11.0 SOIL CONDITIONS, GROUNDWATER & GROUND CONTAMINATION

INTRODUCTION

11.1 This Chapter considers the impact of the proposed development on existing soil conditions as a resource, as well as groundwater and ground contamination.

11.2 Following a review by the relevant technical consultant (WYG), it was considered that the revised phasing would not give rise to any previously unidentified significant environmental effects (Appendix 11.1). Therefore, the mitigation outlined within the 2012 ES Chapter (Appendix 1.1) and restated below remains sufficient to ensure that there are no negative residual impacts.

11.3 This Chapter includes an updated review of policy and legislation, and refers back to the assessment methodology and baseline situation identified at the time of the 2012 assessment. The previously identified mitigation and associated residual impacts are then restated.

11.4 This Chapter should be read in conjunction with the WYG Desk-Study presented in Appendix 11.1 in Volume 2: Technical Appendices, and the Land Research Associates Baseline Study presented in Appendix 11.2 of the 2012 ES (Appendix 1.1).

PLANNING POLICY & LEGISLATIVE CONTEXT

11.5 The following section presents the relevant planning policy and legislation as of April 2016.

National Legislation

Environmental Protection Act (1990)

11.6 Specific UK legislation on contaminated land is principally contained in Part IIA of the Environmental Protection Act (EPA) 1990¹, (amended by the Environment Act 1995²). The principles are summarised in Defra guidance from 2012³. This legislation is based on a ‘suitable for use’ approach to contamination where remedial action is only required if there are unacceptable risks to human health or the environment, taking into account the use of the land and its environmental setting. Statutory Guidance in support of the

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² 1995 No. 1301. OPSI.
⁴ Defra, (2012); Contaminated Land Statutory Guidance
EPA describes a risk assessment methodology using a source-pathway-receptor methodology.

11.7 The legislation places a responsibility on the Local Authority to determine whether any land in its area is contaminated by consideration of whether:

- Significant harm is being caused;
- There is significant possibility of significant harm being caused;
- Significant pollution of controlled waters is being caused; or
- There is significant possibility of such pollution being caused.

**Water Resources Act (1991)**

11.8 The national regulatory controls and restrictions used to protect the water environment are set out in the Water Resources Act (WRA) 1991\(^4\).

11.9 Under Section 85 of the WRA\(^4\), it is an offence to cause or knowingly permit any poisonous, noxious or polluting matter to enter into Controlled Waters, which include groundwater and surface waters.

11.10 Furthermore under Section 161 of the WRA\(^4\), the Environment Agency (EA) has the power to serve a Works Order on a person where it appears that poisonous, noxious or polluting matter is likely to enter or to be present in any Controlled Water. The Works Order will specify the actions to be taken to mitigate the risk and timescale for the works to be carried out.

11.11 The Environmental Permitting (England and Wales) Regulations 2010\(^5\) which came into force on 6th April 2010 replace those parts of the WRA that relate to the regulation of discharges to Controlled Waters. Under the Regulations, water discharge activities relate to discharges to surface waters that are Controlled Waters and Groundwater.

**The Building Act (1984)**

11.12 National regulatory controls applied to protect substructures against the soil environment are contained in the Building Act 1984\(^6\) supported by the Buildings Regulation 2000 and their Approved Documents, particularly Document C1; Site Preparation and Resistance to Contaminants\(^7\). Amongst other requirements, it stipulates that the ground to be covered by a building shall be reasonably free from material that might damage the building or affect its stability. It also stipulates that reasonable

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5 Great Britain. Parliament, (2010); Environmental Permitting (England and Wales) Regulations 2010. OPSI
7 ODPM, (2004); Document C1: Site Preparation and Resistance to Contaminants. HMSO.
precautions should be taken to avoid danger to health and safety caused by contaminants on or in the ground covered or to be covered by the building and associated land.

