

10 HYDROLOGY AND FLOOD RISK

10.1 INTRODUCTION

10.1.1 This chapter of the Environmental Statement (ES) assesses the likely significant effects of the Proposed Development on the environment in respect of hydrology and flood risk.

10.1.2 The scope of this Chapter, and the relevant design elements of the Proposed Development, have been informed by consultations with various statutory bodies, specifically: Cherwell District Council, the Environment Agency, Oxfordshire County Council (in their role as Lead Local Flood Authority), and Thames Water.

10.2 ASSESSMENT APPROACH

Methodology

Study Area

10.2.1 The study area for this assessment principally comprises the Application Site, but extends to the relevant natural and man-made water resource catchments where necessary.

Surveys

10.2.2 This Chapter draws on the assessment undertaken within the Flood Risk Assessment (see **Appendix 10.1a**), and the following key background reports:

- Cherwell and West Oxfordshire Level 1 Strategic Flood Risk Assessment 2009¹;
- Cherwell District Council Level 2 SFRA, 2012²;
- Cherwell District Council Level 2 SFRA Addendum, 2012³;
- Cherwell, Thame and Wye Catchment Abstraction Licensing Strategy, 2012⁴;
- Sequential Test and Exception Test (Flooding), 2013⁵;
- Cherwell District Council Level 2 SFRA 2nd Addendum, 2014⁶;
- Sequential Test and Exception Test (Flooding), 2014⁷;
- Thames Catchment Abstraction Licensing Strategy, 2014⁸;

¹ Scott Wilson (2009) Cherwell and West Oxfordshire Level 1 Strategic Flood Risk Assessment, Cherwell District Council.

² URS (2012) Cherwell District Council Level 2 SFRA, Cherwell District Council.

³ URS (2012) Cherwell District Council Level 2 SFRA Addendum, Cherwell District Council.

⁴ Environment Agency (2012) Cherwell, Thame and Wye Catchment Abstraction Licensing Strategy, Environment Agency.

⁵ Cherwell District Council (2013) Sequential Test and Exception Test (Flooding), Cherwell District Council.

⁶ URS (2014) Cherwell District Council Level 2 SFRA 2nd Addendum, Cherwell District Council.

⁷ Cherwell District Council (2014) Sequential Test and Exception Test (Flooding), Cherwell District Council.

⁸ Environment Agency (2014) Thames Catchment Abstraction Licensing Strategy, Environment Agency.

- Water Resources Management Plan 2015 – 2040, 2015⁹;
- Cherwell Level 1 Strategic Flood Risk Assessment, 2017¹⁰;
- Cherwell Level 2 Strategic Flood Risk Assessment, 2017¹¹;
- Sequential Test and Exception Test (Flooding), 2017¹²; and,
- Cherwell Water Cycle Study, 2017¹³.

Assessment of Significance

10.2.3 To assess the effects of the Proposed Development, a set of threshold criteria have been defined to establish the sensitivity, magnitude and significance of the effects identified.

10.2.4 The broad criteria for determining magnitude, sensitivity and significance is outlined in **Chapter 2**. A more specific, detailed approach, in relation to the assessment of potential effects on hydrology and flood risk is presented below.

Sensitivity Criteria

10.2.5 The sensitivity of a receptor is a matter of professional judgement and is based upon the importance and vulnerability of a receptor. These are judged to be:

High

10.2.6 No ability to absorb effect without fundamentally altering baseline condition, and/or is of international / national importance, such as:

- Water resources classified as under 'serious' water stress;
- No capacity within discharge receiving environment, i.e. drainage system and/or waterbody;
- Water quality recorded as 'high' / 'good' within discharge receiving waterbody, and/or classified of international / national ecological importance;
- Underlain by a Groundwater Source Protection Zone and/or an aquifer with a 'high' vulnerability; and,
- Within Flood Zone 3 / high risk of flooding identified from other sources.

Medium

10.2.7 Limited capacity to absorb effect without significantly altering baseline condition, and/or is of moderate importance, such as:

- Water resources classified as under 'moderate' water stress;
- Limited capacity within discharge receiving environment, i.e. drainage system and/or waterbody;
- Water quality recorded as 'moderate' within discharge receiving waterbody, and/or classified of regional ecological importance;

⁹ Thames Water (2015) Water Resources Management Plan 2015 – 2040, Thames Water.

¹⁰ AECOM (2017) Cherwell Level 1 Strategic Flood Risk Assessment, Cherwell District Council.

¹¹ AECOM (2017) Cherwell Level 2 Strategic Flood Risk Assessment, Cherwell District Council.

¹² Cherwell District Council (2017) Sequential Test and Exception Test (Flooding), Cherwell District Council.

¹³ AECOM (2017) Cherwell Water Cycle Study, Cherwell District Council.

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- Underlain by an aquifer with a 'intermediate' vulnerability; and,
- Within Flood Zone 2 / medium risk of flooding identified from other sources.

Low

10.2.8 Receptor tolerant of effect without detriment to baseline condition, and/or is of low importance, such as:

- Water resources classified as under 'low' water stress;
- Unlimited capacity within discharge receiving environment, i.e. drainage system and/or waterbody;
- Water quality recorded as 'poor' within discharge receiving waterbody, and/or classified of local ecological importance;
- Underlain by an aquifer with a 'low' vulnerability; and,
- Within Flood Zone 1 / low risk of flooding identified from other sources.

Negligible

10.2.9 Receptor tolerant of effect without any detriment to baseline condition, and/or is of negligible importance, such as:

- Water resources classified as under no water stress;
- Unlimited capacity within discharge receiving environment, i.e. drainage system and/or waterbody;
- Water quality recorded as 'bad' within discharge receiving waterbody, and/or classified of no ecological importance;
- Not underlain by an aquifer; and,
- Within Flood Zone 1 / negligible risk of flooding identified from other sources.

