9 WATER RESOURCES AND FLOOD RISK

9.1 INTRODUCTION

9.1.1 This chapter has been prepared by Peter Brett Associates LLP (PBA) and considers the potential impacts of the Proposed Development associated with the water environment, particularly hydrological and flooding matters, potable water supply and foul drainage. This chapter is supported by the PBA Flood Risk Assessment (FRA) (**Appendix 9.1**) that has been prepared as part of the application and should be read in conjunction with this assessment

9.1.2 This chapter describes:

- Policy context
- Assessment approach
- Baseline conditions
- Assessment of the likely significant environmental effects
- Mitigation measures required to prevent, reduce or offset any significant effects
- Assessment of the likely residual effects after these measures have been employed

9.1.1 The FRA and ES chapter has been produced in consultation with the following stakeholders:

- Environment Agency (EA)
- Oxfordshire County Council (OCC)
- Cherwell District Council (CDC)

9.2 POLICY CONTEXT

National Planning Policy and Legislation

National Planning Policy Framework and Planning Practice Guidance

9.2.1 The National Planning Policy Framework (NPPF) (NPPF, 2012) and the accompanying Planning Practice Guidance (PPG) sets out the Government's policy on development and flood risk. The NPPF aims are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk. In exceptional circumstances where new development is necessary in flood risk areas the policy also aims to ensure it is safe, without increasing flood risk elsewhere, and where possible, reducing flood risk overall.

9.2.2 The NPPF advocates the use of a risk based sequential test, in which new development is directed towards the areas of lowest risk of flooding. The different areas of flooding are defined by the following Flood Zones:

- Flood Zone 1: Low probability of flooding (less than 1 in 1,000 annual probability of river or sea flooding in any year);
- Flood Zone 2: Medium probability of flooding (between a 1 in 100 and 1 in 1,000 annual probability of river flooding and between a 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year);
- Flood Zone 3a: High probability (1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any year); and

- Flood Zone 3b: The functional floodplain (where water is stored in times of flood, including water conveyance routes, annual probability of 1 in 20 or greater in any given year).

9.2.3 In addition, the PPG specifies the type of land use, defined by its flood risk vulnerability that is appropriate in each Flood Zone. For example, more sensitive developments that would be most severely affected in the event of flooding, such as hospitals, should not be permitted in areas at high probability of flooding, although leisure and tourism developments may be allowed in Flood Zone 3a.

9.2.4 In February 2016, the Environment Agency (EA) updated its guidance on Climate Change. This included updating the guidance for peak river flow by river basin district, peak rainfall intensity, sea level rise and offshore wind speed and extreme wave height. For the individual river basin districts, the climate change allowance for peak river flows range from 10% to 70%, while peak rainfall intensity allowance ranges from 5% to 40%.

9.2.5 The 2015 updates to the PPG reflect the updated Non Statutory technical standards for sustainable drainage systems.

<u>The Ground Water Directive (80/68/EEC) and Groundwater Regulations 1998</u>

9.2.6 The Groundwater Directive (80/68/EEC) aims to protect groundwater from pollution by controlling discharges and disposals of certain dangerous substances to groundwater. In the UK, the directive is implemented through the Groundwater Regulations 1998. The Directive aims to protect groundwater under these regulations by preventing or limiting the inputs of listed substances into groundwater. Substances controlled under these regulations fall into two lists.

- List 1 substances are the most toxic and must be prevented from entering groundwater. Substances in this list may be disposed of to the ground under a permit, but must not reach groundwater. They include pesticides, sheep dip, solvents, hydrocarbons, mercury, cadmium and cyanide.
- List 2 substances are less dangerous and can be discharged to groundwater under a permit, but must not cause pollution. Examples include sewage, trade effluent and most wastes. Substances in this list include some heavy metals and ammonia (which is present in sewage effluent), phosphorous and its compounds.

<u>The Water Framework Directive</u>

9.2.7 The Water Framework Directive (WFD) (Commission of the European Communities, 2000) (ref 13.2) establishes a framework for a European wide approach to action in the field of water policy, its ultimate aim is to ensure all inland and near shore watercourses and water bodies (including groundwater) are of 'Good' status or better, in terms of ecology, and also chemical, biological and physical parameters, by the year 2015. Therefore, any activities or developments that could cause detriment to a nearby water resource, or prevent the future ability of a water resource to reach its potential status, must be mitigated so as to reduce the potential for harm and allow the aims of the Directive to be realised.

9.2.8 Classifications for various water bodies are included as part of the River Basin Management Plan (RBMP) for the Severn River Basin District. The RBMP sets out a Programme of Measures (POM) which need to be undertaken in order for each water body to maintain or reach 'Good' status by 2015. The plan also sets out the various standards that each water body has to meet in order to be classified as having good status.

<u>The Water Framework Directive – Groundwater Daughter Directive</u>

9.2.9 The existing 1980 Groundwater Directive was repealed by the Water Framework Directive in December 2013. The new Groundwater Directive (2006/118/EC) is commonly referred to as the Groundwater Daughter Directive.

9.2.10 The Water Framework Directive and the new Groundwater Directive make changes to how groundwater can be protected. These changes will provide a new regulatory setting for the protection of groundwater. However, the new or amended regulations will be no less protective than those already in place. The existing principle of preventing or limiting the inputs of list 1 or list 2 substances respectively into groundwater under the original Groundwater Regulations 1998 will remain, but will be expanded to encompass all pollutants (any substance liable to cause pollution). For example, nitrate will be included as a pollutant.

The Water Resources Act

9.2.11 The Water Resources Act 1991 (HSMO, 1991a) in particular Section 92(1)(a) stipulates that the Secretary of State may make provisions to prohibit "a person from having custody or control of poisonous, noxious or polluting matter unless prescribed works and precautions and other steps have been carried out or taken for the purpose of preventing or controlling the entry of the matter into any controlled waters". This has implications for the proposed development in that all potential pollution sources of controlled waters must be mitigated.