National Planning Guidance

National Planning Policy Framework

11.13 The Government’s policy on the approach to be taken to soils and best and most versatile agricultural land is given in the The National Planning Policy Framework (NPPF)\(^8\), which states that:

'Local planning authorities should take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality.' (Paragraph 112)\(^8\)

'The planning system should contribute to and enhance the natural and local environment by:

- Protecting and enhancing valued landscapes, geological conservation interests and soils; [and]
- Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.' (Paragraph 102)\(^8\)

11.14 Pollution in the context of paragraph 1028 is defined as anything that affects the quality of land, air, water or soils.

Planning Policy Statement 23: Planning and Pollution Control

11.15 Whilst the EPA1 details the likely risks posed by existing land conditions, potential risks arising from a change in land use are principally managed through the planning regime. Historic land contamination is a material planning consideration that must be taken into account at various stages in the planning process, including proposals for the future use and redevelopment of the site.

11.16 Government guidance on the development of contaminated land is contained within Planning Policy Statement 23: Planning and Pollution Control (PPS23)\(^9\). PPS23 provides

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8 Communities and Local Government, (2012); The National Planning Policy Framework. TSO.
9 DCLG (Former ODPM), (2004); Planning Policy Statement 23 Planning and Pollution Control. TSO.
guidelines for complying with national legislation on contamination, land, air and water quality management as well as remediation of land. PPS23 states that:

‘Any consideration of the quality of land can present risks to human health and the environment which adversely affect or restrict the beneficial use of land, but development presents an opportunity to deal with these risks successfully...’

‘The remediation of land affected by contamination through the granting of planning permission (with the attachment of the necessary conditions) should secure the removal of unacceptable risk and make the site suitable for its use. As a minimum, after carrying out the development and commencement of its use, the land should not be capable of being determined as contaminated land under Part IIA of the EPA 1990.’

11.17 Safeguarding our Soils: a Strategy for England\(^\text{10}\) aims to ensure that soil functions are sufficiently understood in the planning system and that soils are better managed through all stages of construction. An Environment Agency document, Soil - a Precious Resource: Our Strategy for Protecting, Managing and Restoring Soil\(^\text{11}\) has complementary aims.

**Local Planning Guidance**

**The Joint Core Strategy for Broadland, Norwich and South Norfolk**

11.18 The site is located within Broadland District Council and Norfolk County Council. The local planning policy relevant to the site is the Joint Core Strategy for Broadland, Norwich and South Norfolk, adopted March 2014\(^\text{12}\).

**Spatial Planning Objectives**

11.19 Spatial Planning Objective 4 ‘To promote regeneration and reduce deprivation’\(^\text{12}\) states that growth will be used to regenerate under-used Brownfield land.

11.20 Spatial Planning Objective 9 ‘To protect, manage and enhance the natural, built and historic environmental including key landscapes, natural resources and areas of natural habitat of nature conservation value’\(^\text{12}\) states that the use of previously developed land will be prioritised to minimise the loss of agricultural land and the countryside. The scale of development will require the development of significant Greenfield areas and where this is necessary, development must provide environmental gains.

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\(^{10}\) DEFRA, (2009); Safeguarding our Soils: a Strategy for England. DEFRA.


\(^{12}\) Greater Norwich Development Partnership, (2014); Joint Core Strategy for Broadland, Norwich and South Norfolk. GNDP.


**Area Wide Policies**

11.21 The Area wide Policy 1 *Addressing climate change and protecting environmental assets*\(^{12}\) includes that development will protect groundwater sources and protect mineral and other natural resources identified through the Norfolk Minerals and Waste Development Framework\(^{13}\).

11.22 The Area wide Policy 2 *Promoting good design*\(^{12}\) includes the need to design development to avoid harmful impacts on key environmental assets.

11.23 The Area wide Policy 3 *Energy and water*\(^{12}\) covers the requirement of ensuring that water quality is protected or improved with no significant detriment to areas of environmental importance.

