demand investigation has identified that there are technically feasible opportunities for the export of an annual average heat of 25.61 MWth (197,000 MWh/annum) to potential heat consumers - Lamb Weston and Nestlé Purina. Steam extracted from the turbine would supply these potential heat consumers via the CHP Connection Corridor. From the CHP Connection Corridor, the extracted steam could also be transferred to a closed hot water circuit via a heat exchanger to supply hot water to the Eviosys Packaging manufacturing building (Eviosys), before being returned to the heat exchanger for reheating.

While the quantity of heat demand identified is sufficient to achieve Primary Energy Savings (PES) in excess of the 10% technical feasibility threshold, it is not sufficient to be deemed 'Good Quality' CHP in accordance with the CHP Quality Assurance (CHPQA) scheme, which has a CHPQA Quality Index (QI) threshold of 105 at design stage. For the potential heat consumers, the PES was calculated to be 18.22 % and the CHPQA QI score was 66.5. The new efficiency criteria set out in the latest CHPQA guidance means that it is unlikely that any energy from waste plant will achieve 'Good Quality' CHP status. A CHP-Ready Assessment form has been completed and is provided in **Appendix B**.

Article 14 of the Energy Efficiency Directive requires a cost-benefit assessment (CBA) of opportunities for heat and power export when applying for an Environmental Permit. An assessment of the costs and revenues associated with the construction and operation of the proposed district heating network has been undertaken. The results have been considered in a CBA in accordance with the draft Article 14 guidance document issued by the EA. The results of the CBA indicate that the nominal project internal rate of return and net present value (before financing and tax) are positive. Therefore, in its current configuration, the proposed heat network yields an economically viable scheme. Subject to securing a DCO consent, the economic feasibility of the heat network will be reassessed annually going forward, with a report accompanying each review, to keep track of local heat demand opportunities and consider any subsidies that support the export of heat.

The EfW CHP Facility will be designed as CHP Ready to demonstrate BAT and will be designed to facilitate the export of heat in the future with minimum modifications. This is enabled by virtue of having steam export capability designed into the turbine bleed, safeguarded space within the turbine hall for heat export infrastructure and the CHP Connection Corridor.

There are no formal agreements in place for the export of heat from the EfW CHP Facility at this stage. To maximise the likelihood of securing the requisite level of heat demand and to maintain momentum in the development process, an outline action plan has been proposed. This includes provision of annual progress targets to monitor progress and should help to ensure the heat network is delivered in the shortest possible timeframe.

Contents

1. Introduction

1.1 Background

1.1.1 Medworth CHP Limited (the Applicant) is applying to the Secretary of State for a Development Consent Order (DCO) to construct operate and maintain an Energy from Waste (EfW) Combined Heat and Power (CHP) Facility on the industrial estate, Algores Way, Wisbech, Cambridgeshire. Together with associated Grid Connection, CHP Connection, Water Connections, and Temporary Construction Compound (TCC), these works are the Proposed Development.

1.1.2 The Proposed Development will recover useful energy in the form of electricity and steam from 625,600 tonnes of non-recyclable (residual), non-hazardous Municipal and Commercial and Industrial waste each year. However, this CHP assessment is based on the EfW CHP Facility operating at the nominal design point, i.e., it is assumed that it will process approximately 523,500 tonnes per annum of waste with an annual availability of 7,884 hours.

1.1.3 The Proposed Development has a generating capacity of over 50 megawatts and the electricity would be exported to the grid. The Proposed Development would also have the capability to export steam and electricity to users on the surrounding industrial estate. The Proposed Development is a Nationally Significant Infrastructure Project (NSIP) under Part 3 Section 14 of the Planning Act 2008 (2008 Act) by virtue of the fact that the generating station is located in England and has a generating capacity of over 50 megawatts (section 15(2) of the 2008 Act). It, therefore, requires an application for a DCO to be submitted to the Planning Inspectorate (PINS) under the 2008 Act. PINS will examine the application for the Proposed Development and make a recommendation to the Secretary of State (SoS) for Business, Energy and Industrial Strategy (BEIS) to grant or refuse consent. On receipt of the report and recommendation from PINS, the SoS will then make the final decision on whether to grant the Medworth EfW CHP Facility DCO.

1.2 The Applicant and the project team

1.2.1 The Applicant is a wholly owned subsidiary of MVV Environment Limited (MVV). MVV is part of the MVV Energie AG group of companies. MVV Energie AG is one of Germany’s leading energy companies, employing approx. 6,500 people with assets of around €5 billion and annual sales of around €4.1 billion. The Proposed Development represents an investment of approximately £450m.

1.2.2 The company has over 50-years’ experience in constructing, operating, and maintaining EfW CHP facilities in Germany and the UK. MVV Energie’s portfolio includes a 700,000 tonnes per annum residual EfW CHP facility in Mannheim, Germany.

1.2.3 MVV Energie has a growth strategy to be carbon neutral by 2040 and thereafter carbon negative, i.e., climate positive. Specifically, MVV Energie intends to:

- reduce its direct carbon dioxide (CO_2) emissions by over 80% by 2030 compared to 2018;
- reduce its indirect CO_2 emissions by 82% compared to 2018;
- be climate neutral by 2040; and
- be climate positive from 2040.

1.2.4 MVV's UK business retains the overall group ethos of 'belonging' to the communities it serves whilst benefitting from over 50-years' experience gained by its German sister companies.

1.2.5 MVV's largest project in the UK is the Devonport EfW CHP Facility in Plymouth. Since 2015, this modern and efficient facility has been using around 265,000 tonnes of municipal, commercial and industrial residual waste per year to generate electricity and heat, notably for Her Majesty's Naval Base Devonport in Plymouth, and exporting electricity to the grid.

1.2.6 In Dundee, MVV has taken over the existing Baldovie EfW Facility and has developed a new, modern facility alongside the existing facility. Operating from 2021, it uses up to 220,000 tonnes of municipal, commercial and industrial waste each year as fuel for the generation of usable energy.

1.2.7 Biomass is another key focus of MVV's activities in the UK market. The biomass power plant at Ridham Dock, Kent, uses up to 195,000 tonnes of waste and non-recyclable wood per year to generate green electricity and is capable of exporting heat.

1.2.8 The Applicant has engaged Fichtner Consulting Engineers Ltd (Fichtner) to produce the Combined Heat and Power Assessment.

1.3 Development Proposal

1.3.1 The Proposed Development comprises the following key elements:

- The EfW CHP Facility;
- CHP Connection;
- Temporary Construction Compound (TCC);
- Access Improvements;
- Water Connections; and
- Grid Connection.

1.3.2 A summary description of each Proposed Development element is provided below. A more detailed description is provided in **Chapter 3: Description of the Proposed Development (Volume 6.2)** of the ES. A list of terms and abbreviations can be found in **Chapter 1 Introduction, Appendix 1F Terms and Abbreviations (Volume 6.4)**.

- EfW CHP Facility Site: A site of approximately 5.3ha located south-west of Wisbech, located within the administrative areas of Fenland District Council and

Cambridgeshire County Council. The main buildings of the EfW CHP Facility would be located in the area to the north of the Hundred of Wisbech Internal Drainage Board (HWIDB) drain bisecting the site and would house many development elements including the tipping hall, waste bunkers, boiler house, turbine hall, air cooled condenser, air pollution control building, chimneys and administration building. The gatehouse, weighbridges, 132kV switching compound and laydown maintenance area would be located in the southern section of the EfW CHP Facility Site.

- CHP Connection: The EfW CHP Facility would be designed to allow the export of steam and electricity from the facility to surrounding business users via dedicated pipelines and private wire cables located along the disused March to Wisbech railway. The pipeline and cables would be located on a raised, steel structure.
- TCC: Located adjacent to the EfW CHP Facility Site, the compound would be used to support the construction of the Proposed Development. The compound would be in place for the duration of construction.
- Access Improvements: includes access improvements on New Bridge Lane (road widening and site access) and Algores Way (relocation of site access 20m to the south).
- Water Connections: A new water main connecting the EfW CHP Facility into the local network will run underground from the EfW CHP Facility Site along New Bridge Lane before crossing underneath the A47 (open cut trenching or horizontal directional drilling (HDD)) to join an existing Anglian Water main. An additional foul sewer connection is required to an existing pumping station operated by Anglian Water located to the northeast of the Algores Way site entrance and into the EfW CHP Facility Site.
- Grid Connection: This comprises a 132kV electrical connection using underground cables. The Grid Connection route begins at the 132kV switching compound in the EfW CHP Facility Site and runs underneath New Bridge Lane, before heading north within the verge of the A47 to the Walsoken Substation on Broadend Road. From this point the cable would be connected underground to the Walsoken DNO Substation.

1.3.3 Where necessary, compulsory acquisition of land, including interests in land, rights in, under and over land (including subsoil only), imposition of restrictions, powers to override, suspend or extinguish rights and powers for the temporary use of land are sought for the Proposed Development.

1.4 Purpose of this report

1.4.1 The principal objectives of this CHP Assessment are as follows:

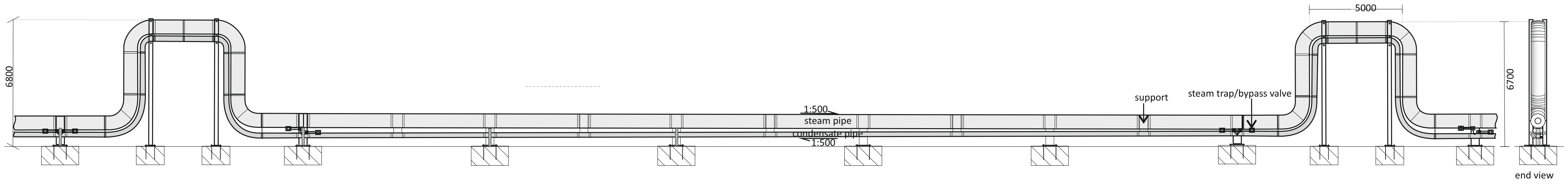
- to prepare a CHP Assessment in accordance with the requirements of the Environment Agency's (EA) 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants' (CHP-ready Guidance), which will support a DCO application;

- to provide a technical description of the EfW CHP Facility and heat export infrastructure;
- to identify heat export opportunities local to the Proposed Development and assess their feasibility for connection to a heating network;
- to assess the feasibility of connecting additional heat sources to the network to maximise benefits of the Proposed Development;
- to calculate heat demand and profiles focusing on viable CHP opportunities, accounting for consumer diversity and seasonal variation;
- to carry out an economic appraisal of the preferred solution in accordance with the requirements of the EA CHP-ready Guidance on cost-benefit assessments (CBA) for combustion installations;
- to calculate relevant energy efficiency measures to demonstrate legislative compliance; and
- to produce a CHP-Ready Assessment in accordance with the EA CHP-ready Guidance, including a clear statement on best available technique (BAT), CHP envelope and the CHP-Ready Assessment form.

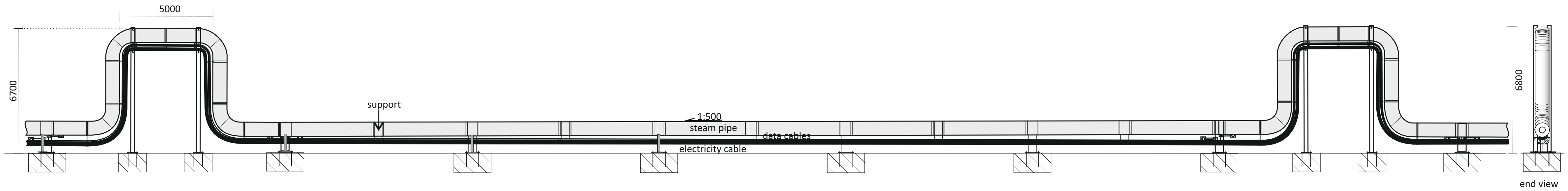
1.5 Structure of this report

1.5.1 This CHP Assessment is structured as below:

- Section 2 gives the conclusions from each section of this CHP Assessment;
- Section 3 considers national, and local-level policy on low-carbon energy, and how these support the use of CHP networks in the Proposed Development locale;
- Section 4 provides the legislative requirements for projects such as the Proposed Development to conduct a CHP Assessment;
- Section 5 gives an overview of the technology that will be used by the EfW CHP Facility, including a discussion of the possible heat supply system;
- Section 6 details the investigation of nearby heat demands and the outline design of a suitable heat network to service these demands;
- Section 7 discusses the financial returns of the heat network outlined in Section 6 using the EA cost benefit analysis (CBA) methodology;
- Section 8 sets out how development of a heat network affects the overall energy efficiency of the EfW CHP Facility;
- Section 9 provides a summary of the CHP-Ready Assessment undertaken for the EfW CHP Facility; and
- Section 10 provides an indicative action plan for the implementation of a scheme for the export of heat to identified heat users.

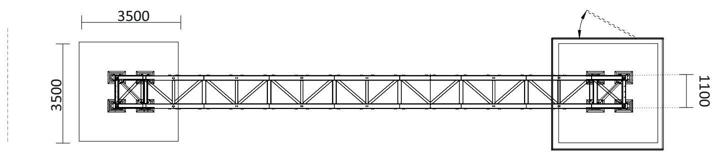


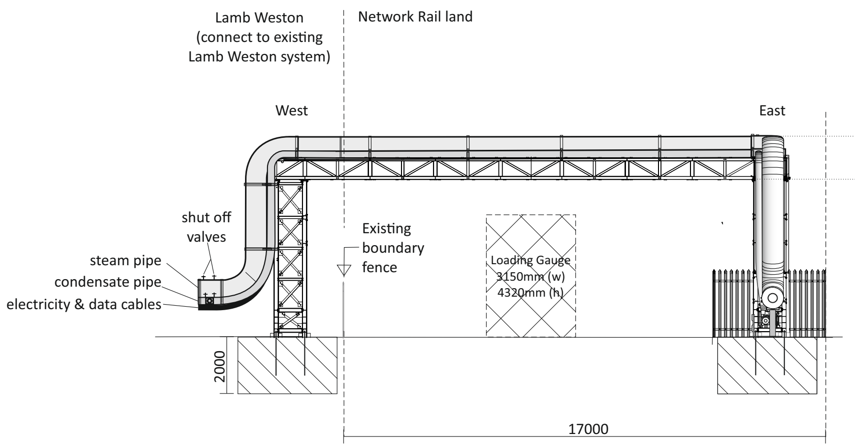
Pipeline elevation including vertical expansion loop (condensate pipe side)



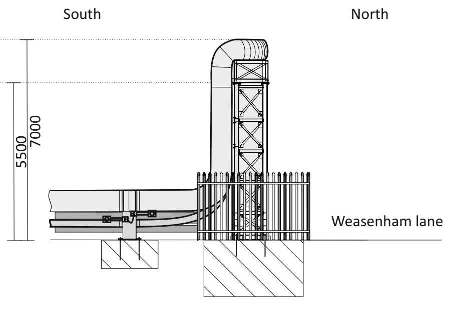
Pipeline elevation including vertical expansion loop (electrical and data cable side)

Pipe bridge plan view (without pipes)

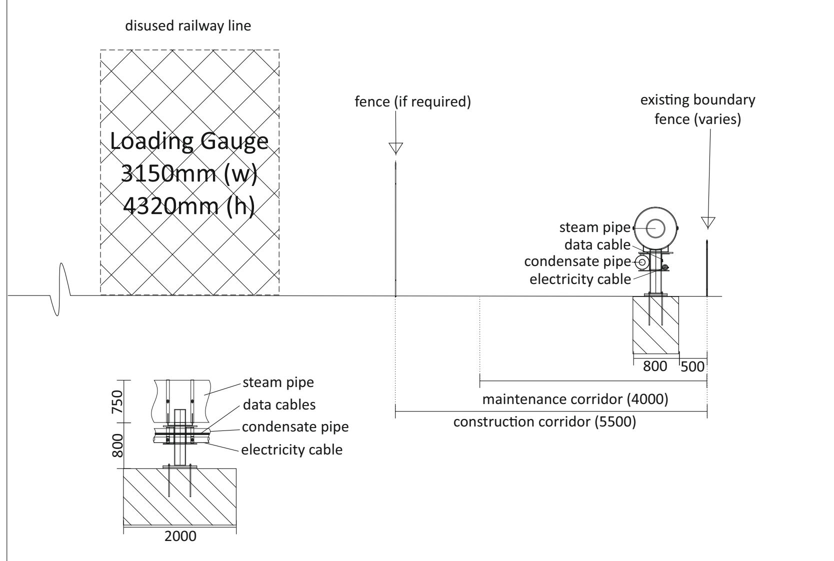




Pipe bridge section view (north) across disused railway line to Lamb Weston connection point



Pipe bridge elevation view (west) across disused railway line to Lamb Weston connection point



Sectional view inc. construction and maintenance corridor

Notes:
Proposed general arrangements for CHP pipeline. Details and location of infrastructure are representative. Subject to detailed design.

