4.0 DESCRIPTION OF THE DEVELOPMENT PROPOSALS AND ALTERNATIVES CONSIDERED

4.1 Introduction

4.1.1 This section provides a description of the intended layout and design of the Sleaford REP, together with details regarding its construction. It also outlines the processes that would take place at the facility and sets out the alternatives that have been considered.

4.2 Intended Layout and Design of the Proposed Development

4.2.1 The Sleaford REP development would be based around four main buildings comprising the turbine and boiler hall (circa 2,550m2 and 29.2m high), two straw storage barns (circa 3,160m2 each and 15.3m high) and a wood storage building (circa 532m2 and 14m high). These four buildings would be linked by a series of high level conveyors. In addition, there would be stack (chimney) of 60m in height. The development would also include the following ancillary / infrastructure elements:

- an air cooled condenser;
- a vehicle weighbridge;
- offices, control room and staff welfare facilities;
- site fencing and a security barrier;
- external hardstanding areas for vehicle manoeuvring / parking;
- internal access roads and car parking;
- radiator fans;
- sedimentation tank;
- water tank;
- bottom ash storage and transfer area;
- transformers;
- silos;
- surface water drainage attenuation basins;
- extensive new areas of landscape planting.

4.2.2 The disposition of these elements is shown on Figure 4.1 (the Site Layout) and Figures 4.2 and 4.3 (Site Elevations). Elevations of the buildings are shown on Figures 4.4 – 4.9 inclusive.

4.2.3 The facility would have an electricity generating capacity of 40MW and would use circa 240,000 tonnes per annum of biomass, consisting primarily of baled straw sourced from the local area.

4.2.4 This sub-section describes the intended layout and design of the proposed development under the following headings.

- design philosophy;
- landscaping;
- employment;
- access;
- drainage;
- lighting;
- construction;
- security fencing and gates
- car parking.

Design Philosophy

4.2.5 Eco2 has appointed award winning local architects, RPS Burks Green (who specialise in large scale industrial architecture) to design the facility. RPS Burkes Green is proposing a landmark architectural solution which seeks to integrate the built form of the REP with a holistic landscape solution.

4.2.6 The rationale behind the chosen design / architectural solution is outlined below under the following headings:

- layout;
- scale;
- appearance.

Layout

4.2.7 The layout of the individual buildings and access to them has been designed to take into account various operational constraints in relation to the functional requirements of the facility.

4.2.8 For safe and efficient operation, the facility will have an internal vehicular circulation road that will allow the delivery of fuels and the export of ash residue. A perimeter one-way system will be operated on the site to link all the building functions. Leading from the perimeter circulation road will be access spurs and service areas located as appropriate to serve the particular operational areas / processes.

4.2.9 The straw barns require constant access for straw laden trailers in a double lane format without causing disruption to other vehicular movements. The arrangement of the buildings therefore takes into account the manoeuvring space of long trailer vehicles.

4.2.10 Biomass fuel (i.e. straw / wood chip) will be transferred to the boiler house by a series of enclosed, overhead conveyors. The conveyors will be at a sufficient height to allow the continued circulation of vehicles throughout the site.

4.2.11 In connection with the operation of the boiler and turbine, certain equipment associated with the process is located externally. The siting of this equipment is intrinsic to the function of that process.

- the air cooled condenser is a large item of plant which cools the circulating water to an acceptable temperature, for re-introduction into the heat exchanger. The equipment requires significant volumes of air and is therefore raised on legs to achieve sufficient air flow;
- the storage silos hold lime and ash residue. The latter is exported for recycling as fertiliser. The lay-by is necessary for the loading of export lorries;
- the filters are components necessary for flue emission control;
- the flue stack is for the emission of the treated gases and is no higher that is required to comply with legislation;

- the transformers are located close to the high voltage switch gear and form the primary connection point to the local electricity supply network.

