11.0 Water Resources

11.1 Introduction

11.1.1 This chapter of the ES will identify and describe the nature and significance of the potential effects on hydrology, drainage and water quality as a result of the Proposed Development.

11.1.2 Brookbanks (BB), instructed by Hallam Land Management, has undertaken the assessment as part of the Environmental Statement (ES) submitted in support of the proposed development at North West Bicester (north east of the Marylebone - Birmingham railway line).

11.1.3 The ES chapter is supported by a Flood Risk Assessment (FRA). The FRA will consider whether the proposed development is likely to be affected by current or future flooding from any source and will categorise the site in accordance with the Flood Zones set out in the National Planning Policy Framework and associated Planning Practice Guidance. The FRA will also consider whether the development will increase flood risk elsewhere and the nature of mitigation measures required to deal with any development impact.

Competancy

11.1.4 In accordance with the Environmental Impact Assessment (EIA) Regulations (2017) the ES chapter have been carried out by competent experts. Brookbanks is a multi-disciplinary environmental, engineering and development consultancy with many years experience of master developer roles; development management, civil engineering, transport and environmental consultancy. The company has extensive experience and expertise of the EIA process and includes Chartered members of the Institute of Civil Engineers and members of the Institution of Water and Environmental Management.

11.2 Regulatory and Policy Context

National Context: Water Framework Directive

11.1.5 To improve the quality of water bodies, European legislation known as the Water Framework Directive (WFD) has been introduced to promote a new approach to water management through river basin planning. One aim of the Water Framework Directive is to improve the ecological health of inland and coastal waters and to prevent further deterioration. A requirement has been placed on nearly all inland and coastal waters to achieve 'Good Status' by 2015.

National Planning Policy Framework (NPPF, 2021)

11.1.6 The NPPF advocates the steering of development away from areas at high risk of flooding. However, the document acknowledges that development is necessary and that a key aim should be to ensure that flood risk is not increased elsewhere.

11.1.7 The NPPF requires that developments covering an area of greater than one hectare prepare a Flood Risk Assessment (FRA). The FRA is required to be proportionate to the risk and appropriate to the scale, nature and location of the development.

Planning Practice Guidance (PPG, 2021)

11.1.8 More detailed guidance on flood risk has been provided in the Government's Planning Practice Guidance (DCLG 2021). This guidance reiterates that allocation and planning of development must be considered against a risk based search sequence. In terms of fluvial flooding, the guidance categorises flood zones into four principal levels of risk, as follows:

Table 11.1 PPG Flood Risk Parameters

Flood Zone	Annual Probability of Flooding	Definition
Zone 1: Low probability	< 0.1 %	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2: Medium probability	0.1 – 1.0 %	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a: High probability	> 1.0 %	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b: Functional Floodplain	> 1.0 %	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

11.1.9 The guidance sets out categories of flood risk vulnerability, using the classifications: essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water compatible. According to this scale, residential and education development would fall within the 'more vulnerable' category, while buildings used for shops or non-residential institutions would be considered 'less vulnerable' and amenity open space, space for nature conservation, outdoor sports and recreation areas would fall into the 'water compatible' category.

11.1.10 According to the guidance, development within the 'more vulnerable' category should be located outside Flood Zone 3b and Flood Zone 3a, unless on application of the 'Sequential Test', the site is demonstrated to be the most appropriate for the proposed development and satisfactory flood mitigation can be provided. Additionally, 'more vulnerable' development proposed within Flood Zone 3a is required to pass the 'Exception Test'.

11.1.11 The development provides wider sustainability benefits to the community that outweigh the flood risk.

11.1.12 The development will be safe, not increase flood risk and where possible reduce flood risk overall.

11.1.13 Development in the 'less vulnerable' category should be directed towards Flood Zones 1, 2 or 3a, while water compatible development may be appropriate in any flood zone.

Other Guidance Documents

11.1.14 In addition to the legislation and policy identified above, the following documents provide relevant guidance on measures to control effects on hydrology and flood risk and have been taken into account in this assessment:

- CIRIA (2004) Sustainable Urban Drainage Systems - Hydraulic, Structural and Water Quality Advice: C609;
- CIRIA (2015) The SuDs Manual: C753;
- CIRIA (2010) Planning for SuDs Making it Happen: C687;
- CIRIA (2014) Site Handbook for the Construction of SuDS: C698;
- CIRIA (2017) Guidance on the Construction of SuDS: C768;
- Environment Agency Pollution Prevention Guidance: PPG1 Understanding Your Environmental Responsibilities – Good Environmental Practices (Environment Agency et al. 2013);
- Environment Agency Pollution Prevention Guidance: PPG3 Pollution Prevention Guidelines: Use and Design of Oil Separators in Surface Water Drainage Systems (Environment Agency et al. 2006);

- Environment Agency Pollution Prevention Guidance: PPG 5 Works and Maintenance in or Near Water (Environment Agency et al. 2007);
- Environment Agency Pollution Prevention Guidance: PPG6 Working at Construction and Demolition Sites (Environment Agency et al. 2012);
- Environment Agency Pollution Prevention Guidance: PPG21 Pollution Incident Response Planning (Environment Agency et al. 2009); and
- Design and Construction Guidance for Foul and Surface Water Sewers (2019)

Local Policy

Cherwell Local Plan Part 1 2011-2031 (Adopted 2015)

11.2.1 The Cherwell Local Plan Part 1 2011 – 2031, adopted in 2015, is the development plan for Bicester.

11.2.2 The Cherwell Local Plan Part 1 is supported by its own technical evidence base including:

- Bicester Environmental Baseline Report, Sept 2013
- Cherwell and West Oxon Strategic Flood Risk Assessment, April 2009
- Sequential Test and Exception Test (Flooding) – Strategic Sites (October 2014)

11.2.3 On the basis of a clear assessment and understanding of strategic and local flood issues, the Local Plan (Policy Bicester 1) allocated land at North West Bicester for a mixed use development including 6000 new homes. Allocated, the site satisfies the sequential test.

