12 Hydrology, Flood Risk and Foul Drainage

12.1 Introduction

12.1.1 This chapter of the Environmental Statement (ES) assesses the hydrology, surface water drainage, flood risk, and foul water drainage, associated with the proposed development of land to the west of Hemel Hempstead. The assessment proposes suitable mitigation measures where appropriate.

12.1.2 The assessment has been based on a review of publically available information, walk over survey, measured topographical survey data, drainage assessment using industry standard professional packages, and intrusive ground investigations.

12.1.3 A detailed Flood Risk Assessment (FRA) and Surface Water Drainage Strategy has been prepared in support of the planning application and is provided at Appendix 12.1. The detailed FRA includes copies of all relevant drawings and calculations.

12.1.4 A preliminary Foul Drainage Strategy has been prepared in support of the planning application and is provided at Appendix 12.2 and includes copies of all relevant records and reports.

12.2 Planning policy and guidance

National Planning Policy and guidance

12.2.1 The National Planning Policy Framework (NPPF) (Ref 12.1) and associated Planning Practice Guidance (PPG) provides national guidance to planning authorities, developers, the public, and the Environment Agency (EA), to ensure that flood risk is taken into account at all stages of the planning process.

12.2.2 The Flood Zones are the starting point for the sequential approach identified in the NPPF. The aim of the approach is to steer new development to areas with the lowest probability of flooding.

- Flood Zone 1 (Low probability) comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
- Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.
- Flood Zone 3 (High Probability) comprises land assess as having a 1 in 100 year or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Flood Zone 3 is further subdivided into Flood Zone 3a and 3b, where Flood Zone 3b is 'The Functional Floodplain' typically considered to have an annual probability of flooding of 1 in 20 or greater (>5%) in any year.

12.2.3 The overall aim should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses (reference: Table 2 of the PPG) and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (refer to Table 3 of the PPG). Only where there are no reasonably available sites in Flood

Zone 1 or 2, should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

12.2.4 PPG categorises different types of development into five flood risk vulnerability classifications:

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;
- Less Vulnerable;
- Water Compatible Development.

12.2.5 Subject to the application of the Sequential Test, the PPG specifies which of these types of development are suitable within each zone:

- Flood Zone 1: All land uses are appropriate in this zone;
- Flood Zone 2: Water compatible, less vulnerable and more vulnerable uses of land are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed.
- Flood Zone 3a: Water Compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. More vulnerable and essential infrastructure should only be permitted if the Exception Test is passed.
- Flood Zone 3b: Only water compatible uses and essential infrastructure that has to be there should be permitted in this zone. Essential infrastructure in this zone should pass the Exception Text and be designed and constructed to meet a number of flood risk related targets. The less vulnerable, more vulnerable, and highly vulnerable uses should not be permitted.

12.2.6 Residential development, residential care homes, non-residential educational facilities, are all classified as 'more vulnerable'. Commercial development is classed as less vulnerable.

12.2.7 The Flood & Water Management Act (2010) places duties on the Environment Agency, Local Authorities, developers, and other bodies to manage flood risk. The Act requires the approval of Surface Water Drainage Strategy by the Lead Local Flood Authority (LLFA).

12.2.8 The Pollution Prevention Guidelines (PPG3) produced by the Environment Agency in 2006 provides guidance on where oil interceptors are required, and on what type and size. PPG3 advises that oil interceptors may not be required if Sustainable Urban Drainage Systems (SuDS) are used.

12.2.9 The Pollution Prevention Guidelines (PPG6): Working at Construction and Demolition Sites, provides practical advice and guidance to help prevent pollution for construction sites.

12.2.10 The Pollution Prevention Guidelines (PPG5): provides specific guidance for works and maintenance on or near water to help prevent pollution.

12.2.11 The Land Drainage Act (1991) is legislation that requires a watercourse to be maintained by its owner in such a condition that the free flow of water is not impeded. The legislation identifies the bodies that can be responsible for these watercourses and defines the powers of those bodies. Any works in, over, or under, any watercourse will require consent from the body responsible. The Environment Agency has permissive rights over the maintenance of main rivers whereas the district council has similar rights for ordinary watercourses.

Development Plan Policy

DACORUM BOROUGH COUNCIL LOCAL PLAN

12.2.12 The Application Site is located within the boundary of Dacorum Borough Council. The Local Plan was adopted in 2004 and covered the period up to 2011 (Ref 12.2). In 2007, the Secretary of State saved many policies, but not all of the policies from that Plan. Policies associated with flooding and drainage (i.e. policy 11, 107 and 124) were not saved.

12.2.13 As the adopted local plan does not contain any policies associated to flooding and drainage, the policies within the Core Strategy have been considered for the preparation of this report, therefore are referenced below.

DACORUM BOROUGH COUNCIL CORE STRATEGY

12.2.14 DBC has adopted its Core strategy, which forms a part of the new Local Plan for the Borough, in September 2013 (Ref 12.3). Key policies within the emerging local plan are summarised below.

12.2.15 Policy CS29 on 'Sustainable Design and Construction', states that,

- *'New development will comply with the highest standards of sustainable design and construction possible. With regard to flood risk and drainage, the following principles should normally be satisfied:*
    - *Provide an adequate means of water supply, surface water and foul drainage;*
    - *Minimise impacts on biodiversity and incorporate positive measures to support wildlife;*
    - *Minimise impermeable surfaces around the curtilage of buildings and in new street design'.*

12.2.16 Policy CS31 on 'Water Management', states that,

- *'Water will be retained in the natural environment as far as possible. Measures to restore natural flows in the river systems and the water environment will be supported. Supply to the Grand Union Canal will be maintained.*
- *Development will be required to:*

    (a) avoid Flood Zones 2 and 3 unless it is for a compatible use: Flood Risk Assessments must accompany planning applications for development in these areas, explaining how the sequential approach to development has been taken into account and outlining appropriate mitigation measures;

    (b) minimise water runoff;

    (c) secure opportunities to reduce the cause and impact of flooding, such as using green infrastructure for flood storage;

    (d) secure opportunities to conserve and enhance biodiversity; and

    (e) avoid damage to Groundwater Source Protection Zones'.

Guidance/ Best Practice

STRATEGIC FLOOD RISK ASSESSMENT

12.2.17 A Level 1 Strategic Flood Risk Assessment (SFRA) for Dacorum Borough Council was carried out in August 2007 (Ref 12.4). The primary objective of the SFRA is to identify the areas within a development plan area that are at risk from all forms of flooding.

12.2.18 In June 2008, DBC produced level 2 SFRA document. This has been prepared to assess the residual flood risk from a breach of the Grand Union Canal in Berkhamsted and the residual flood risk from blockage or collapse of the Hemel Hempstead flood relief culvert. (Ref 12.5).

12.2.19 The site was identified within the level 1 SFRA as a proposed development site and it is clear from the data and mapping within the report that the site is not susceptible to flooding.