General Design Parameters: (measurements in mm)

- Steam Pipe diameter: 750 (300 steam pipe and 450 insulation and cladding)
- Condensate pipe: 250 (100 condensate pipe and 150 insulation and cladding)
- Ground clearance: 400 (minimum)
- Electrical export cables: 110 (includes armour and insulation)
- Data cables: c.3 x wires
- Steam trap and bypass valves: either side of expansion loop and bridge
- Pipe cladding: galvanised/coated steel colour to be agreed
- Pipes lengths: 6000 or 12000 prefabricated sections
- Pipe supports spans: 10000
- Protective barrier/fence: Armco or similar
- Steam and condensate pipe gradient: 1:5000
- Foundation slab: subject to ground conditions up to 2000(w) 2000(w) 2000(d)
- auger piles (if required) 5000(d)
- Customer connection details subject to agreement

General arrangements for future customer offtake from the CHP Connection

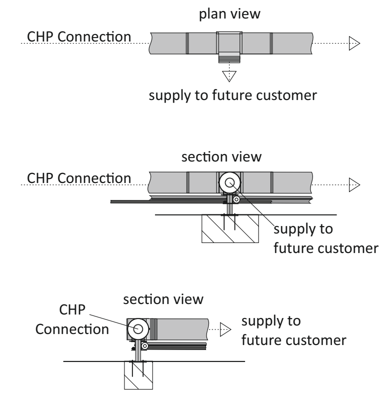


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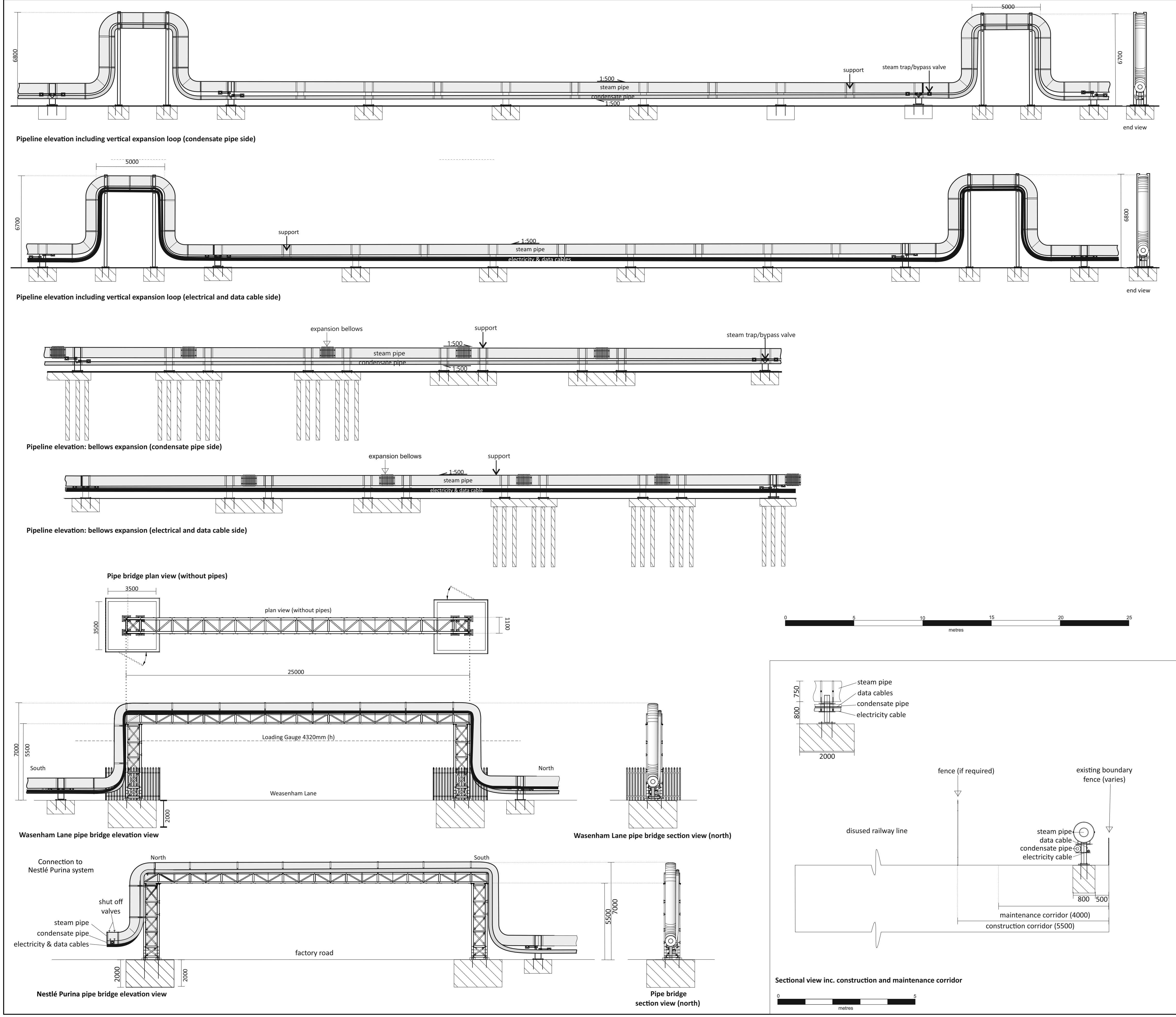
Figure 1.1
CHP Connection General Arrangement (South of Weasenham Lane)

June 2022



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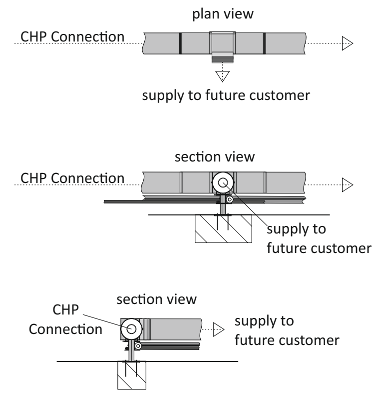

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Figure 1.2
CHP Connection General Arrangement North of Weasenham Lane)

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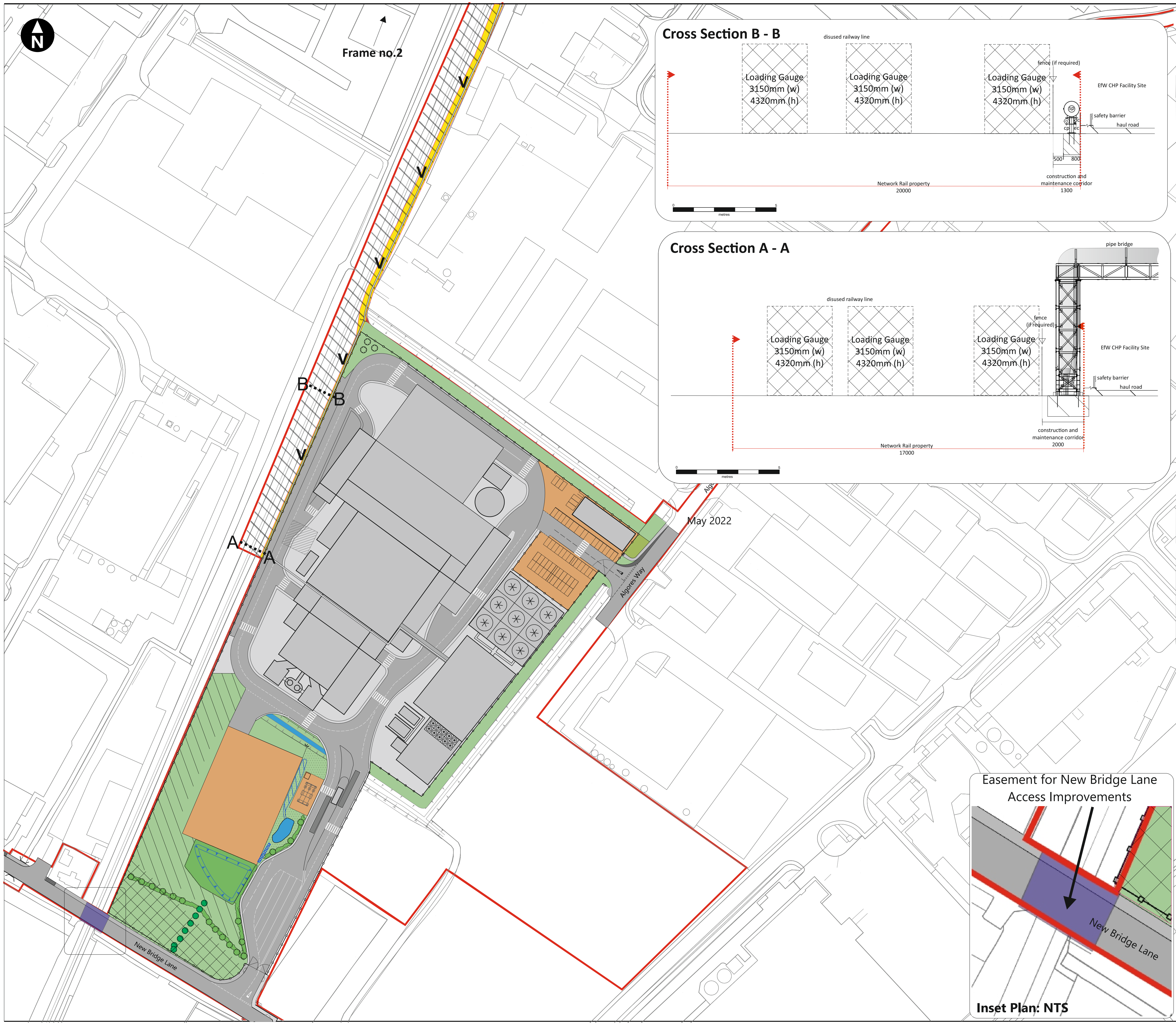

Key:

- Order limits
- CHP Connection Limits of Deviation See Note (1)
- Easement for CHP Connection See Note (2)
- Easement for New Bridge Lane Access Improvements
- CHP Connection proposed alignment
- V Vertical expansion loop (50m to 60m internals)
- Bellows expansion (circa 10m intervals)
- Pipe bridge
- Potential Rail siding unloading area
- Rail bridge embankment (by others) reservation area

Notes:

(1) Limits of Deviation for the placement of the CHP Connection within Network Rail land

(2) Permanent easement required for operation and maintenance of the CHP Connection pipeline (c.4m corridor width except for land adjacent to the EfW CHP Facility Site)

(3) Reintroduction of the March to Wisbech rail does not form part of the Proposed Development. However, the Applicant has considered its reintroduction in the general arrangements for the proposed EfW CHP Facility Site and CHP Connection; including the ability to import waste by rail.

March to Wisbech Railway Concept

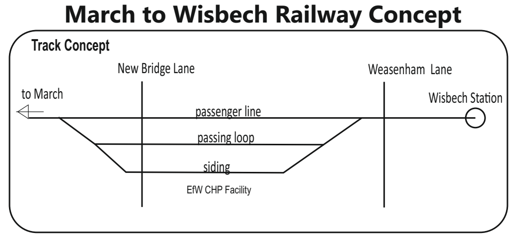

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Figure 1.3i
CHP Connection Operational Limits of Deviation General Arrangements (Frame 1)

June 2022

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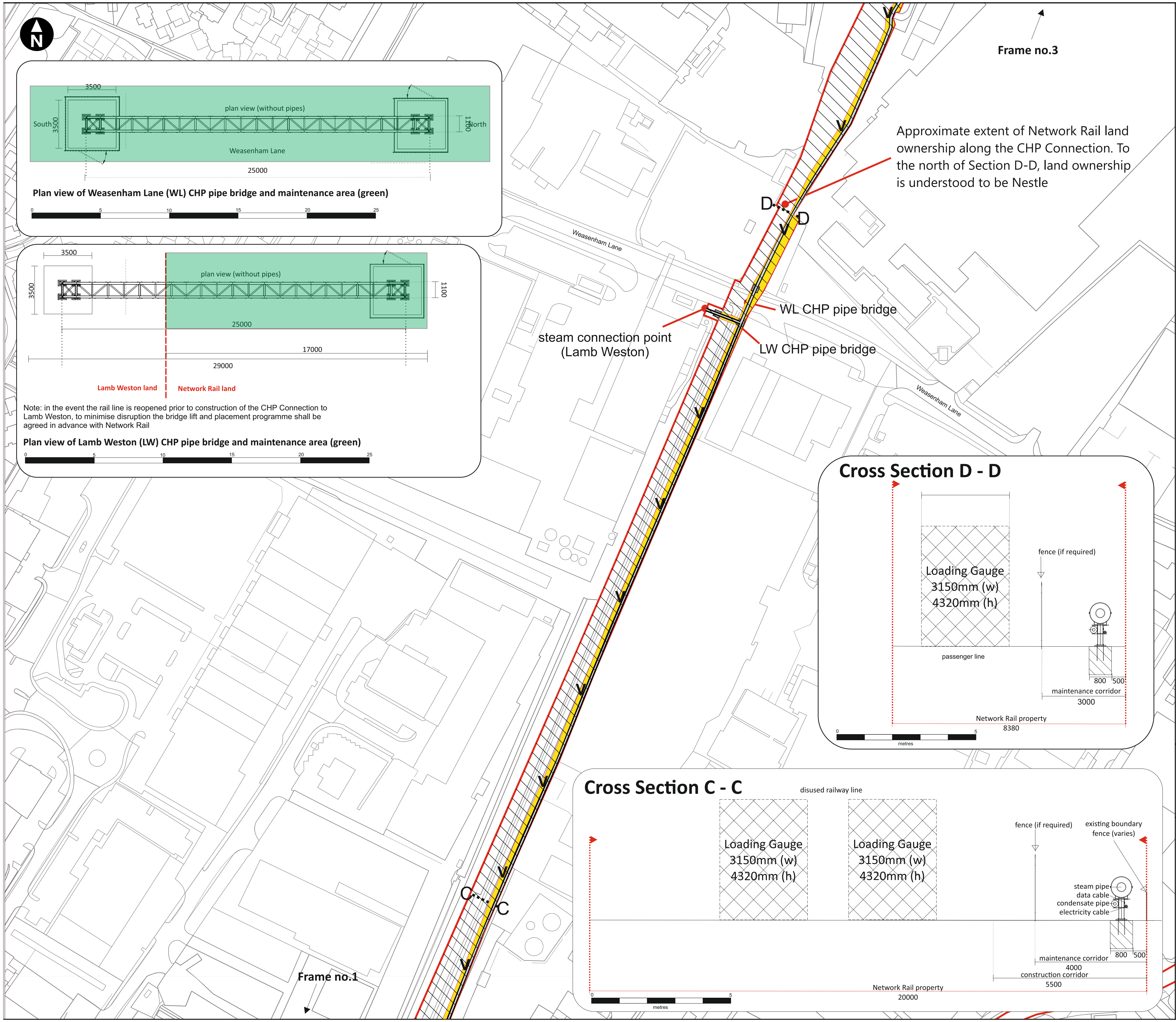

Key:

- Order limits
- CHP Connection Limits of Deviation See Note (1)
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March to Wisbech Railway Concept

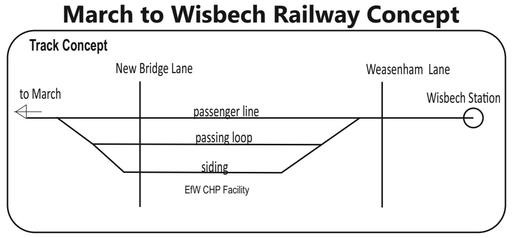

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Figure 1.3ii
CHP Connection Operational Limits of Deviation General Arrangements (Frame 2)

