E2.31

ES Appendix 14.2 - Sustainable Drainage Strategy

Authored by Expedition

November 2025

THE CROWN ESTATE

East Hemel

East Hemel, The Crown Estate

DRAFT Sustainable Drainage Strategy

EHUK-EXP-XXX-XXX-RP-C-0301

November 2025 – For Outline Planning

expedition

Rev	Date	Reason for Issue	Author	Checked	Approved
00	05/08/2025	Draft for review	L Lester	A Garman	F Labbé
01	14/11/2025	For Planning	L Lester	A Garman	F Labbé

Contents

1 Introduction

This Sustainable Drainage Strategy has been prepared to accompany an Outline Planning Application for the East Hemel (EH) development. The Site comprises 356.8 hectares (ha) of land to the East of Hemel Hempstead. The Outline application is seeking consent for the following:

> *“Outline application for: urban extension comprising two new neighbourhoods and a new employment zone. The development to include new dwellings (including affordable housing and specialist accommodation for older people); new employment and industrial floorspace and ancillary facilities, a sports hub and Sports Pitches; green infrastructure and landscaping works*
>
> *(to include a country park, formal and informal open space, amenity space, Suitable Alternative Natural Greenspace, managed woodland, ecological areas); early years, nursery, primary and secondary education facilities; local centre uses (to include retail, community and employment uses; health and fitness, gym and other cultural and recreational uses; medical centre; transport mobility hubs; drainage works (including foul and surface water drainage infrastructure); ancillary infrastructure works; vehicular and active travel infrastructure; improvements to the Nickey Line and delivery of a proportion of the Hemel Garden Communities Green Loop; land for Gypsy and Traveller pitches; provision of an active travel bridge over the A414; safeguarded land for M1 Junction 8 improvements; ground remodelling, acoustic bund, engineering and demolition works. All matters reserved save for access from the A414/Green Lane junction and access from the B487/ Hemel Hempstead Road (Redbourn Road)”.*

The Proposed Development forms part of the Hemel Garden Communities (HGC) programme. This is an ambitious scheme which will transform and grow Hemel Hempstead and create attractive, sustainable new neighbourhoods to its north and east by 2050.

The HGC Programme area covers the town of Hemel Hempstead, within the borough of Dacorum, as well as proposed growth areas straddling both Dacorum and St Albans districts to the north and east of the town and wider movement routes beyond. The partnership is working to develop a strategic approach to ensure the homes, employment opportunities and new infrastructure will bring positive transformative to the whole town of Hemel Hempstead and the wider area.

This drainage statement has been developed in accordance with Hertfordshire County Council (HCC) guidance [1], the Lead Local Flood Authority (LLFA) and should be read in conjunction with the Flood Risk Assessment (FRA).

This document is organised as follows:

- Section 2 provides a description of the site characteristics;
- Section 3 summarises the existing drainage arrangement;
- Section 4 outlines the development proposals;
- Section 5 describes the proposed surface water drainage strategy;
- Section 6 describes the proposed foul drainage strategy; and
- Section 7 discusses operation and maintenance of the drainage system

2 Site Description

2.1 Existing Site Overview

The development site (the ‘Site’) shown in Figure 1 is located 1.7km east of Hemel Hempstead and directly west of the M1 Motorway, with the approximate centre at National Grid reference 509066 208141 as shown in Figure 1 below. The Site covers an area of approximately 356.8ha and is sub-divided into four areas:

- East Hemel (EH) North, comprising the area of the Site within draft SADC Local Plan allocation H2 East Hemel Hempstead (North). This comprises the part of the Site to the north of Punchbowl Lane and south of the B487 Hemel Hempstead Road;
- EH Central, comprising the area of the Site within draft SADC Local Plan allocation H3 East Hemel Hempstead (Central). This comprises the part of the Site to the south of Punchbowl Lane and to the north of the A414;
- EH South, comprising the area of the Site within draft SADC Local Plan allocation H4 East Hemel Hempstead (South). This comprises the part of the Site to the south of the A414 and north of the A4147 St Albans Road; and
- EH East, comprising the land to the east of the M1 motorway

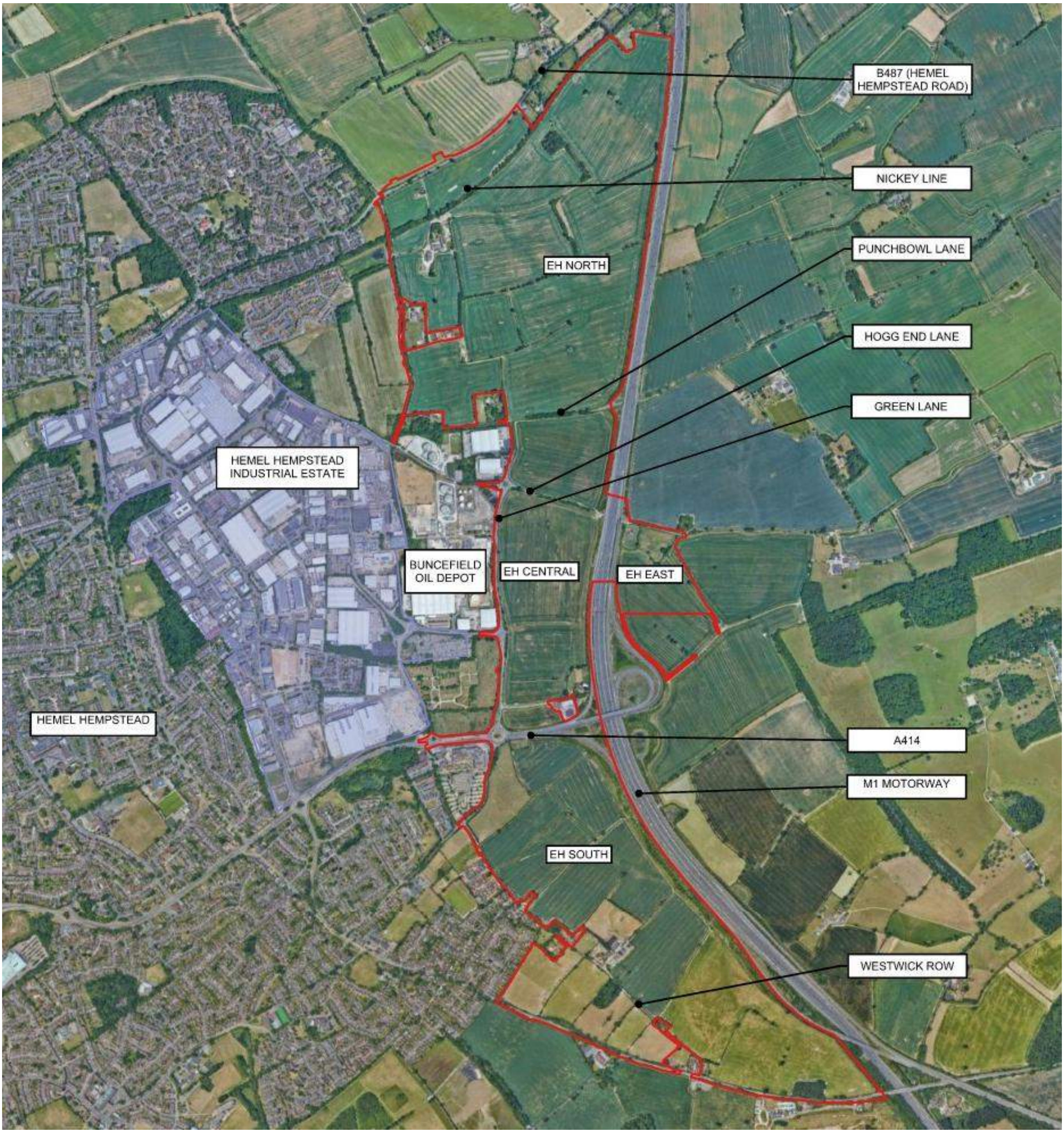


Figure 1: Site Location

2.2 Topography

A detailed topographical survey was undertaken in 2014 and 2019 by Wardell Armstrong and Kings Land Surveyors (Appendix A). The pre-development site levels can be summarised as follows:

- The EH North area generally falls from the south to the north towards the B487 Hemel Hempstead Road (Redbourn Road) with levels between 134mAOD and 106mAOD. The southern part of EH North between Punchbowl Lane and Hogg End Lane slopes to the south, with levels between 134 and 128mAOD.
- The EH Central area slopes in two directions with the high point of approximately 137mAOD down to 124mAOD in the north and 128mAOD in the south.
- The EH South area, slopes between 130mAOD to 126mAOD in the south-east through a low-lying valley running diagonally towards the M1 motorway. At the lowest point, the valley is approximately 111mAOD.
- The EH East area immediately to the east of the M1, has a high point of approximately 136mAOD and falls to the north, east and south. The approximate lowest point is at 124mAOD.The levels of the M1 slope down to the north from approximately 134mAOD to 106mAOD where it approaches the B487 Hemel Hempstead Road (Redbourn Road).

The A414 bisects the central part of the Site from east-west. This forms the ‘boundary’ between EH Central and EH South with levels between 128mAOD in the west to approximately 141mAOD in the east where it connects to the Junction 8 of the M1.

The B487 Hemel Hempstead Road (Redbourn Road) runs parallel to the northern boundary of EH North. The B487 Hemel Hempstead Road (Redbourn Road) is a complement to the major highway and A-roads within and around the Site providing a link between Hemel Hempstead and Redbourn. The levels slope down towards the east and range approximately between 121mAOD to 104mAOD.

Green Lane is located immediately to the west of the site of EH Central. Green Lane is a local route which slopes down towards the north with levels between 138mAOD and 127mAOD.

Punchbowl Lane is located within EH Central, forming the ‘boundary’ between EH Central and EH North. This road goes underneath the M1 via an underpass with levels sloping down from approximately 132mAOD in the west at Green Lane to 130mAOD in the eastern boundary of the Site.

Hogg End Lane is located within EH Central and serves as a local connection between the residential and light industrial area in the west and the agricultural land in the east. This road goes underneath the M1 via an underpass with levels sloping down from approximately 126mAOD at the roundabout to 121mAOD at the eastern boundary of the Site.

The Nickey Line bisects the site from east-to-west within the EH North area. This track slopes down to the east from approximately 114mAOD at the western edge of the boundary to 105mAOD in the east of the Site.

Westwick Row bisects EH South from northeast to southeast and serves as a local connection between the A4147 and the A414 roundabout. There is a local highpoint of approximately 128mAOD near ‘The Orchard’ property, approximately within the upper third of the road. Westwick Row slopes down either side of this local point. Levels in the north of Westwick Row are approximately 118mAOD and 122mAOD in the south.

A4147 forms the boundary of EH South and connects the residential and light industrial areas to the west of the Site to the communities in the east. The A4147 slopes down to the east from approximately 134mAOD from the southwestern boundary of the Site to 131mAOD at the eastern edge approaching the M1.

