Ford | energy from waste

FORD ENERGY RECOVERY FACILITY AND WASTE SORTING AND TRANSFER FACILITY, FORD CIRCULAR TECHNOLOGY PARK

ENVIRONMENTAL STATEMENT

CHAPTER 4

ALTERNATIVES

4

Viridor

GRUNDON

4 Alternatives

Introduction

4.1 This chapter examines the significant alternatives considered during the development of the proposed Ford ERF and WSTF, including: combustion technologies, site layouts, building design, ground levels, building materials and drainage solutions.

Legislation and guidance

4.2 The consideration of alternatives is central to the EIA process. In many cases, adverse environmental effects can best be avoided through consideration of alternative means of achieving a development proposal, such as different sites, layouts, and / or means of access.

4.3 The EIA Regulations provide guidance on the need for and content of an EIA. With regards to alternatives, Schedule 4 (Part 2) of the EIA Regulations states that ESs should include:

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

4.4 Paragraph 035 (Ref ID 4-035-20170728) of the Ministry of Housing, Communities and Local Government's on-line EIA guidance states that:

> "*Where alternative approaches to development have been considered, the Environmental Statement should include a description of the reasonable alternatives studied which are relevant to the proposed development and its specific characteristics and provide an indication of the main reasons for the choice made, including a comparison of the environmental effects (see regulation 18(3)(d)).*

Alternative combustion technology solutions

4.5 The following alternative combustion solutions have been considered for the ERF:

- Advanced thermal treatment
- Conventional combustion systems

Advanced thermal treatment

4.6 There are two types of advanced thermal treatment facilities:

- Pyrolysis
- Gasification

4.7 With regard to pyrolysis there is limited experience of successfully processing residual waste at the proposed waste processing capacity. Therefore, this is not considered to be a proven technology for the Ford ERF.

4.8 Gasification technologies are sensitive to the nature and composition of the waste being treated. To operate gasification facilities efficiently requires both a consistent feed stock and a certain proportion of different waste types. As such, gasification is limited in its flexibility to deal with the potential variation in the composition of the residual municipal solid waste that would be treated at the Ford ERF. The applicants do not consider that gasification technology is proven at the proposed capacity for the Ford ERF.

Conventional combustion systems

4.9 Direct waste combustion in a conventional EfW facility with combined heat and power (CHP) is a proven technology capable of delivering a flexible and sustainable waste management solution. EfW is used throughout the UK and Europe for the management of municipal solid waste (and similar commercial and industrial wastes) and is established as an efficient way to recover energy, especially where CHP can also be delivered from the plant. The technology is, by a very significant margin, the most widely deployed waste recovery solution in Europe (with over 500 operating plants). A conventional EfW facility would be capable of managing the predicted waste volumes and would effectively treat the likely composition of the waste predicted to be managed at the proposed facility. Given the technology is well proven it is also significantly less complex to fund. Furthermore, with developments in conventional combustion technologies in recent years, it has led to significant improvements in efficiency and that such facilities are now fully ‘circular’, with the residues from the process being 100% recoverable, with no residues being transferred to landfill. On this basis, the use of a conventional EfW facility is considered to be the most appropriate waste recovery technology option currently available.

4.10 Conventional combustion EfW facilities can be delivered through a variety of sub-technologies and the applicants have considered these technologies, as summarised below.

Fixed hearth

4.11 This type of furnace is generally not considered to be suitable for the management of large volumes of mixed waste and is best suited to low volumes of consistent waste. As a consequence, this technology is not used for the combustion of municipal waste in the UK.

Pulsed hearth

4.12 Pulsed hearth technology has been used for municipal waste in the past, as well as other solid wastes. However, there have been difficulties in achieving reliable and effective burnout of waste and it is considered that the burnout criteria required by the Industrial Emissions Directive (IED) would be difficult to achieve.

Rotary kiln

4.13 Rotary kilns have achieved good results with clinical waste, but they are not commonly used in the UK for municipal solid waste (or similar wastes). The capacity of a single rotary kiln unit is limited to 8 tonnes per hour. Therefore, four rotary kilns would be required to fulfil the proposed waste processing capacity. Furthermore, the energy conversion efficiency of a rotary kiln is lower than that of a moving grate.

Fluidised bed

4.14 Fluidised bed technology has been used for municipal waste at a few sites in Europe. In the UK, there are only two operating facilities which are located in Dundee and at Allington in Kent. The former has a long history of significant operational difficulties.

4.15 Fluidised bed technology has a number of advantages over moving grate technology, including lower nitrogen oxide (NOx) formation, slightly higher thermal efficiency and the lack of moving parts within the combustion chamber. However, there are also a number of disadvantages:

- The waste stream needs to be homogenised and therefore would need to be pre-treated before feeding to the fluidised bed. This would lead to additional energy consumption and a larger building. The additional energy consumption tends to outweigh the combustion efficiency advantage.
- High fluidisation velocities can lead to the carryover of fine particulate material. This can lead to a higher particulate loading in the flue gases, so leading to higher quantities of flue gas treatment residues, which need to be disposed of as waste. However, the bottom ash tends to be of better quality.
- Although less NOx would be formed, secondary NOx abatement equipment would still be required to meet the emission limits imposed by the Waste Incineration BREF.
- The operational and capital costs of a fluidised bed are higher than the equivalent costs for a moving grate incinerator.
- Experience of fluidised bed plants in the UK has shown that they have a lower reliability than other EfW options.