Magnitude Criteria

10.2.10 The magnitude of effects is judged on the consequences of the effect. The assessment of potential magnitude has been made in accordance with the criteria below:

High

10.2.11 Total loss or major / substantial alteration to key elements / features of the baseline conditions such that the post-Development character / composition / attributes will be fundamentally changed, such as:

- Water resources available within the region;
- Capacity within discharge receiving environment, i.e. drainage system and/or waterbody;
- Water quality within discharge receiving waterbody and/or groundwater; and,
- Flood risk posed to the Proposed Development and/or surrounding areas.

Medium

10.2.12 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, i.e. loss or alteration to those attributes noted above.

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Low

10.2.13 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, i.e. measurable change to those attributes noted above.

Negligible

10.2.14 Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation, i.e. no measurable change to those attributes noted above.

Significance Criteria

10.2.15 The significance of a potential effect is based on a combination of the sensitivity and magnitude of that effect, and assessed as a beneficial, neutral or adverse type of effect, and on a minor, moderate or major scale, as outlined in **Tables 10.1** and **10.2** below, with those effects deemed 'significant' shaded.

Table 10.1: Significance Matrix

Magnitude of Change	Sensitivity of Receptor				
		High	Medium	Low	Negligible
High		Major	Major	Moderate	Negligible
Medium		Major	Moderate	Minor to Moderate	Negligible
Low		Moderate	Minor to Moderate	Minor	Negligible
Negligible		Negligible	Negligible	Negligible	Negligible

Table 10.2: Significance Criteria

Significance Criteria	Description of Criteria
Major Beneficial	Improvement, at a catchment scale, to water resource availability, capacity within discharge receiving environment (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; significant reduction, at a catchment scale, in flood risk.
Moderate Beneficial	Improvement, at a sub-catchment scale, to water resource availability, capacity within discharge receiving environment, (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; reduction, at a sub-catchment scale, in flood risk.
Minor Beneficial	Improvement, at a site scale, to water resource availability, capacity within discharge receiving environment, (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; reduction, at a site scale, in flood risk.
Neutral	No appreciable effect on receptors.

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Significance Criteria	Description of Criteria
Minor Adverse	Reduction, at a site scale, to water resource availability, capacity within discharge receiving environment, (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; increase, at a site scale, in flood risk.
Moderate Adverse	Reduction, at a sub-catchment scale, to water resource availability, capacity within discharge receiving environment, (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; increase, at a sub-catchment scale, in flood risk.
Major Adverse	Reduction, at a catchment scale, to water resource availability, capacity within discharge receiving environment, (i.e. drainage system and/or waterbody), water quality within discharge receiving waterbody and/or groundwater; significant increase, at a catchment scale, in flood risk.

Legislative and Policy Framework

National Planning Policy

National Planning Policy Framework, 2019¹⁴

10.2.16 The National Planning Policy Framework (NPPF) establishes the Government's planning policies for England and how they are expected to be applied. In terms of water resources and flood risk, the NPPF prescribes 'tests' in order to protect people and property from flooding which all Local Planning Authorities are expected to follow, with a view to achieving sustainable development.

10.2.17 Footnote 5 to the NPPF states that a site-specific Flood Risk Assessment (FRA) is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the Local Planning Authority by the Environment Agency); and, where a proposed development or a change of use to a more vulnerable use classification may be subject to other sources of flooding.

Planning Practice Guidance, 2014¹⁵

10.2.18 To accompany the NPPF, the web-based Planning Practice Guidance (PPG) provides additional technical guidance on flood risk and coastal change. The PPG retains key elements of former Planning Policy Statement (PPS) 25 Development and Flood Risk (rescinded on adoption of the NPPF). The original technical guidance published in 2012 has now been replaced by this web-based resource.

10.2.19 In terms of the general planning approach to development and flood risk, the Flood Risk and Coastal Change PPG sets out the following main steps to be followed:

- Assess flood risk;
- Avoid flood risk; and,

¹⁴ Department for Communities and Local Government (2019) National Planning Policy Framework, Department for Communities and Local Government.

¹⁵ Department for Communities and Local Government (2014) National Planning Policy Framework Planning Practice Guidance, Department for Communities and Local Government.

- Manage and mitigate flood risk.

10.2.20 The guidelines also state that in plan-making, Local Planning Authorities should apply a sequential approach to site selection so that development, as far as reasonably possible, is located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk. In plan-making this involves applying the 'Sequential Test' and, if needed, the 'Exception Test', to Local Plans. Guidance on when and how the 'Sequential' and 'Exception' Tests should be applied to Planning Applications is also provided in the PPG.

10.2.21 In addition, the guidelines reiterate that Local Planning Authorities and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and effects of flooding (e.g. through the use of sustainable drainage systems (SUDS) in developments).

10.2.22 Furthermore, the guidelines note that when considering a major development, as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015, SUDS should be provided unless demonstrated to be inappropriate.

10.2.23 The PPG defines Flood Zones, the flood risk 'vulnerability' of different land uses, and the 'compatibility' of different use classes within certain Flood Zones.

10.2.24 The PPG also contains a section on water supply, wastewater and water quality. This guidance indicates that water supply is unlikely to be a consideration for most Planning Applications as water supply is normally addressed through the Local Plan. With regards to water quality, the guidance states that it is only likely to be a significant planning consideration when a proposal will involve:

- Physical modifications to a waterbody such as a flood storage area; channel diversions and dredging; removing natural barriers or existing weirs; constructing new locks, culverts, major bridges, barrages / dams or weirs (including for hydropower); and/or,
- Indirectly affecting a waterbody, for example: as a result of new development such as the redevelopment of land that may be affected by contamination, mineral workings, water or wastewater treatment, waste management facilities and transport schemes including culverts and bridges; and, a lack of adequate infrastructure to deal with wastewater.

Local Planning Policy

The Cherwell Local Plan 2011 - 2031, 2015¹⁶

10.2.25 The key relevant policies from the Local Plan in relation to the Application Site, and hydrology and flood risk, comprise:

- PSD1: Presumption in Favour of Sustainable Development;
- ESD1: Mitigating and Adapting to Climate Change;
- ESD 3: Sustainable Construction;
- ESD 6: Sustainable Flood Risk Management;
- ESD 7: Sustainable Drainage Systems (SUDS); and,
- ESD 8: Water Resources.