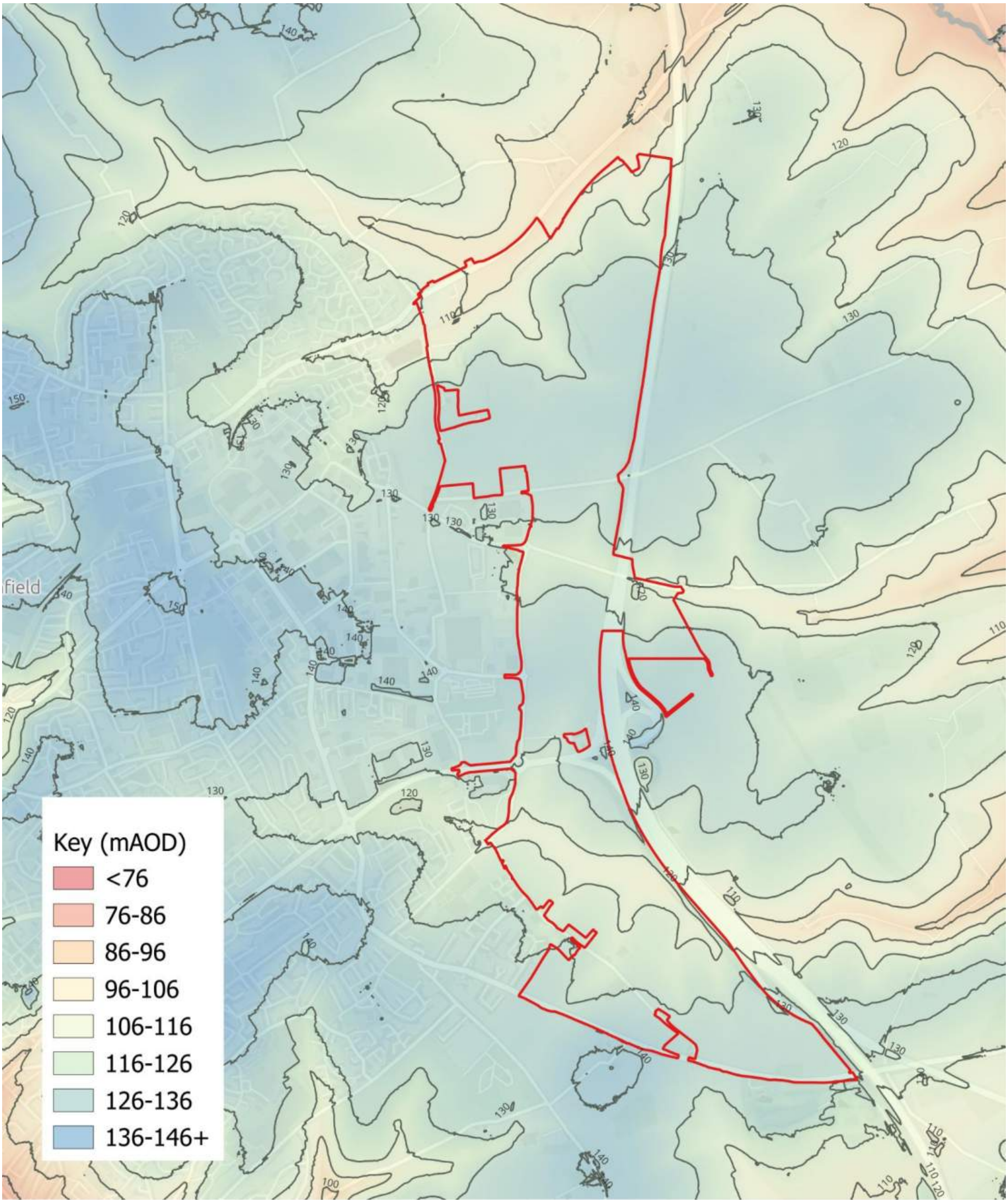


Figure 2: DEFRA LiDAR Mapping of existing topographic levels (2025)

2.3 Hydrology

The Site is currently within the River Colne Management Catchment and located approximately 3km west of the River Ver, and 3.3km east of the River Gade. The Site is located within the hydrological catchment of the River Ver. The River Ver is a protected river, fed by the chalk aquifer and is designated by the EA as a 'Main River' with a 'Moderate ecological status'. No permanent watercourses or rivers run through the Site.

2.4 Flood Risk

The EA surface water flood risk map (Figure 3) illustrates that there is a relatively low risk of flooding from surface water across the majority of the Site. The low-lying valleys, however, function as overland flow conveyance routes and are at risk of surface water flooding during intense rainfall events.

The Site is not formally developed, and mainly consists of agricultural fields, hedgerows and small woodlands and is therefore considered to be greenfield. The Site generally drains by infiltration though during intense storms, excess rainfall runs off to the base of the valleys creating temporary overland flow routes.

Leverstock Green, to the west of EH South, has had a number of historic flood events (2016 and 2020) understood to originate from Marchmont Pond (see Figure 5). Thames Water are responsible for managing the Marchmont Pond and are aware of these flooding incidents. The last recorded flood event associated with Marchmont Pond was October 2020, during Storm Alex, where the nearby Kings Copse development recorded significant flooding. It is understood that this was a 1:99-year storm event where the valve within Marchmont Pond was left open, which exacerbated downstream flooding. No recent flooding has been recorded since the valve has been closed.

The area along the northern Site boundary along the B487 Hemel Hempstead Road (Redbourn Road), has also had reported flooding associated with the existing stormwater drainage system. Thames Water are responsible for managing the Redbourn Reservoir adjacently west of EH North. Thames Water have indicated that they are aware of this known issue with anecdotal evidence following public engagement sessions indicating flooding along the B487 Hemel Hempstead Road (Redbourn Road) is believed to arise from the surcharge of the existing surface water sewer connected to the Redbourn Reservoir. The flooding could therefore be related to sewer capacity issues of the existing 375mm diameter pipeline connecting the reservoir to the outfall at the River Ver.

Given the localisation of these reservoirs and ponds, the risk generally associated with flooding from reservoirs has been deemed low across most of the Site by the EA and in the South-West Herts SFRA (2019). The risk associated with breach or failure is limited to the localised natural overland flow conveyance routes through the low-lying valleys. As outlined in the SFRA, all reservoirs are managed and maintained by Thames Water with dedicated emergency planning teams, response plans and mitigated by regular inspection and supervision by a reservoir panel engineer

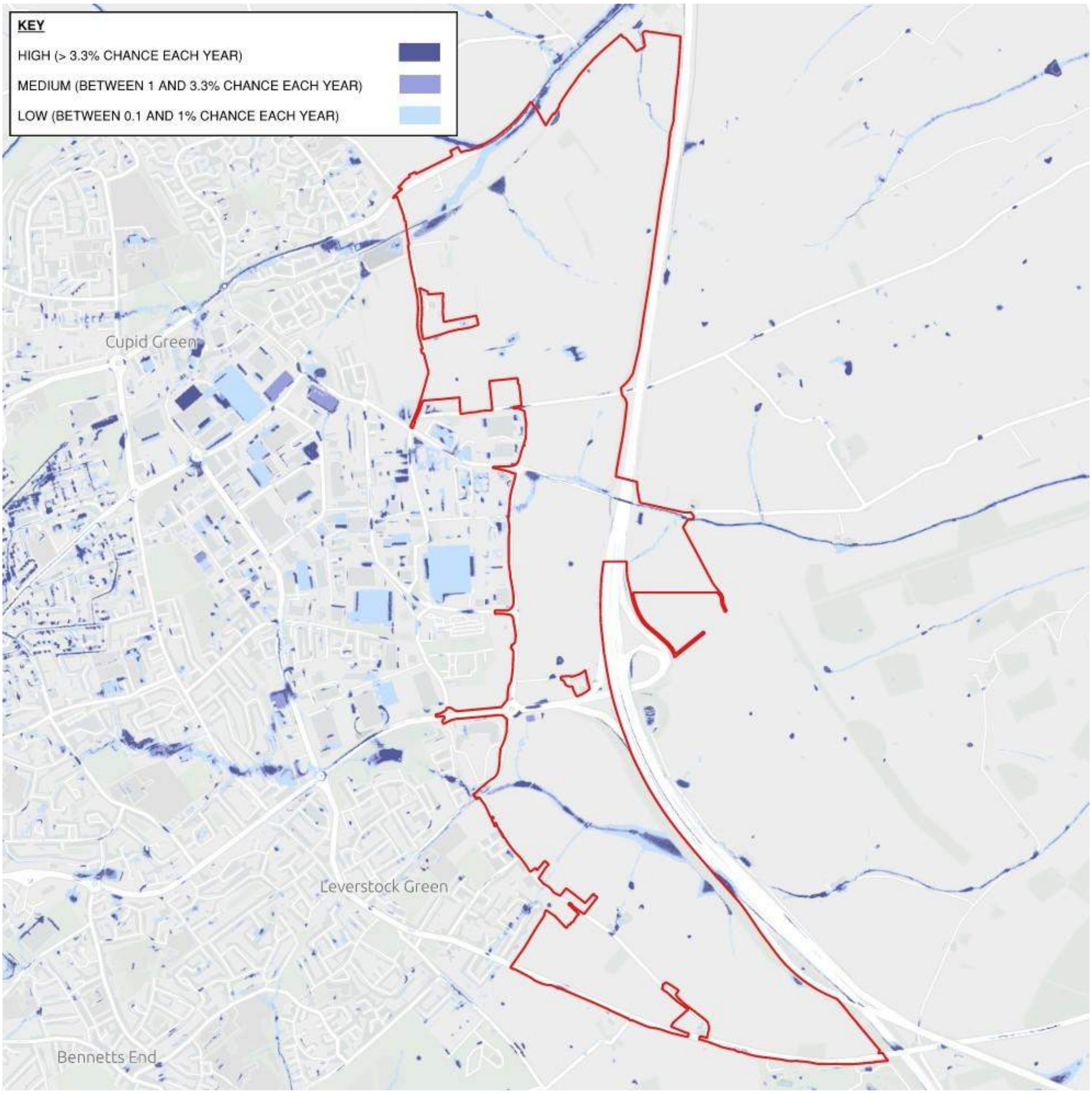


Figure 3: EA risk of surface water flooding without climate change effects [2]

2.5 Ground Conditions

The BGS map shows that the Site lies within three dry Chalk Valleys in proximity to the surrounding Chiltern National Landscape. This has been confirmed by historic geotechnical investigations, carried out on the Site to support previous development proposals. This includes investigations by Wardell Armstrong in 2014, 2017 and 2019. The factual report, prepared by CC on behalf of Wardell Armstrong in 2019, discusses key ground condition information (Appendix B).

The Site is generally found to be underlain by the Lewes Nodular Chalk and Seaford Chalk Formations. The superficial deposits beneath the Site consist of Clay-with-Flints Formation, described as a deposit formed from the dissolution, decalcification and cryoturbation of bedrock strata of the Chalk Group. The depth of the superficial deposits varies with the topography of the Site.

Superficial deposits from the Lambeth Group are also present across the Site, however the strata is not uniform above the chalk and appears to be deepest where the topographical elevation is higher. Figure 4 illustrates the geology of the Site and **Error! Reference source not found.** summarises the ground conditions.

