The North Oxford Consortium

Heyford Park

Flood Risk Assessment

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1 Executive Summary

Arup have, on behalf of North Oxfordshire Consortium (NOC), undertaken this Flood Risk Assessment (FRA) for the Heyford Park development (formerly RAF Upper Heyford), Upper Heyford, North Oxfordshire. This FRA will form part of the outline planning submission to Cherwell District Council, who are the local planning authority (LPA).

The North Oxfordshire Consortium aims to develop the area's existing economic, social and environmental characteristics through the provision of multi-million pound enhancement and renewal scheme. The development is situated on the former Royal Air Force (RAF) air base at Upper Heyford and will be known as Heyford Park. The air base is no longer in active service and was last used during the late 20th century by the United States Air Force (USAF). The site was decommissioned from active service in 1994.

The main residential and commercial area located in the south of RAF Upper Heyford is the main area for redevelopment, although the planning consent for development is being sought for the whole site. The proposed site boundary development area encompasses some 516 hectares, while the main area of development is approximately 70 hectares of existing development. In this area consent is being sought for the construction and development of 1000 dwellings and associated commercial/office buildings and also the development of a primary school, shops and recreational space.

The sequential test aims to steer development to the areas of lowest flood risk i.e. flood zone 1. In this instance the Heyford Park development being considered in this FRA, wholly lies outside of the Environment Agency 1% and 0.1% fluvial floodplains and therefore, within flood zone 1. Consequently, the proposed development is located in an area which is considered to have a low probability risk of flooding. As the development site lies wholly within a flood zone 1 it is not necessary to carry out the exception test in this instance.

The Heyford Park site is situated in central England, approximately 7 kilometres north-west of Bicester, in North Oxfordshire (NGR 451420, 225845). The area surrounding the site is predominately rural in nature, with a number of small villages located in the vicinity. The proposed development site is located on a disused military airbase now owned by the North Oxfordshire Consortium (NOC). Construction of the base originally began in 1916 and the site was used by various defence organisations until 1994.

Throughout the design development, consultation and input has been sought from the key stakeholders including the Environment Agency.

This FRA indicated that the potential sources of flood risk to the development site or adjacent areas to be considered are as follows:

- Groundwater;
- Overland flow of surface water;
- Capacity exceedance of artificial drainage systems.

On the basis of this Flood Risk Assessment and the suggested mitigation measures, it is concluded that the proposed development will not adversely affect onsite, neighbouring or downstream developments and their flood risk. Having identified and categorised the potential sources of flood risk, it has also been possible to identify mitigation measures for each of the sources of potential flooding.

If the documented flood mitigation measures are adhered to, it is recommended that the site is considered suitable for the proposed masterplan development.

2 Introduction

Arup have, on behalf of North Oxfordshire Consortium (NOC), undertaken this Flood Risk Assessment (FRA) for the Heyford Park development (formerly RAF Upper Heyford), Upper Heyford, North Oxfordshire. This FRA will form part of the outline planning submission to Cherwell District Council, who are the local planning authority (LPA).

This FRA has been prepared using the precautionary principle to identify and highlight the issues associated with flood risk at the site. This report has been prepared with reference to Planning Policy Statement 25 (PPS25): Development and Flood Risk[1], and follows the methodology prescribed in CIRIA document C624: Development and Flood Risk, Guidance for the Construction Industry[2].

2.1 Development Proposals

The North Oxfordshire Consortium aims to redevelop the area's existing economic, social and environmental characteristics through the provision of a multi-million pound enhancement and renewal scheme. The development is situated on the former Royal Air Force (RAF) air base at Upper Heyford and will be known as Heyford Park. The air base is no longer in active service and was last used during the late 20th century by the United States Air Force (USAF). The site was decommissioned from active service in 1994.

The main residential and commercial area located in the south of RAF Upper Heyford is the main area for redevelopment, although the planning consent for development is being sought for the whole site. The proposed site boundary development area encompasses some 516 hectares, while the main area is approximately 70 hectares of existing development. In this development area consent is being sought for the construction and development of 1000 dwellings and associated commercial/office buildings and also the development of a primary school, shops and recreational space.

2.2 Flood Risk Planning Context

Planning policy guidance exists to ensure that flood risk issues are considered when planning and designing new development. A detailed flood risk assessment is required for most developments at the time of a planning submission.

2.2.1 Planning Policy Guidance Note 25

Now superseded, Planning Policy Guidance Note 25: Development and Flood Risk (PPG25)[3] was published by the Department of Transport Local Government and the Regions (DTLR) in July 2001. PPG25 explained how flooding should be taken into account when planning for development in England. PPG25 defined three principal flood risk zones for fluvial and coastal flooding.

Table 1 from PPG25 (Flood Zones and degree of flood risk):

Flood Zone	Flood Risk •	
1	Little or no risk (Less than 0.1%)	
2	Low to medium risk	River: 0.1-1%
		Tidal & Coastal: 0.1-0.5%
3	High risk	River: 1% or greater
		Tidal & Coastal: 0.5% or greater

Flood Zone 3 was divided into three sections, depending upon the extent of existing development in an area: 3a (developed areas), 3b (undeveloped & sparsely developed areas) and 3c (functional floodplains). Within PPG25 "functional floodplain" was defined as "unobstructed or active areas where water regularly flows in time of flood".

2.2.2 Planning Policy Statement 25

This FRA has been prepared with reference to Planning Policy Statement 25 (PPS 25): Development and Flood Risk[1], and follows the methodology prescribed in CIRIA document C624: Development and Flood Risk, Guidance for the Construction Industry[2]. CIRIA document C624 provides current best practice guidance on the assessment and management of flood risk in relation the built environment.

The Department for Communities and Local Government (DCLG) intend that PPS25, together with the accompanying practice guide, replaces PPG25. The final version of PPS25 was formally launched on 7 December 2006.

Planning Policy Statement 25 outlines contemporary government policy on planning to reduce flood risk and the contribution of best practice drainage techniques to a more sustainable development.

The aim of PPS25 is to ensure that flood risk is taken into account at all stages in the planning process and to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. It does this by formulating a sequential risk-based approach towards flooding to be adopted at all levels of planning. Ultimately, those proposing developments are responsible for:

- Demonstrating that the proposals are consistent with the policies within PPS25.
- Providing a FRA to show:
  1. The proposed development is unlikely to be affected by flooding and whether the development will increase flood risk elsewhere.
  2. The development is safe and where possible reduces flood risk.
  3. Management and funding arrangements to ensure the site can be developed and occupied safely throughout its proposed lifetime.
- Implementing designs which both reduce flood risk for the development and its surrounding area.
- Identifying opportunities to reduce flood risk, enhance biodiversity, protect the historic environment and seek collective solutions to managing flood risk.

• Flood probability is defined by the annual probability of exceedance of a flood event. A 0.1% annual probability event will be equalled or exceeded once every thousand years on average (a return period of 1 in 1000 years). A 0.5% annual probability event has an average return period of 1 in 200 years. A 1% annual probability event has an average return period of 1 in 100 years.

A key difference between PPG25 and PPS25 are changes to the definition of flood zones, the flood risk vulnerability of different land use types has been more clearly defined and the "Sequential Test" now includes an "Exception Test".

PPS25 proposes that where the Sequential Test has been carried out and it is found that certain types of development *may* be permitted within a given flood risk zone the Exception Test may be applied to see whether it is possible to manage flood risk while allowing necessary development to occur.

PPS25 does not change the definition of Flood Zones 1 and 2, but does change the definition of the sub-zones within Flood Zone 3. PPS25 retains the "functional floodplain" as a sub-zone within Zone 3, with an amended definition. These Flood Zones are shown below in Table D.1 from PPS25. Table D.2 of PPS25 (not shown) determines Flood Risk Vulnerability Classification as; Essential Infrastructure, Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible Development.

These two key table are then referenced together to show Flood Risk Vulnerability and Flood Zone Compatibility in Table D.3, shown overleaf.