The Water Act 2003

9.2.12 The Water Act 2003 (HMSO, 2003) is an amendment to the Water Resources Act 1991 and the Water Industry Act 1991. The four broad aims of the Act are the sustainable use of water resources; strengthening the voice of consumers; a measured increase in competition; and the promotion of water conservation. The Act amends the Water Resources Act 1991 to improve long-term water resource management and amends the Water Industry Act 1991 so that water companies are given a duty to prepare and publicise drought plans; are placed under a duty to agree and publicise water resource management plans; and are placed under an enforceable duty to further water conservation through these measures.

The Flood and Water Management Act

9.2.13 The Flood and Water Management Act 2010 implements several key recommendations of Sir Michael Pitt's Review of the summer 2007 floods, protects water supplies to consumers and protects community groups from excessive charges for surface water drainage. It gives the EA a strategic overview role for flood risk, and gives local authorities (known as Lead Local Flood Authorities, LLFAs) responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas. Oxfordshire County Council (OCC) is the LLFA in this area.

Other National Guidance

- The 'Non-statutory technical standards for sustainable drainage systems' (DEFRA, dated April 2015) should be used in conjunction with the NPPF and PPG. It provides planning guidance for the implementation of SuDS.
- SuDS techniques are described in CIRIA C753 guidance which outlines approaches to deal with surface water as close to the source as possible and reproduce natural drainage patterns to prevent an increase in the volume and peak discharge from development sites.

- Designing for exceedance in urban drainage (CIRIA C635) provides good practice guidance on the design and management of urban sewerage and drainage systems to reduce the impacts from drainage exceedance.
- Sewers for Adoption 7th Edition, provides guidance on the design, construction and maintenance of drains and sewers outside buildings which are to be adopted by a relevant public authority.
- Building Regulations Part H covers Drainage and waste disposal including foul water drainage, wastewater treatment systems, rainwater drainage, building over sewers and separate systems of drainage.
- BS EN 752:2008 – Drain and Sewer Systems Outside Buildings, provides a framework for the design, construction, rehabilitation, maintenance and operation of drain and sewer systems outside buildings.

Local Planning Policy

Oxfordshire County Council Local Flood Risk Management Strategy

9.2.14 The Oxfordshire Local Flood Risk Management Strategy sets out a series of objectives to ensure successful delivery of the strategy across the county:

- Objective 1 Improve Understanding – Understand the different sources of flooding and where flooding is likely to occur, how often and the impacts. An understanding will enable identification and implementation measures to reduce the consequences when flooding does occur.
- Objective 2 Taking a Collaborative Approach – The Oxfordshire Strategic Flooding Group includes representatives from the EA, District Councils, County Council, City Council and Thames Water. The partnership will enable liaison on flood management issues and projects in the area.
- Objective 3 Prevent an Increase in Flood Risk – Work collaboratively with partners to promote sustainable drainage on all proposed developments and redevelopments and invest in permanent and temporary flood alleviation measures.
- Objective 4 Taking a Sustainable and Holistic Approach – Take account of strategic development areas to identify opportunities for holistic approaches to managing flood risk achieving multiple benefits.

Cherwell District Council Local Plan (2006-2031)

9.2.15 Strategic objectives relating to flood risk are as follows:

- SO11 - To incorporate the principles of sustainable development in mitigating and adapting to climate change impacts including increasing local resource efficiency (particularly water efficiency), minimising carbon emissions, promoting decentralised and renewable or low carbon energy where appropriate and ensuring that the risk of flooding is not increased

9.2.16 Policies relating specifically to flood risk are as follows:

- ESD1 Mitigating and Adapting to Climate Change - …Minimising the risk of flooding and making use of sustainable drainage methods
- ESD 6 Sustainable Flood Risk Management - The Council will manage and reduce flood risk in the district through using a sequential approach to development; locating vulnerable developments in areas at lower risk of flooding. Development proposals will be assessed according to the sequential approach and where necessary the exceptions test as set out in the NPPF. Development will only be permitted in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding.

- In addition to safeguarding floodplains from development, opportunities will be sought to restore natural river flows and floodplains, increasing their amenity and biodiversity value. Building over or culverting of watercourses should be avoided and the removal of existing culverts will be encouraged.
- Existing flood defences will be protected from damaging development and where development is considered appropriate in areas protected by such defences it must allow for the maintenance and management of the defences and be designed to be resilient to flooding.
- Site specific flood risk assessments will be required to accompany development proposals in the following situations:
    - All development proposals located in Flood Zones 2 or 3
    - Development proposals of 1 hectare or more located in Flood Zone 1
    - Development sites located in an area known to have experienced flooding problems
    - Development sites located within 9m of any watercourses.
- Flood risk assessments should assess all sources of flood risk and demonstrate that:
    - There will be no increase in surface water discharge rates or volumes during storm events up to and including the 1 in 100 year storm event with an allowance for climate change (the design storm event)
    - Developments will not flood from surface water up to and including the design storm event or any surface water flooding beyond the 1 in 30 year storm event, up to and including the design storm event will be safely contained on site.
- Development should be safe and remain operational (where necessary) and proposals should demonstrate that surface water will be managed effectively on site and that the development will not increase flood risk elsewhere, including sewer flooding.
- ESD 7 Sustainable Drainage Systems (SuDS) – All developments will be required to use SuDS for the management of surface water run-off.
- Where site specific FRAs are required in association with development proposals, they should be used to determine how SuDS can be used on particular sites and to design appropriate systems.
- SuDS should seek to reduce flood risk, reduce pollution and provide landscape and wildlife benefits.