June 2022

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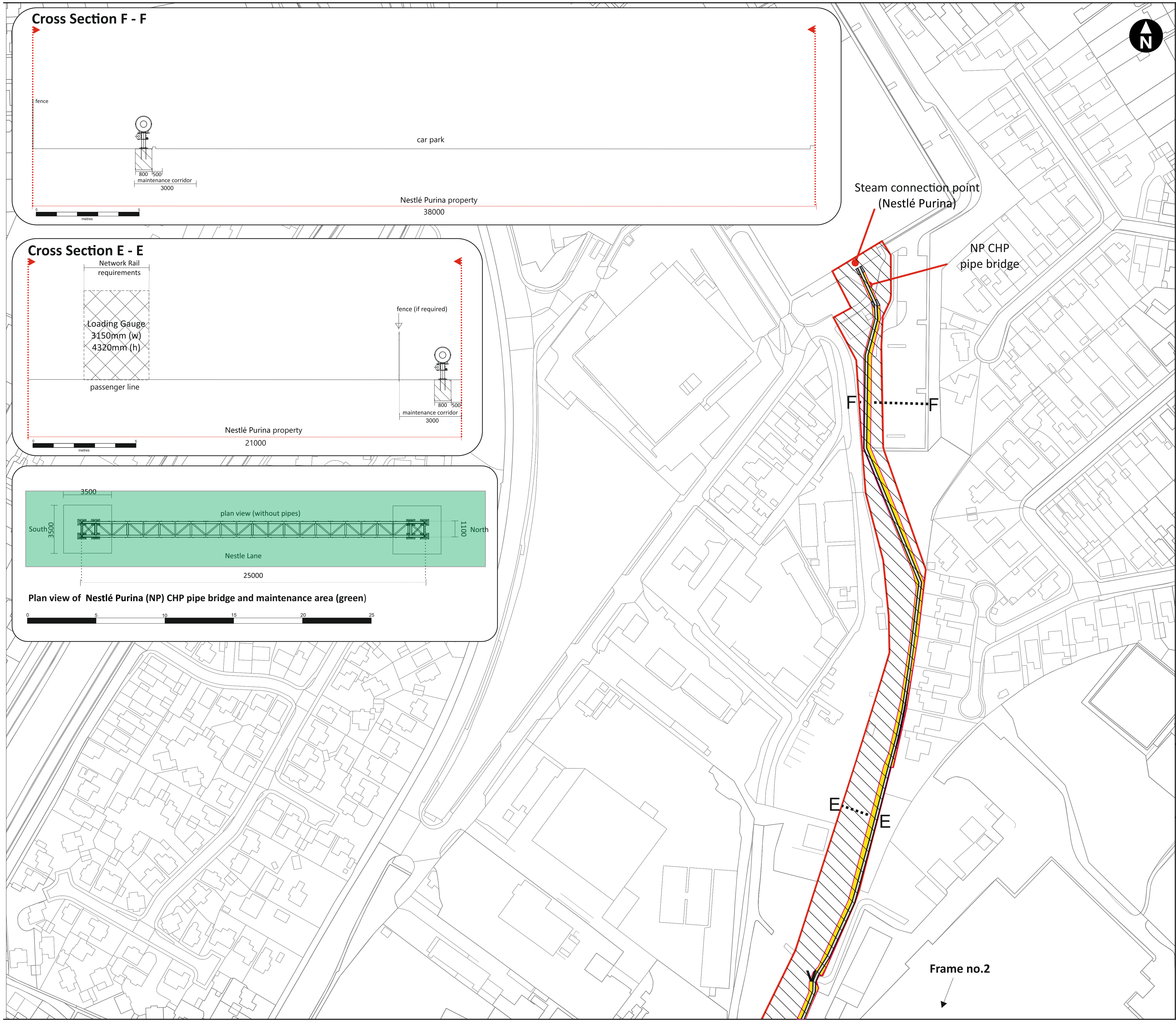

Key:

- Order limits
- CHP Connection Limits of Deviation See Note (1)
- Easement for CHP Connection See Note (2)
- Easement for New Bridge Lane Access Improvements
- CHP Connection proposed alignment
- V — Vertical expansion loop (50m to 60m internals)
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- Rail bridge embankment (by others) reservation area

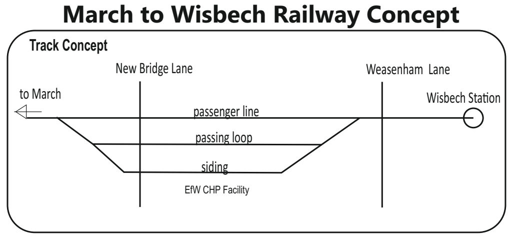
Notes:

(1) Limits of Deviation for the placement of the CHP Connection within Network Rail land

(2) Permanent easement required for operation and maintenance of the CHP Connection pipeline (c.4m corridor width except for land adjacent to the EfW CHP Facility Site)

(3) Reintroduction of the March to Wisbech rail does not form part of the Proposed Development. However, the Applicant has considered its reintroduction in the general arrangements for the proposed EfW CHP Facility Site and CHP Connection; including the ability to import waste by rail.

March to Wisbech Railway Concept



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Combined Heat and Power Assessment

Figure 1.3iii
CHP Connection Operational Limits of Deviation General Arrangements (Frame 3)

June 2022

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2. Conclusions

2.1 Policy

2.1.1 The SoS is required to determine a DCO application in accordance with any relevant National Policy Statement's (NPS) and for the Proposed Development these are NPS EN-1, NPS EN-3 and NPS EN5. Fundamentally, the Proposed Development meets the policy objectives of the NPSs; to deliver new decentralised energy capacity, of a low carbon supply; and in accordance with the waste hierarchy.

2.1.2 The local planning policies for Cambridgeshire County Council (CCC), Norfolk County Council (NCC), Fenland District Council (FDC) and the Borough Council of King's Lynn and West Norfolk (KLWN) identify a need for climate change initiatives including the provision of decentralised low carbon energy sources. These needs will be met by the Proposed Development.

2.1.3 The requirements for the provision of information to support the Proposed Development's CHP credentials in accordance with the relevant national and local policies are addressed in the following sections.

2.2 Technology description

2.2.1 The EfW CHP Facility will have a gross electrical output of 60 MWe, (design when operating in fully condensing mode), and a parasitic load of 5 MWe with the balance exported to the local electricity grid. Therefore, the EfW CHP Facility will export approximately 55 MWe in full condensing mode. For the purposes of this CHP Assessment, it is assumed that the maximum heat export capacity is 50 MWth, which is suitable for the identified heat network. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during detailed design stage. Based on the heat network identified within this CHP Assessment, the average heat load is expected to be 25.61 MWth, which is a significant demand to be exported from the EfW CHP Facility and achieves the relevant efficiency thresholds. In the event that this average heat load was exported the resulting electrical export would be approximately 47.9 MWe on average.

2.2.2 A number of options for heat recovery and export from the EfW CHP Facility are available. However, given the requirements of the potential heat consumers, a combination of steam and hot water export is proposed. The ability to export heat as steam and hot water will provide flexibility in terms of export temperatures and capacity.

2.2.3 It is proposed for steam to be extracted from the turbine to supply the primary potential heat consumers which have been identified - Lamb Weston, which produces and processes frozen potato products and Nestlé Purina, a pet food manufacturing factory – via the CHP Connection Corridor. Extracted steam would be transferred to a steam accumulator from the CHP Connection Corridor.

2.2.4 From the CHP Connection Corridor, the extracted steam could also be transferred to a closed hot water circuit via a heat exchanger to supply hot water to the Eviosys

Packaging manufacturing building (Eviosys), before being returned to their heat exchanger for reheating. The exact location of heat exchanger would be determined during the detailed design stage of the heat export network.

2.2.5 Both technologies are well proven and highly efficient.

2.3 Study Area - Heat demand investigation

2.3.1 Both desktop and field studies have been undertaken to identify current and planned heat demands near the EfW CHP Facility Site. A Study Area of 5km from the EfW CHP Facility Site was used to identify which heat loads could feasibly be connected to a heat network.

2.3.2 Based on the outcomes of these studies, and assuming generic heat demand profiles, the heat demand of the preferred heat consumers has been estimated. The average heat demand of the proposed heat network has been estimated to be 25.61 MWth. This equates to an annual heat demand of 197,000 MWh/annum.

2.3.3 As part of its ongoing engagement with the primary potential heat consumers, the Applicant has requested more detailed heat demand data from Lamb Weston and Nestlé. The same is true of the space heating, and potential process heat requirements, for Eviosys. Industrial processes (and any supporting space heating) are generally optimised for constant operation and are difficult to benchmark against due to limited publicly-available data. Therefore, in lieu of detailed data, Fichtner has modelled all heat demands (both steam and hot water) as constant throughout the year. This assumption will be updated when more detail on individual heat demand profiles is available.

2.4 Economic assessment

2.4.1 A cost-benefit assessment (CBA) has been undertaken, which takes account of heat supply system capital and operating costs, heat sales revenue and lost electricity revenue as a result of utilising steam from the combustion of waste to supply the heat network which would otherwise be used to generate electricity.

2.4.2 The results of the CBA indicate that the estimated £10.5 million capital investment would be offset by heat sales revenue. The nominal project internal rate of return (before financing and tax) (IRR) and the net present value (NPV) over 30-years are 18.1% and £0.64 million respectively, with an estimated heat sales price of £31.3/MWh. On this basis, the proposed heat network potentially yields an economically viable scheme in its current configuration subject to the full development of the EfW CHP Facility. The heat sale price from the EfW CHP Facility would be cheaper than increasing fossil fuel prices which are subject to much market volatility and therefore, would provide consumers with a more attractive option. The heat sale price (to be agreed with the heat consumers) will have effects on the profitability of the heat network. A lower wholesale power price will reduce the revenue ‘lost’ from reduced power export and increase the financial viability of exporting heat. However, this is controlled by external factors and cannot be significantly influenced by the Applicant.

2.4.3 Subject to securing a DCO consent, the economic feasibility of the heat network will be reassessed annually going forward, with a report accompanying each review, to keep track of local heat demands and consider any subsidies that support the export of heat. The Applicant is continuing to explore opportunities to export heat from the EfW CHP Facility to other consumers and will periodically review this position throughout the lifetime of the Proposed Development. Detailed techno-economic modelling will be undertaken when there is a better understanding of consumer heat demands

2.4.4 The EfW CHP Facility will be built to be CHP-Ready and will meet the requirements of the Best Available Technology (BAT) tests outlined in the EA CHP Ready Guidance.

2.5 Energy efficiency measures

2.5.1 In order to qualify as technically feasible under the draft Article 14 guidance [1], the heat demand must be sufficient to achieve high efficiency cogeneration, equivalent to at least 10% savings in primary energy usage compared to the separate generation of heat and power. When operating in fully condensing mode (i.e., without heat export) the EfW CHP Facility will achieve a primary energy saving (PES) of 16.23%, which is above the technical feasibility threshold defined in the draft Article 14 guidance. The proposed heat network will result in a PES of 18.22 % which is also above the technical feasibility threshold.

2.5.2 To be considered ‘Good Quality’ CHP under the CHPQA scheme, the quantity of heat exported to the identified heat customers must be sufficient to achieve a Quality Index (QI) of at least 105 at the design stage (reducing to 100 at the operational stage). Under the latest CHPQA guidance (released in December 2018), the maximum QI score which could be achieved by the proposed heat network would be 66.5. On this basis, heat supplied to any heat network would not qualify as supplied from a Good Quality CHP plant.

2.5.3 The efficiency criteria set out in the latest CHPQA guidance means that it is unlikely that any energy from waste plant will now achieve ‘Good Quality’ CHP status. The EfW CHP Facility would need to export at least 170 MWth for the heat network to be deemed Good Quality CHP at the design stage.

2.6 EA CHP-Ready guidance

A CHP-Ready Assessment has been carried out as part of this CHP Assessment and the completed assessment form is presented in **Appendix B**.

[1] Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive, V9.0 April 2015

3. Policy

3.1 National Planning Policy and Guidance

3.1.1 In accordance with the Planning Act 2008, the SoS is required to determine an application for an order granting development consent for an energy NSIP in accordance with the Overarching NPS EN-1 and the relevant technology specific NPS for the Proposed Development, in this case NPS EN-3. **Table 3.1 Planning policy context for CHP: National Policy Statements,** summarises relevant paragraphs from EN-1 and EN-3, and a response on how the Proposed Development conforms.

Table 3.1 Planning policy context for CHP: National Policy Statements Policy reference

	Paragraph	Policy	Response
Overarching National Policy Statement for Energy (EN-1)[2]	4.6.2	*"In conventional thermal generating stations, the heat that is raised to drive electricity generation is subsequently emitted to the environment as waste. Supplying steam direct to industrial customers or using lower grade heat, such as in district heating networks, can reduce the amount of fuel otherwise needed to generate the same amount of heat and power separately. CHP is technically feasible for all types of thermal generating stations, including nuclear, energy from waste and biomass, although the majority of CHP plants in the UK are fuelled by gas".*	The Proposed Development provides local businesses with a low carbon, commercially attractive means of heat which is particularly relevant to businesses that otherwise use natural gas to raise steam for cooking, a process and operation which is well represented in Fenland and in the businesses which are located adjacent to the proposed CHP Connection Corridor. The use of heat and electricity which are by-products of the EfW CHP Facility operation also displaces fossil fuels and ensures that the maximum benefit is obtained from residual waste which would be otherwise landfilled.

[2] Department of Energy & Climate Change. (2011). *Overarching National Policy Statement for Energy (EN-1).*

Paragraph	Policy	Response
4.6.5	*"To be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand. For industrial purposes, customers are likely to be intensive heat users such as chemical plants, refineries or paper mills. CHP can also be used to provide lower grade heat for light industrial users such as commercial greenhouses, or more commonly for hot water and space heating, including supply through district heating networks."*	The CHP Connection allows for the supply of heat to local businesses. This CHP Assessment confirms that the location of the Proposed Development is well placed to supply local demand and reinforces the Department for Business, Energy and Industrial Strategy's (BEIS) own assessment of CHP potential (as presented in its UK CHP Development Map, (see **Section 6.2** for further details), which identifies Wisbech as being a location comprising three large heat loads, (more than any other settlement in Cambridgeshire and equalled only by Norwich in Norfolk).
4.6.7	*"In developing proposals for new thermal generating stations, developers should consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project. Given how important liaison with potential customers for heat is, applicants should not only consult those potential customers they have identified themselves but also bodies such as the Homes and Communities Agency (HCA), Local Enterprise Partnerships (LEPs) and Local Authorities and obtain their advice on opportunities for CHP. Further advice is contained in the 2006 DECC guidelines and applicants should also consider relevant information in regional and local energy and heat demand mapping."*	**Chapter 2: Alternatives (Volume 6.2)** of the Environmental Statement (ES) summarises the Applicant's essential siting criteria for an EfW CHP facility. One of the essential siting criteria is the proximity to potential heat and electricity users, therefore the Applicant has considered the opportunities for the potential supply of CHP from the very earliest point. The commercial reality of the situation is that discussions with potential customers are ongoing and unlikely to be completed until a DCO is secured.