Table D.1: Flood Zones (as defined by Annex D in PPS 25):

Flood Zone	Definition
Zone 1 **Low Probability**	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2 **Medium Probability**	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.
Zone 3a **High Probability**	This zone comprises land assessed as having a 1 in 100 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.
Zone 3b **Functional Floodplain**	This zone comprises land where water has to flow or be stored in times of flood. Strategic flood risk assessments (SFRAs) should identify this flood zone as land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.

Table D.3 [•]: Flood Risk Vulnerability and Flood Zone Compatibility (as defined by Annex D in PPS25):

	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception Test	✓	✓
Flood Zone 3a	Exception Test	✓	✗	Exception Test	✓
Flood Zone 3b "Functional Floodplain"	Exception Test	✓	✗	✗	✗

✓ Development is appropriate.

✗ Development should not be permitted.

2.3 The Sequential and Exception Tests

A sequential risk based approach to determining the suitability of land for development in flood risk areas is essential at all levels of the planning process. The PPS 25 Sequential Test aims to ensure preference is given to land within flood zone 1 prior to land in zones 2 and 3 being considered for the same development. It also ensures that the flood vulnerability of the proposals is taken into account when locating developments within flood zones 2 and 3.

Should the sequential approach show it is not possible for the development to be located in zones of lower flood risk due to other wider sustainability objectives, it may be possible to show using the Exception Test that the development is still feasible by the management of flood risk.

2.3.1 Sequential Test

The sequential test aims to steer development to the areas of lowest flood risk i.e. flood zone 1. In this instance the Heyford Park development being considered in this FRA, wholly lies outside of the Environment Agency 1% and 0.1% fluvial floodplains and therefore, within flood zone 1. Consequently, the proposed development is located in an area which is considered to have a low probability risk of flooding.

Table D1 in PPS25 indicates that land within flood zone 1 is suitable for all development uses, including buildings used for dwelling houses and classified as "more vulnerable." However, table D1 also advises that developers and local authorities should seek to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

2.3.2 Exception Test

As the development site lies wholly within a flood zone 1 it is not necessary to carry out the exception test in this instance.

[•] This table does not show the application of the Sequential Test (which guides development to Flood Zone 1 first, then Flood Zone 2 and then Flood Zone 3), FRA requirements, or the policy aims for each Flood Zone.

3 Description of the Site

Refer to the Figures in Appendix B.

The Heyford Park site is situated in central England, approximately 7 kilometres north-west of Bicester, in North Oxfordshire (NGR 451420, 225845). The area surrounding the site is predominately rural in nature, with a number of small villages located in the vicinity.

Owing to its central location the area contains a number of strategic transport corridors, shown on the mapping below. The Chiltern Birmingham to London railway line forms part of the site's eastern fringe with junction 10 of the M40 motorway situated half a kilometre to the east.

The western boundary of the site borders Upper Heyford village and the Cherwell Valley. Here the ground topography falls to the west approximately 50m from a site level of 130m AOD to the valley floor. The valley facilitates rail services to and from Oxford and is the through route of the Oxford canal. The River Cherwell, a tributary of the River Thames, flows in a southerly directly along the valley, with The Oxford Canal.

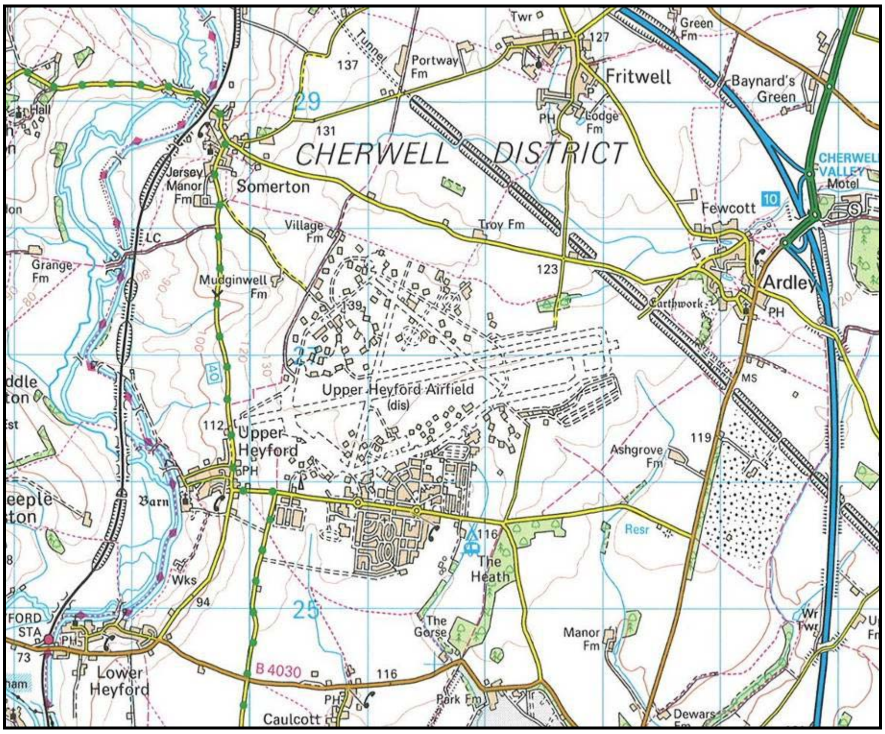

Figure 3.1 Location map of Heyford Park

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3.1 Description of the Heyford Park Site

The proposed development site is located on a disused military airbase now owned by the North Oxfordshire Consortium (NOC). Construction of the base originally began in 1916 and the site was used by various defence organisations until 1994. During the Cold War the base was occupied and developed by the United States Air Force (USAF) to become the largest of its kind in Western Europe. During the 1990s up to 6000 military personnel resided on-site at any one time.

The existing airbase built environment comprises of two distinct areas; the airfield infrastructure to the north and the technical and residential area to the south, which is split by a public highway (Camp Road) running in an east – west direction. The airfield infrastructure contains a mixture of aircraft shelters and other service buildings scattered throughout the area. The concrete central runway crosses the centre of the site in an east-west direction and is served by a number of taxiways and hardstandings.

The inner compound area to the south of the airbase and north of Camp Road has been converted into a large industrial estate (Heyford Park), which accommodates approximately 1000 employees within the existing military buildings. Approximately 300 of the existing site residences have been occupied on a rental basis.

The entire 70 hectare southern area of the site is predominately residential in infrastructure. However, in the past facilities such as sports pitches, hospitals, fuel station and shops (one of the shops is still trading) also occupy this area.

3.1.1 Existing Hydraulic Features

There are no existing hydraulic features located on the development site. The site is located on the top of a plateau, which is approximately 130m AOD in level.

There are a number of hydraulic features in the vicinity of the site boundary. These features are as follows:

- The River Cherwell;
- The Oxford Canal;
- Gallos Brook;
- Gagle Brook;
- Spring Series (consisting of 13 active springs).

The River Cherwell flows within the Cherwell Valley, a narrow v-shaped valley situated 1.5 kilometres west of the site. Reference to the Environment Agency's indicative floodplain map indicates that the development site exists outside of the river's fluvial floodplain (refer to Section 6.3) and there is no risk of fluvial flooding on the site.

The Oxford Canal is located 1.5 kilometres to the west of the site, where it runs parallel to the River Cherwell. Due to the relative levels of the river, canal and the development site, these key hydraulic features do not constitute a flood risk to the development.

There are a series of active springs within 1km of the site boundary, which rise around the plateau surface on which the former airbase is located. The springs are a result of a layered aquifer system. They rise at elevations of between 90 and 125m AOD, the lower elevation springs generally being to the west of the site. The range in water levels for these springs suggest that they represent discharge points for a number of aquifer layers and that there is no one single water table beneath the site.