11.2.4 Bicester 1 notes that the overall approach being sought is "WFD compliance, surface water management to avoid increasing flood risk and water services infrastructure improvement requirements and their delivery, having regard to the Environment Agency's guidance on Water Cycle Studies"

11.2.5 More detailed provisions in Bicester 1 include the following:

- Provision of sustainable drainage in accordance with Policy ESD 7: Sustainable Drainage Systems (SuDS), taking account of the recommendations of the Council's Strategic Flood Risk Assessment Demonstration of climate change mitigation and adaptation measures
- No development in areas of flood risk and development set back from watercourses which would provide opportunity for green buffers.
- Proposals should include a Flood Risk Assessment

11.2.6 The most relevant, more detailed, policies of the Local Plan in relation to Water Resources are as follows, and further detailed within the supporting FRA:

- Policy ESD6 Sustainable Flood Risk Management

- Policy ESD7 Sustainable Drainage Systems
- Policy ESD8 Water Resources

11.2.7 The polices are further detailed within the FRA.

11.3 Assessment Methodology

Overview of Approach

11.3.1 Existing studies/documents, including evidence base studies undertaken in support of the preparation of the Cherwell Local Plan Part 1 (adopted 2015) have been reviewed to identify the best available data to be taken forward to inform the EIA/FRA.

11.3.2 A walkover survey was undertaken to facilitate an understanding of the baseline water environment and the general landform of the site and surrounding area and to define the scope/specifications of technical assessments/surveys.

11.3.3 The nature of flood risk associated with the tributary watercourses, specifically the River Bure, was assessed to enable the site to be categorised in accordance with the Flood Zones set out in the NPPF.

11.3.4 Consideration has been given to the drainage elements of the North West Bicester Supplementary Planning Document and the Water Cycle Study prepared in association with that masterplanning work.

11.3.5 The FRA includes an assessment of the potential impacts of climate change upon flood levels and surface water run-off for the design life of the proposed development, in accordance with EA guidance published in February 2016 (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances).

Scoping and Response

11.3.6 Baseline conditions at the site relating to hydrology, hydrogeology, flood risk and drainage have been established using both published information and detailed site investigations.

11.3.7 The scope of potentially significant effects included within the assessment is outlined below:

- Impact on the floodplain on the proposal in terms of the location of built development;
- The potential for flood compensation measures if any infrastructure or water related development is constructed;
- A surface water drainage strategy to minimise impacts on the watercourses and hydrology in the area; and
- Potential for contamination of nearby watercourses during the course of the construction work.

11.3.8 The approach to be taken in respect of water resources was set out in a ES scoping request submitted to the District Council and consulted upon by CDC. The approach set out was supported in the scoping opinion issued by the District Council. The Environment Agency response sets out a number of issues in a little more detail:

11.3.9 "The report provides a high level account of how flood risk will be assessed and confirms that the EIA will be supported by a flood risk assessment and include an assessment of climate change. It should be noted that the 2016 climate change guidance was updated in October 2021 and the new guidance will need to be referred to.

11.3.10 There are areas of flood zones 2 and 3 within the site boundary and the development will follow a sequential approach. It will need to be shown that there is no built development or land raising within the 1% annual probability flood extent with an appropriate allowance for climate change to ensure the existing floodplain is protected and enabled to perform its primary role of storing flood water in the event of a flood. If this area is to be developed, a detailed explanation of why this is necessary will be required and level for level flood compensation mitigation must be provided.

11.3.11 Level for level compensation is the matching of volumes lost from the floodplain due to increases in built footprint or raised ground levels, with new floodplain volume by reducing ground levels elsewhere. Analysis should be presented in the FRA as a table showing the volumes lost to the development in approximately 100mm increments of level and the volumes gained by the mitigation proposed in the same level increments. It should be demonstrated that there is no loss of floodplain volume in any increment of level, and preferably a net gain (see attached diagram). Please note for this to be achievable, it requires land on the edge of the floodplain and above the 1% AEP, including an appropriate allowance for climate change, flood extent. The FRA should consider whether level for level compensation is possible and if not explain why and detail how any associated risks from the chosen form of mitigation can be minimised.

11.3.12 Finished floor levels for the development should be built above the 1% annual probability climate change flood level to ensure all buildings remain safe from the impact of flooding ."

11.3.13 CDC Land Drainage team noted the very high level overview of surface water drainage strategy and offered no additional comments than to draw attention to take account of the views of the LLFA.