Paragraph	Policy	Response
4.6.8	*"Utilisation of useful heat that displaces conventional heat generation from fossil fuel sources is to be encouraged where, as will often be the case, it is more efficient than the alternative electricity/heat generation mix. To encourage proper consideration of CHP, substantial additional positive weight should therefore be given by the IPC to applications incorporating CHP."*	The proposed EfW CHP Facility is configured to produce low carbon heat in the form of steam and supply this to local businesses and will therefore displace conventional heat generation from fossil fuel sources. **Chapter 3: Description of Development (Volume 6.2)**.
4.6.9	*"CHP may require additional space than for a non-CHP generating station. It is possible that this might conflict with space required for a generating station to be Carbon Capture Ready* [CCS], *as set out in Section 4.7.* [CCS is required for generating stations of over 300MW] *The material provided by applicants should therefore explain how the development can both be ready to provide CHP in the future and also be Carbon Capture Ready or set out any constraints (for example space restrictions) which would prevent this"*	The EfW CHP Facility is designed to be a CHP generating station, it therefore accommodates sufficient space within the proposed layout to accommodate the equipment to export CHP to commercial customers. Consent is being sought for the equipment to export CHP in the draft DCO. For further details see **Chapter 3: Description of Development (Volume 6.2)** and **Figure 3.6**. In developing the site layout, the Applicant has considered the need to ensure that the Proposed Development can deliver future environmental requirements relating to carbon capture and storage (CCS). Since the Proposed Development is a generating station of less than 300MW, currently there is no legal or policy requirement for the EfW CHP Facility to include carbon capture storage (CCS) apparatus or to be carbon capture ready (CCR). However, in the event this position changes, the layout of the EfW CHP Facility Site has been designed to allow sufficient space for the plant and equipment for a CCS facility if required in the future, see **Chapter 2: Alternatives (Volume 6.2**) and **Figure 2.13.**

	Paragraph	Policy	Response
National Policy Statement for Renewable Energy Infrastructure (EN-3)[3]	2.5.2	*"The recovery of energy from the combustion of waste, where in accordance with the waste hierarchy, will play an increasingly important role in meeting the UK's energy needs. Where the waste burned is deemed renewable, this can also contribute to meeting the UK's renewable energy targets. Further, the recovery of energy from the combustion of waste forms an important element of waste management strategies in both England and Wales."*	The Proposed Development would divert residual waste from landfill therefore comply with the waste hierarchy. Due to the biogenic content of the residual waste stream, the Proposed Development would generate low carbon energy, for further details on the biogenic content of residual wate see **Table 14.26 Waste Composition summary Chapter 14: Climate (Volume 6.2**)**.**
	2.5.3	*"Biomass/EfW generating stations can be configured to produce Combined Heat and Power (CHP). Details of CHP criteria are set out in Section 4.6 of EN-1."*	The Proposed EfW CHP Facility is configured to produce CHP and supply this to local businesses from the CHP Connection Corridor, for further details see **Chapter 3: Description of Development (Volume 6.2).**
	2.5.26	*"The Government's strategy for CHP is described in Section 4.6 of EN-1, which sets out the requirements on applicants either to include CHP or present evidence in the application that the possibilities for CHP have been fully explored."*	This CHP Assessment presents evidence to confirm the Proposed Development will be CHP-Ready and has explored realistic possibilities.
	2.5.27	*"Given the importance which Government attaches to CHP, for the reasons set out in EN-1, if an application does not demonstrate that CHP has been considered the IPC should seek further information from the applicant.*	This CHP Assessment presents evidence to confirm the Proposed Development will be CHP-Ready and has explored realistic possibilities.

[3] Department of Energy & Climate Change. (2011). *National Policy Statement for Renewable Energy Infrastructure (EN-3).*

Paragraph	Policy	Response
	The IPC should not give development consent unless it is satisfied that the applicant has provided appropriate evidence that CHP is included or that the opportunities for CHP have been fully explored. For non-CHP stations, the IPC may also require that developers ensure that their stations are configured to allow heat supply at a later date as described in paragraph 4.6.8 of EN-1 and the guidance on CHP issued by BIS in 2006."	

3.1.2 In September 2021, the Department of Business, Energy and Industrial Strategy consulted on a review of Energy National Policy Statements, with consultation closing on 29 November 2021. The Energy National Policy Statements were reviewed to reflect the policies and broader strategic approach set out in the Energy White Paper[4] and ensure a planning framework was in place to support the infrastructure requirement for the transition to net zero. There are no substantive changes with regard to CHP generating stations within those draft Energy National Policy Statements which are considered to be relevant to the Proposed Development.

3.1.3 Other national policies which may provide additional guidance that can be considered important and relevant to the consideration of a NSIP are summarised in **Table 3.2 Planning policy context for CHP: National planning policies**.

[4] HM Government (2020). Energy White Paper: Powering our Net Zero Future.

Table 3.2 Planning policy context for CHP: National planning policies

Policy reference	Paragraph	Policy	Response
National Planning Policy Framework (NPPF)[5]	154	*"New development should be planned for in ways that:* *a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and* *b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."*	ES **Chapter 14: Climate (Volume 6.2)** presents the GHG assessment, concluding that the Proposed Development offers a beneficial significant effect in terms of GHG emissions. However, the export of steam would provide further benefits in displacing the use of fuels by third parties to generate heat and avoid carbon emissions from these sources. Details of the GHG assessment sensitivity analysis to support the additional beneficial effects of steam export are detailed in **Appendix 14C Selectivity Analysis (Volume 6.4).**
	155	*"To help increase the use and supply of renewable and low carbon energy and heat, plans should:* *a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);* *b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and* *c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers".*	The Proposed Development would provide infrastructure to enable the supply of decentralised low carbon energy and heat to adjacent businesses (identified within this assessment), and thereby reduce their reliance of fossil fuels and consequently contribute towards sustainable development. The EfW CHP Facility Site is located within the southwest corner of the Algores Way industrial estate. The land to the north and east comprises industrial units and land to the south comprises vacant land which is allocated in the Fenland Local Plan (2014)[6] as an urban extension (Policy LP8) for predominantly business purposes and, to a lesser extent, residential development. The EfW CHP Facility may act as a stimulus to attract further potential heat customers to the area who could benefit from decentralised low carbon energy.

[5] Ministry of Housing, Communities & Local Government. (2021). National Planning Policy Framework.
[6] Fenland District Council (2014). Fenland Local Plan

Policy reference	Paragraph	Policy	Response
National Planning Policy for Waste (NPPW)[7]	3	Sets out the Government's ambition to develop a more sustainable and efficient approach to resource use and management through (amongst other ambitions) *"delivery of sustainable development and resource efficiency, including provision of modern infrastructure, local employment opportunities and wider climate change benefits, by driving waste management up the waste hierarchy"*	ES **Chapter 14: Climate (Volume 6.2)** presents the GHG assessment, concluding that the Proposed Development offers a beneficial significant effect in terms of GHG emissions. However, the export of steam would provide further benefits in displacing the use of fuels by third parties to generate heat and avoid carbon emissions from these sources. Details of the GHG assessment sensitivity analysis to support the additional beneficial effects of steam export are detailed in **Appendix 14C Selectivity Analysis (Volume 6.4).**

3.2 Local Planning Policy, Strategy and Guidance

3.2.1 Local policies which may provide additional guidance that can be considered important and relevant to the consideration of a NSIP are summarised in **Table 3.3 Planning policy context for CHP: Local planning policies**.

Table 3.3 Planning policy context for CHP: Local planning policies

Policy reference	Paragraph/ Policy	Policy	Response
Cambridgeshire County Council and Peterborough City Council Minerals and Waste Local Plan 2036 (2021)[8]	Policy 1	Sustainable Development and Climate Change: states *"...waste management proposals will be assessed against the overarching principle of whether the proposal would play an active role in guiding development towards sustainable solutions…*	The Proposed Development would provide infrastructure to enable the supply of decentralised low carbon energy and heat to adjacent businesses thereby reducing their reliance of fossil fuels and consequently contribute towards sustainable development.

[7] Ministry of Housing, Communities and Local Government (2014). National Planning Policy for Waste.
[8] Cambridgeshire County Council and Peterborough City Council (2021). Cambridgeshire and Peterborough Minerals and Waste Local Plan 2036.

Policy reference	Paragraph/ Policy	Policy	Response
		…Proposals should, to a degree which is proportionate to the scale and nature of the scheme, set out how this will be achieved, such as: *demonstrating how the location, design, site operation and transportation related to the development will help to reduce greenhouse gas emissions (including through the adoption of emission reduction measures based on the principles of the energy hierarchy); and take into account any significant impacts on human health and wellbeing and on air quality;* *where relevant, setting out how the proposal will make use of renewable energy including opportunities for generating energy from waste for use beyond the boundaries of the site itself, and the use of decentralised and renewable or low carbon energy."*	
Fenland Local Plan (Adopted) (2014)[9]		The Local Plan sets out the key objectives including "*increased use of renewable energy sources whilst minimising waste and the use of other energy sources*". Policy LP14 states that *"All developments (dwellings and non-dwellings) are encouraged to incorporate on site renewable and/or decentralised renewable or low carbon energy sources, water saving measures and measures to help the development withstand the longer-term impacts of climate change."*	The Proposed Development would enable existing and future businesses to benefit from decentralised low carbon energy The EfW CHP Facility Site is located within the southwest corner of the Algores Way industrial estate. The land to the north and east comprises industrial units and land to the south comprises vacant land which is allocated in the Fenland Local Plan (2014) as an urban extension (Policy LP8) for predominantly business purposes and, to a lesser extent, residential development. The EfW CHP Facility may act as a stimulus to attract further potential heat customers to the area who could benefit from decentralised low carbon energy.

[9] Fenland District Council (2014). Fenland Local Plan

Policy reference	Paragraph/ Policy	Policy	Response
Norfolk Core Strategy and Minerals and Waste Development Management Policies DPD (2011)[10]	CS13	The Climate change and renewable energy generation policy states: *"All opportunities for new minerals and waste developments (both brand new sites and extensions to existing sites) to generate renewable energy on-site will be welcomed and should be explored fully, with a minimum of 10 per cent generated from decentralised and renewable or low-carbon sources, wherever this is practicable…* *…All new residual waste treatment plants and any new non-hazardous landfill sites will need to generate electricity and/or capture heat, unless it can be demonstrated that this is not practicable…* *…The co-location of large waste plants generating heat and/or electricity with other nearby industrial and/or residential users of the heat and/or energy will be supported…"*	The EfW CHP Facility would generate over 50MW of decentralised, low carbon energy and/or capture heat and be configured to supply the businesses within the industrial estate.
King's Lynn and West Norfolk Local Development Framework Core Strategy (2011)[11]	3.2	The document identifies climate change as a key sustainability issue and that GHG emissions from the Borough are higher than the national average.	ES **Chapter 14: Climate (Volume 6.2)** presents the GHG assessment, concluding that the Proposed Development offers a beneficial significant effect in terms of GHG emissions. However, the export of steam would provide further benefits in displacing the use of fuels by third parties to generate heat and avoid carbon emissions from these sources. Details of the GHG assessment sensitivity analysis to support the additional beneficial effects of steam export are detailed in **Appendix 14C Selectivity Analysis (Volume 6.4).**

[10] Norfolk County Council (2011). Norfolk Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026.
[11] KLWN (2011). King's Lynn and West Norfolk Local Development Framework Core Strategy

4. Legislative Requirements

4.1 CHP-Ready Guidance

4.1.1 The EA published its CHP-ready Guidance[12] in February 2013. The CHP-ready Guidance applies to the following facilities, which are regulated under the Environmental Permitting (England and Wales) Regulations 2016 ("EP Regulations 2016"):

- new combustion power plants (referred to as power plants) with a gross rated thermal input of 50 MW or more; and
- new energy from waste (EfW) plants with a throughput of more than 3 tonnes per hour of non-hazardous waste or 10 tonnes per day of hazardous waste.

4.1.2 The EfW CHP Facility includes a waste incineration process with a throughput of more than 3 tonners per hour and a gross rated thermal input of more than 50 MW. Therefore, the requirements of the CHP Ready Guidance will apply.

4.1.3 In accordance with the EP Regulations 2016, the EA requires developers to demonstrate BAT for preventing or minimising emissions and impacts to the environment. Three BAT criteria relate to energy efficiency and how this is improved using CHP:

- [Test/Criteria] 1 – Involves considering and identifying opportunities for the immediate use of heat off-site;
- [Test/Criteria] 2 – Where Test 1 concludes CHP is not technically or economically possible, the plant should be built to be CHP Ready; and
- [Test/Criteria] 3 – The operator is required to carry out periodic reviews to determine whether the CHP situation has changed and if there are opportunities for heat use off site.

4.2 Energy Efficiency Directive

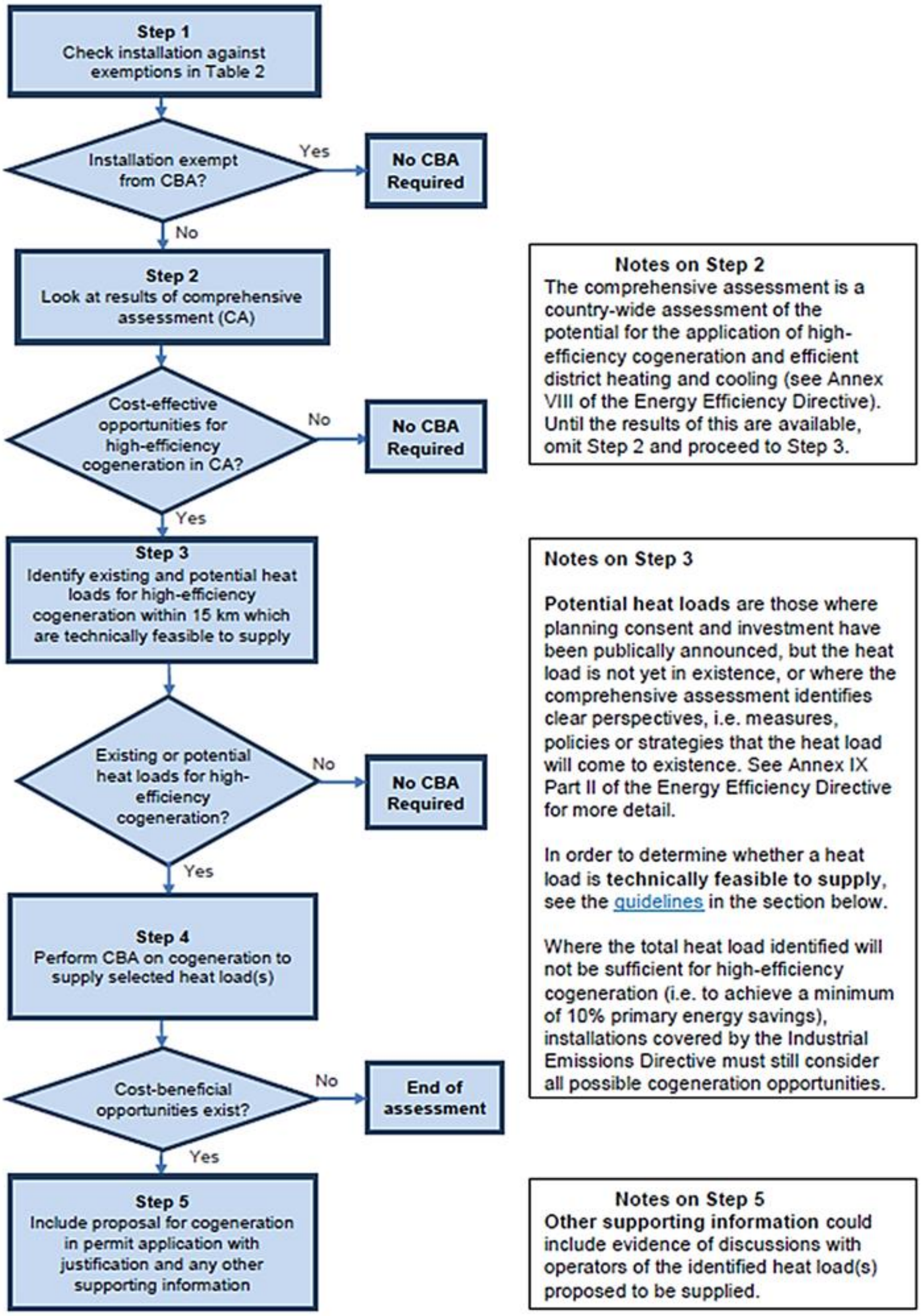
4.2.1 In accordance with Article 14 of the Energy Efficiency Directive[13] operators of certain types of combustion installations are required to carry out a cost-benefit assessment (CBA) of opportunities for CHP. As a new electricity generation installation, with a total aggregated net thermal input of more than 20 MWth, the EfW CHP Facility will be classified as an installation type 14.5(a).

The EA issued draft guidance on completing the CBA, entitled 'Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive[14]. The CBA methodology to be followed for type 14.5(a) installations is summarised in **Graphic 1 CBA assessment methodology for type**

[12] CHP Ready Guidance for Combustion and Energy from Waste Power Plants v1.0, February 2013
[13] It is noted that none of the main pieces of UK legislation implementing the Energy Efficiency Direction 2012/27/EU has been repealed following Brexit (only adapted).
[14] Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive, V9.0 April 2015

14,5(a) and 14,5(b) installations (new and refurbished thermal electricity generation installations).

Graphic 1: CBA assessment methodology for type 14,5(a) and 14,5(b) installations (new and refurbished thermal electricity generation installations)



5. Technology Description

5.1 The Proposed Development

5.1.1 **Section 1.3** summarises the component parts of the Proposed Development, with further details on the EfW CHP Facility and CHP Connection which are relevant to this CHP Assessment report set out below.