Several of the springs (at locations B, K, G, I and L; refer to Section 6.4 and Figure 5) are associated with site's surface water outfall points, some of which are understood to be via oil interceptors. Historic site drainage plans show some sections of the drains which issue to the outfalls to be land drainage. These may have been installed to capture springs present in the area prior to construction of the airbase, or possibly to locally lower groundwater levels.

Springs C2, D, F, P and R west of the site flow a short distance before entering the River Cherwell. Spring N (north of the site) flows dominantly eastward through the village of Ardley to form the Padbury Brook which is a tributary of the River Great Ouse. Springs A, M, T and U on the southern side of the site form the Gallos and Gagle Brooks which are a tributary of the River Ray which eventually enters the River Cherwell.

There are three water bodies and a small number of ponds and pools located around the vicinity of the site. The three water bodies are at Middleton Park (NGR SP 5183, 2333), Rousham, Home Farm (NGR SP 4760, 2326), Middle Aston (NGR SP 4738, 2677). Due to the detached location of these water bodies from the development site and their significantly lower level, they pose no flood risk to the site.

The smaller water bodies adjacent to the site are Crowfoot Pond north of the site (NGR SP 5263, 2737), Trow Pool (NGR SP 5466 2492) and several smaller ponds and pools around Ardley and on local farms. These all pose no flood risk to the site due to lower elevation of them in relation to the site (minimum 10m lower).

3.1.2 Existing Surface Water Infrastructure

The site is served by a separately sewered foul and surface water infrastructure privately owned and operated by NOC. The infrastructure is thought not to be to an adoptable standard by the local water authority (Thames Water Ltd). A drainage survey for the site was undertaken in December 2006.

An extensive existing surface water network (shown in Figure 3), comprising piped and open land drainage systems, conveys runoff from the site's subcatchment areas to a known total of thirteen outfalls positioned around the site's perimeter. Most of the outfalls discharge to four watercourses to the south, east and north of the site; Gallos Brook, Leys Farm Ditch, Gagle brook and an unnamed stream to the northeast of the site flowing past Crowfoot Pond.

Much of the catchment's contributing area generating surface water runoff is associated with the network of runway and taxiways, which will largely remain unchanged post development, with the exception of some scarification. In these subcatchments, there are large permeable areas that are not positively drained.

In the south of the catchment is the approximate 70 hectare subcatchment comprising the redevelopment site. Here a range of buildings and highways systems are positively drained by an extensive network comprising traditional pipes and chambers. It is not known what design standards were used to size the system and much of the infrastructure will be replaced by the development proposals. However, there are four existing surface water outfalls serving this part of the catchment and it is likely that all will be retained for use on the future sustainable drainage system.

The Gallos Brook is a north-south flowing brook starting form the Heyford Park site southern boundary and flowing south until it enters the River Ray which is a tributary of the River Cherwell. Surface water also drains in to the Gagle brook to the south of the site. Gagle Brook is a south - east flowing brook that eventually flows in to the River Ray and finally the River Cherwell. Surface water from the north of the site drains in to a tributary of the Padbury Brook which flows west-east towards Bicester, where it becomes a tributary of the River Great Ouse.

There are believed to be soakaways at the western end of the main runway which drain part of the runway strip and further soakaways that drain part of the residential area to the south of Camp Road.

3.1.3 Existing Foul Water Infrastructure

The foul sewage is collected in two private gravity sewerage networks which transport it from the north and south of Camp Road. However, parts of the site are drained via small foul water pumping stations which discharge into the main gravity sewerage network. It is believed that there is significant infiltration into the foul water system from groundwater.

The majority of foul drainage from the site is treated by a private sewerage treatment works which is located approximately 300m south of Camp Road, in the south east corner of the site. The sewage treatment works discharges to a local drain which ultimately flows in to the River Cherwell.

Within the runway side of the base there are a number of small 'package' type treatment facilities which serve small groups of individual buildings.

4 Description of the Proposed Development

Refer to the Figures in Appendix B.

The North Oxfordshire Consortium aims to develop the area's existing economic, social and environmental characteristics through the provision of multi-million pound enhancement and renewal scheme. The development is situated on the former Royal Air Force (RAF) air base at Upper Heyford. The air base is no longer in active service and was last used during the late 20th century by the United States Air Force (USAF). The site was decommissioned from active service in 1994.

The main residential and commercial area located in the south of RAF Upper Heyford is the main area for redevelopment, although the planning consent for development is being sought for the whole site. The proposed site boundary development area encompasses some 516 hectares, while the main area is approximately 70 hectares of existing development. In this area consent is being sought for the construction and development of approximately 1000 dwellings and associated commercial buildings, also the provision of a primary school, shops and recreational space. The development area will be known as Heyford Park.

The remainder of the site outside of the main redevelopment area will remain largely unchanged. However, some of the existing buildings will be demolished, parts of the main runway will be removed and areas of taxiway will be scarified. Overall, there will be a reduction of impermeable area draining offsite to the local watercourses.

The Heyford Park development aims to:

- Retain and enhance a selected number of existing residential buildings;
- Improve the utilities of the site to adoptable standards;
- Enhance existing employment levels;
- Deliver environmental and biodiversity improvements;
- Preserve the built heritage associated with the airfield.

The new development will be constructed at grade. No basement structures are proposed and earthworks operations associated with the redevelopment will be minimal. Overall, there will be a reduction in the amount of impermeable area.

Across the original Heyford Park airbase, changes will be minimal, with the emphasis on improving biodiversity across the site and to achieve this, there is a comprehensive landscape and environmental masterplan. For the Heyford Park residential area of the site, development parcels will generally be new construction, with some retention for re-use of existing structures. There will be significant landscaping and open spaces, some of which will be utilised for integration with the sustainable drainage system. The integrated highway system will be developed to provide enhanced transportation across the site and will again, be utilised for integration with the sustainable drainage system.

5 Operating Authorities Consultation

Refer to Appendix C for records of consultation.

5.1 Environment Agency

The Environment Agency (EA) is a statutory consultee for flood risk matters. The Agency has wide-ranging responsibilities including the management of water resources, control of pollution in inland waters, and flood defence including water level management. A principal duty of the Agency is to 'contribute towards the achievement of sustainable development.' It is therefore, essential that the EA is consulted throughout the design development of the site. Arup met with the EA on 3rd August 2006 and 26th June 2007 to discuss the Heyford Park development, a record of those meetings can be found in Appendix C.

In accordance with the requirements of Planning Policy Statement 25, Development and Flood Risk, those proposing developments are required to produce a flood risk assessment (FRA) to accompany any planning application even if the development is outside of any floodplain. To gain planning approval from the operating authorities the FRA must identify and mitigate any flood risk to the development and confirm that there will not be an increased flood risk elsewhere (typically downstream of the development).

The historical fluvial floodplain mapping (obtained from the Environment Agency website) for the site (refer to Section 6.3) confirms that it is located in a low probability Flood Zone 1.

The EA's key requirements in terms of flood risk at this stage of the development are:

- Demonstration that the surface water system is designed implemented and managed to mitigate any flood risk downstream of the development, by the strategic management of surface water generated from the site. This will include restricting off-site surface water discharge to a reduced rate and providing flood risk protection for up to the 1% (1 in 100 year) return period event, plus a climate change factor of 30%.
- Consideration of overland flow routes will be required and the level of topographic survey undertaken should be suitable to do this.

5.2 Cherwell District Council

Cherwell District Council (CDC) is the local planning authority (LPA) for the area and is responsible for the preparation and development of local plans and the controlling of development within the area.

CDC has been contacted to determine if they are aware of any historical flooding problems in this area. CDC has advised they have no records of flooding occurring at this location, although the records are based on officer observations and public complaints. A record of the CDC consultation can be found in Appendix C.

Cherwell District Council proposes to control development to protect the River Cherwell and its associated environmental corridor. Development proposals for the Heyford Park site shall only be permitted if they include environmental improvements. If the proposed works impact the existing hydraulic conditions of the river, mitigation measures would have to be proposed which would return the river to a state similar encountered pre-development.