11.3.14 Thames Water welcomed the opportunity to comment on the scoping report and "are satisfied that the report has considered the Water and sewerage needs of the development as set out in the EIA Regulations 2017 Schedule"

Consultations and or Documentation Assembly Undertaken

11.3.15 Published information has been obtained in the form of:

- BGS Published geology

- Environment Agency Data
- Site Investigation Report

11.3.16 Whilst now archived, in the absence of alternative 'good practice' guidance, it is recognised that the Environment Agency Pollution Prevention Guidance (PPG) notes still provide up to date and appropriate guidance for assessing contamination from proposed development.

11.3.17 The Flood Risk Assessment and associated drainage strategy follows the approach set out in the EA Flood Risk Assessment Guidance notes, the NPPF and the Technical Guide to the NPPF along with the published Planning Practice Guidance and the requirements of the Strategic Flood Risk Assessment.

Method for Assessing Baseline and Future Baseline Conditions

11.3.18 The format of this section of the ES follows a standard study pattern, by setting out an appraisal of the baseline conditions, followed by a description of the Proposed Development features and an identification of potential environmental effects due to the Proposed Development. The importance of each mechanism and an assessment of each potential effect are then considered along with any mitigation measures and recommendations for further investigations where necessary.

11.3.19 Methods of assessment have been employed that are consistent with current guidance and recommendations in the form statutory documents and recognised publications to ensure that the findings represent a robust approach to the assessment.

Method for Assessing Impacts and Magnitude and Significance of Effects

11.3.20 The significance of effects will be assessed by considering the sensitivity of receptors (i.e. their importance and ability to tolerate and recover from change) and the likely magnitude of the impact. By combining sensitivity and magnitude, the significance of the effect is established.

11.3.21 The tables below outline the criteria for determining the magnitude and significance of the identified impacts.

Table 11.2 Magnitude of Impact

Magnitude	Criteria
Large	Loss of attribute
Moderate	Losses on integrity or partial loss of attribute
Small	Minor impact / minor loss of attribute
Negligible	Insignificant loss of attribute that does not affect use or integrity

Table 11. 3 Sensitivity of Impact

Sensitivity	Criteria
High	Water body of very good chemical or biological quality. Water dependent SSSI, SPA/SAC, Ramsar sites or highly sensitive aquatic ecosystem. Protected areas including designated bathing waters, shellfish and salmonid fisheries. A source used for public or local potable water supply. Water body of high amenity value, including areas of bathing and where water emersion sports are regularly practised. Areas which are 'highly vulnerable' to flooding.
Medium	Water body of good or fairly good chemical and biological quality and/or non-public water supply. Water body of nature conservation importance at the regional level or a moderately sensitive aquatic ecosystem. Water body of a moderate amenity value including public parks, boating, non-contact water sports, popular footpaths adjacent to watercourses, or watercourses running through housing developments/town centres. Areas which are 'more vulnerable' to flooding.
Low	Water body of poor or fair chemical or biological quality. Water body of no or only local social interest. Water body of low amenity value with only casual access. Areas which are 'less vulnerable' to flooding or 'water compatible'.

Table 11.4 Significance of Impact

MAGNITUDE	SENSITIVITY			
	High	**Medium**	**Low**	**Negligible**
Large	Major	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Negligible
Small	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Table 11.5 Sensitivity of Environmental Receptor

Sensitivity	Receptor

High	Essential Infrastructure' as defined in the Planning Practice Guidance (Reference ID: 7-066-20140306). A source used for public or local potable water supply. Water dependent SSSI, SPA/SAC, Ramsar sites or highly sensitive aquatic ecosystem. Protected areas including designated bathing waters, shellfish and salmonid fisheries. Receptors which are considered 'highly vulnerable' to flooding, as defined in the Planning Practice Guidance (Ref: 7-066-20140306). Water body of very good chemical or biological quality. Water body of high amenity value, including areas of bathing and where water immersion sports are regularly practised.
Medium	Receptors which are considered 'more vulnerable' to flooding, as defined in the Planning Practice Guidance. Water body of good or fairly good chemical and biological quality and/or non-public water supply. Water body of nature conservation importance at the regional level or a moderately sensitive aquatic ecosystem. Water body of a moderate amenity value including public parks, boating, non-contact water sports, popular footpaths adjacent to watercourses, or watercourses running through housing developments/town centres.
Low	Receptors which are considered 'less vulnerable' to flooding, as defined in the Planning Practice Guidance. Water body of poor or fair chemical or biological quality.
Negligible	Receptors which are considered to be 'water compatible', as defined in the Planning Practice Guidance. Receptors which are outside of the proposed development catchment. Water body of no or only local social interest. Water body of low amenity value with only casual access.

Table 11.6 Magnitude of Impact

Magnitude	**Criteria**
Major	Loss of attribute
Moderate	Losses on integrity or partial loss of attribute
Minor	Minor impact / minor loss of attribute
Negligible	Insignificant loss of attribute that does not affect use or integrity

Table 11.7 Significance of Impact

MAGNITUDE	**SENSITIVITY**

	High	Medium	Low	Negligible
Major	Major	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Negligible
Minor	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Table 11.8 Definition of Significance of Environmental Impacts

Significance of Impacts	Definition
Major	An effect which in isolation could have a material influence on the decision-making process.
Moderate	An effect which on its own could have moderate influence on decision making, particularly when combined with other similar effects.
Minor	An effect which on its own is likely to have a minor influence on decision making, but when combined with other effects could have a more material influence.
Negligible	An effect which on its own or in combination with other effects will not have an influence on decision making.

