13 WATER RESOURCES AND FLOOD RISK

Introduction

13.1 This chapter of the ES assesses the likely significant effects of the Development on the environment in respect of water resources and flood risk. This chapter will cover the following topics: flood risk, surface water drainage (surface water quantity), water quality (surface water and groundwater), wastewater drainage and potable water (demand and supply).

13.2 A Flood Risk Assessment (FRA) is included at Appendix 13.1 and forms the Technical Appendix for this chapter.

13.3 This chapter has been prepared by Vectos and Stantec (see Appendix 1.2 Statement of Expertise).

Policy Context

National Planning Policy Framework[i]

13.4 The National Planning Policy Framework (NPPF) sets out the Government's national policies for flood risk management in a land-use planning context within England, and how these are expected to be applied. Section 14, paragraphs 155-165, provide clear guidance within a flood risk context. These paragraphs advocate against development in areas of high flood risk, and instead promote the use of a sequential-based approach to ensure that development is prioritised, in the first instance, to available areas of the lowest risk of flooding. Where development cannot feasibly be allocated in areas of the lowest flood risk, then it is required that all development must ensure that it is protected from flood risk for the duration of its lifetime without increasing flood risk elsewhere.

Planning Practice Guidance[ii]

13.5 The PPG provides a web-based resource which supplements the NPPF and provides further guidance on flood risk within its "Flood Risk and Coastal Change" section, as well as explanatory advice on water quality within its "Water supply, wastewater and water quality" section.

13.6 As with the NPPF, the PPG promotes the use of a sequential-based approach to flood risk to steer development into areas with the lowest probability of flooding. Table 1 of the PPG

defines the flood zones (a flood zone is an area of land that has a specified risk of flooding on an annual basis) which broadly speaking can be classed as high, medium, or low. The assessment of the flood zones present within the Site are covered in detail in the FRA (Appendix 13.1) but are also discussed later in this chapter. Table 2 of the PPG outlines the matrix to be used to classify a development's flood risk vulnerability, which is determined based on a development's land-use. Finally, Table 3 of the PPG sets out the compatibility of the vulnerability classification with the identified flood zones.

13.7 The PPG promotes the use of green infrastructure and Sustainable Drainage Systems (SuDS) as a best design practice to both reduce flood risk and to enhance and protect water quality and biodiversity from the impact of development.

13.8 The PPG also provides a chapter dedicated to climate change, which identifies the requirement for all developments to mitigate against the impact of climate change. For instance, in relation to flood risk, this requires the need to assess the impact of increased rainfall intensities, to ensure that all drainage systems are adequately sized to cope with the anticipated increases in rainfall.

Local Planning Policy

13.9 The Cherwell Local Plan 2011 – 2031[iii] was adopted in July 2015 (with Policy Bicester 13 re-adopted on 19th December 2016). The Local Plan sets out Cherwell District Council's (CDC) vision for the District up to 2031 with respect to future development and expansion. The policies relevant to water resources and flood risk are summarised here, with further detailed provided in the FRA (Appendix 13.1).

13.10 Policy ESD 1 discusses CDC's approach to mitigating and adapting to climate change with a focus on efficient use of water resources, and implementation of SuDS to reduce flood risk as a result of climate change.

13.11 Policy ESD 6 outlines the need to undertake a sequential approach to development in line with the NPPF and PPG. Floodplain preservation is also a key theme, with daylighting of rivers encouraged, with culverting of watercourses strongly discouraged. All developments must demonstrate that they are safe from flooding and will not cause any increases in flood risk elsewhere.

13.12 Policy ESD 7 outlines the requirement that all development must implement SuDS as a means to manage surface water run-off from development. Protection of groundwater quality should be considered, particularly with infiltration SuDS.

13.13 Policy ESD 8 outlines CDC's stance on water resources. It states the need to maintain water quality and encourages sustainable water use. It also states that developments which would cause detriment to the water quality of surface or underground water bodies will not be allowed. With respect to water resources, the policy states that development will only be allowed if there are adequate water resources available, with phased development to be implemented to ensure appropriate water infrastructure is in place prior to development activities.

13.14 The 2017 Cherwell Level 1 Strategic Flood Risk Assessment (SFRA)[iv] outlines the flood risk issues from rivers, surface water, groundwater, sewers and other artificial sources for the District. The SFRA refers to the inclusion of SuDS within developments which should seek to reduce flood risk, reduce pollution and provide landscape and wildlife benefits.

13.15 The Oxfordshire County Council (OCC) Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire[v] provides local standards and guidance for surface water drainage relating to major developments. OCC are the Lead Local Flood Authority (LLFA) for the Site. The OCC guide is intended to assist developers in the design of surface water drainage systems, providing specific information on the planning, design and delivery of surface water drainage, designed to reduce the risk of flooding and maximise environmental gain, including water quality, water resources, biodiversity, landscape and amenity. The guide also aims to ensure that all new developments are designed to mitigate the effects of climate change.

Other Guidance Documents

13.16 The Construction Industry Research and Information Association (CIRIA) SuDS Manual[vi] is a comprehensive compendium of general guidance relating to the implementation of SuDS across the UK, including real-life examples and detailed calculations of key parameters such as runoff volumes and peak flows, alongside guidance on the maintenance and construction of SuDS.

Legislative Context

13.17 The Water Framework Directive[vii] (WFD) is a European Union (EU) directive and provides a framework in the form of a river basin planning system on a six-year cycle. The aim of the WFD focuses on protecting water dependent ecosystems, promoting sustainable water use, reducing releases of hazardous and non-hazardous substances, and contributing to mitigating the effects of floods and droughts. 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 'good' status, must be mitigated so as to reduce the potential for deterioration and in order to allow the objectives of the WFD to be realised.

Assessment Methodology

13.18 This chapter identifies and assesses the likely significant effects of the Development on flood risk, surface water drainage (surface water quantity), water quality (surface water and groundwater), wastewater drainage and potable water (supply and demand) as a result of the change in land-use and regime during construction and completed development phases. The assessment of these has involved the following methodology:

- Consultation with the following regulatory authorities: Environment Agency (EA), OCC, CDC and Thames Water Utilities Limited (TWUL) (see Appendix 13.1);
- Completion of a desk-based assessment and a site visit to establish baseline conditions using a variety of data sources including:
  - Site topographical survey[viii];
  - Ordinance Survey (OS) online maps[ix];
  - British Geological Society (BGS) surface geology map of the UK[x];
  - Environmental Site Solutions report for the Site[xi];
  - Hydrock Site Investigation report and supplementary technical notes[xii];
  - EA Flood Map for Planning[xiii];
  - EA Risk of Flooding from Surface Water maps[xiv];
  - Natural England website for designated site details[xv];
  - MAGIC (Multi-Agency-Geographic-Information for the Countryside) map[xvi];
  - Foul water hydraulic modelling; and
  - Potable water network capacity modelling (TWUL confirmed Hydraulic Modelling Study raised 24 February 2021).
- Evaluation of the potential effects of the Development (during both construction and completed development phases) upon baseline conditions;
- Evaluation of the significance of these effects (during both construction and completed development phases) on the baseline conditions based on the baseline's sensitivity to each impact; and
- Identification of mitigation measures, if needed, to avoid or limit any potential adverse effects resulting from the Development (during both construction and completed development phases).

Study Area

13.19 The study area used for the assessment was defined predominantly by the Site's red line boundary as defined in Chapter 3. However, this assessment has also been based on watercourses which lie within, or in close proximity to the Site and are likely to be impacted during the construction and completed development phases of the Development. The principal watercourses assessed are the three watercourses along the Site's boundaries, which are presented in Figure 2 of the FRA in Appendix 13.1. Two are unnamed and one is known as Town Brook (on the eastern boundary of the eastern parcel). In addition, Langford Brook (approximately 3.6 km to the south east of the Site) and Gagle Brook (approximately 5 km to the south of the Site) are located downstream of the Site and are also assessed.