¹⁶ Cherwell District Council (2015) The Cherwell Local Plan 2011 - 2031, Cherwell District Council.

Legislative Context

Land Drainage Acts, 1991 and 1994¹⁷

10.2.26 The Land Drainage Acts set out the responsibilities given to the Environment Agency, Internal Drainage Boards, Local Authorities and riparian landowners in regard to land drainage. Under the Acts, the Environment Agency and Local Authorities have discretionary powers of management and maintenance for 'Main Rivers' and 'Ordinary Watercourses' respectively. It is the riparian owner, i.e. the owner of the land through which a watercourse flows, who is ultimately responsible for the maintenance of the relevant section of the watercourse.

Water Industry Act, 1991¹⁸

10.2.27 The Water Industry Act consolidates previous legislation on water supply and sewerage services and covers a wide range of activities required of the privatised water companies that were created in 1989. The main relevant provisions relate to trade effluent discharges made to sewers for which the privatised companies act as the regulatory authorities.

Environment Act, 1995¹⁹

10.2.28 The Environment Act 1995 (Section 57) makes provisions for a risk based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000 and are aimed at ensuring that actions taken with respect to contaminated land are directed by a technical assessment of risk that exists in the source-pathway-receptor scenario. This extends to preventing the contamination of controlled waters.

Water Framework Directive, 2000²⁰

10.2.29 The Water Framework Directive 2000/60/EC (WFD) applies to all European Union waterbodies and aims to ensure their protection from further deterioration, and that improvements in water quality are made. The assessment and protection of waterbodies should be undertaken irrespective of political or administrative boundaries by implementing River Basin Management Plans to be prepared within a formal series of six year cycles, following the identification of River Basin Districts. In general terms, there is an onus on developers to protect and, if possible, enhance waterbodies close to proposed developments.

Water Act, 2003²¹

10.2.30 The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991. The Act brings about a number of changes, including streamlining arrangements for flood defence organisation and funding, changes to the types of

¹⁷ Parliament of the United Kingdom (1991 & 1994) Land Drainage Act, Her Majesty's Stationery Office.

¹⁸ Parliament of the United Kingdom (1991) Water Industry Act, Her Majesty's Stationery Office.

¹⁹ Parliament of the United Kingdom (1995) Environment Act, Her Majesty's Stationery Office.

²⁰ European Commission (2000) Directive 2000/60/EC of the European Parliament and of the Council establishing a Framework for the Community Action in the field of Water Policy, European Commission.

²¹ Parliament of the United Kingdom (2003) Water Act, Her Majesty's Stationery Office.

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abstraction licence, and places a duty on water companies to conserve water and prepare for drought.

*Water Environment (Water Framework Directive) (England and Wales) Regulations, 2003*²²

10.2.31 This transposes the requirements of the WFD into UK law. Eleven River Basin Districts have been identified in England and Wales. The Regulations include a requirement for waterbodies (categorised as: 'rivers', 'lakes', 'transitional waters', 'coastal waters', or 'groundwaters') to achieve 'good' status with respect to ecology and water chemistry by 2015. Progress is monitored by the Environment Agency in its role as the 'competent authority'.

*Flood Directive, 2007*²³

10.2.32 The Flood Directive 2007/60/EC came into force in November 2007. This Directive requires Member States to assess whether watercourses and coastlines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas, and to take adequate and coordinated measures to reduce this flood risk. The Directive requires Member States to carry out a preliminary assessment of flood risk by 2011, to draw up flood risk maps by 2013 and to establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive is to be implemented in co-ordination with the WFD.

*Water Resources Act, 1991 (Amendment) (England and Wales) Regulations, 2009*²⁴

10.2.33 The Water Resources Act (as amended by the Water Resources Act 1991 Regulations 2009) relates to the control of the water environment. The main aspects of the Act (as amended) which are relevant to the Proposed Development include provisions concerning land drainage, flood mitigation and controlling discharges to watercourses to prevent water pollution. It also outlines the functions and responsibility of the Environment Agency in regulating the water environment.

*Flood and Water Management Act, 2010*²⁵

10.2.34 The Flood and Water Management Act implements the recommendations from Sir Michael Pitt's Review of the summer 2007 floods in the UK, and places a series of responsibilities on County and Unitary Councils as 'Lead Local Flood Authorities' with the intention of improving flood risk management. It also removes the automatic right of connection into public water sewers and places the onus on Local Authorities to adopt SUDS.

Scoping Criteria

10.2.35 The scope of this Chapter, and the relevant design elements of the Proposed Development, have been informed by consultations with various statutory

²² Parliament of the United Kingdom (2003) The Water Environment (Water Framework Directive) (England and Wales) Regulations, Her Majesty's Stationery Office.

²³ European Commission (2007) Directive 2007/60/EC of the European Parliament and of the Council on the Assessment and Management of Flood Risks, European Commission.

²⁴ Parliament of the United Kingdom (2009) Water Resources Act 1991 (Amendment) (England and Wales) Regulations, Her Majesty's Stationery Office.

²⁵ Parliament of the United Kingdom (2010) Flood and Water Management Act, Her Majesty's Stationery Office.

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bodies, specifically: Cherwell District Council, the Environment Agency, Oxfordshire County Council (in their role as Lead Local Flood Authority), and Thames Water.

10.2.36 Based on these consultations, the following receptors will be considered as part of this assessment:

- Potable Water Supply;
- Surface Water Drainage;
- Foul Water Drainage;
- Water Quality;
- Groundwater Quality; and,
- Flood Risk.

Limitations to the Assessment

10.2.37 The assessment process is designed to enable good decision-making based on the best possible information about the environmental implications of a proposed development. However, there will always be some uncertainty as to the exact scale and nature of the environmental effects identified. Where this is the case, this has been highlighted in the assessment of effects. This arises through the detail of information available at the time of the assessment and the limitations of the prediction process itself.