Limitations and Assumptions

11.3.22 Third party information has been used in the preparation of this report, which Brookbanks, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks accepts no liability for same.

11.4 Baseline Conditions

11.4.1 Baseline geology and hydrogeology are covered in Chapter 12: Ground Conditions.

11.4.2 The following paragraphs are based upon the findings of the Flood Risk Assessment (FRA) contained at Appendix 11A.

11.4.3 The environmental receptors will be identified in the following paragraphs and the classification of the sensitivity of each receptor is based upon Table 11.4.

Watercourses and Hydrogeology

11.4.4 With reference to the British Geological Survey map, the site is shown to be underlain by limestone bedrock geology belonging to the Cornbrash Formation. There are outcrops of

Limestone and Mudstone belonging to the Forest Marble Formation following line of the ordinary watercourses.

11.4.5 The underlying limestone bedrock forms Secondary A aquifer.

11.4.6 In terms of groundwater vulnerability the bedrock below the site is shown to be situated within a 'high risk' area.

Topography

11.4.7 The site falls towards the two onsite watercourses. The exception to this is in the western field where there is a ridge in the centre of the field. East of this ridge falls away from the ordinary watercourse.

Flood Risk

11.4.8 The Environment Agency's (EA) National Generalised Modelling (NGM) Flood Zones Plan indicates predicted flood envelopes of Main Rivers across the UK. The mapping shows that there are areas of Flood Zones 2 and 3 adjacent to the onsite watercourses. However the substantial majority of the site lies within Flood Zone 1; being an area of Low Probability of flooding, outside both the 1 in 100 (1% AEP) and 1 in 1,000 (0.1% AEP) year flood events. The areas at higher risk are located within a corridor of land immediately adjacent to the existing watercourses which run through the site.

11.4.9 The FRA also finds the land to lie in an area that has a Low Probability of flooding from other sources such as ground water, sewer and artificial water bodies.

11.4.10 The FRA concludes that the site is suitable for development from a flood risk viewpoint. Its allocation for the strategic mixed use community proposal is testament to its suitability for development in planning and drainage terms.

Surface Water Drainage

11.4.11 The site is currently agricultural and served by a watercourses and a tributary running through the site. According to Thames Water there are no records of storm water drains within the site boundary.

11.4.12 The Environment Agency currently monitor 40,000km of rivers across England. To help protect these areas, each stretch of river is monitored and given a river quality grade. This is based upon the chemical quality of the water. The rivers are then graded from A to E with A representing a river with very good water quality and E, a river with very poor water quality.

11.4.13 To improve the quality of water bodies, new European legislation known as the Water Framework Directive (WFD) has been introduced to promote a new approach to water management through river basin planning. One aim of the Water Framework Directive is to improve the ecological health of inland and coastal waters and to prevent further

deterioration. A requirement was placed on nearly all inland and coastal waters to achieve 'good' status by 2015.

11.4.14 An assessment of the water quality of the nearby watercourses are shown to have a moderate to good ecological and water quality.

11.4.15 The hydrology of the area is outlined in more detail within the FRA (Appendix 11.1).

Foul Water Drainage

11.4.16 The existing drainage network surrounding the site is owned and operated by Thames Water.

11.4.17 For a development of this scale, Thames Water will likely require further investigations in the form of hydraulic modelling to confirm whether sufficient capacity exists in their local network.

11.4.18 Under regulations from Ofwat (The Water Services Regulation Authority), it is an obligation for the incumbent foul water company (Thames Water) to accommodate the foul drainage from the proposed development, whilst ensuring nil detriment to the existing network and customers.

Future Baseline Conditions (DO Nothing Scenario)

11.4.19 Should the Proposed Development not come forward the future baseline conditions, as described above, will predominantly remain the same.

11.4.20 Fluvial and pluvial flood risk across the Site will increase as a result of climate change, this will increase the flood plain across the site.

11.4.21 In that scenario it is assumed that the site will continue to be farmed in similar way to how it currently operates and that the various features and habitats within the site will remain and will be managed appropriately.

11.4.22 It is anticipated that none of the receptors identified are any more or less sensitive to the potential change in future baseline conditions should the Proposed Development not be delivered.

11.5 Assessment of Likely Significant Effects

Construction Effects

11.5.1 Two potential construction phase environmental effects have been identified relating to hydrology and hydrogeology. These mechanisms are as follows:.***Contamination of Surface Water***

11.5.2 Direct and indirect contamination of surface water due to mobilisation of soils, existing contamination and spillage of oils and the like from construction plant.

11.5.3 Disturbance of the ground during construction operations has the potential to contaminate the soil and both ground and surface waters due to discharge of solids into water or by the short-term mobilisation of any background contaminants within the soil matrix.

11.5.4 The discharge of suspended solids to watercourses and ground waters will be avoided by prohibiting any temporary construction discharge without the prior approval of the Environment Agency. Discharges of waters resulting from construction activities will generally be directed to foul sewers, subject to approval of the drainage authority.

11.5.5 Site topography is such that limited, if any, earthworks will be required to provide gravity surface water drainage.