Scale

4.2.12 The design of the Sleaford REP has been based around a compact building arrangement which is aimed at minimising the overall scale of the facility. The total gross internal floor area of the buildings 10,596m2 which is allocated as follows:

Building Element		**Area (m^2)**	**Area (ft^2)**
Straw Barn 1		3,160	34,014
Straw Barn 2		3,160	34,014
Wood Storage		532	5,726
Boiler House / Turbine Hall		2,550	27,448
Offices, Workshop, stores and plant	Ground Floor	599	6,447
	First Floor	595	6,404

4.2.13 The volumes of the individual buildings have been determined to be sufficient to satisfy the spatial requirements of the process equipment. The height of the tallest building, the Boiler House, is dictated by the process equipment that it houses. Low pitched roofs have been adopted on all buildings to keep the ridge heights as low as possible and minimise overall building heights. The roofs would be curved to soften the visual impact of the buildings and create an aesthetic link with the landscape bunding and planting.

Appearance

4.2.14 The REP is made up of a series of simple forms that respond to the functional requirements of the internal processes. The overall image created is one of a contemporary modern industrial facility that offers architectural character and aesthetic quality through the use of visually strong materials.

4.2.15 The main focus of this application has been to reduce the actual and perceived height of the development, achieved in a number of ways:

- The buildings are arranged as simple cubic forms strengthening building massing;

- Internal clear heights have been dictated by the minimum functional requirements;
- A simplifying of building form with the inclusion of a repeated ‘L’ shape that is recognisable in every building and increases readability whilst reducing scale and visual clutter;
- Roof overhangs and exposed steelwork at the eaves level have been omitted, allowing the forms to be lost against the skyline as much as possible; and
- The silos and air cooled condensers are screened with louvers or mesh fence which helps link the elements whilst reducing overall impact.

4.2.16 The composition of the elevational treatment has a strong horizontal emphasis using different types and proportions of vertical and horizontal cladding material that help to break-down the scale of the large buildings.

4.2.17 The elevational treatment of the buildings has been designed to minimise visual impact, through consideration of the juxtaposition of the buildings with each other and their integration into the landscape.

4.2.18 The strategic use of feature western red cedar timber cladding to the upper level of the office block provides a response to the adjacent existing woodland to the eastern boundary. Timber cladding also delivers a visual contrast from the other buildings as well as differentiation of function. Timber as a material in this context makes a striking visual statement as regards to the sustainable objectives of this project. The timber cladding will be maintenance-free and will weather over time to a greyish brown colour after approximately 1 year.

4.2.19 The cladding materials chosen are of a high quality and are appropriate for large industrial buildings. The finishes of the proposed panels are durable and the colour coatings used achieve an industry standard design-life consistent with the life of the facility. This will ensure that aesthetic result remains suitable for an appropriate length of time.

4.2.20 Colour-coated metal sheeting will form the predominant cladding material to the various buildings. A standard palette of horizontally laid white profiled panels combined with vertically laid Alaska Grey profiled cladding will be used to give a consistent theme to the elevations comprising dark base colour to anchor the buildings whilst complimenting a lighter shade to merge with the skyline. Where glazing is provided it will comprise anthracite powder-coated frames with tinted glass.

4.2.21 Notwithstanding the design proposed by the applicant, all colours and materials could be made subject to agreement with the LPA via a suitably worded planning condition.

Landscaping

4.2.22 A landscape scheme has been designed to mitigate visual impact through screening, assist in integrating (over time) the development into the wider landscape and to create valuable new areas of habitat for wildlife. Soil bunds of around three to four metres in height will be formed along the north, south and west boundaries utilising materials excavated wholly from within the site. This sustainable re-use of resources will prevent unnecessary disposal and heavy goods vehicle movements. The bunds will be planted with over 10,000 locally appropriate native trees and shrubs which will mature to provide an effective screen of both the operational activities on site and a substantial proportion of the built form. The new woodland and scrub areas will link with the established site of nature conservation interest (Birch Wood SNCI) which adjoins the site and provide a new wildlife corridor. Approximately a hectare of wildflower rich calcareous grassland will also be created.

4.2.23 Off-site planting is proposed that will serve to limit views of the Sleaford REP as one travels from Sleaford along Boston Road. Further off-site planting is also proposed, to take the form of several discrete copses to the east of the development site. This will break up the distant views experienced by residents on the west side of Church Lane in Kirkby-La-Thorpe.

Employment

4.2.24 During the operation phase, the following permanent jobs would be created:

operational staff	5 shifts of 4 jobs each (20 in total)
administration and management staff	approximately 10 jobs
baling, management and haulage of straw	approximately 50 jobs
Total	approximately 80 jobs

4.2.25 It should also be noted that further (temporary) employment opportunities might be available during the construction of the facility.