Oxfordshire County Council Preliminary Flood Risk Assessment

9.2.17 In June 2011 Oxfordshire County Council published a Preliminary Flood Risk Assessment (PFRA) to provide a high level review of areas of significant flood risk within the county. The PFRA also includes a broad scale assessment of flood risk from local sources and investigates the consequences of future flooding predicted for the area.

Cherwell and West Oxfordshire Strategic Flood Risk Assessment (SFRA)

9.2.18 Cherwell and West Oxfordshire published a SFRA Level 1 in April 2009. The objective of the document was to "assess and map the different levels and types of flood risk in the study area for the land use planning process".

9.2.19 The report includes overview maps showing flood risk information for the district as well as a more focussed assessment of key study areas. The Upper Heyford settlement is shown in Appendix B, page 92 and shows the site to be away from the Flood Zones associated with the River Cherwell and to be entirely within Flood Zone 1, land with the lowest probability of flooding.

9.2.20 A Level 2 SFRA was produced for Cherwell District Council in March 2012 and includes a detailed assessment of flood risk within the district. The key areas of assessment were for Banbury and Bicester, with four and eight strategic sites assessed respectively. The site does not feature specifically in the Level 2 SFRA.

EA Thames Catchment Flood Management Plan

9.2.21 The Thames Catchment Flood Management Plan (CFMP) published in 2009 outlines the sources and receptors of flooding in the Cherwell catchment and sets out the EA's strategy for managing flood risk within the catchment.

9.2.22 The site lies within the upper northern area of the catchment. The CFMP highlights that for this area it will be important to utilise floodplains and to direct and manage run-off in locations that provide overall flood risk reduction or environmental benefits.

EA River Basin Management Plan – Thames River Basin District

9.2.23 The area of Upper Heyford is part of the Thames River Basin District. The purpose of the river basin management plan is to provide a framework for protecting and enhancing the benefits provided by the water environment. The plan sets objectives for each quality element in every water body, including and objective for the water body as a whole. For most water bodies, the default objective status is *Good*, however some water bodies have less stringent objective have been set where natural conditions, technical feasibility or disproportionate cost make the improvement of the water body impractical.

9.2.24 The plan provides a framework for action and future regulation by summarising the existing mechanism that is used to manage the quality of the water environment. It also summarises the type of action and who needs to do this to achieve the statutory objectives.

EA Catchment Abstraction Management Strategy – West Thames

9.2.25 The area of Upper Heyford is part of the EA's West Thames Catchment Abstraction Management Strategy (CAMS). The EA's CAMS for West Thames set out their policy for managing surface and groundwater abstraction licences and proposals to help recover resources in parts of the catchment where abstraction is unsustainable.

9.2.26 The area of Upper Heyford is in the Middle Cherwell catchment of the EA's West Thames CAMS. The document states Middle Cherwell has local resource status of 'water available for licencing' in the area. Yet the status is overridden by the flow requirements of the Thames, which changes the status to 'water not available for licensing' at low flows.

Guidance

9.2.27 Technical guidance and calculations relating to surface water runoff can be found in DEFRA publication *Preliminary Rainfall Runoff Management* and design guidance on SuDS is available in *CIRIA Manual C753 – The SuDS Manual*.

9.3 ASSESSMENT APPROACH

9.3.1 This section details the methodology used to assess the effects of the Proposed Development and includes some of the material used for assessment

Methodology

9.3.2 The assessment of the likely significant environmental effects has entailed:

- Identifying the flood risk on site
- Reviewing the sensitivity of proposed land uses to the risk of flooding
- Assessing the effect of the construction phases upon the risk of flooding in the local area and water quality in the receiving body
- Assessing the effect of the operation phases upon the risk of flooding in the local area, water quality in the receiving water bodies, existing foul water drainage and potable water in the local area

9.3.3 This chapter has been prepared drawing upon a FRA which has been prepared in accordance with the requirements of the NPPF and the NPPG. The assessment is a qualitative assessment of likely significant effects drawing upon information provided and professional experience of assessing effects for similar developments.

Flood Risk Assessment

9.3.4 Data collected as part of the desk study to inform the FRA includes the following:

- Topographical Survey
- Online flood mapping provided by the EA
- Online geological maps provided by the British Geological Society
- Cherwell District Council Level 1 SFRA
- Cherwell District Council Level 2 SFRA

Assessment of Sensitive Receptors and Significance

9.3.5 A seven-point scale (shown below) has been used to assess the likely significant environmental effects. The significance of a particular effect is gauged, as appropriate, by a combination of the sensitivity of the receptor and the magnitude of the effect.

9.3.6 The sensitivity of the receptor with regards to water resources and flood risk refers to its considered value e.g. as a water dependent ecological habitat, a source of drinking water, a recreational resource, a watercourse with a significant ecological status or a watercourse with a significant history of flooding. This is set out in the table below.

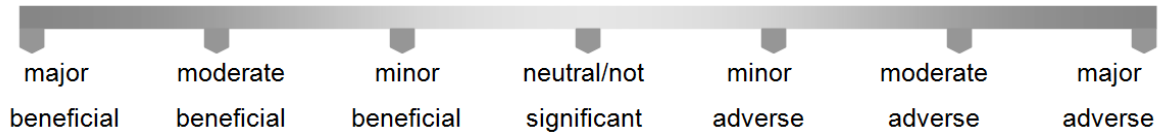
Table 9.1: Sensitivity of Receptors

Sensitivity of the receptor	Description
High	Water resource with an importance at a national level. e.g. A water resource forming part of a Site of Specific Scientific Interest (SSSI), a resource providing potable water on a large scale, a resource with a target ecological status or a watercourse causing significant flooding issues to vulnerable development
Medium	Water resource with an importance at a regional level. e.g. A resource providing potable water on a small scale, a resource with an ecological status to maintain or a watercourse causing flooding issues or with a historical flood problem to less vulnerable development.
Low	Water resource with a low importance at local level. e.g. A non-main river or stream, or waterbody without significant ecological habitat.
Negligible	The sensitivity of the water resource is minimal.