Moving grate

4.16 This is the leading technology in the UK and Europe for the combustion of municipal and other similar wastes, being installed on approximately 90% of UK waste incineration facilities and some 98% of European incinerators. The applicants consider that moving grate is a proven technology from experience at the Lakeside EfW. Furthermore, there are a number of potential technology providers available to supply moving grate technologies. The various designs are proven to achieve the burnout requirements for compliance with the IED.

4.17 For the reasons set out above moving grate technology is proposed for the Ford ERF.

4.18 It is also worth noting that a front-end materials recycling facility (MRF) has not been included within the proposals for the Ford ERF as it is not considered to be a financially viable solution for the target residual waste market. The applicants will rely on source segregation of waste or segregation currently being undertaken at other waste management facilities who in turn will be contracted to supply non-recyclable waste to the Ford ERF.

4.19 Waste to be received at the WSTF will either be pre-sorted at source or will be subject to manual sorting and segregation upon arrival in preparation for bulking and onward transfer to appropriate waste management facilities. All non-recyclable waste leftover after sorting within the WSTF will be transferred to the ERF.

Alternative site layouts, building designs and materials

4.20 The development of the site layout has been informed by a number of factors, including the constraints and opportunities offered by the site, meeting the design objectives (as set out in the Design and Access Statement (DAS)) the requirement to ensure operationally efficient facilities and consideration of how to best mitigate the development's impact within its setting. With specific regard to the latter the key issues to be addressed were considered to be:

- Minimising the overall footprint of buildings and road infrastructure to maximise areas for landscaping
- Developing a proposed layout that would assist in mitigating the visual impact upon the identified landscape and heritage assets
- Locating the air cooled condensers (ACCs) in the south of the site and use the main building scale to best shield them from nearby noise receptors
- Centralising the highest parts of the ERF within the site to best mitigate the scale of the development from key nearby views and maximise areas for landscaping and bunding around the site's boundaries

4.21 It was accepted from the outset that the ERF and the WSTF would share the single access point in the south east corner of the site, as well as the entrance gatehouse and its weighbridge arrangement.

Stage 1 design evolution

4.22 In July 2020 an application (WSCC/036/20) was submitted to WSCC for the demolition of existing buildings and structures at the site, and the construction and operation of an ERF and a WSTF for treatment of municipal, commercial and industrial wastes, including ancillary buildings, structures, parking, hardstanding and landscape works.

4.23 Following consultation on the submitted application and discussion with WSCC officers, it was considered that the landscape and visual impact, together with the associated impact on the setting of designated heritage assets, was unlikely to be acceptable. WSCC also provided an EIA Regulation 25 request for further information.

4.24 A detailed re-design and analysis of the related technical issues was subsequently undertaken, and the proposals revised to take account of this feedback. Application WSCC/036/20 was then subsequently withdrawn on the submission of this new planning application.

4.25 The design development process sought to achieve a significant reduction in the height and mass of the buildings and an increase in space for landscape provision, with colours and materials that would help to reduce visual impacts, as well as further consideration of potential noise issues. This process is explained further below.

4.26 The first phase of work focussed on developing alternative arrangements and locations for the ERF and it was decided that in order to minimise the development footprint of the ERF, rather than adopt the most common linear arrangement for the waste reception hall, waste bunker, boiler hall, and flue gas treatment (FGT) hall / stacks, that either a U-shaped or L-shaped arrangement would need to be adopted. Site layouts were then developed for both options.

U-shaped

4.27 This option centrally located the ERF within the site and incorporated:

- The waste reception hall at the eastern end and boiler hall at the western end of the ERF
- The FGT hall and turbine hall rotated 180 degrees to run along the southern face of the boiler hall to form the ‘U-shaped’ arrangement
- A linear arrangement of ACCs running parallel to the south of the ERF
- Standalone administration and workshop buildings and car parking running parallel to the north of the ERF
- The WSTF facility to the west of the ERF
- Landscaped bunding along the site’s west, north, and east boundaries

L-shaped

4.28 The L-shaped option centrally located the ERF within the site and rotated it and the WSTF by 45 degrees on plan. It incorporated:

- The WSTF in the south western corner of the site and the ERF arranged with its waste reception hall at its south west end, and boiler hall at its north east end
- The FGT hall and turbine hall rotated 90 degrees to run to the south east of the boiler hall to form the ‘L-shaped’ arrangement
- A 3 x 2 arrangement of ACCs located south of the ERF and acoustically shielded between the bunker hall and the turbine hall
- Standalone administration and workshop buildings and car parking running parallel to, and north east of the ERF
- Landscaped bunding along the site’s west, north and east boundaries.