4.2.26 Further details of the employment impacts of the proposals are provided as Appendix 4.1 in Volume 2 of this ES.

Access

4.2.27 The site is currently in agricultural use. Site vehicular access is therefore limited to existing field access points from Boston Road to the south. No formal hard surfaced access is currently available.

4.2.28 Vehicular access to the proposal site would be taken from Boston Road via a new industrial standard access junction located in the south eastern corner of the site. The proposed layout of this new access would be based on a traditional simple T-junction arrangement (see Figure 10 of the Transport Statement contained within Appendix 6.1).

4.2.29 At the request of LCC highways officers, the proposed site access junction layout has been designed to discourage large goods vehicle movements associated with the Sleaford REP facility from attempting to use the section of Boston Road to the west of the site. This has been achieved through the use of suitable geometric design parameters within the layout such as width restrictions on exit lanes and limited entry / exit turning radii. Such a layout strategy accords with the proposed routeing agreement developed to manage operational movements to / from the site and also assists in reinforcing the existing height / weight restrictions associated with the limited height railway bridge to the west of the site. It is anticipated that the combination of the proposed access design, routeing agreement and bridge height limit will result in no HGV's associated with the Sleaford REP proposal site entering Sleaford Town Centre via Boston Road.

Drainage

4.2.30 Surface water runoff generated by the development would be collected via a separate system of below-ground sewers. Paved areas such as car parks, access roads and hardstandings would be served, as appropriate, by Environment Agency approved oil separators/interceptors.

4.2.31 The resulting flows would be discharged into a dry, on-line attenuation basin located close to the site's northern boundary. This facility would be designed to accommodate a storm event with a statistical frequency of 1 in 100 years (plus an allowance for climate change) and to regulate flows to rates equivalent to 'greenfield' conditions that, ultimately, would be discharged into the adjacent land drainage system.

4.2.32 The proposals also involve an element of 'rainfall harvesting' which would collect water for use in the renewable energy process and wash-down activities.

4.2.33 Foul effluent generated by the proposed development would be collected via a separate system of below-ground sewers and conveyed to the existing public sewer system serving the area.

4.2.34 Depending upon the final design solution adopted and, in particular, the available depth to the receiving sewer system, it may be necessary to introduce a proprietary pumping station to transfer effluent to the public sewer network.

Lighting

4.2.35 As stated above, once commissioned the Sleaford REP would operate on a continuous basis. During hours of darkness there would be a need for a degree of illumination to ensure a safe working environment for operatives on site. The lighting proposals would be as follows:

- there would be no building mounted lights and no lighting of external façades;

- lighting of external yard and parking areas would use modern flat glass high pressure sodium (or similar) lanterns which achieve full 'cut-off', meaning that all of the light shines down with minimal upwards or sideways spill. The lit surfacing would not materially extend beyond the operational boundary of the site;
- the full external lighting system would only operate during hours of darkness (i.e. in winter) when vehicle deliveries are occurring, this being during the normal working day. After this time the main lighting would automatically be switched off. In order to cater for the health and safety needs of night shift workers at the plant, a reduced, low level lighting system would remain in operation after dark, utilising low level lanterns and restricted to required walking routes and staff parking areas;
- similarly, internal building lighting to the upper floors of the proposed office accommodation, which would be vacant outside of the normal working day, would incorporate intelligent lighting control systems and as such would switch off after operational hours;
- the internal operational areas of the REP would be lit to provide a safe working environment according to task in specific working areas, rather than to provide a consistent light level. This approach would ensure that light spillage from within the plant would be kept to a minimum;

4.2.36 It should be noted that any impact of the proposed lighting scheme beyond the site boundaries would be further mitigated by the landscaped screening bunds.

4.2.37 It is suggested that full details of a lighting scheme be controlled by way of a suitably worded planning condition.

Construction

4.2.38 Construction of the Sleaford REP and associated infrastructure would involve typical / standard construction practices, with specialist fit-out on the boiler house.

4.2.39 The building shells are likely to be constructed upon piled foundations (this is the assumption used in predicting construction impacts). The buildings themselves would be steel framed structures with the external envelope formed from a combination of masonry blocks, cold rolled sheeting rails, timber and metal cladding and glazing. The roofs of the buildings would be constructed of cold rolled perlins.