11.5.6 Other potential effects relate to the contractor's working practices. For example, there is the potential for fuel oil spillage from stored materials supplying site plant if plant and vehicles are not stored and maintained appropriately to protect the surface and ground water quality environment. This potential impact will be controlled by storing such materials within bunded tanks.

11.5.7 It is assessed that the proposals could result in short term negative (**Moderate adverse**) environmental effects if none of the above potential issues are managed and mitigated. However, as referred to above they are common risks and issues which can be managed and mitigated, will be a relatively low significance due to appropriate mitigation being employed.

Flooding and changes to baseline drainage hydrology

11.5.8 Direct and indirect flooding and changes to baseline drainage hydrology due to disturbance of the ground during construction works.

11.5.9 Flooding and changes to the baseline hydrology can occur due to various construction related activities, such as; deposition of materials within the floodplain, temporary diversion of watercourse, infilling of land altering preferential drainage flow paths and flood routes, and dewatering of excavations. Such effects can have major consequences.

11.5.10 If a temporary diversion of a watercourse is necessary, the contractor shall implement an alternative flow route, as close to the source as possible, which will be designed to have no lesser capacity than the original feature. The proposals for such diversions shall be agreed with the regulatory bodies and implemented for the shortest possible time to progress the works.

11.5.11 The contractor will not be permitted to temporarily store materials or introduce 'borrow pits' or the like in areas that may affect drainage flow paths.

11.5.12 Any proposed dewatering will be designed to have no material impact on potential receptors such as local watercourse and points of ground water abstraction. Where necessary, the contract will be required to implement ground water recharge as mitigation.

11.5.13 Implementation of appropriate working practices will ensure that no flooding or hydrological environmental effects result from the construction activities.

11.5.14 Such effects can have potentially **moderate adverse** consequences if not managed and planned properly i.e. unmitigated.

Operational Effects

Off site flooding

11.5.15 Direct and indirect flooding of surrounding watercourses, the wider catchment area, adjacent land and property due to increases in surface water runoff from positively drained hard areas.

11.5.16 Hydrological effects in terms of flooding and the like arise from changes in the catchment drainage characteristics. Urbanisation of a catchment can increase peak storm water discharge from an area due to the accelerated run-off and reduced times of concentration of the storms associated with hard paved areas, with resulting increase in flood risk.

11.5.17 In the absence of mitigation, the proposed development could potentially create or exacerbate off-site flooding risks to downstream areas and have major effects on the off-site areas or land-uses.

11.5.18 It can therefore be concluded that there could be a **moderate adverse** effect if not managed and planned properly.

On site flooding

11.5.19 Direct flooding of the Proposed Development due to inadequate flooding resilience and management of residual flood risk. Unmitigated there could be a **moderate adverse** effect if not managed and planned properly.

11.5.20 The FRA identifies a range of measures to provide flooding resilience and manage residual flood risk.

11.5.21 Development proposals, informed by the FRA demonstrate that best practice principles of flooding resilience and residual flood risk management will be implemented. Accordingly, the environmental effect is assessed as nil impact.

Contamination of Surface waters from onsite activities

11.5.22 Direct contamination or deterioration of surface water quality can occur in the operational stages of development due to leakages of fuel oils, general spillages and other contaminants from within the development and the associated collection of surface water drainage from hardstanding areas.

11.5.23 In assessing the environmental impact of the development in terms of pollution prevention, a water impact appraisal has been completed to assess the potential pollution receptors. The prime water receptors at risk are the ground water and the onsite watercourses.

11.5.24 National and European legislation will ensure water quality is improved over time, primarily by the implementation of more stringent controls. Accordingly, if the potential impact of development activities is to be avoided, surface water discharged from the development will need to be treated to improve water quality prior to discharge from the site.

11.5.25 Direct contamination of surface and ground water may arise from accidental spillages of chemicals sometimes employed in commercial and industrial development. Such spillages can result in major pollution incidents. Protection of the environment through the usage of chemicals in industry is rigorously defended through appropriate environment legislation, requiring statutory registration of such use and implementation of appropriate means of control.

11.5.26 Surface water run-off from development sites routinely contains a series of contaminants, including petrochemical compounds, heavy metals and suspended solids, being predominant in industrial service yards and large car parks. In residential development the small volumes of fuel oils washed from cars represents a far lower pollution risk to surface or ground water quality. The direct discharge of development drainage to adjacent watercourses can potentially lead to a degradation of water quality with associated ecological effects.

Table 11.9 Typical Pollutant Concentrations

Water Source	Mean Pollutant Concentration (mg/l)					
	Solids	BOD	COD	NH4	Pb	Oils
Rainfall	8 - 80	1 - 15	2.5 - 32	-	0.024 - 10.4	-
Typical residential areas	187	8.5	80	0.6	0.14	5.1

11.5.27 Such effects can have potentially **moderate adverse** consequences if not managed and planned properly i.e. unmitigated.

Contamination of Surface Water from foul sewer surcharging

11.5.28 Direct and indirect contamination of surface water, soil and potential groundwater contamination due to surcharging of the foul water network or the discharge of untreated foul flows.

11.5.29 When assessing potential effects of the foul drainage, it is important that the proposed system is designed to convey foul waters safely from the site to a suitable treatment facility, without overloading the existing sewerage systems. Furthermore, it is also important that the treatment facility is designed to accommodate the load from the Proposed Development and that same achieves a discharge quality that does not impact on water quality standards in the receiving watercourse.