12.2.20 With reference to future development within the Dacorum BC, Chapter 6.3 of the level 1 SFRA states that;

- *'Use the sequential test to locate new development in least risky areas, giving highest priority to flood zone 1.*
- *SuDS should be a requirement for all new development*
- *All development greater than 1 hectare in size require the following*
    - *SuDS*
    - *Greenfield discharge rates*
    - *1in 100year on site attenuation taking into account climate change.*
    - *Space should be specially set-aside for SuDS and used to inform the overall site layout.'*

12.2.21 Guidance on Sustainable Drainage techniques for managing surface water runoff at new development sites is included in Chapter 6.5 of the level 1 SFRA. Advice relevant to this development site is summarised below;

- *'It is recommended that as part of the outline planning application and site-specific FRA, those proposed developments will need to provide the following (for both greenfield and brownfield).*
    - *Information to demonstrate how the principles of Sustainable Drainage Systems have been applied to the development identifying what techniques will be used,*
    - *A SUDS design strategy which identifies the most suitable options (taking into account specific site constraints) for the design of the surface water drainage system and how it will affect the site layout,*
    - *Plans which show the land has specifically set aside for SuDS, and calculations of the greenfield discharge rate for the site and required attenuation volume for 1 in 100 year rainfall event with consideration of the effect of climate change.*
    - *A long-term management plan to identify future maintenance requirements and responsibilities.*
- *Due to the relatively permeable soil characteristics throughout much of the study area (large areas of alluvium and loam over gravel and chalk within the valleys and upland areas) it is recommended that the priority is given to the use of infiltration drainage techniques, as opposed to discharging surface water to watercourses as directly to the sewer system. However, in areas where there is a high water table, where there are groundwater source*

protection zones or where there are localised impermeable soils (or more widespread areas of London Clay) infiltration techniques will not be viable'.

12.2.22 The SuDS scheme provided within the Flood Risk Assessment (Appendix 12.1) complies with this guidance.

LOCAL FLOOD RISK MANAGEMENT STRATEGY (LFRMS)

12.2.23 Hertfordshire County Council produced the Local Flood Risk Management Strategy (LFRMS) in 2013 (Ref 12.6). The LFRMS aims at effectively identifying the flood risks that arise from local flooding and providing an action plan to manage them.

12.2.24 In relation to flood risk management and SuDS, the LFRMS states:

''Flood risk management offers unique opportunities to achieve a range of social and environmental benefits. These multiple benefits generally arise out of a need to protect the floodplain from development or create flood storage areas, usually through the planning system. Measures such as the use of Sustainable Drainage Systems (SuDS) to manage risk should be considered wherever possible as they can also deliver multiple benefits. These benefits include:

- *Creation of multi-use, open green space;*
- *Amenity enhancement through the creation of attractive landscape features such as swales and bunds and marginal planting;*
- *Habitat Creation and enhancement;*
- *Recreation Features e.g. open spaces such as flood storage areas;*
- *Reduction in Pollutants entering waterways – such as metals and hydrocarbons from roads and car parks, meaning that water entering a watercourse is cleaner;*
- *Passive cooling which helps mitigate any increase in temperatures due to climate change'.*

HERTFORDSHIRE SUSTAINABLE DRAINAGE SYSTEM POLICY STATEMENT

12.2.25 As the Lead Local Flood Authority, Hertfordshire County Council (HCC), produced its sustainable Drainage Policy Statement in March 2015 as an Addendum to the Local Flood Risk Management Strategy (Ref 12.7). The primary objective of the policy statement is to contribute to the achievement of sustainable development and deliver the requirements of the NPPF. Key policies included within HCC policy statement are summarised below.

12.2.26 SuDS Policy 2: Conceptual drainage design:

'During any pre-submission discussion those seeking planning approval must:

a) Demonstrate an understanding of the drainage characteristics: within and outside the development envelope; during flooding; and downstream of the site.

b) Provide an outline assessment of existing geology, ground conditions, contaminant status and permeability through desk-based research and site visit observations. Soakage tests, conforming to industry standards should be carried out at this stage wherever possible.

c) Provide a flow route analysis for existing conditions and modified surface flow pathways as a result of proposed development.

d) Prepare a Conceptual Drainage Plan to show the above together with:

- *the proposed 'management train'*

- *location and type of source control*
- *site controls with storage locations*
- *conveyance routes*
- *the destination of runoff*
- *suggested mitigation proposals for known flood risk issues, or proposed betterment*

e) Provide a Preliminary SuDS Design Statement describing the SuDS proposals in general terms together with the SuDS Design Criteria agreed for the site and initial thoughts on how the site will be maintained'

12.2.27 SuDS Policy 3: Outline drainage proposals:

'At the Outline Drainage Design stage those seeking planning approval must submit spatial and technical information to cover all aspects which may or may not have been considered at the pre-submission stage, and furthermore to demonstrate:

a) the SuDS 'management train' in detail

b) 'source control' measures including how they will be managed at adoption

c) the use of sub-catchments

d) 'treatment stages in each sub-catchment

e) conveyance techniques including low flow, overflow and exceedance arrangements

f) the storage hierarchy both spatially and for different return periods.

g) how flows and volumes are controlled

h) the final site runoff arrangements

i) results of soakage tests

j) an initial health and safety assessment which assesses risks and proposes how these will be managed to an acceptable level

k) how any contaminants will be dealt with

This above should be accompanied by the following:

a) A SuDS design statement describing the SuDS proposals in detail terms together with how they meet the SuDS design criteria identified for the site at the concept stage.

b) A climate change statement.

c) The key operation and maintenance principles'.

12.2.28 SuDS Policy 6: Source Control:

- *Proposals for SuDS must demonstrate that 'source control measures' have been used to intercept runoff as close as possible to where runoff falls as rain, for water quality objectives as much as for attenuation.*
- *The source control features must be illustrated on Outline and Detailed drainage plans indicating both the type and extent of technique being used.*
- *The source control features must also be described in detail in each iteration of the SuDS design statement with clear requirements for ongoing maintenance into the future.*

12.2.29 SuDS Policy 13: Runoff Destination

- *Proposals for SuDS must result in discharge into the ground, to a surface water body or, where these can be demonstrated to be impractical, to the storm sewer or combined sewer where no storm sewer is available.*
- *The destination of runoff (drainage route) for proposed SuDS must be justified in accordance with the SuDS standard requirement for runoff destination using a methodology acceptable to Hertfordshire County Council and the Local Planning Authority.*

12.2.30 SuDS Policy 15: Water Quality

- *Proposals for SuDS must demonstrate that sufficient treatment stages are provided in line with the intended site use and sensitivity of the receptor. Where the required number of treatment stages cannot be provided acceptable justification for derogations sought on the basis of the 'sensitivity' of receptors or not being 'reasonably practicable' must be provided.*

12.2.31 SuDS Policy 16: Design and flood risk:

- *The design of the SuDS must demonstrate:*

  a) The management of water falling directly on the development site by SuDS.

  b) The management of existing and predicted overland flows entering the site from adjacent areas.

  c) The management of runoff produced by impermeable areas on site to prevent increase in flood risk downstream (unless an area is designated for flood management in the Local Flood Risk Management Strategy).

- *Flooding must not occur:*

  a) On any part of the site for a 1 in 30 year rainfall event.

  b) During a 1 in 100 year rainfall event in any part of:

  - *a building (including a basement)*
  - *utility plant susceptible to water (e.g.: pumping station or electrical sub-station)*
  - *on neighbouring sites during a 1 in 100 year rainfall event*

- *Flows that exceed design criteria must be managed in flood conveyance routes (exceedance routes) that minimise risks to people and property both on and off the site.*
- *Consideration must be given to increase in rainfall intensity due to climate change; increased runoff due to urban creep; and potential for blockage at any of the control structures. These considerations must be factored into the calculations for the 1 in 30 and 1 in 100 year design calculations.*

12.2.32 The use of Sustainable Urban Drainage techniques for the infiltration and attenuation of surface water runoff has be discussed within the Flood Risk assessment (Appendix 12.1), which has ensured that policy and guidance, such as that required under the Local Plan, National Planning Policies, the Flood and Surface Water Management Act 2010 and the recently released national SuDS Guidance, are all met and satisfied.