4.2.40 External hardstanding and roads would be a combination of bitmac and concrete construction, with the actual specification depending upon vehicular usage.

4.2.41 From commencement of site operations, the total construction, fit-out and commissioning period is likely to be approximately 30 months.

Security Fencing and Gates

4.2.42 The REP complex perimeter would be secured by a 3.0 metre high weld mesh boundary fence (e.g. Betafence Securifor 358 high security fencing) with matching lockable steel gates to provide means of access. All fencing would be dark green in colour.

4.2.43 Further security would be provided by virtue of a CCTV monitoring system.

Car Parking Provision

4.2.44 Twenty car parking spaces will be provided on the site to accommodate a regular requirement for twelve spaces and an overspill of eight spaces to allow for visitors, shift overlap and annual maintenance periods. At least one disabled car parking space would be provided. A shelter with a capacity of ten spaces would also be provided for bicycles and motorcycles.

4.2.45 Designated lorry parking spaces are not considered necessary. Any temporary / short-term requirement for lorry parking can be accommodated within the service yards and circulation roads provided.

4.3 Proposed Site Operations

4.3.1 For the purposes of this description, it is helpful to consider the process as a combination of two interlinked systems:

- the combustion line, consisting of fuel storage, fuel feeding, combustion, flue gas treatment and ash handling; and
- the water / steam cycle, comprising the steam raising heat exchangers, the steam turbine generator and the air-cooled condensers.

4.3.2 The two systems above are linked at the furnace, where heat released by burning the fuel is transferred to water / steam cycle in various heat exchangers. The process description is shown on Figure 4.11.

The Combustion Line – Fuel Handling

Vehicle Access / Egress – All Fuel

4.3.3 All lorries accessing the site would use a swipe card system or similar to raise the security barrier at the site entrance. All HGV movements from the site will turn left onto Boston Road.

Straw Deliveries

4.3.4 Straw will typically be delivered in the form of Hesston bales. These bales will be delivered in large loads on HGVs with flat bed trailers, normally carrying three layers of 12 bales or 36 bales per load. Once on site, lorries will be directed to one of the two straw barns. The lorries would not need to pass over the weighbridge at the site entrance as straw is weighed as it is lifted off the cranes in the straw barns.

4.3.5 Each straw barn contains two overhead cranes which are capable of unloading two lorries at the same time. The specially designed cranes contain 6 pairs of grabs that remove a layer of 12 straw bales at a time. Each grab records the weight and moisture content of their particular bales for stock control and payment purposes.

4.3.6 The cranes may, if required, unload a lorry directly to the straw conveyors to feed into the furnace. However, fuel is normally stored within the fuel hall until required. Each straw barn is capable of storing enough bales for 36 hours operation, giving 72 hours storage overall.

4.3.7 An unloaded lorry will be swept clean of any remaining straw within the straw barn, prior to leaving the site.

Wood Deliveries

4.3.8 Wood will be delivered in chip form in bulk tipping lorries. Wood lorries will drive onto the weighbridge situated just beyond the automatic entrance barrier and their gross weight will be recorded. The lorry will then travel to the north of the site, via the perimeter road, and enter a manoeuvring space in front of the wood chip storage building main doors.

4.3.9 The wood chip storage building would have sufficient space to enable two lorries to stand side-by-side in front of a push floor system. The push floor carries wood chip from the front of the stockpile to the rear of the building and onto the fuel feeding system for the combustors.

4.3.10 Wood chips are stored in a stockpile directly on top of a push floor mechanism that delivers the chips into the feeding line (described later). Lorries will reverse into the wood chip storage building, up to the wood chip pile and tip directly onto the front face of the wood chip pile.

4.3.11 Wood chip is not intended to be the primary fuel for the plant. As such, it is only expected to be consumed during the day and only limited storage capacity is required. The store will hold approximately 300 tonnes (t) of wood, which is sufficient for 10 hours' operation at the maximum wood fuel feeding rate.

4.3.12 Lorries that have discharged their loads will drive forward out of the wood chip storage building and turn down the eastern perimeter road. They will be weighed at the weighbridge before leaving the site in order that the net weight of the load can be calculated.