11.5.30 In the baseline condition, the Proposed Development does not benefit from a connection to the foul sewerage network. However, DETR Circular 3/99 and Building Regulations state that the first presumption when considering new development is to provide positive drainage from that development in conjunction with the local sewerage undertaker.

11.5.31 It can therefore be concluded that there could be a **moderate adverse** effect if not managed and planned properly.

Foul Drainage

11.5.32 It is the intention to install a foul drainage sewer system on-site to collect and discharge the foul water generated by the development. The site is currently not served by foul drainage services given the largely agricultural use of the land to date.

11.5.33 If this mitigation is not implemented then there would be a direct, permanent, long term **major adverse** effect.

11.6 Mitigation Measures

Mitigation of Construction Stages of Development

Contamination of Surface Water

11.6.1 It will be incumbent on the selected contractor to assess working practice related risks and effects before implementation and control such by employing industry good practice techniques. Furthermore, the contractor will be required to develop emergency spillage, flood, fire and contamination control procedures such that any inadvertent incidents are immediately controlled to minimise the potential impact. All works will be completed in accordance with the Environment Agency documents, PPG 6 Working at Construction and Demolition Sites and PPG21 Pollution Incident Response Planning together with current best practice measures for the management of construction activities.

11.6.2 Proposed implementation methods will be developed with the Environment Agency in advance of all works, with appropriate construction phase method statements developed to ensure that no impact on the site hydrology or hydrogeology results from the construction activities

11.6.3 The principal contractor appointed to manage and control all construction activities, including management of water resources and the storage of fuel and chemicals will put a Construction Environmental Management Plan (CEMP) for the site in place. The CEMP will detail the procedures and methods that must be followed to minimise the potential environmental effects of construction activities at the site.

11.6.4 The CEMP will describe the procedure if there is an environmental emergency, such as a fuel or chemical spillage on the site. All contractors and personnel will be briefed on this procedure before construction work commences.

11.6.5 The CEMP would stipulate:

- All construction works would be designed in accordance with the latest relevant EA guidelines and the ADAS Technical Note on Workmanship and Materials for Drainage Schemes (1995).
- Method statements would be agreed with the EA to ensure compliance with PPG prior to the commencement of construction works to ensure that surface run-off quality is managed during the construction process.
- Contractors undertaking earthworks would develop risk assessments and method statements covering all aspects of their work that have the potential to cause physical damage to structures (e.g. water supply and sewerage infrastructure), mobilise large quantities soil/sediments or block open watercourses. Earth moving operations would be undertaken in accordance with BS 6031: 2009 Code of Practice for Earthworks.
- Works affecting soils would follow MAFF's Good Practice Guide for Handling Soils (2000) which provides comprehensive advice on soil handling, including stripping, soil stockpiling and reinstatement.
- Works would comply with DEFRA guidance in the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) which provides guidance on the use, management, and movement of soil on site. This action should prevent the mobilisation of sediment and prevent pollution of watercourses.
- Good practice guidance on erosion and pollution control would be followed, e.g., CIRIA Environmental Good Practice on Site (C650) and Control of Water Pollution from Construction Sites (C532).
- The principal contractor would avoid the storage of plant, machinery fuel or materials (including soil stockpiles) alongside watercourses unless unavoidable. Construction works should be programmed as far as is practicable to minimise soil handling and temporary soil storage.
- The refuelling of plant, storage of fuels and chemicals and overnight storage of mobile plant would be within the designated contractors compound areas. The compounds would contain appropriate facilities for the storage of fuels and chemicals i.e., bunded and locked storage containers and would also be equipped with spill kits.

11.6.6 Therefore, there is likely to be a **negligible** effect on the site following implementation of mitigation measures.

Flooding and Changes to Baseline Drainage Hydrology

11.6.7 To prevent localised flooding associated with extreme rainfall events during the construction phase, a temporary localised run-off management system will be employed by the contractor. This will comprise temporary surface water run-off facilities such as storage

tanks, ditches or ponds and provide on-site attenuation for surface water flows and thereby reducing flood risk.

11.6.8 Where a temporary diversion of a watercourse is necessary, the contractor shall implement an alternative flow route, as close to the source as possible, which will be designed to have no lesser capacity than the original feature. The proposals for such diversions shall be agreed with the regulatory bodies and implemented for the shortest possible time to progress the works.

11.6.9 The contractor will not be permitted to temporarily store materials or introduce 'borrow pits' or the like in areas that may affect drainage flow paths.

11.6.10 Any proposed dewatering will be designed to have no material impact on potential receptors such as local watercourse and points of ground water abstraction. Where necessary, the contract will be required to implement ground water recharge as mitigation.

11.6.11 Implementation of appropriate working practices will ensure that no flooding or hydrological environmental effects result from the construction activities.

11.6.12 Filling of the land, where necessary, will be by way of 'cut and fill' earthworks and imported inert material to trim building levels and highway infrastructure to provide gravity drainage across the land. These works will be completed in a manner that protects the water quality environment and ecological interest of the watercourse. The nature of the works and the proposed implementation methods will be agreed with the Environment Agency in advance and all works will accord with the recommendations of EA Pollution Prevention Guidance for Works in, Near or Liable to Affect Watercourses.