CDC will be consulted throughout the design process to ensure the proposals do not conflict with any existing or proposed developments in terms of flooding and drainage.

5.3 Thames Water Limited

The existing foul and surface water infrastructure is privately owned and operated by NOC. Thames Water is the incumbent drainage authority providing public foul and surface water drainage to the area. However, none of the surface water draining from the site will discharge into any Thames Water sewers and will instead use existing outfalls into local watercourses. In this instance, a formal developer enquiry to confirm surface water discharge from the site was not required.

Thames Water Utilities Ltd has stated that for the private foul network to be adopted, the current condition and extent of groundwater infiltration must be remediated. In addition to infiltration, recent survey work has highlighted areas of the air base which have incorrectly connected surface water drainage into the foul water network increasing the conveyance of the surface water.

The majority of the existing sewage system within the development area will be replaced as part of the development. These replaced section will be designed in accordance with current design requirements; Sewers for Adoption, 6th Edition[4]. However, where existing infrastructure such as housing is to be maintained it is not always possible to get them adopted due to their location. In these instances the sewers will be rehabilitated to a serviceable condition, and maintained as private sewers to the point where they connect to the newly adopted system.

6 Description of Potential Flooding Mechanisms

Table 1 has been used to qualitatively identify the potential flooding mechanisms considered for the application site. These flooding mechanisms (where applicable) are subsequently discussed in more detail.

6.1 Table 1: Potential Flood Risk Summary

Question	Flood Hazard						
Key: **✓ = Yes,** **✗ = No,** **? = Unconfirmed but possible.**	**Fluvial**	**Sea**	**Estuaries**	**Groundwater**	**Overland flow**	**Artificial Drainage Systems**	**Infrastructure Failure**
Is the development site next to any watercourse shown on Ordnance Survey maps?	✓	✗	✗				
Is the development site, or part of the development site, identified as being at risk of flooding within available documentation?	✗	✗	✗	?	?	?	✗
If a strategic flood risk assessment is available, is the development site, or part of the development site, identified as being at risk of flooding?	**No SFRA available**						
If a flood zone map is available, is the development site, or part of the development site, within a Flood Risk Zone?	✗	✗	✗				
If there is an existing property on, or next to the site at the same level, is the property within a flood warning area?	✗	✗	✗	✗			
Are the LPA/FDA aware of any existing, historical or potential flooding problems that may affect the site?	✗	✗	✗	✗	✗	✗	✗
Do the physical characteristics of the site suggest that it may be prone to flooding?	✗	✗	✗	?	?	?	✗
If a flood zone map is not available, is the development site, or part of the development site below 10m AOD AND does the FDA consider the development to be at risk from tidal flooding?		✗	✗				
Is the development located within a natural or artificial hollow, or at the base of a valley or at the bottom of a hill slope?				✗	✗		
Does examination of historical maps indicate any likelihood of flood risk at the site?	✗	✗	✗	✗	✗		
Do the names of surrounding roads, areas or houses suggest the possibility of seasonal or historical flooding?	✗	✗	✗	✗	✗		
Is the site likely to involve excavation / construction below existing ground levels (excluding foundations)?	✗			✗			
Is the land use upslope of the site such that the generation of overland flow may be encouraged, and can water from this area flow onto the site?				✗			
Are there any artificial drainage systems on or next to the site, at the same level, or upslope of, the site?						✓	✗
Is the development site protected by an existing flood defence?	✗	✗	✗			✗	✗
Is the development site protected by a flood control structure (e.g flap valve, sluice gate, tidal barrier etc)?	✗	✗	✗			✗	✗
Is the development site located upstream of a tunnel/bridge which may be prone to blockage?	✗		✗	✗	✗	✗	✗
Are water levels in a watercourse/body located in or next to a development site controlled by a pumping station?	✗	✗	✗	✗	✗	✗	✗
Is the development site downstream/downslope of a reservoir or other significant water body?						✗	✗

6.2 Table 2: Flood Risk Identification

Potential Flood Hazard	Flood risk to the development?	Increased upstream flood risk?	Increased downstream flood risk?*
Fluvial flooding	✗	✗	✗
Flooding from the sea	✗	✗	✗
Flooding from estuaries/watercourses affected by tide locking	✗	✗	✗
Groundwater flooding	✓	✗	✗
Overland flow flooding	✓	✗	✓
Flooding from artificial drainage systems	✓	✗	✓
Flooding due to infrastructure failure	✗	✗	✗

Tables 1 and 2 indicate that the potential sources of flood risk to the development site or adjacent areas to be particularly considered by this FRA are as follows:

- Groundwater;
- Overland flow;
- Capacity exceedance of artificial drainage systems.

6.3 Fluvial Flood Risk

Flooding from rivers, streams and other natural inland watercourses is usually caused by prolonged or intense rainfall generating high rates of surface water runoff throughout the catchment, which overwhelms the capacity of the fluvial system as a flood flow and as a result spills into available floodplain storage areas.

Upper Heyford is located on top of a plateau approximately 130m AOD. The River Cherwell runs to the west of the site at approximately 70m AOD, due to the 60m difference in elevation of the site and the floodplain of the River Cherwell, the site is not at risk from flooding from the river. The fluvial floodplain mapping (obtained from the Environment Agency website) for the site confirms that it is located in a low probability Flood Zone 1 and this is shown on the next page.

Other fluvial features adjacent to the site do not pose a flood risk due to the difference in elevation. The tributary of the Padbury Brook north of the site has a small 1% floodplain which is at an elevation of 120m AOD and therefore does not pose a flood risk to the site. This is shown on the Environment Agency's historical flood plain mapping on the next page.

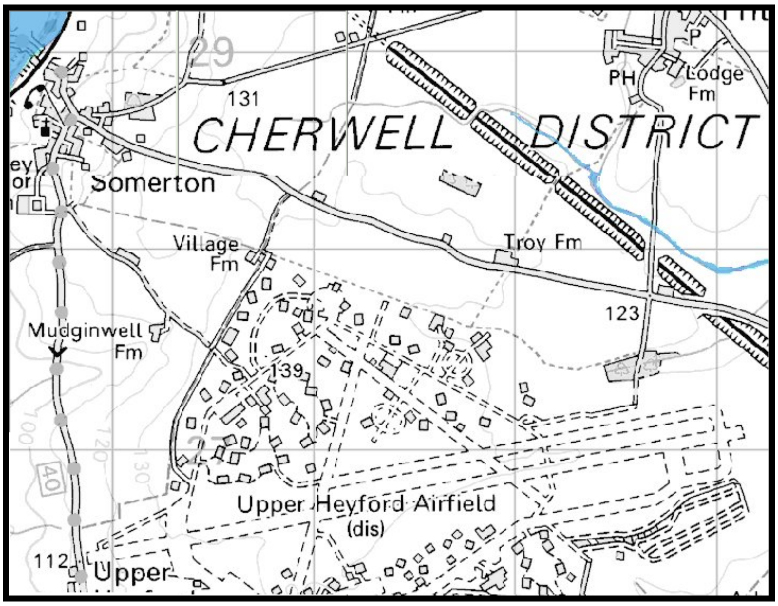

Figure 6.3.1. Indicative Fluvial Floodplain Mapping for Heyford Park

(Courtesy of Environment Agency website).

A tributary of the Gallos Brook to the south of the site has a small 1% floodplain which is shown on the Environment Agency's indicative floodplain mapping below. The site lies outside the brook's floodplain, which is also approximately 60m or more below the site.