**ASSESSMENT METHODOLOGY**

11.24 Whilst several of the guidance documents may now have been superseded, WYG have confirmed that the assessment remains valid (Appendix 11.1). The methodology utilised for the 2012 assessment can be found in Chapter 11.0 of Appendix 1.1.

**BASELINE CONDITIONS**

11.25 Baseline from the 2012 assessment is still considered to remain valid and can be found in Chapter 9.0 of Appendix 1.1.

**ASSESSMENT OF POTENTIAL IMPACTS**

11.26 As above, the assessment of potential impact from the 2012 is still considered to remain valid and can be found in Chapter 9.0 of Appendix 1.1.

**MITIGATION MEASURES**

11.27 The mitigation measures included within the 2012 ES (Appendix 1.1) are considered to still remain valid and are restated below.

**Introduction**

11.28 The key objective of mitigation is to avoid, offset or deduce the significant negative effects of the proposed development. Mitigation can be carried out through design or management and the strategy should be informed by the following hierarchy of options:

- Avoidance;

\(^{13}\) Norwich County Council, (2011); *Norfolk Minerals and Waste Development Framework*. NCC.
• Reduction;
• Compensation;
• Remediation; or
• Enhancement.

**Groundwater and Ground Contamination**

11.29 Mitigation measures relating to groundwater and ground contamination have been split into design phase, construction phase and operational phase.

11.30 A site specific ground investigation will be undertaken to investigate the ground conditions of the application site. The investigation will consider the geology, ground contamination sources, ground gases and groundwater regimes.

11.31 The ground investigation will aim to generate site specific data that will be used to refine the Preliminary Conceptual Site Model that will be used to assess risks to human health and the environment including Controlled Waters. It is understood that there have been no other ground investigations on the application site.

11.32 Following the specific ground investigation, a risk assessment will be undertaken and, if required, remediation works or operational amendments will be recommended to reduce the risks from any potential contamination to identified receptors. This will lead to the refinement of the mitigation measures which are proposed below.

11.33 Mitigation measures in the context of Groundwater and Ground Contamination are separated into design, construction and after completion, which should be adhered to in accordance with best practice procedures.

**Design Phase**

11.34 The following measures have been identified, which will be incorporated at the detailed design stage:

- Specification of concrete used in foundations and building structures will be selected based on the results of soil and groundwater sulphate analyses. Guidance is provided by the Building Research Establishment (BRE) series *Concrete in Aggressive Ground*\(^\text{14}\);

- Installation of service pipes will be suitable to the site ground conditions in consultation with the local water provider. Vapour protection measures in building foundations will be installed if required;

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\(^{14}\) BRE, (2006); Concrete in Aggressive Ground. BRE.
• If piles are proposed, the Piling Method Statement will be prepared incorporating principles of *Piling in Contaminated Ground*\(^{15}\) to minimise potential migration along piling shafts. The piling specification will require approval by the EA;

• Ensure appropriate audit trail, testing frequency and verification to ensure chemically suitable materials across the site, in particular in landscaped areas and imported materials; and

• Design substructure with an appropriate level of protection to ground gases where necessary.

**Construction Phase**

11.35 A ground investigation will be undertaken to investigate the ground conditions at the site. The investigation will further consider the geology, ground contamination sources, ground gases and the groundwater regimes. A Ground Contamination Interpretative Report will be prepared, a subsequent risk management strategy will be developed, and remediation method statement where required on completion of the ground investigation to address any pollutant linkages identified.

11.36 A Demolition/Refurbishment Asbestos Survey will be undertaken to identify the presence or absence of any ACMs within existing site structures. Any ACMs will be removed by appropriate licensed specialist prior to any demolition and substructure construction.

11.37 A specialist contractor will undertake an unexploded bomb desk-based assessment and a further investigation if an assessment if required.