9.3.7 The following factors are considered in determining whether the magnitude of a change with regard to water resources and flood risk:

- Extent - this is the area over which an effect occurs, which could be the overall site, a specific catchment or sub-catchment;
- Magnitude - the size or amount of an effect, determined on professional judgement and on a quantitative basis where possible
- Duration - the time for which an effect is expected to last prior to recovery or replacement of the resource or feature;
- Reversibility - an irreversible (permanent) effect is defined as one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A reversible (temporary) effect is one from which will only occur over a relatively short time frame such as the impact of the construction phase of a development.
- Timing and frequency - some effects are only likely if they happen to coincide with a critical life-stage or seasons. Others may occur if the frequency of an activity is sufficiently high.

Diagram 9.1: Significance Scale



9.3.8 The significance scale is derived from the interaction of the receptor sensitivity and magnitude of change of effect as detailed in the matrix set out in Table 9.2.

Table 9.2: Significance Matrix

Magnitude of Change	**Sensitivity of Receptor**				
		High	**Medium**	**Low**	**Neutral/Not Significant**
	High	Major	Major	Moderate	Neutral/Not Significant
	Medium	Major	Moderate	Minor to Moderate	Neutral/Not Significant
	Low	Moderate	Minor to Moderate	Minor	Neutral/Not Significant
	Neutral/Not Significant	Neutral/Not Significant	Neutral/Not Significant	Neutral/Not Significant	Neutral/Not Significant

Limitation of the Assessment

9.3.9 Given the outline nature of the application, there is only limited information available on the layout of the Proposed Development. Therefore an assessment of the potential effects in principle has been undertaken based upon the land use plan and available scheme information.

9.4 BASELINE CONDITIONS

Site Description and Context

9.4.1 The site is situated near Upper Heyford, Oxfordshire approximately 1 mile north of Caulcott, 1.8 miles east of Steeple Aston and 5.3 miles north west of Bicester. The site comprises approximately 12.5ha of brownfield land referred to as land south of Camp Road, Heyford Park. The site lies to the south west of the former RAF site and is currently accessed off Camp Road.

9.4.2 The site is bounded to the north by the former RAF site, to the east and west by residential dwellings and to the south by fields. There is one watercourse that originates along the southern boundary of the site called Gallos Brook.

Baseline Survey Information

Hydrological Context

9.4.3 The site is situated on high ground with ground levels falling gradually at an approximate gradient of 1 in 160.

9.4.4 It is understood that the majority of surface water from the site currently drains either via a pipe network or via overland flow to a watercourse (Gallos Brook) to the south of the site. The watercourse converges with another brook approximately 2.8 miles south of the site and continues to flow south before converging with Bletchington Stream.

Flood Risk

9.4.5 The EA online flood maps show the site to lie entirely within Zone 1 Low Probability (defined in Table 1 of PPG ID: 7 as land with less than a 1 in 1,000 annual probability of river or sea flooding).

9.4.6 The maps show areas of higher flood risk (Zones 2 and 3) associated with the Gallos Brook at Weston-on-the-Green, approximately 4.4 miles south of the site; however this flood risk does not impact on the proposed development.

9.4.7 The maps also show areas of higher flood risk (Zones 2 and 3) associated with the River Cherwell approximately 0.75 miles to the west of the site; however, this flood risk does not impact the proposed development.

Ground Conditions

9.4.8 Information gathered from the British Geological Survey (BGS) shows the site to primarily consist of limestone. The borehole logs provided by BGS show that the site consists of dark brown sandy, silty clay with large amounts of limestone gravel for the first meter. This is followed by grey course angular limestone gravel in a dense orange brown silty sand matrix. Refer to Chapter 10 for more detailed information on the ground conditions.

Surface Water Drainage

9.4.9 It is understood that surface water drainage from the site is currently conveyed to the Gallos Brook. The highway drainage from Camp Road is collected within a pipe network without any attenuation provision.

Water Quality

9.4.10 The overall objectives for water quality are set out in the River Basin Management Plan (RBMP) for the Thames District. The RBMP sets out the main water body objectives, setting targets for the 2015 status with the main environmental objective to prevent deterioration in the water body status between 2015 and 2021. The RBMP also sets out future targets for 2021, 2027 and sets out deadlines for achieving the planned status.

9.4.11 The site is located in the upper region of the Cherwell catchment. In general, the Cherwell catchment is predominately rural and the RBMP has identified the river basin management issues to tackle in the catchment as being diffuse pollution from agricultural run-off, pollution from waste-water and heavily modified channels.

9.4.12 Surface water quality in most of the catchment is generally 'Good', however, phosphates show a high concentration across most of the catchment due to diffuse and point source input. The catchment also suffers from degraded physical habitat, localised low flows and diffuse pollution.

9.4.13 The Gallos Brook watercourse from source prior to convergence with Bletchingdon Stream is classified as having a 'Poor' ecological status. Chemical quality does not require assessment according to the EA website.

9.4.14 Further downstream following convergence with Bletchingdon Stream, the water quality improves to a 'Moderate' ecological status. Again, chemical quality does not require assessment.

Foul Water Drainage

9.4.15 The existing foul water drainage network is owned and operated by the The Applicant as a private asset.

9.4.16 The Applicant has employed Kelda Water to oversee and manage the existing foul water treatment works on their behalf and to ensure that it is fit for purpose and complies with the discharge consents as set by the Environment Agency.

9.4.17 The foul treatment works are located to the south of Camp Road at the end of an unnamed lane.

Potable Water Supply

9.4.18 The development site is currently within the network area that is supplied by Thames Water (TW). TW record mapping indicates that there is a 355mm dia High Pressure Polyethylene (HPPE) trunk main and a 4" dia Cast Iron (CI) main within Camp Road.