Significance Criteria

13.20 The overall significance of an environmental effect is determined by the assessed magnitude of the impact and the sensitivity of the receptor in question. The likely significant environmental effects resulting from the Development have been identified using the criteria set out in Tables 13.1 to 13.3.

13.21 The magnitude of impact for flood risk, surface water drainage (surface water quantity), water quality (surface water and groundwater), wastewater drainage and potable water (supply and demand) resulting from the Development has been assessed using the criteria given in Table 13.1.

Table 13.1: Methodology for Assessing Magnitude

Magnitude of Impact	Criteria for assessing impact
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre-Development) conditions such that the post Development character/composition/attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post Development character/composition/attributes of the baseline will be materially changed.
Minor	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre-Development circumstances/situation.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

13.22 The sensitivity of a receptor is based on the relative importance of the receptor using the criteria given in Table 13.2.

Table 13.2: Methodology for Determining Impact Sensitivity

Sensitivity	Examples of receptor
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character or is of international or national importance. Examples include: • Cyprinid or salmonid fishery; • High or Good WFD Ecological status; • High or Good WFD Chemical status; • Species protected under EU or UK habitat legislation; • Source Protection Zones 1 or 2; • Flood Zone 3; • Critical Drainage Area; • High risk of surface water flooding; • High Groundwater Vulnerability Risk; • Underlain by Principal Aquifer; • Protected under EU or UK habitat legislation (e.g. Site of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Area (SPA), EA Water Protection Zone, Ramsar site); • Water resource – Site located within a serious water stress area; and • Major increase in foul water volume.
Moderate	The receptor/resource has moderate capacity to absorb change without significantly altering its present character or is of high importance. Examples include: • Moderate WFD Ecological status; • Moderate WFD Chemical status; • Source Protection Zone 3; • Flood Zone 2; • Medium risk of surface water flooding; • Medium Groundwater Vulnerability Risk; • Located in an 'Impact Risk Zone' of a protected EU or UK habitat; • Water resource – Located within a moderate stress area; and • Moderate increase in foul water volume.
Low	The receptor/resource is tolerant of change without detriment to its character, is of low or local importance. Examples include: • Poor WFD Ecological Status; • Poor WFD Chemical Status; • Fluvial / Tidal Flood Zone 1; • Low Risk of Surface Water Flooding; • Low Groundwater Vulnerability Risk; • Water resource – Located within a low stress area; and • Minor increase in foul water volume.

13.23 The significance of effect is determined using the matrix given in Table 13.3.

Table 13.3: Effect Significance Matrix

Magnitude	Sensitivity		
	High	Moderate	Low
Major	Major Adverse/Beneficial	Major - Moderate Adverse/Beneficial	Moderate - Minor Adverse/Beneficial
Moderate	Major - Moderate Adverse/Beneficial	Moderate – Minor Adverse/Beneficial	Minor Adverse/Beneficial
Minor	Moderate - Minor Adverse/Beneficial	Minor Adverse/Beneficial	Minor Adverse/Beneficial - Negligible

Magnitude	Sensitivity		
	High	Moderate	Low
Negligible	Negligible	Negligible	Negligible

13.24 The threshold level of effect that is considered significant is defined as minor adverse/beneficial (and above), with the exception of effects relating to wastewater generation and potable water, for which the threshold level of effect that is considered significant is defined as moderate adverse/beneficial (and above).

Limitations and Assumptions

13.25 A number of sources have been used to compile this chapter and, whilst it is believed that these sources are both trustworthy and widely used within the industry, the accuracy of the information that has been provided by others cannot be completely guaranteed.

13.26 Whilst recognising that all assessment is subject to limitations, it is believed that the limitations associated with this assessment have not affected the validity of the conclusions made for this chapter.

Baseline Conditions

13.27 The following section provides a summary of the baseline conditions at the Site with respect to the various potential flood risk sources (fluvial, tidal, surface water, groundwater and artificial). In addition, water quality, surface water quantity (i.e. management of surface water runoff), topography, hydrology, and geology are also discussed. Furthermore, the baseline conditions at the Site are also summarised with respect to water resources, including: the assessment of existing foul flows (wastewater drainage), current potable water demand and usage, and existing sewerage network infrastructure.

Topography

13.28 In general, existing ground levels slope in a south easterly direction for most of the Site, towards the unnamed watercourse located on the southern Site boundary and Town Brook located on the eastern Site boundary. In the north west corner of the western parcel, the topography slopes to the north east, towards a ditch. The remainder of the western parcel slopes in a south easterly direction. The highest elevation in the western parcel is approximately 92 m above ordinance datum (AOD) towards the north and the lowest elevation is approximately 85 m AOD to the south east. The eastern parcel slopes in a south easterly direction with ground levels falling from approximately 91 m AOD to approximately 83 m AOD.

Hydrology

13.29 As noted previously, there are three watercourses that lie along the Site's boundaries, all of which lie within the same drainage catchment. Along the northern boundary of the western parcel there is a manmade field ditch which drains the northern part of the western parcel. This ditch drains to the north and is culverted beneath the B4100 and discharges into a tributary of Town Brook. Town Brook flows into a pond in the proximity of Caversfield House. The pond is approximately 30 m to the north of the Site's eastern parcel. Town Brook eventually flows alongside the eastern boundary of the eastern parcel. The rest of the western parcel drains to an unnamed watercourse which runs along part of the western parcel's southern boundary and forms a confluence with Town Brook at the south east corner of the eastern parcel. Town Brook continues in a southerly westerly direction towards the A4095 and Bicester town centre.

13.30 The Town Brook (also known as Bure Brook or the River Bure) passes through Bure Park Local Nature Reserve and then through Bicester town centre. The Town Brook eventually discharges into the Gagle Brook (via Langford Brook), approximately 5 km to the south east of the Site.

13.31 The watercourses along the Site boundaries are designated as ordinary watercourses and as such it is the LLFA who have the permissive powers to carry out works, where required.

Geology

13.32 The BGS online mapping at the 1 in 50,000 scale indicates that the majority of the solid bedrock geology beneath the Site consists of Cornbrash Formation – Limestone. Small portions of the Site along the southern and eastern Site boundaries have bedrock geology which consists of Forest Marble Formation – Limestone and Mudstone. According to the Hydrock Site Investigation report, at depth (beneath Cornbrash and Forest Marble Formations), the Site is underlain by White Limestone Formation – Limestone. Superficial deposits of Alluvium- Clay, Silt, Sand and Gravel are identified within the eastern part of the Site and the eastern Site boundary (i.e. in the proximity of Town Brook).

13.33 A site investigation was undertaken in September 2020 by Hydrock which found that encountered ground conditions were broadly consistent with the BGS maps, with Cornbrash Formation observed at depths between 0.2 m below ground level (BGL) and 3.73 m BGL, and Forest Marble Formation observed at deeper depths. No White Limestone Formation was observed at depths excavated. Infiltration testing was performed in accordance with BRE (Building Research Establishment) 365[xvii] using 30 trial pits distributed across the Site. In 19 of the pits, water drained sufficiently to enable infiltration rates to be determined, suggesting

that in certain parts of the Site, infiltration may be possible. However, shallow groundwater was also encountered across the Site, and whilst monitoring is ongoing by Hydrock, groundwater was found to be marginally below the ground surface in isolated parts of the Site.

Fluvial and Tidal Flood Risk

13.34 The Flood Map for Planning indicates the risk of flooding from rivers and the sea. The Flood Map for Planning identifies that most of the Site is located within Flood Zone 1 (land defined as having less than a 1 in 1,000 annual probability of river or sea flooding). This indicates a low level of flood risk from river (fluvial) and tidal sources. The NPPF guidance on development and flood risk indicates that all development types are considered to be appropriate in Flood Zone 1.