10.3 BASELINE CONDITIONS

Site Description and Context

10.3.1 The Application Site occupies an elevated position within the local area. There are a number of gradients across the Application Site but, in general, ground levels fall from a high point of 138m AOD close to the northern boundary (which also represents the highest ground level within the local area) towards all other boundaries, to a recorded low of around 110m AOD on the western boundary.

10.3.2 The closest watercourse, of note, to the Application Site is the River Cherwell which is approximately 0.6km beyond the western boundary and is shown by Ordnance Survey contour mapping to be a minimum of around 35m below Application Site ground levels on the western boundary. This watercourse discharges in to the River Thames to the south of the Application Site, in Oxford.

10.3.3 A number of small streams issue close to the Application Site's boundaries and flow away from the Application Site. Such streams include:

- The Crowfoot Pond which issues just to the north-east of the Application Site boundary and which flows north-eastwards away from the Application Site;
- Two unnamed streams issuing just to the east of the Application Site boundary and which flow south-eastwards away from the Application Site;
- Two unnamed tributaries of the Gallos Brook which issue just to the south-east of the Application Site boundary and which flow southwards away from the Application Site;
- A third unnamed tributary of the Gallos Brook issuing just within the south-western portion of the Application Site and which flows southwards away from the Application Site; and,
- A number of unnamed streams issuing just to the west of the Application Site boundary and which flow westwards away from the Application Site.

Baseline Survey Information

Potable Water Supply

10.3.4 Potable water is currently supplied to the area by Thames Water.

10.3.5 The Application Site is located within Thames Water's 'Swindon and Oxfordshire Water Resource Zone'. Resources for the Zone are largely provided by abstractions from the River Thames, with overall supply comprising around 77% from surface waters (i.e. river abstractions) and around 23% from groundwater (i.e. aquifer abstractions).

10.3.6 The Environment Agency's Catchment Abstraction Management Strategies for the area indicate that the River Cherwell catchment is defined as locally having 'water available' for licencing under all flow scenarios, with the exception of the upper River Cherwell which has 'no water available' for licencing at Q70 (i.e. the flow that is exceeded up to 70% of the time) flow scenarios. However, the downstream lower River Thames is classified as having 'no water available' and consequently low to medium flows within the River Cherwell catchment (a tributary of the River Thames) are protected from consumptive abstraction to account for the flow requirements of the River Thames.

10.3.7 The River Thames itself has 'restricted water available' for licencing between Q50 (i.e. the flow that is exceeded up to 50% of the time) and Q70 flow scenarios, and 'no water available' for licencing at Q70 and Q95 (i.e. the flow that is exceeded up to 95% of the time) flow scenarios. Where water is available, new abstractions will be subject to Thames Q50 'Hands Off Flow' abstraction, which means that surface water can only be abstracted where a minimum of the equivalent Q50 flow remains within the River.

10.3.8 This analysis indicates that there is potential for local abstractions in the River Cherwell catchment, and limited potential for abstractions in the River Thames catchment, with which to supply water to the District.

10.3.9 The Environment Agency's assessment of relative water stress shows that the Thames Water area is classified as being under 'serious' water stress, the highest classification.

10.3.10 Thames Water's Water Resources Management Plan, which takes into account water resource availability and projected demand (including an allowance for new development), states that there will be a supply-demand deficit within the 'Swindon and Oxfordshire Water Resource Zone' increasing through the Management Plan period (i.e. until 2040), if unmanaged. The Plan indicates that the predicted deficit is driven largely by a combination of population growth and the effect of climate change as well as sustainability reductions which will reduce overall supply capability.

10.3.11 However, as a result of implementation of several demand management and supply reinforcement measures, as outlined within the Management Plan, the supply-demand deficit is predicted to be removed and the Water Resource Zone will remain 'in balance' throughout the period.

Application Site Discharges

Surface Water

10.3.12 Currently, the Application Site is served by an extensive surface water drainage system which is understood to comprise a gravity system draining to the small streams (via thirteen individual discharge locations) issuing close to the Application Site's boundaries and flowing away from the Application Site.

Foul Water

10.3.13 Foul water is currently disposed (via gravity and pumping) to a private waste water treatment plant located in the south-eastern corner of the Application Site. Treated water from the plant is discharged to an unnamed tributary of the Gallos Brook which issues just to the south-east of the Application Site boundary and which flows southwards away from the Application Site. The Brook discharges to the River Ray around 11.2km south of the Application Site, which in turn discharges to the River Cherwell.

10.3.14 The Water Cycle Study for the area has identified that the existing waste water treatment plant is likely to have sufficient volume capacity to accommodate the additional growth anticipated within its catchment.

10.3.15 However, to accept and treat all of the additional wastewater flow expected from proposed growth within the area it serves, without effecting water quality objectives, the quality conditions of a new discharge permit will need to be altered compared to the current permit, and treatment process upgrades required (although such required upgrades are advised as being 'technically feasible').

Water Quality / Ecological Classifications

10.3.16 Gallos Brook, which receives treated effluent from the existing waste water treatment plant (via an unnamed tributary), has an overall water body quality classification of 'moderate', as do those catchments to the immediate north, east and west of the Application Site.

10.3.17 The overall water body quality classification of the catchment to the immediate south-east of the Application Site is 'poor'.

10.3.18 The Crowfoot Pond flows through the 'Ardley Cutting and Quarry' Site of Special Scientific Interest (SSSI), to the north-east of the Application Site.

Hydrogeology

10.3.19 The entirety of the Application Site is indicated by British Geological Survey mapping to be underlain by a bedrock of the White Limestone Formation, which is classified as a 'Principal Bedrock Aquifer'. Such aquifers are typically defined as comprising a geology which has high intergranular and/or fracture permeability, meaning they usually provide a high degree of water storage, thereby supporting water supply and/or river base flow on a strategic scale.

