Runnymede Outline Water Cycle Study

Runnymede Borough Council

FINAL

March 2018

Quality information

Prepared by	Checked by	Approved by
Miguel Headley Graduate Engineer Hannah Booth Graduate Water Consultant	Bernadine Maguire Principal Flood Risk & Coastal Consultant	Carl Pelling Associate

Revision History

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Prepared for:

Runnymede Borough Council

Prepared by:

AECOM Limited
Midpoint
Alencon Link
Basingstoke
Hampshire RG21 7PP
UK

T: +44(0)1256 310200
aecom.com

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List of Acronyms

AMP	Asset Management Plan
AWS	Affinity Water Services
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CBA	Cost Benefit Analysis
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CLG	Communities and Local Government
CRC	Carbon Reduction Commitment
DEFRA	Department for Environment, Food and Rural Affairs
DWF	Dry Weather Flow
EA	Environment Agency
EFI	Environmental Flow Indicator
GI	Green Infrastructure
l/h/d	Litres/head/day (a water consumption measurement)
LCT	Limits of Conventional Treatment
LFE	Low Flow Enterprise (low flow model)
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LPA	Local Planning Authority
Ml	Mega Litre (a million litres)
NE	Natural England
NPPF	National Planning Policy Framework
OAHN	Objectively Assessed Housing Need
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
ONS	Office for National Statistics
OR	Occupancy Rate
P	Phosphorous
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBC	Runnymede Borough Council
RBMP	River Basin Management Plan
RoC	Review of Consents (under the Habitats Directive)
RoFSW	Risk of Flooding from Surface Water
RQP	River Quality Planning (tool)
S106	Section 106 (Town and Country Planning Act 1990)
SAC	Special Area for Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP09	United Kingdom Climate Projections 2009
UKTAG	United Kingdom Technical Advisory Group (to the WFD)
UKWIR	United Kingdom Water Industry Research group
UWWTD	Urban Wastewater Treatment Directive
WCS	Water Cycle Study
WFD	Water Framework Directive
WwTW	Wastewater Treatment Works
WRMP	Water Resource Management Plan
WRMU	Water Resource Management Unit (in relation to CAMS)
WRZ	Water Resource Zone (in relation to a water company's WRMP)
WSI	Water Services Infrastructure

Non-Technical Summary

Runnymede Borough Council (RBC) is expected to experience considerable growth, particularly in relation to domestic development for the period up to 2031. This growth represents a challenge in ensuring that both the water environment and water services infrastructure has the capacity to sustain this level of growth and development proposed.

The Outline Water Cycle Study (WCS) forms an important part of the evidence base that will help RBC determine the most appropriate options for development within the area (with respect to water infrastructure and the water environment). The Outline WCS was preceded by a Scoping Stage WCS (completed in January 2018) which identified the following issues which needed to be assessed further at the Outline Stage:

- the increase in wastewater flow to be treated at Chertsey Wastewater Treatment Works (WwTW), which has the potential to impact on the quality of the Chertsey Bourne and associated ecological designations;
- water quality modelling of the impact of the additional discharge and assessment of ecological impact pathways is required to determine the feasibility and nature of wastewater treatment upgrade requirements;
- some major development sites have limited foul sewer network capacity and some potentially have limited water supply network capacity to service major development sites; and
- surface water sewer coverage is limited in some locations in the Borough, and groundwater and geological conditions may limit the infiltration of surface water at major development sites.

Planned future growth across the Runnymede Borough has been assessed with regards to the above issues within this Outline WCS. This WCS provides information at a level suitable to demonstrate that there are workable solutions to key constraints to deliver future development for all development sites (committed and allocations), including recommendations on the policy required to deliver it.

Wastewater Strategy

The Scoping WCS identified that the Chertsey WwTW will serve all the proposed future developments, revealing that it does not have sufficient capacity to accept all future developments proposed within the plan period. The water quality modelling undertaken in the Outline WCS assessment shows that Chertsey WwTW will require tighter permit conditions (within the limits of conventional treatment) on the future discharge volumes to accept future development proposed within the plan period. Therefore some treatment upgrades will be required in order to accommodate the growth to ensure that the increased wastewater flow discharged does not impact on the current quality of the Chertsey Bourne, their associated ecological sites and also to ensure that the waterbody can still meet with Water Framework Directive (WFD) requirements.

The WCS has concluded that feasible solutions are possible to ensure legislative objectives are met. However, this WCS recommends that RBC, the Environment Agency and Thames Water Utilities Ltd (TWUL) continue to work together to co-ordinate regular updates about the timing and quantity of development that can be accommodated across the Borough in the early phases of the Local Plan delivery period. TWUL (as sewerage undertaker) is responsible for identifying future investment at existing WwTWs to accommodate further growth (where required) and applying to the Environment Agency for any revisions to existing permits where necessary.

To ensure that the planned level of development within the Plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that RBC and TWUL use the results of this WCS to inform their Local Plan documents and asset management plans respectively. By working together, this will ensure that as developments come online there is sufficient capacity available locally to ensure all objectives of the WFD continue to be met.

In order to ensure wastewater from growth can be drained to Chertsey WwTW, an assessment of sewer capacity constraints on potential growth sites was undertaken. This assessment has determined that there are no major constraints to development, but identifies that network upgrades may be required to existing sewerage infrastructure (sewer mains or pumping stations). If required, upgrades will be delivered by TWUL in line with development coming forward and will be funded through the Thames Waters Infrastructure Charge.

Water Supply Strategy

Based on the growth assessed, the Scoping WCS concluded that, allowing for the planned water resource management within the Affinity Water Services (AWS) supply area, there would be adequate water supply to cater for growth over the plan period. Updates to AWS' water resource planning documents (draft due to be available in 2019) suggests that this conclusion is still valid, and there are sufficient water resources to cater for the proposed growth within the Local Plan.

In order to ensure water supply infrastructure capacity is available to growth areas, an assessment of the water supply network constraints on potential growth sites was undertaken. This assessment has determined no significant constraint, but highlights where developers will need to contribute to upgrades to existing water supply infrastructure or towards new infrastructure.

Overall Impact of Development

The WCS sets out recommendations for what is required, when, and where in order to address any emerging issues from investigating the impact of development. These recommendations must take account of potential environmental impacts, and the availability of funding and future management arrangements to ensure that adverse impact on the water environment is minimised as a result of development arising from the Local Plan process. With the recommendations from the WCS implemented and mitigations in place, there would be no water cycle constraint to the proposed levels of growth within the Local Plan taking place.

In order to support the further development of the Local Plan for Runnymede with respect to water services infrastructure and the water environment, the WCS provides a site specific assessment of the potential constraints on each of the proposed major development sites within the emerging Local Plan and how these local site issues should be considered by the developer.

1. Introduction

1.1 Background

Runnymede is located in North West Surrey only twenty miles from Central London, and is strategically located at the junction of the M25 and M3 motorways. The Borough has three main towns; Addlestone, Chertsey and Egham. Approximately 79% of its area lies within the Metropolitan Green Belt, which is an area of open land on the south west edge of the London Metropolitan area [1]. RBC is currently preparing the Runnymede 2030 Local Plan which will set out the level of development required in the Borough up to 2030 to meet identified needs, including housing, employment and retail.

This Outline WCS has been commissioned to form an evidence base for further decision-making on the water environment within the planning process and to ensure the Local Plan meets with the requirements of the National Planning Policy Framework (NPPF) with respect to the water environment and water infrastructure provision.

1.2 WCS History

A Scoping WCS was completed in January 2018 and identified that all wastewater generated from the proposed future development sites in Runnymede would be served by Chertsey WwTW and that the additional flows generated would result in the WwTW exceeding its permitted flow capacity. The increase in treated wastewater discharge has the potential to adversely affect the quality of the receiving watercourse, the Chertsey Bourne, and potentially impact on the attainment of water quality standards set under the requirements of the Water Framework Directive (WFD).

Numerical assessment of the impact was therefore identified as being required in an Outline WCS to determine the quality conditions which would need to be applied to a new (or existing) discharge permit in order to mitigate any impact on water quality and to determine whether these permit conditions can be reasonably met with conventional treatment solutions and available technology.

The Scoping WCS found that AWS's approach to address the water supply and demand balance for the supply area in the 2014 Water Resources Management Plan could accommodate the projected growth identified in the development of the Local Plan. Therefore, further assessment of water resources was scoped out of the Outline WCS but consideration has been given to the emerging update to the 2019 WRMP.

1.3 Study Governance

This WCS has been carried out with the guidance of the Steering Group established at the project inception meeting, held on 30th November 2017, comprising the following organisations:

- Affinity Water Services;
- Environment Agency;
- Runnymede Borough Council;
- Surrey County Council; and
- Thames Water Utilities Ltd.

1.4 Outline WCS Scope

This WCS provides information at a level suitable to ensure that there are solutions to deliver growth for the preferred development allocations, including the policy required to deliver it. The outcome is the development of a water cycle strategy for the Borough which informs the Council's new Local Plan, sustainability appraisals and appropriate assessments specific to the water environment and Water Services Infrastructure (WSI) issues.

The following sets out the key objectives of the Outline WCS, as informed by the Scoping WCS (2018):

[1] Runnymede Borough Council (2017) Runnymede Local Plan 2035: Additional Sites & Options Consultation Document

- provide a strategy for wastewater treatment across the Borough which determines if solutions to wastewater treatment are required and if the solutions are viable in terms of balancing environmental capacity with cost;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine upgrades required to wastewater network infrastructure relative to the proposed locations for growth through collaboration with TWUL;
- determine upgrades required to water supply network infrastructure relative to the proposed locations for growth through collaboration with AWS;
- determine the impact on flood risk resulting from the increase in discharge from Chertsey WwTW as a result of proposed growth across the Borough; and
- provide policy recommendations.

1.5 Key Assumptions and Conditions

1.5.1 Water Company Coverage

TWUL is the wastewater undertaker and AWS is the potable water supplier for all of Runnymede Borough.

1.5.2 Water Use

As part of the UK Building Regulations, new developments are required to be built as water efficient properties, with a household consumption rate of 125 litres per head per day (l/h/d), as published in AWS's 2014 WRMP. For the wastewater assessment, a different assumption was made on the likely consumption of water per new household going forward in the plan period. A starting assumption of 125l/h/d was used to calculate wastewater demand per person based on the potable supply; but in addition, to account for infiltration of surface water, groundwater and misconnections to the sewer network in the future, an additional proportion (34%[2]) was included in the calculations for 'unaccounted for' flows.

1.5.3 Household Occupancy Rate

The latest Office for National Statistics (ONS) population projections[3] and household projections[4] have been used to determine the occupancy rate of each household coming forward in the plan period, and have been provided in Table 1-1 below.

Table 1-1 Calculation of Occupancy Rate

	Projection for 2031
Population	99,500
Number of households	40,896
Calculated Occupancy Rate (people per household)	2.43

1.5.4 Wastewater Treatment

As a wastewater treatment provider, TWUL are required to use the best available techniques (defined by the Environment Agency as the best techniques for preventing or minimising emissions and impacts on the environment) to ensure emission limit values stipulated within the WwTW permit conditions are met.

Through application of the best available technologies in terms of wastewater treatment, the reliable limits of conventional treatment (LCT) have been determined for the key parameters of Biochemical Oxygen Demand (BOD)[5], ammonia and phosphate, and are provided in Table 1-2.

[2] TWUL provided the level of sewer infiltration for the Chertsey WwTW which was calculated as 34%.
[3] 2014-based Subnational Population Projections (ONS) (May 2016). Available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29
[4] 2014-based Household Projections to 2039 for England (ONS) (July 2016). Available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

Table 1-2 Reliable limits of conventional treatment technology for wastewater

Water Quality Parameter	LCT
Ammonia	1.0 mg/l 95 percentile limit[6]
BOD	5.0 mg/l 95 percentile limit
Phosphate	0.25 mg/l annual average[7]

1.6 Report Structure

Section 2 of this report provides a summary of the study drivers (as initially defined in the Scoping WCS). Section 3 of this document then outlines the total proposed number of dwellings which will need to be catered for in terms of water supply and wastewater treatment. Understanding what the level of growth is and where it might be located informs the assessment stage of the study (reported in Section 4), assessing the current wastewater treatment facilities in regards to both capacity and compliance with legislation and environmental permits. The wider, supporting environment has also been considered, including climate change and local ecology.

In parallel to the wastewater assessment, Section 5 outlines the emerging update to water resource planning and discusses the water efficiency plan for Runnymede.

The report also covers a water cycle infrastructure assessment of proposed major development sites (defined as having more than 10 dwellings) in more detail (Section 6), assessing each site by identifying local receptors such as watercourses, outlining current and future flood risks (inclusive of surface water and groundwater flood risks) and assessing the current wastewater and water supply network.

Ultimately, recommendations have been made as part of the WCS (Section 7) in regards to wastewater, water supply, surface water management and flood risk, ecology and stakeholder liaison.

[5] Amount of oxygen needed for the biochemical oxidation of the organic matter to carbon dioxide in 5 days. BOD is an indicator for the mass concentration of biodegradable organic compounds

[6] Considered within the water industry to be the current LCT using best available techniques

[7] National Asset Management Plan 6 (AMP6) trials to investigate new sewage treatment technologies to reduce Phosphate treatment were completed in 2017 and a new Technically Achievable Limit (TAL) of 0.25 mg/l for Phosphate has been agreed between water companies and the Environment Agency. This new limit is being used for current AMP7 planning work.

2. Study Drivers

There are two key overarching drivers shaping the direction of the WCS as a whole:

a. Delivering sustainable water management – ensure that provision of WSI and mitigation is sustainable and contributes to the overall delivery of sustainable growth and development and that the Local Plan meets with the requirements of the National Planning Policy Framework (NPPF) with respect to water; and

b. WFD compliance – to ensure that growth, through abstraction of water for supply and discharge of treated wastewater, does not prevent waterbodies within the Borough (and more widely) from achieving the standards required of them as set out in the WFD River Basin Management Plans (RBMPs).

A full list of the key legislative drivers shaping the study was defined in the Scoping WCS, and is detailed in this Outline WCS as a summary table in Appendix A for reference. However, it is important to note that the key driver for this study is WFD compliance.

Other relevant studies that have a bearing on the provision of water services infrastructure for development are provided in Appendix B and include, but are not limited to, key documents including the Runnymede Level 1 SFRA Update (2017), AWS WRMP and the Environment Agency's latest Thames River Basin Management Plan (RBMP) (2015).

2.1 OFWAT Price Review

The price review is a financial review process governed by the Water Services Regulatory Authority (Ofwat) - the water industry's economic regulator. Ofwat determines the limits that water companies can increase or decrease the prices charged to customers over consecutive five year periods.

Figure 2-1 summarises the timescale in the build up towards the next price review. The price limits for the next period (2020 to 2025) will be set at the end of 2019 to take effect on 1st April 2020 and is referred to as Price Review 19 (PR19). Each water company will submit a Business Plan (BP) for the next period which will be assessed by Ofwat, before being agreed. Price limit periods are referred to as AMP (Asset Management Plan) periods, with the current AMP period being referred to as AMP6.

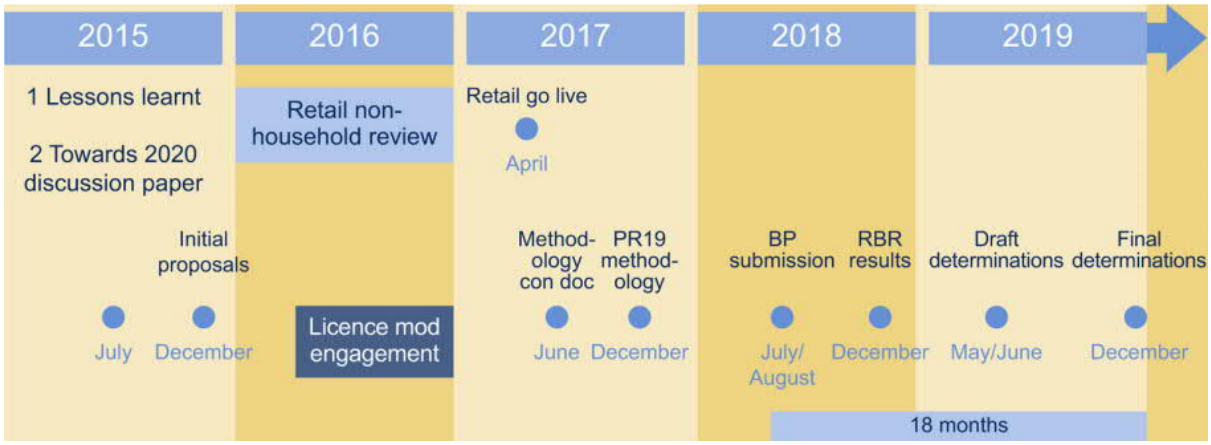


Figure 2-1 Proposed timescales for PR19 (Water 2020) programme[8]

As the wastewater undertaker for the Borough, TWUL has a general duty under Section 94 of the Water Industry Act 1991 to provide effectual drainage which includes providing additional capacity as and when required to accommodate planned development. However this legal requirement must also be balanced with the price controls as set by the regulatory body Ofwat which ensure TWUL has sufficient funds to finance its functions, and at the same time protect consumers' interests. The price controls affect the bills that customers pay and the sewerage services consumers receive, and ultimately ensure wastewater assets are managed and delivered efficiently.

[8] Water 2020: Regulatory framework for wholesale markets and the 2019 price review (December 2015)

Consequently, to avoid potential inefficient investment, TWUL generally do not provide additional infrastructure to accommodate growth until there is certainty that development is due to come forward. This Outline WCS is a key evidence base to support TWUL in making its business planning decisions.

2.2 Water Framework Directive

The environmental objectives of the WFD, as published in the Environment Agency's RBMPs and relevant to this WCS are:

- to prevent deterioration of the status of surface waters and groundwater,
- to achieve objectives and standards for protected areas, and
- to aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status.

These environmental objectives are legally binding, and all public bodies should have regard to these objectives when making decisions that could affect the quality of the water environment. The Environment Agency publishes the status and objectives of each surface waterbody on the Catchment Data Explorer[9], and describes the status of each waterbody as detailed in Table 2-1.

Table 2-1 Description of status in the WFD

Status	Description
High	Near natural conditions. No restriction on the beneficial uses of the water body. No impacts on amenity, wildlife or fisheries.
Good	Slight change from natural conditions as a result of human activity. No restriction on the beneficial uses of the water body. No impact on amenity or fisheries. Protects all but the most sensitive wildlife.
Moderate	Moderate change from natural conditions as a result of human activity. Some restriction on the beneficial uses of the water body. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the water body. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

Source: Environment Agency RBMPs

This Outline WCS is a key evidence base to demonstrate how compliance with the WFD objectives will not be compromised by the proposed growth as set out in the Borough's Local Plan.

[9] http://environment.data.gov.uk/catchment-planning/

3. Proposed Growth

3.1 Preferred Growth Strategy

The Scoping WCS identified the level of growth to be assessed as part of the WCS process. A summary is provided in this Outline WCS.

The Runnymede 2035 Additional Sites and Options Consultation Document[1] identifies the preferred sites to accommodate future growth in the Borough. The administrative area of Runnymede Council covers Chertsey, Egham and Addlestone, with significant areas of Green Belt (6,078 hectares of the total Borough area of 7,804 hectares).

The majority of new development occurs in or adjacent to the larger towns and villages where there is already a wide range of facilities available as outlined in Figure 3-1. In terms of phasing, it is estimated that over 1,000 new homes are likely to be delivered by 2020.

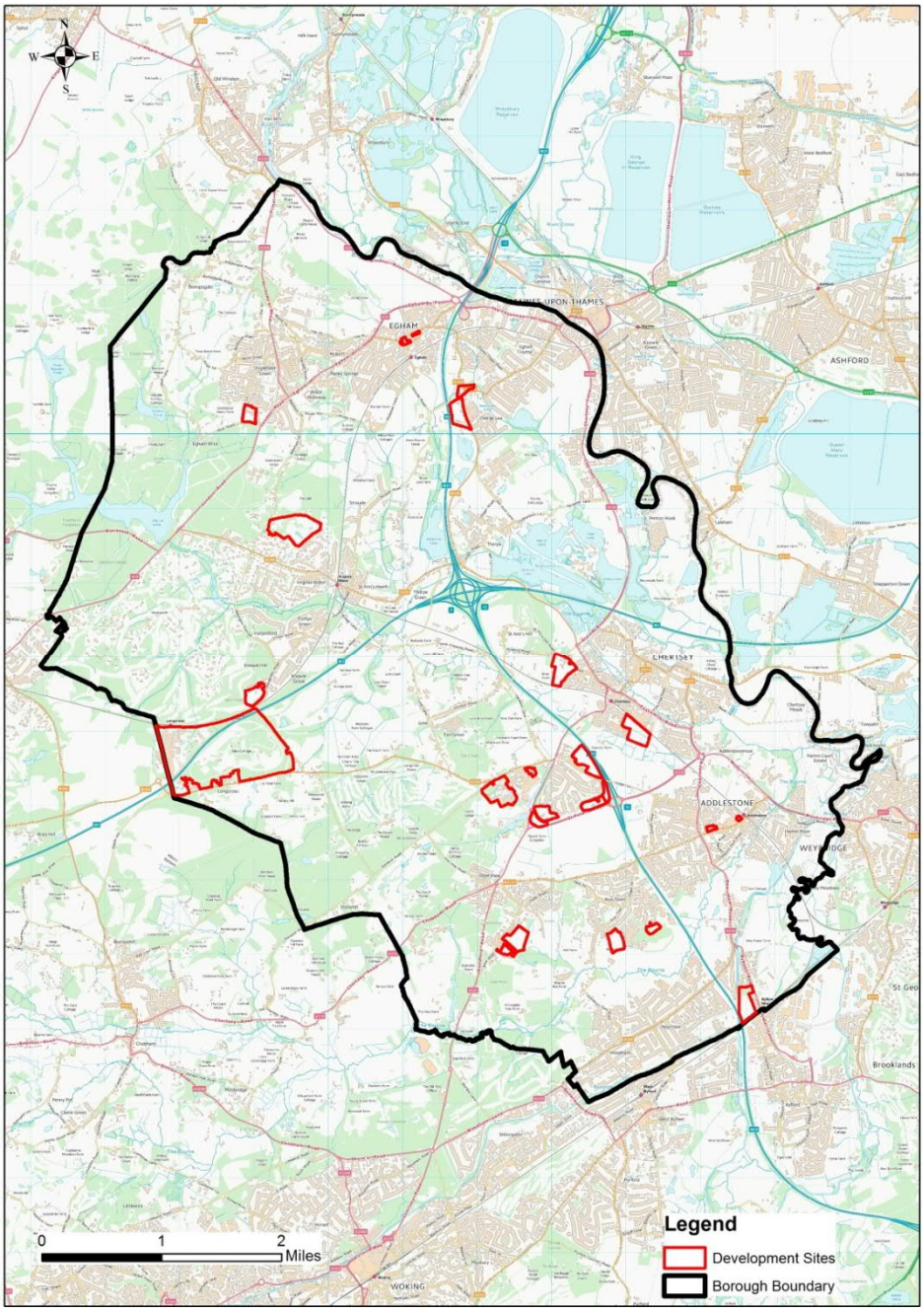


Figure 3-1 Proposed major development areas within Runnymede

3.1.1 Housing

The Outline WCS is to consider future growth up to 2031 which includes a total of 6,662 residential dwellings. Table 3-1 provides an overview of the number of residential units to be built within the planned period which is assessed as part of the Outline WCS.