11.38 The following measures detailing provisions for environmental protection will be included in the Construction Environmental Management Plan (CEMP) and followed during construction:

• Measures for the management of site drainage accidental spills and storage of materials to prevent pollution of surface and ground water (including establishment of emergency response procedures in accordance with EA guidelines and provision and maintenance of spill containment equipment);

• Risk to construction workers to be dealt with by the Principal Contractor. The Contractor will be responsible for site health and safety and will manage the risk through control of suitable Health and Safety measures including provision of Personal Protective Equipment (PPE), education of the workforce and inductions for all site staff and visitors;

• Good site practice measures with regards to the on-site storage, handling and transfer of fuels, chemicals and waste material;

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\(^{15}\) Wescott, (2001); *Piling in Contaminated Ground*. CMB.
- Adherence to EA Pollution Prevention Guidelines;
- Regulation of Health and Safety Rules including provision welfare facilities;
- A Material Management Plan will be put in place for managing all excavated soils prior to transfer to a treatment centre, disposal by a suitably licensed contractor or re-use on-site. All copies of the paper work and transfer notes will be retained on-site;
- Verification testing will be carried out for landscape areas and imported materials; and
- An environmental watching brief during site enabling works in key areas where contamination is suspected or known.

**Soil Conditions as a Resource**

**Soils**

11.39 *The Construction Code of Practice for Sustainable Use of Soils on Construction Sites*\(^{16}\) provides guidance on good practice in soil handling. Soil management to be employed on the proposed development will include:

- Avoidance of traffic in areas that do not need to be disturbed;
- Careful stripping of topsoils (using suitable soil-handling equipment) from areas to be disturbed, ensuring no mixing with the subsoils;
- Storing soils in temporary low stockpiles, protected from contamination by other materials and sown with grass if being stored for more than 6 months;
- Spreading topsoils only onto subsoil that has been de-compacted; and
- Using any surplus topsoil beneficially elsewhere.

11.40 These measures, and the soil and land functions that they are designed to protect, are summarised in Table 11.1 below.

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\(^{16}\) DEFRA, (2009); *Construction Code of Practice for the Sustainable Use of Soils on Construction Site*. Department of the Environment, Food and Rural Affairs.
Table 11.1 - Design Measures to Avoid or Reduce the Main Effects of Construction on Soil and Land Functions

<table>
<thead>
<tr>
<th>Soil/Land Function</th>
<th>Design Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape support</td>
<td>Retention of stripped topsoil. Minimising soil compaction in landscaped areas. Avoidance of traffic on undisturbed areas</td>
</tr>
<tr>
<td>Production of food &amp; fibre</td>
<td>None possible in disturbed land</td>
</tr>
<tr>
<td>Transformation &amp; buffering</td>
<td>Maximising use of porous surfaces. Minimizing soil compaction</td>
</tr>
<tr>
<td>Supporting habitats/biodiversity</td>
<td>Creating landscape and habitat areas and minimizing soil compaction in them. Avoidance of traffic on undisturbed areas</td>
</tr>
<tr>
<td>Storing and transmitting water</td>
<td>Maximising use of porous surfaces. Minimizing soil compaction in landscaped areas</td>
</tr>
</tbody>
</table>

**Best and Most Versatile Agricultural Land**

11.41 While the application site is being developed, new accesses will be created to agricultural fields that become severed from their normal access routes.

**Operational Phase**

11.42 The Environmental Management System (EMS) will include site maintenance, storage of fuels, chemicals, waste management and emergency response procedures to protect the soil and groundwater from operational activities.

**RESIDUAL IMPACTS**

11.43 The mitigation outlined within the 2012 ES Chapter and restated above remains sufficient to ensure that there are no negative residual impacts at either the construction or operational phases.

**Groundwater and Ground Contamination**

**Introduction**

11.44 Whilst a degree of impact during the construction phase of the proposed development is anticipated, the adoption of the mitigation measures discussed above would reduce the magnitude impacts on land quality to a **Negligible** level. During construction, potential risks will be managed through appropriate design and construction techniques together with appropriate site management procedures.
11.45 The implementation of risk management measures to mitigate identified areas of contamination within the application site will be undertaken throughout the site enabling and construction phase of the proposed development, such that existing pollutant linkages will have been broken prior to the operational phase of the proposed development.