13.35 As the Site is located over 100 km from any coastline, with the lowest elevation on Site being approximately 83 m AOD, the flood risk presented on the Flood Map for Planning relates to fluvial flooding only. For this reason, tidal flood risk is not considered further in this chapter.

13.36 A small portion of the Site (in the eastern parcel) lies within the extents of Flood Zone 2 (land defined as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding) and Flood Zone 3 (land defined as having a 1 in 100 or greater annual probability of river flooding) along the eastern boundary of the eastern parcel (see Appendix 13.1). This is associated with Town Brook.

Surface Water Flood Risk

13.37 Surface water (pluvial) flooding is the result of overland flow that can follow a rainfall event before the runoff enters a watercourse or sewer. The Risk of Flooding from Surface Water map shows that most of the Site is unaffected by this source of flooding, which is defined as very low risk and means that each year, these areas have an annual chance of surface water flooding of less than 1 in 1,000.

13.38 Similar to the Flood Map for Planning, the Risk of Flooding from Surface Water map identifies surface water flooding in the immediate vicinity of Town Brook along the eastern boundary of the eastern parcel. Along the southern boundary in the western parcel, surface water flood extents are mainly identified as low risk which means that each year this area has a chance of flooding of between 1 in 100 and 1 in 1,000. However, there are some regions of medium risk (annual chance of surface water flooding of between 1 in 30 and 1 in 100) and high risk (annual chance of surface water flooding of greater than 1 in 30), but these are generally

contained within the watercourse. In the eastern parcel, along the eastern boundary, surface water flood extents of high risk, medium risk and low risk are present.

Groundwater Characteristics

13.39 The Site does not lie within a groundwater Source Protection Zone nor are there any Source Protection Zones within 500 m of the Site. The Site is not located within a groundwater Drinking Water Safeguard Zone. The majority of the Site lies within a groundwater vulnerability zone defined as High, with a small portion of the Site (associated with Town Brook) within a Medium-High vulnerability zone.

13.40 As the majority of the Site is defined as an area of High groundwater vulnerability, groundwater quality on the Site is highly sensitive to activities which may provide a pathway to groundwater.

13.41 Areas underlain by Cornbrash Formation and superficial Alluvium deposits (i.e. the majority of the Site) are considered to be relatively permeable, and thus have the potential to provide pathways for contaminants into groundwater supplies.

Groundwater Flood Risk

13.42 Groundwater flooding has also been considered as part of this ES chapter. Groundwater flooding is most likely to occur after periods of sustained heavy rainfall typically near Principal aquifers etc. The bedrock geology for the whole Site is underlain by a Secondary A aquifer. Superficial deposits of type Secondary A are identified along the eastern boundary of the eastern parcel. Secondary A aquifers comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers. As previously mentioned, at depth beneath the Site, the deeper geology consists of White Limestone Formation which is classified as a Principal Aquifer. However, the Hydrock Site Investigation report states that although the White Limestone Formation is a Principal Aquifer with some sources of public water supply, the Forest Marble Formation's upper layer generally acts as an aquiclude (impermeable barrier) between the Cornbrash Formation and the underlying White Limestone Formation.

13.43 The Site Solutions report presents groundwater flood risk data prepared by GeoSmart Information Ltd. This shows that most of the Site is at negligible risk of groundwater flooding with an annual probability of groundwater flooding of less than 1 in 100. In the western parcel, it shows that there is a negligible portion which is at a low risk from groundwater flooding, located in the south east corner. Low risk is classed as having a 1 in 100 probability

of groundwater flooding.

13.44 The Hydrock Site Investigation report cites the BGS Groundwater Flooding Susceptibility data which shows that (based upon the underlying geology of the Site) there is a potential for groundwater flooding to occur at the surface and for properties located below ground i.e. basement properties. The BGS data does not provide the probability of groundwater flooding to occur, rather it highlights regions where underlying geology could provide conditions which enable groundwater emergence. These areas broadly correlate with the areas of superficial Alluvium deposits overlying the Forest Marble strata, within the vicinity of the watercourses to along the southern boundary of the western parcel and eastern boundary of the eastern parcel. In addition, the Level 1 SFRA presents the EA Areas Susceptible to Groundwater Flooding dataset for Cherwell District. This shows that the Site is located within an area that has less than 25% chance of groundwater flooding (i.e. a low risk). However, both the BGS and EA datasets are produced on a national scale and only represent susceptibility to groundwater flooding (rather than risk), although they indicate the Site to be in the second lowest category. Thus, the GeoSmart Information Ltd groundwater flood data is considered more useful as it presents a quantified groundwater flood risk.

13.45 As discussed previously, the Hydrock Site investigation was completed in September 2020 where groundwater was encountered at depths between 0.8 m BGL and 3.2 m BGL. Continual monitoring of groundwater levels is currently in place, which is to record the change in groundwater level with time and in relation to weather conditions. At the time of writing, found groundwater to be shallower in places towards the western part of the western parcel. Groundwater levels monitored over the period from September to November 2020, showed that groundwater levels varied from 0.51 m BGL to 4.37 m BGL across the Site. However, groundwater levels obtained from January 2021 showed levels varying from 0.1 m BGL to 2.4 m BGL.

13.46 The site investigation report states that water seepages during excavations should be able to be managed via sump pumping in general, with the use of high-capacity pumps likely to be required for high return period rainfall events. The site investigation report also concludes that although infiltration rates were obtained in several of the trial pits, the infiltration rates are highly variable and sporadic across the Site. Furthermore, the presence of shallow groundwater would preclude the use of infiltration to manage surface water runoff from the Site.

13.47 Whilst it is accepted that some parts of the Site may experience regions of shallow groundwater, these are localised and are not considered to represent a significant source of flood risk. Should groundwater rise above the surface, the sloping ground would not promote

accumulation of water, with the water running off towards a watercourse.

Other Sources of Flood Risk

13.48 There are other sources of flood risk to consider, in addition to risks from rivers, sea, surface water and groundwater flooding. These include infrastructure and artificial sources (such as canals and reservoirs).

13.49 At present there is no wastewater drainage infrastructure within the Site. To the immediate north of the Site, construction is ongoing for an approved residential scheme. Although this scheme lies upstream of the Site, it is assumed that sewerage systems will be in place and designed to modern standards and should not present a flood risk to the Site. If sewer flooding did occur at this scheme, it is assumed that the scheme would be designed to ensure that exceedance flow paths are directed towards Town Brook. Therefore, flooding from this source is not considered a current flood risk and is not considered further in this Chapter.

13.50 No canals are identified within the Site and consequently, flooding from this type is not considered a flood risk and is not considered further in this Chapter.

13.51 According to the EA's Long-Term Flood Risk Map, the Site does not lie within the maximum extent of flooding from reservoirs. Therefore, reservoir flooding is unlikely to occur and flood risk from this source is considered negligible and is not considered further in this Chapter.

13.52 A lake is located upstream of the Site and is associated with Town Brook. It is understood that the water level within the lake is controlled by a sluice gate and weir. Whilst any hydraulic controls on the lake are unlikely to have been considered as part of the EA Flood Map for Planning, it is not anticipated that the lake will introduce an additional source of flood risk and is not considered further.

Surface Water Quality

13.53 The WFD establishes a common approach to managing water and aims to achieve "good" ecological status for all water bodies and no deterioration. Key actions to improve water quality are described in the Thames River Basin Management Plan[xviii]. Other strategies such as the Thames Catchment Flood Management Plan[xix] will have multiple benefits that will also help improve water quality. The Site lies within the Oxon Ray operational catchment.

There are no water quality data available for the reach of Town Brook along the eastern boundary of the eastern parcel, or the other watercourses along the Site's boundaries. Water quality data are available for Town Brook, at its confluence with the unnamed watercourse

on the western parcel's southern boundary. Town Brook subsequently passes through Bicester town centre until it converges with Langford Brook approximately 3.6 km to the south east of the Site. Langford Brook then converges with the Gagle Brook approximately 1.4 km further downstream (approximately 5 km to the south east of the Site).