Table 3-1 Proposed number of residential units up to 2031

Type of Site	No. units
Residential (including windfall allowance)	6,662
Student & older accommodation	3,837
Traveller sites	34[10]
Total proposed housing growth to be assessed	**10,533**

3.1.2 Employment

The proposed employment sites will provide employment growth for the Runnymede area, within the plan period (up to 2030) and beyond, and is expected to generate approximately 10,014 jobs (as shown in Table 3-2).

Table 3-2 Proposed employment figures and assumed water requirements

Site name	Jobs expected to be generated	Approximate water use requirement (m3/day)[11]
Byfleet Road, New Haw	308	4.93
	480	7.68
Longcross Garden Village	5,259[12]	84.14
Meadlake Place, Thorpe Lea Road	93	1.49
Units 4-9, Weybridge Business Park, Addlestone Road	100	1.6
TAMESIS 1, The Glanty	613	9.81
Former Reservoir Site, Lovett Road	468	7.49
Chilsey House, Chilsey Green Road	37	0.59
Land fronting The Glanty including land north and south of Lovett Road	1,027	16.4
Culverdon House, Abbots Way	46	0.74
Three Stars Industrial Estate	27	0.43
31 The Causeway	1,500	24
Quantum House, 59 Guildford Street	13	0.21
Otterhill Farm, Rowtown	9	0.14
Milton House, 27 Station Road	3	0.05
Thorpe Industrial Estate	5	0.08
Plot D, Hanworth Lane, Chertsey	14	0.22
Heritage House, Egham	0	0
Nursery Barn, Otterhill Farm, Rowtown	4	0.06
52 Station Road, Egham	8	0.13
Total:	**10,014**	**160.19**

[10] The draft Local Plan (2018) specifies that the number of traveller sites is 35, however this updated figure was confirmed after the wastewater assessment was undertaken.

[11] A high level assessment of job numbers and approximate water use has been made based on a number of assumptions in line with other RBC planning documents as follows:

- 1 job per 12.5m2 office (B1) floorspace;
- 1 job per 43m2 industrial (B2) floorspace (or where use class not specified);
- 1 job per 65m2 storage and warehousing/distribution (B8);
- Average employment consumption is 16 l/h/d .

[12] The Longcross Garden Village site has an extant planning permission and the number of jobs has been taken from the planning application documentation.

4. Wastewater Treatment

4.1 Wastewater in the Borough

The Scoping WCS identified that wastewater treatment in the Borough is provided via wastewater infrastructure (WwTWs) operated and maintained by TWUL, ultimately discharging treated wastewater to a nearby fluvial watercourse. Each WwTW is connected to a network of wastewater pipes (the sewerage system) which collects wastewater generated by homes and businesses to the WwTW; this is defined as the WwTWs 'catchment'.

The majority of wastewater from the Borough is treated at Chertsey WwTW and the Chertsey Bourne (Virginia Water to Chertsey) catchment is expected to receive the additional treated wastewater as a result of growth. The Scoping WCS therefore identified that the Outline WCS should be focused on assessing the impact of additional wastewater volumes on Chertsey WwTW only. The location of Chertsey WwTW is illustrated in Figure 4-1, alongside an overview of other watercourses within the Borough.

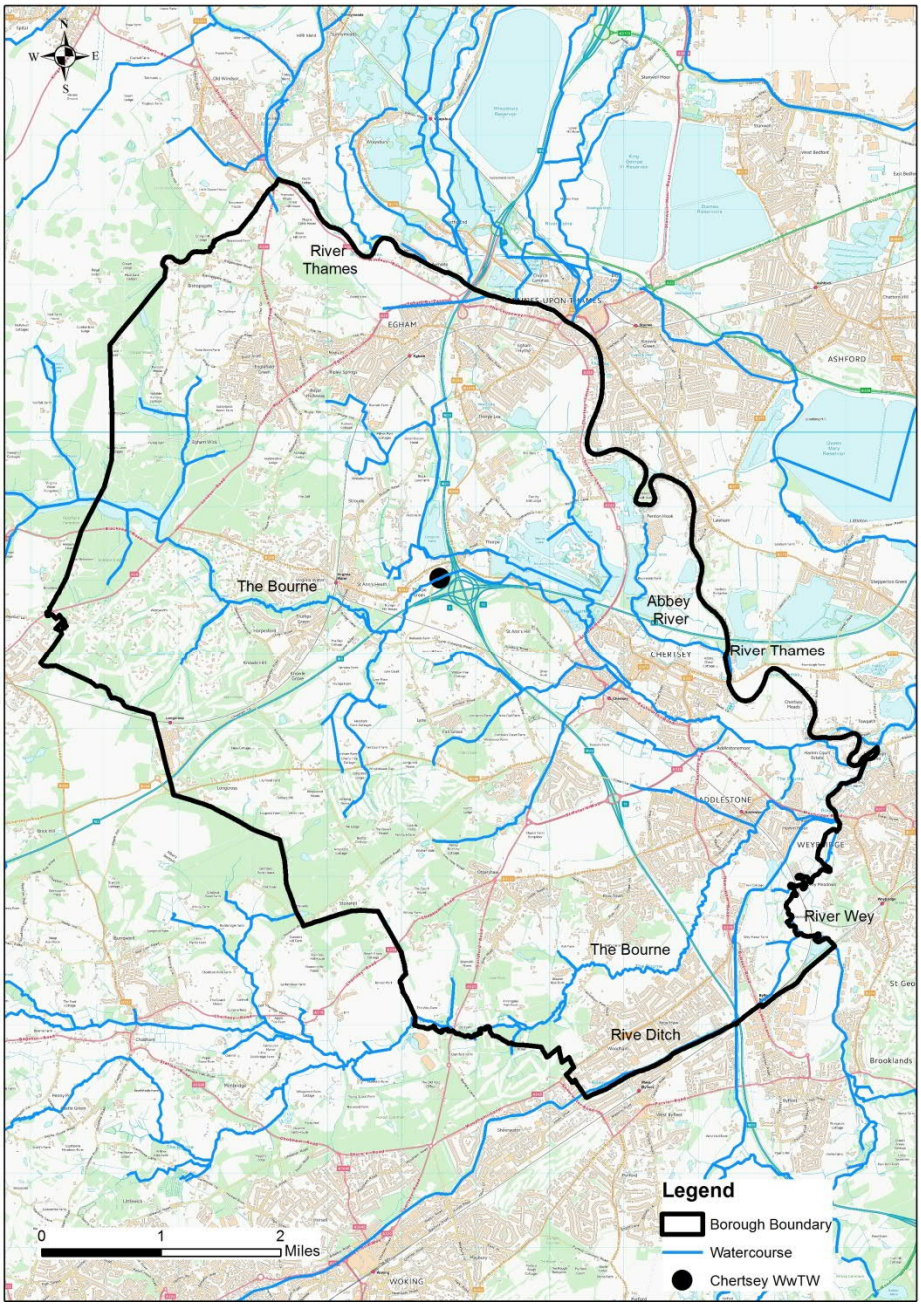


Figure 4-1 Location of Chertsey WwTW

4.2 Management of WwTW Discharges

All WwTWs are issued with a permit to discharge by the Environment Agency, which sets out conditions on the maximum volume of treated wastewater that it can discharge and also limits on the quality of the treated discharge. These limits are set in order to protect the water quality and ecology of the receiving waterbody. They also dictate how much wastewater each WwTW can accept, as well as the type of treatment processes and technology required at the WwTWs to achieve the quality permit limits.

The flow element of the discharge permit determines an approximation of the maximum number of properties that can be connected to a WwTW catchment. When discharge permits are issued, they are generally set with a flow 'headroom', which acknowledges that allowance needs to be made for future development and the additional wastewater generated. This allowance is referred to as 'permitted headroom'. The quality conditions applied to the discharge permit are derived to ensure that the water quality of the receiving waterbody is not adversely affected, up to the maximum permitted flow of the discharge permit.

For the purposes of this WCS, the assumption is applied that any permitted headroom at Chertsey WwTW is usable[13]. This headroom determines how many additional properties can be connected to the WwTW catchment before Thames Water would need to apply for a new discharge permit.

The Scoping WCS determined that a new permit is required because headroom would be exceeded, and the study identified that the quality condition of the permit would need to be reviewed to ensure compliance with relevant water quality standards can be maintained once the additional flow is discharged. If the quality conditions remain unchanged, the increased flow of wastewater received at the WwTW would result in an increase in the pollutant load[14] of some substances being discharged to the Chertsey Bourne. This may have the effect of deteriorating water quality requiring more stringent (or tighter) conditions on the quality of the discharge.

If there is a requirement to meet tighter discharge conditions, there may be a need to provide a higher standard of treatment and hence an increase in the intensity of treatment processes at Chertsey WwTW, which may also require improvements or upgrades to be made to allow the new conditions to be met. It may be possible that the quality conditions required to protect water quality and ecology are not achievable with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

The primary legislative driver which determines the quality conditions of any new permit to discharge are the WFD and the Habitats Directive as described in the following subsections.

4.3 WFD Compliance

The definition of a waterbody's overall WFD 'status' is a complex assessment that combines standards for chemical quality and hydromorphology (habitat and flow conditions), with the ecological requirements of an individual waterbody catchment. A waterbody's 'overall status' is derived from the classification hierarchy made up of 'elements', and the type of waterbody will dictate what types of elements are assessed within it. The following is an example of the classification hierarchy and Figure 4-2 illustrates the classifications applied within the hierarchy;

Overall water body status or potential

- Ecological or Chemical status (e.g. ecological)
  - Component (e.g. biological quality elements)
    - Element (e.g. fish)

[13] In some cases, there is a hydraulic restriction on flow within a WwTW which would limit full use of the maximum permitted headroom.
[14] Concentration is a measure of the amount of a pollutant in a defined volume of water, and load is the amount of a substance discharged during a defined period of time.

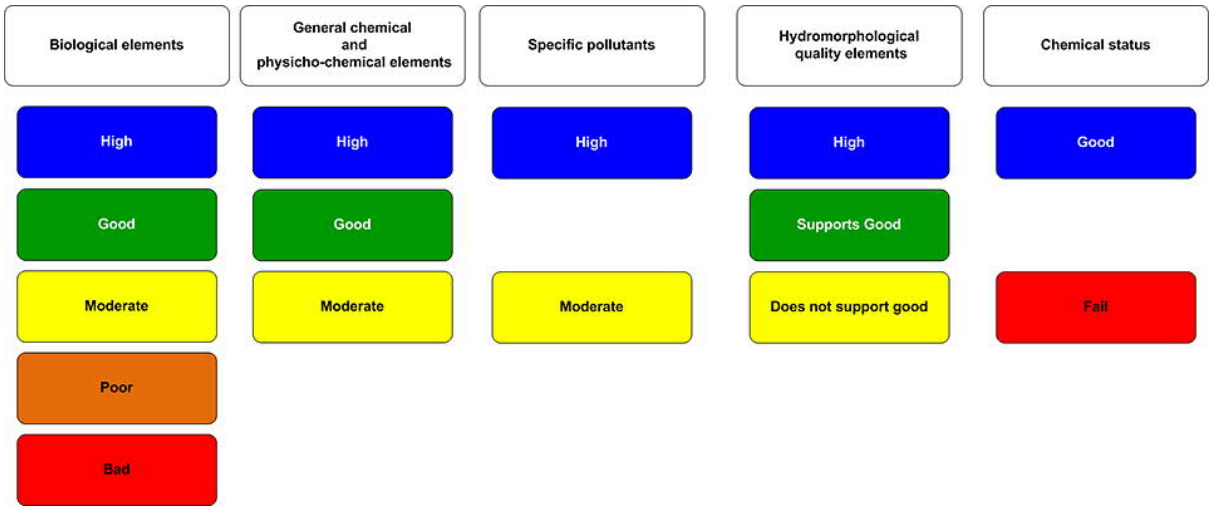


Figure 4-2 WFD status classifications used for surface water elements

The two key aspects of the WFD relevant to the wastewater assessment in this WCS are the policy requirements that:

- Development must not cause a deterioration in WFD status of a waterbody[15]; and
- Development must not prevent a waterbody from achieving its future target status (usually at least Good status).

It is not acceptable to allow deterioration from High status to Good status even though the overall target of Good status as required under the WFD is still maintained; this would still represent a deterioration. In addition, if a waterbody's overall status is less than Good as a result of another element, it is not acceptable to justify a deterioration in another element because the status of a waterbody is already less than Good. Finally, following a ruling made by the European Court of Justice, it is not acceptable to allow any deterioration in an element at Bad status.

The Scoping WCS identified that a significant amount of additional wastewater will drain to Chertsey WwTW resulting in the permitted headroom being exceeded, which could impact on the WFD objectives of the Chertsey Bourne. Therefore, a modelling assessment has been undertaken to determine the quality conditions that would need to be applied to the new or revised discharge permit to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in Appendix C.

4.4 Habitats Directive

The Habitats Directive and the associated UK Habitats Regulations has designated some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been on-going since the translation of the Habitats Directive into the UK Habitats Regulations called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the abstraction licences and discharge permit it has previously issued on sites which became protected (and hence designated) under the Habitats Regulations.

If the RoC process identifies that an existing licence or permit cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the licence or permit. As a result of this process, quality conditions on some discharge permits have been introduced to ensure that any identified impact on downstream sites is mitigated. Although the Habitats Directive does not directly stipulate conditions on discharge, the Habitats Regulations can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions) from water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

The Scoping WCS identified a need to determine if there are any Habitats Directive designated sites which could be affected as a result of increases in discharges from Chertsey WwTW once the impact had been modelled. The Scoping Study also identified the need to consider other ecological sites designated under other legislation such as water dependent Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR). This

[15] i.e. a reduction High Status to Good Status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained

Outline WCS includes an ecological appraisal to consider these sites and is reported in Section 4.8 of this chapter.

4.5 Wastewater Assessment Overview

4.5.1 Approach

The Outline WCS considers both the infrastructure and environmental capacity for Chertsey WwTW.

4.5.1.1 Infrastructure Capacity

Infrastructure Capacity is defined in this WCS as the ability of the wastewater infrastructure to collect, transfer and treat wastewater from homes and business. The following objectives are answered in the results section:

- What new infrastructure is required to provide for additional wastewater treatment?
- Is there sufficient treatment capacity within Chertsey WwTW?

4.5.1.2 Environmental Capacity

Environmental Capacity in this WCS is focused on the water quality needed in the Chertsey Bourne and associated designated sites to maintain the aquatic environments. It also considers the potential for impact on flood risk from the Chertsey Bourne where wastewater discharges will be increased. The following objectives are answered in the results section:

- Could development cause greater than 10% deterioration in water quality?
- Can a feasible solution be implemented to limit deterioration to 10%? To ensure that all the environmental capacity is not taken up by one phase of development and there is remaining environmental capacity for future growth beyond the plan period.
- Could development cause deterioration in WFD status of any element? This is a requirement of the WFD to prevent status deterioration.
- Could development alone prevent the receiving water from achieving its Future Target Status or Potential? Also a requirement of the WFD, which can be separated into the following two objectives:
  - Is the future target status possible now assuming adoption of best available technology? To determine if it is limits in conventional treatment that would prevent the future target status being achieved.
  - Is the future target status technically possible after development and adoption of best available technology? To determine if it is growth that would prevent the future target status being achieved.
- Could development cause an adverse impact on designated ecological sites? This question is answered in Section 4.8 of this chapter.
- Could increases in treated wastewater flow impact on flood risk downstream of the discharge? This question is answered in Section 4.9 of this chapter.

4.5.1 Methodology

A stepped assessment approach has been developed for the WCS to determine the impact of the proposed growth on infrastructure capacity and the environmental capacity of the receiving watercourse. This requires an initial assessment of headroom capacity followed by a water quality assessment.

The Scoping WCS has previously determined that headroom would be exceeded at Chertsey WwTW by 192 m^3/d (see section 4.6 for a summary). This section sets out the method for assessing the impact of this increase on environmental capacity in the Chertsey Bourne.

4.5.1.1 Water Quality Assessment

As part of the Scoping WCS, it was agreed with the Environment Agency that River Quality Planning (RQP) software (as used by the Environment Agency) is a suitable tool to undertake the required water quality modelling for determining the required discharge permit quality condition for Chertsey WwTW (Section 4.7). There are limitations associated with the RQP software which have been acknowledged in this WCS (Appendix C) and a

stepped methodology has been developed to ensure uncertainty which may arise as a result of these limitations is minimal.

The stepped methodology (provided in Appendix C) sets out modelling scenarios which have been developed in line with the water quality assessment approach listed in Section 4.5.1 and was agreed with the Environment Agency (Appendix C). The modelling scenarios undertaken are detailed in Table 4-1.

Table 4-1 Water quality modelling scenarios

Scenario	Description	Objective
10% Deterioration Limit	Limiting deterioration to 10% based on the current river quality for the physico-chemical sub-element (determinand) after growth.	A test requested by the Environment Agency to determine what is required to minimise deterioration within WFD status class to protect environmental capacity for future phases of development
No Deterioration in Status	Ensuring no deterioration from the current WFD status for the sub-element (determinand) after growth. Applied where it is not technically feasible to limit deterioration to 10%.	Aligns with the WFD policy requirement 'development must not cause a deterioration in WFD status'.
Maintain Current Quality	Maintaining the current river quality for the physico-chemical sub-element (determinand) after growth.	Where there is considered to be significant risk that a 10% deterioration could lead to a deterioration in status, this scenario is applied as a precautionary approach and specifically applied if an element is at Bad Status.
Future Target Status	Where a Future Target WFD Status has been set for the sub-element and is not currently being achieved by the waterbody.	Aligns with the WFD policy requirement 'development must not prevent a waterbody from achieving its Future Target Status'.

4.5.2 Assessment Results

The results for the Chertsey WwTW assessment are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG code refers broadly to the following categories:

- **Green** – WFD objectives will not be adversely affected. Growth can be accepted with no significant changes to the WWTW infrastructure or permit required.
- **Amber** – in order to meet WFD objectives, changes to the discharge permit are required, and upgrades may be required to WWTW infrastructure which may have phasing implications;

  Red - in order to meet WFD objectives changes to the discharge permit are required which are beyond the limits of what can be achieved with conventional treatment. An alternative solution needs to be sought.

4.6 WwTW Headroom Assessment Summary

The headroom assessment undertaken in the Scoping WCS, demonstrated that Chertsey WwTW would not have sufficient headroom once all the growth within the catchment is accounted for. Further assessment of the potential phasing of growth has identified that there is likely to be sufficient headroom to accommodate growth towards the end of the AMP 8 period (2025-2030), as shown in Figure 4-3. TWUL will need to work closely with RBC to understand and monitor the scale and phasing of growth and ensure that any necessary upgrades are delivered when required. TWUL are currently reviewing Chertsey WwTW as part of their AMP7 programme (PR19).

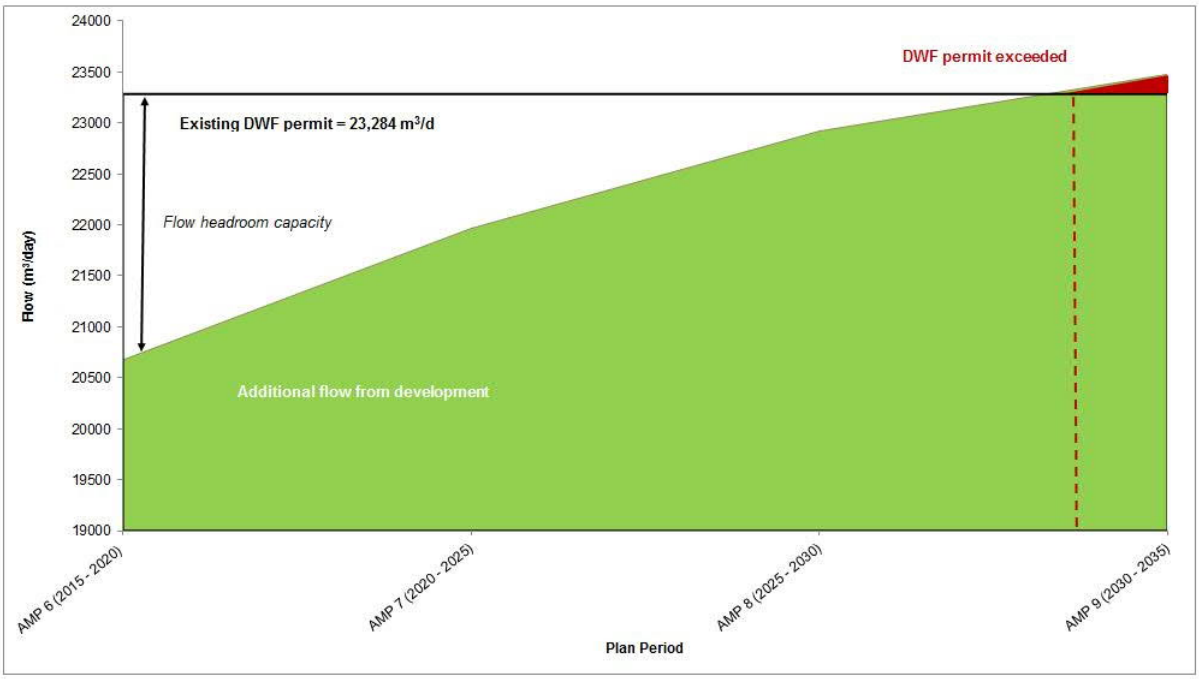


Figure 4-3 Chertsey WwTW across plan period and DWF permit exceedance

4.6.1 Impact of reduced water supply demand

Runnymede Borough Council has proposed a policy in the draft Local Plan for new build residential properties to conform to Part G of the Building Regulations optional requirement of 110 l/h/d. Although the wastewater assessment has assumed a worst case scenario consumption rate of 125l/h/d as the starting point, for comparison the headroom assessment was calculated with the reduced residential consumption rate of 110 l/h/d. The results are presented in Table 4-2, which details that under this scenario, Chertsey WwTW would have sufficient headroom to accommodate all of the proposed growth. Whilst this is an important observation, it would not preclude the need for a water quality assessment to be undertaken, because the use of permitted headroom can still result in deterioration of quality in a receiving watercourse.

Table 4-2 DWF permit capacity at Chertsey WwTW assuming a consumption rate of 110 l/h/d for new residential units

Current DWF capacity (m3/d)	Additional flow generated by proposed new homes (m3/d)	Additional flow from proposed employment requirement (m3/d)	Allowance for infiltration (m3/d)	Total additional flow (m3/d)	Residual flow capacity (m3/d)	Approx. residual housing capacity
3,389	2,211	160	806	3177	212	793

4.7 Water Quality Assessment

Statistical based water quality modelling (using RQP software) has been performed to check for compliance with the WFD objectives in terms of permit conditions for ammonia, phosphate and BOD. This approach follows Environment Agency guidelines and best practice, with further details of the modelling requirements outlined in detail in Appendix C.

4.7.1 Environmental Baseline

The Chertsey Bourne (Virginia to Chertsey) waterbody (GB10663901707) receives treated effluent from Chertsey WWTW. The Scoping WCS reported a detailed assessment of the baseline condition of the watercourse and a summary is provided in this Outline WCS.

The Chertsey Bourne waterbody has an overall waterbody status of Moderate, with the objective of achieving Good status by 2027. Its current overall status is limited to Moderate due to the less than Good status classification of the fish biology element (see Table 4-3). Further details on the reason for alternative objectives specific to this waterbody are included in Appendix D.