GROUNDWATER PROTECTION: PRINCIPLES AND PRACTICE (GP3)

12.2.33 This document published by the Environment Agency provides guidance on the requirements and interventions required when designing infiltration systems to protect groundwater (Ref 12.8). It sets out a series of position statements about the approach to managing and protecting groundwater. However, this GP3 document was withdrawn on the 14th March 2017 and subsequently replaced by a set of Groundwater Protection Guidance Document which include the following guidance document related to this assessment.

- *Protect groundwater and prevent groundwater pollution*
- *Groundwater protection technical guidance*
- *Groundwater protection position statements*
- *Infiltration systems: groundwater risk assessments*

12.2.34 Statement G12 and G13 of the 'Groundwater Protection Position Statement' are relevant to this development and therefore reproduced below;

12.2.35 G12 - Discharge of clean roof water to ground;

The discharge of clean roof water to ground is acceptable both within and outside SPZ1 provided that all roof water down-pipes are sealed against pollutants entering the system from surface run-off, effluent disposal or other forms of discharge. The method of discharge must not create new pathways for pollutants to groundwater or mobilise contaminants already in the ground.

12.2.36 G13 - Sustainable drainage systems;

We support the use of sustainable drainage systems (SuDS) for new discharges. Where infiltration SuDS are to be used for surface run-off from roads, car parking and public or amenity areas, they should have a suitable series of treatment steps to prevent the pollution of groundwater.

Where infiltration SuDS are proposed for anything other than clean roof drainage (see G12 - discharge of clean roof water to ground) in a SPZ1 we will require a risk assessment to demonstrate that pollution of groundwater would not occur. They will also require approval from the SuDS approval body (SAB), when these bodies have been established, to ensure they follow the criteria set out in the SuDS national standards (when published), including standards for water quality, design and maintenance.

DACORUM INFRASTRUCTURE DELIVERY PLAN

12.2.37 An initial infrastructure study of the Borough was undertaken in 2011 followed by a series of updates, the latest in June 2015. The following extract is relevant to the Development;

- *Thames Water has confirmed that the infrastructure upgrades required as a result of the development planned in the Core Strategy is as follows:*
- *With the information that is available to date, Thames Water's modelling and analysis suggested that neither Maple Lodge STW or Blackbirds STW will require significant growth upgrades in AMP6 (2015 to 2020). However ongoing reviews will take place and upgrades may indeed be necessary in AMP7 (2020 to 2025) to cater for the growth envisaged.*
- *Berkhamsted's WWTW has recently been upgraded. There are no current plans to*

significantly upgrade the sewage treatment works but Thames Water will keep this under review to ensure the levels of growth can be catered for at the sewage works. Network upgrades are likely to be required and may require developer funding contributions.

Legislation

THE FLOOD AND WATER MANAGEMENT ACT 2010

12.2.38 The Flood and Water Management Act (Ref 12.8) seeks to provide better, more comprehensive management of flood risk for people, homes and businesses. Two of the key features contained in the Act are;

- *To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods.*
- *To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments.*

12.2.39 Water quality within the local area of the Proposed Development is currently regulated according to the following key European Commission (EC) Directives. These Directives set out standards for water quality and impose monitoring requirements.

WATER INDUSTRY ACT 1991

12.2.40 The Water Industry Act, 1991 (Ref 12.xx) sets out the regulatory controls and restrictions relating to the supply of water and adoption of sewerage services.

NITRATES DIRECTIVE

12.2.41 The European Commission's Nitrates Directive (European Commission, 91/676/EEC) (Ref 12.9) aims to reduce water pollution by nitrate from agricultural sources and to prevent such pollution occurring in the future. The directive requires DEFRA to identify surface or groundwater that are, or could be high in nitrate from agricultural sources. Nitrogen is one of the nutrients that can affect plant growth. Surface waters also have to be identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water. Once a water body has been identified, all land draining to that water is designated as a Nitrate Vulnerable Zone.

WATER FRAMEWORK DIRECTIVE

12.2.42 The European Commission's Water Framework Directive (WFD) (European Commission, 2000/60/EC) (Ref 12.10) seeks to protect, improve and maintain the environmental condition of surface and ground waters. Under the WFD, all inland, estuarial and coastal waters must aim to achieve "good ecological status" by 2015. The WFD aims to do this through the implementation of River Basin Management Plans (RBMPs). The RBMPs set out environmental objectives for all groundwater and surface water bodies and Protected Areas within a River Basin district (RBD). The plans include a programme of measures to meet these objectives. Existing directives have already brought into force measures that are relevant to the implementation of the WFD and some of these are new since the WFD was implemented, some have been re-codified, and some repealed.

12.3 Assessment methodology

12.3.1 The ES chapter considers four main elements; 1) drainage, 2) flood risk, 3) surface water quality and 4) foul drainage. This approach has also been recommended by the HCC's response to ES scoping document. The full application for the first phase of 350 dwellings and the outline application for the rest of the development are considered within the ES chapter.

Scoping Opinion

12.3.2 In relation to Flood Risk, drainage and foul sewers, followings comments/responses have been received for the scoping assessment.

Table 12.1 Consultee Comments

Consultee	Comment	Response/where this is addressed
Hertfordshire County Council (Lead Local Flood Authority (LLFA))	Hertfordshire County Council requires a surface water drainage assessment to be carried out to demonstrate that the proposed development would not create an increased risk of flooding from surface water to the development site and the surrounding area. This should be carried out in accordance with the NPPF and the NPPG.	A surface water drainage assessment is included within the FRA (please refer to Appendix 12.1).
Hertfordshire County Council	Due to the nature of the development, the LLFA would expect the development to demonstrate that the surface water drainage from the development can be managed in a sustainable manner, giving priority to above ground storage and source control. This should be done by giving preference to infiltration, subject to the geology of the site and ground water conditions then discharge to a watercourse and a surface water sewer.	This has been addressed within FRA (please refer to Appendix 12.1) and will be considered further during the detailed design stage.
Hertfordshire County Council	Any FRA submitted to support any future planning applications should demonstrate that the proposed drainage system can be designed to cater within the site and the post development surface water run-off rates and volumes for its lifetime for all rainfall events up to and including the 1 in 100-year rainfall event + 40% allowance for climate change. The FRA should also demonstrate that any existing areas of surface water flood risk can be managed within the site without increasing flood risk elsewhere.	Climate change has been taken into account within the proposed surface water drainage calculations, which are included within the FRA (please refer to Appendix 12.1).