10.3.20 The aquifer underlying the Application Site is classified as a 'Major Aquifer' with a 'high' vulnerability, i.e. aquifers typically characterised by the presence of overlying high leaching soils and the absence of low permeability superficial deposits, meaning pollution can be easily transmitted to groundwater.

10.3.21 A Ground Conditions Desk Study²⁶ undertaken for the Application Site (and which incorporates previous studies undertaken for areas within the Application Site) identifies that the Application Site and underlying groundwater has been marginally affected by petroleum hydrocarbons as a result of the historical Application Site use. The Study also identifies that groundwater comprises a layered system beneath the Application Site, with a shallow groundwater body and a deeper groundwater body, with

²⁶ Hydrock (2017) Ground Conditions Desk Study (HEY-HYD-XX-DS-RP-GE-1000), Hydrock.

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vertical migration of water and contaminants occurring from the shallow to deeper groundwater body.

10.3.22 However, the Study concludes that due to the relatively isolated nature of the contamination, and the previous remediation undertaken across the Application Site where such contamination has been identified, the potential effect posed to groundwater at the Application Site is 'moderate'.

Flood Risk

10.3.23 A detailed assessment of the flood risk posed to the Application Site is presented within a Flood Risk Assessment (see **Appendix 10.1a**).

10.3.24 The report confirms that the entirety of the Application Site is within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk.

10.4 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

10.4.1 The assessment of potential effects assumes that no mitigation measures are in place, except those inherent measures incorporated into the design of the Proposed Development, specifically the proposed surface and foul water drainage systems, which will incorporate appropriate levels of pollution control, and necessary upgrades to the existing waste water treatment plant (and discharge permit), where necessary (see **Appendix 10.1a**).

Construction

Potable Water Supply

10.4.2 Potable water uses during the construction phase will include welfare facilities, construction activities (e.g. mortar silos, concrete mixing and internal wet trades etc.) and cleaning operations (e.g. wheel wash and road sweepers etc.).

10.4.3 Whilst the construction of the Proposed Development will place an additional burden on water supplies, and acknowledging that the area is classified as being under 'serious' water stress, Thames Water's Water Resources Management Plan confirms that a supply-demand balance is forecast within their operational region across the Plan period (which includes an allowance for projected growth, and hence construction, within the region).

10.4.4 Consequently, the effect of the construction of the Proposed Development on potable water supply is considered to be of high sensitivity and negligible magnitude and therefore of 'neutral' significance.

Surface Water Drainage

10.4.5 The construction of the Proposed Development will result in an increase of impermeable surfacing within the Application Site, with the construction of buildings, highways and other hard surfaces. Accordingly, if unmitigated, this could increase the rate and volume of surface water run-off from the Application Site, and hence increase the flood risk posed to downstream areas.

10.4.6 However, the surface water drainage system to be installed as part of the Proposed Development will intercept and manage rainfall run-off and discharge surface water to the surrounding streams, at rates equivalent to a pre-development / undeveloped scenario, i.e. retaining the 'natural' drainage regime, thereby ensuring no

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detrimental downstream effects. The construction phasing will be such that the drainage system will be in place before hard surfaces are installed.

10.4.7 Accordingly, the effect of the construction of the Proposed Development on surface water drainage is considered to be of medium sensitivity and negligible magnitude and therefore of 'neutral' significance.

Foul Water Drainage

10.4.8 Significant volumes of foul water are unlikely to be generated during the construction of the Proposed Development, with any welfare facilities likely to be of a temporary nature and foul water removed from the Application Site for disposal, either via tanker and/or the private existing waste water treatment plant located in the south-eastern corner of the Application Site.

10.4.9 As such, the effect of the construction of the Proposed Development on foul water drainage is considered to be of medium sensitivity and negligible magnitude and therefore of 'neutral' significance.

Water Quality

10.4.10 The surface water drainage system to be installed as part of the Proposed Development, and which will be phased so as to be in place during the majority of the construction of the Proposed Development, will incorporate an appropriate level of pollution control. As such, the system should intercept the majority of any contaminants produced as a result of the construction works, such as silty run-off, and prevent such contaminants entering watercourses downstream of the Application Site.

10.4.11 The proposed upgrades to the existing waste water treatment plant (and discharge permit) will be undertaken prior to the commissioning of the foul water drainage system to be installed as part of the Proposed Development. As such, any additional effluent discharge from the Application Site should not affect downstream water quality in the receiving unnamed tributary of the Gallos Brook.

10.4.12 However, the initial period of the construction phase will be undertaken when the surface water drainage system is not fully operational. During this period, contaminants produced as a result of the construction works could be directed into the surrounding streams and adversely affect downstream water quality. Assuming this worst case scenario, the effect of the construction of the Proposed Development on water quality is considered to be of high sensitivity and medium magnitude and therefore of 'major adverse' significance, on a temporary basis (i.e. only during the initial period of the construction phase), and on a national scale (noting that the downstream SSSI indicates a habitat of national interest).

Groundwater Quality

10.4.13 The primary potential effect posed by construction activities on groundwater quality relates to the mobilisation of existing contaminants as a result of intrusive construction activities. This risk is further increased as a result of the high leaching nature of the soils across the Application Site.

10.4.14 Taking into account the Ground Conditions Desk Study assessment of the potential effect posed to groundwater at the Application Site as 'moderate', the effect of the construction of the Proposed Development on groundwater quality is considered to be of high sensitivity and medium magnitude and therefore of 'major adverse' significance, on a temporary basis, and on a regional scale.

Flood Risk

10.4.15 Noting that the Application Site is within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk, the effect of the construction of the Proposed Development on flood risk is considered to be of low sensitivity and negligible magnitude and therefore of 'neutral' significance.

Operation

Potable Water Supply

10.4.16 Whilst the operation of the Proposed Development will place an additional burden on water supplies, and acknowledging that the area is classified as being under 'serious' water stress, Thames Water's Water Resources Management Plan confirms that a supply-demand balance is forecast within their operational region across the Plan period (which includes an allowance for projected growth within the region).