Table 4-3 Classification elements of less than Good status for Chertsey Bourne (Virginia to Chertsey) waterbody

Classification Element	Current Status (2015)	Objective	Justification for alternative objective
Fish	Bad	Good by 2027	Disproportionally expensive

The Reasons for Not Achieving Good (RNAG) for the fish biology element, as outlined in the Thames RBMP (2015), relevant to the Chertsey Bourne (Virginia to Chertsey) waterbody have been provided in Table 4-4 below.

Table 4-4 Reasons for not achieving good status on the Chertsey Bourne (Virginia to Chertsey) waterbody

Category	Activity[16]	Activity Certainty	Classification Element
Agriculture	Impoundment	Confirmed	Fish
Other	Barriers - ecological discontinuity	Confirmed	

4.7.2 Revised Permit Conditions – Modelling Results

To assess the impact of the additional discharge on water quality in Chertsey Bourne, and to determine the required quality conditions on the discharge, RQP runs have been completed for Chertsey WwTW covering the scenarios set out in section 4.5.1.1.

The revised discharge permit quality conditions required by the end of the plan period for each determinant for each modelled scenario are presented in Table 4-5, and a summary discussion of the water quality results is provided in Table 4-6.

Table 4-5 Required permit quality conditions for Chertsey WWTW by the end of the plan period

Determinant	Current permit quality condition (mg/l)	Future Permit conditions required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain current quality	Achieve Future Target Status
Ammonia (mg/l 95%ile	1.3	**0.83**	**1.88**	N/A	N/A
BOD (mg/l 95%ile)	12	**8.62**	**9.00**	N/A	N/A
Phosphate (mg/l annual average)	2	**1.20**	N/A	**1.09**	N/A

[16] Where an element is classified as being at less than good status an assessment is needed of the measures that could be taken to improve the status to good. In order to identify appropriate measures it is first necessary to understand the cause of the failure and this is recorded using a defined set of reasons within the RBMP. The reasons for the fish classification element not achieving good status within the Chertsey Bourne (Virginia Water to Chertsey) waterbody have been identified within the Thames RBMP (2015) as activities or sources which prevent the passage of fish (in this case either through impounding or a barrier preventing access for fish).

Table 4-6 Chertsey WwTW Assessment Summary

Assessment Criteria	Yes / No	Additional Comments
1. Is there sufficient permitted headroom to accept, treat and discharge the expected volume of wastewater as a result of growth proposed by the end of the plan period?	**No**	Calculated headroom deficit post-growth of 192 m^3/d.
2. Has the water quality assessment demonstrated that utilising the headroom would risk non-compliance with water quality objectives?	**Not Applicable**	The WwTW does not have sufficient permitted headroom to accommodate the growth and therefore a new permit will be required.
3. Has the water quality assessment demonstrated that to accept and treat all of the additional wastewater flow expected from development without impacting on water quality objectives, the quality conditions of the a new discharge permit would need to be altered compared to the current discharge permit and treatment process upgrades required?	**Yes**	
a. Can deterioration be limited to 10% based on the current river quality after growth with current conventional treatment technology?	**No**	Ammonia permit condition will need to be tightened from 1.3 mg/l to 0.83 mg/l. Current limit of conventional treatment is 1 mg/l. A technical solution is not available to maintain less than 10% deterioration for this determinand; however, a technically feasible permit limit can be set to ensure no status deterioration at the point of mixing (see Criteria 3b below).
	Yes	BOD permit condition will need to be tightened from 12 mg/l to 8.62 mg/l and is achievable within limits of conventional treatment.
	Yes	Phosphate permit condition will need to be tightened from 2 mg/l to 1.20 mg/l and is achievable within limits of conventional treatment.
b. Can the WFD objective of 'no deterioration' be achieved after growth with current conventional treatment technology?	**Yes**	'No deterioration' can be achieved for Ammonia with no required changes to the existing permit condition.
	Yes	'No deterioration' can be achieved for BOD through tightening the existing permit condition from 12 mg/l to 9 mg/l.
	N/A	Simulations for Phosphate were undertaken for this test but this demonstrated that it is not technically feasible to achieve the current waterbody status at the point of mixing under current discharge volumes (i.e. no growth), therefore, the "No Deterioration" test could not be applied using the RQP software at the point of mixing. As a conservative measure, the Maintain Current Quality test (see Criteria 3c below) has been applied.
c. Where 'no deterioration' cannot be achieved (or the test cannot be applied using RQP), can the current river quality be maintained after growth with current conventional treatment technology?	**Yes**	Phosphate permit condition will need to be tightened from 2 mg/l to 1.09 mg/l. In the absence of catchment scale modelling, it can be demonstrated that permit conditions within the current limit of conventional treatment can be applied to maintain the current Phosphate quality (at the mixing point) in the Chertsey Bourne. Therefore, there are feasible solutions to ensure overall compliance with the WFD.
d. Will growth prevent the future status targets from being achieved?	**Not Assessed**	Ammonia is already at High status – therefore ensuring no deterioration is adequate. BOD is already at Good status – therefore ensuring no deterioration is adequate. Phosphate is already at Good status – therefore ensuring no deterioration is adequate.
4. Is there the potential for a cumulative impact on water quality upstream of the WwTW from growth proposed in the study area?	**No**	Chertsey WwTW is located in the upper reaches of the Chertsey Bourne with no other significant WwTW discharges upstream.
5. Are WwTW infrastructure upgrades required?	**Yes**	The exact technical specification of the upgrades

Assessment Criteria	Yes / No	Additional Comments
		required should be determined by TWUL for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for Ammonia, BOD and Phosphate. The Environment Agency and TWUL should plan work to determine the exact requirements of the future discharge permit and the specific treatment upgrades that would need to be applied in order to inform TWUL's PR19 Business Plan.

4.7.2.1 Phasing modelling results

An assessment of the phasing of growth was undertaken in line with the AMP periods and are summarised in Appendix C4. The phasing modelling results show that there is minimal variation in required change to the permit conditions and solutions over the four AMP periods which cover the Local Plan period up to 2030.

4.7.2.2 Phasing of Upgrades

TWUL are currently preparing for AMP7 and their PR19 business plan which will outline their investment programme from April 2020 to 2025. Thames Water approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development proposed will come forward during the plan period before improvements to WwTW assets can be justified and funding sought.

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by TWUL to inform their investment programme (AMP7, AMP8 and AMP 9) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WwTW catchment for TWUL to plan their investment and to deliver the necessary upgrades.

4.8 Ecological Appraisal

Having identified the issue of increased wastewater discharges from Chertsey WwTW and impact on water quality of the receiving watercourse as a result of exceeding current discharge permits, the receiving watercourse for Chertsey WwTW was traced downstream from the WwTW discharge location. Where Chertsey Bourne and subsequent downstream waterbodies enter, or pass adjacent to, a statutory designated wildlife site that has potential to be vulnerable to changes in hydrology (based on the available information such as citations), these are identified and discussed in the following section. Where available, reasons for designation of the wildlife sites have been gathered (see Appendix E) primarily from the following sources:

- Joint Nature Conservation Committee (JNCC)
- Environment Agency; and
- Natural England (NE)

Where it was not possible to determine if a site was hydrologically linked to a watercourse downstream of Chertsey WwTW (i.e. merely in close proximity), the site was included in the discussion of the assessment as a precaution.

Following this process, four statutory designated wildlife sites have been identified as being hydrologically connected to Chertsey WwTW as set out in Table 4-7. It should be noted that South West London Waterbodies SPA and Ramsar site and Thorpe Park No. 1 Gravel Pits SSSI, relate to the same land parcel:

Table 4-7 Wildlife sites that contain linking pathways to each relevant WwTW

WwTW	Wildlife Site	Distance from the Discharge Point (km)
Chertsey (discharges to the Chertsey Bourne)	South West London Waterbodies Ramsar site	1.7 km downstream of the discharge point on the Chertsey Bourne at St Ann's Lake (Thorpe Park Gravel Pit No.1)
	South West London Waterbodies Special Protection Area (SPA)	1.7 km downstream of the discharge point on the Chertsey Bourne at St Ann's Lake (Thorpe Park Gravel Pit No.1)

WwTW	Wildlife Site	Distance from the Discharge Point (km)
	Thorpe Park No. 1 Gravel Pits SSSI	1.7 km downstream of the discharge point on the Chertsey Bourne at St Ann's Lake (Thorpe Park Gravel Pit No.1)
	Chertsey Meads LNR	6.8 km downstream of the discharge point on the Chertsey Bourne

The locations of these wildlife sites are illustrated in Figure 4-4. All other designated sites identified within the Borough are remote from watercourses into which the Chertsey WwTW discharges treated effluent.

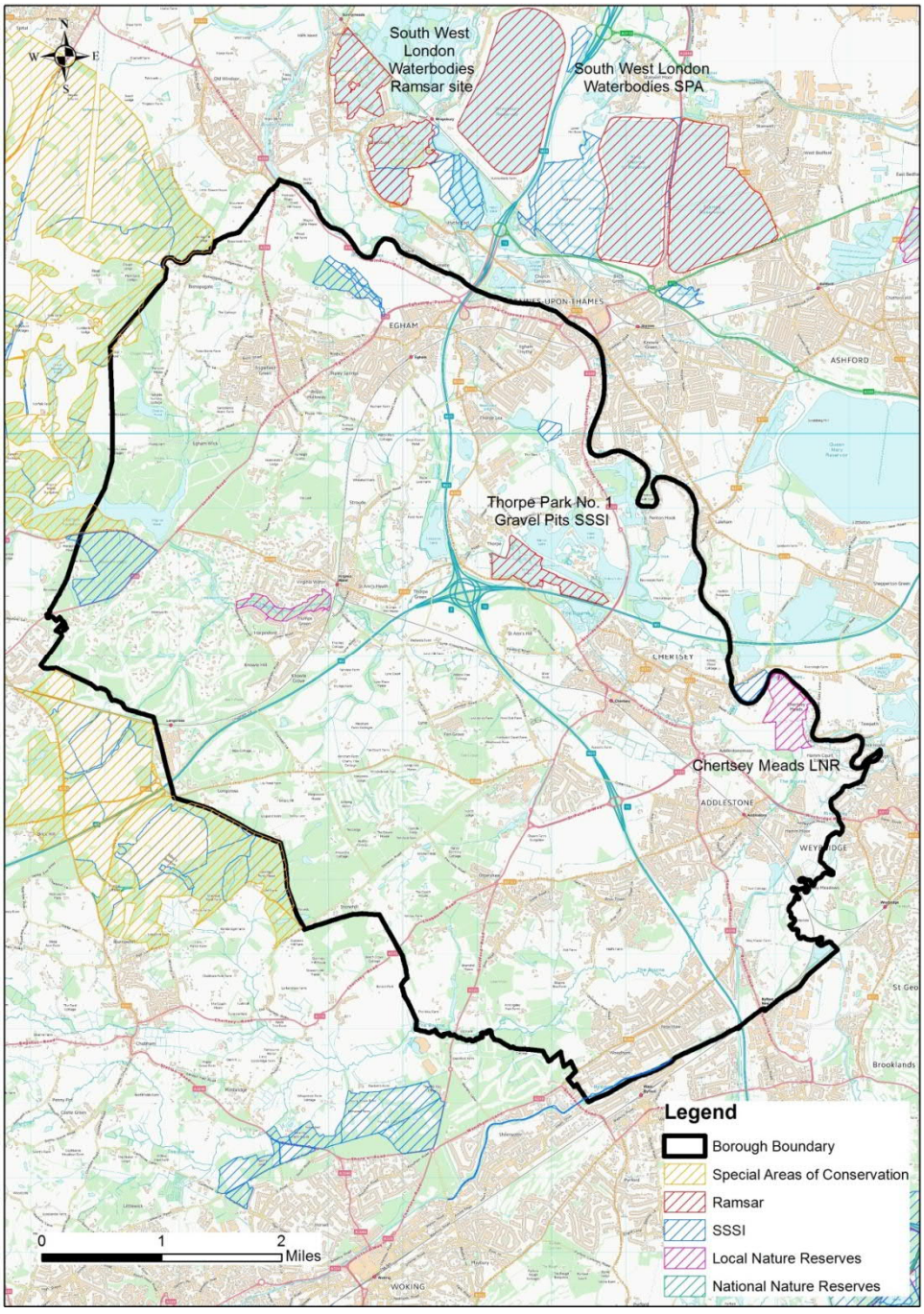


Figure 4-4 Map of designated sites hydrologically linked to Chertsey WwTW

Approximately 8.6km from the discharge point, the Chertsey Bourne enters the River Thames at Hamhaugh Island. Beyond this distance it is considered that discharged water would be sufficiently diluted and mixed to not affect statutory designated wildlife sites.

4.8.1 Effects of Nutrient Inputs on Ecological Receptors

Designated wildlife sites identified in Figure 4-4 are either freshwater aquatic habitats or terrestrial habitats that are influenced by inundation from freshwater riverine environments. This section discusses the potential impacts of modelled determinants (BOD, ammonia and phosphate) on freshwater aquatic habitats, terrestrial habitats influenced by riverine conditions and their associated flora and fauna.

4.8.1.1 Biochemical Oxygen Demand (BOD)

Elevated Biochemical Oxygen Demand (BOD) in treated effluent can result in lower oxygen levels when discharged to freshwater habitats that can in turn result in death to plants and animals. BOD does not affect terrestrial habitats.

4.8.1.2 Ammonia

Ammonia is directly toxic to aquatic organisms in freshwater environments. Low levels of exposure to ammonia may result in reduced growth rates, fecundity and fertility, increase stress and susceptibility to bacterial infections and diseases in fish. Higher levels of exposure can cause fish to increase respiratory activity, thus increasing oxygen uptake and increased heart rate. It can also lead to tissue damage, lethargy, convulsions, coma and death. Ammonia itself does not interact with terrestrial habitats.

Nitrification of ammonia results in increased nitrogen in freshwater environments. Nitrogen is a growth-limiting nutrient in terrestrial and marine environments, although generally not in freshwater. Elevated levels of nitrogen can result in increased plant growth of those plant species that can readily take advantage of increased levels of nitrogen, outcompeting less competitive plant species, thus potentially altering the species composition of a site.

4.8.1.3 Phosphate

In the vast majority of freshwater environments phosphates are growth-limiting nutrients. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication.

Potential effects to wildlife sites located downstream of the discharge point at Chertsey WwTW are discussed in the subsequent section.

4.8.2 Impacts on Ecology within Designated Sites

Chertsey WwTW discharges into the Chertsey Bourne. After 1.7 km the Chertsey Bourne flows past the South West London Waterbodies SPA and Ramsar site which also encompasses Thorpe Park No.1 Gravel Pits SSSI. The waterbody in question is a flooded former gravel pit (Thorpe Park No.1 Gravel Pit) and is therefore likely to be hydrologically connected to the Chertsey Bourne. The next hydrologically connected statutory designated site is Chertsey Meads LNR (6.8 km downstream) which is an open area of remnant floodplain meadow between the banks of the Chertsey Bourne and the River Thames. The grassland is unusual due to it containing flowering plant species usually found in chalk grassland. This is due to calcium carbonate being deposited onto the site through River Thames flood events.

The current WFD status of the Chertsey Bourne is Moderate, with the objective of achieving Good status by 2027. Status is currently limited to Moderate due to being of 'less than good' status for fish. The status for fish is currently 'Bad' due to agricultural impoundment and ecological discontinuity (rather than water quality). Modelling has identified that planned development within this WwTW catchment will result in an exceedance of the permitted effluent discharge volume of 192m^3/d. To accommodate this increase in discharge volume, the quality conditions of any new discharge permits will require alteration. RQP modelling has shown that deterioration of ammonia cannot be limited to 10% or less within to the limits of conventional treatment technology, however a technically feasible permit can be set that would ensure no deterioration in WFD status from the existing 'High' status. Water quality deterioration due to increased BOD can be limited to less than 10%, with 'no deterioration' in status, through tightening of current water quality permit conditions within the limits of conventional technology. It is not feasible within the limits of conventional treatment to achieve 'no deterioration' in WFD status for phosphate but actual deterioration in phosphate concentrations can be limited to less than 10%. To achieve this less than 10% deterioration, phosphate permit conditions will need to be tightened from 2 mg/l to 1.20 mg/l.

The deterioration of water quality due to phosphate can be limited to a less than 10% deterioration and conventional technology can 'Maintain Current Quality' within the river through permit tightening. Although there is predicted to be an increase in ammonia greater than 10% deterioration the levels within the river would remain

within the bounds of 'High' status and there would be no deterioration in status. The increase in ammonia at the point of discharge will be diluted further downstream from the discharge point and the closest of the hydrologically sensitive statutory sites are South West London Waterbodies SPA and Ramsar site and Thorpe Park No. 1 Gravel Pits SSSI, which are approximately 1.7 km downstream. Additionally, since the gravel pits are only indirectly connected to the river (in as much as they are both probably in direct connection with the water table) changes in the water quality in the river will not directly influence water quality in the gravel pits. Surface runoff of nutrients is likely to play a more significant role in the nutrient status of these waterbodies which would not be affected by WwTW discharges.

Chertsey Mead LNR habitats are dependent on regular nutrient enrichment via flooding from the River Thames (and the associated deposition of relatively nutrient rich silt), but an excessive increase in loading of ammonia (and thus nitrogen) within the flood waters could cause changes in conditions within the meadow system. Although there is likely to be more than a 10% increase in ammonia (and a much smaller increase in phosphate) predicted at the point of discharge, these will be substantially diluted due to the fact that Chertsey Meads LNR is 6.8 km downstream of the discharge point and will not therefore materially alter water quality in the LNR.

Therefore it is concluded that it is unlikely that the planned increase in growth within the catchment of Chertsey WwTW will have a significant detrimental effect on hydrologically sensitive statutory designated sites.

4.8.3 Impacts on Ecology outside Designated Sites

Whilst the above assessment is primarily focused on the impact on ecologically designated sites, the following section discusses ecology outside of designated sites. The limitations of a WCS report make it impossible for such a discussion to be exhaustive or spatially very specific.

In addition to impacts on designated sites, a range of other UK or Surrey BAP species or otherwise protected/notable species that are found in the Borough of Runnymede can be affected by wastewater discharge. These include:

- Water vole (protected through Wildlife & Countryside Act 1981 and a Surrey BAP species);
- Grass snake (partially protected through Wildlife & Countryside Act 1981 and Surrey BAP species);
- Common toad and natterjack toad (Surrey BAP species);
- Great crested newt (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a Surrey BAP species);
- Birds such as bittern, kingfisher (protected through Wildlife & Countryside Act 1981 and a UK BAP species), lapwing, snipe and redshank (Surrey BAP species);
- Fish (UK BAP);
- Invertebrates such as white clawed crayfish (protected through Wildlife & Countryside Act 1981 and a Surrey BAP species); and
- Otter (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a Surrey BAP species).

Similarly important habitats (all listed in the Surrey BAP) include:

- Wet woodlands;
- Lowland meadows;
- Lowland heathland;
- Lowland dry acid grassland;
- Eutrophic standing water;
- Rivers;
- Lowland fen;
- Reed beds; and
- Floodplain grazing marsh.

All of these habitats and species are present (or possibly present) in the Borough of Runnymede.

It is not possible within the scope of this commission to undertake a detailed investigation and evaluation of the impacts of the changes in water quality/flow and infrastructure to be delivered under the water cycle study on wildlife generally, since it would be necessary to undertake detailed species surveys of each watercourse and utilise detailed flow and quality data/modelling which has not been available for this commission for most watercourses.

One WwTW in Runnymede borough will require at least a change to their permits in order to comply with the Water Framework Directive requirements for no deterioration downstream:

4.8.4 Ecological Opportunities Associated with Proposed Development Locations

To ensure that the planned level of development within a Plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that Policy is included within a Plan to ensure that these matters are addressed at a strategic level and water quality at these locations will be improved to suitable WFD levels and permit levels. This may include the requirement for new infrastructure to be in place prior to the delivery of new development or the need for phased infrastructure to ensure that the WwTW can accommodate the increased capacity and not result in a detrimental impact upon wildlife features. Further to recommended policy it is recommended that:

a. Where ecological risks resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.

b. Chertsey WwTW cannot accommodate the planned level of future development within its catchment without resulting in more than 10% deterioration of ammonia (whilst this will not prevent WFD target from being achieved). It is recommended that RBC engages with the Environment Agency to ensure that water quality deterioration can be prevented at Chertsey WwTW when providing for planned future growth within its catchment.

4.9 Flood Risk Constraints

In order to determine whether the increase in wastewater discharged from the WwTWs as a result of growth is likely to impact on flood risk downstream, estimates were made of the percentage increase in flood flows that would occur for a variety of return period events.

The Flood Estimation Handbook (FEH) was used to derive flow estimates for the Chertsey Bourne for a range of flood return periods (full results are provided in Appendix F). The calculated additional flow potentially discharging to the Chertsey Bourne from the Chertsey WwTW is 3,581m³/d. This discharge value was calculated as a percentage of the flood flow for different return periods as shown in Table 4-8 below.

Table 4-8 Additional flow from Chertsey WwTW as a percentage of estimated flood flows in Chertsey Bourne

Return Period (1 in x years) (Annual probability)	Chertsey Bourne flood flow (m^3/d)	% additional flow from Chertsey WwTW as a result of growth
2 (50%)	381,888	0.9%
5 (20%)	559,872	0.6%
10 (10%)	673,920	0.5%
25 (4%)	811,296	0.4%
50 (2%)	907,200	0.39%
100 (1%)	1,002,240	0.35%
200 (0.5%)	1,097,280	0.32%

Return Period (1 in x years) (Annual probability)	Chertsey Bourne flood flow (m^3/d)	% additional flow from Chertsey WwTW as a result of growth
500 (0.2%)	1,218,240	0.29%
1000 (0.1%)	1,296,000	0.28%

Based on these estimates the potential additional discharges from Chertsey WwTW into the Chertsey Bourne are not significant (all less than 1%). It is considered unlikely that these additional flows would result in a significant increase in flood levels.

4.10 Wastewater Treatment Summary

The water quality modelling results demonstrate that, subject to the revision or issuing of a new discharge permit and the necessary treatment process upgrades (using conventional treatment technologies) being implemented at Chertsey WwTW, there is environmental capacity for the proposed growth to ensure WFD water quality objectives can be met and there are no significant adverse effects on designated ecological sites.

5. Water Supply Strategy

5.1 Introduction

Water supply in Runnymede Borough is provided by AWS and specifically through a defined management area called the Wey Water Resources Zone (WRZ). The Scoping WCS identified that, based on the growth projections used in formulating the 2014 WRMP, AWS had adequate resources planned to meet the proposed growth levels included with the Borough's Local Plan.

AWS' preferred strategy, as outlined in the 2014 WRMP, was to manage the predicted increase in demand in the Wey WRZ using demand management measures, including leakage reduction, enhanced water efficiency measures for households and the rollout of metering towards the end of the plan period. In addition, they proposed new supply management through bulk imports from neighbouring water companies and local source recommissioning.

Since the Scoping WCS was completed, AWS have completed initial work on the statutory five year update to the WRMP (the draft 2019 WRMP) and have confirmed the revised WRMP is based on a similar supply-demand balance as the 2014 WRMP within the Wey WRZ, and hence a similar plan to manage increase demand through a similar mix of measures (demand and supply options).

It should be noted that the 2019 WRMP is draft and may be subject to change following consultation; however, at the time of completing this WCS, AWS confirmed that the level of growth proposed in the Local Plan has been catered for within their demand predictions for the 2019 WRMP and that a mix of measures is available to meet the future planned WRZ demand, irrespective of whether those measures may change as a result of the consultation process. Therefore, this Outline WCS concludes that there is adequate water resource provision to meet the Local Plan growth requirements.