Consultee	Comment	Response/where this is addressed
Hertfordshire County Council	Where it will be proposed to infiltrate, ground investigations should be carried out and a summary should be provided within the FRA. The full geotechnical investigation could be provided as a standalone document as along as all the required information is provided. This should include a detailed assessment of ground conditions, groundwater levels, permeability of the underlying geology, with infiltration tests carried out in accordance BRE Digest 365.	Hydrogeological conditions of the site have been considered whilst preparing the proposed drainage strategy. (please refer to Appendix 12.1). To assess the risk to groundwater from the surface water discharges into the ground, a standalone Hydrogeological Risk Assessment Has also been prepared (please refer to Appendix 12.1-sub appendix K).
Hertfordshire County Council	The FRA should also demonstrate that there will be sufficient surface water quality treatment by implementing an appropriate amount of water quality treatment stages through the use of Sustainable Urban Drainage Systems (SuDS). We would recommend a minimum of two SuDS treatment stages should be provided to manage any potential contaminants from surface water run-off from car parking areas and access roads.	Water quality treatment have been achieved via open space SuDS which is the principal method for attenuation of surface water. This has been addressed within the FRA (please refer to Appendix 12.1).
Hertfordshire County Council	Details of required maintenance of any SuDS features and structures and who will be adopting these features for the lifetime of the development should also be provided.	Noted, ES will ensure that maintenance measures will be included as part of the detailed design.
Hertfordshire County Council	It is important that the ES addresses all risks of flooding including fluvial, surface water and groundwater, on and off site, to ensure that the risk of flooding does not increase as a result of the development	please refer to Appendix 12.1
Dacorum Borough Council	Include an assessment of the potential impact of the proposal upon the designated sites of ecological importance such as Site of Special Scientific Interest (SSSI) - Roughdown Common, Ashridge Commons & Wood and Little Heath Pit and Special Area of Conservation (SAC) - Chilterns Beechwoods	Only Roughdown Common SSSI is located downstream of the proposed development site. However, this site is located outside of the potential surface water receptors of Grand Union Canal or River Bulbourne and therefore, will not be considered within the hydrogeology ES assessment.
The Environment Agency	Dacorum Borough Council have consulted the Environment Agency and informed that the EA have no significant comments to make at this time.	n/a

Consultee	Comment	Response/where this is addressed
Thames Water	Thames Water emphasise the importance of early consultation as water and waste water infrastructure is essential particularly for a development of this scale.	With regard to foul sewers, Thames Water has been consulted and a standalone foul water assessment has been prepared. Please refer to Appendix 12.2

Baseline Data Collection

12.3.3 The hydrological site conditions and flooding have been determined by assessing maps and other published information regarding topography, soils, geology and hydrology. In addition, the Environment Agency has been consulted regarding flood risk and any historical and current flood data.

12.3.4 Thames Water Utilities have been consulted in respect of foul water drainage and treatment capacities and have provided record plans for their adjacent foul drainage networks and commented on network and waste water treatment capacities.

12.3.5 A site specific Geo-environmental report which includes an assessment to determine the site suitability for infiltration SuDS and a Hydrogeological Risk Assessment have also been prepared by REC Ltd.

Existing Drainage Characteristics

12.3.6 A review of the topographic survey, Ordnance Survey drawing and Thames Water sewer records was undertaken to assess the existing drainage system of the site.

12.3.7 This review of the existing site drainage enables the incorporation of SuDS techniques, where possible, into the surface water drainage designs for the proposed development. The results of this exercise are set out in the FRA (Appendix 12.1).

12.3.8 The use of sustainable drainage systems (SuDS) is promoted within the national/local guidance to manage surface water on new developments. SuDS are an alternative approach to managing surface water runoff, which strike a balance between the management of surface water and the need to conserve natural resources. The three main principles are:

- Reduction of quantity, in particular the large peak runoffs during a storm event which cause flooding of the receiving waters;
- Improvement of quality, by reducing the level of pollution entering the receiving waters; and
- Enhanced amenity, such as community facilities, landscaping potential and wildlife habitats.

12.3.9 Issues relating to foul drainage, including capacity issues, have been investigated by the design team through consultation with Thames Water.

Flood Risk

12.3.10 The flood risk assessment has been undertaken in accordance with the guidance produced by the EA and using the parameters set out in national standards and guidelines.

12.3.11 The Flood Risk Assessment considers whether the Proposed Development is appropriate in planning terms and the impact of the Proposed Development on the local hydraulic regime. This also includes a review of Proposed Development proposals and an identification of any areas likely to be at risk of flooding. All the sources of flooding referred to within the guidance have been assessed, which include tidal, fluvial, groundwater, overland flow, failure of the urban drainage system and failure of the local infrastructure.

12.3.12 A detailed Flood Risk Assessment has been produced to accompany the proposed planning application. This forms an Appendix to the ES chapter (Appendix 12.1) and covers the technical aspects of the flood risk, and surface water drainage strategy.

Surface water and groundwater Quality

12.3.13 Information on the quality of any groundwater source protection zones, rivers and watercourses within the site or in an area of approximately 1km around the Site was collected from the Environment Agency's website. The assessment considered the potential for these water features to be impacted by the Proposed Development, during the construction and operational phases.

12.3.14 The methodology utilised for the assessment of the above elements is outlined below.

Receptor Types and Locations

12.3.15 The assessment of the potential effects of the development on the hydrology, water quality foul sewerage networks and flood risk to the site, surrounding areas and relevant receptors have been undertaken.

12.3.16 There is potential for any changes to surface water runoff or groundwater levels to affect the hydraulic regime of the site. The types of receptors potentially at risk from a change in hydraulic regime are the groundwater resources, proposed residential receptors on site and those within the downstream watercourses. The latter will include designated sites which are located within the catchment area of River Bulbourne/Grand Union Canal.

12.3.17 The receptors will be classed as follows:

- on-site –groundwater source protection zones and premises within the proposed development;
- site-adjacent – groundwater source protection zones, premises & watercourses, surface water sewers adjacent to the proposed development; and
- site adjacent - local foul sewerage networks
- site-distant – premises away from the local area at or en-route to the water processing /disposal point (WWTW).

12.3.18 The impact of the proposed deep-bore infiltration soakaways is considered to be a significant potential risk for groundwater. It is assessed in greater detail within ES Appendix 12.1-sub appendix K.

Receptor Sensitivity

12.3.19 The sensitivity to any change in environmental conditions of a receptor and the site-specific attributes and their sensitivity are explained below.

- High - Attributes that have a high quality and rarity on a local scale are classified as having a high sensitivity. The following have been identified as high sensitivity receptors.
    - River Bulbourne & Grand Union canal (main rivers >10m wide) or designated sites of SSSI and SAC
    - Flood Zone 3a (High probability) area at high risk from a river flood event less than or equal to the 1 in 100-year event
    - Local foul sewerage network
- Medium - Attributes that have a medium quality and rarity on a local scale are classified as having a medium sensitivity. The following have been identified as medium sensitivity receptors.
    - Ordinary watercourse (>5m wide)
    - Flood Zone 2 (Medium probability) area at medium risk from a river flood event between the 1 in 100 and 1 in 1000-year event
    - Groundwater source protection zone 3 (total catchment area)
- Low - Attributes that have a low quality and rarity on local scale are classified as having a low sensitivity. The following have been identified as low sensitivity receptors.
    - Unclassified field drain which is therefore likely to be <5m wide
    - Flood Zone 1 (Low probability)

Magnitude of Impacts

DETERMINATION OF THE MAGNITUDE OF FLOOD RISK AND SURFACE/FOUL WATER DRAINAGE IMPACTS AND THEIR SIGNIFICANCE

12.3.20 The assessment of the magnitude of impact during both construction and operation of the proposed development has been undertaken by calculating the scale at which the proposed development impacts upon the existing hydrology, flood risk & drainage, water quality and foul drainage.

12.3.21 Flood risk impact magnitude has also been determined by applying a qualitative approach. This has followed the following steps:

- Comparison of relevant EA flood mapping and EA flood level survey data with the topographical survey and visual inspection of the Proposed Development layout to determine current flood risk to the Site and site sensitivity;
- Collation of all records relating to historic flooding from all sources, including nearby sewers; and
- Coordination with the proposed drainage strategy to ensure SuDS techniques are adopted and betterment over existing surface water drainage arrangement is achieved, thereby reducing the flood risk and magnitude of impact from the Site.