The EfW CHP Facility

5.1.2 The main activities associated with the EfW CHP Facility will be the combustion of incoming non-hazardous residual waste to raise steam and generate electricity in a steam turbine/generator, with the potential to export heat.

5.1.3 The EfW CHP Facility will include the following key components/infrastructure:

- fuel reception and storage facilities consisting of tipping hall, tipping bays, tipping bunker, main waste bunker, shredder, waste chutes, cranes, cabin and handling and maintenance equipment;
- a combustion system including boiler house, air cooled moving grates, boilers and water tanks;
- air pollution control plant and monitoring systems including silos, reactors, filter houses, fans, cabins and loading and storage areas;
- a steam turbine and generator including turbine hall and cooling system;
- a bottom ash handling system, including ash storage bunker, conveyors, collection bay, cranes and handling and maintenance equipment;
- air cooled condenser(s);
- compressed air system;
- tank(s) for the storage of urea;
- switch gear building;
- control room;
- water treatment and storage plant;
- two chimneys and associated continuous emissions monitoring systems and platform; and
- administration building.

5.1.4 In addition, the EfW CHP Facility will include the following ancillary equipment/infrastructure:

- fire water tank and fire water pump cabin;
- diesel generator and diesel storage tanks;

- electrical switchyard including compound, transformers, switch gear, cabling and associated telemetry;
- workshop and stores;
- gatehouse and weighbridges;
- vehicle layby and queuing areas;
- laydown and maintenance areas;
- internal access roads and pedestrian walkways;
- parking areas and electrical vehicle charging points;
- pipes, cables, telecommunications and other services and associated infrastructure;
- site drainage, including works to drains and culverts, potable and wastewater services and associated infrastructure;
- hard and soft landscaping; and
- biodiversity enhancement measures and environmental mitigation measures.

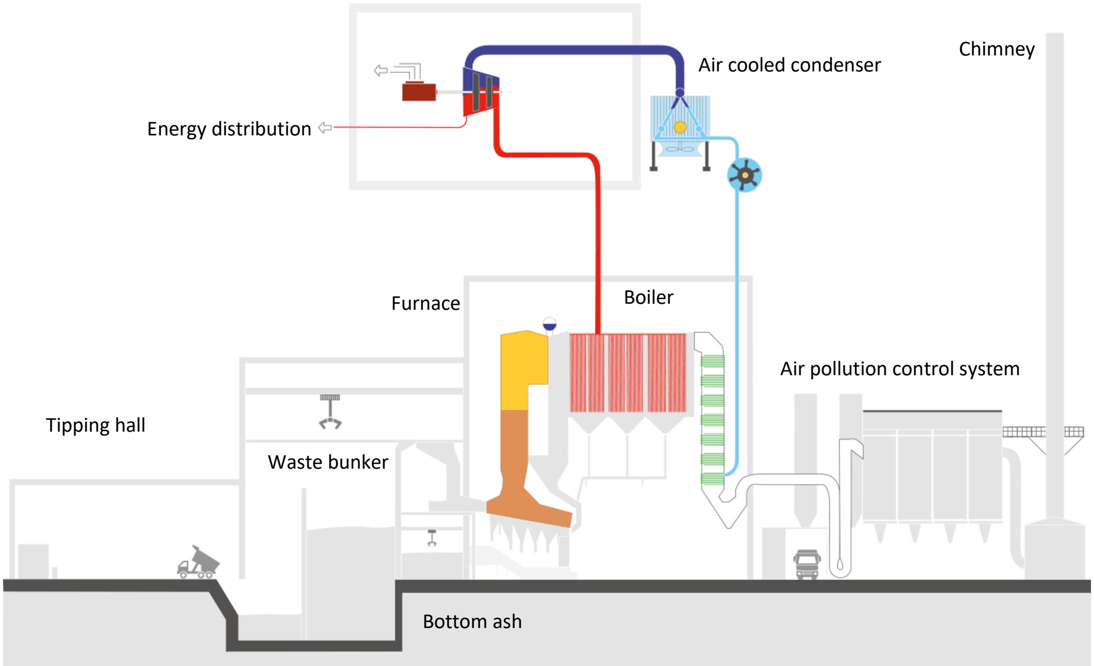
5.1.5 The EfW CHP Facility has been designed to export power to the National Grid. It will have a design thermal input capacity (combined boiler capacity) of approximately 201 MWth, will generate up to approximately 60.0 MWe of electricity and will have a parasitic load of approximately 5.0 MWe. Therefore, the export capacity of the EfW CHP Facility, with average ambient temperature, will be approximately 55.0 MWe. The power exported will vary depending on the ambient temperature, the amount of heat exported and the energy calorific value of the waste.

5.1.6 The EfW CHP Facility will be constructed as 'CHP Ready' and will have the capacity to export approximately 50 MWth of heat to the nearby industrial heat users. The maximum heat capacity will be confirmed during the detailed design stage and will be set as a minimum to meet the requirements of the heat consumers identified.

5.1.7 The EfW CHP Facility will be designed to process 33.2 tonnes per hour of residual waste per line with a design NCV of 10.9 MJ/kg. Assuming an annual availability of 7,884 hours, the EfW CHP Facility will be designed to process approximately 523,500 tonnes per annum of waste. However, the EfW CHP Facility will be capable of processing wastes with a range of NCVs, typically between 8.0 – 14 MJ/kg. To allow for this, the maximum capacity of the EfW CHP Facility will be approximately 625,600 tonnes per annum of waste.

5.1.8 An indicative schematic of the combustion process is shown in **Graphic 2 Process schematic.**

Graphic 2: Process schematic



The CHP Connection Corridor

5.1.9 The EfW CHP Facility has been designed to allow the export of steam and electricity from the facility to surrounding business users via dedicated pipelines and private wire cables. Potential end users of the heat have been identified along the line of the disused March to Wisbech Railway, and initial discussions have been held with these potential users.

5.1.10 The proposed CHP Connection Corridor would run north-northeast, following the route of the disused March to Wisbech Railway that borders the EfW CHP Facility Site to the west. It extends up to the Nestlé Purina pet food factory, terminating near its Coalfield Lane access point.

5.1.11 As the route follows the disused March to Wisbech Railway, the CHP Connection Corridor includes the disused infrastructure, including track and self-seeding vegetation. The CHP Connection Corridor is bounded for the most part by industrial land up until its north-eastern end, where it passes behind residential properties on Victory Road and Oldfield Lane. The route is illustrated in **Figure 1.3i to iii Connection Operational Limits of Deviation General Arrangements**. Details of the route and apparatus are presented in **Section 6.7**.

6. Heat Demand Investigation

6.1 The National Comprehensive Assessment

6.1.1 A report titled 'Opportunity areas for district heating networks in the UK: National Comprehensive Assessment (the NCA) of the potential for efficient heating and cooling'[15], dated September 2021 (herein referred to as the 2021 report), was published by Arup on behalf of the BEIS. The September 2021 report is an update on the original 2016 report, which was prepared when the UK was still a Member State of the European Union. The 2016 report was produced to fulfil the requirement (under the Energy Efficiency Directive 2012/27/EU on energy efficiency) of all EU Member States to undertake an NCA to establish the technical and socially cost-effective potential for high-efficiency cogeneration. The 2021 report also sets out information pertaining to heat policy development in the UK. Due to the low resolution of the data, the results of the NCA can be considered an overview only.

6.1.2 The heat consumption in 2020 and estimated consumption in 2050 by non-domestic and domestic sectors for the East of England, as extracted from the NCA, is presented in **Table 6.1 Heat consumption in the East of England**. This shows that:

i. heat consumption is greatest in the domestic sector;

ii. heat demand from the non-domestic and domestic sectors is below the national average; and

iii. the estimated heat consumption in 2020 is lower than in 2050.

The energy projections in the 2021 report take account of climate change policies where funding has been agreed and where decisions on policy design are sufficiently advanced to allow robust estimates of policy impacts to be made, including measures such as building regulations.

Table 6.1: Heat consumption in the East of England

Sector	2020 Consumption (TWh/annum)	2050 Projected (TWh/annum)
Non-domestic	6.9	-
Domestic	36.1	-
Total	43.0	47.5

Source: National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, Arup, September 2021

[15] Opportunity areas for district heating networks in the UK, Sep 2021

6.1.3 Current space cooling consumption data is detailed in **Table 6.2 Cooling consumption in the East of England** . Forecasts of cooling demand to 2050 were not presented in the 2021 report. BEIS is currently developing the evidence base for cooling in the UK, as part of a separate study. Given the paucity of available data on energy consumption for cooling, these figures are estimates based on consumption indicators, building types and floor areas; consequently, they should be considered as indicative.

Table 6.2: Cooling consumption in the East of England

Sector	2020 Consumption (TWh/annum)
Non-domestic	3.7
Domestic	No assumed domestic cooling
TOTAL	3.7

Note: data as presented in the NCA report

6.1.4 The heating and cooling consumption data presented in the 2021 report should be considered an overview only due to the low resolution of the data, which does not specify the locations of heat and cooling demands within each region.

6.2 National Heat Mapping

6.2.1 BEIS (formerly the Department of Energy and Climate Change) publishes a National Heat Map. The National Heat Map provides an overview of geographical heat demand within various sectors in the UK and enables a prospective developer to identify potential locations where heat network implementation is likely to be economically viable.

6.2.2 From an initial review of the land-use within and surrounding Wisbech, it was identified that there are potential heat export opportunities within Wisbech. However, due to the rural nature of the areas surrounding Wisbech it was considered that there is very little potential for heat export in the surrounding areas. Therefore, a 5km screening distance was applied to the National Heat Map. This 5km screening distance included all areas within Wisbech, which provided ‘potential’ for heat export.

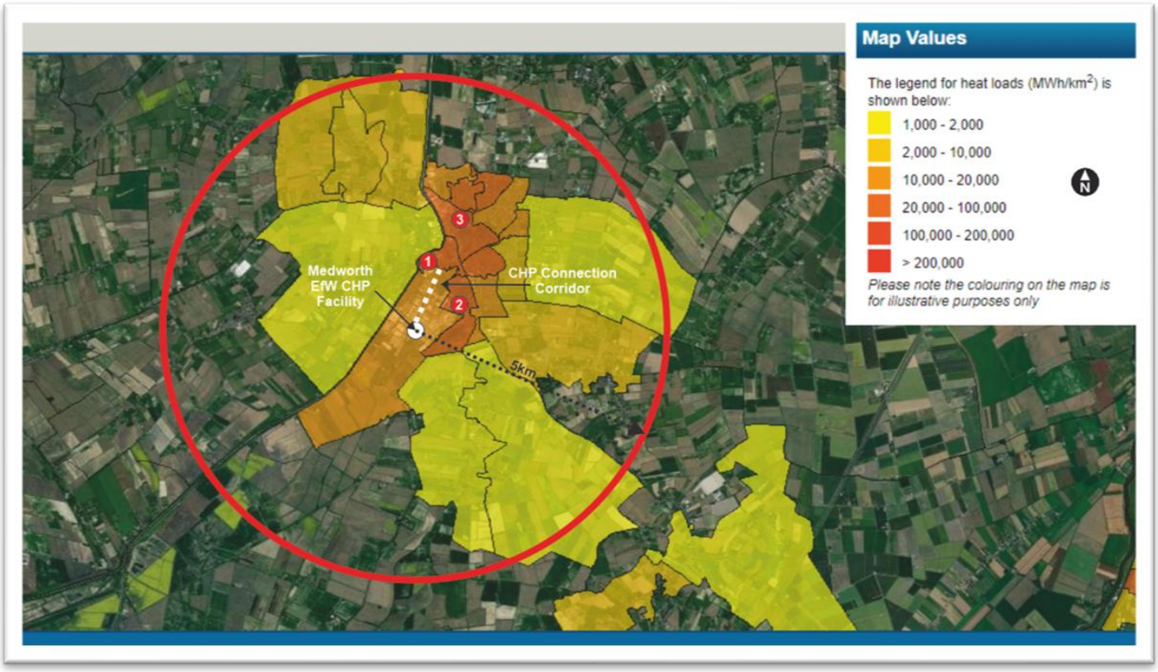
6.2.3 Data on the annual heat demand in MWh within 5km of the Medworth EfW CHP Facility has been extracted from the National Heat Map and is presented in **Table 6.3 Heat Consumption within 5km of the Medworth EfW CHP Facility** and **Graphic 3**.

Table 6.3: Heat Consumption within 5km of the Medworth EfW CHP Facility

Sector	Share	Total MWh
Communications and Transport	0.1%	201
Commercial Offices	0.2%	976
Domestic	54.6%	233,836
Education	1.3%	5,725
Government Buildings	0.5%	2258
Hotels	0.2%	958
Large Industrial	36.9%	158,102
Health	0.2%	887
Other	0.2%	745
Small Industrial	4.9%	21,150
Prisons	0.0%	0.0
Retail	0.4%	1,527
Sport and Leisure	0.1%	527
Warehouses	0.3%	1,358
District Heating	0.0%	0
Total heat load in area	100%	428,250

Source: https://chptools.decc.gov.uk/developmentmap

Graphic 3: Heat Demand Map: 5km radius from Medworth EfW CHP Facility



6.2.4 Three large heat consumers (point heat demands greater than 5 MWth) were identified within 5km of the Facility using the BEIS UK CHP Development Map tool as shown in **Graphic 3 Heat Demand Map: 5km radius from Medworth EfW CHP Facility** and **Table 6.4**. **Large Heat Consumers within 5km of the Medworth EfW CHP Facility** Nestlé Purinais (1) is directly on the CHP Connection Corridor and has been considered as a potential heat consumer. Princes Ltd (3) is further away and would require a prohibitively costly pipe network to connect. Thomas Clarkson Academy (2) is located near to, but not directly on, the CHP Connection Corridor. Due to the estimated distances and complexity of the connections to these heat consumers, these other large heat users have been discounted.

Table 6.4: Large Heat Consumers within 5km of the Medworth EfW CHP Facility

Reference Map No (Graphic 3)	Site
1	Nestle
2	Thomas Clarkson Academy
3	Princes Ltd

Source: https://chptools.decc.gov.uk/developmentmap

6.3 Prospective Developments

6.3.1 Industrial facilities are likely to have significant heat and power demands that the EfW CHP Facility could meet, though the conditions of the heat required (such as temperature and pressure, if the demand is for steam) must be known.

6.3.2 Discussions with the potential heat users are in their preliminary phases, and there are currently no heat supply agreements in place between the heat users and the Applicant. However, this is not unexpected as heat supply agreements are typically only entered into once the Applicant is able to make guarantees as to the heat supply which can only happen once the necessary consents (including the DCO) and permits for the EfW CHP Facility are in place. In addition, at this stage it is difficult for potential customers to make commercial decisions on a heat supply from the EfW CHP Facility before any guaranteed heat price, guaranteed availability and guaranteed schedule can be committed to. All of which, are determined during the detailed design and techno-economic assessment stages.

6.3.3 Due to their evident current heat demands and/or their proximity to the CHP Connection Corridor, this CHP Assessment has focused on the export of heat to three potential heat users - Lamb Weston, Nestlé Purina and Eviosys Packaging. Other industrial facilities which are located near to, but not directly on, the CHP Connection Corridor, such as those for Del Monte, have not yet been approached. Fountain Frozen and Eviosys Packaging have been contacted however, there has been no response to date.

6.3.4 The Applicant is committed to pursuing potential opportunities and will continue to engage with the proposed heat users to progress heads of terms. Once the Proposed Development has received the relevant consents and permits, the Applicant is confident that it will be able to progress these opportunities further. It is also anticipated that once the Proposed Development obtains the relevant consents and permits, additional nearby heat users are likely to express an interest in a connection to the CHP Connection Corridor. Potential connections to users not directly on the CHP Connection Corridor will be subject to additional planning consent(s) which will be the responsibility of the potential customer(s).

Lamb Weston

6.3.5 Lamb Weston is a supplier of frozen potato, sweet potato, appetizer and vegetable products to restaurants and retailers. Lamb Weston is a potential steam user, which is located on Weasenham Lane adjacent to the CHP Connection Corridor.

6.3.6 Lamb Weston has indicated that it requires process steam at 20 bar(a) with an annual average heat load of 16.32 MW and an annual total of 123,801 MWh.