5.2 Water Efficiency Plan

There are several key drivers for ensuring that water use in the development plan period is minimised as far as possible through the adoption of water efficiency policy. The water resources region supplied by AWS is designated as "Areas of serious water stress", as classified by the Environment Agency[17]. This creates a very strong driver for new homes to be made as efficient as economically possible to safeguard the future resources. New developments are governed by legislation that requires developers to build water efficient properties such that occupants use a maximum of 125 l/h/d[18]. RBC have proposed a policy in the draft Local Plan for new build residential properties to go beyond the minimum to conform to Part G of the Building Regulations optional requirement of 110 l/h/d.

[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
[18] Part G of the Building Regulations, updated in April 2010, 125 litres per person per day for domestic dwellings. This comprises internal water use of 120 litres per person per day, and in that respect is in line with Code Levels 1 and 2, plus an allowance of 5 litres per person per day for outdoor water use.

6. Major Development Site Assessment

6.1 Introduction

This section of the WCS addresses local infrastructure capacity issues, flood risk, surface water management and SuDS suitability for each of the proposed major development sites (sites containing more than 10 dwellings). A brief methodology is outlined below. Site proformas detailing the outcome of the site assessments are set out in Section 6.3.

6.2 Assessment Methodologies

6.2.1 Wastewater Network

The wastewater strategy to cater for growth requires an assessment of the capacity of the wastewater network (sewer system) to accept and transmit wastewater flows from the new development to the WwTW for treatment.

The capacity of the existing sewer network is an important consideration for growth, as in some cases the existing system is already at, or over its design capacity. Further additions of wastewater from growth can result in sewer flooding in the system (affecting property or infrastructure) or can increase the frequency with which overflows to river systems occur, resulting in ecological impact and deterioration in water quality.

As the wastewater undertaker for the Borough, TWUL has a general duty under Section 94 of the Water Industry Act 1991 to provide effectual drainage which includes providing additional capacity as and when required to accommodate planned development. However this legal requirement must also be balanced with the price controls as set by the regulatory body Ofwat which ensure TWUL has sufficient funds to finance its functions, but at the same time protect consumers' interests. The price controls affect the bills that customers pay and the sewerage services consumers receive, and ultimately ensure wastewater assets are managed and delivered efficiently.

Consequently, to avoid potential inefficient investment, TWUL generally do not provide additional capacity until there is certainty that the development is due to commence. Where development proposals are likely to require additional capacity upgrades to accommodate new development flows, it is highly recommended that potential developers contact TWUL as early as possible to confirm flow rates and intended connection points. This will ensure the provision of additional capacity is planned into TWUL's investment programme to ensure development is not delayed.

TWUL have undertaken an internal assessment of the capacity of the network system using local operational knowledge. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 6-1.

Table 6-1 Key for wastewater network RAG assessment

Development is likely to be possible without upgrades.	**No significant infrastructure likely to be required. However, local network reinforcements may be required.**	**Major local network reinforcements will be required to support this development and to ensure no reduction in service to existing services in the area.**

6.2.2 Water supply network capacity

In addition to available water resources, there is a requirement to consider whether there is the infrastructure capacity to move water to where the demand will increase.

AWS have undertaken an assessment of the capacity of the water supply system using local operational knowledge. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 6-2.

Table 6-2 Key for water supply network RAG assessment

Capacity available to serve the proposed growth.	**Infrastructure upgrades required to serve proposed growth.**	**Major constraints to the provision of infrastructure to serve proposed growth.**

6.2.3 Flood Risk

The flood risk to each of the major development sites has been considered using the Flood Maps for Planning and Risk of Flooding from Surface Water (RoFSW)[19] mapping produced by the Environment Agency. The Runnymede Level 1 SFRA[20] has also been used to help identify the risk of flooding at each development site. A RAG assessment has been undertaken which relates to the level of risk identified at the site as set out in Table 6-3.

Table 6-3 Key for flood risk assessment

Fluvial **Site is entirely within Flood Zone 1.** **Surface water** **Site is entirely at low or very low risk of surface water flooding.**	**Fluvial** **Site, or part of it, lies within Flood Zone 2.** **Surface water** **Part of the site is at medium risk of surface water flooding.**	**Fluvial** **Site, or part of it, lies within Flood Zone 3.** **Surface water** **Part of the site is at high risk of surface water flooding.**

6.2.4 Surface Water management

An assessment of options for discharge of surface water from each site has been undertaken. This assesses the applicability of different SuDS measures, including feasibility of infiltration as well as options for discharge of attenuated surface water based on presence of surface water bodies or a suitable surface water or combined sewer system. A number of locations in Runnymede are not served by a surface water or combined sewer system and in addition have potential limitations on infiltration options owing to shallow depth to groundwater or other geotechnical limitations. In these locations, specific solutions will be required, potentially resulting in abnormal costs and or phasing constraints to development.

The consideration of the feasibility of infiltration SuDS was undertaken for each major development using the BGS Infiltration SuDS OS mapping[21].

A RAG assessment of the overall surface water management issues has been applied as set out in Table 6-4.

Table 6-4 Key for Sustainable Drainage Systems assessment

The subsurface is highly compatible for infiltration SuDS and/or where residual surface water needs to be discharged, there is an option to discharge to a surface water body, or surface water sewer network.	**The subsurface is probably suitable for infiltration SuDS although ground conditions may limit the extent of infiltration which can be achieved. Surface attenuation options will need to be considered and where discharge is required, there is an option to discharge to a surface water body, or surface water sewer network.**	**Significant constraints for one or more geohazards associated with infiltration will limit success of infiltration SuDS and, there are limited options for discharge of attenuated surface water.**

6.2.5 Groundwater Protection

The assessment of the groundwater protection for each of the major development sites was undertaken using the BGS Infiltration SuDS mapping to obtain a spatial assessment of factors that may influence infiltration SuDS design with respect to protecting groundwater quality[21]. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 6-5.

[19] Previously referred to as the updated Flood Map for Surface Water (uFMfSW)
[20] Runnymede 2035 Strategic Flood Risk Assessment (SFRA) (2016)
[21] User Guide for Infiltration SuDS Map: Detailed (BGS) (2011)

Table 6-5 Key for Groundwater Protection assessment

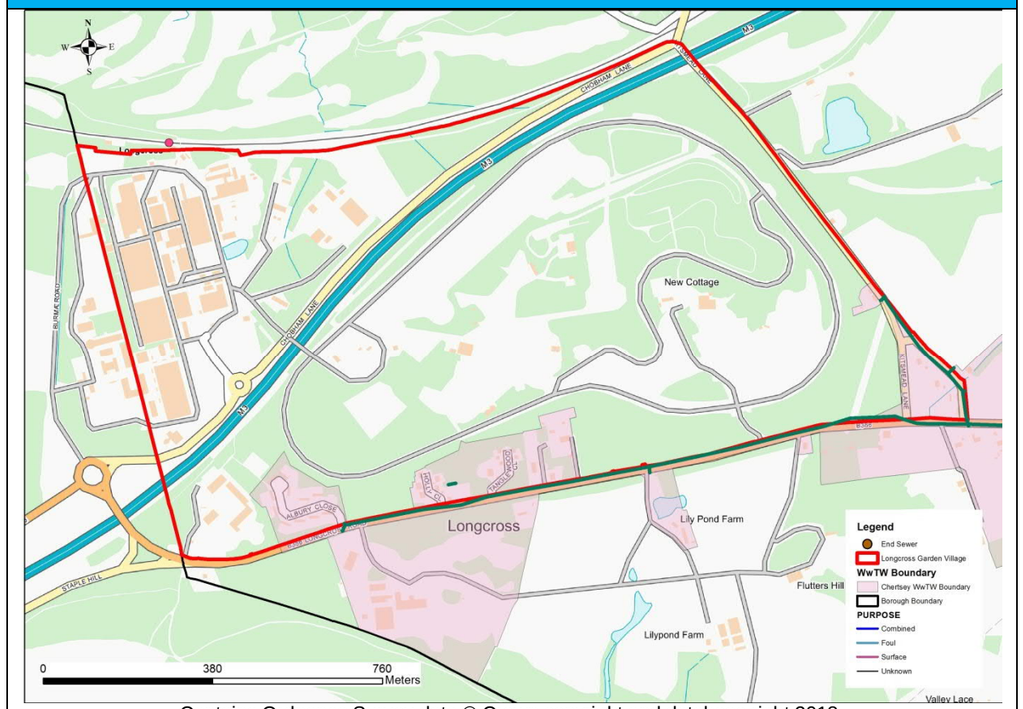
Low susceptibility: Infiltrating water should be free of contaminants.	**Moderate susceptibility: The groundwater may be vulnerable to contamination.**	**High susceptibility: Made Ground is present at the surface. Infiltration may increase the possibility of mobilising pollutants.**

6.3 Site Assessment Proformas

The following section contains the detail of the assessment of each of the proposed major development sites as a series of site proformas.

6.3.1 LONGCROSS GARDEN VILLAGE

Location of Development



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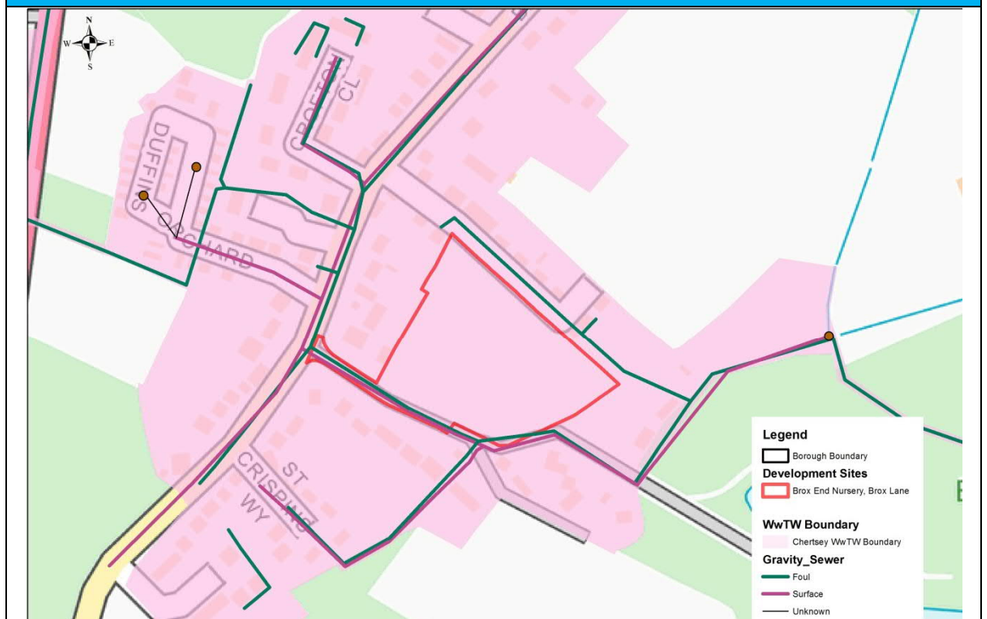
No. Residential Dwellings	Expected year of delivery
1718	2016 - 2030
Employment Jobs	**Expected year of delivery**
5259	2016 - 2030
No. of traveller pitches	**Expected year of delivery**
10	2016-2030

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• Major local network reinforcements will be required to support this development and to ensure no reduction in service to existing services in the area. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions. A good understanding of the construction phasing will be vital.	
Wastewater/sewer network infrastructure requirements	• TWUL has serious concerns regarding waste water services in relation to this site. Specifically, sewage treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. TWUL have been in discussions with the developer regarding the scale and phasing of development to understand the infrastructure requirements. TWUL are currently preparing their business plan for AMP7 which will cover the period from 1st April 2020 until the 31st March 2025. The business plan takes into account proposed growth in Runnymede and Thames Water are confident that necessary network and treatment works upgrades can be delivered alongside development. Continued dialogue between Thames Water, the LPA and the developer is required to ensure alignment of development and wastewater infrastructure requirements.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are multiple areas of high risk (> 3.3% AEP) of flooding from surface water with additional areas at medium risk (1% to 3.3% AEP) and low risk (<0.1% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site has been characterised as having a low vulnerability to groundwater contamination and does not lie within a SPZ.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • Made ground has been identified in the centre of the development site. The site has also been characterised as having significant potential for running sands and landslides to occur. Therefore, consideration should be given to the potential for or the consequences of subsidence associated with slopes. According to the BGS SuDS infiltration mapping, the remainder of the site has been characterised as compatible for infiltration SuDS. • Additionally, the site does not lie near the surface water sewer network, and investigations should be conducted to determine the feasibility of utilising the pond along the eastern border as a potential discharge point.	

6.3.2 BROX END NURSEY, OTTERSHAW

Location of Development



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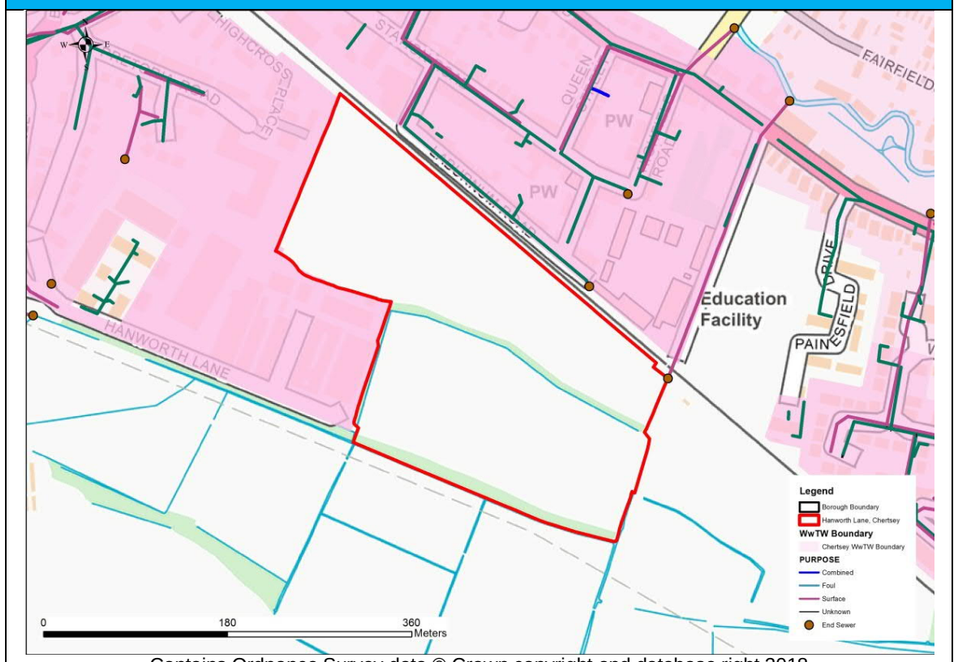
No. Residential Dwellings	Expected year of delivery
40	2019 - 2021

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• Based on information available at the time of this Outline WCS, TWUL do not envisage infrastructure concerns regarding wastewater infrastructure capability in relation to this site.	
Fluvial Flood Risk	• The Brox End Nursery, Ottershaw development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, the site is at very low risk (< 0.1% Annual Exceedance Probability (AEP)) of flooding from surface water, however, it should be noted that along Brox Lane which is adjacent to the site, there is a high risk of flooding from surface water (> 3.3 % AEP).	
Groundwater Protection	• According to the BGS SuDS Infiltration mapping, the site is not located in a Source Protection Zone (SPZ) and is not expected to be especially vulnerable to contamination.	
SuDS and Surface Water Management	• Source control methods such as Water butts, Green roofs, Rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The majority of the site is characterised as potentially suitable for infiltration SuDS, therefore the type of infiltration SuDS implemented would be dependent on stability of ground conditions. • The site's bedrock permeability is free draining; however, the depth to the groundwater table for the majority of the site is less than 3m below the ground surface. Therefore, to determine the site's feasibility for infiltration SuDS, soakaway testing and tests to determine the groundwater table variability should be conducted. These tests should also determine the likely impact of SuDS on the ground stability as the development site is characterised as susceptible to landslides and running sands. • Should the results of the infiltration testing indicate that infiltration is likely, drainage systems such as detention basins, retentions ponds, soakaways and permeable paving should be considered. A waterbody is located along the southern border of the site approximately 270m southeast of the site and should be investigated as a possible discharge point. • In addition, the sewer network runs in close to the site, but they are no existing connection points, which could be utilised. However, it is possible for future connections to the network to be achieved and the developer should consult with TWUL to determine possible connection points and discharge rates. Attenuation to Greenfield runoff rates would need to be achieved on site prior to discharging.	

6.3.3 HANWORTH LANE, CHERTSEY

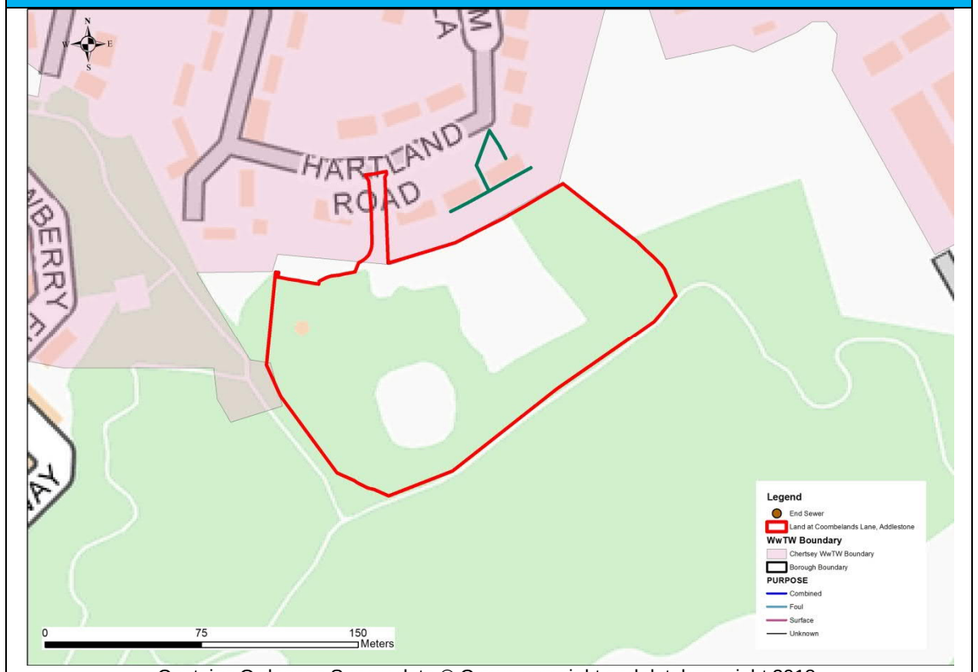
Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

No. Residential Dwellings	Expected year of delivery
325	2017 - 2021

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. However, local network reinforcements may be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are several areas of medium (1% - 3.3% AEP) and high risk water (>3.3% AEP) in the south eastern region of the development site.	
Groundwater Protection	• According to the BGS SUDs infiltration mapping, this site is located on SPZ 2 and is characterised as having a moderate susceptibility to contamination. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • As the site is located in a SPZ, the developer should consult with the Environment Agency to ensure there is no risk to groundwater quality and before infiltration to groundwater is permitted. • Infiltration is likely to be problematical due to high water table. There is a watercourse to the east of the site but due to the site levels it likely that pumping may be required, however pumping should be avoided where possible due to the considerable ongoing maintenance requirements and introduction of additional failure mechanisms. • Additionally, the sewer network runs along the northern border of the site. Attenuation to Greenfield rates should be achieved onsite prior to any offsite discharge. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.4 LAND AT COOMBELANDS LANE, ROWTOWN

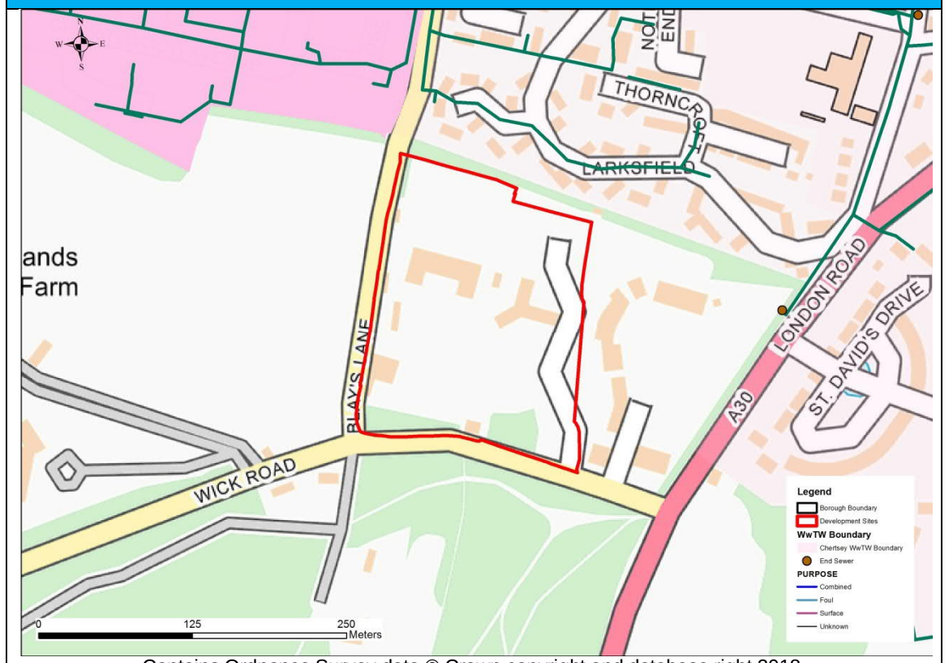
Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

No. Residential Dwellings	Expected year of delivery
40	2018 - 2021

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• Based on information available at the time of this Outline WCS, TWUL do not envisage infrastructure concerns regarding waste water capability in relation to this site.	
Fluvial Flood Risk	• The land at Coombelands Lane is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, the majority of the site is at very low risk (less than 0.1% Annual Exceedance Probability (AEP)) of flooding from surface water, however, there is an area of ponding located in the northwest of the development site characterised with a low risk (0.1 to 1% (AEP)) of flooding from surface water of site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site is not located in a SPZ and the groundwater is not expected to be especially vulnerable to contamination.	
SuDS and Surface Water Management	• Source control methods such as Water butts, Green roofs, Rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The site is characterised as high compatible for infiltration SuDS, and the permeability of the bedrock is characterised as free draining. The depth to the groundwater table is greater than 5m from the surface, and it is recommended in the SuDS infiltration mapping guidance to conduct infiltration testing to determine infiltration rates. • Should the results of the infiltration tests reveal that infiltration is possible, the developer should consider drainage systems such as detention basins, retentions ponds, soakaways and permeable paving. The western, southern and parts of the eastern border is surrounded by green space and which could further be utilised for attenuation and infiltration. • The site lies in close proximity of an existing surface water sewer network, which could be utilised, depending on its current and future load, which is subject to agreement of connection points and discharge rates with TWUL.	