Table 1: Ground Conditions (summarised by A-Squared from 2014 and 2017 Wardell Armstrong investigations)

Strata type	Depth from (m bgl)	Depth to (m bgl)	Thickness (m)
Topsoil	Ground level	0.10 to 1.20	0.10 to 1.20
Made Ground	Ground level	0.40 to 0.90	0.40 to 0.90
Superficial Deposits	0.10 to 1.20	0.80 to 13.00	0.50 to 12.80
Chalk	0.20 to 13.00	6.30 to 68.00*	1.80* to 50.90*
*Where base of superficial deposits encountered			

Groundwater levels identified in previous investigations and synthesised by A-Squared (Appendix D of the FRA) indicate that groundwater levels range from 84.6mAOD to 96.3mAOD with the groundwater depth generally increasing to the south and east. Contouring of groundwater elevations identified an easterly groundwater flow in the north and centre of the Site and a southeasterly flow in EH South.

In 2005 a major incident (fire and explosion) occurred at the Buncefield Oil Depot, immediately adjacent to the west of the Site. Following this incident, contamination was released from the oil depot site, which presented a risk to the underlying chalk aquifer. Contaminants included fuel hydrocarbons, BTEX compounds and contaminants originating from firefighting foam. In particular, the firefighting foams included Perfluoro-Octanesulfonic acid (PFOS). This is an environmentally persistent substance with no natural sources and has subsequently been banned.

Historic investigations have identified that ground and groundwater contamination related to PFOS is present within the Site, particularly near Buncefield in EH Central. The Environment Agency (EA) therefore consider the Site and its groundwater to be contaminated (Appendix C).

This, however, is evolving, with the extent of the groundwater contamination being investigated as part of ongoing geo-environmental investigations in 2025 forming part of the ongoing work to support the Proposed Development. The latest suite of groundwater investigations has been undertaken July 2025 with the suite of possible contaminants tested in line with the Drinking Water Inspectorate and best practice guidance and was agreed upon with the EA.

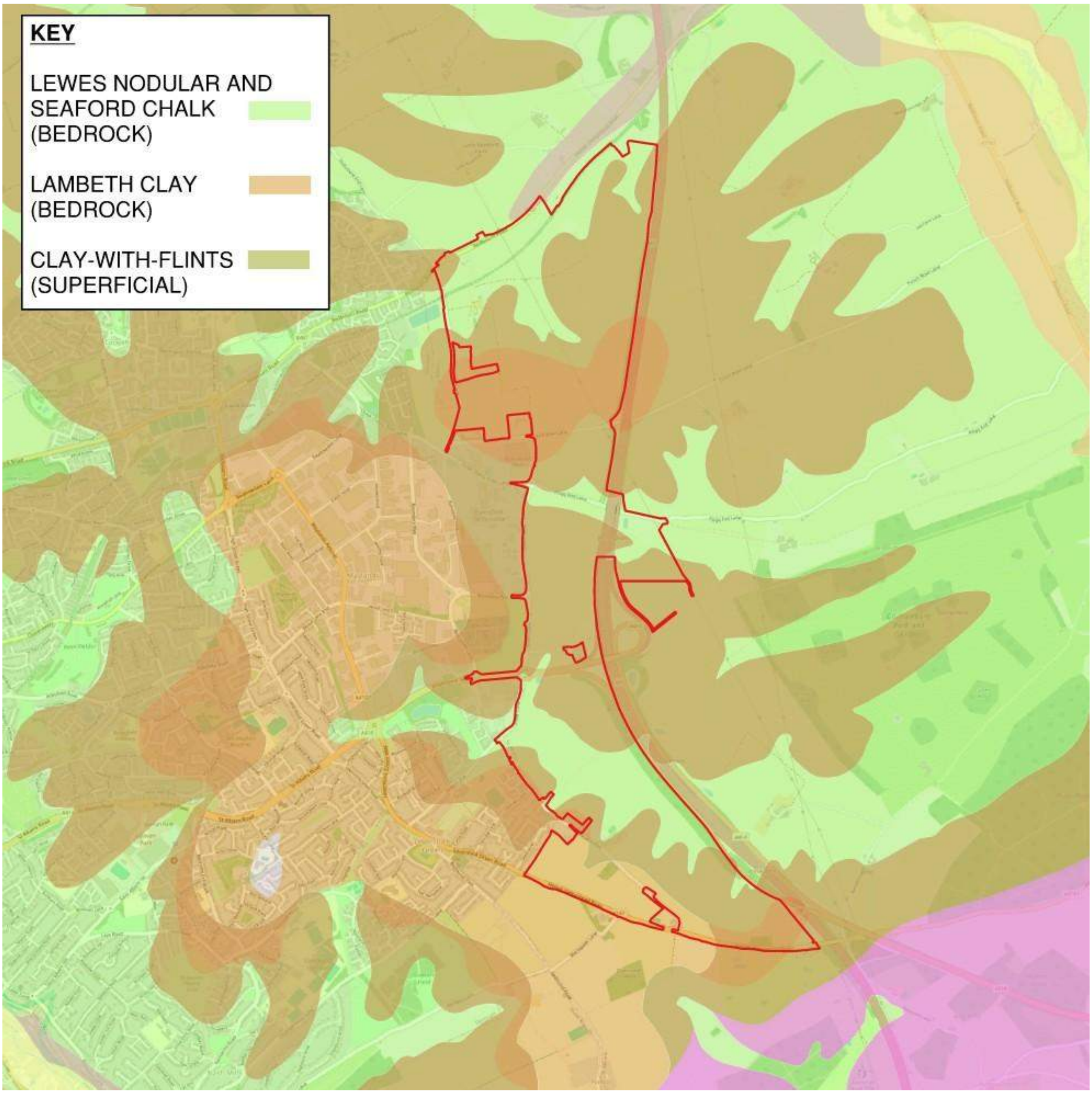


Figure 4: Bedrock and Superficial Geology Mapping [2]

3 Existing Drainage Arrangement

3.1 Overview

Our understanding of the existing drainage arrangement is based on a site visit, review of background information, in particular Thames Water asset records. We confirmed this understanding in a meeting with Thames Water on 8 January 2025 (Appendix D). The existing drainage arrangement is presented in Figure 5 and shown in more detail in Appendix E.

As discussed in Section 2.4, the Site is currently undeveloped and considered to be greenfield. It generally drains naturally via infiltration, though during intense storms excess rainfall runs off to the base of the valleys creating temporary overland flow routes.

In EH North, an existing 375mm diameter surface water sewer runs adjacent to the B487 Hemel Hempstead Road (Redbourn Road) which connects to Redbourn Reservoir and is understood to discharge to the River Ver. There is also a 375mm diameter surface water sewer in Three Cherry Lane draining the caravan park. These sewers connect to an 875mm and then 1200mm diameter sewer which discharge to the Redbourn Reservoir.

In EH South, an existing 375mm diameter surface water sewer which bisects the Site through the valley. This sewer collects stormwater runoff from existing housing developments to the west of the Site and passes beneath the M1 motorway, before discharging into the River Ver. This sewer also functions as an outlet for the Thames Water owned and operated Marchmont Pond, to the west of EH South.

In addition to the above, surface water runoff from the M1 motorway is managed through five balancing ponds adjacent to the eastern side of the M1. Surface water runoff from the A414 is managed through a local balancing pond to the south of the A414. These ponds are owned and managed by National Highways

These surface water sewers and balancing ponds are illustrated in Figure 5.

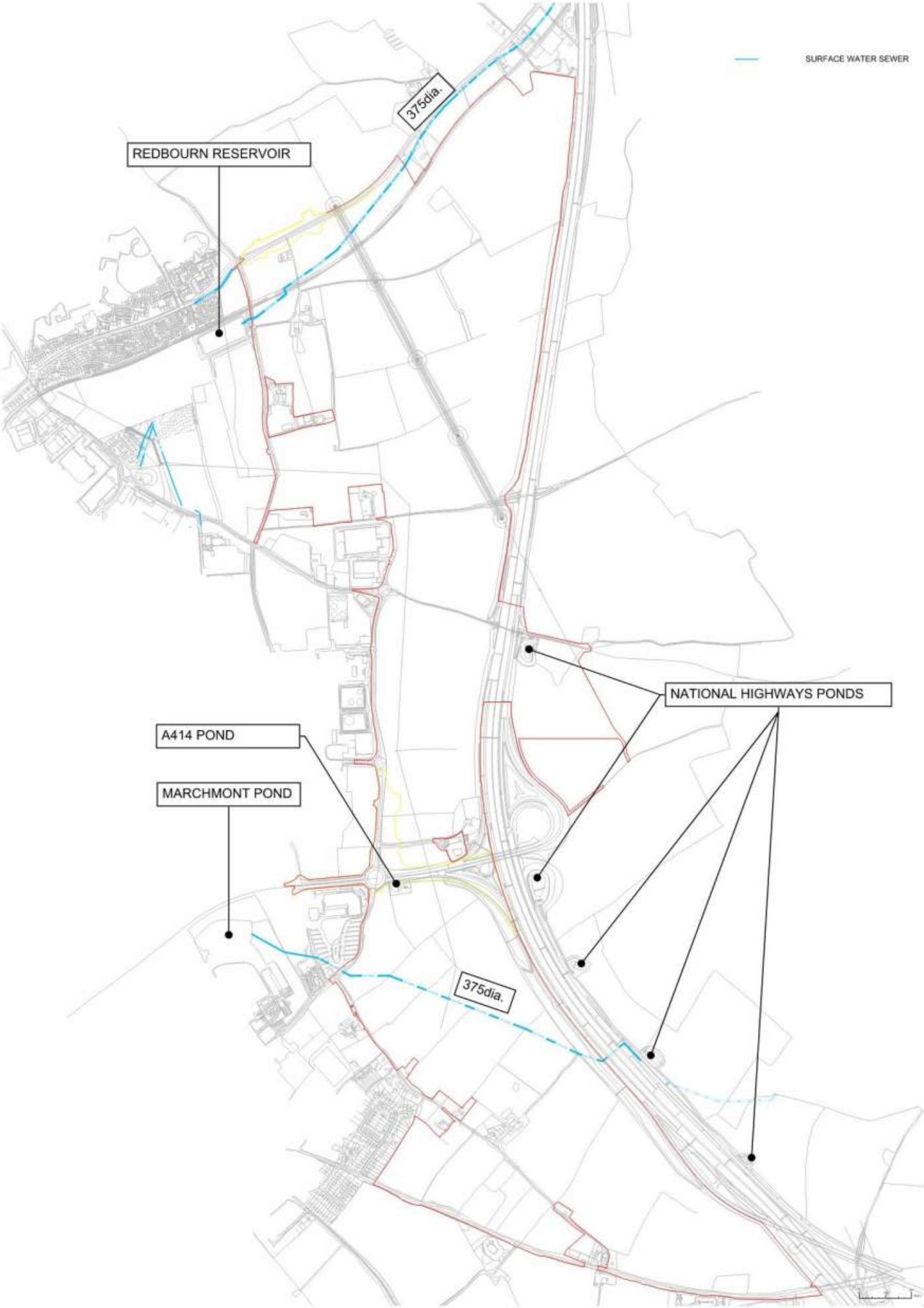


Figure 5: Existing Surface Water Network

There are no foul sewers within the Site but there is an existing Thames Water network to the west of the Site serving the surrounding residential and commercial buildings. This is illustrated, in part, by Figure 6. These range in size of pipework from 150mm diameters serving several smaller properties up to 450mm diameter main serving parts of Maylands Business Park. There is also an existing rising main connected to the pump station directly to the northwest of the Site (near the Nickey Line and Redbourn Reservoir off Hunters Oak Road).