13.54 The Site does not lie within any surface water Drinking Water Safeguard Zones, but immediately to the east of the Site is an extensive surface water Drinking Water Safeguard Zone, which eventually extends southwards towards Charlton-on-Otmoor. However, the Site will drain first via Town Brook, Langford Brook, and Gagle Brook, where it does not pass through this safeguard zone. It is not until the Gagle Brook's confluence with the River Ray at Merton Borrow Pit (approximately 8 km south of the Site), that the hydrological path from the Site enters into the safeguard zone. Hence, the impact of the Development is considered to be negligible upon the integrity of the surface water Drinking Water Safeguard Zone.

13.55 Therefore, the water quality of Town Brook (at Bicester) and Langford Brook (Bicester to Ray including Gagle Brook) are considered to be good measures of baseline surface water quality from which to assess the effect of the Development, since the catchment area of Town Brook (at Bicester) covers the entire Site, and the Langford Brook (Bicester to Ray including Gagle Brook) is Town Brook's receiving downstream watercourse.

13.56 The EA catchment explorer classifies Town Brook (at Bicester) as "Moderate" overall in 2019, with an ecological classification of "Moderate" and a chemical classification of "Fail".

13.57 The EA catchment explorer classifies Langford Brook (Bicester to Ray including Gagle Brook) as "Poor" overall in 2019, with an ecological classification of "Poor" and a chemical classification of "Fail".

13.58 Although the Site lies within SSSI impact risk zones for Ardley Cutting and Quarry SSSI, Ardley Trackways SSSI and Stratton Audley Quarries SSSI, these are either located upstream of the Site (Ardley Cutting and Quarry, Ardley Trackways) and/or have no hydrological link to the Site. Thus, from a hydrological perspective, the Development will not impact these SSSIs.

13.59 Although the SSSIs of Wendlebury Meads & Mansmoor Closes and Otmoor are downstream of the Site and have direct hydrological links via streams and rivers, given that the Site lies outside of their impact risk zones and are located approximately 7 km and 10 km away respectively, any runoff from the Site is likely to experience dilution effects, minimising any impact on these SSSIs.

Groundwater Quality

13.60 The EA catchment explorer identifies that the entire Site is located within the Bicester-Otmoor Cornbrash groundwater body, which classifies the Bicester-Otmoor Cornbrash groundwater body with an overall classification of "Poor" in 2019. It gives a quantitative classification of "Good" and a chemical classification of "Poor". The chemical classification of "Poor" is attributed to it failing to meet the requirements for a chemical Drinking Water Protected Area.

Surface Water Drainage

13.61 The Site is believed to rely upon a natural surface water runoff regime. Water that is unable to infiltrate into the ground will runoff in accordance with the topography and into boundary watercourses.

Licensed Discharge Consents

13.62 The Site Solutions report states that there are no licensed discharge consents within the Site. However, there is one active discharge consent located within 500 m of the Site. The details are given in Table 13.4.

Table 13.4: Licensed Discharge Consents

Location	Distance	Operator and Address	Details
Off-Site, SE	28 m	A G Phipps, Esq., Home Farm Complex, Home Farm, Banbury Road, Caversfield, Bicester, Oxfordshire, OX27 0TG	Discharge Type: Sewerage Discharges - Final/ Treated Effluent

Licensed Pollutant Release

13.63 There are no licensed pollutant releases within the Site or within 500 m of the Site.

Surface Water Abstractions

13.64 There are no recorded surface water abstractions within the Site or within 500 m of the Site.

Groundwater Abstractions

13.65 The Site Solutions report states that there are no groundwater abstractions within the Site. However, there are four groundwater abstractions located within 1km of the Site. The details are given in Table 13.5.

Table 13.5: Groundwater Abstractions

Location	Source	Name & Permit	Abstraction Use	Status
Off-Site, 674 m SE	Groundwater	W & W Malins, 28/39/14/0214	General Farming and Domestic	Active
Off-Site, 761 m S	Groundwater	W V Malins & Sons, 28/39/14/03848/R01	General Farming and Domestic	Active
Off-Site, 761 m S	Groundwater	W V Malins & Sons, 28/39/14/0348	General Farming and Domestic	Active
Off-Site, 814 m SW	Groundwater	W & W Malins, 28/39/14/0214	General Farming and Domestic	Active

Wastewater (Foul) Drainage

13.66 There are currently no demands on the wastewater drainage network within the Site boundary.

13.67 TWUL asset records indicate an adopted foul water network located along the northern section of Charlotte Avenue. This sewer continues south into Wintergreen fields to continue across the existing field into the Exemplar scheme. A private rising main is also present along the eastern section of Charlotte Avenue which serves the Exemplar scheme development.

13.68 TWUL are in the process of updating their asset records as the Exemplar scheme is built out.

Potable Water/ Water Demand and Supply / Water Neutrality

13.69 There are currently no demands on the potable water supply network within the Site boundary. The area is shown by the EA to be considered as a serious water-stressed area, with the statutory water undertaker for the area – TWUL, predicting supply demand deficits in the area from 2014 (North West Bicester Water Cycle Study (WCS)[xx]) onwards. It is unlikely that abstraction of groundwater would be the preferred option for supplying the Development. The potable water for the Development is likely to originate from the TWUL Swindon and Oxfordshire (SWOX) Water Resource Zone (WRZ), either directly or via an inset network. An initial enquiry to Thames Water in September 2020 confirmed that the existing clean water supply network does not have sufficient capacity for more than 49 houses.

Future Baseline

13.70 The UK Climate Projections 2018[xxi] (UKCP18) predict that the UK will experience significant increases in winter rainfall, with lower rainfall during the summer[x]. The UKCP18 also predicts increased summer storm intensities which is anticipated to result in more frequent and more

extreme surface water flood incidents, putting pressure on existing drainage systems (with urban areas likely to be more sensitive to this change)[x]. Increased rainfall and storm intensities will also likely cause increased runoff rates and impact flood zones (due to increased river flows), with the potential to see an expansion of areas at high risk from river flooding i.e. an increase in the coverage area of Flood Zones 2 and 3, with river flooding potentially more common. However, surface water drainage calculations (presented in the FRA in Appendix 13.1) incorporate these anticipated changes by ensuring proposed systems are adequately sized to account for increased rainfall intensities with runoff rates restricted to current baseline rates.

13.71 For the Thames river basin district, using the EA's higher central allowance, peak river flows are predicted to increase by 35% over the period 2070-2115. For the whole of England, using the EA's upper end allowance, peak rainfall intensity is predicted to increase by 40% over the period 2070-2115.

13.72 Climate change has been considered within the master planning of the Development, with the expansion of Flood Zone 3 (as a result of climate change) considered. Predicted JFlow flood levels were obtained for current Flood Zone 3 extents and a 35 % increase was applied to account for climate change (in accordance with the EA), generating an expanded Flood Zone 3. As per NPPF requirements, all developments must be safe up to and including the 1 in 100 year plus climate change event. Thus, all development has been steered outside of the climate change Flood Zone 3, and the Development is considered protected from future changes to the baseline environment with respect to climate change.

Likely Significant Effects

Construction Phase

13.73 The likely significant effects during the construction phase have been considered under the following categories: flood risk, surface water drainage (surface water quantity), water quality (surface water and groundwater), wastewater generation (including infrastructure capacity) and potable water supply/demand. Inherent mitigation measures are also discussed in this section and have been considered when assigning likely significant effects.

Flood Risk (Fluvial, Surface Water, Groundwater)

13.74 As per the Parameter Plans (see Chapter 3 of the ES as Figures 3.1 to 3.3), in line with the NPPF, all proposed land use vulnerability classifications that are "More Vulnerable" (areas of residential development) but also SuDS, will be located within Flood Zone 1 (land with the

lowest probability of river flooding) and outside of the surface water floodplain. This is an inherent form of mitigation. However, during the construction phase, it is possible that construction activities (such as construction compounds and storage of materials) may need to take place within areas of flood risk (namely to the south east corner of the western parcel and the south corner of the eastern parcel). Furthermore, any excavations could experience some groundwater seepage.