9.4.19 In addition to the TW mains infrastructure there is also a trunk water main within Camp Road that is owned and operated by Albion Water. This main was installed as part of the Bovis Homes residential development to the south of Camp Road.

9.5 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

Construction Phase

9.5.1 The construction of the Proposed Development could affect hydrology, drainage and flood risk. Given the outline nature of the planning application and as a principal contractor has not been appointed only limited information is available on the proposed construction works. Consequently, a detailed assessment of potential effects is not possible at this stage; however, there is sufficient information at outline stage to make an assessment of the potential effects in principle.

9.5.2 This section presents a qualitative assessment of likely effects drawing upon the construction information available and professional experience of assessing the environmental effects of similar developments. Appropriate mitigation measures are identified that will be incorporated into a Construction Environmental Management Plan (CEMP) which will be secured through a suitably worded planning condition.

Flood Risk

9.5.3 The construction works have the potential to produce a temporary change to the surface water regime prior to the drainage network being installed. In particular, the removal of surface vegetation and compaction of the soil has the potential to increase runoff rates. This could potentially increase flood risk.

9.5.4 Intense localised rainfall may cause minor localised flooding within the site. There is considered to be a low risk of flooding to the construction works or workers themselves as the Proposed Development is located within Flood Zone 1. Additionally, this impact will only occur during the construction phase and will be reversed for the operation phase. It is therefore considered that the sensitivity of the receptor is 'Low' and the magnitude of change is going to be 'Neutral/Not Significant'.

9.5.5 The increase in both rate and volume runoff could increase flood risk from the Gallos Brook watercourse downstream of the development site and the drainage network that currently serves land south of Camp Road. A marginal increase in water levels could be experienced in the watercourse, however due to the topography of the site and the rural nature of the immediate downstream catchment; it is unlikely that any receptors would experience an increase in flood risk. Construction of the surface water drainage system as per the drainage strategy (or appropriate temporary alternatives) prior to commencement of each phase of works will remove the risk of increasing peak flood flows from the Proposed Development site as demonstrated by the FRA.

9.5.6 Due to the limited potential for employing infiltration based SuDS during the construction phases, there will be an increase in volumes of runoff where the areas of non-paved ground are replaced with hard surfacing. The surface water drainage strategy described in the FRA has been designed to provide control the additional runoff volume generated during phases of construction. Given that the site already consists of a degree of impermeable surfacing, the magnitude of change in the additional flow from the site is considered to be 'Neutral/Not Significant'.

9.5.7 Therefore, given the sensitivity of the receptor to be 'Low' and the magnitude of change as a result of localised rainfall and additional flow is considered to be 'Neutral/Not Significant', the overall impact on flood risk during the construction phases of development is considered to be 'Neutral/Not Significant'.

Water Quality

9.5.8 The construction for the Proposed Development has the potential to introduce contaminants (through construction plant) and silt into surface water runoff which has the potential to drain to the adjacent watercourse.

9.5.9 Key potential pollution sources from construction activities include:

- Mobilisation and deposition of fine materials (e.g. silts and clays) from the use of machinery and vehicles (e.g. access routes, construction compounds, storage areas);
- Pollution risk in relation to the use of certain materials (e.g. cement, lubricants);
- Accidental leaks or spills during transportation, storage and maintenance;

- Creation of new access tracks for construction related traffic – and with the movement of vehicles to and from and also around the site;
- Soil erosion and increased sediment loading from localised changes to catchment hydrology (e.g. removal of vegetation, compaction of soil surfaces and the excavation of material);
- Concentrated flows of water and the increased potential from erosion and mobilisation, such as along temporary drains in areas with steep gradients; and / or
- Provision of temporary on-site sanitary facilities for construction site staff could also introduce a source of pollution, which is not currently present in the catchment.

9.5.10 Construction of the Proposed Development would be undertaken in phases. For each phase surface water runoff would be managed via temporary attenuation and pollution control systems. On completion, each phase would include relevant permanent attenuation to effectively manage surface water runoff rates and water quality as per the FRA.

9.5.11 The phased nature of the development will mean that the extent of the area affected will be minor. Additionally, the duration of the change will be limited, and reversible.

9.5.12 Therefore, as the sensitivity of receptor is deemed 'Medium' and the magnitude of change is 'Neutral/Not Significant', the overall impact on surface water quality is deemed to be 'Neutral/Not Significant'.

Operation Phase

9.5.13 The submitted design incorporates an outline surface water management strategy which seeks to address the impacts of development upon the water environment. The strategy is presented within the FRA and includes mitigation as follows:

- The built development is sited entirely outside of any identified flood risk areas.
- Measures to reduce runoff rates to match existing greenfield rates to ensure flood risk downstream is not increased.
- Measures to treat runoff water and protect water quality in the receiving water bodies.

9.5.14 As part of the masterplanning process a surface water drainage strategy has been developed to eliminate the risk of surface water flooding for all return periods up to the design event (1 in 100 annual probability event plus a 30% allowance for predicted climate change). The surface water drainage strategy is summarised below.

9.5.15 Typically, the preferred solution for managing runoff would be to utilise infiltration drainage techniques. However, a review of geological mapping suggests that infiltration is unlikely to be a viable method of discharging surface water and that in-situ infiltration testing will be required to determine the latent infiltration capacity of the site. Based on this the FRA concludes that infiltration techniques are unlikely to provide a viable solution to the development's surface water management however this will be confirmed at a later stage following infiltration testing. The general topography of the site means the site will drain to the watercourse, Gallos Brook, to the south of the site with attenuation storage strategically placed near the area of discharge into the watercourse.

9.5.16 Discharge rates will be limited to the corresponding greenfield rate up to the 1 in 100 annual probability greenfield runoff rates of 12.9 l/s/ha. Typically, to manage this additional volume of runoff, the long term volume would be restricted down to 2 l/s/ha. However, in matching the existing greenfield runoff rate mentioned above, the runoff

rate will already be restricted to below 2l/s/ha and should not therefore increase the volume of runoff leaving the site.