12.3.22 The magnitude of an impact can be negligible or either positive or negative. The magnitude of change associated with flood risk and drainage and surface water quality and example criteria can be broadly defined as follows in Table 12.2.

DETERMINATION OF SURFACE WATER QUALITY IMPACTS AND THEIR SIGNIFICANCE

12.3.23 The magnitude of potential impacts during both construction and operation of the Proposed Development has been assessed using the criteria presented in Table 12.2. The magnitude (scale of change) is determined by considering the degree of deviation from the baseline conditions and whether this is likely to result in any changes in the use of the receptor concerned.

12.3.24 In determining the scale of effects some consideration has to be made regarding the likelihood of impact occurring under normal operating conditions. Where accidental events could arise, but are of a very low likelihood, this is clearly stated.

12.3.25 Surface water quality impact magnitude has been determined by applying a qualitative conceptual model approach. This requires the identification of a source of impact, pathway to the receptor and the likelihood of the impact occurring, for the various activities associated with construction and operation. This has involved the following steps:

- A review of the key activities likely to occur on the construction site and within the operation of the development;
- Determination of the risks associated with the development's construction and operational activities identified;
- Determination of the likelihood of a pollution incident and its severity. This is based on historic evidence of construction site pollution incidents, operational known pressures to the water environment from similar developments, and the nature and scale of the site activities; and
- Determination of the likelihood of change to existing WFD status of water bodies affected and effects on their progress towards meeting future target status. This is achieved by undertaking a review of the chemical failing elements and existing surface water quality pressures on the water bodies concerned.

12.3.26 The magnitude of change associated with surface water quality can be broadly defined as shown in Table 12.2.

Table 12.2 Assessing the Magnitude of change Magnitude of Impact on Flood Risk/Drainage, Water Quality and foul drainage.

Magnitude of Impact	Criteria - Change predicted as a result of the proposals
High – negative	A pollution incident or release during construction or operation of a development likely to result in a major pollution incident. A significant change (reduction) in the water body's existing failing physico chemical elements and the addition of new failing chemical elements resulting in a substantial change in current WFD physico chemical status. Therefore, significant increased pressure in meeting target status. A significant negative change in hydromorphological characteristics of the water feature which would affect the water body's existing WFD ecological status. Therefore, significant increased pressure in meeting WFD ecological target status as a result of the proposals. Indirect increase in flood risk elsewhere. Additional foul flows from the development site into the local treatment works
Medium - negative	A pollution incident or release during construction or operation of a development likely to result in a moderate or minor pollution incident. A moderate change (reduction) in the water body's physico chemical elements resulting in a moderate change in current WFD physico chemical status. Therefore, moderately increased pressure in meeting target status.

Magnitude of Impact	Criteria - Change predicted as a result of the proposals
	A moderate negative change in hydromorphological characteristics of the water feature which would affect the water body's existing WFD ecological status. Therefore, moderate increased pressure in meeting WFD ecological target status as a result of the proposals. Indirect increase in flood risk elsewhere.
Low - negative	Small reduction in water quality. Reduction in the water body's chemical elements but insufficient to change the current WFD chemical status. Therefore, only slight increased pressure in meeting target WFD chemical status. A small change in the hydromorphological characteristics but insufficient to change the current WFD ecological status. Therefore, only small increased pressure in maintaining target WFD ecological status as a result of hydromorphologic change. Indirect increase in flood risk elsewhere.
Negligible	Very low levels of pollution from discharges insufficient to significantly affect water quality. Very low risk of pollution from accidental spillages. No perceptible change in the water body's chemical elements. Therefore, no perceptible change to WFD chemical status of waterbody. No perceptible movement towards or away from the target WFD chemical status.
Low - positive	Improvement in the water body's physico chemical elements but insufficient to change the current WFD chemical status. Therefore, a slight improvement towards meeting target WFD chemical status. Indirect decrease in flood risk elsewhere
Medium - positive	Moderate change (improvement) in the water body's physico chemical elements resulting in a moderate positive change in current WFD chemical status. A limited number of substances previously failing WFD standards, would now pass standards as a direct or indirect result of the proposal. Therefore, a moderate improvement towards meeting target WFD chemical status. A moderate positive change in hydromorphological characteristics of the water feature which would affect the water body's existing WFD ecological status. Therefore, moderate decreased pressure in meeting WFD ecological target status as a result of the proposal. Indirect decrease in flood risk elsewhere
High – positive	A significant change (improvement) in the water body's existing failing physico chemical elements. A large number of previously failing physico chemical elements would now pass WFD chemical standards, resulting in possibly a substantial change in current WFD chemical status. Therefore, a significant improvement towards meeting target WFD chemical status. A significant beneficial change in hydromorphological characteristics of the water feature which would affect the water body's existing WFD ecological status. Therefore, a significant decreased pressure in meeting WFD ecological target status as a result of the proposal. Indirect decrease in flood risk elsewhere.

12.3.27 Magnitude and sensitivity for flooding and drainage, surface water quality and foul drainage attributes are combined as shown in Table 12.3 to determine the significance of the impacts.

Table 12.3 Impact significance

Receptor Sensitivity	Magnitude of Impact			
	High	Medium	Low	Negligible
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible

Level of significance

12.3.28 The level of significance of each impact is determined by combining the impact risk with the sensitivity of the receptor.

- For flood risk and drainage impacts, a level of significance of moderate significance or greater is defined as being significant in EIA terms.
- For surface water and groundwater quality impacts, a level of significance of moderate significance or greater is defined as being significant in EIA terms.
- For foul drainage impacts, a level of significance of moderate significance or greater is defined as being significant in EIA terms.

12.4 Baseline conditions

Existing Surface Water and groundwater

12.4.1 Drainage features such as natural drainage ditches and an existing attenuation pond is identified on the topographical survey plan. The topographical setting of the site suggests that the site has two main drainage catchment areas. The catchment plan is included in the FRA (Appendix 12.1).

12.4.2 The downstream freshwater watercourses shall be regarded as medium sensitivity for water quality based on their size, rarity and existing 'good' water quality status (Ref 12.11).

12.4.3 During the intrusive site investigation work, groundwater was observed at depths ranging between 15.00mbgl in the southern part of the site and 64.00mbgl in the northern part of the site.

Flood risk

12.4.4 A detailed Flood Risk and Drainage assessment has been undertaken in accordance with the guidance produced by the EA, DBC and HCC, and using the parameters set out in national standards and guidelines. This forms a Appendix of the ES chapter and covers the technical aspects of the flood risk and surface water drainage strategy (Appendix 12.1).

12.4.5 The Flood Risk Assessment considers whether the proposed development is appropriate in planning terms and the impact of the proposed development on the local hydraulic regime. This also includes a review of the development proposals and an identification of any areas likely to be at risk of flooding.

12.4.6 The Environment Agency's indicative flood map is included in the FRA (Appendix 12.1). As shown in the Flood Map, the Proposed Development Site is located within Flood Zone 1 (little or no risk of flooding).

12.4.7 All potential sources of flood risk at the Proposed Development Site have been assessed, and the risks of flooding occurring at the Site have all been assessed as low.

Surface Water and groundwater quality

12.4.8 The River Basin Management Plan (RBMP) for Thames river basin district shows the current ecological status of the watercourse downstream of the development site as 'moderate' with the classification of the individual elements as follows:

- Ecological status or potential – Moderate

- Chemical status – Good

12.4.9 The River Basin Management Plan (RBMP) for Thames river basin district shows the current quantitative and chemical status of the groundwater sources underlying the site and surrounding area as 'poor'. The groundwater source protection zone (total catchment) is located to the south of the development shall be regarded as medium sensitivity for groundwater quality based on its existing 'poor' chemical status of water quality.