11.46 The sealing of soils within areas built on or paved and the eventual loss of best and most versatile land from agricultural use cannot be mitigated.

11.47 Activities during the operation phase of the proposed development have the potential to create additional contaminant sources on the application site. However, it is considered likely that the magnitude of impacts due to contamination during the operational phase of the proposed development will be Negligible as site operations will be undertaken under appropriate operational management procedures.

11.48 The risk to future site occupants will be managed through appropriate design measures incorporated into the proposed development. As discussed previously, a ground investigation will be undertaken for the application site and the information generated will be used to inform the risk management measures required in the context of the design details of the proposed development.

11.49 Provided the mitigation measures outlined above are adopted, the overall significance of the environmental effects during the construction phase of the proposed development with respect to land quality is considered Negligible.

11.50 The overall significance of the environmental effects of the proposed development with respect to land quality during the operational phase is considered Negligible as above-ground activities are unlikely to affect ground conditions and are likely to improve surface water discharge quality and a reduction in potential existing ground contamination and ground gases, due to the historic and current land uses, to affect environmental receptors.

11.51 Residual impacts in the context of Groundwater and Ground Contamination are separated into design, construction and after completion which should be adhered to in accordance with best practice procedures.

**Construction Phase**

11.52 A summary of residual impacts on ground conditions underlying the site during construction is provided in Table 11.2 below.
Table 11.2 Summary of Residual Effects during Construction

<table>
<thead>
<tr>
<th>Description of Effect</th>
<th>Residual Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction workers may come into contact with contaminated soils/waters through</td>
<td></td>
</tr>
<tr>
<td>ingestion/exposure inhalation pathways</td>
<td>Duration: Short-term</td>
</tr>
<tr>
<td></td>
<td>Significance: Negligible due to use of appropriate PPE</td>
</tr>
<tr>
<td>Contaminated soils may migrate to off-site properties as airborne dust, surface run-off</td>
<td>Duration: Long-term</td>
</tr>
<tr>
<td></td>
<td>Significance: Negligible as appropriate mitigation measures will be implemented following a site-specific risk assessment. Pollutant linkage will be broken by hardstanding and cover systems in soft landscaped areas</td>
</tr>
<tr>
<td>Ground gases can accumulate in confined spaces. This can be inhaled by residents/future</td>
<td>Duration: Long-term</td>
</tr>
<tr>
<td>site users/neighbours, leading to potential asphyxiation</td>
<td>Significance: Negligible as appropriate mitigation measures will be implemented following a site-specific risk assessment</td>
</tr>
<tr>
<td>Contaminated soils/water could affect services via direct contact</td>
<td>Duration: Long-term</td>
</tr>
<tr>
<td></td>
<td>Significance: Negligible as any significant contamination identified will be remediated and appropriate materials used in the provision of services</td>
</tr>
<tr>
<td>Contaminated soils/water could affect site structures via direct contact</td>
<td>Duration: Long-term</td>
</tr>
<tr>
<td></td>
<td>Significance: Negligible as any significant contamination will be remediated and concrete will be selected to be resistant to chemical attack</td>
</tr>
<tr>
<td>Mobilisation of contaminants during earthworks and creation of preferential pathways</td>
<td>Duration: Long-term</td>
</tr>
<tr>
<td>during substructure construction affecting groundwater quality</td>
<td>Significance: Negligible as appropriate mitigation measures will be implemented following a site specific risk assessment</td>
</tr>
</tbody>
</table>

**Operational Phase**

11.53 A summary of the residual impacts on ground conditions underlying the proposed development during operation is provided in Table 11.3.
Table 11.3 Summary of Residual Effects during Operation

<table>
<thead>
<tr>
<th>Description of Effect</th>
<th>Residual Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spillages from above ground activities such as stored chemicals may be transported in surface run-off followed by migration to groundwater as well as off-site</td>
<td>Duration Long-term</td>
</tr>
<tr>
<td></td>
<td>Significance Negligible as an appropriate environmental management plan will be put in place and the management of the buildings will be to best practice standards</td>
</tr>
</tbody>
</table>