13.75 This could put construction workers in danger and result in a minor loss of flood water storage or changes to existing flow paths, which could temporality increase flood risk posed to the Site and land adjacent to the Site. In addition, construction of foundations and subsurface infrastructure has the potential to affect groundwater and near-surface water flows and movement, which may alter the susceptibility of areas to groundwater upwelling and flooding.

13.76 Without additional mitigation, the likely significant effect of the construction phase on flood risk is assessed to be of high sensitivity and minor magnitude, which is classified as minor (adverse) which is assessed as significant. The effect is considered short-term in terms of duration, direct in nature, and temporary/reversible in effect.

Surface Water Drainage (Surface Water Quantity)

13.77 The construction phase will alter the land usage at the Site by creating both temporary and permanent impermeable surfaces via the construction of new buildings, roads and other hard standing areas. These construction activities will adversely affect the surface water runoff as impermeable surfaces result in higher discharge of surface water rates and produce greater surface water discharge volumes. Unmitigated, this would increase surface water flood risk both within the Site and downstream of the Site.

13.78 Without mitigation, the likely significant effect of the construction phase on surface water drainage is assessed to be of high sensitivity and moderate magnitude, which is classified as major (adverse) which is assessed as significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Quality

13.79 There is the potential for an effect on the surface water quality of the nearby watercourses as a result of construction works. Runoff from the construction site may contain quantities of soil and silt resulting from soil removal processes, in addition to the presence of oil/fuel resulting from construction vehicles and roads surfaces.

13.80 Surface water runoff from the Site will discharge into Town Brook (which has a "Moderate" water quality status). The Town Brook then discharges into the Langford and Gagle Brooks which have a "Poor" water quality status.

13.81 As aforementioned, runoff from the construction phase is likely to contain silt and sediment, which unmitigated could have an adverse impact on the unnamed watercourses and the Town Brook (and its receiving watercourses downstream).

13.82 Without mitigation, the likely significant effect of the construction phase on surface water quality is assessed to be of moderate sensitivity and moderate magnitude, which is classified as moderate (adverse) which is assessed as significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Groundwater Quality

13.83 Given that shallow groundwater affects part of the Site, it is likely that construction activities such as piling, trenches for foundations and installation of subsurface infrastructure will occur at depths close to or within the groundwater table. As such, there is a risk of contaminants (such as oil/fuel) and silt/sediment, arising from these construction activities, directly entering the groundwater table. As previously mentioned, considering the Forest Marble Formation acts as an aquiclude between the Cornbrash Formation and the White Limestone Formation, it is not anticipated that a pathway exists for contaminants to enter deep groundwater bodies of the White Limestone Formation. Whilst it is accepted that the Forest Marble Formation is capable of holding small quantities of water within limestone bands, permeability is described in the Hydrock report as low.

13.84 Without mitigation, the likely significant effect of the construction phase on groundwater quality is assessed to be of high sensitivity and moderate magnitude, which is classified as major (adverse) which is assessed as significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Wastewater Generation

13.85 During the construction phase there will be a requirement for temporary infrastructure to provide welfare facilities to construction operatives, resulting in the generation of wastewater from on-Site activities. Unmitigated, this would have a detrimental effect on TWUL's existing network.

13.86 Without mitigation, the likely significant effect of the construction phase on wastewater

generation is assessed to be of low sensitivity and minor magnitude, which is classified as minor (adverse) which is assessed as not significant. The effect is considered short-term in terms of duration, direct in nature, and reversible in effect.

Potable Water (Supply and Demand)

13.87 The construction phase will alter the land usage at the Site by creating a demand for potable water for site welfare and construction practices. Unmitigated, this would have a detrimental effect on TWUL's existing supply network.

13.88 Without mitigation, the likely significant effect of the construction phase on potable water is assessed to be of high sensitivity and moderate magnitude, which is classified as moderate (adverse) which is assessed as significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Completed Development

13.89 The likely significant effects during the completed development phase have been considered under the following categories: flood risk, surface water drainage (surface water quantity), water quality (surface water and groundwater), wastewater generation (including infrastructure capacity) and potable water supply/demand. Inherent mitigation measures are also discussed in this section and have been considered when assigning likely significant effects.

Flood Risk (Fluvial, Surface Water, Groundwater)

13.90 The Parameter Plans demonstrate that during the completed development phase, all "More Vulnerable" development, but also SuDS, will be located within Flood Zone 1 and outside of areas susceptible to surface water flooding. In addition, all development will be located outside of the climate change Flood Zone 3 (for further details see FRA in Appendix 13.1). This is considered as inherent mitigation embedded within the master planning of the Site.

13.91 Whilst groundwater has been identified to be shallow in places across the Site, the risk of flooding from this source is low, and more likely to affect isolated parts of the Site. No other significant sources of flood risk have been identified as part of the baseline assessment.

13.92 Without additional mitigation, the likely significant effect of the completed development phase on flood risk is assessed to be of moderate sensitivity and moderate magnitude, which is classified as moderate (adverse) which is assessed as significant. The effect is considered

long-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Drainage (Surface Water Quantity)

13.93 As discussed previously, the Site is currently undeveloped, relying primarily on a natural drainage system. The Development will result in the introduction of new impermeable areas. These will include roofs, roads, car parks, pavements and other hard standing surfaces. This will affect the surface water runoff regime, as impermeable surfaces are known to increases peak runoff rates and volumes, as well as reducing the time to peak of the runoff, which puts pressures on downstream receiving watercourses and/or drainage systems.

13.94 Without additional mitigation, the likely significant effect of the completed development phase on surface water drainage is assessed to be of high sensitivity and major magnitude, which is classified as major (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Quality

13.95 During the completed development phase, surface water quality could be adversely affected by the presence of pollutants, including hydrocarbons and sediment from proposed roads and other hard standing surfaces. In addition, there is an elevated risk of spillage events with increased vehicular movements across the Site associated with residential activities.

13.96 Surface water runoff from the Site will first discharge into Town Brook (which has a "Moderate" water quality status) followed by the Langford and Gagle Brooks (which have "Poor" water quality status.

13.97 Without mitigation, the likely significant effect of the completed development phase on surface water quality is assessed to be of moderate sensitivity and moderate magnitude, which is classified as moderate (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Groundwater Quality

13.98 Any additional ground disturbance is considered unlikely as part of the completed development stage. However, foundations and below ground infrastructure installed during the construction phase would remain in place during the completed development phase. The Site is in a high groundwater vulnerability area. Although the Site in underlain by Secondary A aquifers (bedrock and superficial) no groundwater abstractions are recorded on Site or

within 500 m. However, there are four groundwater abstraction licenses recorded between 500 – 1,000 m of the Site. Given the distance from the Site, it is likely that if any contaminants do enter groundwater supplies (most likely in areas where shallow groundwater is present) will be subject to some degree of dilution at the point of abstraction.

13.99 Without mitigation, the likely significant effect of the completed development phase on groundwater quality is assessed to be of high sensitivity and minor magnitude, which is classified as minor (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Wastewater Generation

13.100 During the completed development phase there will be an increase in wastewater flow, resulting from additional households in the area, which will increase the load on the existing foul water network.

13.101 TWUL has confirmed that the existing network does not have sufficient capacity to fulfil the potable water demands of the entire development.

13.102 Without mitigation, the likely significant effect of the completed development phase on wastewater volume is assessed to be of high sensitivity and major magnitude, which is classified as major (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and reversible in effect.