Nestlé Purina

6.3.7 Nestlé Purina is a pet food manufacturing factory and a potential steam user located at the northern end of the proposed CHP Connection Corridor.

6.3.8 Nestlé Purina has indicated that it requires process steam at 10.2 bar(a) with an annual average heat load of 9.26 MW and an annual total of 79,391 MWh.

Eviosys Packaging Manufacturing

6.3.9 Eviosys Packaging Manufacturing (Eviosys) is a packaging company with a manufacturing plant located on the CHP Connection Corridor.

6.3.10 Eviosys has been contacted and a response is awaited. Therefore, it has not been requested to provide details on its process heating demands. It is assumed that it will require space heating, and potentially may also have other heat demands. For the purposes of this assessment, it has been assumed that it only has a heat demand for space heating. This could be provided by a hot water loop fed by a heat exchanger connected to steam supply infrastructure. The space heating demand for Eviosys has been estimated based on benchmark figures from the Chartered Institution of Building Services Engineers (CIBSE) Guide F (Energy Efficiency in Buildings). Based on an estimate of floor areas and development type, the annual energy usage has been estimated.

6.3.11 It is estimated that Eviosys will have an annual average heat demand, for space heating, of 0.028 MW and an annual total of 243 MWh/a.

6.4 Heat Network Profile

6.4.1 The Applicant has requested detailed heat demand data from Lamb Weston and Nestlé. To date, this information has not been provided to the Applicant and the Applicant considers it unlikely that such information will be provided until after the Proposed Development has obtained the relevant consents and permits. The same is true of the space heating that may be required by Eviosys, as well as any process heat demands.

6.4.2 Industrial processes (and any supporting space heating) are generally optimised for constant operation and are difficult to benchmark against due to limited publicly available data. Therefore, in lieu of detailed data showing otherwise, all heat demands (both steam and hot water) have been modelled as a constant throughout the year. This can be updated when more detail on individual heat demand profiles is available.

6.5 Heat Network Design

6.5.1 Process steam for heat export will be extracted via bleeds on the turbine and piped to the steam user. Medium pressure (MP) steam from the EfW CHP Facility will be exported in insulated steam pipes designed to satisfy both Lamb Weston and Nestle heat loads. The MP steam delivery pipe design criteria is presented in **Table 6.5 Steam Piping design criteria**.

6.5.2 It is assumed that there will not be a condensate return from the steam users. However, the design of the heat infrastructure includes a smaller diameter condensate pipeline (Diameter Nominal (DN)[16] 100) to return condensate back to the EfW CHP Facility, if it is of a suitable quality for re-use within the steam cycle.

[16] Nominal Diameter is also known as the mean or average outside diameter and is represented by DN. It is neither equal to the inner diameter (ID) nor the outer diameter (OD) of the pipe. Nominal is a word that denotes non-specificity and in this case, identifies the approximate inner diameter with a non-dimensional number.

6.5.3 Assuming that the heat demand for Eviosys would be hot water, MP steam could be put thought a heat exchanger at the Eviosys site boundary to heat water for space heating purposes.

Table 6.5: Steam Piping design criteria

Pipeline	Steam delivery Conditions (Pressure, Temperature)	Heat demand (MW)	Main Pipe size DN
Lamb Weston	20 bar(a), 213°C	16.32	300
Nestlé Purina	10.2 bar(a), 180°C	9.26	300
Eviosys	Hot water from heat exchanger at 110°C Return to heat exchanger at 70°C	0.028	Hot water pipe at DN25

6.6 Back-up Heat Source

6.6.1 The heat users considered above have existing on-site boilers which can be used as a back-up heat source when the EfW CHP Facility is not available, for example due to periods of maintenance.

6.7 Indicative Pipe Route

6.7.1 A detailed pipe route design has yet to be confirmed but would follow the proposed CHP Connection Corridor (as described in **Section 5.1**) connecting to the potential industrial heat users identified in **Section 6.3**. Any infrastructure would follow the disused railway line route, crossing Weasenham Lane via a pipe bridge, before terminating at the Nestlé Purina pet food factory, connecting near its Coalfield Lane access point. The route for the CHP Connection within the CHP Connection Corridor is presented in **Figure 1.3i to iii CHP Connection Operational Limits of Deviation General Arrangements**.

6.7.2 The Steam Pipeline would be located on a steel structure with a 1:500 gradient, approximately 1.6 – 1.7m in height, with a return Condensate Pipeline and Private Wire Connections and data cables running underneath. The Steam Pipeline would have a diameter of approximately 0.75m (0.300m steam pipe and 0.450m insulation and cladding) and the return Condensate Pipeline would have a diameter of 0.25m (0.100m condensate pipe and 0.150m insulation and cladding). To enable easy maintenance of the pipework, the Applicant proposes to locate the Steam Pipeline, Condensate Pipeline and Private Wire Connections and data cables above ground.

6.7.3 At distances of 50 – 60m along the route, expansion loops would be required to allow small movements of the pipeline as it expands due to heat from the steam to ensure the safe operation of the pipeline. The expansion loops would raise the

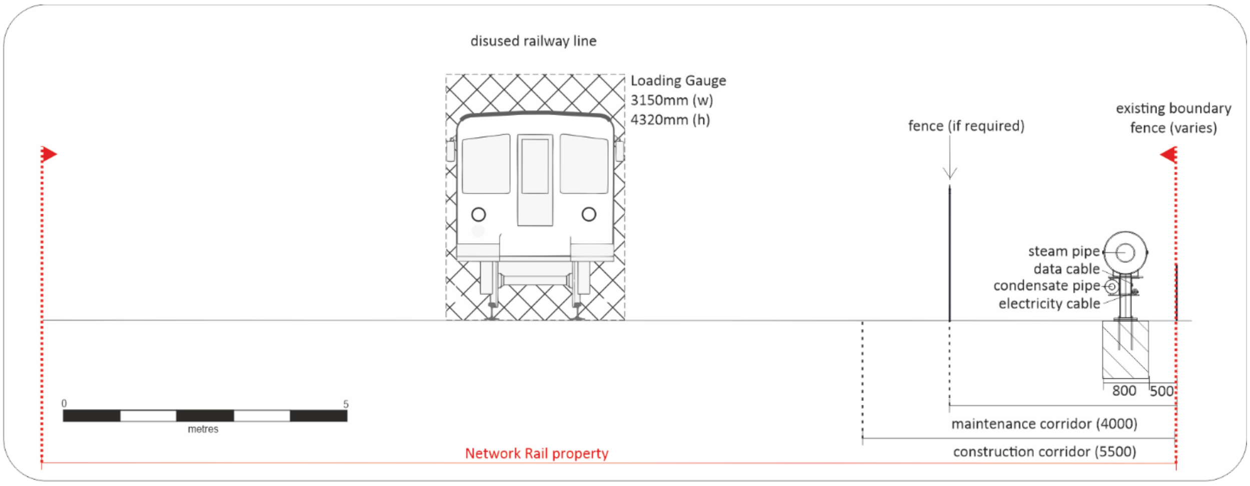
Steam Pipeline, Condensate Pipeline and Private Wire Connections and data cables to a height of 6.7m for a distance of 5m, before returning to a 1.6 – 1.7m height. At a point south of the rear of properties fronting Victory Road the use of expansion loops would be replaced with expansion bellows. These perform a similar function to the expansion loops and consist of a section of corrugated pipe in the same alignment and at the same height as the rest of the pipeline.

6.7.4 A pipe bridge measuring approximately 25m in length would be constructed over Weasenham Lane, allowing traffic to pass underneath. The pipe bridge would have an approximate height of 7m, with a 5.5m clearance from the highway. Concrete foundations extending up to 2m below the ground would form the footings of the pipe bridge.

6.7.5 A spur from the CHP Connection would cross the disused March to Wisbech Railway on a pipe bridge to Lamb Weston. This bridge would be approximately 25m in length and approximate height of 7m with a 5.5m clearance from the rail track. The Steam Pipeline would have a diameter of approximately 0.75m and the return Condensate Pipeline would have a diameter of 0.25m. The Private Wire Connections and data cables would sit underneath the steam pipe.

6.7.6 An illustrative cross section demonstrating how the CHP Connection would be accommodated within the railway corridor is presented in **Graphic 4 Illustrative CHP Corridor cross section**. This shows how the design of the CHP Connection will not prohibit the currently disused March to Wisbech Railway from being re-opened in the future.

Graphic 4: Illustrative CHP Corridor cross section



6.7.7 The CHP Connection would be predominately constructed in steel, with the pipes insulated in accordance with industry standards.

6.7.8 The CHP Connection is designed to provide future end users within the neighbouring industrial area with the opportunity to take low carbon steam. **Figure 1.1 CHP Connection General Arrangements (South of Weasenham Lane)**, and **Figure 1.2 CHP Connection General Arrangements (North of Weasenham Lane)**, also provides an example of a blank T-connection which would allow for a future customer offtake from the CHP Connection. The detailed design of the future connection spurs to end users will be consistent with the design for the CHP Connection and good utility practice and would be the subject of a separate consent.

7. Economic Assessment

7.1 Fiscal Support

7.1.1 There are a number of fiscal incentives available to energy generation projects and impact the feasibility of delivering a heating network, as follows:

i. Capacity Market for electricity supplied by the EfW CHP Facility;
ii. Renewable Heat Incentive;
iii. Contracts for Difference;
iv. Heat Network Investment Project funding; and
v. Green Heat Networks Scheme.

Capacity Market for electricity supplied by the EfW CHP Facility

7.1.2 Under the Capacity Market (CM)[17], subsidies are paid to electricity generators (and large electricity consumers who can offer demand-side response) to ensure long term energy security for the UK. Capacity Agreements are awarded in a competitive auction and new plants (such as the EfW CHP Facility) are eligible for contracts lasting up to 15-years. Based on the eligibility criteria of the mechanism, the EfW CHP Facility would potentially be eligible for Capacity Market support.

7.1.3 As Capacity Market support is based on electrical generation capacity, which would reduce when operating in CHP mode, these payments will act to disincentivise heat export. Therefore, Capacity Market support has not been included in the economic assessment.

Renewable Heat Incentive

7.1.4 The Renewable Heat Incentive (RHI) was created by the Government to promote the deployment of heat generated from renewable sources. However, funding for RHI payments ended in March 2022. As a result, the EfW CHP Facility is not eligible for RHI.

Contracts for Difference

7.1.5 Contracts for Difference (CfD) replaced the Renewables Obligation (RO) as the mechanism by which the UK Government supported low carbon power generation. Launched in 2014, to date there have been three completed auction rounds aimed at incentivising investment in renewable energy. CfD incentivises investment by providing project developers with protection from volatile wholesale prices while protecting consumers from paying increased support costs when electricity prices are high. CfD de-risks investments by guaranteeing a fixed price (the Strike Price)

[17] The Capacity Market forms part of the government's Electricity Market Reform policy. It is intended to incentivise investment in more sustainable, low-carbon electricity capacity at the least cost for energy consumers, and is intended to help secure future electricity supply by providing a payment for reliable sources of capacity.

for electricity over a 15-year period. The fourth CfD allocation round (AR4) was executed on 13 December 2021, with the deadline for bids on 14 January 2022.

7.1.6 For AR4, the Government has identified three pots of eligible technologies based on how well technologies are established, risks, costs, and ability to move the UK towards its net zero emissions target. The three pots, and the eligible technologies allocated to each pot, are presented in **Table 7.1 Contracts for Difference funding pots for allocation round 4 (AR4)**. This also provides indications of maxima and minima where applicable. Maxima and minima have been included to either restrict certain technologies or encourage others. Note that cap breaches and/or budget breaches will close an auction if they occur in any one of the four years covered by AR4.

Table 7.1: Contracts for Difference funding pots for allocation round 4 (AR4)

	Pot 1	Pot 2	Pot 3
Eligible Technologies (including minima, if applicable)	Solar (> 5 MW); onshore wind (> 5 MW); landfill gas; hydro (> 5 MW); energy from waste with CHP; sewage gas.	Remote island wind (> 5 MW); floating offshore wind; anaerobic digestion (> 5 MW); geothermal; dedicated biomass with CHP; advanced conversion technology (ACT); tidal stream; wave.	Offshore wind.
Budget	£10m per year	£75m	£200m
Maxima (if applicable)	Any applicant (5,000 MW); solar PV (3,500 MW); onshore wind (3,500 MW); hydro (50 MW)		

Source: BEIS "Contracts for Difference (CfD): Budget Notice for the fourth Allocation Round, 2021" published 25 November 2021

7.1.7 Based on the budget allocation, energy from waste with CHP and dedicated biomass with CHP are not high priorities. The primary focus of the CfD mechanism continues to be on offshore fixed wind, with some effort to encourage offshore floating and tidal stream (both have no minima) and maxima restraints placed on solar PV and onshore wind in pot 1 due to limited budget. In this case, it is assumed that the EfW CHP Facility would not receive support under the CfD AR4.

Heat Network Investment Project funding

7.1.8 The Heat Network Investment Project (HNIP) aims to deliver carbon savings and create a self-sustaining heat network market through the provision of subsidies, in the form of grants and loans, for heat network projects. £320 million has been made available to fund the HNIP between 1 April 2019 and 1 April 2022. Following a pilot scheme, which ran from October 2016 to March 2017, BEIS confirmed that funding will be available for both public and private sector applicants, and that there will be no constraints on scheme size. The 2020 Budget confirmed £96 million for the final year of the HNIP, which ended in March 2022. As a result the EfW CHP Facility is not eligible for HNIP.

Green Heat Networks Fund

7.1.9 The HNIP has been replaced by the Green Heat Networks Fund (GHNF). Key notes follow below.

i. The GHNF is a £288 million capital grant fund to support the commercialisation and construction of new low and zero carbon heat networks.

ii. It is available to both the public and private sectors.

iii. It is limited to England only.

iv. It opened to applicants in March 2022 and is to run for 3-years with a final application date in November 2024.

v. The minimum project eligibility metrics include the following.

   a. 100 g CO2e/kWh thermal energy delivered to consumers.

   b. Minimum demand of 2 GWh/year for urban networks.

vi. The GHNF will fund up to, but not including, 50% of a project's total combined commercialisation and construction costs (with an upper limit of £1 million for commercialisation).

vii. The GHNF will provide support for accessing heat sources such as capturing waste heat from an industrial process, energy from waste, and wastewater; support for low carbon generation such as energy centres and low-carbon generation and support for primary heat network distribution including distribution pipework for transmission and distribution of low-carbon heating and cooling.

7.1.10 Whether the EfW CHP Facility would be eligible for GHNF would be investigated in more detail at a later stage. To be conservative, GHNF is not included in the economic assessment at this stage.

7.2 Technical Feasibility

7.2.1 The CBA methodology (Step 3) requires identification of existing and proposed heat loads which are technically feasible to supply. The draft Article 14 guidance states that the following factors should be accounted for when determining the technical feasibility of a scheme, pertaining to a type 14.5(a) installation:

- The compatibility of the heat source(s) and load(s) in terms of temperature and load profiles;
- Whether thermal stores or other techniques can be used to match heat source(s) and load(s) which will otherwise have incompatible load profiles; and
- Whether there is enough demand for heat to allow high-efficiency cogeneration.

7.2.2 These have been considered in **Sections 6.5** and **6.6**.

7.2.3 The CHP elements of the Proposed Development have been developed on the basis of delivering heat at typical heating conditions, as identified in **Section 6.5**. It is reasonable to assume that identified potential heat consumers would be able to utilise steam at the design conditions. Consumer requirements (in terms of steam temperature and load) will need to be verified in any subsequent design process prior to the implementation of a heat network. Therefore, the heat source and heat load are considered to be compatible.

7.2.4 Conventional thermal stores or back-up boilers (as detailed in **Section 6.6**) will likely be retained by heat users to ensure continuity of supply. The specific arrangement will be selected when there is greater certainty with regards heat loads.

High-efficiency cogeneration is cogeneration which achieves at least 10% savings in primary energy usage compared to the separate generation of heat and power.

Primary Energy Savings (PES)

7.2.5 To be considered high-efficiency cogeneration, the scheme must achieve at least 10% savings in primary energy usage compared to the separate generation of heat and power. The PES for the EfW CHP Facility, assuming no heat export, has been calculated in accordance with European Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015 Annex II part (b), using the following assumptions.