4.29 While both layouts successfully addressed the previously identified key issues, it was considered that the rotated L-shaped arrangement offered several benefits:

- The building's angled rotation maximised the areas that could be set aside for earth bunding and landscaping, particularly in the north west and north east corners, where mitigating the visual impact of the development to nearby sensitive receptors to the north east and north west was a key concern. Located along the site's western, eastern, and northern boundaries these areas would be capable of being bunded and in some areas up to 8 m in height in order to visually and acoustically shield nearby receptors from the site's low-level operational activities, particularly that of manoeuvring vehicles, and the buildings themselves. It has not been possible to provide a similar zone for bunding along the site's southern boundary due to the alignment of the access road into the site and the area required to incorporate the necessary entrance gatehouse and weighbridge arrangements. Sufficient area does, however, remain for planting and a timber acoustic fence to be included along that boundary
- The L-shaped orientation also enables the highest parts of the building to be set back from the site perimeter and the current and potential future receptors lying beyond these
- It uses the main part of the ERF building to best shield the ACCs from the same areas as well as being located away from the eastern boundary
- It best segregates the ERF and WSTF operations within the site
- It delivers a coherent traffic strategy which optimises the independent operation of the ERF and WSTF and maximises the adoption of one-way traffic systems and the safer right hand down reversing arrangement for HGVs across the site
- The layout's arrangement and road infrastructure offer the opportunity to explore lowering the ground level in the vicinity of the highest parts of the ERF

4.30 The L-shaped arrangement was then further refined and in order to better balance the allocation of landscaped areas across the site it was decided to increase the extent of landscaped bunding in the north east corner. In order to achieve this, the administration reception building and the workshop were relocated to the north west side of the ERF. This allowed the car park layout to be rationalised and this in turn increased the area available for landscaping in the north east corner.

4.31 As a result of reviews with the applicant's operations teams and with technology providers the footprints of both the ERF and the WSTF were revised, and the site layout adjusted accordingly and included:

- A widening of the main ERF building to accommodate internal technology arrangements
- A realignment of the ERF turbine hall to stagger the north east face of the building and assist in breaking up the scale of that facade
- A slight increase in footprint of the WSTF was made to ensure that the internal material storage bays were sufficiently sized to accommodate the required storage of material, but also the internal unloading / loading of HGVs

4.32 This stage of design development established a site layout which fully integrated the ERF and WTSF within a single overall masterplan and it was this principal layout that formed the basis for the development of the architectural design.

Stage 2 design evolution

4.33 The design team carefully considered how to best mitigate the visual impact of the proposed development when seen from key views and this determined the development of the architectural design.

4.34 The first stage of architectural design focussed upon the massing of the ERF building (this being the largest building) and was developed in parallel with the refinement of the site layout design to enable the potential visual impact of the development to be considered from the outset. A number of key viewpoints were identified, and the design has been largely informed throughout its development by the use of 3D modelling, photomontages and the feedback from the landscape and visual impact assessment (LVIA) work.

4.35 Whilst recognising that the internal process equipment and related activities dictate the minimum building envelopes required for the main ERF structures, how the design might be developed to best mitigate its visual impact was a key consideration. While accepting that it would be impossible to make a facility of this size ‘disappear’ it was important that alternative design approaches be considered at an early stage in the design evolution process in order to best minimise the scale of the development.

4.36 Initial massing studies of the proposed design were prepared using outline 3D (computer aided design) models. As the design was being developed in parallel with the LVIA assessment work, the views used to test the alternative approaches included a selection of ‘formal’ record photographs as well as ‘informal’ eye level views from key viewpoints and all were used to test the visual impact and appearance of the proposed design from near, mid-range and distant views from the surrounding area.

4.37 The importance of assessing the proposed development in elevated views from the South Downs National Park (SDNP) is well documented within the LVIA (see Chapter 12) however, once tested in visualisations it was considered that these views were too distant to be a main driver for determining the design of the buildings form, or the selection of materials and colour of the proposed cladding. For that reason, stage 2 of the design development focussed on reviewing the impact the proposed design would have upon views in the nearer surrounding area, as it was considered that these would better inform the development of the architectural design and that any measures adopted would be similarly successful in more distant views.

4.38 There are several designated heritage assets within the surrounding area and a number of viewpoints were selected in which to test the proposed design:

- View from St Andrew’s Church in Ford, which lies 0.7 km to the north east of the site
- View from the PROW near to St Mary’s Church in Yapton, which lies approximately 1 km to the west of the site

- View from Arundel Castle Keep, which lies more than 4 km to the north of the site

4.39 There are also several public right of way (PROW) close to the site and a selection of these viewpoints were also considered in testing the proposed design:

- View from PROW - Lyminster and Crossbush 2207-1, looking west towards the site
- View from PROW - Ford 175-1, looking north east towards the site

4.40 A 3D massing model, which included the main buildings, and the perimeter landform bunds was generated and tested in a range of the selected viewpoints. In order to minimise the overall size and scale of the main ERF building the design that was tested treated the buildings as a series of refined interlocked cubic forms. The design included parapet ‘flat’ roofs to avoid the creation of high level shadows that would otherwise be created by oversailing roof plates. This reduces the darker colour contrast that high level shadows would create when seen against a background of sky and avoids ‘drawing the eye’ up to the upper parts of the facades. While it was considered that the recessive appearance of this design approach was successful in the views, when read within the flat landscape and the skyline, it also identified several issues that would need to be addressed:

- The ERF would clearly be seen as a large building within the landscape and that while consideration should be given to architectural designs which might assist in blending the building with its surroundings, alternative building roof profiles should be reviewed and include straying from strictly volumetrically efficient form in order to ensure that softening or curving the roof profile of the building might have visual benefits when seen from the selected viewpoints
- The impact of the choice of cladding materials and the colour being used on the buildings would be important in softening its visual impact and alternatives would need to be reviewed, as would how the overall visual scale of the building might be broken down by consideration of contrasting materials / colours
- Further review of the recorded and current groundwater levels on the site would need to be undertaken and opportunities to lower parts of the buildings below ground should be explored in order to lower the overall height of the main ERF buildings as far as possible
- While the raised bunds clearly assisted in both visual and acoustic mitigation, further review of their size and form would need to be tested to ensure that they visually imbed themselves within the predominantly flat landscape
- How the planting of the bunds might appear would need further investigation, both in terms of the extent and type of planting, and that testing the appearance of new trees at year 0 and at year 15 in the visualisations would be important in order to show how screening effects will advance with time
- Consideration would need to be given to increasing the range of viewpoints to fully test the proposed design in principle and in its detail

- How the design might respond to the former canal and incorporating references to this within the design would need further exploration

Stage 3 design evolution

4.41 At the start of Stage 3 the site layout was updated to incorporate a number of changes which focussed upon the layout of the WSTF and the ERF workshop building and some fine tuning of the road infrastructure within the site. The range of viewpoints within which the proposed design was being tested was also increased and the following views added:

- View from the site's former exit road lying to the west of Rodney Crescent, looking west towards the site
- View from public footpath 366, looking south towards the site
- View from southern airfield near Horsemere Green, looking north towards the site

4.42 Using the expanded range of viewpoints further design studies were then undertaken to seek to address the issues raised from the previous stage of design development.

Building form

4.43 A range of design options were developed and tested alternative building profiles and the roof form of the main ERF facility in the visualisations:

- Cubic - this design was basically a repeat of that which was used in the first stage of design development work. It ignored the stepped ‘top hat’ profile of the flat roofs on top of the main ERF building and instead maintained a single consistent parapet line in order to simplify its appearance and to visually conceal the stepped profile.
- Stepped - this option explored a more volumetrically efficient design. It allowed the parapet along the top of the ERF to follow the stepped profile of the roofs behind in order to reduce the overall scale and massing of the building. Parapets were incorporated around most of the roof plates to maintain a clean edge to the building’s profile.
- Radiused - a variant of the cubic design, this applied curves to the vertical corners of the main building to test if by removing its ‘corners’ and blurring the transition between facades in light and shadow there would be softening in the appearance of the building.
- Vaulted - this option explored softening the profile of the upper part of the ERF by profiling the top edge of the parapet walls to give a curved appearance to the roofline. The roof plates behind could either be retained as stepped flat roofs or areas of curved roof could be added if this offered further improvement to the design.
- Curved - this design option incorporated a single curved roof plate which in covering both the upper and lower parts of the ERF and being continued over the WSTF building, created a single architectural form and sought to test if this would offer an overall softer profile and appearance.

Landscaped bunds

4.44 The design of the proposed landscaped bunds was taken further and updated in the 3D model. A representation of trees at 15 years was also added and tested in the views. A key view was that from the site's former exit road lying to the west of Rodney Crescent, as it was closer to the site than other views and offered a better understanding of the scale of the bunds and the planting within the surrounding landscape and the context of the site. To further test the tree growth at 15 years another image was prepared which included an artistic representation of the trees instead of a simple representation.

Colour studies

4.45 How the overall massing might be broken down through the use of varying colours / tones was explored on the stepped design option. It was recognised from the outset that the use of any dark colour on the upper parts of the main buildings would undermine efforts being adopted to soften the overall appearance and mitigate its visual impact, and only by adopting a lighter colour would best blend and soften the appearance of the buildings against a background of sky. Therefore, the colour studies focussed on applying different colours to the lower building forms and considered their effectiveness and the relationship with the proposed landscaped bunds.

Stacks

4.46 The early technical decision to minimise the overall height of the ERF building by adopting a twin stream, rather than single stream process, led to the requirement for two flue stacks. It was concluded that in order to best mitigate their appearance against the sky from nearby and distant views that the stacks should be treated simply and played down in their appearance rather than adopting a more adventurous design. This led to there being two options for the stacks, either wrap them within a single ‘cylindrical’ or ‘oval’ wind shield, or alternatively treat then as a pair of ‘pencil’ stacks, and all options were tested in the visualisations.

4.47 These studies showed that while the single shielded version of the stack would appear as a single ‘column’, with the large width of both options presented a greater visual impact against the sky, particularly in the cylindrical option where it would maintain the same width when viewed from all viewpoints. In contrast, the twin ‘pencil’ stack arrangement appearance was, on the whole, narrower than the single wind shield. The twin stack appearance changed depending upon the viewpoint - at times appearing as twin and when overlapped, visually appearing as a much slenderer single stack.