11.6.13 Therefore, there is likely to be a **negligible** effect on the site following implementation of mitigation measures.

Mitigation of Operational Stages of Development

Alteration of the Drainage Regime (On and Off Site Flooding)

11.6.14 To mitigate against the potential impact of development on the baseline hydrological characteristics, it is important that the site drainage provision is designed to reflect the pre-development conditions as closely as possible. Both the maximum rate of run-off and the total direct discharge to adjacent watercourses needs to be controlled if the potential impact of the site is to be minimised. This is addressed within the FRA.

11.6.15 The Proposed Development has been designed to avoid significant hydrological effects resulting from changes in the catchment drainage characteristics and provides for site run off controlled to the baseline rate assessed using the IoH124 methodology. By introducing Sustainable Urban Drainage measures (SuDS), the design takes account of the potential accelerated run-off and reduced times of concentration associated with hard paved areas to avoid increasing peak storm water discharge and consequential flood risk.

11.6.16 The FRA calculates the green field run off rates post development and shows the proposed sustainable drainage system to ensure these rates are not exceeded.

11.6.17 The FRA outlines a proposed storm water management system providing a SuDS management train, incorporating source control and infiltration systems, where viable. The network will convey and attenuate storm water discharges from the Proposed Development to the points of discharge along the onsite watercourse.

11.6.18 The SuDS scheme will incorporate detention and conveyance features.

11.6.19 One of the key principles of Sustainable Drainage Systems (SuDS) is that the management of flows should be as close as reasonably practicable to the baseline conditions and their location as close as possible to the source.

11.6.20 The outline SuDS scheme has had regard to sustainable methods that are readily accepted for adoption by the relevant authorities in discharging their maintenance responsibilities. The SuDS system will be maintained by way of an appropriate management scheme operated by the Local Authority or private management company. The below ground drainage system will be adopted and maintained by the drainage authority, Thames Water. Maintenance will ensure that the storm water management system remains functional for the lifetime of the Proposed Development and protect the catchment from increased flood risk.

11.6.21 To minimise the potential adverse environmental effects on Flood Risk and Drainage related matters, the following specific measures are being incorporated into the Proposed Development:

- Compliance with guidance in terms of flood routing and resilience for new developments;
- Provision of a storm water SuDS management system;
- Connection to a point of adequacy on the foul water drainage network;
- Provision of ongoing maintenance for SuDS features, ordinary watercourse and existing artificial water bodies.

11.6.22 The Proposed Development has been designed to provide a long term **minor beneficial** effect on the site following implementation of mitigation measures.

Contamination of Surface Waters from On-Site Activities

11.6.23 Guidance published in CIRIA C522, SuDS Design Manual for England & Wales, recommends that surface waters from development being primarily of a residential nature have at least one stage of treatment through an appropriately sized sustainable drainage feature. Similarly, at least one treatment stage should be provided on a non-trunk road. Two levels of treatment are recommended for higher risk commercial and industrial areas.

11.6.24 In any higher polluting areas, two stages of treatment will be employed by implementing a management train approach of pre-treatment prior to discharge to the underlying strata.

11.6.25 Recently published research and procedures, outlined in CIRIA C609, shows that the incorporation of a treatment train as part of a sustainable urban drainage system provides the most effective method of removing polluting materials from surface water. Removal of between 80 - 95% of the suspended solids, heavy metals and oils can be achieved. Corresponding reductions in Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) can also be achieved.

11.6.26 The FRA outlines a proposed storm water management system providing a SuDS management train, incorporating source control measures and infiltration drainage systems.

11.6.27 The SuDS scheme will form part of the development's Green Infrastructure framework providing both a drainage and ecological as well as recreational function.

11.6.28 The drainage proposals contained within the FRA demonstrate compliance with current guidance by providing appropriate sustainable drainage features that passively treat storm water from the site, ensuring no deterioration in water quality.

11.6.29 Surface water run-off from all hardstanding areas will be collected in a piped drainage system and conveyed via gravity through the internal road network before out-falling to the proposed basins situated adjacent to the watercourses on site.

11.6.30 By introducing Sustainable Drainage measures, the design takes account of the potential accelerated run-off and reduced times of concentration associated with hard paved areas to avoid increasing peak storm water discharge and consequential flood risk.

11.6.31 Therefore, the adoption and integration of SuDS measures into the Proposed Development will deliver a range of potential benefits relating to flood-risk and drainage, as set out in the appended FRA report (Appendix 11.1). This will provide benefits both on and off-site by controlling and managing storm water and releasing it into the wider network in a managed, predictable way. This includes in the context of climate change which is generating changing weather patterns and more dramatic storm events, requiring resilient, well designed and maintained drainage systems.

11.6.32 There are also wider benefits from the creation of new water features and habitats for a range of wildlife.

11.6.33 Therefore, there is likely to be a direct, permanent, long term **minor beneficial** effect on the site following implementation of mitigation measures.

Contamination of Surface Water from foul sewer surcharging

11.6.34 The outline SuDS scheme has had regard to sustainable methods that are readily accepted for adoption by the relevant authorities in discharging their maintenance responsibilities.

The SuDS system will be maintained by way of an appropriate management scheme operated by the Local Authority or private management company.

11.6.35 The below ground drainage system will be adopted and maintained by the drainage authority, Thames Water. Maintenance will ensure that the storm water management system remains functional for the lifetime of the Proposed Development and protect the catchment from increased flood risk. Accordingly, it is assessed as having a Negligible effect.