- Annual nominal throughput capacity of 523,500 tonnes per annum based on an NCV of 10.9 MJ/kg;
- Nominal gross electrical output (expected capacity in fully condensing mode) of 60.0 MWe;
- Parasitic load of 5.0 MWe;
- Z ratio of 3.62; and
- Efficiency reference values for the separate production of heat and electricity have been taken as 75% and 25% respectively as defined in Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015.

7.2.6 Without heat export, the EfW CHP Facility will achieve a PES of 16.23%. This is in excess of the technical feasibility threshold defined in the draft Article 14 guidance. The inclusion of heat export at the design case level anticipated for the proposed heat network increases the PES to 18.22%. On this basis, the EfW CHP Facility will qualify as a high efficiency cogeneration operation when operating in CHP mode.

7.3 Cost-Benefit Assessment (CBA)

7.3.1 A CBA has been carried out on the selected heat load, in accordance with section 3 of the draft Article 14 guidance. The CBA uses an Excel template, ‘Environment Agency Article 14 CBA Template.xlsx’ provided by the EA, with inputs updated to correspond with the specifics of this CHP Assessment.

7.3.2 The CBA model considers:

- the revenue streams (heat sales);
- the costs streams for the heat supply infrastructure (construction and operational);
- the lost fresh water over the lifetime of the scheme, as no condensate return is assumed; and
- the lost electricity sales revenue, over the lifetime of the scheme.

7.3.3 The following assumptions have been made:

- The heat scheme will commence operation in 2028;
- The heat export infrastructure required to export heat from the EfW CHP Facility to the identified consumers is estimated to have a capital cost of approximately £6.53 million, split over a two-year construction programme;
- The heat station will cost approximately £3.95 million, split over a two-year construction programme;
- Operational costs have been estimated based on similar sized projects;
- Heat sales revenue will be £31.3 / MWh[18] based on the counterfactual of heat from gas boilers, current price and index linked for inflation in CBA; and
- Electricity sales revenue will be £55.57 / MWh, current price and index linked for inflation in CBA.

7.3.4 The results of the CBA indicate that the nominal project internal rate of return (IRR) and net present value (NPV) (before financing and tax) over 30-years are 18.1% and £0.64 million respectively. Therefore, the proposed heat network will yield an economically viable scheme in its current configuration. Model inputs and key outputs are presented in **Appendix A**.

[18] BEIS energy-and-emissions-projections Annex M for 2028. Retail prices, industrial sector, reference scenario tab. Boiler efficiency of 85% is applied

8. Energy Efficiency Measures

8.1 Heat and Power Export

8.1.1 The Z ratio, which is the ratio of reduction in power export for a given increase in heat export, can be used to calculate the effect of variations in heat export on the electrical output of the EfW CHP Facility. A value of 3.62 has been obtained from the heat and mass balance diagrams for the design, assuming steam extraction at a pressure of 22 bar(a), which is considered sufficient to meet the requirements of the potential heat consumers identified. The heat and power export has been modelled across a range of load cases and the results are presented in **Table 8.1 Heat and power export.**

Table 8.1: Heat and power export

Load case	Heat export at turbine (MWth)	Gross power generated (MWe)	Net power exported (MWe)	Z ratio
1. No heat export	0.0	60.0	55.0	N/A
2. Proposed network heat load (see Section 6.3)	25.61	52.9	47.9	3.62
3. Maximum heat export capacity	50.00	46.2	41.2	3.62

8.1.2 The results indicate that for the potential heat consumers identified, load case 2 corresponding to an annual average heat export of 25.61 MWth will result in an annual average net power export of 47.9 MWe.

8.2 CHPQA Quality Index

8.2.1 The Combined Heat and Power Quality Assurance (CHPQA) Programme is an energy efficiency best practice initiative organised by the UK Government. The CHPQA Programme aims to monitor, assess and improve the quality of CHP in the UK. To do this, the UK Government has developed a metric to determine CHP scheme quality, known as the CHP Quality Index (QI). A plant is said to be a 'Good Quality' CHP plant if it can achieve a QI of at least 105 at the design, specification, tendering and approval stages. Under normal operating conditions (i.e., when the scheme is operational) this QI threshold drops to 100. The QI is calculated as a function of a CHP scheme's heat efficiency and power efficiency, according to the following formula:

$$QI = X\eta power + Y\eta heat$$

where:

$\eta power$ = power efficiency; and

$\eta heat$ = heat efficiency.

8.2.2 The power efficiency within the formula is calculated using the gross electrical output and is based on the gross calorific value of the input fuel. The heat efficiency is also based on the gross calorific value of the input fuel. The coefficients X and Y are defined by CHPQA based on the total gross electrical capacity of the scheme and the fuel/technology type used.

8.2.3 In December 2018, the Government released a revised CHPQA Standard Issue 7. The revised CHPQA Standard sets out revisions to the design and implementation of the CHPQA scheme. These revisions are intended to ensure schemes which receive Government support are supplying significant quantities of heat and delivering intended energy savings. The following X and Y coefficients apply to the EfW CHP Facility:

- X value = 220; and
- Y value = 120.

8.2.4 The QI and efficiency values (based on a gross calorific value of 12.09 MJ/kg) have been calculated in accordance with CHPQA methodology for various load cases and the results are presented in **Table 8.2 QI and efficiency calculations.**

Table 8.2: QI and efficiency calculations

Load case	Power efficiency [%]	Heat efficiency [%]	Indicative overall efficiency [%]	CHP QI
1. No heat export	27.13	0.00	27.13	59.7
2. Proposed network heat load (see Section 6.3)	23.93	11.58	35.51	66.5
3. Maximum heat export capacity	20.88	22.61	43.49	73.1

8.2.5 The results indicate that the EfW CHP Facility will not achieve a QI score in excess of the 'Good Quality' CHP threshold (QI of 105 at the design stage) for the average heat load exported to the proposed heat network. The Applicant notes that the efficiency criteria used in the latest CHPQA guidance set a very high bar, most notably the underpinning requirement to achieve an overall efficiency (NCV basis) of at least 70%, means that none of the load cases considered will enable heat export from the EfW CHP Facility to be considered Good Quality. The efficiency criteria set out in the latest CHPQA guidance mean that it is unlikely that any energy recovery facility will now achieve 'Good Quality' status.

8.2.6 For reference, assuming the same Z ratio as set out in the preceding section, an average heat export of 170 MWth would be required for a heat network to achieve

Good Quality status. It is clear that the design proposed for heat recovery is not capable of supplying this quantity of heat at the assumed conditions required by the local network.

9. EA CHP-Ready Guidance

9.1 CHP-Ready Assessment

9.1.1 This report includes a CHP-Ready (CHP-R) Assessment which considers the requirements of the EA's CHP-Ready Guidance. The completed CHP-R Assessment form is provided in **Appendix B.**

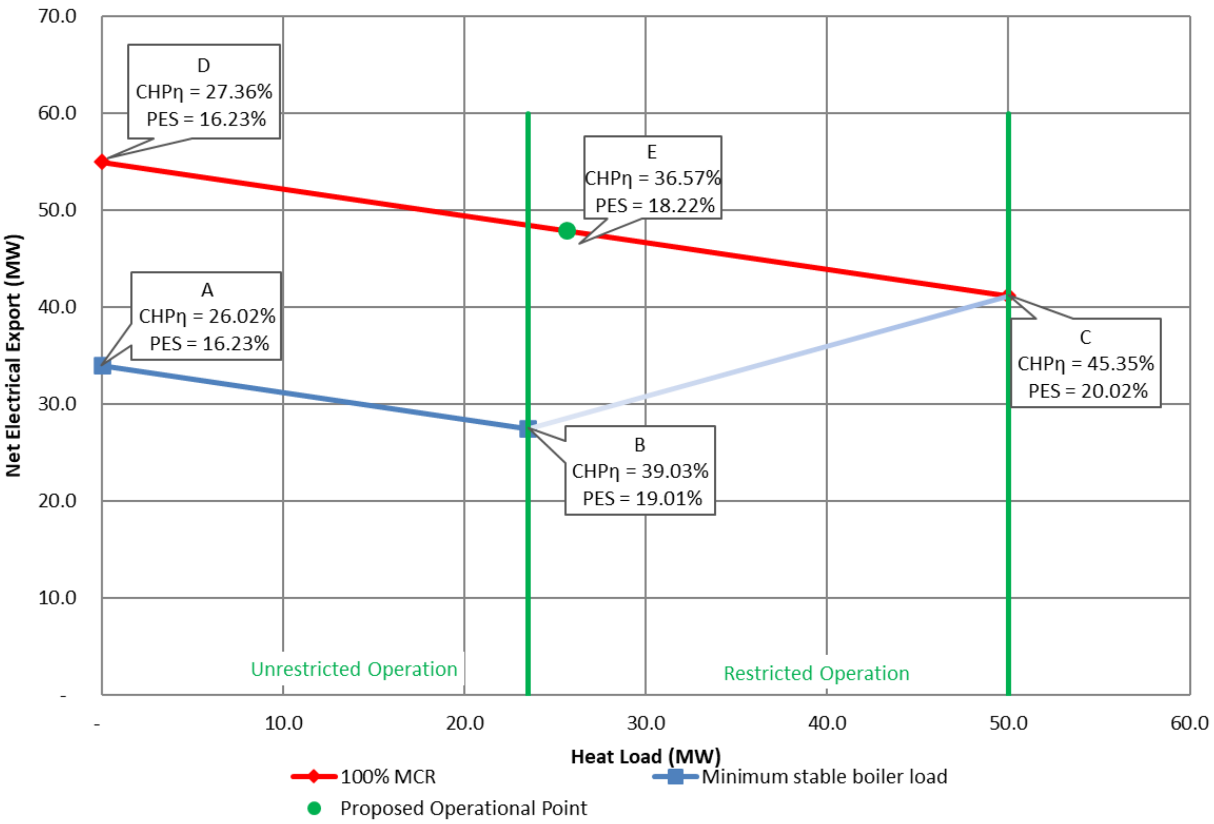
9.2 CHP Envelope

9.2.1 The 'CHP envelope' identifies the potential operational range of a new plant where it could be technically feasible to operate electrical power generation with heat generation. This must be prepared under Requirement 2 of the CHP-Ready Guidance; the CHP envelope for the EfW CHP Facility is provided in **Graphic 5**. **Graphical representation of CHP envelope for proposed heat network**.

9.2.2 The points defining the CHP envelope are as follows:

- A: minimum stable load (with no heat extraction);
- B: minimum stable load (with maximum heat extraction);
- Line A to B: minimum electrical power output for any given heat load (corresponds to the minimum stable plant load);
- C: 100% load (with maximum heat extraction);
- D: 100% load (with no heat extraction);
- Line D to C: maximum electrical power output for any given heat load (corresponds to 100% plant load);
- E: proposed operational point of the EfW CHP Facility, based on the proposed heat network;
- Unrestricted operation: if a selected heat load is located in this region, the EfW CHP Facility will have the ability to operate at any load between minimum stable plant load and 100% plant load whilst maintaining the selected heat load; and
- Restricted operation: if a selected heat load is located in this region, the EfW CHP Facility will not have the ability to operate over its full operational range without a reduction in heat load.

Graphic 5: Graphical representation of CHP envelope for proposed heat network



9.2.3 The proposed operational point (point E) represents the annual average heat demand exported to the proposed heat network. It considers the heat losses and pressure drop in the pipe network and therefore corresponds to the annual average heat demand predicted at the EfW CHP Facility Site boundary. The operational range for the EfW CHP Facility will ultimately be subject to the required steam flow temperature and final steam turbine selection, which are subject to detailed design.

9.3 CHP-Ready Provisions

9.3.1 Provision has been made in the design of the steam turbine for controlled steam extraction which can then be sent along the CHP Connection to the identified heat users. The steam would be transported via the steam pipeline to its destination.

10. Action Plan

10.1.1 It is feasible to export heat from the EfW CHP Facility to consumers located along the CHP Connection Corridor. Additional heat consumers may emerge as the Proposed Development progresses. In particular, a number of process heat users and/or manufacturing facilities are anticipated but have not been included in the heat network at this stage due to uncertainty over their heat requirements.

10.1.2 In order to build the EfW CHP Facility as CHP Ready from the outset and realise the full energy export potential of the facility, an action plan will be implemented. The outcome of the action plan will be to ensure that the EfW CHP Facility can expand as a CHP facility by maintaining momentum with key stakeholders in the development process.

10.1.3 The action plan will be structured and have well defined objectives, involving all the local stakeholders and be supported at the highest levels within MVV. The action plan will identify the strategic phases required for the heat network development. Potential heat consumers are more likely to engage in the process if they know that there is a realistic prospect of a connection; it is therefore proposed that the action plan is implemented alongside the construction programme. The following project development phases are proposed.

10.1.4 Based on consumers identified as part of this CHP Assessment, the EfW CHP Facility will be CHP enabled to be able to deliver up to 50 MWth, subject to heat demand verification and plant design. In order to achieve CHP, the scope of the proposed heat network needs to be well defined and technically assessed to prove that it is deliverable. Potential consumers need to be approached so that there is a high degree of certainty about heat sales. The economic viability of the heat network then needs to be confirmed.

10.1.5 Constructing a detailed and reliable database of potential heat consumers is a key activity. This should be revisited and updated at least every 2-years so that new developments can be added, and existing developments can be updated. Change in building ownership and use can affect the potential to be a heat customer. Boiler age can be tracked so that the consumer can be targeted when they are already considering investing in a new heating system.

10.1 Initial phase

1. Follow up initial heat load plan and research with a detailed heat load survey when more information is available from potential consumers.
2. Engage with the relevant local authority(s).
3. Agree annual progress targets with EA and review annually.
4. Build a detailed database of potential heat consumers.
5. Target buildings identified as potential heat consumers.
6. Carry out heat use surveys at targeted heat consumers.
7. Verify seasonal heat demand over time.
8. Develop pipe routing options and/or phases.
9. Size and configure the required infrastructure.
10. Confirm technical viability.
11. Develop capital cost estimates.
12. Develop cost estimates for operation and maintenance.
13. Assess economic viability.
14. Establish a carbon saving benchmark.
15. Draw up a project master plan.
16. Set up a joint working group with stakeholders.
17. Develop a marketing strategy.

10.2 Intermediate phase

1. Undertake detailed negotiations with heat consumers.
2. Finalise initial heat demand.
3. Finalise sizing of infrastructure.
4. Discuss pipe routing options with landowner(s)
5. Finalise pipe routing.
6. Tender for initial infrastructure.
7. Sign heads of terms for heat supply agreements with Energy Services Company (ESCO).
8. Install initial infrastructure.
9. Sign heat supply agreement with an ESCO.
10. Commission the heat network.

10.3 Final phase

1. Market the scheme.
2. Expand the scheme by adding heat consumers if possible.
3. Expand the scheme by developing on existing infrastructure or connecting additional heat sources if possible.

