CONTENTS

TABLES

6.0 ALTERNATIVES AND DESIGN EVOLUTION

6.1 Introduction

6.1.1 This chapter of the Environmental Statement (ES) sets out the alternatives that have been considered during the definition and evolution of the Proposed Development design as presented in Chapter 4: The Proposed Development.

6.1.2 Schedule 4 of the Environmental Impact Assessment (EIA) Regulations sets out the requirement for the consideration of alternatives and states that the ES should contain "*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen, option, including a comparison of the environmental effects*".

6.1.3 This chapter recognises and fulfils this requirement respect of the Proposed Development.

6.1.4 The consideration of alternatives and design evolution has been undertaken with the aim of avoiding and/ or reducing adverse environmental effects (following the mitigation hierarchy of avoid, reduce and, if possible, remedy), while maintaining operational efficiency and cost-effectiveness.

6.2 The 'Do Nothing' Scenario

6.2.1 A 'do nothing' scenario in which the Proposed Development does not proceed is the baseline against which the impacts of the Proposed Development are compared within this EIA.

6.2.2 The Planning, Design and Access Statement submitted in support of the planning application sets out the need that exists for the Proposed Development.

6.3 Preferred Site Selection

6.3.1 EP SHB has chosen the Site at its existing South Humber Bank Power Station (SHBPS) for the Proposed Development. Whilst no alternative sites were considered, careful consideration has been given to the suitability of the Site for the Proposed Development and the location and layout for the Main Development Area (which is discussed further in Sections 6.4 and 6.7). Central to informing this suitability assessment was the completion of an initial environmental appraisal, which identified key environmental sensitivities within and surrounding the Site.

6.3.2 Table 6.1 summarises the key environmental sensitivities identified through the desk based study and provides commentary on each of them.

Table 6.1: Summary of Preliminary Environmental Appraisal

SENSITIVITY	DISTANCE	PRELIMINARY APPRAISAL CONCLUSION
Highways and access	Adjacent to Site	The Site has good access to the highway network which is likely to have sufficient capacity for traffic associated with the Proposed Development. Assessment of cumulative traffic impacts with other proposed developments required.
Proximity to residential receptors	Over 1 km to the west of the Main Development Area	The Main Development Area is a substantial distance from residential receptors and is largely screened from the west by the existing SHBPS. Emissions to air and noise effects should be insignificant at residential receptors based on distance and prevailing wind directions.
Land use	The Site	The Site lies within operational land associated with the SHBPS, and within the South Humber Industrial Investment Programme area promoted by the Greater Lincolnshire Local Enterprise Partnership and North East Lincolnshire Council.
Archaeological remains (non-designated assets)	Within the Site, but outside the Main Development Area	The Main Development Area was stripped during the construction of the SHBPS and any surviving remains would have been removed during this process.
Proximity to designated nature conservation sites (Humber Estuary Site of Special Scientific Interest (SSSI), Special Area for Conservation (SAC), Special Protection Area (SPA) and Ramsar site	Approximately 175 m to the east of the Main Development Area.	Habitats Regulations Assessment process to be followed, including assessment of operational air emissions. Stack height to be set at suitable height to avoid significant adverse effects on designated sites. Noise disturbance to bird populations requires careful consideration and influences siting of the Proposed Development on the Site.
Flood risk	The Site is located within Flood Zone 3.	Flood Risk Assessment required to assess flood risk on and off Site and to inform design, although the Site is defended by existing and maintained flood defences.

SENSITIVITY	DISTANCE	PRELIMINARY APPRAISAL CONCLUSION
Surface water features (Humber Estuary and ponds and ditches)	Within and immediately adjacent to the Site.	No controlled waters or Water Framework Directive waterbodies are present on the Site. However the Humber Estuary lies 175 m to the east of the Main Development Area There are two small artificial ponds and several ditches on Site. These need to be surveyed for ecological value/ protected species. Layout of Proposed Development to avoid direct impacts on surface water features where possible, and design/ construction methods to avoid potential pollution of ditches, which discharge to the Humber Estuary. Water Framework Directive assessment is required.
Potential for contaminated land due to former industrial land uses	On Site	Phase I Geo-environmental Study required.
Potential for cumulative effects with other proposed developments	There are other proposed developments within 1 km of the Site	Assessment of potential for cumulative effects with other proposed developments required, including South Humber Bank Link Road and Humber SPA Habitat Mitigation Land.

6.3.3 Following the completion of the preliminary appraisal, EP SHB considered that the Site was suitable for a development of this type and chose to progress with the design of the Proposed Development taking into consideration the potential sensitivities outlined in Table 6.1.

6.3.4 As the design progressed some preliminary environmental assessments were carried out to inform the initial design. This enabled early consideration of potential environmental impacts from the Proposed Development location or layout that may have the potential to give rise to any significant environmental effects so that an alternative solution could be achieved. These preliminary assessments included:

- preliminary flood risk appraisal;
- preliminary Habitats Regulations Assessment (including air dispersion modelling);
- preliminary ecological appraisal; and
- preliminary traffic and transport appraisal.