6.3.5 BLAYS HOUSE, BLAYS LANE, ENGLEFIELD GREEN

Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

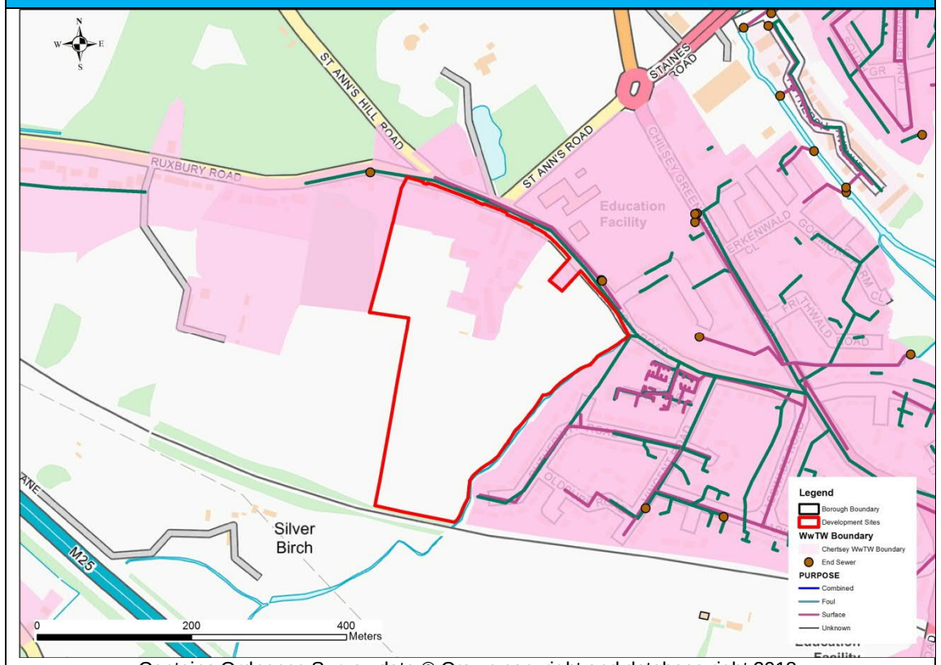
No. Residential Dwellings	Expected year of delivery
90	2022 - 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, parts of the site are at high risk (> 3.3% AEP) of flooding from surface water, with additional areas at medium risk (1% to 3.3% AEP) and low risk (<0.1% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site has been characterised as having a low vulnerability to groundwater contamination.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The majority of the development site geology is characterised as free draining and highly compatible for infiltration SuDS such as soakaways and permeable pavements, however, it is recommend that tests be conducted to determine the seasonal variations in groundwater levels, as the groundwater table is less than 3m below the surface. • In addition, consideration should be given to ground stability as there is significant potential that increased infiltration could result in landslides and running sands, and consideration should be given to the potential for or the consequences of subsidence associated with slope stability. It is recommended that soakaway testing be conducted. • Should the testing reveal that infiltration is feasible, consideration should be given to infiltration SuDS applications. • Should the testing reveal that infiltration is not feasible, the site lies in close proximity to an existing surface water sewer network on Larkfield Road, which could be utilised as a discharge point, depending on its current and future load. Attenuation to Greenfield rates should be achieved onsite prior to any offsite discharge. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.6 PYRCROFT ROAD, CHERTSEY

Location of Development



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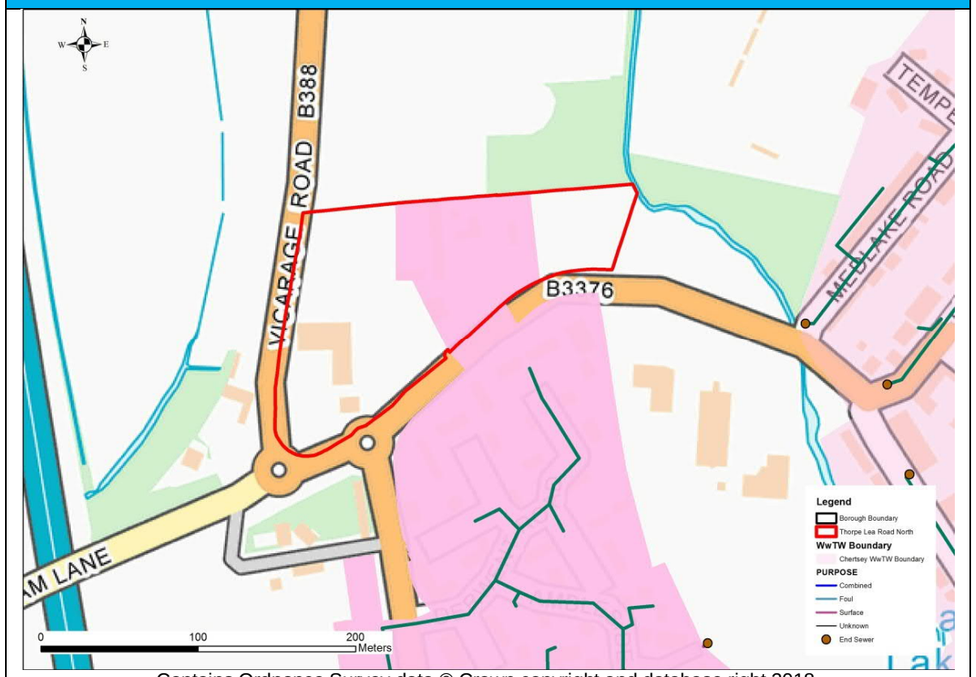
No. Residential Dwellings	Expected year of delivery
275	2022 - 2027
No. of traveller pitches	**Expected year of delivery**
5	2022 - 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. However, local network reinforcements may be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• Approximately a third of the site which is located along the eastern site border is in Flood Zone 3; and towards the centre of the development site, flowing north east to south west, that region is located in Flood Zone 2. It should be noted that the eastern side of the site is prone to flooding even from low return period events and property flooding occurs.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, the development site is located in an area characterised at medium risk (1.1% to 3% AEP) of flooding from surface water in the areas surrounding the unnamed watercourse that flows along the eastern site border, and there are multiple areas at low risk (0.1% to 1% AEP) of flooding from surface water also along the eastern border of the development site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site is in SPZ 2 and may be vulnerable to groundwater contamination. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • According to the SuDS Infiltration mapping database, shallow groundwater has been identified in the north eastern region of the site. Shallow ground water occurs when there is less than 1m of unsaturated zone thickness between the base of an infiltration system and the groundwater table; and infiltration could result in contaminants entering the groundwater. The implementation of SuDS is not recommended in this region. • The rest of the site's permeability has been characterised as free draining, and presents opportunities for infiltration SuDS. As the site is located in a SPZ, the developer should consult with the Environment Agency to ensure there is no risk to groundwater quality and before infiltration to groundwater is permitted. • Any discharge into the watercourse on the eastern boundary of the site should be no greater than Greenfield runoff as it is prone to flood within the site but downstream as well, even from relatively low return period events.	

6.3.7 THORPE LEA ROAD NORTH, EGHAM

Location of Development


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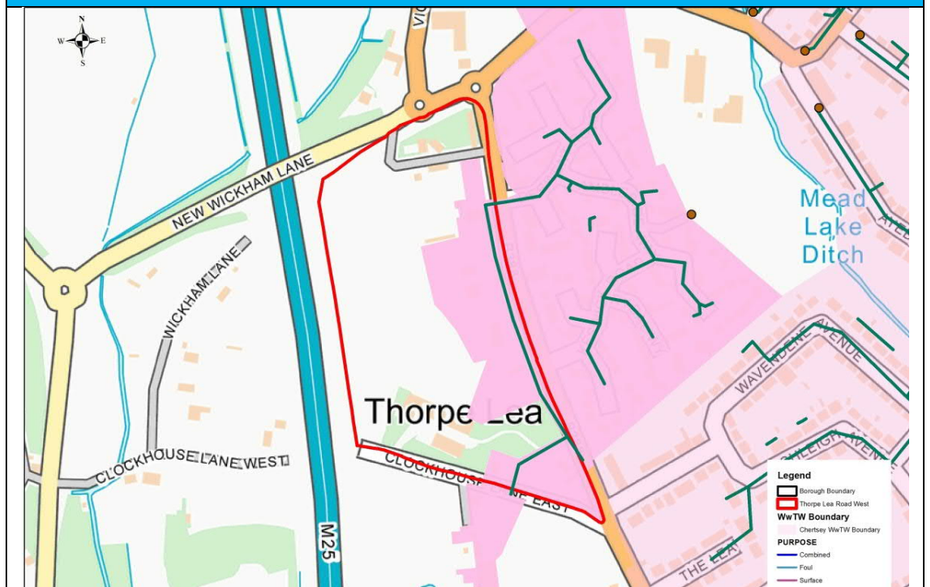
No. Residential Dwellings	Expected year of delivery
85	2019 - 2030
No. of traveller pitches	**Expected year of delivery**
2	2019 - 2030

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The majority of the development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk. However, a small area in the north eastern vicinity of the site is located in Flood Zone 3.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are small areas at low risk (<0.1% AEP) of flooding from surface and medium risk (1% to 3.3% AEP) of flooding from surface water across the development site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, this region is characterised in the SPZ 3, indicating a moderate susceptibility to contamination. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • According to the SuDS infiltration mapping database, very significant infiltration constraints have been identified for the entire development site. These constraints are identified as shallow ground water and compressible ground along the north-eastern border of the development site adjacent to the Mead Lake and adjacent to Vicarage Road. In addition, the site is characterised as having the potential for running sands and landslides to occur from increased infiltration. Infiltration SuDS is not recommended for this development. • There is a watercourse which flows along north-eastern border of the site, and could be utilised as a possible discharge point. Attenuation to Greenfield rates should be achieved using onsite storage methods prior to discharge into the watercourse. • There is no public surface water sewer in this area. TWUL have indicated that they have concerns about the capacity of their foul sewer to drain this development and additional discharge of surface water, even if attenuated will add to these concerns. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.8 THORPE LEA ROAD WEST, EGHAM

Location of Development


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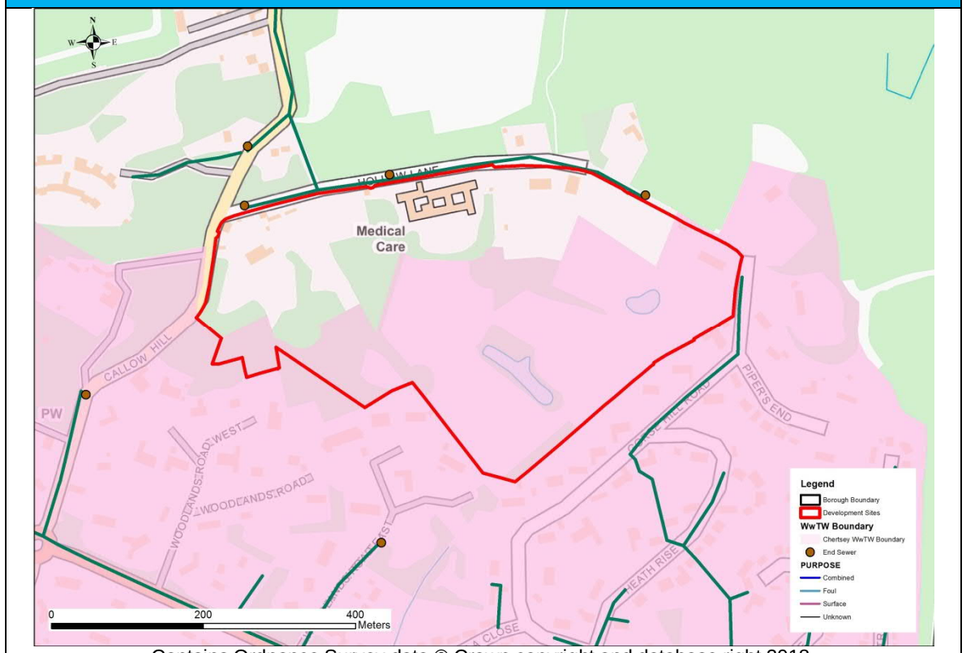
No. Residential Dwellings	Expected year of delivery
200	2019 - 2021
No. of traveller pitches	**Expected year of delivery**
3	2019 - 2021

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk. However, the north-western border of the development site falls approximately 10 m from an area that lies within flood zone 2, and could potentially impact the development site under extreme fluvial conditions.	
	• According to the Risk of Flooding from Surface Water mapping, there are multiple areas at low risk (<0.1% AEP) of flooding from surface and medium risk (1% to 3.3% AEP) of flooding from surface water across the development site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, this region is characterised in the SPZ 3, indicating a moderate susceptibility to contamination. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • According to the SuDS infiltration mapping database, very significant infiltration constraints have been identified for the entire development site. These have been identified as shallow ground water and compressible ground, and are georeferenced along the western border of the development site. In addition, the majority of the site has been characterised as potentially vulnerable to running sands and landslides. • The sewer network runs along the eastern border of the site, however, there is no public surface water sewer in this area. TWUL have indicated that they have concerns about the capacity of their foul sewer to drain this development and additional discharge of surface water, even if attenuated will add to these concerns. Attenuation to Greenfield rates should be achieved onsite prior to any offsite discharge. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.9 VIRGINIA WATER NORTH

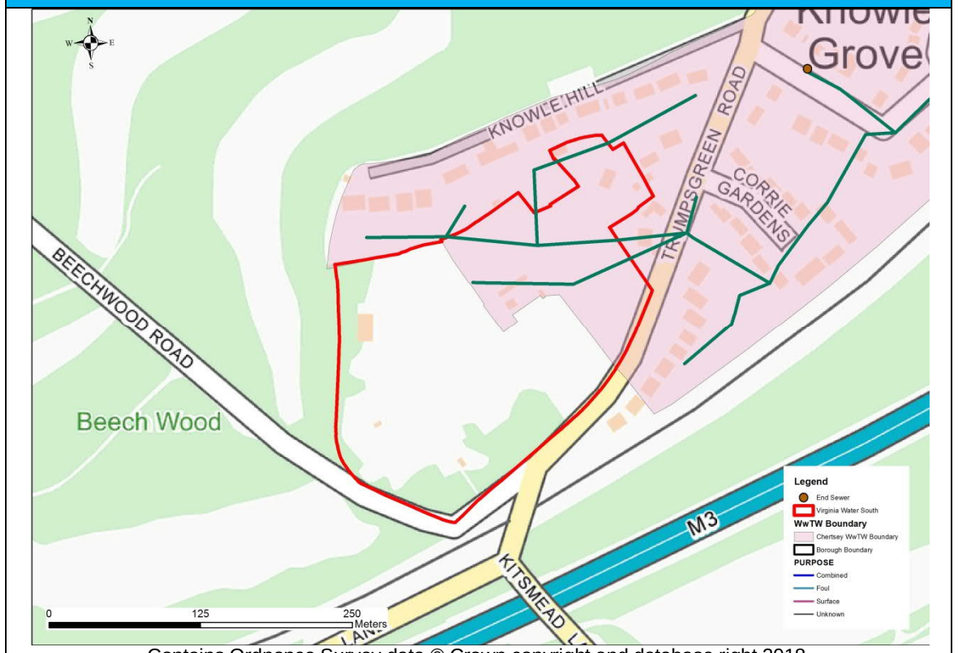
Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

No. Residential Dwellings	Expected year of delivery
120	2019 - 2030

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. However, local network reinforcements are likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are several areas of low risk (0.1% - 1% AEP) of flooding from surface water. In addition, the area surrounding the ponds located within the development site are characterised at high risk (> 3.3% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site has been characterised as having a low vulnerability to groundwater contamination.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The majority of the development site is characterise as free draining and highly compatible for infiltration SuDS such as soakaways, however, along the north and north-western borders, variable permeability has been observed. It is recommended to quantify the infiltration rates in those areas by soakaway testing, as the groundwater table is more than 5m below the surface. • In addition, consideration should be given to ground stability as the development site is susceptible to landslides and running sands. These hazards have been identified as significant and could affect the stability of ground conditions, and consideration should be given to the potential for or the consequences of subsidence associated with slopes. • Should the testing reveal that infiltration is feasible; consideration should be given to permeable paving, soakaways, detention basins and ponds. • It is also recommended that an assessment of the capacity of the ponds that lie within the development site be carried out to determine their potential to be utilised as discharge points. • Additionally, the sewer network runs along the northern border of the site Attenuation to Greenfield rates should be achieved onsite prior to any offsite discharge. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with Thames Water regarding available capacity, possible connections points and discharge rates.	

6.3.10 VIRGINIA WATER SOUTH

Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

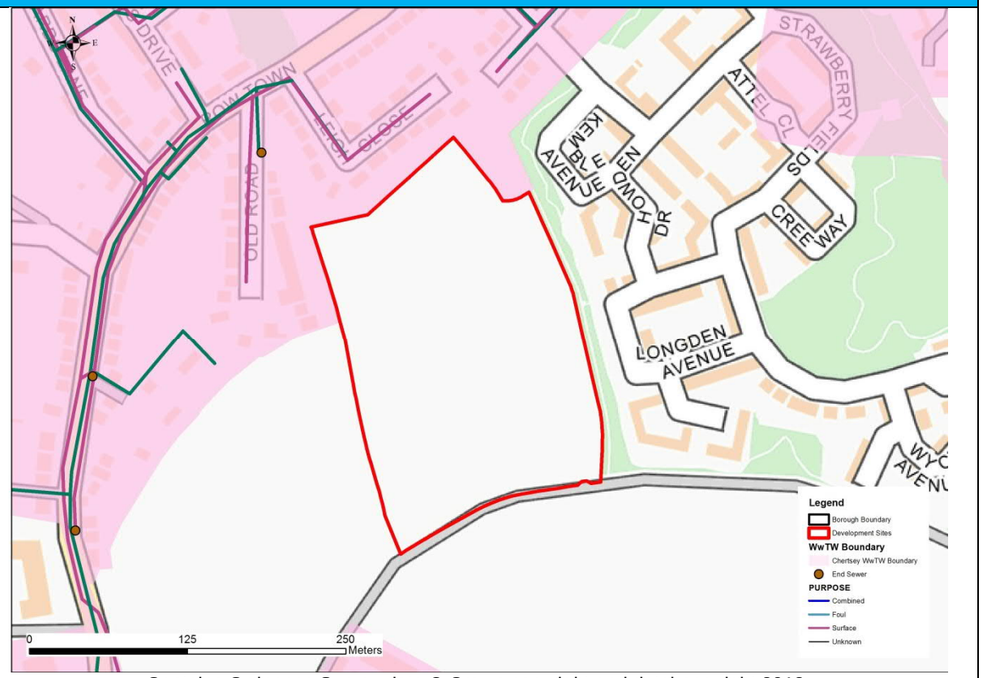
No. Residential Dwellings	Expected year of delivery
150	2019 - 2022
No. of traveller pitches	**Expected year of delivery**
2	2019 - 2022

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• Local network reinforcements will be required to support this development and to ensure no reduction in service to existing services in the area. This is partly linked to the new Longcross Garden Village development which falls within close proximity to this site. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are several hotspots of low risk (0.1% - 1% AEP) of flooding from surface water located along the border with Trumpsgreen Road.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site has been characterised as having a low vulnerability to groundwater contamination.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The majority of the development site is characterise as free draining and highly compatible for infiltration SuDS such as soakaways, however, in north of the site, the bedrock's permeability is characterised as spatially variable, but still likely to permit moderate infiltration. It is recommended to quantify the infiltration rates in those areas through soakaway testing as the groundwater table is more than 5m below the surface. • In addition, consideration should be given to ground stability as the development site is susceptible to landslides and running sands. These hazards have been identified as significant and could affect the stability of ground conditions. Therefore, consideration should be given to the potential for or the consequences of subsidence associated with slopes. • Should the testing reveal that infiltration is feasible, consideration should be given to infiltration SuDS applications. • Additionally, the sewer network runs near the site, however there is no surface water sewer in the area. Attenuation to Greenfield rates should be achieved onsite prior to any offsite discharge. If discharge to the public sewer is the only feasible option then it is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates. It should be noted that there is a history of foul sewage flooding downstream in Knowle Grove and Tyler Gardens which could be exacerbated with additional flow.	

6.3.11 CENTRAL VETERINARY LAB (PARCEL B), ROWTOWN

Location of Development



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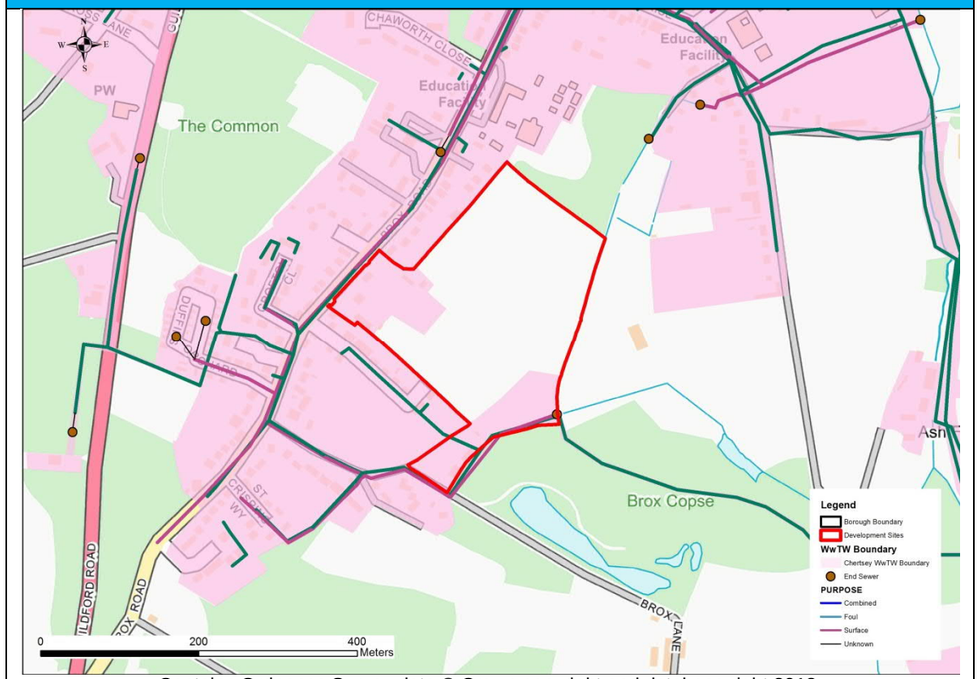
No. Residential Dwellings	Expected year of delivery
150	Post 2027
No. of traveller pitches	**Expected year of delivery**
2	Post 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. However, local network reinforcements may be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The Central Veterinary Lab (Parcel B) development area is located in Flood Zone 1and is not considered to be vulnerable to fluvial risk .	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, a small area of low risk (0.1% to 1% AEP) of flooding from surface water runs from the Northeast of the development site to the Southwest.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site is not located in a SPZ. In order to assess the risk of contamination in that part of the site, investigation will be required on previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as Water butts, Green roofs, Rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The development site is characterised as potentially suitable, and highly suitable for infiltration SuDS, and the site's bedrock permeability is free draining. . Therefore, to determine the site's feasible for infiltration SuDS, it is recommended that soakaway testing be conducted. In addition to tests to determine the groundwater table variability, consideration should also be given to the likely impact of infiltration SuDS on the ground stability, as the development site is characterised as susceptible to hazards such as landslides and running sands.. • In the areas of the site where infiltration is possible, drainage systems such as detention basins, retentions ponds, soakaways and permeable paving should be considered • The site has an existing surface water sewer network, which could be utilised, depending on its current and future load. This option should be considered only if infiltration SuDS and discharge into the watercourse are not feasible, and attenuation to Greenfield runoff rates and an agreement with TWUL on potential connection points and discharge rates is required.	