12.4.10 The Environment Agency's website shows a record of one major pollution incident within a 1km radius of the Site. This incident (incident number 15511) took place in July 2001 within an area circa 200m to the southwest of the Site. The impact to water was classed a 'Significant' and resulted from pollution by 'sewage materials'.

Foul Drainage

12.4.11 The local sewerage undertaker for the area, Thames Water Utilities Ltd (TWU) was consulted in 2016 to understand the available capacity within their local sewer network and also within the Wastewater Treatment Works (WWTW).

12.4.12 TWU confirmed that existing networks adjacent to the Site have limited spare foul capacity to cater for the full development.

12.4.13 A series of discussions took place with TWU to help inform a Foul Drainage Strategy for the Development. These identified the necessary upgrades required to the local foul sewerage networks and treatment capacity to cater for the foul water runoff over the lifetime of the development. A Foul Drainage Strategy has been undertaken for the Development which forms a Appendix to this ES chapter, (Appendix 12.2)

Hydrogeology

12.4.14 A review of the British Geological Survey records for the site indicates that the site is underlain by 'Clay-with-Flints Formation' (clay, silt, sand and gravel) over bedrock, predominantly comprising chalk of the Lewes Nodular and Seaford (Undifferentiated) Chalk Formation. This suggests that infiltration techniques can be utilised for attenuation of surface water runoff from the development.

12.4.15 Review of the Environment Agency's (EA) records confirm that a small part of the site located to the south falls within Zone 3 of a Groundwater Source Protection area (total catchment area). The EA records also confirm that the site is underlain by a 'Principal Aquifer' within the bedrock deposits of Chalk. A Groundwater Risk assessment has been carried out to assess the risk of pollution to groundwater, which confirmed that there is a low risk to groundwater from the proposed development at this location.

12.4.16 To verify above an extensive intrusive geotechnical survey was undertaken by Geotechnical Engineers in April/May 2016. The Phase 1 & 2 Geo-Environmental Site assessment report is included at Appendix 2.1 to ES Chapter 2.

12.4.17 The Solution Feature Occurrence Assessment conducted by Peter Brett Associates (PBA) indicated that the probability of natural cavities occurring across the site was moderately low to moderately high. Figure 3.17 of ES Chapter 3 shows the zones with varying solution feature occurrence potential.

12.4.18 Recommendations for design of soakaways which are included within the Geo-Environmental

Site assessment and the Solution Feature Occurrence Assessment, were fully considered whilst preparing the drainage strategy for the development.

12.5 Potential effects

Construction Phase Effects

SURFACE WATER DRAINAGE & FLOODING

12.5.1 During the construction works there is the potential for a short-term change in the hydraulic regime; potentially leading to ponding of water on site, accidental runoff and increased runoff rates as the impermeable areas are increased. This may impact on local watercourses.

12.5.2 Overall, the adverse impacts associated with the surface water runoff on local watercourses of medium sensitivity, with no mitigation, are considered to be local, temporary, of moderate magnitude and of adverse moderate significance.

FOUL DRAINAGE

12.5.3 Given that there is no existing foul drainage onsite, it is not considered that the proposed on site construction works will affect the local drainage network.

12.5.4 During construction of off-site foul drainage works to form new connections to the TWU sewerage network there is the potential, without mitigation, for impacts of a local temporary, moderate magnitude of adverse moderate significance to occur. A construction environmental management plan will be in place prior to the construction of any new foul sewers which will include appropriate mitigation.

SURFACE WATER AND GROUNDWATER QUALITY

12.5.5 The potential for contamination of controlled waters from site plant and activities during the works can occur from intrusive works or general construction activities. There are a number of materials and wastes or by-products which could arise during the construction activities, and which may give rise to water quality effects within the surrounding watercourses. These materials are summarised below:

- Fine materials (e.g. silts and clays);
- Cement;
- Oil and chemicals (form plant machinery and processes);
- Other wastes such as wood, plastics, sewage, and rubble.

12.5.6 The adverse impacts associated with the site runoff on the water quality of the downstream watercourse of medium sensitivity, with no mitigation, are considered to be local, temporary, of moderate magnitude and of adverse moderate significance.

12.5.7 Given that there is no existing boreholes or infiltration basins on-site, it is not considered that construction works will affect the groundwater sources. A construction environmental management plan will be in place prior to the construction of new foul sewers.

Operational Phase Effects

SURFACE WATER DRAINAGE & FLOODING

12.5.8 The main potential impacts relate to changes to the current drainage regime, which may result in increases in the volume of surface water runoff. This may impact on the local watercourses, local sewers and surface water flooding.

12.5.9 The adverse impacts associated with the surface water runoff on the local watercourses or local sewers of medium sensitivity, with no mitigation, are considered to be local, permanent, of moderate magnitude and of adverse moderate significance.

FOUL DRAINAGE

12.5.10 As a result of the proposed development there will be additional foul water discharges to the existing TWU sewer network.

12.5.11 TWU confirmed that there is insufficient capacity within the local foul sewer network to accept flows from the full Development without implementing upgrades. A maximum of 100 residential units can be connected to the adjacent foul sewer network. The impact of discharging excess flows beyond 100 units to these sewers prior to any mitigation is likely to be local, permanent, of moderate magnitude and of adverse moderate significance.

12.5.12 Thames Water's response also indicates that additional phased improvements to the existing treatment facilities will be necessary to provide sufficient capacity over the lifetime of the development. It is proposed that foul drainage from majority of the site will be discharged into Berkhamsted Waste Water Treatment works (WWTW) via a new foul rising-main.

12.5.13 The impacts on the high sensitivity receptors (i.e. local foul sewer networks), with no mitigation, are considered to be local, permanent, of moderate magnitude and of adverse moderate significance.

SURFACE WATER AND GROUNDWATER QUALITY

12.5.14 There is potential for the operational phase of the development to impact upon the water quality of the watercourses downstream. The operational causes are likely to be significantly different than those experienced during the construction phases. As a result of the development there is potential for an increase in hydrocarbons and other chemical loads; accidental spills and/or other wastes discharged to the surface water and groundwater receptors.

12.5.15 The adverse impacts associated with the site runoff on the water quality of downstream watercourses of medium sensitivity, with no mitigation, are considered to be local, permanent, of moderate magnitude and of adverse moderate significance.

12.5.16 Infiltration drainage techniques at shallow depths in the southern part of the site and deep-bore soakaways in the northern part of the site will be utilised within this development. The adverse impacts associated with the site runoff on the quality of the groundwater sources of medium sensitivity, with no mitigation, are considered to be local, permanent, of moderate magnitude and of adverse moderate significance.

12.6 Mitigation and enhancement

12.6.1 The following Section highlights those elements which have been incorporated within the design of the development to prevent/reduce any potential for adverse impacts on flood risk, drainage, water quality and foul drainage, both for the development and the surrounding environment.

Construction Phase

12.6.2 Potentially significant effects during the construction phase are associated with intrusive works on Site and on the route of the off-site foul water rising main. By employing appropriate site management practices, the potential for contamination of controlled waters from site plant and activities during the works can be minimised. A range of mitigation measures are proposed which will form part of a site-specific Construction and Environmental Management Plan (CEMP) within which all contractor activities will be undertaken.