Figure 6: Existing Foul Sewer Network

3.2 Existing surface water run-off rates

As the Site is currently mainly agricultural (i.e., undeveloped), the existing greenfield runoff rates have been estimated using the ReFH2 method for three large catchments. This was agreed with HCC, the LLFA, given the size of the Site and supports the estimation of both the greenfield runoff rate and volume. The three large catchments are:

- Catchment A – represents EH North
- Catchment B – represents EH Central
- Catchment C – represents EH South

The catchments are shown in Figure 7 and the associated proposed development areas of the above catchments are summarised in Table 2, below. The greenfield runoff rates have been calculated for the areas proposed for development.

Table 2: Site Catchment and areas proposed for development

Drainage catchment – Site Areas	Total surface area (ha)	Area proposed for development (ha)
A – EH North	146.5	44.35
B – EH Central	58.4	53.09
C – EH South	128.3	68.86

Given the scale of the Site, the catchment characteristics sourced from FEH Web (part of the Centre for Ecology & Hydrology data service) [4] for a single data point is not representative of the entire site.

The soil characteristics were therefore obtained specifically from the LandIS Site Soil Report (Appendix F). This approach has been agreed with HCC LLFA (Appendix G).

The specific BFIHOST19 values (a representative value of the area's responsiveness to storms and generated runoff based on soil type and permeability) used in the greenfield runoff calculation have been estimated by using a weighted average of BFIHOST 19 value for HOST (soil type) Class 18 and Class 1 present within the site. The resulting BFIHOST19 values are summarised in the table below.

Table 3: Subarea specific BFIHOST19 values

BFIHOST19 Determination			
HOST Class	**BFIHOST19 Value**	*These are the standard BFIHOST19 values associated with the different HOST soil classes*	
Class 1	0.949		
Class 18	0.492		
Catchment	**% Area in Class 1**	**% Area in Class 18**	**Resultant BFIHOST19**
A	18%	82%	0.572
B	0%	100%	0.492
C	2%	98%	0.499

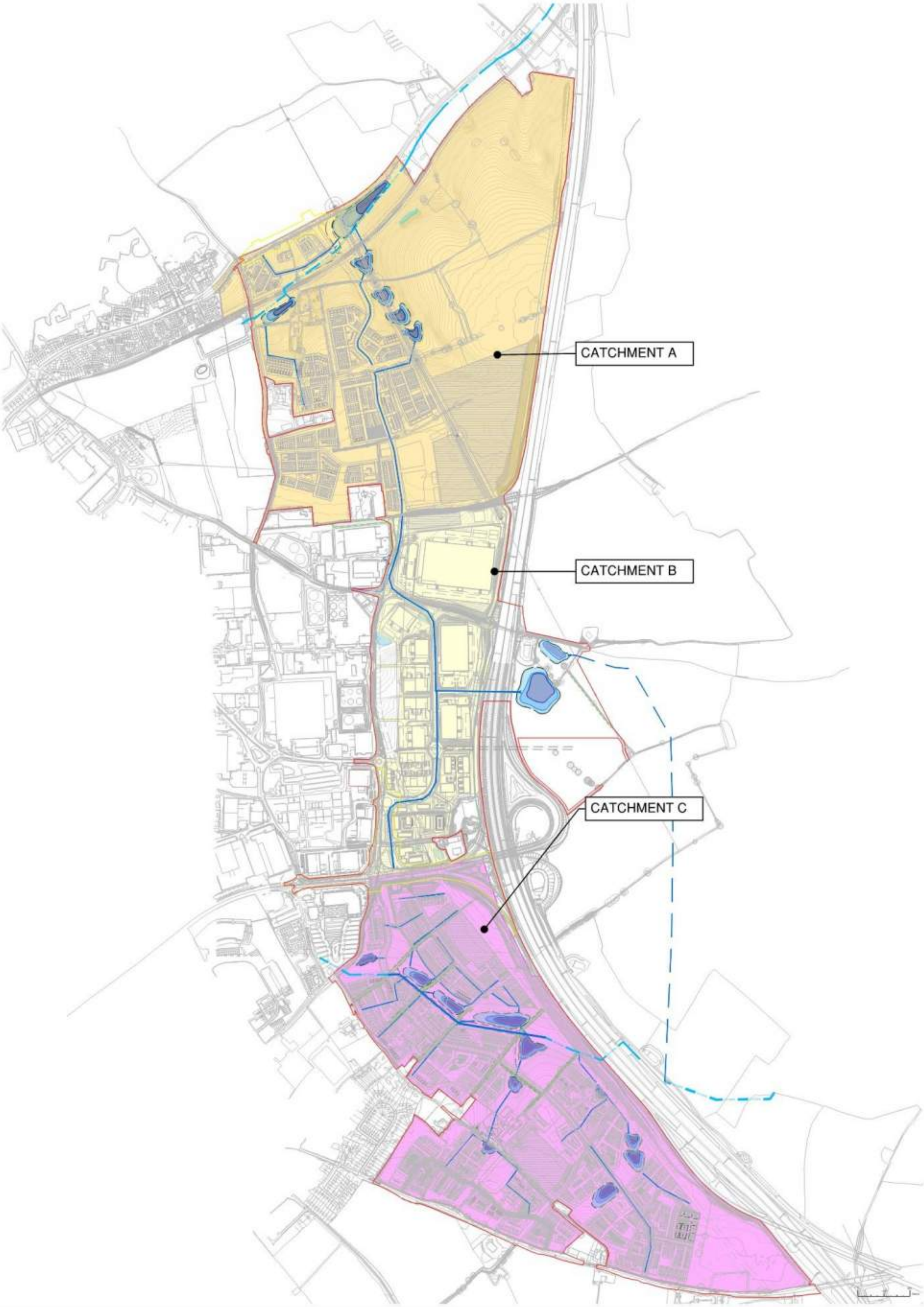


Figure 7: Proposed large drainage catchments

Table 4, below, summarises the greenfield peak runoff rates and volumes for the three catchments for different storm return periods, determined with the specific BFIHOST19 values with the ReFH2 software (full results included in Appendix H).

Table 4: Greenfield runoff rates and 1:100 6-hour storm volumes for large site catchments

Storm Return Period	Peak Runoff Rate (l/s)		
	Catchment A	Catchment B	Catchment C
Qbar	115.0	191.5	244.4
1 in 1 years	82.2	137.6	176.8
1 in 30 years	207.8	342.6	428.3
1 in 100 years	263.9	432.6	540.0
Greenfield volume for the 1:100 6-hour storm (m^3)			
1 in 100 years, 6-hour	4,600	7,000	8,800

4 Development Proposals

The Outline Planning Application is submitted in duplicate to St Albans City & District Council as the Local Planning Authority (LPA) for development falling within the District, and to Dacorum Borough Council as LPA for development falling within the Borough. The development components for which outline planning permission is sought (the Development) is as follows:

- All matters (Access, Appearance, Landscape, Layout and Scale) are reserved for future determination, save for access from the A414/Green Lane junction and access from the B487/ Hemel Hempstead (Redbourn Road).
- Up to 4,000 new dwellings (Class C3) including up to 640 elderly care / extra care units (Class C2 residential institutions) and 16 supported living units.
- Up to 190,600 sq.m of Employment Use including up to 54,500 sq.m Business and Research & Development (Class E(g)); and up to 104,250 sq.m Distribution (Class B8); and up to 31,850 sq.m Mixed Industrial Uses (Class B2 / Class E(g)(iii)).
- Three Primary Schools (Class F1) incorporating Early Years provision on sites of 2.03ha per 2FE school site, and 2.92ha per 3FE school site (up to 7.87ha in total).
- Secondary School (Class F1) for up to eight forms of entry on a site of not more than 10.78 hectares.
- Up to 2,000 sqm in total of Community Uses (Classes F1 and F2) including community centres and meeting places, library use, places of worship and other community facilities.
- Up to 2,300 sqm of health care services (Class E(e) including medical and dental services.
- Up to 18.8ha for a Sports Hub and Sports Pitches including up to 3,400 sqm in total of sports hub uses in Class E(d). Up to 775 sqm health and fitness, gym and other cultural and recreational uses in Class E(d).
- Up to 525 sqm nursery uses in Class E(f).
- Up to 76.8 ha of Suitable Alternative Natural Greenspace (SANG).
- Green infrastructure and landscape works to include a country park, formal and informal open space, including natural / semi-natural open space, parks & gardens, amenity space, managed woodland, ecology areas and links including mitigation works, green corridors, outdoor sports facilities including changing facilities, play areas, allotments and associated lighting and infrastructure.
- Mobility hubs.
- An active travel (pedestrian and cycle) bridge over the A414
- Vehicular and active travel access points and connections to the surrounding highway
- Vehicular and cycle parking including electric vehicle charging points.
- Pedestrian, cycle, equestrian, vehicle and bus routes, with associated bus stops, crossings, street furniture and lighting.
- Improvements to existing Public Rights of Way

- Improvements to the Nickey Line through the site. Delivery of the Hemel Garden Communities (HGC) Green Loop through the site.
- Land for up to 40 Gypsy and Traveller pitches.
- Safeguarded land for M1 Junction 8 improvements
- Engineering works including ground remodelling
- Creation of bunds (incorporating acoustic fencing) adjacent to the M1 motorway.
- Any necessary demolition of existing buildings.
- Retention of and improvements to listed buildings (subject to separate Listed Building Consent).
- Infrastructure works (comprising energy/utilities provision and diversions as necessary).
- Drainage works including foul drainage infrastructure, sustainable drainage systems and multi-function stormwater attenuation features

The inset figure illustrates the Proposed Development areas and Parameter Plans included in Appendix C of the Flood Risk Assessment.

The highways layout for the accesses from the A414/Green Lane and B487/Hemel Hempstead Road (Redbourn Road) are submitted at this stage for approval. Landscape and drainage detail will be conditioned for both these junctions.