9.5.17 Flow rates will be achieved by means of a flow control device and attenuation storage provided in the open attenuation areas.

9.5.18 A portion of the site in the north east corner naturally falls north towards a low spot along Camp Road. It is proposed that this portion of the site will drain to an existing surface water sewer that flows adjacent to Camp Road and outfalls to Gallos Brook. A flow control device will be placed at the outfall to Gallos Brook and runoff allowed to back up into an adjacent attenuation area.

9.5.19 The Proposed Development once completed could lead to potential environmental effects through introducing additional hard standing to the site that may increase the risk of flooding on site and downstream of the site. Mitigation has been proposed as an integral part of the Proposed Development and therefore the following has been assessed in this context.

Flood Risk

9.5.20 The Proposed Development will be situated entirely within Flood Zone 1, meaning the on-site flood risk of the completed development and the end user will be negligible.

9.5.21 Consideration has been given to the potential for the development to increase the risk of flooding on site and in the surrounding areas due to the introduction of impermeable surfaces.

9.5.22 The site will benefit from a formal drainage network, designed to prevent flood risk downstream of the site. The drainage network will attenuate surface water runoff to match existing greenfield runoff rates and not increase flood risk downstream.

9.5.23 Therefore, as the sensitivity of the receptor is 'Medium' and magnitude of the effect is likely to be 'Neutral/Not Significant', the overall impact will be 'Neutral/Not Significant'.

Water Quality

9.5.24 During the operation phase, runoff generated by the development could contain urban pollutants which could enter the adjacent watercourse, increasing pollution levels in the watercourse and downstream of the site. The mitigation strategy (contained within the accompanying Flood Risk Assessment) proposes to use an attenuation pond to remove any undesirables from the runoff.

9.5.25 The Proposed Development will benefit from a formal drainage network that will control all surface water falling on the site. The drainage network will employ a flow control device to replicate the natural drainage processes of the site pre-development.

9.5.26 As the site is currently brownfield with an outdated drainage system, the proposed drainage network will introduce an attenuation basin, therefore, additional steps in the treatment train currently not employed on site.

9.5.27 As the sensitivity of the receptor is 'Medium' and the magnitude of change is 'Neutral/Not Significant' the overall impact on water quality during the operation phase is likely to be 'Neutral/Not Significant'.

Foul Water Drainage

9.5.28 The proposed sewers will be constructed in accordance with Sewers for Adoption 7th Edition and Building Regulation Part H.

9.5.29 Due to the volume of sewerage reaching the already overwhelmed treatment works, a series of upgrades are proposed to identify and correct cross connections with the combined network to the north of Camp Road being separated and reduce the overall volume going to the treatment works. These upgrades will likely consist of a combination of lining or relaying pipe runs. Therefore, the sensitivity of the receptor is 'Medium' and the magnitude of the effect is classified as 'Neutral/Not Significant'. The overall effect is considered 'Neutral/Not Significant'.

Potable Water

9.5.30 TW has undertaken a network capacity investigation based on a peak demand profile for up to 300 residential units. The network capacity investigation identified that there was not sufficient capacity to supply all the proposed development demand.

9.5.31 TW has advised that in order to create capacity within their network they need to lay a 355mm HPPE main along Camp Road linking existing TW distribution mains west and east of the site.

9.5.32 In addition, a booster station may be required for properties at higher ground level although this generally for the site north of Camp Road and subject to a detailed site layout. Therefore, the sensitivity of the receptor is 'Medium' and the magnitude of the effect is classified as 'Neutral/Not Significant'. The overall effect is deemed 'Neutral/Not Significant'.

Decommissioning

9.5.33 Given the nature and intended longevity of the Proposed Developments operational life, decommissioning has not been considered relevant as part of this study. Accordingly, the EIA is to focus on the potential likely significant effects of the Proposed Development during construction and operational phases only.

9.6 MITIGATION AND ENHANCEMENT

Mitigation by Design

Water Quality

9.6.1 The impacts on water quality will be managed by utilising types of SuDS which mimic natural runoff treatment processes. The following types of SuDS features are proposed as part of the surface water management strategy:

- Attenuation basins
- Bioretention
- Swales
- Filter strips
- Permeable pavements
- Vortex control device

9.6.2 The proposed surface water strategy is currently limited by the development being at outline planning stage. The strategy for the north east of the site utilises existing surface water sewers and a flow control device. The south east of the site will utilise strategic swales draining to attenuation ponds. As the design progresses, additional SuDS techniques as outlined above can be detailed to form a comprehensive treatment

train and reduce the magnitude of effect of the Proposed Development on water quality. Further information will therefore be provided as part of reserved matters submission.

Foul Water Drainage

9.6.3 In order to reduce the volume of sewerage reaching the sewage treatment works a series of upgrades will be made to the existing combined sewers to the north of Camp Road. The main improvements will be to identify and correct cross connections and therefore reduce the overall volume of surface water going to the treatment works. A series of upgrades will be undertaken to eliminate such infiltration, either by lining or relaying pipe runs.

Potable Water Supply

9.6.4 To create additional capacity for the proposed development a 355mm HPPE main along Camp Road will be laid to link the existing TW distribution mains west and east of the site. A booster station for properties at higher ground will also be considered.

Additional Mitigation

9.6.5 Additional mitigation techniques are available that can be implemented through the life cycle of the Proposed Development that are not specifically included within the design of the scheme. For the construction phase, a Construction Environmental Management Plan (CEMP) will be prepared to manage the construction processes and would be agreed with the local council prior to the commencement of construction works.