6.3.12 OTTERSHAW EAST

Location of Development



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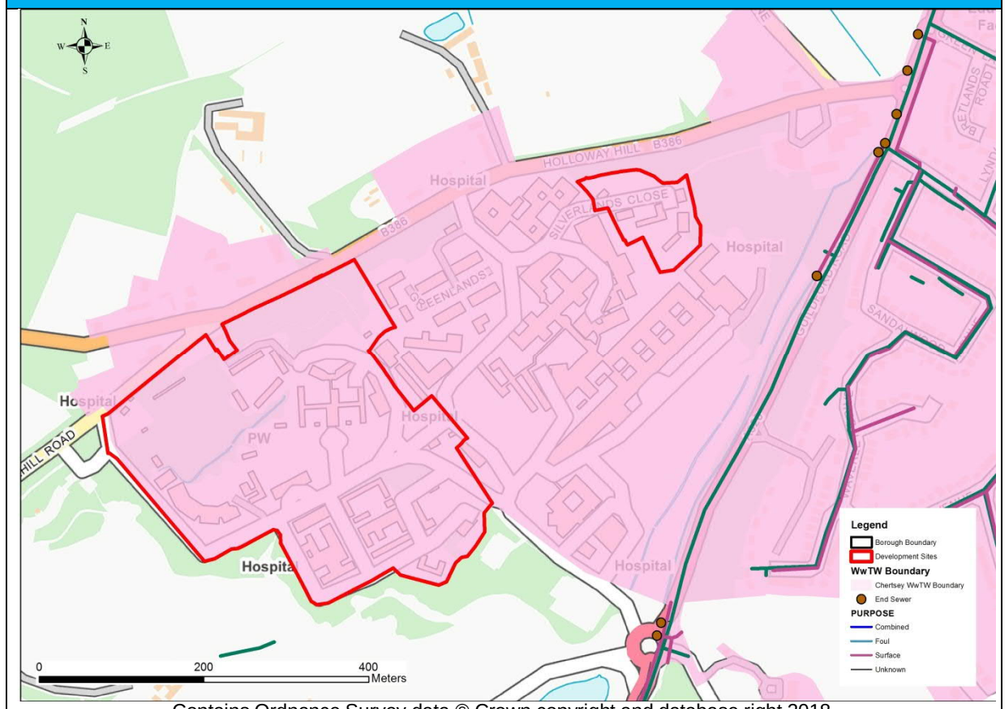
No. Residential Dwellings	Expected year of delivery
230	2019 - 2022
No. of traveller pitches	**Expected year of delivery**
2	2019 - 2022

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. However, local network reinforcements may be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The Ottershaw East development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, an area of low risk (0.1% to 1% AEP) of flooding from surface water runs from the Northwest of the development site to the Southeast. However, it should be noted that to the North of the development site, in the vicinity of Meath School, there is an area of high risk (> 3.3 % AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site is not located in a SPZ and is not expected to be especially vulnerable to contamination.	
SuDS and Surface Water Management	• Source control methods such as Water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • Approximately 95% of the development site is characterised as potentially suitable for infiltration SuDS, and the site's bedrock permeability is free draining. • A potential constraint is that groundwater table across the majority of the site is likely to be less than 3m below the ground surface; therefore to determine the site's feasibility for infiltration SuDS such as soakaways, infiltration testing should be carried out determine the infiltration rates as well as the groundwater table variability. These tests should also consider the likely impacts on the ground stability as the development site is characterised as susceptible to landslides and running sands. • Should the results of the infiltration testing indicate that infiltration is likely, drainage systems such as detention basins, retentions ponds, soakaways and permeable paving should be considered. • In addition, the site has an existing surface water sewer network connection points to the north and south of the site which could be utilised, depending on its current and future load. If infiltration systems are not feasible, the additional runoff from the site should be attenuated to Greenfield rates prior to discharge to the surface water course flowing through the site, which should be investigated to determine potential discharge locations.	

6.3.13 ST PETER'S HOSPITAL, CHERTSEY

Location of Development



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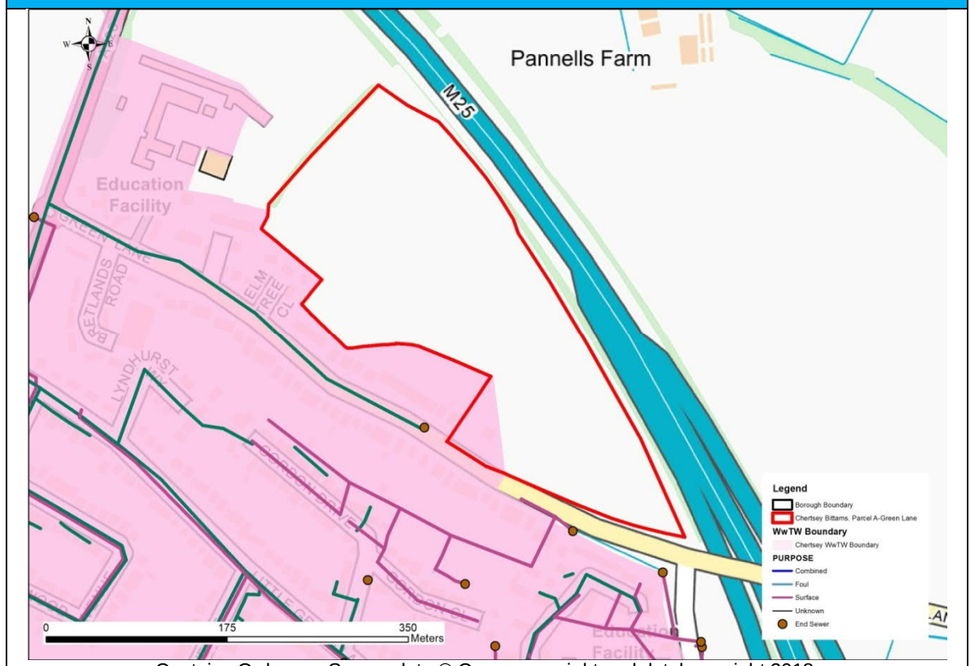
No. Residential Dwellings	Expected year of delivery
400	2019 - 2022

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• Local network reinforcements will be required to support this development and to ensure no reduction in service to existing services in the area. This is partly linked to the new Longcross Garden Village development which falls within close proximity to this site. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The St Peter's Hospital development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there is a medium risk of flooding (between 1% and 3.3% AEP) from the unnamed watercourse, and across several hardstanding areas across the development site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, this site is not in a SPZ and therefore the groundwater is not especially vulnerable to contaminants. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• The developer should also consider utilising source control methods such as green roofs and rainwater harvesting. • According to the SuDS infiltration mapping database, some of the site (in the north and north east) has been characterised as highly compatible for SuDS. Infiltration SuDS such as permeable paving and soakaways can be utilised in those areas of the site to reduce the impermeable area. • The SuDS infiltration mapping database indicates that the ground conditions in the west to eastern regions of the development site are susceptible to landslides and running sands. Infiltration testing should be conducted in this part of the site to determine the impact of the infiltration on the ground stability. Should the testing reveal that infiltration is feasible, infiltration SuDS such as soakaways and permeable paving can be installed. • If it is not possible to fully drain the site by infiltration then attenuated discharge to the watercourse may be possible. Flows should be no greater than Greenfield runoff as the watercourse in Guildford Road is prone to flooding.	

6.3.14 CHERTSEY BITTAMS (PARCEL A – GREEN LANE)

Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

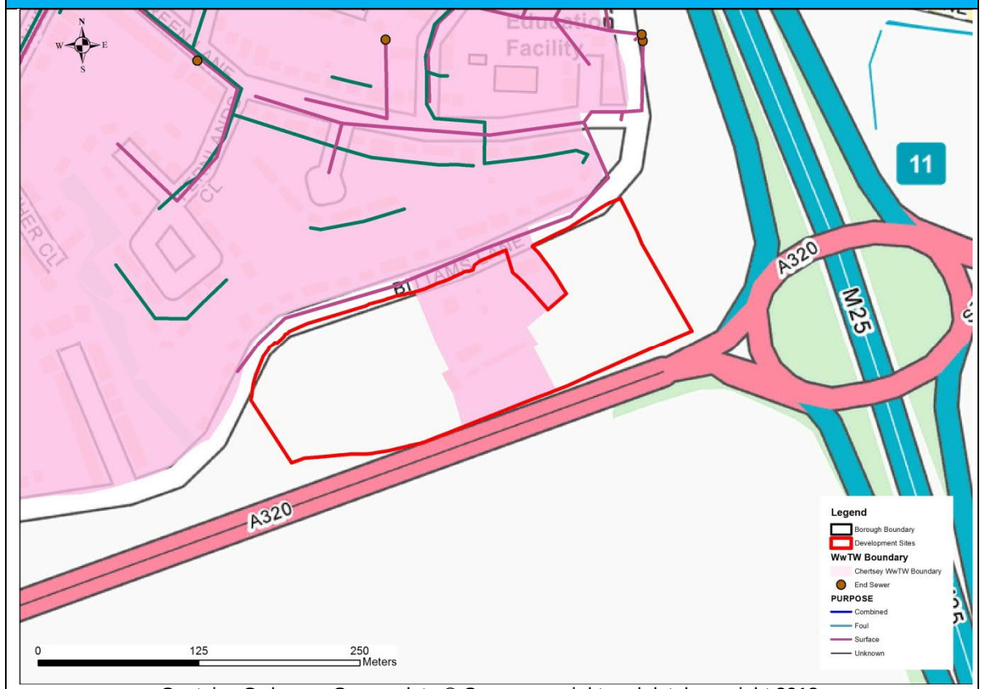
No. Residential Dwellings	Expected year of delivery
175	2022 - 2027
No. of traveller pitches	**Expected year of delivery**
5	2022 - 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The majority of the site is Flood Zone 1, and is not considered to be vulnerable to fluvial risk, however, the southern part of the site adjacent to Green Lane falls in Flood Zones 2 and 3.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there is an area of high risk (>3 % AEP) of flooding from surface water along the southern border of the site, and several areas located in the North of site behind the football field, towards the centre of site, and in the region adjacent to Green Lane.	
Groundwater Protection	• According to the BGS SUDs infiltration mapping, the site is located in SPZ 3, and the groundwater may be vulnerable to contamination. In order to assess the risk of contamination, investigation will be required on previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • Given the site is located in SPZ 3, the groundwater is likely to be vulnerable to contaminants. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency guidance official documentation for guidance • Moreover, the groundwater table is less than 3m below the surface, and is characterised under the category 'potential for landslides and running sands to occur. Infiltration tests should be carried out to quantify infiltration rates and consider whether infiltration can be used as a SuDS technique. Additionally, testing should be carried out to investigate seasonal variations in the groundwater table. • There are two existing surface water sewer network connections in the vicinity of the site, and these serve the development opposite the site location. If Infiltration is not practicable then it may be possible to discharge an attenuated flow into the public surface water sewer located along Green Lane. It is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.15 CHERTSEY BITTAMS (PARCEL B – WOODSIDE FARM)

Location of Development



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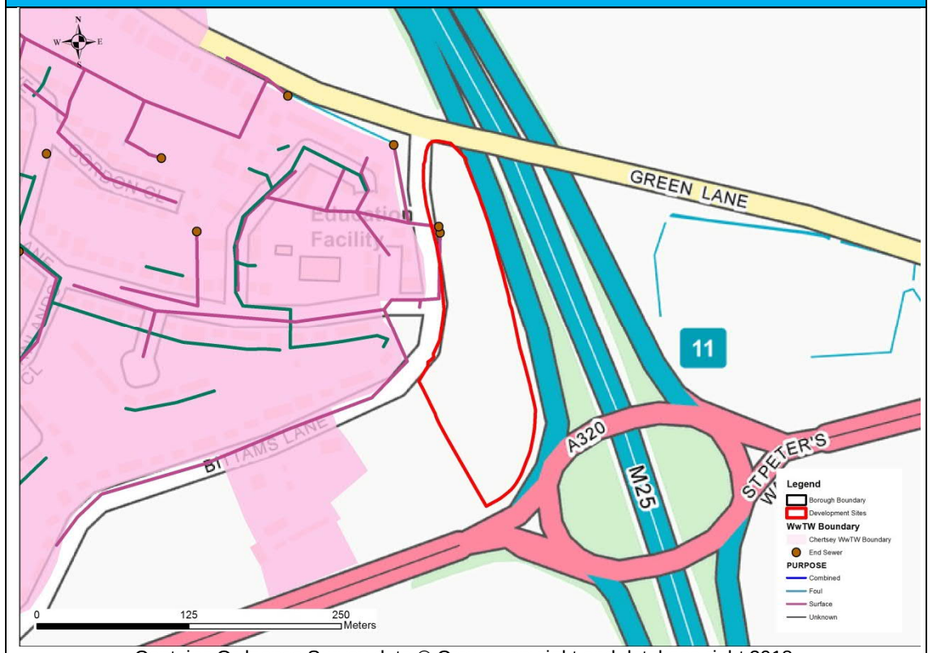
No. Residential Dwellings	Expected year of delivery
110	Post 2027
No. of traveller pitches	**Expected year of delivery**
2	Post 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The Chertsey Bittams (Parcel B) development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, in the centre of the development, the hard standing parking area of Woodside farm is an area of medium risk (between 1 % and 3.3% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the majority of the site is not in a SPZ; however, the south-eastern area of the site, is characterised as a SPZ3. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • Along the south eastern border of the Parcel B development site, there are significant constraints preventing the implementation of infiltration SuDS. This results from the site being characterised as consisting of Made ground. The presence of Made ground indicates that the site has been previously infilled or landscaped, and infiltration SuDS could result in ground instability in this area. According the SuDS infiltration mapping database, the site is also considered potentially vulnerable to running sands and landslides. Infiltration SuDS may be unfeasible in this part of the development site; however across the remainder of the site, infiltration SuDS can be implemented. • If infiltration is not practicable in the south eastern part of the site, then it may be possible to discharge attenuated flow into the public surface water sewer in Bittams Lane. It is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates.	

6.3.16 CHERTSEY BITTAMS (PARCEL C – LAND EAST OF WOODSIDE FARM)

Location of Development



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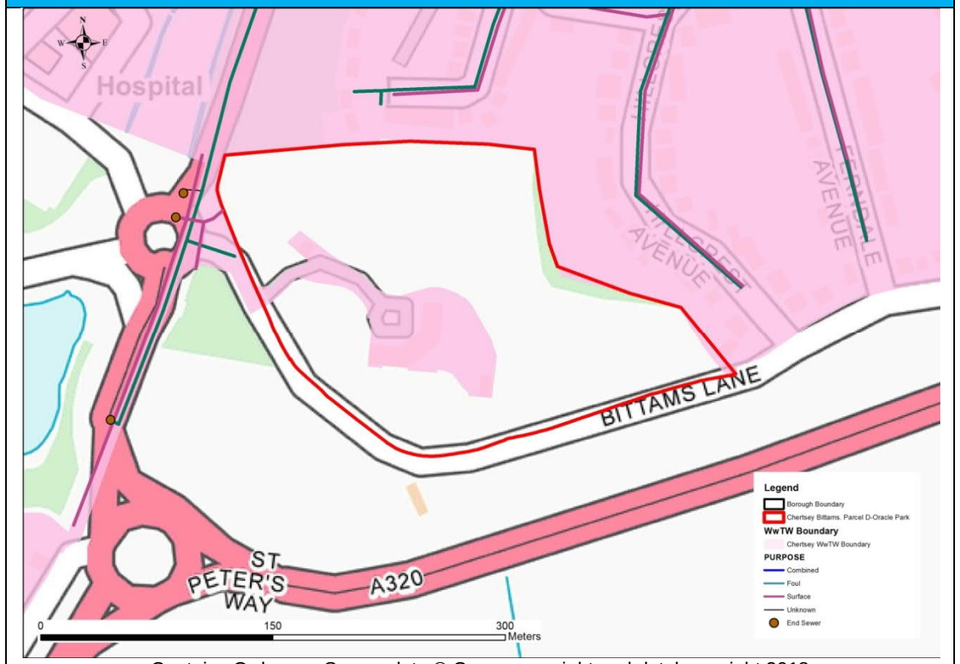
No. Residential Dwellings	Expected year of delivery
35	Post 2027
No. of traveller pitches	**Expected year of delivery**
2	Post 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• On the information available to date TWUL do not envisage infrastructure concerns regarding wastewater infrastructure capability in relation to this site.	
Fluvial Flood Risk	• The Chertsey Bittams (Parcel C) development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, in the North, central and eastern areas of the development site, there is a high risk (>3.3% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site lies in SPZ3 and infiltration may increase the possibility of contaminants entering the groundwater. In order to assess the risk of contamination, investigate previous land use and potential for the presence of contaminated ground. Refer to the Environment Agency official documentation for guidance.	
SuDS and Surface Water Management	• The presence of Made ground indicates that the site has been previously infilled or landscaped and infiltration SuDS could result in ground instability in this area. • In addition, the depth to the water table is less then 3m from the surface, therefore, it is recommended that further consideration be given to SuDS methods such as green roofs, and rainwater harvesting. • Infiltration SuDS may not be infeasible but they should be explored further by the developer. • If Infiltration is not practicable then it may be possible to discharge an attenuated flow into the watercourse at the northern end of the site. • Additionally, it may be possible to discharge an attenuated flow into the public surface water sewer located along Bittams Lane. It is recommended that the developer consult with TWUL regarding available capacity, possible connections points and discharge rates	

6.3.17 CHERTSEY BITTAMS (PARCEL D – ORACLE PARK)

Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

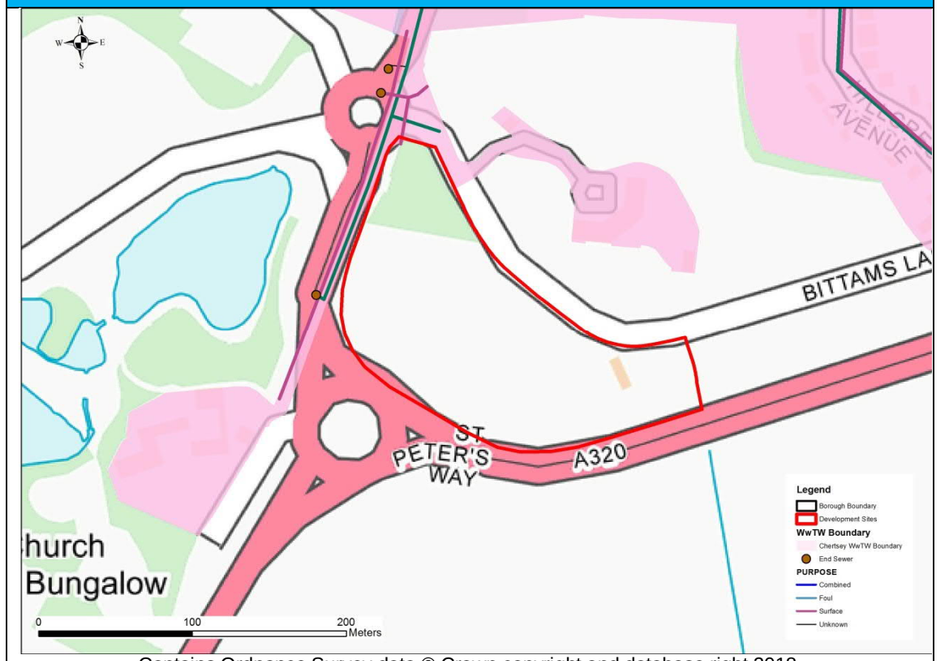
No. Residential Dwellings	Expected year of delivery
125	2022 - 2027
Student Accommodation/ Care Home Beds	**Expected year of delivery**
93	2022 - 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are several areas across the development site characterised at low risk (0.1% to 1% AEP) of flooding from surface water.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site lies within a region characterised as low susceptibility and therefore the groundwater is not especially vulnerable to contaminants.	
SuDS and Surface Water Management	• Source control methods such as Water butts, Green roofs, Rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • Approximately 50% of the development site in the western, southern, and south eastern regions are characterised as potentially suitable for infiltration SuDS, and the remainder of the site has been characterised as highly to potentially compatible for infiltration SuDS. • The site's soil is free draining; however, a potential constraint is that the groundwater table is likely to be less than 3m below the ground surface in the western, southern, and south eastern regions. Therefore to determine the site's feasibility for infiltration SuDS in those areas, soakaway testing and tests to determine the groundwater variability should be conducted. Moreover, these tests should consider the likely impact on the ground stability as the development site is characterised as potentially susceptible to landslides and running sands. • Should the results of the infiltration testing indicate that infiltration is likely to be possible, drainage systems such as detention basins and retentions ponds should be considered, and permeable paving should be considered to reduce the impermeable area located to the south of the site. • The previous redevelopment of the existing office utilises partial infiltration and partial drainage to a detention pond. It is possible that it will not be easy to fully drain the site by infiltration alone and it may be necessary to discharge into the watercourse on Guildford Road. Flows should be no greater than Greenfield runoff as the watercourse in Guildford Road is prone to flooding.	

6.3.18 CHERTSEY BITTAMS (PARCEL E – LAND EAST AND WEST OF WHEELERS GREEN)

Location of Development



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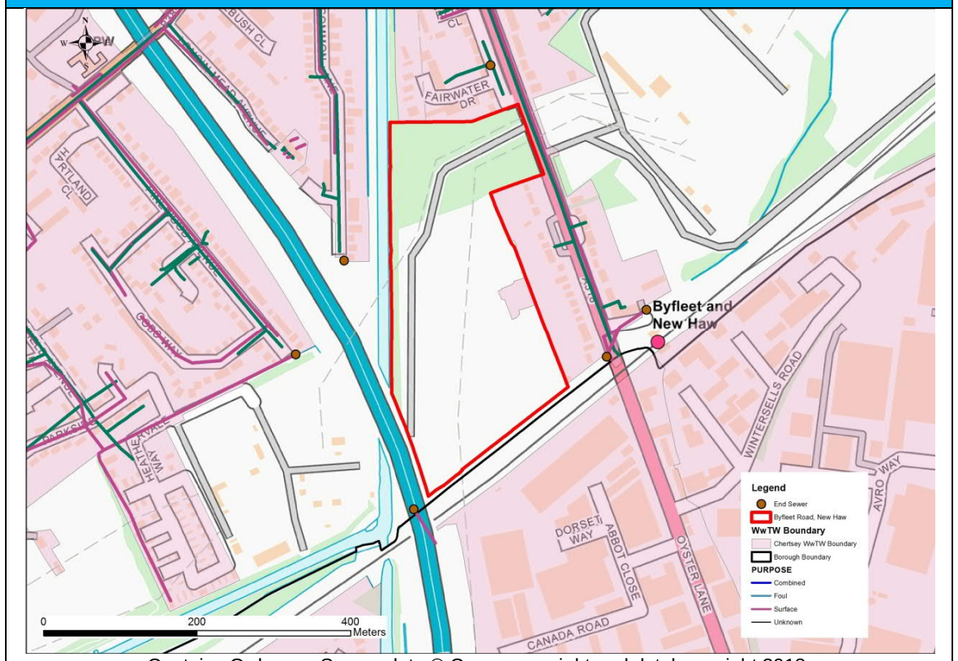
No. Residential Dwellings	Expected year of delivery
70	2022 - 2027

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• The development area is located in Flood Zone 1 and is not considered to be vulnerable to fluvial risk.	
Surface Water Flood Risk	• There are several hotspots characterised as high risk (> 3.3% (AEP)) of flooding from surface water along St. Peters Way, and in the north eastern region of the site, there are also several hotspots indicating high risk of surface water flooding	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site lies within a region characterised as low susceptibility and therefore the groundwater is not especially vulnerable to contaminants.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The entire development site is characterised as potentially suitable for infiltration SuDS, and the site's geology is characterised as free draining by the BGS SuDS infiltration mapping. A potential constraint is groundwater is likely to be less than 3m below the ground surface, therefore to determine the site's feasibility for infiltration SuDS, it is recommended that soakaway testing and tests to determine the groundwater variability should be conducted. These tests should determine the likely impact on the ground stability as the development site is characterised as susceptible to landslides and running sands. • Should the results of the infiltration testing indicate that infiltration is likely, drainage systems such as detention basins and retentions ponds should be considered. • If Infiltration is not practicable then it may be possible to discharge an attenuated flow into the watercourse in Guildford Road. Flows should be no greater than Greenfield runoff as the watercourse in Guildford Road is prone to flooding.	