Fuel Feeding

4.3.13 Each straw barn contains two cranes. Each crane is capable of carrying 12 bales at a time out of the fuel hall and onto a fuel conveyor that carries the fuel.

4.3.14 The fuel conveyor transfers the bales onto one of four fuel feed systems, which are enclosed, inclined conveyors. At the entrance to the fuel feed systems are seal gates which limit air flow into the system to minimise the risk of fire. The feed systems are also equipped with fire fighting nozzles. Towards the top of the fuel feed system is a dosing conveyor that controls the rate at which straw is fed into the onward feeding system. Immediately after this is a twine cutter that cuts the string binding the bale in preparation for the next stage.

4.3.15 At the top of each fuel feed conveyor there is a scarifer, which breaks up the straw bales and chops up the stalks in readiness for combustion. The straw drops down through a damper onto a screw conveyor, called the stoker that pushes straw into the combustion chamber through a fire damper and water-cooled duct. This feeds the fuel into the conveyor at a controlled rate whilst maintaining an airtight seal.

4.3.16 Wood chips would be tipped directly onto a push floor that uses a hydraulic system of raised bars to drag the wood chip to the rear wall of the wood chip storage building. Here wood chips would enter a feed chain that incorporates screening for over-size material and a magnetic separator for the removal of ferrous metal.

4.3.17 Wood chip is then transferred to the boiler house via an enclosed, inclined conveyor where it is fed into the straw feeding system at the scarifiers. The fuel feed system for both baled straw and wood chip is shown on Figures 4.12 and 4.13.

The Combustion Line – The Furnace

Combustion

4.3.18 Straw, or a combination of straw and wood chips, are burned on a water-cooled vibration grate that is specially designed to ensure high burn-out of such fuels, with low emissions, whilst ensuring the safe transport of ash towards the end of the grate where it can be handled effectively.

4.3.19 The grate is water cooled, which is ideal for dry, volatile fuels such as straw by virtue of the fact that up to 100% the combustion air can be supplied above the grate (with no air required to cool the grate itself).

4.3.20 Air is blown into the furnace at various points to ensure complete combustion of the fuel while minimising the formation of nitrogen oxides that would otherwise have to be removed during flue gas treatment.

4.3.21 Auxiliary fuel burners (probably fired by natural gas) would be installed in the furnace. These would only be used during start up to raise the temperature of the boiler before any biomass is burned, thus ensuring that emissions from the plant stay within regulatory limits.

4.3.22 The end of the grate is sealed by a water bath containing a submerged conveyor onto which ash drops. The conveyor transfers the ash to an ash storage room. Ash is periodically removed from this room and onto a lorry for removal from site using a front-end loader.

Heat Exchange

4.3.23 The furnace is surrounded by water tubes which form the primary heat exchanger in which water is converted to steam. The combustion gases themselves flow around the furnace structure up and down through several passes. The temperature in the furnace is around 1100ºC; as the combustion gases pass through the various passes of the furnace they transfer their heat to other heat exchangers that are arranged within the furnace passes. These heat exchangers are described in the water / steam cycle description (see below). The last heat exchangers transfer heat from the combustion gas into incoming combustion air pre-heaters, offering further increases in the overall efficiency of the process.

The Combustion Line - Flue Gas Treatment

4.3.24 Lime is injected into the flue gas stream after it leaves the furnace. This reacts with and thus removes any acid gases in the flue gas, principally HCl (hydrogen chloride) produced from the small amount of chlorine that is naturally present in biomass fuel.

4.3.25 The flue gases then enter a bag filtration house. Particles, including ash carried over from the furnace, reacted lime and any unreacted lime, collect on the surface of hundreds of filter bags while the flue gas itself passes through the bags. The bag filters are periodically cleaned and the solid residue drops into silos below the filter housing.

4.3.26 The final part of the flue gas train is the induced draft fan and stack. The induced draft fan pulls the flue gases out of the system and into the stack, the action of the fan, combined with the natural buoyancy of the warm gas and the height of the stack itself ensures good dispersion of the cleaned flue gases into the atmosphere. Emissions limits and consequent impacts on air quality are described in Section 11.0 of this ES.

4.3.27 Lime and fly ash is collected in silos following which it is transported off site by tanker for re-se as a fertiliser.