12.6.3 The following measures to control ground and water pollution effects from construction have been collated from the CIRIA publications 'Control of Water Pollution from Construction Sites' and would form part of the CEMP.

- Protection of existing drainage systems at the start of construction works;
- Management of construction works so as to comply with the necessary standards and consent conditions to be identified by the EA, DBC and HCC;
- Consideration will be given to the appropriate storage of materials in wet weather and certain site activities may be postponed during heavy rainfall to prevent pollution entering watercourses;
- The environmental regulator will be consulted before any mains or tankered water, even if not contaminated, is discharged to the local watercourse;
- Any oil, fuel lubrication and other potential pollutants shall be handled on the Site in such a manner as to prevent pollution of any watercourse or aquifer. For any liquid other than uncontaminated water, this shall include storage in suitable, bunded tanks;
- No extraction, tipping or temporary storage of materials shall take place within an agreed distance of any watercourse unless part of the approved works. Under no circumstances shall tipped material enter any watercourse or culvert without prior consent;
- Provision of self-contained welfare facilities;
- Effective wheel/body washing facilities to be provided and used as necessary;
- A road sweeper to be available whenever the need for road cleaning arises; and
- Vehicles carrying waste material off-site to be sheeted.

12.6.4 The surface water runoff during the construction phase will be managed through a temporary drainage network strategy, whilst the operational strategy is being constructed. The early phasing of the operational surface water drainage strategy and additional temporary construction measures will ensure that the surface runoff is controlled and discharged so as not to increase the overall runoff rate or increase the sediment run-off over what would have been expected from the existing land use.

12.6.5 It should be noted that the change of use from agricultural to developed area will have a beneficial effect with respect to agricultural pollution. Specifically, it will reduce the run-off and leaching associated with sediment, manure, fertilizers, pesticides and herbicides, which currently discharge into the downstream watercourses or could infiltrate into the ground.

Operation Phase

Inherent Design Mitigation

12.6.6 The development will contain two principal drainage networks, consisting of separate foul water and surface water systems, with the surface water from the majority of the site being infiltrated into the ground.

SURFACE WATER DRAINAGE & FLOODING

12.6.7 Where possible, SuDS are incorporated into the outline drainage design owing to their additional environmental and ecological benefits.

12.6.8 The surface water drainage strategy for the proposed development is illustrated in Flood Risk Assessment (Appendix 12.10 which includes drawings 16-021-1004, 16-021-1005, 16-021-1006 and 16-021-1007) and Figure 3.12 –Surface water network overview plan. This incorporates appropriate mitigation measures and includes the provision of Sustainable Urban Drainage Systems (SuDS). Key elements are confirmed within the Figure 3.4 - Hydrology Parameter Plan for the wider site and also Figure 3.6 – Composite Phase 1 Site Layout for the first phase of 350 houses.

12.6.9 The outline drainage design for the site is based upon guidance prepared by HCC and CIRIA Report C753 - The SuDS Manual (Ref 12.12). This is to ensure the protection of water quality and to simulate as naturally as possible the flood hydrograph for the area.

12.6.10 Careful consideration will be given to the development design levels to channel overland flow away from the development (Appendix 12.1 Flood Risk Assessment).

SURFACE WATER AND GROUNDWATER QUALITY

12.6.11 The surface water runoff from potentially polluted areas (e.g. access roads and parking areas) will be discharged via source control measures. This effectively reduces total suspended solids, heavy metals and hydrocarbons from the runoff, providing water quality treatment (Volume 2 – Appendix 12.1 Flood Risk Assessment).

12.6.12 Recommendations for design of soakaways which are included within the Geo-Environmental Site assessment and the Solution Feature Occurrence Assessment were fully considered whilst preparing the drainage strategy for the development. The groundwater source protection zone (total catchment) is located to the south of the development. However, no deep-bore soakaways will be located within the southern part of the site. The maximum depth of deep-bore soakaways proposed for the northern part of the site will be approximately 25.0m below existing ground maintaining more than 10m of unsaturated zone between the base of the deep bored soakaway and the groundwater level, which will mitigate any risk to the groundwater sources.

FOUL DRAINAGE

12.6.13 As there is limited capacity within the existing adjacent foul water sewerage networks beyond

100 residential units TWU have identified a Point of Connection for flows beyond 100 units at the inlet of the existing Berkhamsted WWTW.

12.6.14 In order to connect the Development to this Point of Connection it will be necessary to construct an on-site pumping station and a new dedicated off site rising main between the Development and the WWTW. This off site sewer will be procured through a Section 98 requisition in accordance with the Water Industry Act 1991. This will ensure that the sewer networks continue to operate satisfactorily and that these is no increase in the risk of foul water flooding.

12.6.15 Details of these proposals are set out in Appendix 12.2, which also includes details of the foul water network (see drawings 16-021-1008, 16-021-1009, 16-021-1010 and 16-021-1011). They are also presented in Figure 3.11 - Foul water network overview plan and Figure 3.13 – Pumping station details.

Outline drainage scheme

12.6.16 Key elements of the Outline Drainage Scheme for the Disposal of Surface Water run-off from the different elements within the site as part of the illustrative scheme (Appendix 12.1, Overall Drainage Plan 16-021-1004A, Detailed surface water drainage plans 16-021-1005A to 16-021-1007A inclusive) are as follows:

- Initial infiltration tests on site included within Phase 1 & 2 Geo-Environmental Site assessment (included as an Appendix to the ES Chapter 2) have demonstrated that the site is suitable for infiltration drainage. It is considered that infiltration techniques at shallow depths in the southern part of the site and deep-bore soakaways in the northern part of the site are feasible on this development.
- Attenuation ponds can provide both storm water attenuation water quality treatment and ecological enhancement. The basins with permanent areas of water would be located in the vicinity of the main entrance. Runoff from each rain event is cascaded through the attenuation basins and detained and treated in the pool. The retention time promotes pollutant removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations before discharging at a restricted rate into the public sewer on Long Chaulden.
- Infiltration Basins are alternative open space SuDS attenuation features, which are similar in function to ponds, except that they would not contain areas of permanent water. This would be more typical away from the low areas of the site as there are perceived safety issues concerning open water in close proximity to residential areas.
- Permeable paving is an effective SuDS method of providing a structural pavement suitable for pedestrians and vehicular traffic whilst allowing water to pass straight through the surface into the pavement construction for temporary storage or storm attenuation. Pervious paving will be used for some of the communal car parking and commercial areas. These would provide initial ‘interception’ storage and water quality treatment, but will be designed to fall towards traditional drainage. Permeable paving would also improve water quality by filtration through the pavement as they are an effective ‘first flush’ method of removing total suspended solids, heavy metals and hydrocarbons from runoff.
- Swales are linear vegetated drainage features in which surface water can be stored or conveyed. Swales can provide pre-treatment upstream of the attenuation areas whilst increasing the retention time. Instead of using traditional pipe system, swales will be utilised where feasible to convey the runoff to main attenuation areas within the drainage strategy.

- Due to the gradient of the existing topography, it may be necessary to provide check dams at regular intervals along the swale alignment. Check dams will help to achieve the shallow gradients that are preferable in swale design. This will also increase the storage capacity of the swale and promote low velocities to allow much of the suspended particulate load in the storm water to settle out, thus providing effective pollutant removal.

12.6.17 It should be noted that the change of use from agricultural to developed area will have a beneficial effect with respect to agricultural pollution. Specifically, it will reduce the run-off and leaching associated with sediment, manure, fertilizers, pesticides and herbicides, which currently discharge into downstream watercourses or infiltrates into the ground.