9.6.6 The CEMP will draw upon the EA's Pollution Prevention Guidance and other relevant standards and guidance to ensure that best practice is adopted for all site works. Measures that should be included in the CEMP are anticipated to include:

- The construction works will be managed so as to comply with the necessary standards and consents as identified by the EA and/or the local planning authority, and secured through planning condition;
- Any construction water runoff from the site will require the filtering out of suspended solids before reintroduction to the water system;
- Runoff areas will be identified and water drainage in those areas would be actively managed;
- Water bodies will be monitored regularly to ensure the quality and quantity remains unaffected;
- Areas where contamination may occur will be provided with suitable pollution protection. Storage areas and vehicle refuelling/maintenance areas will be protected by an impervious base, while impermeable bunds of an adequate capacity will be provided around tanks containing potential pollutants;
- Construction plant will have drip trays and undergo regular maintenance checks;
- Pollution control packs will be positioned within vulnerable areas to allow immediate reaction to any pollution incident;
- A toolbox briefing about the importance of the water supply, water bodies and use of pollution control packs will be disseminated to all site staff;
- All fuel and chemical storage will be away (twenty metres minimum) from all watercourses;
- The contractors will be required to use closed circuit wheel and chassis washing facilities located at all site boundary access and egress points;
- Particular care will be taken when working with concrete as it is highly alkaline and can cause serious pollution to controlled waters;

- In the event of a water quality incident the EA will be notified as necessary;
- The potential for flooding will be monitored via weather forecasts; and
- Should the potential for a flood event be identified all potential pollutants will be moved to a safe area and drainage routes checked to make sure they are free from obstruction.

9.6.7 A comprehensive CEMP will ensure that the construction of the Proposed Development will have a minimal impact on flood risk and water quality downstream.

9.6.8 A summary of mitigation measures for the construction and operation phases and how they will be secured are listed in Table 9.3.

Table 9.3: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Ensure all proposed buildings and sensitive uses are located in FZ1.	X		
2	Ensure flood risk downstream is not increased by attenuating surface water runoff and controlling runoff rates leaving the Proposed Development.	X		
3	Implement SuDS techniques to improve water quality	X		
4	Implement a CEMP during the construction phase to help manage the construction process and avoid any environmental impacts			X
5	Upgrade to existing combined drainage network to reduce volume of surface water going to the treatment works.	X		

Enhancements

9.6.9 The mitigation techniques outlined above in Table 9.3 are considered necessary to ensure the development is deemed acceptable and the required planning permission is granted. However, the Proposed Development offers an opportunity to improve environmental aspects of the site.

9.6.10 As outlined in the Section 9.4 Baseline Conditions, the Cherwell catchment as a whole is considered to have relatively poor water quality. Therefore, the surface water drainage strategy contained within the FRA has been designed to provide water quality benefits.

9.6.11 The strategy currently contains strategic swales draining to shallow attenuation basins and flow control devices, with the potential for further upstream SuDS techniques to be utilised as a more detailed masterplan is developed. This strategy will form a comprehensive treatment train that will remove pollutants and improve the quality of water being discharged from the site.

9.6.12 Kelda Water, as the management company on behalf of the Applicant will continue to manage and upgrade the existing foul sewer treatment works to ensure its

continued improvement and to ensure that it meets and exceeds the discharge consent imposed by the EA.

9.7 CUMULATIVE EFFECTS

Baseline Assumption

9.7.1 There are five developments in the local area that are being considered within this EIA as existing, including existing buildings/development within the flying field, existing/new buildings subject to the Outline Consent as confined to the New Settlement Area and three others (Phase 5, Village Centre South and Phase 6) which have not yet been built or consented. It is considered that it would be double-counting if these three were considered as future developments as they fall within the scope of the approved Outline Consent.

9.7.2 It is assumed that the extent planning permission for Heyford Park Camp Road Upper Heyford comprising 1,075 dwellings including retention and change of use of other specified buildings will be in operation upon the completion of the Proposed Development in 2019. The development is subject to local and national planning policy therefore permission would not have been granted if it was anticipated that the development would impose an adverse impact on flood risk, surface water run-off rates or water quality. Due to the nature and scale of the development an FRA was required as part of the planning application. The development is not in an area of water scarcity and potable water resource demands can be accommodated.

9.7.3 It is therefore considered that the Proposed Development, in conjunction with this committed development will not give rise to likely significant cumulative effects.

Future Developments

9.7.4 There are two developments in the local area that are being considered within this EIA including two future development schemes. All of the future developments in the local area are or will be subject to local and national policy that will not grant permission of a development if it anticipated that it will impose an adverse impact on flood risk, surface water run-off rates or water quality within the area. It is therefore considered that the Proposed Development in conjunction with the other future development schemes will not give rise to likely significant cumulative effects.

9.8 SUMMARY

Introduction

9.8.1 This assessment considers the potential impacts of the Proposed Development associated with the water environment, particularly hydrological and flooding matters, potable water supply and foul drainage. This chapter is based on the findings of a Flood Risk Assessment.

Baseline Conditions

9.8.2 It is understood that the Proposed Development site currently drains either via a pipe network or via overland flow to a watercourse that originates from the south of the site.

9.8.3 The EA online flood maps show the site to lie entirely within Flood Zone 1 Low Probability which is land with less than a 1 in 1,000 annual probability of river or sea flooding.

9.8.4 Information gathered from the British Geological Survey (BGS) shows the site to primarily consist of limestone and clay and assumed to have poor infiltration potential.

9.8.5 The site is located in the upper region of the Cherwell catchment. In general, the Cherwell catchment is predominately rural with some urban areas including the towns of Banbury to the north of the site and Oxford to the south. The ecological status of watercourse into which the site currently has been classified as 'Poor' as shown on the EA's website. Once the watercourse has converged with a tributary several miles downstream, the water quality improves to a 'Moderate' ecological status.