Development level

4.48 In order to limit visual impacts, an important objective has been to minimise the overall height of the proposed development, which would be facilitated by extension of structures to a greater depth below ground. Initial design proposals prior to stage 3 included the following to meet the ideal requirements of the ERF:

- A reduced level dig across a large portion of the site to a depth of 5 metres below ground level (mbgl)

- Creation of two bunker areas, one to 10 m depth (IBA bunker) and the other to 15 m depth (bunker hall)

4.49 The proposed elevations of the dig and bunkers under this design scenario would be below the groundwater table, and therefore were tested at this stage in the context of the potential for hydrogeological impacts.

4.50 The construction of the proposed development would require groundwater control by lowering of the water table to produce a dry working environment to allow construction operations to proceed. The impact of dewatering to achieve this was assessed to be significant in terms of impact on availability of water in the Chalk aquifer, which is already limited in resource. There would also be an impact to existing abstractions in the vicinity of the site and base flow to surface water courses, as well as to the water quality of the waterbody receiving the abstracted water. Potentially, there may also have been risks relating to erosion of banks of surface water courses, and scour and flooding.

4.51 Designing to these levels would likely have required groundwater to be recharged to the Chalk aquifer to mitigate risks of surface water flooding and erosion/scour of watercourses and to mitigate derogation of existing groundwater supplies. Such a recharge scheme would require careful design and management, and access to land outside of the boundaries of the site, which the applicant do not have control over. Due to the expected depth of piles that would be required, the proposed development may also have created a barrier to groundwater flow, which could have caused groundwater mounding and increases in groundwater elevation on the up-hydraulic gradient side of the proposed development. This could potentially increase risk of groundwater flooding in the long term.

Conclusions of third stage design review

4.52 A number of conclusions were drawn from this third stage of design development:

- When considering the alternative designs in the view from Arundel Castle it was clear that with it being so distant it was on the whole difficult to differentiate between the alternative designs, particularly as the curved profiles of the vaulted and curved designs were not apparent in this view due to the orientation of the building. However, it did show the reduced massing offered by the stepped profile design over the others
- The simpler cubic and stepped building designs tended to offer a more refined appearance and tended to be easier to read in all views when compared with the vaulted and curved designs
- The increased massing generated by the curved design was particularly evident in many of the views and when considering the context of the site, the benefit of creating a larger building than operationally needed was questioned
- While the orientation and visibility of the curved profiles of the vaulted and curved designs varied form view to view, it was clear that at certain times of day any curved roof, whatever its colour, might lead to sun ‘glinting’ from its surface. This raised concerns that on those occasions the building would appear much brighter and stand out within the landscape

- While the curved corners of the radiused design had the potential to soften the views from nearby heritage assets, the visualisations also raised concerns that the potential for 'glinting' on the curved corners could accentuate the corners and in so doing frame the outline of the building against the sky
- It was considered that the twin 'penicil' stacks offered visual benefits over the single windshield options and was therefore adopted into the final design, as was the decision to adopt a light sky blending colour, having been tested in the views
- The further development of the design of the proposed bunds and their landscaping, and their testing in the views, showed that their scale would be in keeping with the scale of existing tree belts in the area
- The additional versions of the views from Arundel Castle and from Rodney Crescent, which included more representative images of the likely tree growth over 15 years, reinforced the benefit that the planted bunds would have in screening low levels within the site and reducing the apparent scale of the larger building
- It was concluded that treating the elevations with darker colour banding at lower levels offered little benefit when seen in more distant views and was considered to have more of a negative impact in closer views, and that a light, sky blending colour should be consistently applied to the building to ensure a clean and refined appearance
- The existing groundwater levels on the site had been reviewed and established as sitting at around -6mbgl, and there would be hydrogeological impacts in sinking structures below this level; hence it was assumed that the extent the boiler hall, the tallest structure, could be lowered into the ground, was -5mbgl

4.53 Overall, this stage of design development had established that the stepped design was the most successful in reducing the overall mass and scale of the building, and when compared with the other designs it best mitigated the visual impact of the building from the selected views.

4.54 However, a number of issues remained to be resolved at the next stage of design development including:

- The impact of the choice of cladding materials and the colour being used on the buildings would be important in softening its visual impact and alternative cladding materials and finishes would need to be reviewed
- Reviewing how the preferred design might look in elevated views from the SDNP
- Testing the shadow path from the proposed design, particularly in respect of the nearest residential property to the north east, Atherington House
- Considering how the design might respond to the former canal and incorporate references to this within the design
- Reviewing the extent to which the buildings might be sunk below ground level without significant impacts on the underlying groundwater regime

Stage 4 design evolution

4.55 The final stage of design development sought to address the remaining issues from the previous stage of work, and to incorporate additional detail.