Appendix A
CBA Inputs and Key Outputs

INPUTS

Version Jan 2015

Scenario Choice (dropdown box)	**1**	Power generator (Heat Source) same fuel amount	
Technical solution features			
Heat carrying medium (hot water, steam or other) (dropdown box)	Steam	**Key**	
Total length of supply pipework (kms)	1.65	2	Participant to define
Peak heat demand from Heat User(s) (MWth)	25.608		
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) (MWh)	*Lines 49 & 79*	2	Regulatory prescribed
DCF Model Parameters		2	Calculated
Discount rate (pre-tax pre-financing) (%) - 17% suggested rate	17%		
Project lifespan (yrs)	30	2	Prescribed - but possibility to change if make a case
Exceptional shorter lifespan (yrs)	0		

Cost and revenue streams

Construction costs and build up of operating costs and revenues during construction phase

		% operating costs and revenues during construction phase	Heat Supply Infrastructure - used in Scenarios 1, 2, 3 and 5	Heat Station - used in Scenarios 1, 2 and 3	Standby boilers (only if needed for Scenarios 1, 2 and 3)	Industrial CHP - used in Scenario 4 *
Project asset lifespan (yrs)			30	30	30	
Exceptional reason for shorter lifespan of Heat Supply Infrastructure, Standby Boiler and/ or Heat Station (yrs)						
Construction length before system operational and at steady state (yrs)	2					
Number of years to build			2	2	0	0
		% (ONLY IF APPLICABLE)	£m	£m	£m	£m
Year 1 costs (£m) and build up of operating costs and revenues (%)		0%	3.2630262	1.97324271		
Year 2 costs (£m) and build up of operating costs and revenues (%)		0%	3.2630262	1.97324271		
Year 3 costs (£m) and build up of operating costs and revenues (%)						
Year 4 costs (£m) and build up of operating costs and revenues (%)						
Year 5 costs (£m) and build up of operating costs and revenues (%)						

Non-power related operations

OPEX for full steady state Heat Supply Infrastructure on price basis of first year of operations (partial or steady state) (£m)	0.1
OPEX for full steady state Heat Station on price basis of first year of operations (partial or steady state) (£m)	1.2
OPEX for full steady state Standby Boilers on price basis of first year of operations (partial or steady state) (£m)	0.0
OPEX for full steady state Industrial CHP on price basis of first year of operations (partial or steady state) (£m) *	
Additional equivalent OPEX to pay for a major Industrial CHP overall spread over the life of the asset (£m) on price basis of first year of operations (partial or steady state) (£m) *	

INPUTS

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Other 1 - Participant to define (£m)	
Other 2 - Participant to define (£m)	
Total non-power related operations	**1.3**
Annual inflation for all non-power related OPEX from first year of operations (full or partial) (%)	2.0%

Unit Energy Prices, Energy Balance, Fuel Related Operational costs and Revenue Stream

	Scenario used	1 Power generator (Heat Source) same fuel amount	2 Power generator (Heat Source) same electrical output	3 Industrial installation (Heat Source) - use waste heat	4 Industrial installation (Heat Source) - CHP set to thermal input	5 District heating (Heat User)
Heat sale price (£/ MWh) at first year of operations (partial or full)	31.28	31.28				
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	196,803	196,803				
Equivalent heat sales if first year of operations is steady state (£ m)	6.2					
Heat sale price inflation from first year of operations (full or partial) (% per year)	2.0%	2.0%				
Percentage of heat supplied by Standby Boiler (if relevant)	0%	0%				
'Lost' electricity sale price (£/ MWh) at first year of operations	55.57	55.57				
Z-ratio (commonly in the range 3.5 - 8.5)	3.62	3.62				
Power generation lost at steady state (MWh)	54,400	54,400				
Equivalent 'lost' revenue from power generation if first year of operations is steady state (£ m)	3.02					
Electricity sale price inflation from first year of operations (full or partial) (% per year)	2.0%	2.0%				
Industrial CHP electricity sale price (£/ MWh) at first year of operations (full or partial)	0.00					
Industrial CHP electrical generation in steady state (MWh)	0					
Equivalent revenue from power generation if first year of operations is steady state (£ m)	0.00					
Industrial CHP electricity price inflation from first year of operations (full or partial) (% per year)	0.0%					
Fuel price for larger power generator/ CHP at first year of operations (full or partial) (£ / MWh)	0.00					
Z-ratio (commonly in the range 3.5 - 8.5)	0					
Power efficiency in cogeneration mode (%)	0					
Additional fuel required per year for larger power generator / CHP in steady state (MWh)	0		#DIV/0!			
Equivalent additional fuel costs if first year of operations is steady state (£ m)	0.00					
Fuel price inflation from first year of operations (full or partial) (% per year)	0.0%					
Fuel price for Standby Boiler at first year of operations (£ / MWh)	25.00	25.00				
Boiler efficiency of Standby Boiler (%)	80%	80%	80%	80%		
Additional fuel required per year for Standby Boiler in steady state (MWh)	-	-	-	-		

INPUTS

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Equivalent additional fuel costs if first year of operations is steady state (£m)	-					
Fuel price inflation for Standby Boiler from first year of operations (full or partial) (% per year)	2.00%	2.0%				
Heat purchase price (£/ MWh) at first year of operations (partial or full)	0.00					
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	0					
Equivalent cost of heat purchased if first year of operations is steady state (£ m)	0.0					
Heat purchase price inflation from first year of operations (full or partial) (% per year)	0.0%					
Fuel price (£ / MWh) at first year of operations (partial or full)	0.00					
Boiler efficiency of district heating plant	0%					80%
Fuel avoided per year in steady state (MWh)	0					-
Equivalent fuel savings if first year of operations is steady state (£m)	0.0					
Fuel price inflation from first year of operations (full or partial) (% per year)	0.0%					4.0%
Fiscal benefits (£m) in first year of operations assuming it is at steady state **	0.00	0.00				
Fiscal benefits inflation rate from first year of opeations (full or partial) (%) **	0.0%					

* In the case of Industrial CHP a separate model template is available for typical indicative CAPEX, non-power related OPEX, additional equivalent OPEX to pay for a major overall, MWh of electricity generated in the steady state and the additional fuel required.

** Operator only needs to enter a value for fiscal benefits (£m) and the annual fiscal benefit inflation rate (%) if the NPV without fiscal benefits is negative at the specified discount rate

OUTPUTS

Nominal Project IRR (before financing and tax) over 32 years	18.1%
Nominal NPV (before financing and tax) (£m) over 32 years	0.64

Appendix B
CHP-R Assessment Form

#	Description	Units	Notes / Instructions
Requirement 1: Plant, Plant location and Potential heat loads			
1.1	Plant name		Medworth EfW CHP Facility
1.2	Plant description		The main activities associated with the EfW CHP Facility will be the combustion of incoming waste to raise steam and the generation of electricity in a steam turbine/generator. The EfW CHP Facility includes two waste incineration lines, waste reception hall, main thermal treatment process, turbine hall, on-site facilities for the treatment or storage of residues and wastewater, flue gas treatment, stack, boilers, devices and systems for controlling operation of the waste incineration plant and recording and monitoring conditions. In addition to the main elements described, the EfW CHP Facility will also include weighbridges, water, auxiliary fuel and air supply systems, site fencing and security barriers, external hardstanding areas for vehicle manoeuvring, internal access roads and car parking, transformers, grid connection compound, firewater storage tanks, offices, workshop, stores and staff welfare facilities. The EfW CHP Facility has been designed to export power to the National Grid. The EfW CHP Facility will generate approximately 60 MWe of electricity in full condensing mode. The EfW CHP Facility will have a parasitic load of 5.0 MWe. Therefore, the maximum export capacity of the EfW CHP Facility is 55.0 MWe. In addition to generating power, the EfW CHP Facility has been designed to be capable of exporting approximately 50 MW_{th} heat to the identified heating network. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during detailed design stage. At the time of writing this report, there are no formal agreements in place for the export of heat from the EfW CHP Facility. The power exported may fluctuate if heat is exported from the EfW CHP Facility to local heat users in the future. The EfW CHP Facility has been designed to thermally treat waste with a range of net calorific values (NCV's) with a Net Calorific Value (NCV) of 8 MJ/kg to 14.0 MJ/kg. The nominal capacity of the EfW CHP Facility is 66.4 tonnes per hour of fuel with an NCV of 10.9 MJ/kg. The expected operational availability is 7,884 hours per annum (~90%), which is regarded as typical for an EfW plant in the UK. Therefore, the nominal capacity for the installation is 523,500 tonnes per annum. It is expected that the maximum capacity of the EfW CHP Facility will be approximately 625,600 tonnes per annum.
1.3	Plant location (Postcode / Grid Ref)		The EfW CHP Facility is approximately 5.3ha in size and is located south-west of Wisbech. It is within the administrative areas of Fenland District Council and Cambridgeshire County Council. The site forms part of a wider industrial estate centred on Algores Way. The location of the main EfW CHP Facility would be predominantly located on an area of land currently operated by Mick George Ltd/Frimstone Ltd as a waste and aggregates recycling facility and waste transfer station (WTS). It is accessed off Algores Way. The site in its current form includes a Waste Reception Building (WRB), approximately 30m in width, 50m in length and 11.5m in height. Located adjacent to the WRB are office and welfare facilities. These facilities consist of secure portable buildings, approximately 3m in width, 8m in length and between 3m (single storey) and 6m (two storey) in height. A raised gatehouse and single weighbridge control for vehicle access into and out of the site. Vehicle parking is located off the site's entrance on Algores Way and adjacent to the office and welfare accommodation. To the west of the WRB various types of primary aggregates are stored in an open yard. To the south of the WRB secondary aggregate storage and processing, including crushing, takes place in an open yard. The EfW CHP Facility will be located at an approximate national grid reference TF 45564 07955.
1.4	Factors influencing selection of plant location		Refer to EIA, submitted with DCO Application.
1.5	Operation of plant		
a)	Proposed operational plant load	%	100
b)	Thermal input at proposed operational plant load	MW	201.04
c)	Net electrical output at proposed operational plant load	MW	55.00
d)	Net electrical efficiency at proposed operational plant load	%	27.36%
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	201.04
g)	Net electrical output at maximum plant load	MW	55.00
h)	Net electrical efficiency at maximum plant load	%	27.36%
i)	minimum stable plant load	%	65%

#	Description	Units	Notes / Instructions
j)	Thermal input at minimum stable plant load	MW	130.68
k)	Net electrical output at minimum stable plant load	MW	27.50
l)	Net electrical efficiency at minimum stable plant load	%	21.05%
1.6	Identified potential heat loads		
			Details of the identified heat loads are in Sections 6.3 and 6.5. Lamb Weston, Nestle and Eviosys are potential heat user with a constant heat load of 25.61 MW_{th} for the proposed heat network. The estimated heat use of the identified network is 197,000 MWh/year.
1.7	Selected heat load(s)		
a)	Category (e.g. industrial / district heating)		Process steam and process building heating
b)	Maximum heat load extraction required	MW	The heat demand of the proposed heat network has been calculated to be 25.61 MW_{th}.
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		Network to supply steam from turbine steam extractions at approximately 22 bar(a).
b)	Description of heat load profile		The heat load profile is constant. The consumer heat load and profile is subject to verification.
c)	Export pressure	bar a	22
d)	Export temperature	°C	217
e)	Export flow	t/h	32.86 (nominal case)
f)	Return pressure	bar a	No condensate return assumed
g)	Return temperature	°C	No condensate return assumed
h)	Return flow	t/h	No condensate return assumed
Requirement 2: Identification of CHP Envelope			
2.0	Comparative efficiency of a standalone boiler for supplying the heat load	% LHV	80% - updated in accordance with CHPQA Stakeholder Engagement Document, April 2016, Table 1.
2.1	Heat extraction at 100% plant load		
a)	Maximum heat load extraction at 100% plant load	MW	50.0
b)	Maximum heat extraction export flow at 100% plant load	t/h	Assuming steam extraction at 22 bar(a), export flow rate would be: 64.16 t/hr
c)	CHP mode net electrical output at 100% plant load	MW	41.18
d)	CHP mode net electrical efficiency at 100% plant load	%	20.48%
e)	CHP mode net CHP efficiency at 100% plant load	%	45.35%
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	20.02%
2.2	Heat extraction at minimum stable plant load		
a)	Maximum heat load extraction at minimum stable plant load	MW	23.50
b)	Maximum heat extraction export flow at	t/h	Assuming steam extraction at 22 bar(a), export flow rate would be:

#	Description	Units	Notes / Instructions
	minimum stable plant load		30.15 t/h
c)	CHP mode net electrical output at minimum stable plant load	MW	27.50
d)	CHP mode net electrical efficiency at minimum stable plant load	%	21.05%
e)	CHP mode net CHP efficiency at minimum stable plant load	%	39.03%
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	19.01%
2.3	Can the plant supply the selected identified potential heat load (i.e.is the identified potential heat load within the 'CHP envelope')?		Yes, but not deemed 'Good Quality' CHP as detailed in section 8.2 of the Heat Plan.
Requirement 3: Operation of the Plant with the Selected Identified Heat Load			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	47.92
b)	CHP mode net electrical efficiency at proposed operational plant load	%	23.84%
c)	CHP mode net CHP efficiency at proposed operational plant load	%	36.57%
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	MW	7.08
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	3.52%
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	18.22%
g)	Z ratio		3.62
Requirement 4: Technical provisions and space requirements			
4.1	Description of likely suitable extraction points		Steam flow extraction from medium pressure turbine bleed at approximately 22 bar(a). Full details are provided in section 6.5 of the Heat Plan.
4.2	Description of potential options which could be incorporated in the plant, should a CHP opportunity be realised outside the 'CHP envelope'		The CHP opportunity lies within the CHP envelope.
4.3	Description of how the future costs and burdens associated with supplying the identified heat load / potential CHP opportunity have been minimised through the implementation of an appropriate CHP-R design		If the scheme were to be implemented, space will be allocated for the CHP equipment within or in the area adjacent to the turbine hall to avoid the cost of building a dedicated heat station at a later date. The turbine design will be selected to maximise electrical efficiency while allowing for the option of heat export to be implemented in the future. This is in line with the EA CHP-Ready Guidance which states that the initial electrical efficiency of a CHP-R plant (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-R plant.
4.4	Provision of site layout of the plant, indicating available space which could be made available for CHP-R		Detailed design of the EfW CHP Facility has not been undertaken at this stage. However, space will be left available within the turbine hall for heat export infrastructure. Please see the site layout in **Figure 1.3i CHP Connection Operational Limits of Deviation General Arrangements**.

#	Description	Units	Notes / Instructions
			The heat network will (likely) include steam extraction piping, control and shutoff valves, steam supply line, control and instrumentation / electrical connections and heat metering. If necessary, a back-up boiler will be located at a suitable location within the installation boundary for ease of connection to the steam supply network.
Requirement 5: Integration of CHP and carbon capture			
5.1	Is the plant required to be CCR?		No
5.2	Export and return requirements identified for carbon capture		
	100% plant load		
a)	Heat load extraction for carbon capture at 100% plant load	MW	N/A
b)	Description of heat export (e.g. steam / hot water)		N/A
c)	Export pressure	bar a	N/A
d)	Export temperature	°C	N/A
e)	Export flow	t/h	N/A
f)	Return pressure	bar a	N/A
g)	Return temperature	°C	N/A
h)	Return flow	t/h	N/A
i)	Likely suitable extraction points		N/A
	Minimum stable plant load		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	N/A
k)	Description of heat export (e.g. steam / hot water)		N/A
l)	Export pressure	bar a	N/A
m)	Export temperature	°C	N/A
n)	Export flow	t/h	N/A
o)	Return pressure	bar a	N/A
p)	Return temperature	°C	N/A
q)	Return flow	t/h	N/A
r)	Likely suitable extraction points		N/A

#	Description	Units	Notes / Instructions
5.3	Operation of plant with carbon capture (without CHP)		
a)	Maximum plant load with carbon capture	%	N/A
b)	Carbon capture mode thermal input at maximum plant load	MW	N/A
c)	Carbon capture mode net electrical output at maximum plant load	MW	N/A
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	N/A
e)	Minimum stable plant load with CCS	%	N/A
f)	Carbon capture mode CCS thermal input at minimum stable plant load	MW	N/A
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	N/A
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	N/A
5.4	Heat extraction for CHP at 100% plant load with carbon capture		
a)	Maximum heat load extraction at 100% plant load with carbon capture [H]	MW	N/A
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	N/A
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	N/A
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	N/A

#	Description	Units	Notes / Instructions
5.5	Heat extraction at minimum stable plant load with carbon capture		
a)	Maximum heat load extraction at minimum stable plant load with carbon capture	MW	N/A
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	N/A
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	N/A
f)	reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	N/A
5.6	Can the plant with carbon capture supply the selected identified potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		N/A
5.7	Description of potential options which could be incorporated in the plant for useful integration of any realised CHP system and carbon capture system		N/A
Requirement 6: Economics of CHP-R			
6.1	Economic assessment of CHP-R		In order to assess the economic feasibility of the CHP scheme (as required under Article 14 of the Energy Efficiency Directive) a cost benefit assessment has been carried out in accordance with the draft Article 14 guidance. The results of the CBA indicate an internal rate of return of 18.1% and a net present value of £0.64 million. The proposed heat network will yield an economically viable scheme in its current configuration. The economic feasibility of the scheme will be reassessed in the future when there is a better understanding of heat demands and considering any subsidies that support the export of heat.
BAT assessment			
	Is the new plant a CHP plant at the outset (i.e. are there economically viable CHP opportunities at the outset)?		No

#	Description	Units	Notes / Instructions
	If not, is the new plant a CHP-R plant at the outset?		Yes
	Once the new plant is CHP-R, is it BAT?		Yes