Potable Water (Supply and Demand)

13.103 As discussed previously, the Site is currently undeveloped, with no demand on potable water supply. The Site is located in a serious water stress area and TWUL has confirmed the Site is considered to be water-stressed, predicting supply demand deficits in the area from 2014 onwards. TWUL has confirmed that the existing network does not have sufficient capacity to fulfil the potable water demands of the entire development, but 49 homes can be accommodated. Unmitigated the completed development will result in a significant increase in demand on the potable water resource.

13.104 Without additional mitigation, the likely significant effect of the completed development phase on potable water is assessed to be of high sensitivity and major magnitude, which is classified as major (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Mitigation Measures

13.105 Mitigation measures are implemented in order to offset against any identified significant adverse effects associated with the Development during both construction and completed development phases. Mitigation measures are those over and above inherent mitigation already incorporated into the detailed design or Parameter Plans.

Construction Phase

Flood Risk (Fluvial, Surface Water and Groundwater)

13.106 Whilst most of the construction will take place outside of areas susceptible to flooding, a Construction Environmental Management Plan (CEMP) will be in place and all construction will be performed in line with this to manage the potential impacts of construction. A CEMP will be secured by a condition of the planning permission. The CEMP will outline appropriate construction methods and best practices to mitigate against construction impacts and worker safety, including allocating all temporary buildings (such as site offices) and construction equipment, outside of the floodplain wherever possible. In addition, all construction work will be carried out in line with guidance detailed in the CIRIA document: Control of Water Pollution from Construction Sites[xxii]. Adverse weather conditions should also be monitored, and procedures put in place to minimise impacts during the construction phase. This will include raising awareness of flood hazards through contractor briefing.

Surface Water Drainage (Surface Water Quantity)

13.107 As per the OCC Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire document, local standard L16 states that the "*drainage system must be operational before construction of any impermeable surfacing, to mitigate the risk of flooding during construction. For large phased developments, any strategic drainage elements that serve more than one parcel or phase must be designed and constructed to be fully functional prior to construction of each parcel.*"

13.108 As per this local standard requirement, the proposed surface water drainage management system will be in place (including SuDS) prior to any construction of impermeable surfaces.

13.109 The OCC Local Standards document also states that "*surface runoff from the construction site should not drain into SuDS components unless it has been allowed for in the design and specification. This will avoid silt-laden runoff from clogging infiltration systems or building up in storage systems*". This will be adhered to during the construction phase.

13.110 Furthermore, in accordance with the OCC Local Standards document, which states that all new developments are strongly encouraged to use SuDS as a tool for managing surface water runoff rates and volumes, the Development will implement a SuDS-based drainage strategy to control runoff rates and volumes. A detailed surface water drainage management plan will be developed for the Site, which will be secured by a condition of the planning permission. As previously discussed, surface water drainage systems will be in place prior to the construction of any impermeable surfaces. The detailed surface water drainage management plan will ensure that surface water runoff generated during construction is effectively managed to mitigate against the adverse effects of increases in surface water runoff. The Parameter Plans identify potential locations of key SuDS features across the Site for the completed development phase. These SuDS can also be used to manage the surface water runoff from construction areas and release it at greenfield rates.

Surface Water Quality

13.111 The SWDMP will include best practices with regards to managing construction runoff and will also outline methods to mitigate against water quality degradation by implementing the guidance as set out in the CIRIA SuDS Manual and the OCC Local Standards document.

13.112 The SWDMP would outline suitable measures that can be implemented to limit contamination of watercourses. These may include the use of SuDS to act as settlement basins to help treat construction runoff, use of straw bales to aid in settlement filtering, alongside traps (such as nets around gullies and outfalls) and silt fences prior to construction commencing.

13.113 The CEMP will also outline appropriate methods for the transport and/or storage of hazardous materials (such as petrol) in order to minimise risk of spillages. Should a spillage occur, and the spilt pollutant were to enter drainage systems or watercourses, this could adversely affect the surface water quality. To mitigate against this, the provision of SuDS will provide some pollutant-removal capability, thus diluting the pollutant concentration and thus mitigating damage. In addition, further procedures will also be put in place, such as the requirement to report all spillages to staff trained in clean-up procedures. Wheel washing facilities may also be used to help reduce dust accumulation on roads, with the potential to use road sweepers where the Site cannot accommodate wheel washing.

Groundwater Quality

13.114 In areas where shallow groundwater is present, appropriate construction techniques would be set out in the CEMP and adhered to. These would include the use of the SuDS and outlined measures for mitigating against surface water quality to prevent groundwater quality

degradation and appropriate construction methods.

Wastewater Generation

13.115 The CEMP will be in place and wastewater disposal from site during construction phase can be achieved using different methods and is expected that the appointed contractor will provide a wastewater disposal strategy as part of the site compound proposals. The proposals should state how wastewater from on-Site activities will be disposed and include all required permits and agreements from the local overseeing organisation where required.

Potable Water (Supply and Demand)

13.116 The CEMP will be in place and all construction will be performed in line with this to manage the potential impacts of construction. The CEMP will outline appropriate construction methods and best practices to mitigate against the identified construction effects. The mitigation will include the use of water efficient fixtures in the Site welfare facilities, where possible recycling of water and operative training would be implemented (as part of Site operative inductions and toolbox talks) and monitoring and implementation of construction best practices.

Completed Development

Flood Risk (Fluvial, Surface Water and Groundwater)

13.117 In addition to the previously outlined inherent mitigation measures, in accordance with building regulations, finished floor levels will also be elevated at least 150 mm above surrounding ground levels. This will further mitigate against flood risk.

Surface Water Drainage

13.118 A SuDS-based drainage strategy will be in place during the completed development phase which will ensure that all surface water runoff is contained and controlled in accordance with the SuDS management train and the sustainable drainage hierarchy as per the OCC's Local Standards. This will see the implementation of source control techniques and surface water drainage managed on a sub-catchment basis with further details discussed in the FRA (Appendix 13.1). Increased runoff rates and volumes from the Development will be mitigated using SuDS. These will ensure that flood risk is not increased downstream, and as outlined in the FRA (Appendix 13.1), have been adequately sized (accounting for climate change) to provide attenuation storage in line with planning policy and LLFA requirements.

13.119 The SuDS will reduce runoff rates from the Development to QBAR greenfield rates, to mimic

the existing drainage regime as closely as is feasibly possible. Therefore, in the larger rainfall events, the rate of water running off from the Development is likely to be reduced.

Surface Water Quality

13.120 As aforementioned, SuDS will be implemented within the surface water drainage strategy using the SuDS management train principles to avoid a 'pipe to pond' scenario and will therefore help to facilitate the removal of pollutants via filtration and retention methods. Runoff will be managed at source, with residual flows to drain to additional storage and treatment systems downstream. Suitable maintenance regimes will also be in place as per the CIRIA SuDS manual to ensure the upkeep of SuDS features to ensure their efficiency to mitigate against water quality changes in the Site's receiving watercourses.

Groundwater Quality

13.121 Given that the Site lies in a high groundwater vulnerability area and shallow groundwater effects parts of it, source control SuDS techniques will be implemented throughout to help mitigate against any degradation in groundwater quality as a result of the completed development phase. In areas where shallow groundwater is present all SuDS will be suitably lined to ensure there is no pathway to groundwater bodies.

Wastewater Generation

13.122 Following consultation with Thames Water, it has been confirmed that there is not enough capacity in the existing foul water network to accommodate the additional flows from the Development, and that an upgrade of the existing network will be required to connect the site into the existing adopted network.

13.123 To assist Thames Water in determining the extent of the required improvement works, a preliminary wastewater drainage strategy has been considered to identify points of connection onto the existing network and proposed flow rates. Consultation with TWUL, to agree a Wastewater Strategy will continue, to allow the connection of the Development into the adopted sewer network. A Wastewater Strategy will be secured by a condition of the planning permission.