Development level

4.56 An important requirement has been to reduce the volume of water required to be managed during construction, and thus to reduce environmental impacts relating to groundwater derogation and impacts on surface water as far as is reasonably practicable whilst still enabling delivery of the proposed development. The key elements of the design are:

- A reduced level dig across a large portion of the site to a depth of 2.5 metres below ground level (mbgl); this provides a finished floor level (FFL) of -1.5 m plus a 1m thick concrete floor
- Creation of one bunker area to 4 m depth (3 m FFL plus 1m thick floor)
- Installation of a small surface water pumping system to 5 m depth (4m FFL plus 1m thick floor)

4.57 These evolutions in design will substantially reduce the extent to which the groundwater table is required to be lowered and therefore avoids the associated potential impacts. Discharge of abstracted groundwater would be to the River Arun via the existing surface water drainage network on site, and it is likely that the existing drainage network would be suitable to accommodate the smaller volumes of water which would be abstracted. It is also noted that potentially, and depending on seasonal groundwater elevations, the works could be constructed with the need for minimal or possibly no dewatering if they are carried out when groundwater levels in the Chalk aquifer are low. Furthermore, the estimated zone of influence from any dewatering would be such that impacts to existing abstractions in the vicinity of the site and base flow to surface water courses would be unlikely.

4.58 As a result, revised below-ground FFLs and excavation depths impacted upon both how the proposed building design would sit in the selected viewpoints, and in the layout of the site.

Architectural design

4.59 While the key principles of the architectural design remained unchanged, they were developed to add further detail, and the following changes were made:

- Reducing the depth of the waste bunker required the floor level of the waste reception hall to be elevated to +3m above ground level in order to ensure sufficient storage capacity was maintained within the bunker
- Incorporating areas of flint walling to key areas on the ERF administration reception building and to face the wall forming the western edge of the car park and its access road, and to add local character and visual interest and offer a visual contrast to the scale and finish of the metal cladding
- Incorporating photovoltaics on the majority of high level flat roofs of the ERF and the WSTF buildings

- Detailed development of the floor layout of the ERF administration accommodation, including offices, meeting rooms, staff welfare facilities, reception and visitor facilities
- Identifying the location of ventilation louvres on both the ERF and WSTF, and avoiding their location on the higher parts of the main building to ensure their visual darkening of the facades does not occur
- Refinement of the glazing arrangements of the ERF's administration wing and the decision to include automated blackout roller blinds to prevent the potential night-time light spill to receptors around the site
- Including a screen that would span between the turbine hall and the ACCs, which would also shield outdoor equipment and the pipe duct and support structure
- A review of cladding material options and finishes / colours was undertaken
- Shadow path studies were undertaken which showed there to be no significant effects upon residential amenity

Site layout

4.60 While the key principles of the site layout remained unchanged, the development of the landscape design and the detail of interfaces between planting, screening, landforms, mitigation and ecology required there to be slight modifications to the site layout. Other operational related amendments were also being accommodated in the final design. The final iteration of the site layout included the following changes:

- A 1 in 10 gradient vehicle ramp was added to allow HGVs to access the +3m raised waste reception hall
- An additional inbound weighbridge and an additional outbound weighbridge were added to reduce potential queuing of HGVs
- The secure boundary of the site was adjusted in the north east corner to maintain the route of the existing PROW at the north east of the site
- The landscape design and planting proposals were developed and led to adjustments in the design and contouring of the landform bunds and the addition of a flint faced wall at the foot of the bunds to add local character and visual interest when viewed from outside of the site
- A flint faced cutting and recessed pond was added into the side of the landform bund adjacent to the site's western boundary to mark the alignment of the former canal route, and a change in paving colour and texture within the site's car park to mark its alignment at the eastern end of the site

Visualisations

4.61 An additional view was added to those that had been used to test the design from the outset – the view from the site's access road looking north towards the site entrance. The 3D model of the proposed design was then updated in order to reflect the developments in the design and included:

- The change in depth of the lowered site level to -1.5m

- The selection of standing seam aluminium cladding for the main facades of the building and its matt silver finish
- The updated design for the landscaped bunds.

4.62 When considering the initial massing study when viewed from Arundel Castle it was evident that the building would be read mainly against a backdrop of ground and slightly against the seascape, and that while the shape of the building may not be discernible, the colour would. While it may be considered that using mid tone colours instead of very light or very dark from such long distance views would better blend the building with the landscape, it would have a negative impact from more mid-range and short-range views where the building is read against a background of sky. For that reason, it was decided that on balance the adoption of light neutral colours for both the buildings and the stacks would, on the whole, best mitigate their visual impact upon their surroundings.

4.63 The proposed design was also reviewed in a number of additional viewpoints. This included consideration of a range of views from the SDNP that had been identified through the LVIA work.

4.64 These studies concluded that in the more distant views from the higher ground of the SDNP, the simple building form and the strategy to maintain the minimum necessary height helped to reduce its perceived scale and the selected colour of the envelope, whilst light in colour, assimilated well with the other many lighter coloured elements also seen in the view, such that the overall composition of the view of the coastal plain appears largely as existing.

4.65 From the limited closer areas of the SDNP with clear views towards the site, for example from the Binsted area, the proposed design is not seen in the wider context of coastal plain development and from a lower elevation, so the change in the view is a result of its partial appearance on the skyline in some views.

4.66 This is also the case in the closer, more local views, where the relatively flat landscape results in upper parts of the building being seen partly against the sky, and often partially screened and filtered by skyline vegetation.