6.3.5 Taking the findings of the above into account, the Site, and specifically the Main Development Area, was selected by EP SHB for the Proposed Development for the following reasons:

- the Site is currently undeveloped land within the boundary of the SHBPS;
- locating the Proposed Development adjacent to the existing operational SHBPS provides opportunities for the export of heat (in the form of hot water or steam);
- the Site is also located within an existing industrial area with potential for off-site Combined Heat and Power opportunities;
- the Site has excellent transport links with capacity on the surrounding network to accommodate construction and operational traffic associated with the Proposed Development; and
- the Site is in the freehold ownership of EP SHB.

6.4 Alternative Locations within the Site

6.4.1 The location of the Proposed Development within the SHBPS site was kept as far away from the Humber Estuary designated nature conservation site as possible, so as to minimise the risk of disturbance on that receptor. Alternative configurations of the layout within the Main Development Area were considered, and this is summarised within Section 6.6 below.

6.5 Alternative Technologies

Technology Options

6.5.1 The principal available technical options to manage and treat waste are listed below.

- **Conventional combustion** - combustion of waste using grate or fluidised bed technologies followed by energy recovery using a steam turbine and electricity generator.
- **Advanced Thermal Treatment** - including gasification, plasma gasification and pyrolysis followed by energy recovery by combustion of the syngas arising from the process.
- **Anaerobic Digestion** - a biological process whereby organic waste (e.g. food or green waste) is biodegraded by naturally occurring bacteria in a sealed tank in the absence of oxygen. This process produces a 'biogas' and an organic residue called 'digestate'. The biogas is captured, and the methane is cleaned and can then be used in a variety of ways, including in a gas engine, to produce electricity and/or heat; compressed and used as a vehicle fuel; or injected into the national gas transmission system. The 'digestate' can potentially be used in a number of land applications (mainly farming but also restoration and landscaping) depending on its nutrient content and level of stability. However, its use is restricted when mixed wastes are used as an input due to the risk of contamination.
- **Mechanical Biological Treatment (MBT) -** a generic term for a combination of mechanical equipment (similar to that used in a materials recycling facility to physically separate different materials fractions) and some biological treatment element (aerobic with air or anaerobic without air to biodegrade or biodry the organic fraction of the waste).
- **Mechanical Pre-Treatment -** combines a number of screening/ mechanical sorting techniques to extract a small amount of additional recyclate from residual municipal waste. It should be noted that this recyclate will generally be of a lower quality than that collected during front end materials recycling and it is not intended to replace that system but to enhance recycling rates where necessary.

6.5.2 Of these options, grate fired combustion was considered optimal for the Proposed Development for the reasons discussed below.

6.5.3 Thermal treatment is assessed primarily on technical performance including minimising pollutant emission to air and water and maximising energy recovery. In respect of gasification/ pyrolysis and other advanced techniques, the available technologies do not currently demonstrate environmental benefits and may in some cases recover less energy than conventional combustion techniques.

6.5.4 Non-thermal technologies such as anaerobic digestion and MBT are complimentary to rather than a replacement for thermal treatment since they can only treat the organic fraction of the waste, and the inorganic part (e.g. plastics) would require separate treatment.

6.5.5 Mechanical pre-treatment is suitable for extracting additional recyclable materials in waste prior to energy recovery using thermal treatment. The layout of the Proposed Development allows for the potential future installation of a materials recovery facility (MRF) using mechanical pre-treatment so as to recover additional recyclables. However this does not form part of the Proposed Development; if required this would be the subject of a separate planning application.

6.6 Consideration of Alternative Designs and Design Evolution

6.6.1 During the design of the Proposed Development, a number of design iterations and design alternatives have been considered to avoid, reduce and/ or remedy potential environmental effects and the proposed design has been consulted upon with relevant consultees. Table 6.2 summarises the design iterations of note that have taken place during the design and throughout the EIA process and the reasons for the iteration, and noting where the change related to reducing potential impacts on the environment or sensitive receptors, having regard to the requirements of the EIA Regulations noted at the start of this Chapter.

Table 6.2: Summary of Design Evolution

DESCRIPTION OF DESIGN ELEMENT	SUMMARY OF OPTIONS CONSIDERED	COMPARISON OF ENVIRONMENTAL EFFECTS	OUTCOME
Site access	Various options for access were considered, including: - access via the existing SHBPS entrance; and - a new dedicated access from South Marsh Road to the east of the SHBPS entrance (at various locations along the northern boundary of the Site).	Both access options would introduce additional traffic to South Marsh Road, but the new dedicated access would minimise disruption to the existing SHBPS's operation. New dedicated access would require widening of an existing ditch culvert with potential for adverse effects on water vole and surface water quality during construction, but these can be mitigated by temporary pre-construction displacement of water voles from the working area (if any are present) and good construction practice to prevent surface water pollution. The position of the proposed new access has been identified with consideration of proximity to the existing SHBPS entrance and access to other neighbouring sites including Synthomer, NEWLINCS, farmland and Humber Estuary flood defences, to minimise the potential for disruption.	A new access to be developed from South Marsh Road in the north-east of the Main Development Area, to minimise disruption to the SHBPS's operation.
Site layout	Various layouts have been considered throughout the design evolution, all of which located the	Layouts that would not allow an offset between buildings and the ditches around the Site would	The Proposed Development layout has been optimised to include a 5 m offset between ditches and