12.7 Residual effects

Construction Phase Effects

SURFACE WATER DRAINAGE & FLOODING

12.7.1 With temporary measures in place as part of the CEMP to limit uncontrolled run-off during the construction period, the impact on the local watercourse with respect to run-off rate will not be greater than the agricultural baseline condition. The impact on the local watercourse of medium sensitivity is considered to be local, temporary, of negligible magnitude and of negligible significance.

FOUL DRAINAGE

12.7.2 By applying the mitigation measures set out in the CEMP residual effects arising from the construction of the off-site sewer network are considered to be local, temporary, of negligible magnitude and of negligible significance.

SURFACE WATER QUALITY

12.7.3 With measures in place as part of the CEMP to limit uncontrolled run-off during the construction period, the impact on the local watercourse with respect to sediment run-off is not judged to be greater than the existing agricultural use. Similarly, with good practice chemical and hydrocarbon run-off should be negligible. The cessation of agricultural activity will have a slight beneficial impact with respect to certain pollutants. The impact on the local watercourse of medium sensitivity is considered to be local, temporary of negligible magnitude and of negligible significance.

Operational Phase Effects

SURFACE WATER DRAINAGE & FLOODING

12.7.4 The completed development will provide on-site infiltration or attenuation of surface water and discharge into the local sewer at a restricted rate not exceeding the existing runoff rate. Therefore, any effects on local sewer network and surrounding land uses are considered to be not significant.

FOUL DRAINAGE

12.7.5 Following completion of the Development the local foul sewerage network and treatment facilities will be upgraded to cater for the additional flows generated by the Development. This results in a predicted direct permanent long term effect of low magnitude and negligible significance on the off-site TWU sewer networks and treatment facilities.

SURFACE WATER AND GROUNDWATER QUALITY

12.7.6 Due to the implementation of SuDS (at source and locally), surface water runoff from the proposed development will be subjected to minimum of two to three levels of treatment prior to discharging into the local sewer. Therefore, the potential impact associated with surface water runoff on the water quality of local receiving watercourses of medium sensitivity, is considered to be negligible, which is not considered to be significant.

12.7.7 To ensure that groundwater quality is not affected, the outcome of the Hydrogeological Risk Assessment (Appendix 12.1-sub appendix K) was considered whilst preparing the drainage strategy. Taking the mitigation into account, the impact on the groundwater of medium sensitivity is considered to be local, permanent of low magnitude and of adverse minor significance.

12.8 Cumulative effects

Surface Water Runoff

12.8.1 There will be no significant interference to any known flood paths for the 1 in 100-year flood event (allowing for climate change) in the implementation of this development, as a result of which there will be no impact on flood risk elsewhere. In addition, the outline surface water drainage strategy will incorporate drainage techniques to reduce surface water run-off rates from the Site to a rate not greater than the existing discharges to the local sewer in Long Chaulden, for storm return periods up to the 1 in 100-year event, allowing for the detrimental effects of climate change. Therefore, it is not considered that there will be significant cumulative impacts on flooding.

Foul Drainage

12.8.2 The foul drainage system for the Proposed Development will be developed in consultation with Thames Water and all necessary upgrades will be phased to accord with increased capacity requirements. All upgrades will be appropriately consented and accordingly it is not considered that there will be significant cumulative impacts on drainage infrastructure.

Surface Water and Groundwater Quality

12.8.3 Proposed is a residential development with a relatively low pollution risk and surface water and groundwater protection measures have been included within the design which complies with the relevant legislation and guidance. Therefore, it is not considered that there will be significant cumulative impacts on surface water or groundwater quality.

12.8.4 Overall, it is anticipated that the proposed development would only have low-level and localised effects that would not affect other sites. As other development comes forward, any potential effects on receptors would need to undergo similar assessment to evaluate the risks and significance, with remediation / mitigation provided as necessary to ensure that development does not give rise to significant adverse effects. It is therefore considered that would be no measurable cumulative effects from other developments when considered together with the proposal at West Hemel.

12.9 Conclusion

12.9.1 The construction and operation of the proposed development could have moderate to slight adverse impacts on the surrounding water environment (in terms of surface water runoff, water quality and foul drainage) should suitable mitigation not be incorporated. However, with the mitigation outlined in section 12.6, the significance of impacts upon the local water environment can be considered to range from minor adverse to negligible. A summary is provided in table 12.4 below.

Table 12.4 Significance of residual impact

Potential impact	Nature of impact	Significance prior to mitigation	Mitigation / Enhancement measures	Residual effect	Significant / not significant
Construction					
Impact upon surface water runoff rate - on local watercourses	Local, temporary, Direct	Moderate adverse	appropriate site management practices will be employed in accordance with a site-specific Construction and Environmental Management Plan (CEMP)	negligible	not significant
Impact upon surface water runoff quality - into local watercourses	Local, temporary, Direct	Moderate adverse	appropriate site management practices will be employed in accordance with a site-specific Construction and Environmental Management Plan (CEMP)	negligible	not significant
Operation					
Surface water runoff rate into local watercourses/sewers	Local, permanent, Direct	Moderate adverse	SuDS will be used to attenuate the surface water runoff from the site to pre-development (greenfield) rates and surface water will be attenuated/infiltrated into the ground.	negligible	not significant
Surface water runoff quality into local watercourses	Local, permanent, Direct	Moderate adverse	SuDS will be used to provide water quality treatment	negligible	not significant
Surface water runoff quality into groundwater sources	Local, permanent, Direct	Moderate adverse	SuDS will be used to provide water quality treatment before being discharged into the soakaways.	Low- negative	not significant
Cessation of agricultural practices on site – impact on local watercourses	Local, permanent, Direct	Minor adverse	none	Low- positive	not significant
Additional foul drainage discharge to new or upgraded sewers	Local, permanent, Direct	Minor adverse	none	Low- positive	not significant
Cumulative Effect					
None		Neutral	None required	Neutral	

REFERENCES

Ref 12.1: National Planning Practice Guidance, http://planningguidance.planningportal.gov.uk.

Ref 12.2: Dacorum Borough Local Plan, 2004

Ref 12.3: Dacorum Borough Council Core Strategy 2006-2031, September 2013

Ref 12.4: Dacorum Borough Council Level 1 Strategic Flood Risk Assessment, August 2007, Halcrow Group Ltd

Ref 12.5: Dacorum Borough Council – Level 2 Strategic Flood Risk Assessment, June 2008, Halcrow Group Ltd

Ref 12.6: Local Flood Risk Management Strategy (LFRMS), Hertfordshire County Council, 2013

Ref 12.7: Hertfordshire County Council Sustainable Drainage Policy Statement, Addendum to the Local Flood Risk Management Strategy, March 2015

Ref 12.8: Department for Environment, Food and Rural Affairs (2010), Flood and Water Management Act, TSO, London

Ref 12.9: The European Parliament and of The Council, 1991, Nitrates Directive, 91/676/EEC

Ref 12.10: European Commission's Water Framework Directive, 2000/60/EC, The European Parliament and of The Council

Ref 12.11: Environment Agency, December 2015, River Basin Management Plan, Thames River Basin District

Ref 12.12: CIRIA. 2016, The Sustainable Drainage (SuDS) Manual -C753, CIRIA, London

Ref 12.13: CIRIA. 2001, Control of Water Pollution from Construction Sites, Guidance for consultants and contractors –C532, CIRIA, London

Ref 12.14: CIRIA. (2001), Control of Water Pollution from Construction Sites, Guidance for consultants and contractors –C532, CIRIA