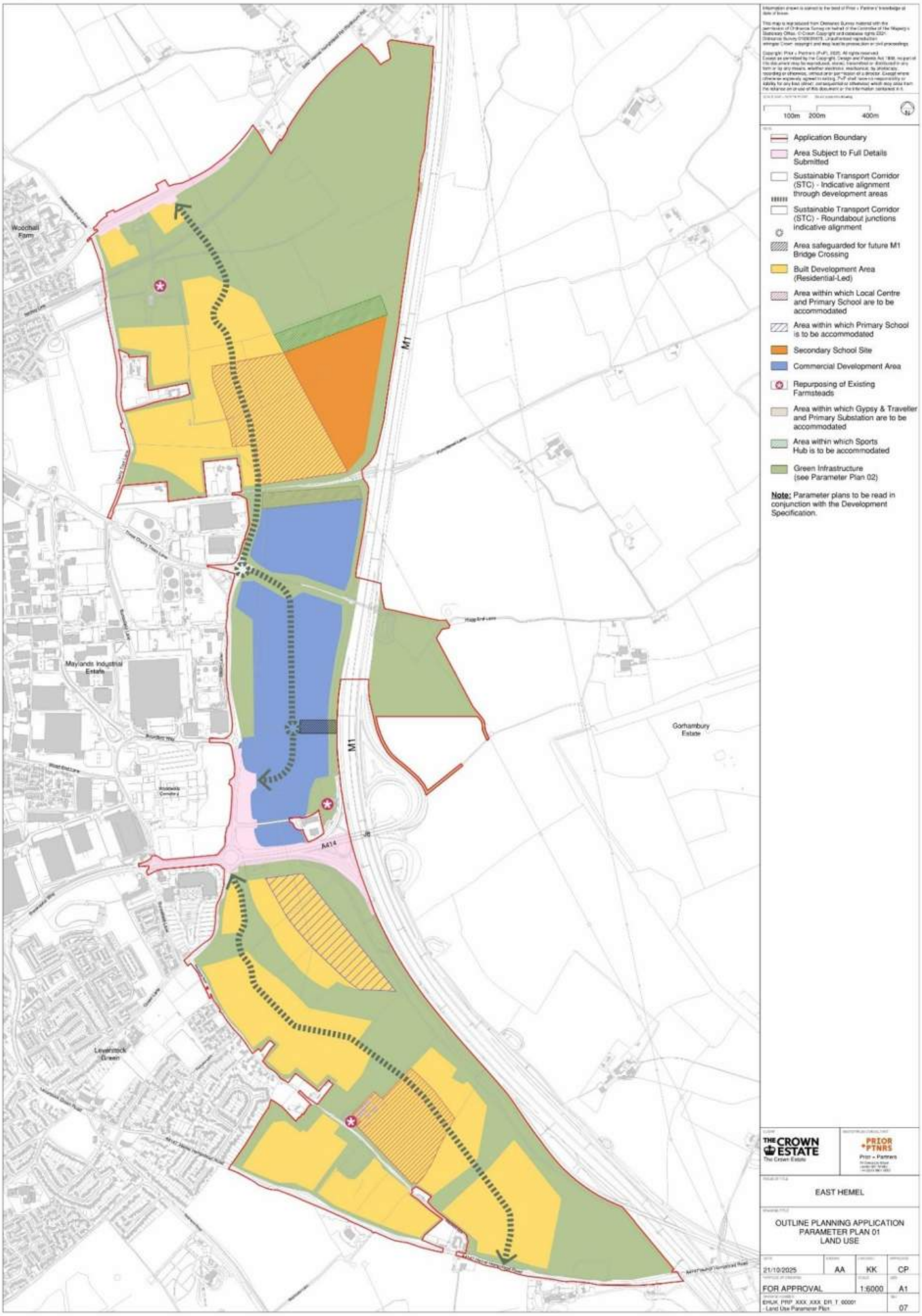


Figure 8: Land Use Parameter Plan

5 Surface Water Drainage Strategy

5.1 Strategic Principles

Key strategic aims and principles for the development of this sustainable drainage strategy have been agreed with Hertfordshire County Council (HCC), the Lead Local Flood Authority (LLFA), the Environment Agency (EA) and Thames Water (TW). Relevant minutes of consultation meetings are included in Appendices C, D, and G.

The sustainable drainage strategy is proposed to be integrated with the landscape and green infrastructure strategies, with climate resilience at its heart. The strategy is illustrated in Figure 10, and shown in the drawings included in Appendix I.

This strategy has been developed in line with the following strategic principles:

- Adopting the most sustainable disposal route for surface water drainage flows, in line with the drainage hierarchy set out in the SUDS Manual (C753) [5]
- Implementing a resilient approach to flooding considering the effects of climate change and reducing the risk of off-site flooding, in line with BS EN 752, the National Planning Policy Framework (NPPF) and National Planning Guidance (NPG).
- Control pollution and manage water quality to minimise any impact on the receiving water environment in line with SUDS Manual (C753) best practice. This shall include the integration of SUDS in the fine grain of the masterplan through source control measures along streets and development parcels to reduce runoff and intercept diffuse urban pollutants at source.
- Managing stormwater in efficient multi-function stepped attenuation ponds nested in hollow of valleys with a minimal impact on earthworks whilst enhancing biodiversity and amenity in line with SUDS Manual best practice.
- Consideration of extreme events and existing overland flow routes, in line with National Policy Guidance [8], and BS EN 752.
- Water circularity to minimise footprint on scarce water resources, including exemplar water efficiency and weather-controlled smart harvesting of rainwater

5.2 Disposal and Drainage Hierarchy

The SUDS Manual CIRIA C753 [5] defines the following drainage hierarchy in order of preference: infiltration to the maximum extent that it is practical, where it is safe and acceptable to do so; discharge to surface waters; discharge to surface water sewers; and discharge to combined sewers, as last resort.

Given the nature of the ground with generally poor infiltration potential, the risk of mobilising ground contaminants following the Buncefield Oil Depot incident (see Section 2.5), and the risk of dissolution features, ‘concentrated’ infiltration is not proposed as the preferred disposal route.

The potential use of deep bore soakaways has also been discarded. Though this would achieve better infiltration rates, the risk of contaminating the aquifer and causing dissolution is considered high. This was agreed with the EA and the LLFA (Appendices C and G, respectively).

Sitewide infiltration testing was conducted June 2025 (Appendix J), concluding varied infiltration rates ranging from favourable rates of 3.06×10^{-5} m/s in the north to poorer rates of 1.93×10^{-6} m/s in the south. Across the Site, 11 of the 27 infiltration tests failed due to pit collapses or slow soakage rates further indicating generally poor infiltration across the Site.

However, a number of source control measures including soft landscape, bio-retentions, bio-swales and permeable surfacing will dispose of some of the rain falling on the Site to ground. ‘Diffuse infiltration’, where rain falling on a catchment permeates through the ground, mimics the current condition, does not present a significant risk of mobilisation of ground contaminants and dissolution features. It is also less dependent on high infiltration rates than soakaway infiltration. The inclusion of such source control measures within the sustainable drainage strategy was agreed in principle with the EA.

There are no existing surface water features on the Site. On this basis, it is proposed that all surface water flows will be discharged to the River Ver, approximately 3km to the east of the Site via the existing Thames Water surface water sewer network.

5.3 Drainage system and catchments

The Site has been split into three large catchments (Figure 7) which have been further sub-divided based on the development proposals and phasing. The sub-catchments are shown in Figure 9 and are as follows:

Catchment A – Northern Residential A and B

Catchment B – Central Commercial

Catchment C – Southern Residential C, D, E, F and G.

The sub-division of the three large catchments was largely determined by the development phasing but also aligns with the Site levels strategy and is constrained by key barriers such as the A414, and the proposed Sustainable Transport Corridor (STC).

Multi-function, cascading open water attenuation ponds nested in the valleys will attenuate stormwater runoff before discharge to the existing surface water sewers. These ponds will include permanent water to enhance their landscape quality and support a varied range of ecological habitats.

Source control measures along street corridors and within development parcels will also play a key role in the control of pollution and mitigation of site runoff at source. The local Highway Authority have confirmed that they will be prepared to adopt SUDS along streets.

New primary surface water sewers will run along the STC and main roads. This will be designed to adoptable standards and will be offered to Thames Water for adoption. Minimum Thames Water stand-off distances between sewers and buildings will be maintained.

A new drainage connection will be installed under the M1, from Catchment B to the attenuation ponds to the east of the motorway. This will be installed by micro-tunnelling and has been agreed in principle with National Highways and Thames Water (Appendices J and D, respectively).

The drainage network will also include secondary runs along other streets, also designed to adoptable standards and offered for adoption.

Tertiary runs within development parcels will remain private.

All attenuated surface water will be discharged to the River Ver through the existing Thames Water 375mm diameter sewer to the north in the B487 Hemel Hempstead Road (Redbourn Road) and existing 375mm diameter sewer in the south, running across the M1. Catchment B will be connected to the Thames Water network through a strategic requisition, indicated by the dashed line in the inset figure.

The existing 375mm diameter sewer running in the south of the site will be diverted to accommodate the proposed attenuation ponds.

Additional to the strategic attenuation ponds and source control measures, there is an intention to provide a separate wild swimming pond in the Country Park of EH North for amenity use. This pond, if implemented, would include a nature-based filtration system topped-up by harvested and treated stormwater runoff. It is not, however, part of the sustainable drainage attenuation capacity.

Schematic drawings of the proposed drainage system for the three areas are included in Appendix I.