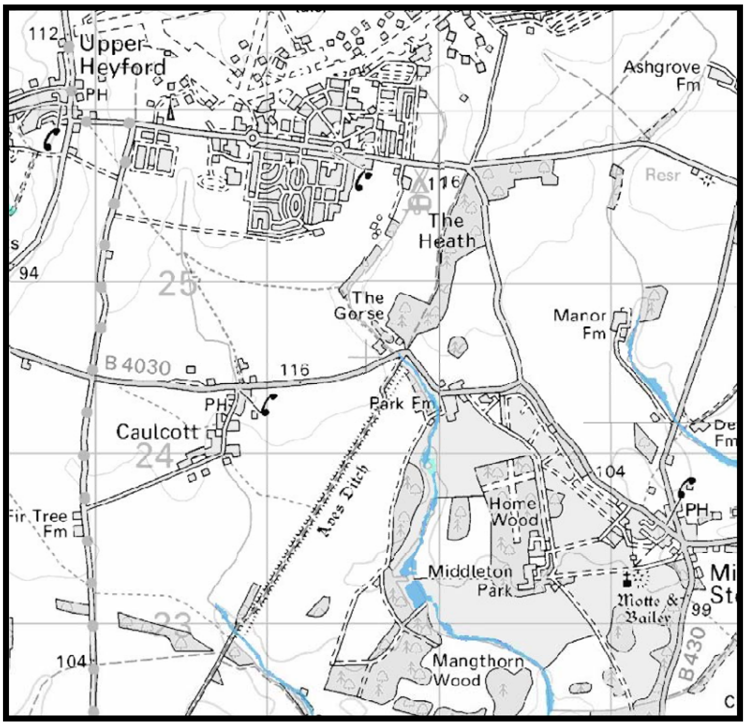

Figure 6.3.2. Indicative Fluvial Floodplain Mapping for Heyford Park

(Courtesy of Environment Agency website).

The fluvial features in the surrounding area of the site do not pose a flood risk to the development. As there is no flood risk, no fluvial features have been hydraulically modelled for this FRA.

6.4 Groundwater Flood Risk

A Landmark Envirocheck report[5] indicates a Minor Aquifer beneath the site, surrounded by a Major Aquifer. The outline of the Minor Aquifer coincides with the development site boundary. There appears to be no geological reasons for the presence of the Minor Aquifer.

Therefore, based on currently available information, it is considered that groundwater beneath the development and surrounding area should be considered as a Major Aquifer, until otherwise determined.

Boreholes have been drilled by Aspinwall & Company in 1997[6] as part of a land quality assessment (Figure 5) and they have been re used to test and monitor the water quality and the water levels. The water level monitoring indicates that groundwater movement is radially outwards from the site in all directions, discharging at a number of springs. The presence of mudstone bands can limit vertical water movement and has resulted in a layered aquifer exhibiting different water levels at different depths.

There has been no significant change in the ground water levels at the boreholes since the monitoring of the water began in 1997. The results of the groundwater level monitoring on the site have been illustrated in figure below, borehole (BH) locations are shown on Figure Figure 5)in Appendix B.

From these results it can be determined that the ground water levels are fairly constant and unlikely to change.

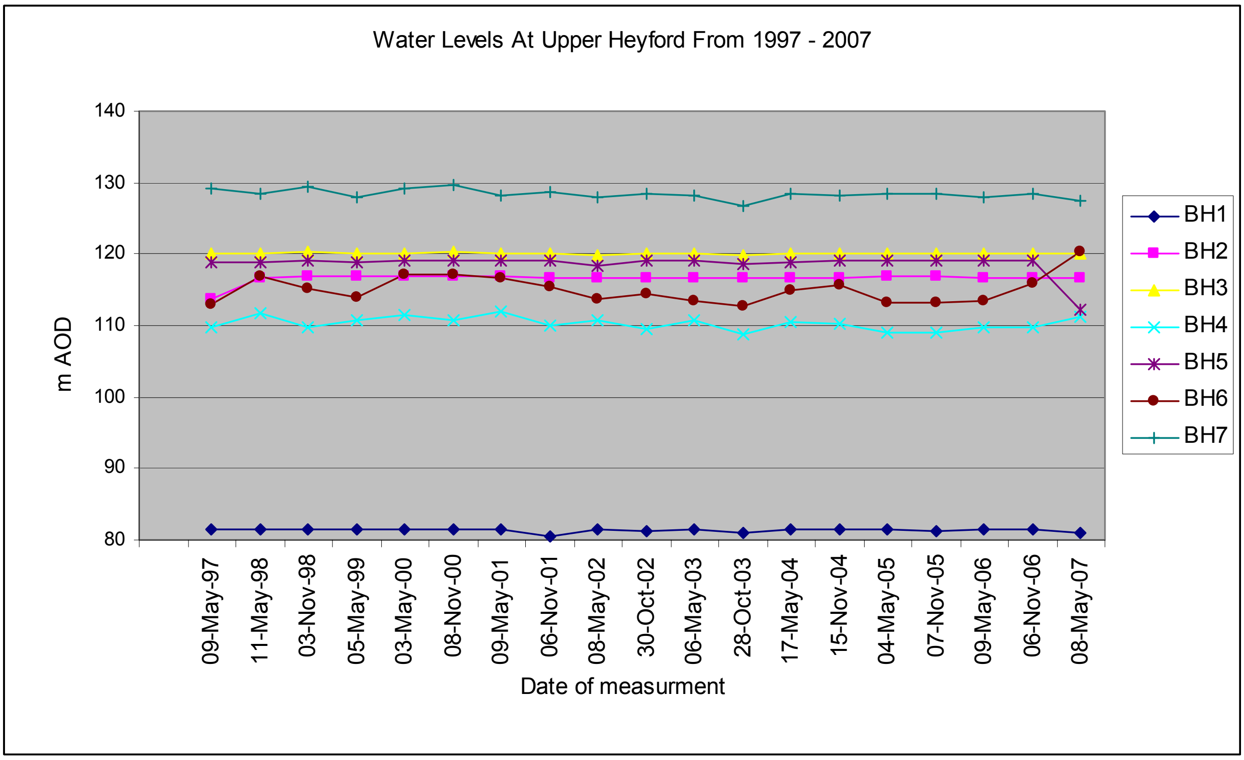

Figure 6.4: Ground Water Levels at Upper Heyford[6]

The level difference between the groundwater and the ground elevation varies significantly within the site with differences from 1.05m to 35.08m. This is shown the following Figure 6.5, which uses the most recent ground water levels taken form all seven boreholes in May 2007.