10.4.17 Consequently, the effect of the operation of the Proposed Development on potable water supply is considered to be of high sensitivity and negligible magnitude and therefore of 'neutral' significance.

Surface Water Drainage

10.4.18 The Proposed Development will result in an increase of impermeable surfacing within the Application Site, with the presence of buildings, highways and other hard surfaces. Accordingly, if unmitigated, this could increase the rate and volume of surface water run-off from the Application Site, and hence increase the flood risk posed to downstream areas.

10.4.19 However, the surface water drainage system to be installed as part of the Proposed Development will intercept and manage rainfall run-off and discharge surface water to the surrounding streams, at rates equivalent to a pre-development / undeveloped scenario, i.e. retaining the 'natural' drainage regime, thereby ensuring no detrimental downstream effects.

10.4.20 Accordingly, the effect of the operation of the Proposed Development on surface water drainage is considered to be of medium sensitivity and negligible magnitude and therefore of 'neutral' significance.

Foul Water Drainage

10.4.21 Foul water will be discharged to the existing waste water treatment plant via a new foul water drainage system to be installed as part of the Proposed Development. The Water Cycle Study for the area has identified that the existing waste water treatment plant is likely to have sufficient volume capacity to accommodate the additional growth anticipated within its catchment.

10.4.22 Accordingly, the effect of the operation of the Proposed Development on foul water drainage is considered to be of medium sensitivity and negligible magnitude and therefore of 'neutral' significance.

Water Quality

10.4.23 The surface water drainage system to be installed as part of the Proposed Development will incorporate an appropriate level of pollution control to ensure a high water quality discharge from the Application Site. This will include the management of

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potential pollutants such as hydrocarbons, and sediment from proposed highways and other hard surfaces.

10.4.24 The proposed upgrades to the existing waste water treatment plant (and discharge permit) will ensure that any additional effluent discharge from the Application Site should not adversely affect downstream water quality in the receiving unnamed tributary of the Gallos Brook.

10.4.25 As such, the effect of the operation of the Proposed Development on water quality is considered to be of high sensitivity and negligible magnitude and therefore of 'neutral' significance.

Groundwater Quality

10.4.26 Significant ground intrusions are not anticipated as part of 'normal' Proposed Development operations. As such, the risk of mobilising contaminants is not considered to be increased as a result of the operation of the Proposed Development.

10.4.27 Furthermore, the surface water drainage system to be installed as part of the Proposed Development will not comprise infiltration as a primary means of disposal, and consequently the potential risks associated with soil leaching following the Proposed Development are not considered to be increased.

10.4.28 The effect of the operation of the Proposed Development on groundwater quality is therefore considered to be of high sensitivity and negligible magnitude and therefore of 'neutral' significance.

Flood Risk

10.4.29 Noting that the Application Site is within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk, the effect of the operation of the Proposed Development on flood risk is considered to be of low sensitivity and negligible magnitude and therefore of 'neutral' significance.

Decommissioning

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

10.5 MITIGATION AND ENHANCEMENT

Mitigation by Design

10.5.1 Measures considered 'mitigation by design', i.e. those inherent measures incorporated into the design / layout of the Proposed Development comprise: the proposed surface and foul water drainage systems, which will incorporate appropriate levels of pollution control, and necessary upgrades to the existing waste water treatment plant (and discharge permit), where necessary.

Additional Mitigation

Potable Water Supply

10.5.2 Given the essential use of water during the construction and operation phases, additional mitigation measures are not considered feasible, although 'standard' measures

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will be incorporated into the construction phase and detailed design of the Proposed Development to limit potable water demand, use and wastage wherever practicable (i.e. ensure water supply connections are not leaking; installation of water efficient welfare devices; and, landscaping and open space areas designed to be low water use).

10.5.3 Whilst the implementation of such measures will help to reduce potable water use, in isolation such measures are unlikely to result in a demonstrable decrease in potable water demand at a regional scale. As such, the residual effects of the construction and operation of the Proposed Development on potable water supply is considered to remain of 'neutral' significance.

Surface Water Drainage

10.5.4 Assuming that the surface water drainage system to be installed as part of the Proposed Development is appropriately designed, constructed, phased, and maintained, no additional mitigation measures are considered necessary.

10.5.5 Consequently, the residual effects of the construction and operation of the Proposed Development on surface water drainage are considered to remain of 'neutral' significance.

Foul Water Drainage

10.5.6 Assuming that the foul water drainage system to be installed as part of the Proposed Development is appropriately designed, constructed, phased, and maintained, no additional mitigation measures are considered necessary.

10.5.7 Consequently, the residual effects of the construction and operation of the Proposed Development on foul water drainage are considered to remain of 'neutral' significance.

Water Quality

10.5.8 The construction works will be appropriately phased to ensure that the surface water drainage system to be installed as part of the Proposed Development is in place as early as possible within the construction programme, to thereby manage potential pollutants during the majority of the construction phase, and entirety of the operation phase.

10.5.9 The proposed upgrades to the existing waste water treatment plant (and discharge permit) will also be phased to occur prior to the commissioning of the foul water drainage system to be installed as part of the Proposed Development.

10.5.10 To address the potential effects posed to water quality during the initial period of the construction phase (whilst the surface water drainage system to be installed as part of the Proposed Development is not fully operational), 'standard' management and operational systems will be put in place to minimise the potential effects posed to water quality. Such measures are prescribed in: Pollution Prevention Guidelines 5: Works and Maintenance In or Near Water (PPG5)²⁷; and, Pollution Prevention Guidelines 6: Working at Construction and Demolition Sites (PPG6)²⁸ (both documents withdrawn, but still considered relevant until superseded).

²⁷ Environment Agency (2007) Pollution Prevention Guidelines 5: Works and Maintenance In or Near Water, Environment Agency.

²⁸ Environment Agency (2012) Pollution Prevention Guidelines 6: Working at Construction and Demolition Sites, Environment Agency.