6.3.19 BYFLEET ROAD, NEW HAW

Location of Development
 Contains Ordnance Survey data © Crown copyright and database right 2018.

Employment Floorspace	Expected year of delivery
20,000 sqm (B1C, B8)	2018 - 2023

Water Cycle Constraints Assessment

Water Cycle Element	Summary	Overall Assessment
Water supply network requirements	• No significant infrastructure likely to be required. The developer should contact Affinity Water Developer Services at the earliest opportunity to discuss their connection and infrastructure cost contributions.	
Wastewater/sewer network infrastructure requirements	• The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with TWUL to discuss the scale and phasing of development and what wastewater infrastructure may be required to support it at the earliest opportunity.	
Fluvial Flood Risk	• Approximately 50% of the site is located in flood zones 2 and 3 and as such large areas of the site are considered to be vulnerable to flood risk.	
Surface Water Flood Risk	• According to the Risk of Flooding from Surface Water mapping, there are several areas at low risk (0.1% to 1% AEP) of flooding from surface water across the development site.	
Groundwater Protection	• According to the BGS SuDS infiltration mapping, the site is not located in a SPZ and therefore, groundwater is not expected to be especially vulnerable to contamination.	
SuDS and Surface Water Management	• Source control methods such as water butts, green roofs, rainwater harvesting and raingardens should be considered to reduce the runoff from the site. • The site is characterised as having the potential for infiltration SuDS, and the permeability of the bedrock is characterised as free draining. The depth to the groundwater table is less than 3m from the surface, and it is recommended in the SuDS infiltration mapping that infiltration tests be carried out to determine potential impacts of infiltration SuDS on the seasonal ground water variation and the ground stability. • In addition, the ground stability is vulnerable to running sands and landslides, and it is recommended to consider the potential for or the consequences of subsidence associated with these hazards before installing infiltration SuDS. • If the results of the infiltration testing indicate that infiltration is likely, infiltration SuDS should be considered. The watercourse which flows along the west and southern borders of the development site could be used as a discharge point for attenuated flow.	

7. Water Cycle Strategy Recommendations and Policy

The following policy recommendations are made and should be considered by RBC to ensure that the Local Plan considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, as well as phasing of growth.

7.1 Policy Recommendations Overview

7.1.1 Wastewater

Major Development
It is recommended that the Council consider including a requirement within the development control validation process that developers must provide evidence to them that they have both consulted with TWUL regarding wastewater treatment capacity, and the outcome of this consultation, prior to validation of a planning application. The Council should consider the response from TWUL when determining the application, including any response from direct consultation the Council undertakes with TWUL.

Treatment Capacity Review
In addition to the Council publishing its Annual Monitoring Report (AMR) on the Council's website, it is recommended that RBC continues to consult with TWUL on Local Plan proposals to ensure that plans for WwTW upgrades, in response to permit change requirements or flow capacity constraints, take account of the most up to date planning position. In addition, it is recommended that RBC provide regular updates about the timing and delivery of strategic sites to TWUL, which would assist TWUL in planning where further investment in water recycling infrastructure is required to accommodate further growth.

Development and the Sewerage Network
It is recommended the development sites assessed by TWUL as part of the Outline WCS as Amber or Red for wastewater network constraints should be subject to a pre-development enquiry[22] at an early stage, and if possible before submitting a planning application, to inform the asset management plans prior to planning permission being granted. Assessments made within this WCS consider each site in isolation and network capacity will change depending on when and where sites come forward.

7.1.2 Water Supply

Water Supply Demand Balance
It is recommended that RBC continues to update AWS on future development phasing and changes to growth allocations via the Councils AMRs, to ensure the future supply-demand balance can be appropriately captured in the next asset planning period (AMP7).

7.1.3 Surface Water Management and Flood Risk

SuDS and Green Infrastructure
It is recommended that developers should ensure linkage of SuDS in new development sites to provide environmental, biological, social and amenity value. SuDS designs should maximise opportunities to create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space. The Department for Environment, Food and Rural Affairs (Defra) funded Local Action Toolkit can be applied to urbanised/urbanising environments to identify how SuDS and Green Infrastructure can be most effectively applied in a constrained urban setting, while also considering the benefits of biodiversity and natural capital.

Surface water runoff rates should be no greater than the existing Greenfield rates. Brownfield sites should aim to reduce the surface water discharge back to Greenfield runoff rates. Surrey County Council (SCC), as the Lead Local Flood Authority (LLFA), offers a pre-application advice service[23] which all applicants are recommended to use.

[22] Pre-development enquiries to TWUL can be made via the Thames Water website: https://developers.thameswater.co.uk/Developing-a-large-site/Planning-your-development/Wastewater/Pre-development-enquirie-Form

[23] https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/suds-planning-advice

SuDS and Water Efficiency
Developers should ensure linkage of SuDS to water efficiency measures where possible, including rainwater harvesting.

Linkages to SFRA
Developers should ensure the design and long term maintenance of SuDS, supports the findings and recommendations of the Runnymede Level 1 SFRA (2017).

Sewer Separation
Developers should ensure foul and surface water from new development and redevelopment are kept separate where possible. Surface water should be discharged as high up the following hierarchy of drainage options as reasonably practicable, before a connection to the foul network is considered:

1. into the ground (infiltration);
2. to a surface waterbody;
3. to a surface water sewer or another drainage system; and
4. to a combined sewer.

Where sites which are currently connected to combined or foul sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken. This approach will also aid in improving capacity constraints at the Chertsey WwTW.

Water Quality Improvements
Developers should ensure, where possible, that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of WFD.

Watercourses
It is recommended that RBC include the following policy recommendations with respect to sites which have a main river or ordinary watercourse flowing through or in close proximity to the site boundary:

- Watercourses should not be culverted or straightened, as these activities cause deterioration of their quality;
- Where watercourses have in the past been culverted or straightened, reinstatement to a more natural landscape should form part of the development;
- Each development should enhance the quality of the local watercourse; and
- For main rivers, a minimum easement of 8 meters from the top of bank of a main river is required to allow maintenance of the watercourse. For ordinary watercourses a minimum easement of 8 meters is required to allow for maintenance. Where possible a larger easement should be provided. Consent may be required from the Environment Agency[24] for works that affect a main river or from SCC[25] (as the LLFA) for works that affect an ordinary watercourse.

7.1.4 Ecology

Biodiversity Enhancement
It is recommended that RBC include a policy within its Local Plan which commits to seeking and securing (through planning permissions etc.) enhancements to aquatic biodiversity in the Borough through the use of SuDS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities).

7.2 Further Recommendations

Stakeholder Liaison
It is recommended that key partners involved in the development of the WCS maintain regular consultation with each other as development proposals progress.

[24] https://www.gov.uk/guidance/flood-risk-activities-environmental-permits
[25] https://www.surreycc.gov.uk/people-and-community/emergency-planning-and-community-safety/flooding-advice/more-about-flooding/ordinary-watercourse-consents

WCS Review

Development phasing and new sites should continue to be monitored by RBC when future development plans evolve via the Councils AMRs, to enable continued assessment on water supply and wastewater treatment. Where growth is expected to be significant, RBC should consider carrying out an update to the WCS to account for additional growth. In any future updates to the WCS, note should be taken of changes to the various studies and plans that support it.

Appendix A Policy and Legislative Drivers Shaping the WCS

Directive/Legislation/Guidance	Description
Birds Directive 2009/147/EC	Provides for the designation of Special Protection Areas.
Building Regulations Approved Document G – sanitation, hot water safety and water efficiency (March 2010)	The current edition covers the standards required for cold water supply, water efficiency, hot water supply and systems, sanitary conveniences and washing facilities, bathrooms and kitchens and food preparation areas.
Eel Regulations 2009	Provides protection to the European eel during certain periods to prevent fishing and other detrimental impacts.
Environment Act 1995	Sets out the role and responsibility of the Environment Agency.
Environmental Protection Act 1990	Integrated Pollution Control (IPC) system for emissions to air, land and water.
Flood & Water Management Act 2010	The Flood and Water Management Act 2010 is the outcome of a thorough review of the responsibilities of regulators, local authorities, water companies and other stakeholders in the management of flood risk and the water industry in the UK. The Pitt Review of the 2007 flood was a major driver in the forming of the legislation. Its key features relevant to this WCS are: 8. To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods. 9. To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments. 10. To widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list. 11. To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges. 12. To make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the SoS following a full public consultation.
Future Water, February 2008	Sets the Government's vision for water in England to 2030. The strategy sets out an integrated approach to the sustainable management of all aspects of the water cycle, from rainfall and drainage, through to treatment and discharge, focusing on practical ways to achieve the vision to ensure sustainable use of water. The aim is to ensure sustainable delivery of water supplies, and help improve the water environment for future generations.
Groundwater Directive 80/68/EEC	To protect groundwater against pollution by 'List 1 and 2' Dangerous Substances.
Habitats Directive 92/44/EEC and Conservation of Habitats & Species Regulations 2010	To conserve the natural habitats and to conserve wild fauna and flora with the main aim to promote the maintenance of biodiversity taking account of social, economic, cultural and regional requirements. In relation to abstractions and discharges, can require changes to these through the Review of Consents (RoC) process if they are impacting on designated European Sites. Also the legislation that provides for the designation of Special Areas of Conservation provides special protection to certain non-avian species and sets out the requirement for Appropriate Assessment of projects and plans likely to have a significant effect on an internationally designated wildlife site.
Land Drainage Act 1991	Sets out the statutory roles and responsibilities of key organisations such as Internal Drainage Boards, local authorities, the Environment Agency and Riparian owners with jurisdiction over watercourses and land drainage infrastructure.
Making Space for Water, 2004	Outlines the Government's strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England. The policy aims to reduce the threat of flooding to people and property, and to deliver the greatest environmental, social and economic benefit.
National Planning Policy Framework	Planning policy in the UK is set by the National Planning Policy Framework (NPPF). NPPF advises local authorities and others on planning policy and operation of the planning system. A WCS helps to balance the requirements of various planning policy documents, and ensure that land-use planning and water cycle infrastructure provision is sustainable.
Pollution Prevention and Control Act (PPCA) 1999	Implements the IPPC Directive. Replaces IPC with a Pollution Prevention and Control (PPC) system, which is similar but applies to a wider range of installations.

Ramsar Convention	Provides for the designation of wetlands of international importance
Urban Waste Water Treatment Directive (UWWTD)	This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its aim is to protect the environment from any adverse effects caused by the discharge of such waters.
Water Act 2003	Implements changes to the water abstraction management system and to regulatory arrangements to make water use more sustainable.
Water Framework Directive (WFD) 2000/60/EC	The WFD, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. The overall requirement of the directive is that all river basins must achieve 'Good ecological status' by 2015 or by 2027 if there are no grounds for derogation. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[26], an advisory body which has proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that the water bodies in the UK (including groundwater) meet the required status[27]. Standards and waterbody classifications are published via River Management Plans (RBMP) the latest of which were completed in 2015.
Natural Environment & Rural Communities Act 2006	Covering Duties of public bodies – recognises that biodiversity is core to sustainable communities and that Public bodies have a statutory duty that states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity
Water Resources Act 1991	Protection of the quantity and quality of water resources and aquatic habitats. Parts have been amended by the Water Act 2003.
Wildlife & Countryside Act 1981 (as amended)	Legislation that provides for the protection and designation of SSSIs and specific protection for certain species of animal and plant among other provisions.

[26] The UKTAG (UK Technical Advisory Group) is a working group of experts drawn from environment and conservation agencies. It was formed to provide technical advice to the UK's government administrations and its own member agencies. The UKTAG also includes representatives from the Republic of Ireland.
[27] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B Relevant Planning Documents to the WCS

Category	Author	Document Name	Publication Date
Water Resources	Affinity Water Services	Affinity Water Resources Management Plan	2014
Local Plan	Runnymede Borough Council	Runnymede Local Plan 2035: Additional Sites & Options Consultation Document	2017
Flood Risk	Surrey County Council	Surrey Local Flood Risk Management Strategy 2017 – 2032	2017
Flood Risk	Runnymede Borough Council	Runnymede Level 1 Strategic Flood Risk Assessment	2017
Water Cycle	AECOM, on behalf of Runnymede Borough Council	Runnymede Water Cycle Study: Phase 1 Scoping	2018

Appendix C WwTW Capacity Assessment Results

Section C1 – C3 provides an overview of the RQP modelling software, assumptions and assessment methodology. The assessment results for the proposed phased growth within Runnymede up to 2031 are summarised in Section C4. A percentage deterioration assessment at the mixing point for Chertsey WwTW was undertaken to determine the impact on the water quality if the ammonia permit was set to the 1mg/l 95%ile permit limit and the results are presented in Section C5.

C.1 Modelling Software

Modelling of the quality permits required to meet the water quality objectives has been undertaken using RQP 2.5 (River Quality Planning), the Environment Agency's software for calculating permit conditions. The software is a monte-carlo based statistical tool that determines the statistical quality required from discharges in order to meet defined downstream targets, or to determine the impact of a discharge on downstream water quality compliance statistics.

It is recognised that RQP has limitations including:

- It can only calculate the river quality at the mixing point, and therefore the downstream sampling point (from which the waterbody status is defined) cannot easily be incorporated without some degree of uncertainty; and
- The tool is unable to assess the cumulative impact of growth of WwTW upstream.

The methodology detailed in this appendix has been developed in order to minimise the effect of the limitations and thereby reducing the uncertainty in the results produced.

C.2 Modelling assumptions

Several key assumptions have been used in water quality and permit modelling as follows:

WwTW discharge flow

- WwTW current flows were taken as the average of dry weather flows (DWF) from 2010-2016 provided by the Environment Agency;
- The wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.43 people per house and an average consumption of 125 l/h/d with an additional allowance value of 34% of additional flow for an increase in infiltration and 16 l/h/d added to factor in employment; and
- WwTW future flows were calculated by adding the volume of additional wastewater generated by new dwellings to the current observed DWF value.

WwTW discharge quality

- The current discharge quality for each determinand (Ammonia, BOD and Phosphate) was calculated from the available WwTW discharge quality monitoring data provided by the Environment Agency and current measured flow data provided by Thames Water;
- The future discharge quality for each determinand was calculated based on the available WwTW discharge quality monitoring data provided by the Environment Agency and future flow data derived from current measured flow data provided by TWUL. Additional calculated flow to represent the proposed level of growth was also used;
- BOD and Ammonia discharge qualities have been reported as 95 percentiles (as per discharge permits);
- Phosphate discharge qualities have been reported as annual averages (as per discharge permits); and
- For the purposes of this study, the limits of conventionally applied treatment processes are considered to be:
  - 1mg/l 95%ile for Ammoniacal-N; and
  - 5mg/l 95%ile for BOD;
  - 0.25mg/l annual average for Phosphate.

River water quality

- River water quality monitoring data was provided by the Environment Agency;

- The Environment Agency provided the published 2016 WFD status for the downstream sampling point (status defined using water quality data collected between 2012 and 2014);
- BOD and Ammonia river water qualities have been reported as 90 percentiles; and
- Phosphate river water qualities have been reported as means.

C.3 Water Quality Modelling Methodology

Baseline Review

Effect of Current Discharge By modelling the current WwTW discharge flow (pre-growth) and measured discharge quality, does the current WwTW discharge cause the river quality at the mixing point to fall below the status threshold?

Test 1-10% Deterioration

1a. Effect of current WWTW discharge Modelling the current WwTW discharge flow (pre-growth).	
1b. 10% deterioration limit Determine the 10% deterioration target for the 10% deterioration test.	
1c. 10% deterioration test Modelling of the future WwTW discharge flow (post-growth) and 10% deterioration target, is the future permit technically feasible with conventional technology?	
Yes: Limiting deterioration to 10% is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: Limiting deterioration to 10% is not possible because the tighter permit cannot be achieved with conventional technology.

Test 2- Status Deterioration Target

2a. Current permit required to ensure no deterioration in status Modelling of the current WwTW discharge flow (pre-growth) and current status, is the permit required technically feasible with conventional technology?	
2b. Future permit required to ensure no deterioration in status Modelling of the future WwTW discharge flow (post-growth) and current status, is the permit required technically feasible with conventional technology?	
Yes: Ensuring no deterioration in status is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: Ensuring no deterioration in status is not possible because the tighter permit cannot be achieved with conventional technology. Therefore, growth may cause a deterioration in status, unless improvements in technology or non-conventional technologies are used. Test 4.- Maintain current quality test needs to be carried out

Test 3-Maintain Current Quality Target

4. Revised future permit required to maintain current quality Modelling of the future WwTW discharge flow (post-growth) and current discharge quality, is the permit technically feasible with

conventional technology to maintain current quality?	
Yes: maintaining current quality is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: maintaining current quality is not possible because the tighter permit cannot be achieved with conventional technology. Catchment modelling is required to provide sufficient confidence there will be no deterioration in status at the downstream sampling point.

C.4 Assessment Table

Chertsey WwTW	**AMP 6 (2015 – 2020)**			**AMP 7 (2020 – 2025)**			**AMP 8 (2025 – 2030)**			**AMP 9 (2030 – 2035) Growth to 2031 (End of Plan Period)**		
Is there flow headroom in the Permit? If so, what is the volume of flow headroom available after growth (m^3/d)	2,608 m3/d			1,319 m3/d			364 m3/d			None (headroom exceeded by 192 m3/d)		
Parameters considered	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)
Permit condition	1.3	12	2	1.3	12	2	1.3	12	2	1.3	12	2
Limit of Conventional Treatment (LCT)	1	5	0.25	1	5	0.25	1	5	0.25	1	5	0.25
WFD receiving waterbody and ID	**Chertsey Bourne (Virginia Water to Chertsey) (GB106039017070)**			**Chertsey Bourne (Virginia Water to Chertsey) (GB106039017070)**			**Chertsey Bourne (Virginia Water to Chertsey) (GB106039017070)**			**Chertsey Bourne (Virginia Water to Chertsey) (GB106039017070)**		
Parameters considered	Ammonia (mgl - 90%ile)	BOD (mgl - 90%ile)	Phosphate (mgl - mean)	Ammonia (mgl - 90%ile)	BOD (mgl - 90%ile)	Phosphate (mgl - mean)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Receiving waterbody Quality Element Published Status (Cycle 2 - 2015)	**High**	**Good**	**Good**	**High**	**Good**	**Good**	**High**	**Good**	**Good**	**High**	**Good**	**Good**
Upstream sample point	**PBNR0057 - CHERTSEY**			**PBNR0057 - CHERTSEY**			**PBNR0057 - CHERTSEY**			**PBNR0057 - CHERTSEY**		
Measured quality upstream of discharge (2013 to 2015)	0.25	N/A	0.02	0.25	N/A	0.02	0.25	N/A	0.02	0.25	N/A	0.02
Quality Element Status based on measured data	**High**	N/A	**High**	**High**	N/A	**High**	**High**	N/A	**High**	**High**	N/A	**High**
Test 1 - 10% deterioration	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Mixing Point Quality with current WwTW flow (90 percentile Ammonia & BOD, annual average Phosphate)	0.31	4.42	0.35	0.31	4.42	0.35	0.31	4.42	0.35	0.31	4.42	0.35
Modelled status at mixing point with current flow	**Good**	**Good**	**Poor**	**Good**	**Good**	**Poor**	**Good**	**Good**	**Poor**	**Good**	**Good**	**Poor**
10% deterioration limit (90 percentile Ammonia & BOD, annual average Phosphate)	0.34	4.86	0.39	0.34	4.86	0.39	0.34	4.86	0.39	0.34	4.86	0.39
Permit condition required to be within 10% deterioration target (95 percentile Ammonia & BOD, annual average Phosphate)	**0.85**	**8.60**	**1.31**	**0.84**	**8.53**	**1.26**	**0.83**	**8.67**	**1.22**	**0.83**	**8.62**	**1.20**
Test 2 - WFD Status: no deterioration (waterbody status)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Threshold at which status deterioration would occur (90 percentile Ammonia & BOD, annual average Phosphate)	0.60	5.00	0.053	0.60	5.00	0.053	0.60	5.00	0.053	0.60	5.00	0.053
permit condition required at mixing point - current WwTW flow (95 percentile Ammonia & BOD, annual average Phosphate)	**2.00**	**9.50**	**0.14**	**2.00**	**9.50**	**0.14**	**2.00**	**9.50**	**0.14**	**2.01**	**9.50**	**0.14**
permit condition required at mixing point - after growth (95 percentile Ammonia & BOD, annual average Phosphate)	**2.00**	**9.49**	**0.14**	**1.93**	**9.24**	**0.14**	**1.89**	**9.08**	**0.14**	**1.88**	**9.00**	**0.13**
Maintain current quality	N/A	N/A	1.19	N/A	N/A	1.14	N/A	N/A	1.11	N/A	N/A	1.09
Key to 'Effluent Quality Required'	**Green Value – no change to current permit required**			**Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes**			**Red Value – not achievable within limits of conventionally applied treatment processes**					

C.5 Mixing Point Quality Deterioration for Ammonia

A percentage deterioration assessment was conducted at the Chertsey WwTW mixing point to determine the impact on the water quality if the ammonia permit was set to the 1mg/l 95%ile permit limit and the results are summarised below.

	Mixing Point Quality (90 percentile Ammonia mg/l)	Percentage Deterioration
Current WwTW flow	0.31	-
1mg/l 95%ile permit limit with current flow	0.37	19.35%
1mg/l 95%ile permit limit with future flow (up to 2031)	0.39	25.8%

Appendix D Reason for Alternative Objective

Where certain conditions apply and are met then alternative WFD objectives have been set by the Environment Agency for water bodies; these involve taking an extended time period to reach the objective or meeting a lower status or a combination of both. In some water bodies it is recognised that time constraints on putting actions in place, or the time taken for the environment to respond once actions are implemented, mean that the objective will only be achieved over more than one river basin management planning cycle. An objective of less than good status is set where:

- there is currently no solution to the problem;
- the costs of taking action exceed the benefits; and/or
- background conditions in the environment mean achieving good status is not possible.

D.1 Justification for alternative Ecological Status Objective

Section 5.3.4 of the Thames River Basin District RBMP Part 2[28] sets out the specific circumstances for the particular elements and the justification behind the alternative objective. The individual sub-elements and the alternative objectives for the Chertsey Bourne (GB106039017070) waterbody are set out below.

The reason the alternative objective has been set is described as '**Technically infeasible – No known technical solution is available'**.

The explanation for the use of this exemption, as detailed in Table 6 of the Thames RBMP is provided below.

Natural barriers to fish migration sometimes result in fish being classified at less than good status in a water body. In these situations there is no technical solution to the fish failure since natural barriers do not require removal or easement and a less stringent objective is set under Article 4(5).

[28]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500573/Part_2_River_basin_management_planning_process_overview_and_additional_information.pdf

Appendix E Reasons for Statutory Site Designations

E. 1 South West London Water Bodies SPA and Ramsar

The South-West London Water Bodies SPA and Ramsar comprises a series of embanked water supply reservoirs and former gravel pits that support a range of man-made and semi-natural open water habitats. The reservoirs and gravel pits function as important feeding and roosting sites for wintering wildfowl, in particular Gadwall *Anas strepera* and Shoveler *Anas clypeata*, both of which occur in numbers of European importance.