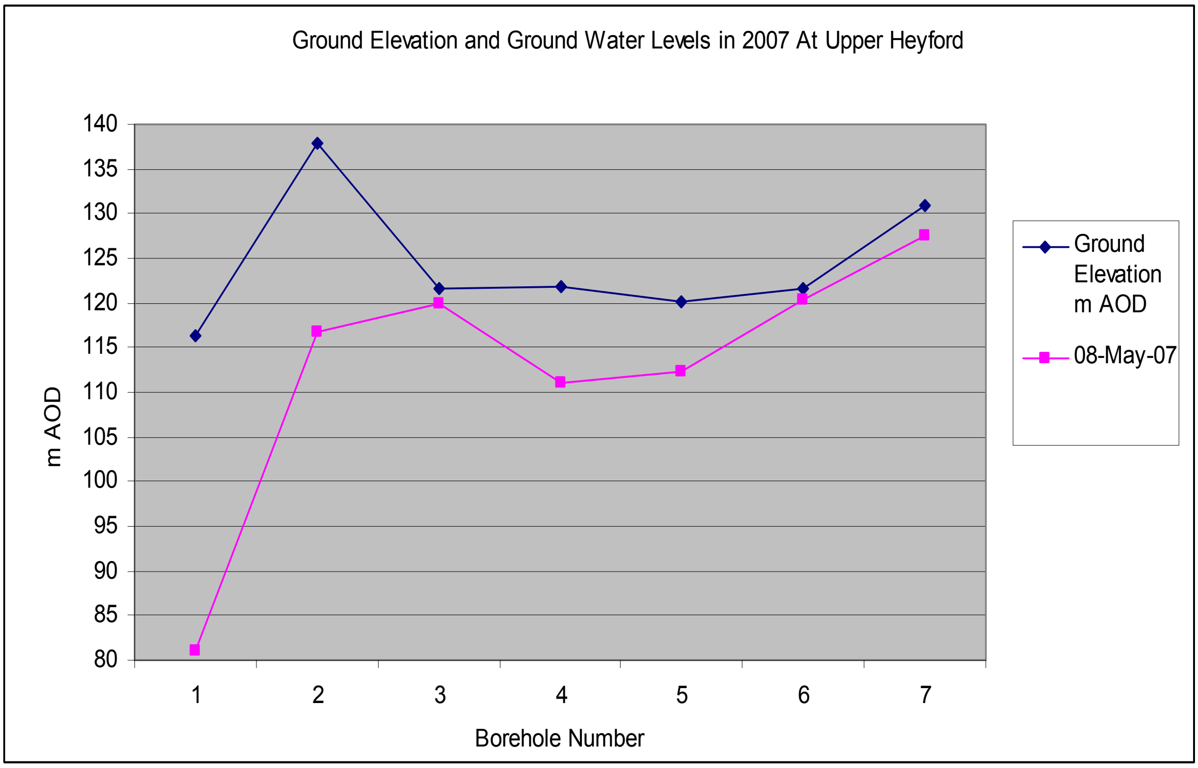

Figure 6.5: Ground Elevation and Ground Water Levels in May 2007 at Upper Heyford[6]

The variation in groundwater levels is thought to be caused by the differently layered aquifers beneath the site. Where ground water levels are high (within 2m of the ground level) the subsurface infrastructure will need to be considered. Subsurface drainage networks, water storage, and sustainable drainage systems (SUDS) will need to be designed to prevent the ingress of groundwater into this infrastructure.

Groundwater infiltration into the sewage network is currently a problem at the site with an infiltration of surface water level of up to an estimated 273% (based on the measured dry weather flow). This problem will be resolved during the development by either lining of existing systems or through the installation of new networks.

The construction of basements and deep foundations is not envisaged at this point however if the development does construct basements the design of these structures shall take into account existing groundwater levels and any predicted rises.

6.4.1 Spring Series

A series of springs rise around the plateau surface on which the former airbase is located shown in Figure 5. The series of springs are a result of a layered aquifer system. There are at least 13 active springs within 1km of the site boundary (20 were identified in 1999). This rise at elevations of between 90 and 125m AOD, the lower elevation springs generally being to the west of the site. The range in water levels for these springs suggest that they represent discharge points for a number of aquifer layers and that there is no one single water table beneath the site.

Several of the springs (at locations B, K, G, I and L on figure 5 are associated with site storm outfall points, some of which are understood to discharge off site via oil interceptors. The remaining springs flow into local rivers.

The flow rates of the surface water springs are regularly monitored by Apsinwall. The monitored surface water springs that have been sampled are A, B, C2, D, F, G, I, M, N, P, R, T and U shown in Figure 5. The flow rate results obtained from the springs/outfalls are very variable in comparison with records of previous results. The behaviour of a spring's flow regime is dependent on many of the natural hydrological and hydrogeological regime of the area.

There are no consistent flow rate results for the monitored springs (beginning since 1997). The most recent results demonstrate that springs A, F, and N have dried up and no results for these springs could be obtained. The flow rates obtained by Enviros Consulting[7] in November 2005 are shown in Table 6.5 and demonstrate the flow rates the springs in the area surrounding the site are discharging.

Spring	Date	Flow (Q) l/sec
A	09/11/05	DRY
B	09/11/05	6.75
C2	09/11/05	0.028
D	09/11/05	2.31
F	09/11/05	DRY
G	08/11/05	0.698
I	08/11/05	2.88
M	09/11/05	0.7
N	09/11/05	DRY
P	08/11/05	0.83
R	08/11/05	0.02
T	09/11/05	6.8
U	09/11/05	11.9

Table 6.5: Insitu Flow rates at Spring/Outfalls around Upper Heyford Site[7]

The results of the monitoring of the springs shows no apparent flood risk issues, although the flow rates are not consistent predictions of the flow regime of the springs.

6.5 Overland Flow Flood Risk

Overland flow is a description for water flowing over the surface, which has yet to enter a natural drainage channel, an artificial drainage system or the natural substrate. It is often a result of very intense short lived rainfall events but can also be produced during mild rainfall events when drainage systems are at capacity or the ground is already saturated. This can result in the inundation of low-lying areas. It is also related to sewer flooding, excessive groundwater and infrastructure failure.

The site is located at the top of plateau above the Cherwell Valley which is a high spot in relation to the immediate surroundings. This makes it physically impossible for overland flow from surrounding areas to affect the development due to being elevated well above the surrounding topography.

Any overland flow generated from large impermeable areas on the redevelopment site will flow in a southerly direction. However, overland flow would only occur if the drainage systems associated with the surrounding area failed or were exceeded by an extreme event, in which case the whole area would likely be at flood risk in such an instance. As the existing surface water drainage network previously served a strategic military airfield, a reasonable level of hydraulic performance can be assumed.

Furthermore, across the airfield and between areas of impermeable hardstanding are large expanses of permeable ground. Not only do these areas permit significant rates of infiltration, but more importantly during extreme events, they also provide huge areas for surface storage of overland flows.

In addition the proposed development of the site will actually reduce the impermeable area and therefore encourage infiltration of water into the ground.

All surface water generated within the site boundary, including overland flows, will be managed by the new sustainable drainage infrastructure, which will be able to manage storm events up to and including the 1% return period (1 in 100 years) plus a 30% allowance for climate change.

In addition, the proposed development of the Heyford Park site will not dramatically alter the existing topography of the area and therefore, no increased off-site overland flows will be generated by the development.

6.6 Artificial Drainage System Flood Risk

Artificial drainage systems designed to manage surface water runoff can pose a flood risk if the system is overwhelmed. This may occur if the amount of surface water run off exceeds the systems capacity or if the system becomes blocked or surcharged by the receiving watercourse. Artificial drainage systems designed to manage foul water (and combined effluent) can pose a flood risk and public health risk if the system is overwhelmed. This may occur if the amount of foul water allowed to discharge, exceeds the systems capacity.

Wherever proposed buildings are to be located downstream of a significant sewer line or along the route of a potential overland flow from sewer flooding (foul or surface water), consideration and mitigation from flow flood risk should be undertaken. Finished floor levels and building thresholds should be set with due regard for potential overland flow paths.

Refer to section 7, where the surface water management strategy and preliminary design are discussed in more detail.

6.7 Infrastructure Failure Flood Risk

Where significant infrastructure exists that retains, transmits or controls the flow of water, flooding may result if there is a structural, hydraulic, geotechnical, mechanical or operational failure. This may not be infrastructure that has been specifically designed and implemented as a water controlling structure, such as a water main or a dam. It may be a structure such as a road or rail embankment that acts as an informal defence during severe storm events.

Approximately 1km to the west of the development site in the Cherwell Valley lies the Oxford Canal. Flooding from the canal either from overtopping or bank failure will not be a flood risk due to the distance and the elevation the canal is from the development.

There is a negligible flood risk resulting from the failure of on-site water mains, although there are no significant pipelines of this nature planned from the site. The resulting overland flow from any such failure would be managed by the highway and associated infrastructure, while building thresholds will be designed secure from flood risk.

6.8 Climate Change Flood Risk

Increasing global temperatures and changing weather patterns indicate that climate change is a reality. Therefore, an allowance for the impact of climate change is a critical part of any assessment of flood risk and assessment of design mitigation measures. In accordance with PPS 25, the following climate change allowances have been included in the infrastructure design for this FRA:

- Surface Water Drainage: Peak rainfall intensity added 30% (Table B.2).

6.9 Historical Flooding Data

In order to ascertain the precise extent of any flood risk, Arup undertook a number of site visits and requests to validate any historical flooding data. Of the sources questioned, none identified any known major flooding or flood risks in the vicinity of the development site.