**Soil Conditions as a Resource**

**Soils**

11.54 Where subsoils of gardens and landscape areas remain over-compacted, rainfall fails to percolate beyond the base of the topsoil and run-off increases, increasing pressure on sustainable urban drainage systems. The lack of a full soil profile into which roots can proliferate not only affects the performance and visual quality of the vegetated areas, but also reduces soil moisture deficits in summer so that moisture repletion occurs sooner in autumn, further exacerbating the soil’s ability to absorb excess rainfall. The consequence is increased hydraulic and sediment loadings to watercourses and an increased risk of flooding.

**Best and Most Versatile Agricultural Land**

11.55 179ha of agricultural land, all but 3ha of it in the best and most versatile category, will be removed from agricultural use.

**SUMMARY & CONCLUSIONS**

11.56 Following a review by WYG, it was considered that the revised phasing would not give rise to any previously unidentified significant groundwater and contamination effects. Therefore, the mitigation outlined within the 2012 ES Chapter and restated above remains sufficient to ensure that there are no negative residual impacts.

11.57 The existing baseline conditions of topography, land use, geology, land contamination and environmental receptors were determined through a review of desk-based information.

11.58 The application site is predominantly undeveloped open land with some residential development and established commercial farm holdings.
11.59 Historically, the land within the redline boundary of the application site has been predominantly rural with limited development restricted to farm holdings and detached residential developments. Very little changes have occurred to these areas over the past century. Roads that transgress the site and define the boundaries typically follow the routes of roads and tracks established during the early development of the land.

**Groundwater and Ground Contamination**

11.60 There is the potential for localised soil and groundwater contamination and ground gases to be present on the application site. Limited information is available on the nature of this although it is not anticipated to be significant or widespread.

11.61 A number of environmental receptors have been identified. These include human health (future site users and construction workers), land and property (soils, materials and site structures) and controlled waters comprising of a Secondary Aquifer and Principal Aquifer beneath the site as well as surface water features comprising of Rackheath Springs (interconnected ponds) along the northeast boundary of the application site.

11.62 The likely significant impacts from the proposed development have been identified and potential effects of the proposed development have been considered. The effects on the relevant environmental receptors have been estimated as **Minor Negative**, in the absence of mitigation measures.

11.63 The mitigation measures proposed in the study will initially be refined through a targeted ground investigation that will be undertaken to confirm the ground conditions at the application site. The ground investigation will consider the geology, ground contamination source, ground gases and groundwater regimes. The ground investigation results will be used to further inform of the risks to human health and the environment as well as Controlled Water, and determine the risk management in the context of the design details of the proposed development. Following the site-specific ground investigation, a risk assessment will be undertaken and, if required, remediation works will be recommended to reduce the risks from any potential contamination to identified receptors.

11.64 Providing the mitigation measures are adopted, the overall significance of the environmental effects during the construction phase of the proposed development and after completion with respect to groundwater and contamination is considered **Negligible**.

**Soil Conditions as a Resource**

11.65 The development of land to the northeast of Norwich will remove 179ha of land from agricultural use of which 176ha is in the best and most versatile category and mainly in arable use. Soil functions will be severely compromised over most of the site through
sealing by roads and buildings. However, this will be partly mitigated by ensuring that the soils within domestic gardens and open space are in the best possible condition.

11.66 The effects are summarised in Table 11.4.

**Table 11.4 Overall Effect of the Proposed Development on Soil and Agricultural Quality**

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best and most versatile agricultural land</td>
<td><strong>Major Negative</strong></td>
</tr>
<tr>
<td>Soil ecosystem services/functions</td>
<td><strong>Major Negative</strong> in built areas</td>
</tr>
<tr>
<td></td>
<td><strong>Minor Positive</strong> in landscape areas</td>
</tr>
</tbody>
</table>