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10.5.11 Assuming such pollution prevention guidelines are adopted and observed, the residual effect of the construction of the Proposed Development on water quality is considered to be reduced to high sensitivity and negligible magnitude and therefore of 'neutral' significance. The residual effect of the operation of the Proposed Development on water quality is considered to remain of 'neutral' significance.

Groundwater Quality

10.5.12 As part of the enabling works / construction of the Proposed Development, a scheme of contamination remediation of identified contaminated material will be undertaken (see **Chapter 11**).

10.5.13 This measure is considered to significantly reduce the risk of the mobilisation of contaminants as a result of intrusive construction activities, and indeed reduce / remove the potential contamination source on a permanent basis. Consequently, the residual effect of the construction and operation of the Proposed Development on groundwater quality is considered to be reduced to high sensitivity and medium magnitude and therefore of 'major beneficial' significance, on a permanent basis, and on a regional scale.

Flood Risk

10.5.14 No additional mitigation measures are considered necessary.

10.5.15 Acknowledging the 'neutral' significance effects identified pre-mitigation, the residual effects of the construction and operation of the Proposed Development on flood risk is considered to remain of 'neutral' significance.

Table 10.3: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Surface water drainage system, including pollution control, and assuming appropriate design, construction, phasing, and maintenance.	X		
2	Foul water drainage system, including necessary upgrades to the existing waste water treatment plant (and discharge permit), and assuming appropriate design, construction, phasing, and maintenance.	X		
3	Potable water demand, use and wastage reduction 'standard' measures.			X
4	Pollution prevention 'standard' management and operational systems (PPG5 and PPG6).			X
5	Contamination remediation.			X

Enhancements

10.5.16 Whilst the proposed contamination remediation is required in order to address the potential adverse effect posed to groundwater quality, the reduction /

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removal of contaminated material from the Application Site will result in the enhancement of groundwater quality beneath the Application Site / within the underlying aquifer (thus the assessed 'major beneficial' residual effect of the construction and operation of the Proposed Development on groundwater quality).

10.6 CUMULATIVE AND IN-COMBINATION EFFECTS ASSESSMENT

10.6.1 The projects to be considered as part of the Cumulative Effects Assessment are located within and immediately adjacent to the Application Site. As such, the same 'baseline conditions' apply to these sites as those identified for the Application Site.

Potable Water Supply

10.6.2 Whilst the Proposed Development and other third party developments will place an additional burden on water supplies, and acknowledging that the area is classified as being under 'serious' water stress, Thames Water's Water Resources Management Plan confirms that a supply-demand balance is forecast within their operational region across the Plan period (which includes an allowance for projected growth within the region).

10.6.3 Consequently, the cumulative effect of the Proposed Development and other third party developments on potable water supply is considered to be of 'neutral' significance.

Surface Water Drainage

10.6.4 Assuming that the surface water drainage systems to be installed as part of the Proposed Development and other third party developments are appropriately designed, constructed, phased, and maintained, the cumulative effect of the Proposed Development and other third party developments on surface water drainage is considered to be of 'neutral' significance.

Foul Water Drainage

10.6.5 On the assumption that the foul water drainage systems to be installed as part of the Proposed Development and other third party developments are appropriately designed, constructed, phased, and maintained, the cumulative effect of the Proposed Development and other third party developments on foul water drainage is considered to be of 'neutral' significance.

Water Quality

10.6.6 Assuming that: the surface water drainage systems to be installed as part of the Proposed Development and other third party developments are in place as early as possible within the respective construction programmes; the proposed upgrades to the existing waste water treatment plant (and discharge permit), which will serve the Proposed Development and other third party developments, will also be phased to occur prior to the commissioning of the respective foul water drainage systems; and, that the appropriate pollution prevention guidelines are adopted and observed, the cumulative effect of the Proposed Development and other third party developments on water quality is considered to be of 'neutral' significance.

Groundwater Quality

10.6.7 The contamination remediation proposed as part of the Proposed Development and other third party developments will significantly reduce the risk of the mobilisation of contaminants as a result of intrusive construction activities, and indeed reduce / remove the potential contamination source on a permanent basis. Consequently, the

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cumulative effect of the Proposed Development and other third party developments on groundwater quality is considered to be of 'major beneficial' significance.

Flood Risk

10.6.8 Noting that the Application Site and other third party developments are within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk, the cumulative effect of the Proposed Development and other third party developments on flood risk is considered to be of 'neutral' significance.

10.7 SUMMARY

Introduction

10.7.1 This chapter of the Environmental Statement assessed the likely significant effects of the Proposed Development on the environment in respect of hydrology and flood risk, specifically in relation to:

- Potable Water Supply;
- Surface Water Drainage;
- Foul Water Drainage;
- Water Quality;
- Groundwater Quality; and,
- Flood Risk.

Baseline Conditions

10.7.2 The closest watercourse, of note, to the Application Site is the River Cherwell which is approximately 0.6km beyond the western boundary. A number of small streams issue close to the Application Site's boundaries and flow away from the Application Site.

10.7.3 Potable water is currently supplied to the area by Thames Water, and whilst the Environment Agency classify the area as being under 'serious' water stress, Thames Water forecast a supply-demand balance going forward, which takes into account water resource availability and projected growth within the region.

10.7.4 The Application Site is currently served by extensive surface and foul water drainage systems which discharge water to surrounding streams, directly (with respect surface water) and via a private waste water treatment plant located in the south-eastern corner of the Application Site (with respect foul water).

10.7.5 The existing waste water treatment plant has been identified as having sufficient volume capacity to accommodate the additional growth anticipated within its catchment, but requiring upgrading to ensure the additional wastewater flow does not affect downstream water quality.

10.7.6 The entirety of the Application Site is indicated to be underlain by a 'Major Aquifer' with a 'high' vulnerability. A separately prepared Ground Conditions Desk Study identified that the Application Site and underlying groundwater has been marginally impacted by petroleum hydrocarbons as a result of the historical Application Site use.

10.7.7 A separately prepared Flood Risk Assessment confirmed that the entirety of the Application Site is within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk.