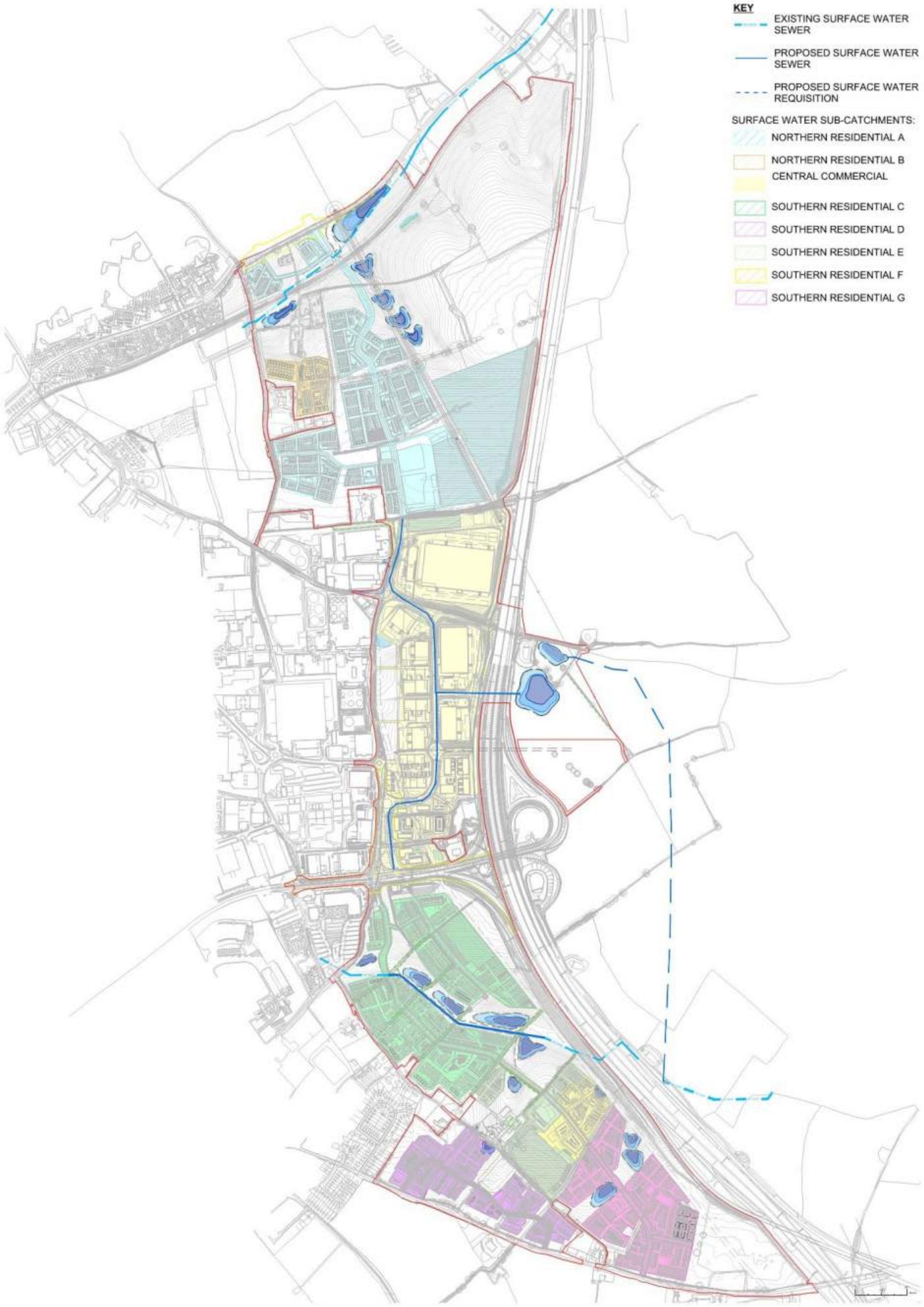


Figure 9: Proposed surface water sub-catchments

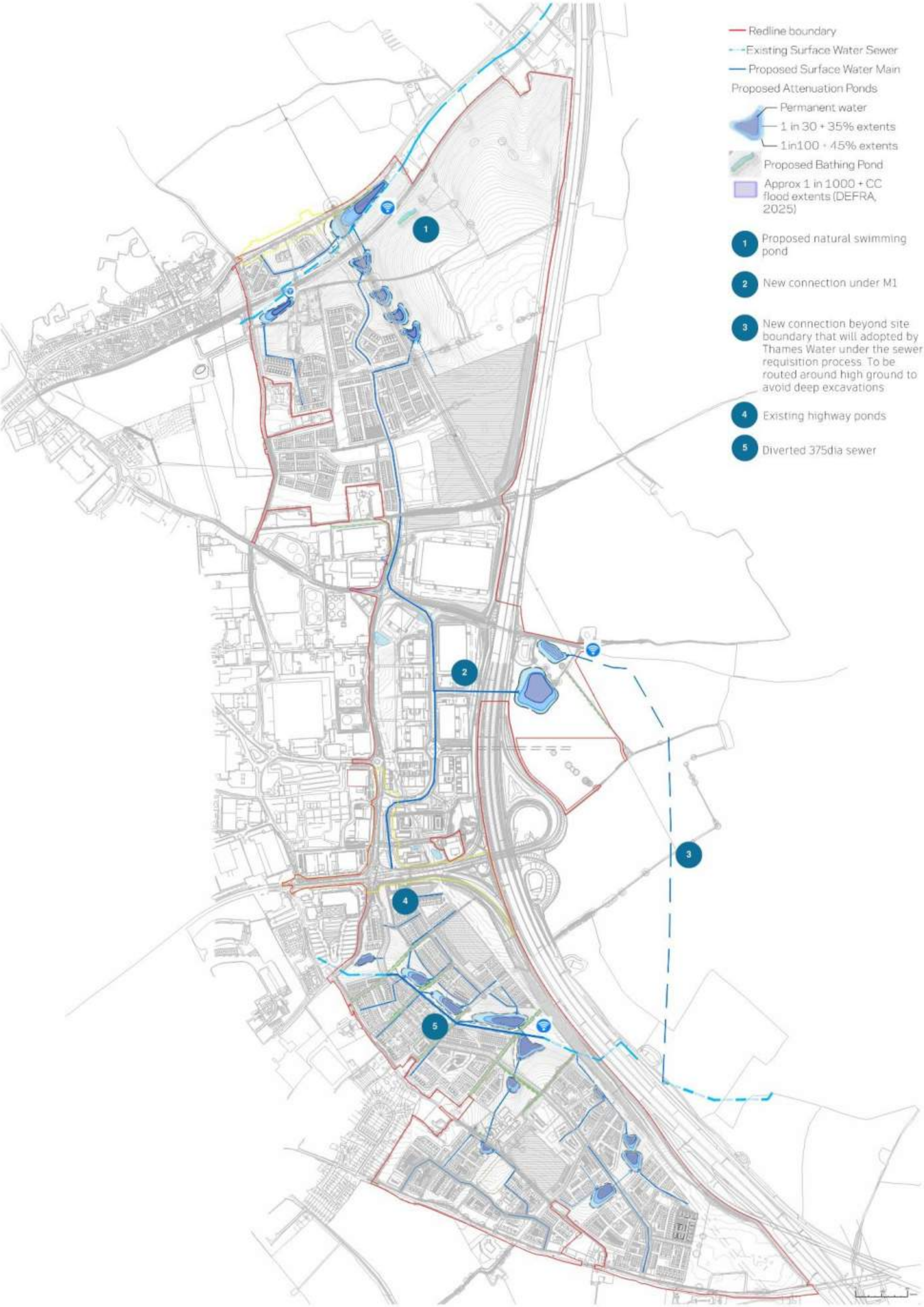
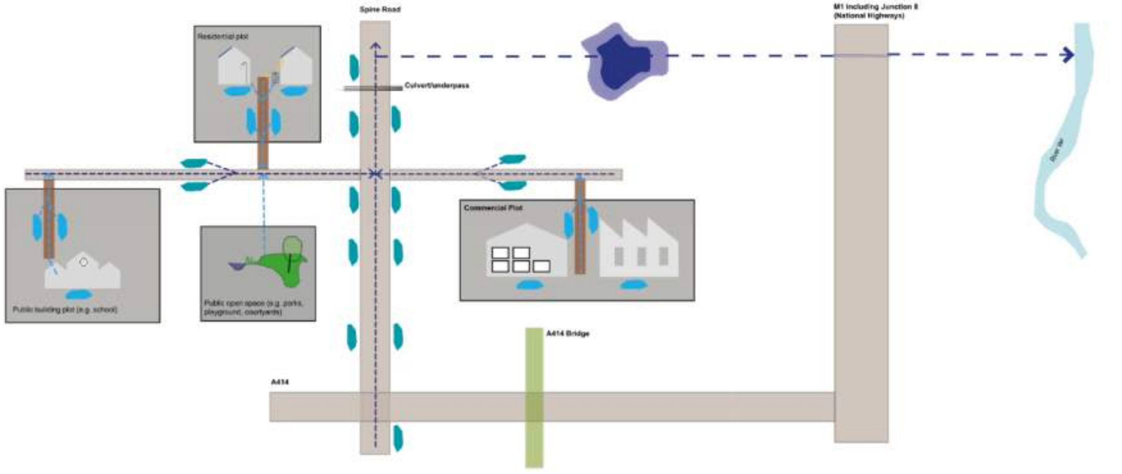


Figure 10: Proposed sustainable drainage arrangement

The proposed ownership, adoption and maintenance arrangement are shown in Table 5: SuDS Adoption and associated sketch.

Table 5: SuDS Adoption and associated sketch



	Key	The Crown Estate / Private	Hertfordshire County Council	Thames Water
Primary highways (including A414 widening and spine road)			✓	
Secondary highways			✓	
Streets within plots		✓		
Surface water sewer under public highway or in public open space				✓
Plot surface water drainage		✓		
SuDS along public highways			Subject to confirmation on type of SuDS	
SuDS within plots		✓		
Main attenuation pond		TCE with potential engagement from organisation like Wildlife Trust		
Culvert/bridges			✓	
A414 Bridge (including structure, surfacing and drainage)			✓	

5.4 Source control measures

It is proposed to integrate the drainage system within the green infrastructure and maximise opportunities for enhancement of the landscape and biodiversity following best practice, in line with the SUDS Manual (CIRIA C753) [4].

Alongside the strategic multi-function attenuation ponds, this includes source control measures, to minimise runoff and control diffuse urban pollution at source. Examples are shown in Figures 11a-g below. The following summarises the inclusion of sustainable drainage features (SUDS) and source control measures along street corridors and on plots:

Street Corridors: Swales and Raingardens – bio-swales and raingardens will be provided along street corridors. Adoptable primary and secondary street corridors are assumed to be entirely impermeable. This will contribute to achieving pollution control requirements and provide additional storage capacity for generated storm runoff.

On-plot storage: Raingardens – raingardens will be provided within residential parcels to contribute to achieving pollution control requirements and provide additional storage capacity for generated storm runoff.

Permeable surfacing – Majority of the proposed hard landscaped areas, particularly in residential-led EH North and South, are proposed to include permeable surfacing. This is to reduce runoff volumes that require attenuation and infiltration in addition to providing source pollution control. It is assumed that permeable surfacing will be 40% impermeable and utilised for office, retail and residential parking bays, hardstanding pedestrian areas, and local tertiary streets. Within the commercial area, a higher robusticity is required given the proposed HGVs and number of vehicles. Parking bays and pedestrian hardstanding areas are therefore proposed to be 65% impermeable.

Open space (soft landscaped areas) – Generous soft landscaping will be provided within residential areas in addition to the soft landscaped park and open spaces. Soft landscaping will also be locally provided in the commercial area, particularly in the west EH Central near the Buncefield Oil Depot boundary and existing British Pipeline Association (BPA) pipelines. This is assumed to be entirely permeable.

Roofs – Green roofs may be utilised within the Proposed Development to contribute to the sustainable drainage strategy; however, these are not suitable for pitched residential roofs and the large commercial warehouses in EH Central. As the building typologies of the residential areas has not yet been defined, all roofs of the Proposed Development are preliminarily assumed to be impermeable and therefore directly contribute to runoff.

Figure 11a-g: Source control measures

Sitewide strategic attenuation is assumed to benefit from the proposed source control measures. An estimate of on-plot storage was validated through a catchment parameter and on-plot SuDS allocation study over a representative test parcel in EH South. This study is included in Appendix M. This study resulted in an assumed 160m^{3}of on-plot storage per impermeable hectare to be allocated across the catchments. A similar provision of on-plot storage was validated for the proposed commercial area which is provided through source control measures along street corridors, parking areas and in local green spaces

The proposed catchment characteristics based on the supporting studies are as follows:

Table 6: Proposed catchment characteristics - residential

Surface Type	% Impermeable
Adoptable primary & secondary roads	100
Tertiary roads (in-plots)	40
Building roofs (all)	100
Parking bays	40
Hardstanding pedestrianised areas	40
Soft landscaped areas	0
Average residential catchment impermeability	**60**

Table 7: Proposed catchment characteristics - commercial

Surface Type	% Impermeable
Adoptable primary & secondary roads	100
Building roofs (all)	100
Parking bays	65
Footpaths	80
Hardstanding surfaces	65
Soft landscaped areas	0
Average commercial catchment impermeability	**60**

The proposed catchment characteristics and source control measures will form part of briefing requirements for the development of parcels to ensure design requirements and sustainable drainage strategy principles are met.