Foul Drainage

11.6.36 When assessing potential effects of the foul drainage, it is important that the proposed system is designed to convey foul waters safely from the site to a suitable treatment facility, without overloading the existing sewerage systems. Furthermore, it is also important that the treatment facility is designed to accommodate the load from the Proposed Development and that this achieves a discharge quality that does not impact on water quality standards in the receiving watercourse.

11.6.37 In the baseline condition, the site does not benefit from a connection to the foul sewerage network. However, DETR Circular 3/99 and Building Regulations state that the first presumption when considering new development is to provide positive drainage from that development in conjunction with the local sewerage undertaker.

11.6.38 The implementation of an adoptable foul drainage network within the site coupled with the potential upgrading to the existing infrastructure network surrounding the site will ensure that the scheme mitigates the likely effects on foul drainage. Accordingly, it is assessed as having a **negligible** effect.

11.7 Residual Effects

11.7.1 There will be no change in long term residual effects to those assessed at section 11.5 above.

11.7.2 Following the implementation of the mitigation measures set out, the residual impacts of the construction phase and the operation phase are as set out in the paragraphs below.

Construction Effects

11.7.3 With appropriate mitigation and regulation through a Construction Environmental Management Plan, no residual impacts are anticipated at the construction stage.

11.7.4 This Chapter identified the following potential construction phase impacts for the proposed development:

- Contamination of Surface Water
- Flooding and changes to baseline drainage hydrology

11.7.5 Mitigation measures have been outlined above in order to mitigate the potential construction phase impacts upon these identified receptors.

11.7.6 Following the implementation of the mitigation measures, the assessments reported above do not identify any likely significant adverse residual impacts. No adverse residual impacts are anticipated either.

11.7.7 During the construction phase, and in the context of the potential impacts summarised above, there will therefore be a 'negligible' residual impact to the identified receptors following mitigation.

Operational Effects

11.7.8 The measures implemented will ensure that following construction, the baseline site situation is not detrimentally altered and as such, no residual impacts are expected.

11.7.9 This Chapter identified the following potential operation impacts for the proposed development:

- Offsite flooding
- Onsite flooding
- Contamination of surface waters from onsite activities
- Increase on foul drainage to the existing network

11.7.10 Mitigation measures have been outlined above in order to mitigate the potential operation phase impacts upon these identified receptors

11.7.11 In particular, the implementation of sustainable drainage systems within the site boundary will provide a long term **Minor Beneficial** effect by improving water quality and reducing peak rates of run-off from the site.

11.7.12 Following the implementation of the mitigation measures the assessments reported above do not identify any likely significant adverse residual impacts in relation to water quality. **Minor Beneficial** residual impacts are anticipated.

11.7.13 During the operation phase there will therefore be a 'negligible' or **Minor Beneficial** residual impact to the identified receptors following mitigation.

11.8 Cumulative Effects

11.8.1 Professional judgement of review of the available data and nearby environment has determined that there no cumulative effects likely.

11.8.2 This is due to the mitigation proposed on site ensuring storm water discharge downstream remains at a constant maximum flow of Greenfield runoff. Surface water discharged from the Proposed Development will need to be treated to improve water quality prior to discharge from the site.

11.9 Summary Statement of Effects

11.9.1 It is anticipated that the construction and operation of the Proposed Development will result in a Negligible effect in terms of hydrology and hydrogeology as surface water and foul water will be effectively managed and controlled.

11.9.2 A detailed FRA in accordance with PPS25 has been undertaken for the proposed site and is set out at Appendix 11.1.

11.9.3 During the construction phase, mobilisation of construction materials and spillages will be controlled by implementation of controlled drainage, good site management and monitoring in the CEMP.

11.9.4 During operation a full drainage system will be installed to control surface water run-off.

11.9.5 During operation a full drainage system will be installed to control foul water collection and discharge.

Table 11.10: Assessment of Significance of Residual Effects

Possible Effect	Duration	Significance unmitigated	Scale	Mitigation	Residual Effect
Construction					
Waterbodies (Flood Risk and Surface Water Drainage)	Temporary	Surface Water – Minor Flood Risk - Minor	Regional	Development located within Flood Zone 1 Implementation of SuDS-based surface water drainage scheme	Negligible
Hydrogeology (Surface water and Groundwater Quality)	Temporary	Groundwater - Moderate	Regional	Implementation of SuDS-based surface water drainage scheme	Negligible
Operational Development					
Waterbodies (Flood Risk and Surface Water Drainage)	Temporary	Surface Water – Moderate Flood Risk - Moderate	Regional	Development located within Flood Zone 1 Implementation of standard mitigation measures, comprising a SuDS-based surface	Minor Beneficial

				water drainage scheme	
Hydrogeology (Surface water and Groundwater Quality)	Temporary	Groundwater – Moderate Surface Water - Moderate	Regional	Implementation of standard mitigation measures, comprising a SuDS-based surface water drainage scheme	Minor Beneficial
Drainage Network (Foul and surface water)	Temporary	Foul Sewer Network - Moderate	Local	Implementation of standard mitigation measures comprising a SuDS-based surface water drainage scheme and a fully adopted sewerage scheme by Thames Water	Negligible