This site qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

Over winter;

a. Gadwall *Anas strepera*

b. Shoveler *Anas clypeata*

E.2 Thorpe Park No. 1 Gravel Pit SSSI

Thorpe Park No. 1 Gravel Pit is a former gravel pit which has now matured to a relatively stable ecological state, the banks being almost entirely dominated by trees and shrubs. The site also supports a number of other species of wintering waterfowl including goldeneye *Bucephala clangula* and smew *Mergus albellus* which occur regularly in small but significant numbers.

The site is of national importance for wintering gadwall and overlaps designations with the South West London Waterbodies SPA and Ramsar site.

E.3 Chertsey Meads LNR

Chertsey Meads is an open area of remnant floodplain meadow on the banks of the River Thames.

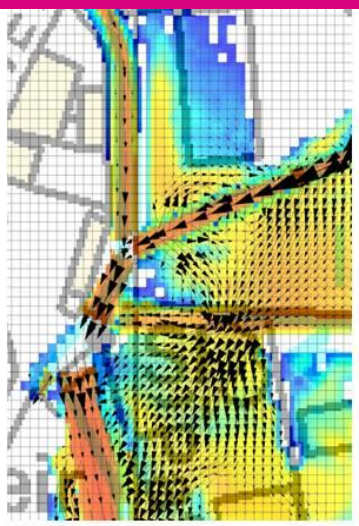
Over 400 species of plants have been recorded, including flowers, grasses and sedges. 108 species of bird have been recorded including lesser whitethroat Sylvia curruca, reed bunting Emberiza schoeniclus and sedge Acrocephalus schoenobaenus and reed warbler Acrocephalus scirpaceus. Some of the flowering plant species found in the grassland are unusual due to calcium carbonate that has been deposited onto the site when the Thames has flooded. These unusual plants, which are usually found in chalk grassland, including meadow cranesbill Geranium pratense.

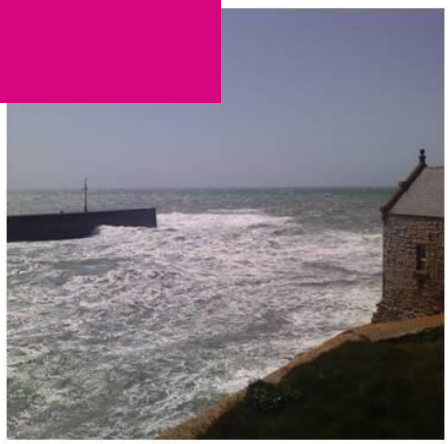
Appendix F FEH Calculation Workbook

AECOM FEH Calculation Workbook

Version 1.38

February 2018





Flood Estimation Calculation Record

This document is a supporting document to the Environment Agency's flood estimation guidelines. It provides a record of the calculations and decisions made during flood estimation. It will often be complemented by more general hydrological information given in a project report. The information given here should enable the work to be reproduced in the future. This version of the record is for studies where flood estimates are needed at multiple locations.

Revision Record

Version	Status	Issue Date	Prepared By	Checked By	Approved By
1	Draft	14/02/2018	Helen Harfoot Principal Hydrologist		

AECOM
Royal Court
Basil Close
Chesterfield
S41 7SL

Project contact: Katie.Pearson@aecom.com

Limitations

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken in February 2018 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

AECOM disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to AECOM's attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report.

Subject Sites

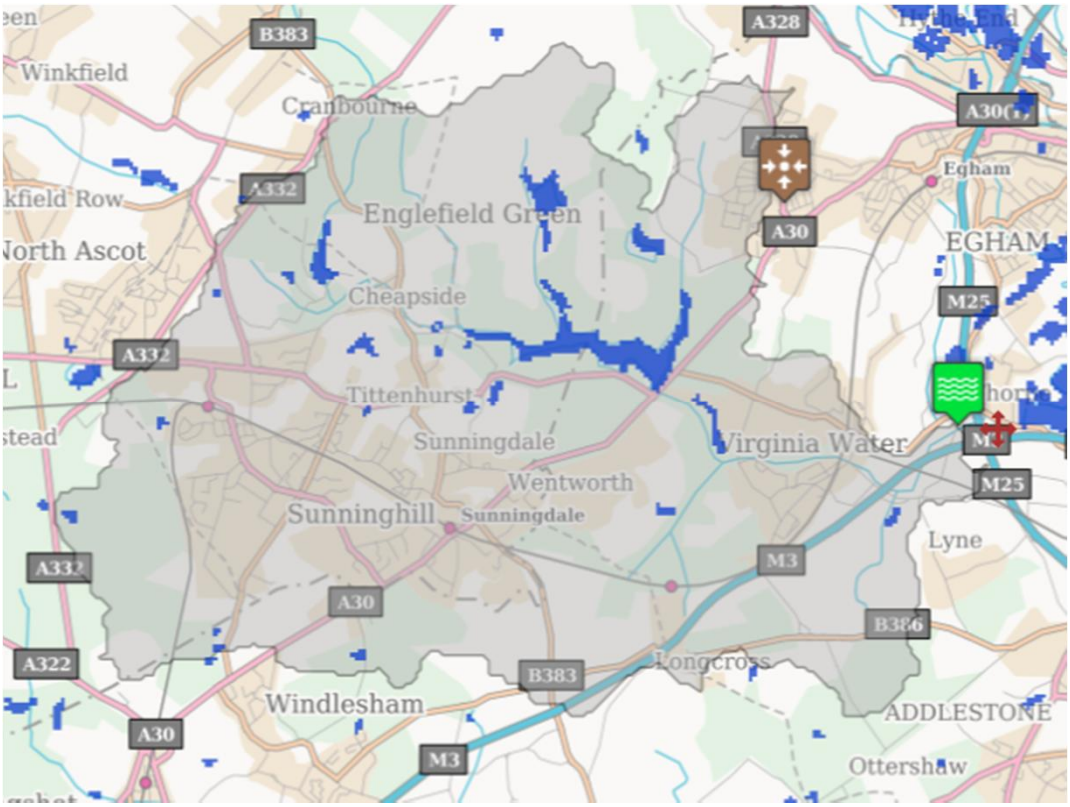
Site Locations

No.	Site Reference Code (12 character maximum)	Site Description	Easting	Northing	AREA	AREA (MODIFIED)
1						
2	Chertsey STW		501500	168000	59.6875	59.6875
3						
4						
5						
6						
7						

Comments

Subject Sites

Catchment Map



Site Catchment Descriptors (RAW DATA FROM FEH)

Descriptor	Subject Site						
		Chertsey STW					
Catchment X		501500					
Catchment Y		168000					
Centroid X		495872					
Centroid Y		168094					
AREA		59.69					
ALTBAR		58.00					
ASPBAR		86.00					
ASPVAR		0.19					
BFIHOST		0.57					
DPLBAR		8.79					
DPSBAR		35.80					
FARL		0.84					
FPEXT		0.07					
FPDBAR		0.51					
FPLOC		0.90					
LDP		15.62					
PROPWET		0.29					
RMED-1H		12.60					
RMED-1D		34.40					
RMED-2D		41.90					
SAAR		683.00					
SAAR4170		699.00					
SPRHOST		32.22					
URBCONC1990		0.52					
URBEXT1990		0.03					
URBLOC1990		1.08					
URBCONC2000		0.81					
URBEXT2000		0.10					
URBLOC2000		1.01					
C		-0.03					
D1		0.29					
D2		0.26					
D3		0.27					
E		0.31					
F		2.70					
C(1 km)		-0.03					
D1(1 km)		0.31					
D2(1 km)		0.26					
D3(1 km)		0.24					
E(1 km)		0.31					
F(1 km)		2.67					

Urban Expansion Factor (UEF) for URBEXT

Design Year	2015	URBEXT1990	1.076	URBEXT2000	1.0328785

Comments

Site Catchment Descriptors (MODIFIED FOR CALCULATIONS)

Descriptor	Subject Site						
		Chertsey STW					
Catchment X		501500					
Catchment Y		168000					
Centroid X		495872					
Centroid Y		168094					
AREA		59.69					
ALTBAR		58.00					
ASPBAR		86.00					
ASPVAR		0.19					
BFIHOST		0.57					
DPLBAR		8.79					
DPSBAR		35.80					
FARL		0.84					
FPEXT		0.07					
FPDBAR		0.51					
FPLOC		0.90					
LDP		15.62					
PROPWET		0.29					
RMED-1H		12.60					
RMED-1D		34.40					
RMED-2D		41.90					
SAAR		683.00					
SAAR4170		699.00					
SPRHOST		32.22					
URBCONC1990		0.52					
URBEXT1990		0.03					
URBLOC1990		1.08					
URBCONC2000		0.81					
URBEXT2000		0.10					
URBLOC2000		1.01					
C		-0.03					
D1		0.29					
D2		0.26					
D3		0.27					
E		0.31					
F		2.70					
C(1 km)		-0.03					
D1(1 km)		0.31					
D2(1 km)		0.26					
D3(1 km)		0.24					
E(1 km)		0.31					
F(1 km)		2.67					

Comments

Key

Modified Value

No modifications made to CDs. AREA and FARL look reasonable. Virginia Water sits upstream of 'The Bourne'. Assumed it is

Study Site Catchment Desciptors - Notes

Notes	Subject Site						
		Chertsey STW					
Is the catchment small (< 5 km2)?		NO					
Is the catchment permeable (SPRHOST < 20)?		NO					
Is the catchment urbanised (URBEXT > 0.03)?		YES					
Is the catchment flat (DPSBAR < 20)?		NO					
Is the catchment low lying (ALTBAR < 20)?		NO					
Is the catchment affected by lakes and reservoirs (FARL < 0.95)?		YES					

Comments

FEH Statistical

QMED Estimation (Study Sites) - Catchment Descriptors

QMED (rural)

Site Code	Area	FARL	BFIHOST	SAAR	SPRHOST	QMED (rural)	Rural or urban?
Chertsey STW	59.69	0.84	0.57	683	32.22	**3.55**	Urban catchment

QMED (urban)

Site Code	QMED rural	$URBEXT_{2000}$	PRUAF (Kjeldsen, 2010)	UAF (Kjeldsen, 2010)	QMED (urban)	QMED (design)
Chertsey STW	**3.55**	0.10	1.06	1.18	4.19	4.19

The guidelines recommend great caution in urban adjustment of QMED on catchments that are also highly permeable (BFIHOST>0.8). The adjustment method used in WINFAP-FEH v3.0.003 is likely to overestimate adjustment factors for such catchments. In this case the only reliable flood estimates are likely to be derived from local flow data.

Comments

AMAX estimated from daily mean flows gauged by the Environment Agency for ten hydrological years at a location immediately downstream of the assumed discharge location = 4.42 m^3/s. This estimateis slightly larger than the modelled urban estimate but will be used in preference to the modelled flow estimates.

Hydrological Year	AMAX (m^3/s)	Date
2006/07	5.83	20/07/2007
2007/08	4	03/06/2008
2008/09	8.65	10/02/2009
2009/10	5.61	28/02/2010
2010/11	2.37	18/01/2011
2011/12	3.35	11/06/2012
2012/13	4.84	25/12/2012
2013/14	6.18	01/02/2014
2014/15	2.96	23/11/2014
2015/16	3.45	11/01/2016
QMED	**4.42**	

FEH Statistical

Initial Pooling Group

	Pooling Group ID			Pool1		
	Site Code			TEST1		
Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
37013 (Sandon Brook @ Sandon Bridge)	0.5	49	8.35	0.318	0.14	0.517
42007 (Alre @ Drove Lane Alresford)	0.7	46	2.266	0.171	0.17	1.847
42009 (Candover Stream @ Borough Bridge)	0.8	44	1.056	0.303	0.407	2.376
41022 (Lod @ Halfway Bridge)	0.9	45	16.61	0.29	0.172	1.262
33054 (Babingley @ Castle Rising)	0.879	39	1.129	0.209	0.069	0.759
30004 (Lymn @ Partney Mill)	0.89	53	6.837	0.233	0.056	0.267
39042 (Leach @ Priory Mill Lechlade)	0.924	43	3.194	0.193	0.055	0.758
205005 (Ravernet @ Ravernet)	0.984	43	14.731	0.211	0.31	1.157
26003 (Foston Beck @ Foston Mill)	1.002	55	1.718	0.249	0.012	0.846
33032 (Heacham @ Heacham)	1.027	47	0.453	0.311	0.109	0.58
20007 (Gifford Water @ Lennoxlove)	1.036	42	16.895	0.328	0.199	0.631
Total		506				
Weighted means				0.256	0.154	

Legend

Sites Not OK for Pooling	
Sites Not OK for Pooling or Qmed	
Discordant Sites	
Short Record	

Comments

37013 - retain
- Good fit to SAAR, FARL and AREA
- Rating scattered

42007 - remove
- Baseflow dominated, station 2nd in pooling group not good fit for subject site.
- Strong positive trend in AMAX

42009 - remove
- Baseflow dominated, station 2nd in pooling group (once station above removed).

41022 - retain
- SAAR good fit

33054 - remove
- Baseflow dominated
- Scatter in flow gaugings about rating

30004 - retain
- Rating good fit to gaugings.
- BFIHOST = 0.568
- AREA and SAAR good fit

39042 - retain
- Baseflow dominate but responsive catchment.
- SAAR and AREA good fit

205005 - retain
- Catchment descriptors good fit - SAAR at higher end of acceptable range (946)
- Highly discordant site once additional sites added. AMAX1 is 3 x QMED. But looks plausible, correlates with known extreme rainfall event in August 2008. No reason to remove.

FEH Statistical

Revised Pooling Group

	Pooling Group ID			Pool1		
	Site Code			TEST1		
Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
37013 (Sandon Brook @ Sandon Bridge)	0.51	49	8.35	0.318	0.14	0.22
41022 (Lod @ Halfway Bridge)	0.855	45	16.61	0.29	0.172	1.402
30004 (Lymn @ Partney Mill)	0.89	53	6.837	0.233	0.056	0.585
39042 (Leach @ Priory Mill Lechlade)	0.924	43	3.194	0.193	0.055	1.093
205005 (Ravernet @ Ravernet)	0.984	43	14.731	0.211	0.31	2.979
26003 (Foston Beck @ Foston Mill)	1.002	55	1.718	0.249	0.012	0.742
33032 (Heacham @ Heacham)	1.027	47	0.453	0.311	0.109	0.503
20007 (Gifford Water @ Lennoxlove)	1.036	42	16.895	0.328	0.199	0.518
37016 (Pant @ Copford Hall)	1.038	51	7.47	0.289	0.081	0.402
36003 (Box @ Polstead)	1.059	54	3.935	0.304	0.087	1.072
36007 (Belchamp Brook @ Bardfield Bridge)	1.06	50	5.025	0.383	0.173	1.484
Total		532				
Weighted means				0.283	0.126	

Comments (Sites Removed)

FEH Statistical

Derivation of Flood Growth Gurves at Subject Sites

Site Code	Method	Name of Pooling Group (if not SS)	Distribution Used	Goodness-of-fit value	Parameters of Distribution		Growth factor for 100-year return period
Chertsey STW	P	Chertsey STW	Gen. Extreme Value	0.51	Location	0.844	2.633
					Scale	0.429	
					Shape	0.044	
					Bound	10.665	

Notes
Methods: SS – Single site; P – Pooled; ESS – Enhanced single site; J – Joint analysis
A pooling group (or ESS analysis) derived at one gauge can be applied to estimate growth curves at a number of ungauged sites. Each site may have a different urban adjustment, and therefore different growth curve parameters.
Urban adjustments to growth curves should use the version 3 option in WINFAP-FEH: Kjeldsen (2010).
Growth curves were derived using the revised procedures from Science Report SC050050 (2008).

Comments

FEH Statistical

Growth Curve Fittings

Return Period	Site Code						
		Chertsey STW					
2		1					
5		1.467					
10		1.764					
25		2.125					
50		2.4					
100		2.6					
200		2.9					
500		3.2					
1000		3.4					

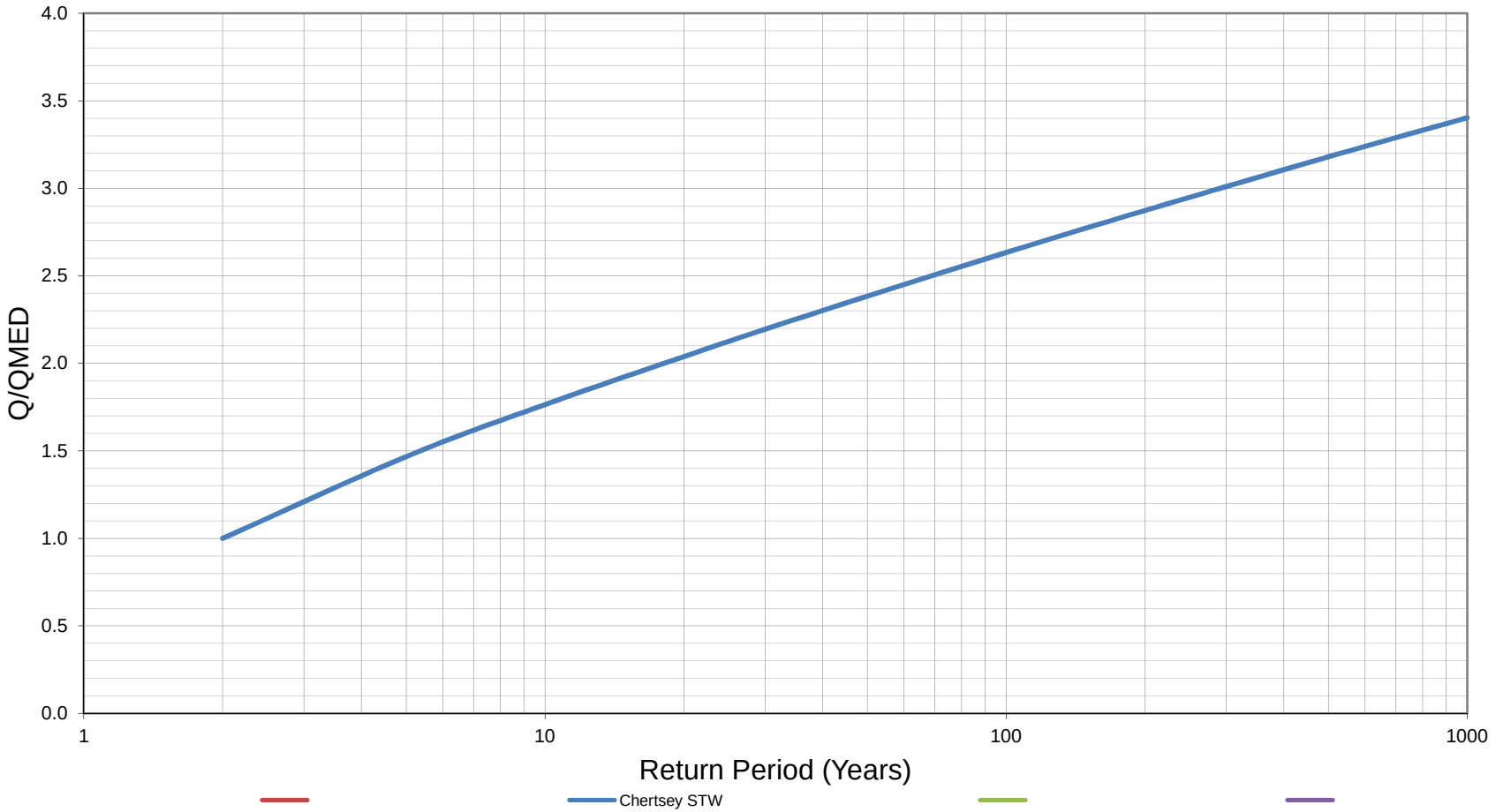
FEH Statistical

Fittings for Flood Frequency Curves

Return Period	Site Code						
		Chertsey STW					
2		4.42					
5		6.48					
10		7.80					
25		9.39					
50		10.5					
100		11.6					
200		12.7					
500		14.1					
1000		15.0					

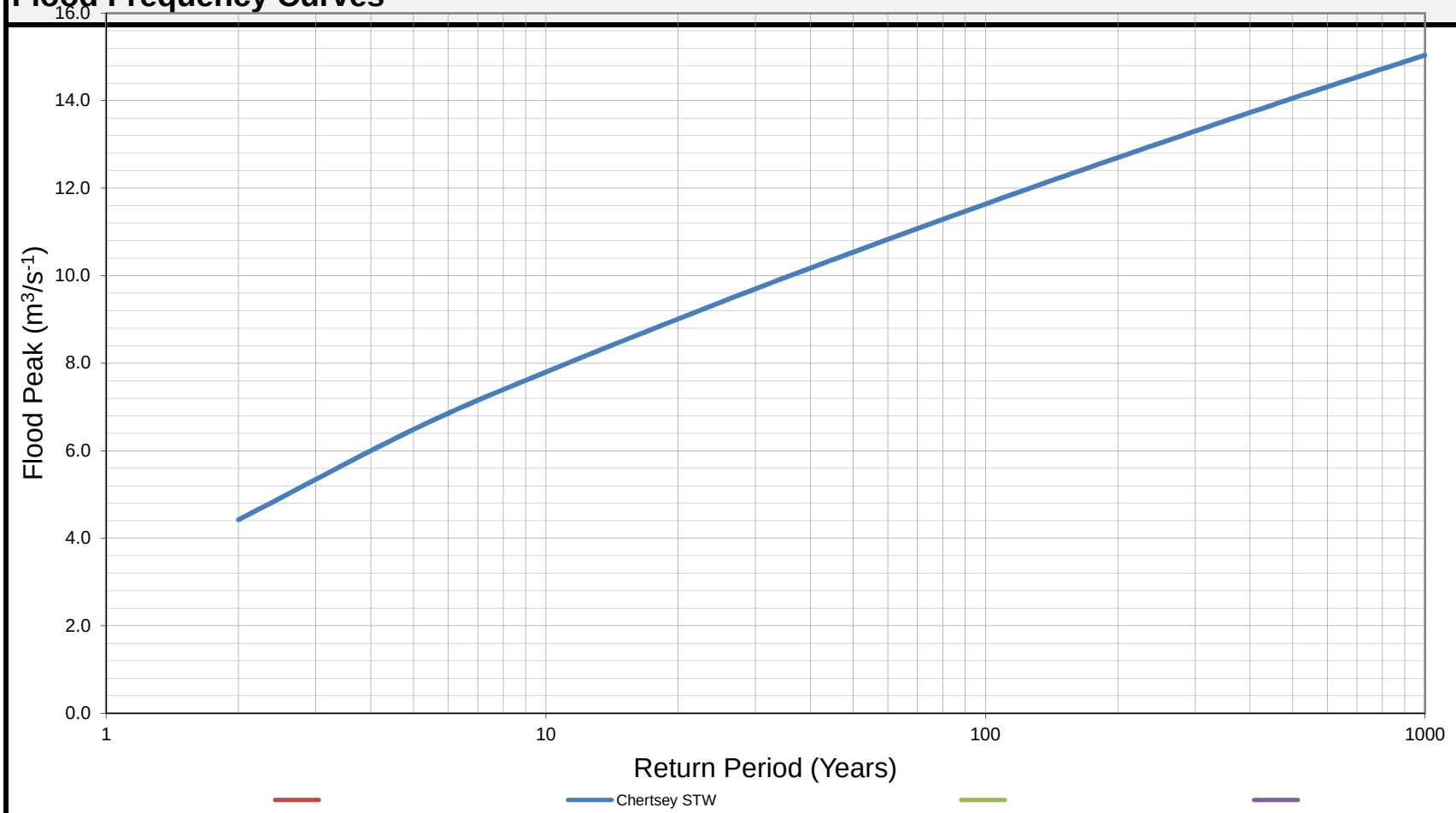
FEH Statistical

Growth Curves



FEH Statistical

Flood Frequency Curves



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