6.10 Emergency Access Requirements

In terms of emergency access and egress, all of the local external main highway and pedestrian routes serving the site are elevated well above any fluvial floodplain. The routing of the main access route into and out of the development site is also located outside of any fluvial floodplain and hence, any restriction of access from flood risk is deemed negligible and no specific mitigation measures are required.

Furthermore, it is mandatory that emergency access to and from the buildings on the application site is maintained during extreme storm conditions. There will also be a need to consider flood risk mitigation to any new buildings proposed in future.

6.11 Maintenance Requirements

Specific maintenance or access requirements have not yet been discussed in detail with the appropriate parties during preparation of this flood risk assessment, as the project is at masterplan stage.

On this basis, the only key requirements identified thus far are that the drainage infrastructure (existing and proposed) and any flood risk infrastructure should be adequately maintained at Heyford Park throughout its operational life to ensure a sustainable level of service. This is especially relevant to the existing and proposed attenuation and flow control structures.

7 Preliminary Surface Water Analysis & Design

Refer to the Figures in Appendix B.

7.1 Surface Water Management Strategy

While the majority of the application site's 516 hectare catchment will remain unchanged, the 69.4 hectare Heyford Park residential redevelopment will require an effective surface water management strategy to contemporary standards. The widespread implementation of sustainable drainage system (SUDS) best management practices (BMPs) to contemporary standards, will be integral to the Heyford Park surface water management strategy. This will provide the platform to mimic the response of the existing catchment and its surfaces and ultimately with some betterment, negating any increased off-site flood risk.

A contemporary sustainable drainage methodology for managing surface water runoff will use BMPs to focus on three key areas; controlling surface water quantity, improving surface water quality and providing added development amenity value. It is anticipated that contemporary sustainable drainage techniques shall be used throughout the Heyford Park development plan to manage and control surface water runoff. Three key tenets will be developed as part of an integrated Heyford Park surface water management strategy:

- Maximise natural runoff losses through infiltration techniques;
- Maximise surface water runoff quality improvements through natural BMP techniques such as bioremediation;
- Attempt to reduce the total volume of surface water runoff discharged.

7.2 Heyford Park's "Green Streets"

In an attempt to ensure that the future Heyford Park sustainable drainage system is designed to mimic the original characteristics of the catchment and attain the key tenets above including betterment in terms of a reduced overall rate of runoff, the surface water management train will ensure that surface water runoff is addressed through a number of key stages during conveyance to the local fluvial system; these will be prevention – source control – site control.

This will be achieved by designing and implementing a blend of natural and proprietary sustainable drainage BMPs, complemented by traditional drainage techniques, all integrated into the development's infrastructure to create Heyford Park's "Green Streets". Such integrated techniques may include, although not be limited to the following:

7.2.1 Natural Sustainable Drainage BMPs

These structures will be focused around natural materials and integrated into the landscape, which may include utilising engineered highway features. They include surface water planter boxes (in footways or as kerb extensions into the highway), rainwater gardens (located in larger landscaped garden areas), swales, infiltration trenches, open channels, detention basins (dry features), balancing ponds (wet features) and temporary floodable areas (where deemed safe in terms of flood risk). They can be designed to operate with or without infiltration and all will afford excellent attenuation and bioremediation properties.

7.2.2 Proprietary Sustainable Drainage BMPs

These BMPs are a range of manufactured techniques that include porous or pervious surfacing, cellular storage systems, rainwater harvesting systems, on or off-line detention tanks, flow control devices and pipework. They will generally be hidden below ground, integrated into the surface water drainage infrastructure.

7.3 Integration with the Landscape

It is essential that the "Green Streets" structures are seamlessly integrated into the proposed landscape architecture. This is essential for the successful implementation of contemporary sustainable drainage on any development site and this will be inherent to the Heyford Park sustainable drainage implementation. This would require the following:

- Successfully integrating engineered sustainable drainage BMP structures into the landscape and highway infrastructure features, to maximise the amenity value and overall aesthetics.
- Adopting pervious or porous surface finishes to designated paved areas where technically feasible and/or aesthetically required.
- Disconnecting roof drainage downpipes wherever technically feasible and managing the surface water runoff within the landscape (either in water collection systems or as discharge onto ground).
- Utilising the potential of both existing mature trees across Heyford Park and planned tree planting, for maximising evapotranspiration potential and long-term sustainable catchment management.
- Integrating landscape features into the sustainable drainage infrastructure; this will include a series of natural structures acting as primary drainage channels, the use of strategic planting to provide source control and promoting natural filtration and bioremediation properties available from plants.

7.4 Preliminary Surface Water Storage Calculations

7.4.1 Existing Surface Water Runoff

The precise existing off-site surface water discharge rates are currently unknown and would require a very detailed drainage area study to determine. The Institute of Hydrology Report No 124 (IOH 124)[8] method for calculating existing rates of surface water runoff has been used to calculate discharge rates (this methodology was recommended by the Environment Agency). What is known is that none of the surface water outfalls are currently flow controlled and therefore, the actual discharge rates are not fixed and will fluctuate with rainfall intensity (and therefore the runoff generated) falling across the site.

Furthermore, while the original surface water design parameters are not known (they have been assumed as the 1 in 2 year or 50% return period event), it is safe to assume they were significantly less onerous than contemporary requirements; for example, there is no flow control or attenuation in the system.

During a very intense storm period event, it is likely that the surface water system would surcharge, flood in places resulting in overland flows and continue to discharge uncontrolled rates of surface water into the local watercourses. By implementing contemporary sustainable drainage best management practices, the proposed Heyford Park surface water infrastructure will address all of these unsatisfactory levels of service and reduce overall development flood risk and flood risk off site.

7.4.2 Calculated Existing Surface Water Runoff Rates

After consultation with the Environment Agency (refer to Appendix C), the Institute of Hydrology Report No 124 (IOH 124)[8] method for calculating existing rates of surface water runoff was adopted for the Heyford Park development. The calculated 69.4 hectares of total area in the redevelopment catchment was analysed against the IOH 124 method and the following runoff rates were determined:

Return Period (Years)	Design Flow (m^3/s)	Site Specific Surface Water Runoff (l/s/ha)	*Total Permissible Off-site Discharge Rates (l/s)
2	4.86	**5.70**	**399**
100	17.64	**20.70**	**1449**

Table 7.4.2: Calculated Surface Water Runoff Rates

(*The total permissible off-site discharge rates have been factored against the total catchment area of 69.4ha)

7.4.3 Proposed Attenuation and Flow Control

As the redevelopment site is large, complex and is capable of generating significant amounts of surface water runoff, the proposed attenuation volumes required to control surface water runoff in storm conditions will ultimately be administered across the whole catchment as source control wherever feasible. This source control will be reinforced by strategically located attenuation and storage structures across the catchment.

The preliminary design at this flood risk assessment stage has assumed that surface water will be discharged into the local watercourses at no greater than the existing situation with some betterment and discharge being limited by employing complex and staged flow controls to maximum rates of the 1 in 2 year (50%) and 1 in 100 year (1%) return period events. The staged complex flow control philosophy has been adopted to reflect the current developed state of the catchment, with its extensive and uncontrolled existing surface water infrastructure.

The proposed complex flow control for the site will be as follows:

Stage 1 Flow Control: 5.7l/s x contributing area (ha) for the 1 in 2 year return period;

Stage 2 Flow Control: 20.7l/s x contributing area (ha) for the 1 in 100 year return period.

Complex flow control will be achieved by staging a series of Hydro-Brakes[9] in bespoke chambers. The Hydro-Brakes[9] will be set at differing inlet levels determined by detailed hydraulic modelling to achieve the staged flow control. It is likely given the size and complexity of the site, that a number of these complex flow control chambers will be required across the catchment at strategic locations, finalised at the future detailed design stage. This preliminary design has assumed four such chambers, one each in four distinct subcatchments.