9.8.6 The existing combined drainage network is owned and operated by the Applicant as a private asset. The Applicant has employed Kelda Water to oversee and manage the existing foul water treatment works on their behalf and to ensure that it is fit for purpose and complies with the discharge consents as set by the Environment Agency.

9.8.7 With regards to potable water, the development site is currently within the network area that is supplied by Thames Water (TW). TW record mapping indicates that there is a 355mm dia High Pressure Polyethylene (HPPE) trunk main and a 4" dia Cast Iron (CI) main within Camp Road.

Assessment of Likely Significant Effects

9.8.8 The construction and operation works of the Proposed Development could affect hydrology, drainage and flood risk. The works for the development have the potential to increase run-off rates and introduce contaminants (through construction plant and urban pollutants) and silt into surface water runoff which has the potential to drain to the watercourse south of the site.

9.8.9 The submitted design incorporates an outline surface water management strategy which seeks to address the impacts of development upon the water environment. The strategy is presented within the FRA and includes mitigation as follows:

- The built development is sited entirely outside of any identified flood risk areas.
- Measures to reduce runoff rates to match existing greenfield rates to ensure flood risk downstream is not increased.
- Measures to treat runoff water and protect water quality in the receiving water bodies.

Construction Phase Effects

Flood Risk

9.8.10 The construction works have the potential to produce a temporary change to the surface water regime prior to the drainage network being installed. In particular, the removal of surface vegetation and compaction of the soil has the potential to increase runoff rates. This could potentially increase flood risk. However due to the ongoing phased mitigation of the development and the fact that the impact of the construction phase is temporary and reversible, the effects are deemed to be 'Neutral/Not Significant'.

9.8.11 Intense localised rainfall may cause minor localised flooding within the site. There is considered to be low risk of flooding to the construction works or workers themselves as the Proposed Development is located within Flood Zone 1.

Water Quality

9.8.12 The construction for the Proposed Development has the potential to introduce contaminants (through construction plant) and silt into surface water runoff which has the potential to drain to the adjacent watercourse.

9.8.13 The phased nature of the construction process will allow for each phase to manage surface water via temporary attenuation and pollution control systems. However similar to the flood risk effects and the fact that the impact of the construction phase is temporary and reversible, it is therefore assumed that the overall effects on surface water quality would be 'Neutral/Not Significant'.

Operation Phase Effects

Flood Risk

9.8.14 The Proposed Development will be situated entirely within Flood Zone 1, meaning the on-site flood risk of the completed development and the end user is likely to be 'Neutral/Not Significant'.

9.8.15 Consideration has been given to the potential for the development to increase the risk of flooding on site and in the surrounding areas due to the introduction of impermeable surfaces. Therefore, the surface water drainage strategy will store the additional volume of surface water runoff leaving the site and restrict discharge rates to manage the rate of additional runoff leaving the site. Based on this, the flood risk is assumed to be 'Neutral/ Not Significant'.

Water Quality

9.8.16 During the operation phase, runoff generated by the development could contain urban pollutants which could enter the adjacent watercourse, increasing pollution levels in the watercourse and downstream of the site. The mitigation strategy (contained within the accompanying Flood Risk Assessment) proposes to use an attenuation basin and pollution control systems which will introduce an additional step in the treatment train to remove any undesirables from the runoff. It is therefore considered that the effect is likely to be 'Neutral/Not Significant'

Foul Water Drainage

9.8.17 Due to the volume of sewerage reaching the already overwhelmed treatment works, a series of upgrades are proposed to identify and correct cross connections with the combined network to the north of Camp Road being separated and reduce the overall volume going to the treatment works. These upgrades will likely consist of a combination of lining or relaying pipe runs. The overall effect is expected to be 'Neutral/Not Significant'.

Potable Water

9.8.18 The network capacity investigation identified that there was not sufficient capacity to supply the demand of the proposed development. Therefore, a 355mm HPPE main will be laid along Camp Road linking existing distribution mains west and east of the site. The overall effect is therefore expected to be 'Neutral/Not Significant'.

Conclusion

9.8.19 The nature and size of the development means there is potential for the site to have a detrimental impact on the environment. However, the Flood Risk Assessment includes a surface water drainage strategy coupled with the proposed sewerage upgrades means any potential significant environmental impacts related to water

resources and flood risk are mitigated against. This will ensure that Proposed Development is acceptable and does not have a detrimental effect on the surrounding area when compared to the existing use.

9.8.20 Table 9.4 comprises a summary of effects, mitigation and residual effects of the Proposed Development.

Table 9.4: Summary of Effects, Mitigation and Residual Effects.

Likely Significant Effect	Nature of Effect (Permanent/ Temporary/ None)	Sensitivity of Receptor	Magnitude of Change	Mitigation / Enhancement Measures	Geographical Importance* (I, UK, E, R, C, B & L)	Significance of Effects	Residual Effects (Major/ Moderate/ Minor) (Beneficial/ Adverse/ Neutral/Not Significant)
Construction							
Water Quality - Increase in contaminants and silt leaving site to watercourse	Temporary	Medium	Neutral/Not Significant	Implementation of CEMP Implementation of temporary attenuation and pollution controls	Local	Minor to Moderate	Neutral/Not Significant
Flood Risk - Increase of runoff rate due to removal of vegetation and compaction of soil	Temporary	Low	Neutral/Not Significant	Implementation of CEMP Implementation of temporary attenuation and pollution controls	Local	Neutral/Not Significant	Neutral/Not Significant
Operation							
Water Quality - Increase in urban pollutants	Permanent	Medium	Neutral/Not Significant	Implementation of attenuation and pollution controls	Local	Neutral/Not Significant	Neutral/Not Significant
Flood Risk - Increase in	Permanent	Medium	Neutral/Not	Implementation of attenuation	Local	Neutral/Not	Neutral/Not

flood risk on and off site			Significant	and pollution controls Locate all development within flood Zone 1		Significant	Significant