The Water / Steam Cycle

Steam Production

4.3.28 Water is pumped from the air-cooled condensers by the boiler feed water pumps into a feed water tank. This marks the start of the high-pressure side of the water / steam cycle (from the exit of the boiler feed water pumps to the entrance of the steam turbine).

4.3.29 Water from the boiler feed water tank passes to the steam drum (at the top of the boiler itself) via the economiser. The economiser is one of the heat exchangers located within the furnace. It is used to raise the temperature of the boiler feed water to boiling point whereupon; the water is transferred to the steam drum at the top of the boiler.

4.3.30 The steam drum is a vessel that holds boiling water and steam. The water sits in bottom of the steam drum and water flows from here through downcomers to the bottom of the furnace wall where it then circulates up the pipes which form the furnace wall. The water in the pipes absorbs heat from the furnace which turns some of it into steam and the water / steam mixture, being less dense than the cooler water behind it, rises to the top of the furnace and returns to the steam drum.

4.3.31 At the steam drum, water from the water tubes in the furnace is separated from the steam and returns to the boiler tubes once more. The steam leaves the top of the steam drum from where it passes to the superheaters. These are heat exchangers that are located in the path of the combustion gases in the hottest parts of the furnace and its subsequent passes. The superheaters use the hot combustion gases to raise the temperature of the steam to much higher than boiling point, resulting in very high quality steam at a temperature of 540ºC and a pressure of 112 bar. This steam is ready for use in the steam turbine.

Electricity Generation

4.3.32 Superheated steam from the last superheater passes into the steam turbine. The steam turbine converts the thermal energy in the steam into mechanical energy that rotates the turbine. The turbine turns the rotor in an electricity generator. This electricity is delivered, via a transformer and appropriate switchgear, into the distribution system of the regional electricity company.

The Air Cooled Condenser

4.3.33 Steam leaves the steam turbine at low temperature and pressure. This steam must be condensed back into water before returning to the boiler. This is achieved in an air-cooled condenser, in which the steam flows through a series of pipes; air is blown over these pipes and this cools and condenses the steam.

4.3.34 The water that leaves the air-cooled condenser returns to the boiler feed water pumps and so the water / steam cycle begins again.

Operating and Maintenance Regime

4.3.35 The biomass plant is designed to operate continuously, 24 hours a day 7 days per week. Operational staff would be required to operate the plant around the clock on a 5-shift pattern, Monday to Sunday. There would be 4 staff per shift.

In addition, 10 other office / administration staff would work a normal working day, typically 8.30am to 5pm, Monday to Friday.

4.3.36 Plant maintenance shall be required once a year, halting the operation for a period of two weeks (typically scheduled during the summer).

4.3.37 Fuel delivery periods shall be limited to:

- 0700 to 1900 hrs from Monday to Friday;
- 0800 to 1400 hrs on Saturdays

No fuel deliveries shall be accepted on Sundays or public holidays

4.4 Alternatives Considered

4.4.1 The requirement to consider alternatives stems primarily from the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. Schedule 4 of the Regulations identifies the information for inclusion in Environmental Statements. Parts 1 (2) and 2 (4) include:

"An outline of the main alternatives studied ………. And an indication of the main reasons for his choice, taking into accounts the environmental effects".

4.4.2 Paragraph 83 of Circular 2/99 which accompanies the Regulations notes that:

"Although the Directive and the Regulations do not expressly require the developer to study alternatives, the nature of certain developments and their location may make the consideration of alternatives a material consideration…."

4.4.3 The appraisal of alternatives includes:

- alternative locations / sites;
- alternative designs;
- alternative technologies.

The consideration of each has been outlined below.

Alternative Locations / Sites

4.4.4 It is Eco2's policy to carry out a comprehensive site search exercise in order to ensure, where practical, that any such development is located in accordance with accepted planning criteria. This exercise has been completed notwithstanding current Government policy stating that applicants no longer have to demonstrate the need for their renewable energy proposal to be sited in a particular location.

4.4.5 The site search exercise has adopted a sequential approach whereby preference is given to developing appropriately allocated and brownfield sites, prior to development in other locations. The approach Eco2 has followed recognises that where development is not proposed on allocated or brownfield land, the company may need to justify their choice of site.