Potable Water (Supply and Demand)

13.124 The Development will accord with the North West Bicester WCS, aspiring to achieve BREEAM excellent standard for residential buildings, and a design standard to set home water demand

to 105l/p/d, further reducing the potable demand by providing at least 25l/p/d of this demand from non-potable local water recycling features either on plot, site wide schemes or a combination of the two. In order to achieve the reduced daily consumption per household the WCS concluded that water efficiency measures will be implemented in all new residential properties, including:

- 2.6/4.0l dual flush toilet cistern
- 9l/minute shower valves
- 150l bath; and
- 6l/minute taps.

13.125 The above proposals will be enshrined in future reserved matters development proposals and designed and instigated by planning conditions.

13.126 Discussions and modelling have been carried out by the designer and TWUL which have confirmed that reinforcement works to potable water infrastructure is also required to enable the completed site to be connected. The extent of the works required will be confirmed by TWUL once capacity modelling of the existing potable network is completed. Therefore, further to the onsite solutions to be provided for the development off site reinforcement works will also be delivered by TWUL prior to there being a high demand placed on the water supply.

Residual Effects

13.127 The residual effects of the Development following the implementation of the previously outlined proposed mitigation measures have been determined for both the construction and completed development phases.

Construction Phase

Flood Risk (Fluvial, Surface Water and Groundwater)

13.128 The residual effect of the construction phase on flood risk, with mitigation measures included, is assessed to be of high sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Drainage

13.129 The residual effect of the construction phase on surface water drainage, with mitigation measures included, is assessed to be of high sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Quality

13.130 The residual effect of the construction phase on surface water quality, with mitigation measures included, is assessed to be of moderate sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Groundwater Quality

13.131 The residual effect of the construction phase on groundwater quality, with mitigation measures included, is assessed to be of high sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Wastewater Generation

13.132 The residual effect of the construction phase on wastewater generation, with mitigation measures included, is assessed to be of low sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant.

Potable Water (Supply and Demand)

13.133 The residual effect of the construction phase on potable water, with mitigation measures included, is assessed to be of High sensitivity and minor magnitude which is classified as minor adverse which is assessed as not significant for potable water. The effect is considered short-term in terms of duration, direct in nature, and non-reversible in effect.

Completed Development

Flood Risk (Fluvial, Surface Water and Groundwater)

13.134 The residual effect of the completed development phase on flood risk, with mitigation

measures included, is assessed to be of moderate sensitivity and minor magnitude which is classified as minor (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Drainage

13.135 The residual effect of the completed development phase on surface water drainage, with mitigation measures included, is assessed to be of high sensitivity and minor magnitude which is classified as minor (adverse) which is assessed as significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Surface Water Quality

13.136 The residual effect of the completed development phase on surface water quality, with mitigation measures included, is assessed to be of moderate sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Groundwater Quality

13.137 The residual effect of the completed development phase on groundwater quality, with mitigation measures included, is assessed to be of high sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Wastewater Generation

13.138 The residual effect of the completed development phase on wastewater generation, with mitigation measures included, is assessed to be of moderate sensitivity and negligible magnitude which is classified as negligible which is assessed as not significant. The effect is considered long-term in terms of duration, direct in nature, and reversible in effect.

Potable Water (Supply and Demand)

13.139 The residual effect of the completed development phase on potable water supply with mitigation measures included, is assessed to be of high sensitivity and minor magnitude which is classified as minor (adverse) which is assessed as not significant. The effect is considered long-term in terms of duration, direct in nature, and non-reversible in effect.

Cumulative Effects

13.140 In terms of the assessment of flood risk, surface water drainage (surface water quantity) and water quality (surface water and groundwater), there are no adverse cumulative effects anticipated in either construction or completed development phases. As required by the NPPF, all new development proposals need to be self-mitigating with measures incorporated to ensure that they have no adverse impact on flood risk to the site in question and its surrounding areas. In accordance with current national and local policies, it is anticipated that all committed or planned future development would also be required to adhere to strict pollution prevention techniques (using practices similar to those outlined in this ES chapter) to ensure no adverse cumulative effects (as a result of further future development) on water quality. In addition, run off rates and volumes are required to meet existing baseline levels as a minimum and measures must be incorporated to ensure no detrimental impact upon groundwater and surface water quality.

13.141 It is therefore assumed that any future development schemes within the vicinity will also be compliant with the NPPF and other local policy including the preparation and adoption of site-specific CEMP requirements, and thus no significant adverse cumulative effects are anticipated with respect to flood risk, surface water drainage (surface water quantity) and water quality (surface water and groundwater).

13.142 In relation to wastewater generation during the construction and completed development phases, no adverse cumulative effects are anticipated. As requested by OCC Local Flood Risk Management Strategy[xxiii], TWUL as Risk Management Authority responsible for the public foul sewer, has been approached to comment on the proposals for the new development. Consultation with TWUL will continue, to address any significant cumulative effect in the existing foul water network and minimise the impact of the proposed development.

13.143 During the construction and completed development phases, no adverse cumulative effects are anticipated in relation to potable water (supply and demand). As Risk Management Authority responsible for water supply in the area, Thames Water has been consulted to identify the demand of the proposed development and limitations in supply. Liaison with TWUL will continue, to address any possible limitations and identify any requirements to guarantee there is no significant impact in the existing water supply network.

Summary

13.144 This ES chapter has assessed the likely significant effects of the Development in terms of flood risk, surface water drainage (surface water quantity), water quality (groundwater and

surface water), wastewater generation and potable water during both construction and completed development phases.

13.145 An FRA has also been prepared to accompany this chapter and is given in Appendix 13.1.

Methodology

13.146 The assessment methodology used for this ES chapter has included consultation with key regulatory authorities (EA, OCC, CDC, TWUL), a site visit and a desktop review of relevant policy documents, site-specific data (site topographical survey, site investigation report) and online resources (OS, MAGIC and BGS maps, EA Flood Maps) to inform the baseline assessment. Sensitivity and impact magnitudes (and their significance) for both construction and competed development phases have been assessed upon baseline conditions. Mitigation measures have been identified, where needed, to limit any potential adverse impacts resulting from the Development for both construction and completed development phases.

13.147 Furthermore, in addition to consultation with TWUL, a preliminary outline drainage strategy has been developed. This strategy will assist TWUL to identify the extent of the required upgrade works on the adopted foul water network. In relation to potable water (demand and supply), an agreement with TWUL has been entered into to carry out capacity modelling of the impact of the proposed development on the potable water network in advance of any planning permission being granted. This will identify the extent of any reinforcement works necessary to supply the proposed development.

Baseline Conditions

13.148 The baseline environment for the Site has been assessed and is summarised here. Most of the Site is located within Flood Zone 1 and is considered to be at low risk from fluvial flooding (a small portion of the Site lies within Flood Zones 2 and 3 to the east of the eastern parcel). In addition, most of the Site is considered to be at very low risk from surface water flooding, with areas at risk of surface water flooding located within the vicinity of the watercourses along the southern boundary of the western parcel and the eastern boundary of the easter parcel. The risk of groundwater flooding is low, but some shallow groundwater has been encountered in parts of the site. No other significant sources of flooding have been identified.

13.149 The entire Site is underlain via Secondary A aquifers within the Cornbrash and Forest Marble Formations. The deeper geology of the Site is underlain via a Principal aquifer within the White Limestone Formation. However, the White Limestone Formation does not outcrop within the Site. The Site is located within an area of high groundwater vulnerability. The Site drains

via various watercourses to the Town Brook which has an overall water quality status of "Moderate".

13.150 As identified in the provided asset records from TWUL, an existing adopted foul water sewer runs through the middle of the site, along Charlotte Avenue flowing from north to south.

13.151 There are currently no demands on the potable water supply network within the development site boundary. The area is considered to be water-stressed, with the statutory water undertaker for the area – TWUL, predicting supply demand deficits in the area from 2014 onwards. It is unlikely that abstraction of groundwater would be the preferred option for supplying the development area. The potable water for the development area is likely to originate from the TWUL Swindon and Oxfordshire (SWOX) Water Resource Zone (WRZ), either directly or via an inset network. An initial enquiry to Thames Water in September 2020 confirmed that the existing clean water supply network does not have sufficient capacity for more than 49 houses.