4.67 In both these instances the light and partially reflective colour of the building envelope appeared light against the sky and responded to prevailing weather and light conditions. These visual effects and, particularly in the immediate locality, the existing industrial context, helped to reduce the magnitude of change experienced in the views.

4.68 Overall, it was concluded that the incorporated changes raised no significant concerns and that no further changes were required to be made to the proposed design. The orientation and form of the proposed building and its combination with the proposed landscaped screening bunds has consistently proved to be the optimised design in mitigating its visual impact and best blends the proposed development with its surroundings.

4.69 Further details on the design approach are set out in the DAS that supports the ERF and WSTF planning application.

Alternative drainage strategies

4.70 Although a wide range of sustainable drainage system (SuDS) techniques were considered, there are very few methods that would be practically feasible and suitable due to the extensive built footprint within the site boundary and its geological and hydrogeological setting. Specifically, considering the high potential groundwater levels and contamination at the site in conjunction with its location within a high vulnerability zone on a Principal aquifer. Infiltration was therefore not considered to be a viable option. A summary of the SUDS options considered but rejected is set out in table 4.1.

SuDS Group	Technique	Description	Reason for rejection
Retention	Balancing pond	Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation	The space within the site boundary is considered to be too limited for this option
Wetland	Shallow wetland, extended detention wetland, pond wetland, pocket wetland, submerged gravel wetland, wetland chanel	Wetlands provide storm water attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants. They can provide significant ecological benefits	The space within the site boundary is considered to be too limited for this option
Infiltration	Infiltration trench, infiltration basin, soakaway	Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated	Considering the hydrogeology of the site, infiltration is not considered a suitable option
Filtration	Surface sand filter, sub-surface sand filter, perimeter sand filter	Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required	There is no requirement for high pollution reduction at the site
	Filter trench / drain	Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff. They receive lateral inflow from an adjacent impermeable surface	Not suitable due to the hydrogeology of the site
Detention	Detention basin	Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility	Not suitable due to the limited availability of space within the site boundary

SuDS Group	Technique	Description	Reason for rejection
	Enhanced dry swale, enhanced wet swale	Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate	Not suitable due to the limited availability of space within the site boundary
Conveyance	Conveyance swales, rills	Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate	Conveyance swales/rills might cause disabled access issues and thus, these options are not considered suitable for the proposed development

Table 4.1: A summary of the SUDS options considered but rejected

4.71 The following SuDS were, however, considered potentially suitable:

- Sub-surface storage (and infiltration) – achieved through oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.
- Porous paving / permeable paving - which allows runoff to infiltrate through to sub-base layer and then infiltrate into the ground or be conveyed into storage or drainage systems. Porous paving was considered viable for access routes, car parking and bike storage areas on site.
- Bioretention / filter swale – where vegetated strips of land are designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system. Filter swales were considered possible, however, limited space on site was considered an issue.
- Rainwater harvesting - using the rainwater coming from the roofs to supply site activities / processes where appropriate and / or watering plants.

4.72 Of the above, lined below ground cellular storage tanks, with an impermeable membrane to avoid potential groundwater ingress, was considered most practical at the site, together with rainwater harvesting. The proposed attenuation storage systems will be located at the north, north eastern and eastern parts of the site and will collect surface water from rainwater pipes and external hardstanding areas. If required, oversized pipes will supplement the attenuation tanks.