DESCRIPTION OF DESIGN ELEMENT	SUMMARY OF OPTIONS CONSIDERED	COMPARISON OF ENVIRONMENTAL EFFECTS	OUTCOME
	main development away from the Humber Estuary so as to minimise the potential effects on the habitat. The various layouts have included different configurations for buildings, structures and internal access arrangements, with consideration of the need to: - allow suitable offset distance from the ditches in the north and south of the Site to reduce impacts on water vole; - avoid siting buildings and structures above the SHBPS underground cooling water pipes where possible; - avoid occupied buildings being located within the Health and Safety Executive (HSE) Inner Zone around nearby hazardous installations; and - achieve operational functionality.	require water voles to be translocated prior to construction, whereas layouts including a suitable offset would minimise effects on water vole and not require translocation. There are no notable differences in environmental effects between layouts in relation to the underground cooling water pipes, HSE consultation zones and operational functionality.	buildings/ internal access roads (with the exception of the ditch crossing), avoid siting buildings/ structures above the cooling water pipes where possible, avoid the administration/ office building being located in the HSE Inner Zone, and maximise operational functionality.
Stack height	Stack heights of 90 m and 100 m were considered with regards to the dispersion of air pollutants.	A 100 m stack would provide better dispersion of air pollutants than a 90 m stack, avoiding potential for significant adverse effects on human or ecological receptors (including the Humber Estuary). A 100 m stack would have a slightly larger Zone of Theoretical Visibility	Following completion of the air dispersion modelling a stack height of 100 m was identified as required to mitigate significant environmental effects on sensitive ecological receptors.

DESCRIPTION OF DESIGN ELEMENT	SUMMARY OF OPTIONS CONSIDERED	COMPARISON OF ENVIRONMENTAL EFFECTS	OUTCOME
		(ZTV) compared to a 90 m stack, although the landscape and visual effects would not be significantly different.	
Cooling technology	Water, hybrid and air cooling have been considered.	Water and hybrid cooling technologies would have a large water demand (which air cooling would not). This would require upgrading of the existing SHBPS cooling water pumping station (potentially requiring works in the Humber Estuary, with corresponding effects on the habitat) and either an increase in the permitted abstraction volumes from the Estuary, or a new groundwater borehole and abstraction licence, both of which would have water resources implications. Air cooling technology would generate more noise than water cooling and is typically slightly less efficient.	Air cooling is considered to represent the Best Available Technique (BAT) for the Proposed Development because it would not affect water resources or directly affect the Humber Estuary and the slight loss of efficiency is minimal for the cooling demand of the Proposed Development. Air cooling therefore chosen as the cooling technology.
Sizing of Proposed Development	The size of the Proposed Development is a commercial consideration based on the anticipated availability of fuel and construction costs.	The larger the Proposed Development the greater the potential for significant adverse air quality, noise, traffic, ecology, landscape and visual and waste effects, but the lesser the potential for significant beneficial socio-	The Proposed Development will be capable of a fuel throughout of up to 753,500 tonnes per annum with an electrical export of up to 49.9 MW, taking account of potential fuel availability. In general the maximum size of the

DESCRIPTION OF DESIGN ELEMENT	SUMMARY OF OPTIONS CONSIDERED	COMPARISON OF ENVIRONMENTAL EFFECTS	OUTCOME
		economic effects.	Proposed Development is assessed as this represents the 'worst case' in terms of environmental impacts (with the exception of the socio-economics assessment which considers a single stream development to be a 'worst case' because it would generate less employment and economic benefits).
Potential phasing of the Proposed Development	For commercial reasons, the Proposed Development (two streams) may be built in two phases, or a single stream development may be built.	As for the discussion above regarding the size of the Proposed Development, a single stream development would potentially have less air quality, noise, traffic, ecology, landscape and visual and waste effects but also lesser beneficial socio-economic effects. Constructing the two stream development in a single phase would generate slightly increased potential for air quality, noise and traffic effects during construction. Constructing a two-stream development in two phases would increase the duration of construction effects and disturbance.	In addition to allowing for flexibility in the size of the Proposed Development as discussed above, flexibility is allowed in the layout and single/ two construction phase options are considered within this ES. In general as construction of the two stream development in a single construction phase would require the most intensive level of activity this is considered to represent the 'worst case' in terms of environmental impacts.

6.7 Conclusions

6.7.1 Following the selection of the preferred site, consideration of alternative technologies, and design evolution process, with consideration and comparison of environmental effects at each stage of this process, the form and approach to the Proposed Development has been identified and has been taken forward for assessment in this ES.