5.5 Design events and climate change allowances

The surface water drainage system will be designed for:

- No surface water flooding for all events up to 1 in 30-year return period, in line with BS EN 752;
- No flooding of buildings and containment on site for extreme events up to the 1 in 100-year period, in line with NPPF

The following climate change allowances have been considered in the design of the surface water drainage system, in line with NPG and latest DEFRA mapping of climate change allowances for the Colne Management catchment:

Residential areas (Catchment A, EH North, and Catchment C, EH South):

- 35% increase in rainfall intensities on the 1:30-year rainfall event (Upper End allowance to 2070s horizon); and
- 40% increase in rainfall intensities on the 1:100-year rainfall event (Upper End allowance to 2070s horizon)

Commercial area (Catchment B, EH Central):

- 25% increase in rainfall intensities on the 1:30-rainfall event (Central allowances to 2070s horizon)
- 25% increase in rainfall intensities on the 1:100-year rainfall event (Central allowance to 2070s horizon)

5.6 Approach to attenuation

Surface water runoff from the Proposed Development will be attenuated within open water ponds, integrated in the natural topography and landscape of the Site. A key aim for the Development is for stormwater storage features to provide multiple benefits. Ponds have been integrated within the green infrastructure to enhance the landscape, biodiversity, remove diffuse urban pollutants and contribute to climate resilience and environmental quality. Minimal use of below ground stormwater storage tanks is proposed. Dual function below ground storage is proposed as part of the harvesting of rainwater for non-potable reuse (discussed further in Section 5.10). Primarily, the minimal use of below ground storage generally reduces the overall embodied carbon impact of the Proposed Development.

The permanent water area of the proposed ponds will be lined to retain water for biodiversity and landscape value in addition to preventing concentrated infiltration, as agreed with HCC LLFA. The remaining margins of the proposed ponds are proposed to remain unlined. These extents are proposed to support slow infiltration through the Clay-with-Flints where contamination is low. This aspiration will be subject to further contamination testing and validation assessments of localised risk of dissolution features.

The sustainable drainage strategy proposes a total of 19no. ponds to be arranged across the site catchments in the cascading arrangement within the low-lying valleys. Figure 12 presents a typical pond configuration illustrating the benching provided for marginal wetland planting and dedicated permanent water. It is proposed to provide at least 0.4m depth for the 1:100 +cc% event and 0.6m depth for the 1:30 +cc% event. The maximum water depth in all ponds will not exceed the 2m maximum outlined in the CIRIA SuDS Manual C753 [5] for the 1:100 +cc% storm. Depths in the 1:30 +cc% will be even shallower.

As the ponds are arranged in the low-lying valley areas the ponds need to provide adequate space for overland flows. The ponds are separated from the proposed dedicated overland flow corridor to ensure the safe conveyance of off-site generated surface water. This is discussed further in Section 5.4.

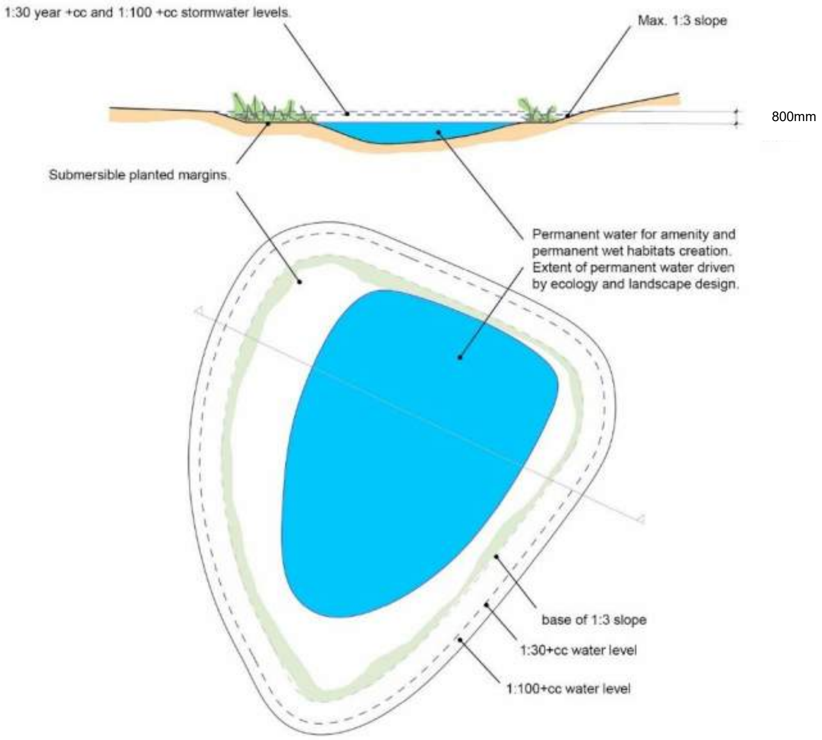


Figure 12: Typical pond configuration

A spatial layout exercise was undertaken to allocate the attenuation across the undeveloped areas of the catchments considering the site levels and development phasing which define the sub-catchments shown in Figure 9.

Figure 13 presents the cascade groups and ponds across the three large catchments, which are summarised as:

- Catchment A (EH North): 1no. cascade of 5no. ponds (Cascade A.1) through the valley of the Country Park and 1no. pond (A.6) servicing the western EH North development parcel.
- Catchment B (EH Central): 1no. cascade of 2no. ponds (Cascade B.1) to the east of the M1 motorway. This is connected to EH Central through a primary surface water sewer which passes beneath the M1, as agreed with National Highways and Thames Water (Appendices D and J) and presented in Section 5.1.
- Catchment C (EH South): 3no. cascades of 3no. ponds each (Cascades C.1-C.3) within the southern valleys and 2no. ponds (C.1 and C.11) servicing smaller development parcels of EH South.

The majority of ponds are assumed to contain the 1:100 +40% storm event, however given spatial constraints 4no. ponds in EH South (Cascade C.2 and pond C.11, Figure 13) are only able to contain the 1:30 storm event. These ponds are sensitively placed away from any Proposed Development buildings and through a dedicated overland flow route allow for excess runoff to safely be conveyed to the existing undeveloped southern valley in the intense storm conditions. The use of the base of the southern valley as additional safe storage is further discussed in Section 5.7.

As agreed with the LLFA (Appendix G), the proposed attenuation has been designed to discharge as per HCC LFRMS2 Policy 14 [1], which stipulates that "*for greenfield sites, the peak runoff rate from the development for the 1 in 1 year rainfall and the 1 in 100 year rainfall event must not exceed the peak greenfield runoff rate from the whole site for the same event. The runoff volume from the developed site in the 1 in 100 year, 6 hour rainfall event must not exceed the greenfield runoff volume for the same event.*"

This is known as the 'complex control' approach and limits peak discharge from the proposed ponds to:

- Peak greenfield runoff rate, for all discharge adding up to the 1:100 6-hour generated greenfield runoff, and
- 2l/s/ha for all discharge beyond this volume.

This has been agreed with the LLFA despite new DEFRA National Standards for Sustainable Drainage Systems [7] not permitting 'complex' controlled discharges as the Outline Planning Application is due to be submitted before the end of 2025 and the development of the drainage strategy preceded the release of the standard on 30 July 2025. Therefore, the greenfield and post-development runoff for the 1:100 year 6 hour storm and associated proportion of volume to be released at greenfield rates has been calculated with ReFH2 and is presented in Table 8.

Table 8: Proportion of attenuated runoff to be discharged at greenfield rates

Catchment	Greenfield Runoff (1:100 6h storm) (m^3)	Post-development runoff (1:100 6h storm) (m^3)	Proportion of generated runoff to be released at greenfield rate (%)
A	64,600	18,400	25%
B	7,000	21,900	32%
C	88,800	27,400	32%

The remainder of the Site runoff will be released at an equivalent 2l/s/ha. This is proposed to be achieved through the use of 2no. hydrobrakes. Figure 14 illustrates a typical arrangement where the outfall chamber includes 2no. hydrobrakes separated by a weir to achieve the discharge requirement. The weir crest will be set at the top level of the volume in the pond discharging at 2l/s per ha.

Figure 13: Proposed cascading pond delineation

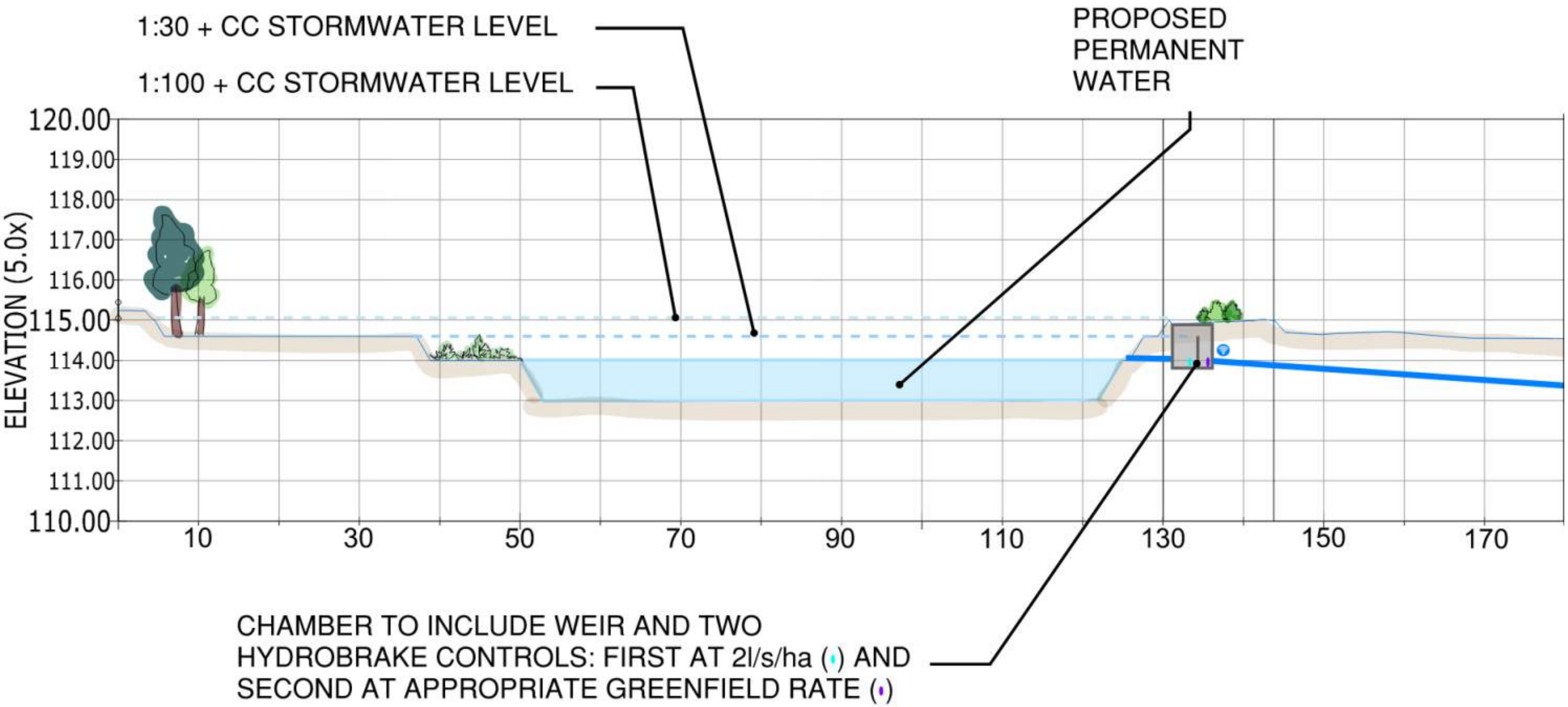


Figure 14: Illustrative section through pond with dual Hydrobrake control

The cascading ponds have been sized by calculating the appropriate sub-catchment peak greenfield runoff rates and 'base' (2l/s/ha) rates and are illustrated in Figure 13. The resultant restricted discharge rates are presented in the table below. Rates between ponds within a cascade has been controlled to maximise the pond's storage whilst still providing freeboard.