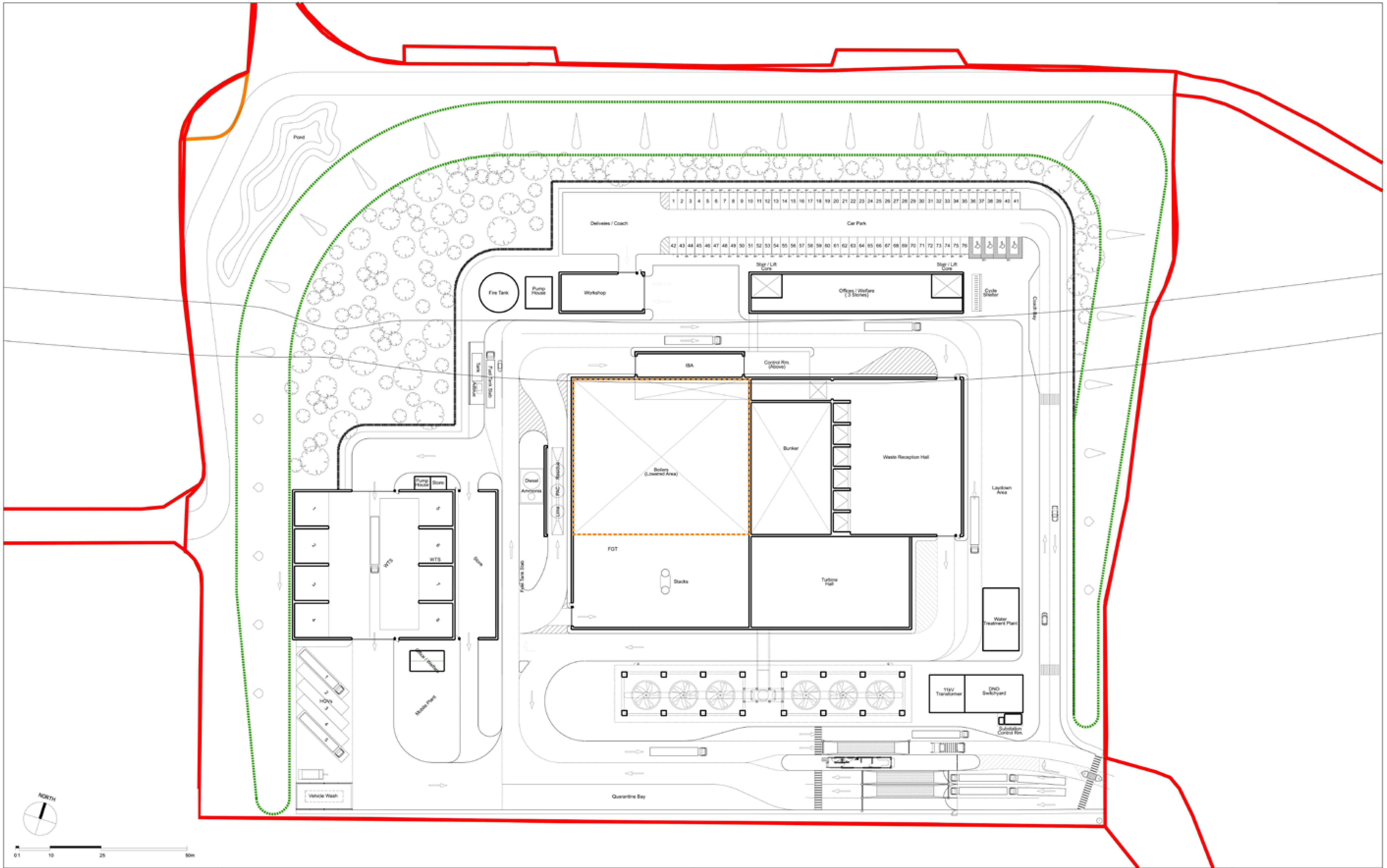
4.73 The design of the tanks will ensure that surface water from the site will be attenuated prior to discharge at greenfield runoff rates. Further details on the drainage strategy proposed are set out in Chapter 3 and in the Outline Surface Water Drainage Strategy report that forms part of Technical Appendix G.

Conclusion

4.74 This chapter has summarised the alternatives considered during the development of the proposed ERF and WSTF:

- A number of alternative combustion solutions have been considered for the ERF, including both advanced thermal treatment and conventional combustion systems (i.e. fixed hearth, pulsed hearth technology, rotary kilns, fluidised bed technology and moving grate). As moving grate is a leading technology with a proven track record for achieving the burnout requirements for IED compliance, it has been selected for the Ford ERF.

- A review of alternative site layouts, building designs, ground levels, materials and colours has led to the selection of a design that meets the operational requirements of the technical processes, is practical in terms of vehicle circulation, reflects the local history of the site and reduces potential noise and visual impacts as far as practicable.
- The review of alternative SuDS has led to the selection of lined, below ground cellular storage tanks and rainwater harvesting for dealing sustainably with surface water at the site.



NOTE

1. THIS DRAWING IS COPYRIGHT GSDA LTD.
2. THE CONTRACTOR MUST NOT SCALE FROM THE DRAWING ALL DIMENSIONS TO BE TAKEN FROM DIMENSION STRINGS.
3. WHERE ANY DISCREPANCIES ARE FOUND BETWEEN DIMENSIONS THESE MUST BE BROUGHT TO THE ATTENTION OF THE ARCHITECTS FOR RESOLUTION.
4. WHERE DISCREPANCIES EXIST BETWEEN REFERENCE OR ASSEMBLY DRAWINGS & DETAIL DRAWINGS, THE LATTER TAKE PREFERENCE.

Key

- Fencing Line
- Red Line Boundary
- Assumed Ownership Boundary
- ROW Exclusion
- Extent of bunding
- 6.7m Wide Aligned ROW Route

Figure 4.1 Initial site layout study – U-shaped arrangement of the ERF

NOTE

1. THIS DRAWING IS COPYRIGHT GSDA LTD.
2. THE CONTRACTOR MUST NOT SCALE FROM THE DRAWING ALL DIMENSIONS TO BE TAKEN FROM DIMENSION STRINGS.
3. WHERE ANY DISCREPANCIES ARE FOUND BETWEEN DIMENSIONS THESE MUST BE BROUGHT TO THE ATTENTION OF THE ARCHITECTS FOR RESOLUTION.
4. WHERE DISCREPANCIES EXIST BETWEEN REFERENCE OR ASSEMBLY DRAWINGS & DETAIL DRAWINGS, THE LATTER TAKE PREFERENCE.

Key

- Fencing Line
- Red Line Boundary
- Assumed Ownership Boundary
- ROW Exclusion
- -4m Lowered Area
- Extent of bunding
- 6.7m Wide Aligned ROW Route

Figure 4.2 Initial site layout study – L-shaped arrangement of the ERF