Mitigation Measures Proposed

13.152 A wide range of mitigation measures have been proposed which include the development of a CEMP outlining appropriate construction methods and best practices to mitigate against adverse impacts resulting from the Development. This will include the installation of adequate drainage systems prior to construction of impermeable surfaces which are sized appropriately to provide the required capacities during the completed development stages with climate change allowances incorporated into their design. Furthermore, groundwater and surface water quality mitigation measures have been proposed to protect and mitigate against adverse impacts on water quality as outlined in the CIRIA SuDS Manual.

13.153 The Development will accord with the North West Bicester WCS, aspiring to achieve BREEAM excellent standard for non residential buildings, and a design standard to set home water demand to 105l/p/d, further reducing the potable demand by providing at least 25l/p/d of this demand from non-potable local water recycling features. The reduced daily consumption will be achieved by the implementation of water efficient fixtures and practices.

13.154 Discussions have been carried out between the designers and TWUL which have confirmed that reinforcement works to both the waste and potable water infrastructure is required to enable the completed site to be connected. The extent of the works required will be confirmed by TWUL once the Wastewater Strategy has been reviewed and capacity modelling of the existing potable network is completed.

Residual Effects

13.155 The residual effects of the Development have been assessed and are summarised as follows.

Construction

13.156 Flood risk: negligible (not significant) surface water drainage: negligible (not significant), surface water quality: negligible (not significant), groundwater quality: negligible (not significant), wastewater (generation): negligible (not significant), potable water demand: minor adverse (not significant).

Completed Development

13.157 Flood risk: minor (significant, adverse), surface water drainage: minor (significant, adverse), surface water quality: negligible (not significant), groundwater quality: negligible (not significant), wastewater (generation): negligible (not significant), potable water demand: minor adverse (not significant).

Cumulative Effects

13.158 The cumulative effects have been assessed. In terms of flood risk, surface water drainage (surface water quantity) water quality (surface water and groundwater), no cumulative effects are anticipated. This is because the NPPF requires that all new development must be safe from flooding over its lifetime and must also ensure that flood risk is not increased elsewhere as a result of development. By ensuring surface water drainage is suitably managed to existing baseline conditions (greenfield), this will ensure flood risk is not adversely affected. Local policy also requires that surface water and groundwater quality is protected and not adversely affected as a result of development. It is assumed that any future or committed development will also implement robust mitigation measures (similar to techniques outlined in this ES chapter) to ensure water quality is not adversely affected, and thus ensuring that no significant cumulative effects occur. The Site is considered to be compliant with both the NPPF and local policy. It is assumed that all future development will also be compliant with the NPPF and local policy, and as such, no cumulative effects upon the current baseline environment are anticipated with respect to flood risk, surface water drainage (surface water quantity) and water quality (surface water and groundwater).

13.159 In terms of wastewater (generation) no cumulative effects are anticipated. The proposed mitigation measures will require reinforcement to the existing foul water network which will result in a situation similar to the pre-development scenario.

13.160 In terms of potable water demand no cumulative effects are anticipated given the introduction of water consumption reduction measures set out in BREEAM and the proposed introduction of surface and waste recycling schemes.

13.161 Table 13.6 contains a summary of the likely significant effects of the Development.

Table 13.6: Table of Significance – Water Resources & Flood Risk

Potential Effect	Nature of Effect (Permanent/Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	E	R	C	B	L	
Construction											
Flood Risk	Temporary	Minor (Adverse)	CEMP							x	Negligible
Surface Water Drainage	Temporary	Major (Adverse)	CEMP/OCC Local Standards							x	Negligible
Surface Water Quality	Temporary	Moderate (Adverse)	CEMP/CIRIA SuDS Manual							x	Negligible
Groundwater Quality	Temporary	Major (Adverse)	CEMP/CIRIA SuDS Manual						x		Negligible
Wastewater Generation	Temporary	Minor (Adverse)	CEMP						x		Negligible
Potable Water (Demand & Supply)	Temporary	Moderate (Adverse)	CEMP				x				Minor (Adverse)
Completed Development											
Flood Risk	Permanent	Moderate (Adverse)	CEMP							x	Minor (Adverse)
Surface Water Drainage	Permanent	Major (Adverse)	SuDS							x	Minor (Adverse)
Surface Water Quality	Permanent	Moderate (Adverse)	SuDS							x	Negligible
Groundwater Quality	Permanent	Minor (Adverse)	CEMP/CIRIA SuDS Manual						x		Negligible
Wastewater Generation	Permanent	Major (Adverse)	Network reinforcement							x	Negligible
Potable Water (Demand & Supply)	Permanent	Major (Adverse)	Rainwater harvesting taps etc Network reinforcement				x				Minor (Adverse)
Cumulative Effects											
Construction											
No effects											
Completed Development											
No effects											

*** Geographical Level of Importance**

I = International; UK = United Kingdom; E = England; R = Regional; C = County; B = Borough; L = Local

REFERENCES

[i] Ministry of Housing, Communities and Local Government (February 2019) *National Planning Policy Framework*

[ii] Department for Communities & Local Government, Planning Practice Guidance, http://planningguidance.planningportal.gov.uk/blog/guidance/, accessed on-line 2014

[iii] Cherwell District Council (July 2015) *The Cherwell Local Plan 2011 -2031 Part 1*

[iv] AECOM (May 2017) *Cherwell Level 1 Strategic Flood Risk Assessment*

[v] Oxfordshire County Council (2018) *Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire*

[vi] CIRIA (2015) C753 *The SuDS Manual*

[vii] United Kingdom Government (2017) *Water Environment (Water Framework Directive) (England and Wales) Regulations 2017*

[viii] SV Surveying Ltd (2020) *Topographic Site Survey, Drawing Number 19280-20-01*

[ix] Ordinance Survey Online Maps, https://osmaps.ordnancesurvey.co.uk/, accessed on-line 2020

[x] British Geological Society Online Surface Geology Maps, http://mapapps.bgs.ac.uk/geologyofbritain/home.html, accessed on-line 2020

[xi] Argyll Environmental (2020) *Site Solutions Combined:* AEL-0013-FSC-988590, AEL-0013-FSC-1001160, AEL-0013-FSC-1001164

[xii] Hydrock (2020) *North-West Bicester – Sites A, B and Caversfield Desk Study and Site Investigation and supplementary reports*

[xiii] Environment Agency, *Flood Map for Planning*, https://flood-map-for-planning.service.gov.uk/, accessed online 2020

[xiv] Environment Agency, *Risk of Flooding from Surface Water Map,* https://flood-warning-information.service.gov.uk/long-term-flood-risk/map, accessed online 2020

[xv] Natural England, https://naturalengland-defra.opendata.arcgis.com/, access on-line 2020

[xvi] MAGIC Maps, https://magic.defra.gov.uk/magicmap.aspx, accessed on-line 2020

[xvii] Building Research Establishment (2016) *BRE Digest 365 Soakaway Design*

[xviii] Environment Agency (December 2015) *Thames River Basin Management Plan*

[xix] Environment Agency (December 2009) *Thames Catchment Flood Management Plan*

[xx] Hyder Consulting (UK) Limited (2014) Outline Application NW Bicester Planning Application 1 Water Cycle Study – Detailed Report

[xxi] UK Met Office (2019) *UK Climate Change Projections: Headline Findings Version 2*

[xxiii] HM Government The Building Regulations 2010 Drainage and Waste Disposal approved Section H

[xxiiii] WRc Plc Sewers for Adoption a Design and Construction Guide for Developers Seventh Edition (August 2012)

[xxii] CIRIA (2001) *Control of Water Pollution from Construction Sites*

[xxiii] Oxfordshire County Council *Local Flood Risk Management Strategy*