This will also provide a degree of betterment from the existing situation, whereby the current system can and would increase for storm events of increasing intensity, the redeveloped surface water infrastructure, the off-site impacts will be improved as the staged discharges will be flow controlled (by Hydro-Brakes[9]) and attenuated on-site to the maximum flow rates. This flow control effectively reduces the amount of surface water runoff able to leave the developed site during storm events, in comparison to the current situation.

7.4.4 Surface Water Hydraulic Modelling

A proposed surface water layout can be seen in Figure 4 in Appendix B. A preliminary system hydraulic model has been built using Micro Drainage WinDap software[10] and the required storage has been modelled in greater detail using Micro Drainage Source Control software[10]. The printouts from this hydraulic modelling can be found in Appendix D.

At detailed design the required storage volumes will be administered as source control over the whole catchment, utilising a combination of natural and proprietary techniques as discussed in Section 7.2. For this preliminary design stage, the 69.4ha development site has been split into four subcatchments and the storage requirements modelled based upon the two stage complex flow control philosophy.

The following table determines the maximum surface water storage requirements to limit maximum discharge from the site to the 100 year return period event with the required climate change allowance of 30% (100 years for residential development; Table B.2 in PPS 25). In this instance a 30% increase in peak rainfall intensity has been used for the 100 design life required against residential development.

Subcatchment Details	Total Area (Ha)	Total Contributing Area (Ha)	A 1 in 2 Years Design Flow (l/s)*	B 1 in 100 Years Design Flow (l/s)*	A+B Maximum Permissible Discharge (l/s)	Required Storage: 1 in 100 Years + 30% CC (m^3)
North West (NW)	15.3	9.9	57	259	316	5180
North East (NE)	17.0	10.2	58	295	353	5247
South West (SW)	24.2	13.3	76	424	500	6727
South East (SE)	13.0	7.8	44	225	269	4001
	69.4	**41.2**			**1438**	**21155**

Table 7.4.4: Maximum Required Surface Water Attenuation Volumes

(* The discharge figures in these columns are for the complex flow control Hydro-Brake designs.)

7.4.5 Post Development Overland Flows

All surface water generated within the site boundary, including overland flows, will be managed by the new sustainable drainage infrastructure, which will be able to manage storm events up to and including the 1% return period (1 in 100 years) plus a 30% allowance for climate change.

In addition, the proposed redevelopment of the Heyford Park site will not dramatically alter the existing topography of the area and therefore, no increased off-site overland flows will be generated by the final development.

8 Conclusions and Recommendations

The following section summarises the identified key Flood Risk Conclusions (FRC) of the proposed Heyford Park development and how they have been removed or reduced to acceptable levels using appropriate Flood Mitigation Measures (FMM), determined from the key infrastructure requirements discussed in Sections 6 and 7.

8.1 The Sequential and Exception Tests Conclusions

FRC:	Table D1 in PPS25 determines that land within flood zone 1 is suitable for all development uses, including buildings used for dwelling houses and classified as "more vulnerable."
FMM:	As the development sites lies wholly within a low probability flood zone 1 it is not necessary to carry out the exception test in this instance.

8.2 Approving Authority Consultation

FRC:	The infrastructure design development should be undertaken in conjunction with consultation with all relevant approving authorities.
FMM:	The masterplan design development has been undertaken thus far after consultation with the Environment Agency, Thames Water and Cherwell District Council and this should continue through planning and detailed design.

8.3 Fluvial Flood Risk Conclusions

FRC:	As the development sites lies some distance away from and elevated some 60m above any watercourse, it lies wholly within a low probability flood zone 1.
FMM:	No mitigation measures required.

8.4 Groundwater Flood Risk Conclusions

FRC:	Elevated groundwater levels could affect subsurface infrastructure such as basements, and services.
FMM:	Elevated groundwater is not considered to be a significant flood risk on this development and no basement structures are proposed. This negligible flood risk will be considered in the future detailed design of the buildings.

8.5 Overland Flow Flood Risk Conclusions

FRC:	On-site buildings generally at flood risk from overland surface water flood flows.
FMM:	All surface water generated within the site boundary, including overland flows, will be managed by the new sustainable drainage infrastructure, which will be able to manage storm events up to and including the 1% return period (1 in 100 years) plus a 30% allowance for climate change.
FRC:	Off-site overland flow flood risk.
FMM:	In addition, the proposed redevelopment of the Heyford Park site will not dramatically alter the existing topography of the area and therefore, no increased off-site overland flows will be generated by the final development.

8.6 Artificial Drainage System Flood Risk Conclusions

FRC:	The post development rates for surface water runoff should reflect the current situation on the existing site.
FMM:	After consultation with the Environment Agency, the Institute of Hydrology Report No 124 (IOH 124) method for calculating existing rates of surface water runoff was adopted for the Heyford Park development
FRC:	The redevelopment site is large, complex and is capable of generating significant amounts of surface water runoff.
FMM:	The preliminary design at this flood risk assessment stage has assumed that surface water will be discharged into the local watercourses at no greater than the existing situation with some betterment and discharge being limited by employing complex and staged flow controls to maximum rates of the 1 in 2 year (50%) and 1 in 100 year (1%) return period events. The maximum surface water storage requirements to limit maximum discharge from the site to the 100 year return period event have been calculated, with the required climate change allowance of 30% (100 years for residential development). The proposed complex flow control for the site will be as follows: Stage 1 Flow Control: 5.7l/s x contributing area (ha) for the 1 in 2 year return period; Stage 2 Flow Control: 20.7l/s x contributing area (ha) for the 1 in 100 year return period. Complex flow control will be achieved by staging a series of Hydro-Brakes in bespoke chambers. The Hydro-Brakes will be set at differing inlet levels determined by detailed hydraulic modelling to achieve the staged flow control.

8.7 Infrastructure Failure Flood Risk Conclusions

FRC:	On-site water main failure could lead to flooding of site infrastructure.
FMM:	The unlikely failure of a water main would not cause a significant flood risk, as any resulting flood waters would flow down the highway infrastructure and be directed away from buildings.

8.8 Climate Change Flood Risk Conclusions

FRC:	Future climate change may increase the frequency of flood risk to the development site.
FMM:	In accordance with PPS 25, the following climate change allowances have been included in the infrastructure design: • Surface Water Drainage: Peak rainfall intensity added 30% (Table B2).

8.9 Emergency Access Flood Risk Conclusions

FRC:	Maintain external access routes for emergency vehicles during flood risk events.
FMM:	The site and its main access routes lie outside of the 1% and 0.1% fluvial floodplains in a flood zone 1 and are not at risk from fluvial flooding; no mitigation measures required.

8.10 Maintenance Flood Risk Conclusions

FRC:	There is a negligible flood risk to the development from failure of parts of the drainage infrastructure caused by lack of maintenance.
FMM:	The drainage infrastructure (existing and proposed) and any flood risk infrastructure should be adequately maintained at Heyford Park throughout its operational life to ensure a sustainable level of service.

8.11 Recommendations

On the basis of this Flood Risk Assessment and the suggested mitigation measures, it is concluded that the proposed development will not adversely affect onsite, neighbouring or downstream developments and their flood risk.

Having identified and categorised the potential sources of flood risk, it has also been possible to identify mitigation measures for each of the sources of potential flooding. If these measures are incorporated into the design and implementation of the proposed masterplan development, it should be possible to drastically reduce the flood risks associated with the site to acceptable levels, such that the residual risks can be judged low to zero risk.

It is recommended that this Flood Risk Assessment be accepted on the basis of an outline planning consent for the development of Heyford Park and that the issues raised herein are integral and optimised in the future detailed design stages of the proposed development, paying careful consideration to the key infrastructure design requirements outlined. It is also essential that future consultation with the operating authorities is maintained.

If the documented flood mitigation measures are adhered to, it is recommended that the site is considered suitable for the proposed masterplan development.

9 References

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