4.4.6 A series of site search criteria have been developed which reflect the sequential approach. These were applied to a search exercise which encompassed both desk study and fieldwork. This work failed to identify any suitable, available sites on allocated employment land, or brownfield land; (all classed as Primary Sites).

4.4.7 Given the failure to identify any suitable Primary Sites for the renewable energy plant, it was necessary to extend the site search exercise and consider alternatives locations (Secondary Sites) that best meet the site selection criteria.

4.4.8 Following further evaluation it was concluded, for reasons set out within the report, that a plot of land off Boston Road, on the eastern periphery of the Sleaford settlement, (the site of the current application) best met the relevant criteria.

Alternative Designs

4.4.9 With regards to alternative designs, prior to selecting the current proposals, the consultancy team developed a number of design options, the preliminary versions of which were discussed with the Council during pre-application consultation.

4.4.10 Options that were considered and discounted included:

- alternative building orientations and configurations;
- alternative boundary treatments (i.e. fencing, bunding and landscaping);
- alternative arrangements for the access road;
- alternative building materials.

4.4.11 The applicant is aware that the only existing straw fired power station in the UK, at Ely in Cambridgeshire, has been sunk into a pit approximately 8m deep as a means of reducing its visual impact. A similar approach was considered, but rejected, for Sleaford REP. The reasons for this were:

- The high water table at the development site would have made it impractical to engineer the excavations;
- There was insufficient space to offer suitable inclines for delivery vehicles that would need to descend into the pit from Boston Road upon arrival and climb out of the pit to reach Boston Road when leaving the site;
- The overall land required to accommodate the proposals would have increased significantly once appropriate gradients are applied at the side of the excavation (for example a minimum practicable slope of 1:3 for a 8m deep plant would have extended the size of the plot required by 24m in all directions, before landscaping).

In conclusion it was decided that it would be better to focus on good quality building design, landscaping and planting as mitigation measures for visual impact rather than the approach used at Ely.

4.4.12 Following discussions and further assessment, between the consultancy team the present scheme was adopted as:

- it maximises screening of operational activities from the nearest and most sensitive receptors;
- it provides the optimum vehicular access solution;
- it benefits from the use of sympathetic building materials (including timber panelling);

- It is based around a compact building arrangement aimed at minimising the overall scale of the facility;

4.4.13 Based upon the above, the current scheme is considered to be the most preferable option in terms of site specific location and design.

Alternative Technologies

4.4.14 The generation of electricity from biomass is an established, proven renewable energy technology whose development is supported by Government Policy. The Sleaford REP uses straw which is readily available, in excess quantities, in the East of England (recognised in the UK Biomass Strategy – May 2007). Biomass based renewable energy production from crops within the East Midlands is supported by the Regional Spatial Strategy and the Lincolnshire Structure Plan.

4.4.15 Given the aim of generating electricity from straw, there were two main choices concerning the technology to be employed. These were: (a) the thermal process used to generate electricity and (b) the generating capacity.

4.4.16 A great deal of research has been undertaken that reviews the feasibility of various generating cycles based on biomass fuels. The conventional approach is to burn the fuel to raise steam for use in a steam turbine; other options involve the use of conversion technologies, pyrolysis or gasification, which turn the biomass fuel into a liquid or gaseous fuel. The theory is that these intermediate fuels can then be burned more efficiently in internal combustion engines or gas turbines. The reality is that most if not all of the efficiency gains from burning the intermediate fuel are lost in the fuel conversion process. Moreover, the advanced technologies are relatively unproven and present more risk to third parties that might otherwise fund the project. For these reasons, the applicant decided to adopt the proven combustion and steam turbine process.

4.4.17 With regard to scale of the development, all biomass-based generating technologies offer significant economies of scale as plant capacity increases. These are eventually outweighed by the costs of transporting fuel ever increasing distances to supply plants as they get larger. Smaller plants, with an output of less than 5 MWe can sometimes be made viable by sharing overheads with existing infrastructure but this is unlikely in the case of straw because of the expensive bespoke equipment required to store, handle and feed straw bales into a combustion unit. At the larger scale, the optimum balance between capital and operating cost savings and the cost of fuel is achieved at around 30-40 MWe.

4.4.18 In light of the above, the Applicant proposes to build a 40MWe combustion / steam cycle straw-fired power station.