Likely Significant Effects

10.7.8 Whilst the construction and operation of the Proposed Development will place an additional burden on water supplies, and acknowledging that the area has been classified as being under 'serious' water stress, Thames Water's Water Resources Management Plan confirmed that a supply-demand balance is forecast within their operational region across the Plan period (which includes an allowance for projected growth). Consequently, the effect of the construction and operation of the Proposed Development on potable water supply was considered to be of 'negligible' significance.

10.7.9 The surface water drainage system to be installed as part of the Proposed Development will intercept and manage rainfall run-off and discharge surface water to the surrounding streams, at rates equivalent to a pre-development / undeveloped scenario. Accordingly, the effect of the construction and operation of the Proposed Development on surface water drainage was considered to be of 'negligible' significance.

10.7.10 Significant volumes of foul water are unlikely to be generated during the construction of the Proposed Development. During the operation of the Proposed Development, foul water will be discharged to the existing waste water treatment plant via a new foul water drainage system to be installed as part of the Proposed Development. The Water Cycle Study for the area has identified that the existing waste water treatment plant is likely to have sufficient volume capacity to accommodate the additional growth anticipated within its catchment. Accordingly, the effect of the construction and operation of the Proposed Development on foul water drainage was considered to be of 'negligible' significance.

10.7.11 The surface water drainage system to be installed as part of the Proposed Development, which will incorporate an appropriate level of pollution control; and, the proposed upgrades to the existing waste water treatment plant (and discharge permit), will ensure that any discharge from the Application Site should not adversely affect downstream water quality. However, the initial period of the construction phase will be undertaken when the surface water drainage system is not fully operational. During this period, contaminants produced as a result of the construction works could be directed into the surrounding streams and adversely affect downstream water quality. As such, the effect of the construction of the Proposed Development on water quality was considered to be of 'significant adverse' significance, whilst the effect of the operation phase was considered to be of 'negligible' significance.

10.7.12 The primary potential effect posed by construction activities on groundwater quality relates to the mobilisation of contaminants as a result of intrusive construction activities. However, such a scenario is considered unlikely as part of 'normal' Proposed Development operations. As such, the effect of the construction of the Proposed Development on groundwater quality was considered to be of 'significant adverse' significance, whilst the effect of the operation phase was considered to be of 'negligible' significance.

10.7.13 Noting that the Application Site is within Flood Zone 1, and at low / negligible risk of flooding from all assessed potential sources of flood risk, the effect of the construction and operation of the Proposed Development on flood risk was considered to be of 'negligible' significance.

Mitigation and Enhancement

10.7.14 A range of measures are to be integrated into the design, construction and operation of the Proposed Development in order to mitigate the effects identified.

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10.7.15 Inherent measures incorporated into the design / layout of the Proposed Development include:

- The proposed surface and foul water drainage systems, which will incorporate appropriate levels of pollution control, and necessary upgrades to the existing waste water treatment plant (and discharge permit), where necessary.

10.7.16 Additional measures include:

- 'Standard' measures to limit potable water demand, use and wastage wherever practicable;
- 'Standard' management and operational systems to reduce the risk posed to water quality during the initial period of the construction phase, as prescribed in: Pollution Prevention Guidelines 5: Works and Maintenance In or Near Water, and, Pollution Prevention Guidelines 6: Working at Construction and Demolition Sites; and,
- Contamination remediation of identified contaminated material to significantly reduce the risk of the mobilisation of contaminants as a result of intrusive construction activities, and indeed reduce / remove the potential contamination source on a permanent basis.

10.7.17 The implementation and observation of such measures was considered to retain / reduce the assessed effect of the Proposed Development on the receptors considered to 'negligible' significance, with the exception of the assessed effect of the Proposed Development on groundwater quality. This was assessed to be altered to 'significant beneficial' significance, post-mitigation, due to the proposed reduction / removal of the potential contamination source posing a potential effect to the underlying groundwater quality.

Conclusion

10.7.18 Provided the mitigation measures outlined are integrated into the design, construction and operation of the Proposed Development, the Proposed Development is concluded to be acceptable, from a hydrology and flood risk perspective, with all potential effects assessed as being of either 'negligible' or 'significant beneficial' significance.

10.7.19 **Table 10.4** provides a summary of effects, mitigation and residual effects.

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Table 10.4: Summary of Effects, Mitigation and Residual Effects

Receptor	Effect Significance	Mitigation Measures	Residual Effect Significance
Construction			
Potable Water Supply	Neutral	'Standard' measures to limit potable water demand, use and wastage.	Neutral
Surface Water Drainage	Neutral	Surface water drainage system, including pollution control.	Neutral
Foul Water Drainage	Neutral	Foul water drainage system, including necessary upgrades to the existing waste water treatment plant.	Neutral
Water Quality	Major Adverse	Pollution prevention 'standard' management and operational systems (PPG5 and PPG6).	Neutral
Groundwater Quality	Major Adverse	Contamination remediation.	Major Beneficial
Flood Risk	Neutral	-	Neutral
Operation			
Potable Water Supply	Neutral	'Standard' measures to limit potable water demand, use and wastage.	Neutral
Surface Water Drainage	Neutral	Surface water drainage system, including pollution control.	Neutral
Foul Water Drainage	Neutral	Foul water drainage system, including necessary upgrades to the existing waste water treatment plant.	Neutral
Water Quality	Neutral	-	Neutral
Groundwater Quality	Neutral	-	Major Beneficial
Flood Risk	Neutral	-	Neutral
Cumulative Effects			
Potable Water Supply	Neutral	'Standard' measures to limit potable water demand, use and wastage.	Neutral
Surface Water Drainage	Neutral	Surface water drainage systems, including pollution control.	Neutral
Foul Water Drainage	Neutral	Foul water drainage systems, including necessary upgrades to the existing waste water treatment plant.	Neutral

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Water Quality	Neutral	Pollution prevention 'standard' management and operational systems (PPG5 and PPG6).	Neutral
Groundwater Quality	Neutral	Contamination remediation.	Major Beneficial
Flood Risk	Neutral	-	Neutral