As the ponds are to be nested in the low-lying valley below existing ground levels without raised embankments there is no associated risk of embankment failure. Furthermore, the proposed ponds are to be sited away from the Proposed Development buildings to protect the Development and ensure safe conveyance of excess runoff. On this basis, 200mm of freeboard was provided across the proposed attenuation features as the associated risk of flood and failure is relatively low.

Table 9: Proposed discharge rates (l/s)

Cascade/Pond	Proposed base rate (l/s)	Greenfield peak discharge 1:30 year event (l/s)	Greenfield peak discharge 1:100 year event (l/s)
Cascade A.1	72.6	162.9	206.9
Pond A.6	16.1	36.2	46.0
Cascade B.1*	106.2	342.6	432.6
Pond C.1	2.5	7.6	9.6
Cascade C.1	54.2	167.4	211.1
Cascade C.2	44.5	137.6	173.5
Cascade C.3	29.8	92.0	116.0
Pond C.11	12.9	39.9	50.3
*Cascade B.1 receives the entire catchment storm runoff through pipe beneath the M1 motorway			

The volumes generated in the 1:30 +cc% and 1:100 +cc% storms were determined using InfoDrainage for the three catchments.

The final point of discharge to the Thames Water network rates has been restricted in line with LFRMS 2 Policy 14 [1].

Thames Water have agreed in principle to the proposed sustainable drainage proposals (Appendix D). The proposed rates in Table 9 have been shared with Thames Water for preliminary capacity assessment considering the impact of the Proposed Development on the existing network. Following Thames Water's preliminary assessment, it was determined there is insufficient capacity in the existing surface water network and reinforcing will be required to support the Proposed Development (Appendix D)

The models also account for the proposed source control measures discussed in Section 5.4. The model includes an equivalent 160m^3 of storage per impermeable hectare of development, represented as a 'rainwater tank' of equivalent volume which is released at 2l/s per developed hectare in line with guidance. Catchment B (EH Central) further benefits from some local ponds which have also been accounted for within the model.

Table 10: Proposed attenuation provision per catchment and associated on-plot SuDS provision summarises the results of the modelling for each catchment and the total associated on-plot SuDS proposed to be provided. The full results of the calculations are included in Appendix O.

Table 10: Proposed attenuation provision per catchment and associated on-plot SuDS provision

Catchment	Provided Attenuation Volume (m^3)	Provided on-plot SuDS Volume (m^3)
A	13,600	3,700
B	21,000	6,900
C	20,400	3,600

5.7 Dealing with extreme events and resilience

The stormwater storage features will be designed for the 1:30 year event. Events in exceedance of the 1:30 year event and up to the 1:100 year event with an allowance for climate change will be contained on the Site. For Catchments A (EH North) and B (EH Central), the 1:100 +40%cc stormwater will be held within the proposed ponds. For Catchment C (EH South), 4no. ponds have been designed to contain the 1:30 stormwater and allowed for excess volume to flood valley landscape areas of low sensitivity in a controlled manner.

The plans included in Appendix I show the estimate flood extents within the site for the 1:100 year event with an allowance for climate change. Levels will fall away from proposed buildings and towards soft landscaped areas to ensure that storm runoff will not pose a risk to the proposed buildings. Any flows that end up in soft landscaped areas will either infiltrate naturally or continue to be conveyed through the valley overland flow paths.

The extent and depths of controlled flooding will be confirmed at the next stage when more detailed site levels are determined through detailed planning applications. The indicative route of runoff generated in events greater than 1:100 +40% are illustrated in Appendix I (Surface Water Exceedance Plan).

As Catchment C has 4no. ponds (Cascade C.2 and pond C.11, Figure 13) which are designed to contain the 1:30 year event, the additional runoff generated in events of excess of this need to be safely conveyed to the base of the southern valley. It is understood based on current EA flood mapping that the base of the southern valley currently functions as a storage area for excess runoff in intense storms with depths of up to 1.2m in 1:100 +40% storms.

The potential capacity of the base of the southern valley was determined through volumetric modelling in Civil3D (Appendix N). Evaluating the existing topography, it was determined that the sunken base of the southern valley could accommodate approximately 9,700m^3. The excess volume not contained in the 4no. ponds in Catchment C was determined to be less than the total capacity of the base of the southern valley (calculations included in Appendix O). Supported by the dedicated overland flow corridors and landscaped green spaces, the excess stormwater generated in the 1:30 +35% and 1:100 +40% events can therefore safely be conveyed and accommodated in the base of the southern valley. This area is adjacent to the proposed noise bund along the M1, which will need to be designed to consider this flooded area.

Excess runoff from events greater than 1:100 +40% will be safely conveyed through the Site. Overflow will be designed at each pond to ensure water can safely overflow without causing erosion or affecting the stability of the ponds.

Dedicated overland flow corridors designed within the Site topography will support distributing the overflowing water over a wider area within the surrounding low-lying green space and direct excess runoff downstream.

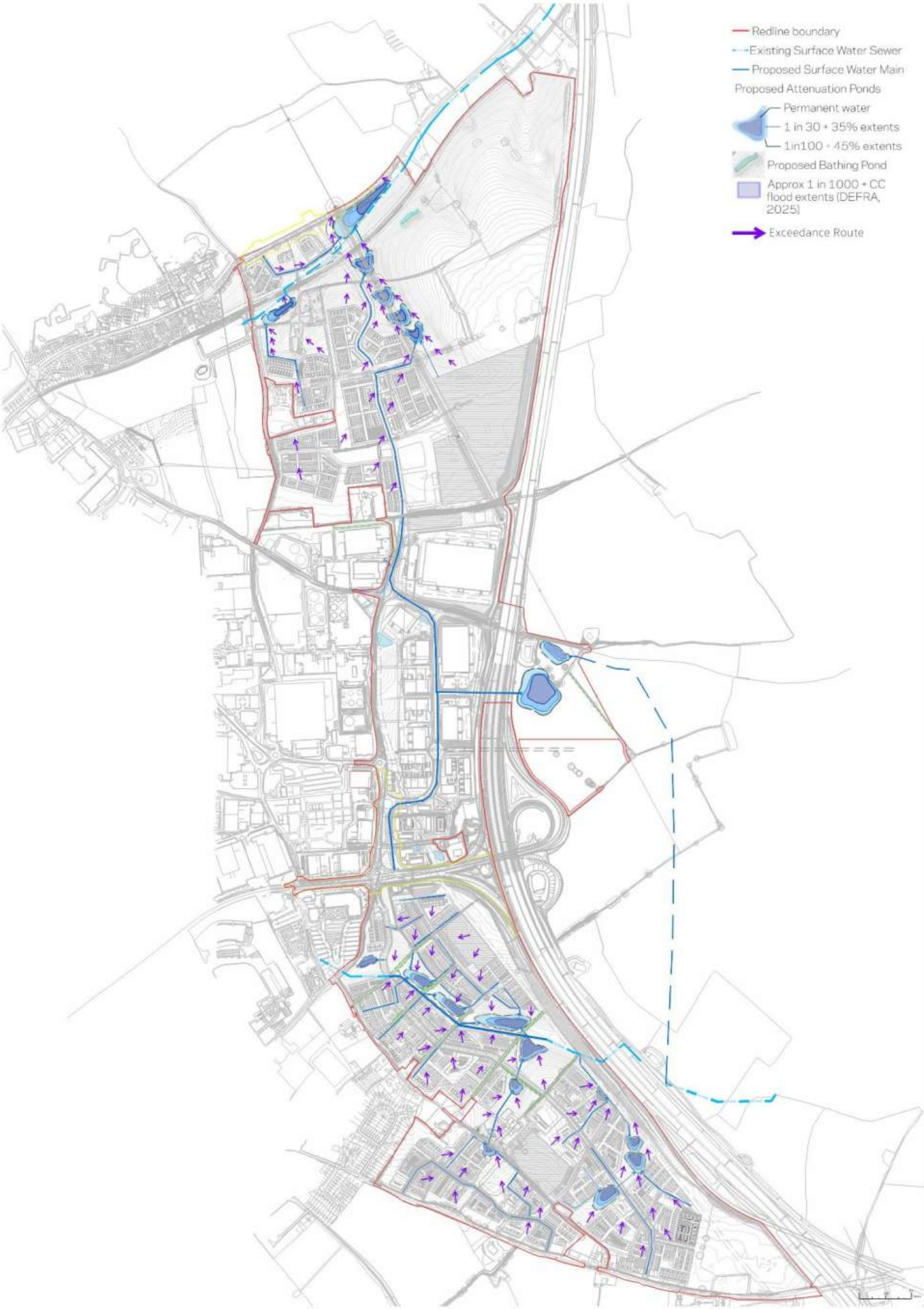


Figure 15: Surface water exceedance route in extreme storms

5.8 Overland flows

As per the EA risk of surface water flood maps [2], excess surface water unable to infiltrate in intense storms runs off towards the low-lying valleys within the Site. The same route is followed by excess from surcharged sewers.

These overland flow routes bisect EH South and EH North (adjacent to B487 Hemel Hempstead Road (Redbourn Road) and part of the Nickey Line). Ensuring that the existing overland flow routes originating off-site are managed through the Site is essential in mitigating flood risk off-site and within the Proposed Development. Furthermore, the Proposed Development will generally reduce the volume of overland flow as a consequence of the Development and management of stormwater runoff through the new sustainable drainage system.

Both overland flow routes and the proposed attenuation ponds naturally want to be located within the valleys. The arrangement of the ponds and key infrastructure has been coordinated with slightly redirected overland flow routes, to ensure that flood risk is mitigated and that the ponds do not fill up with overland flows originating off-site which would affect their capacity.

Dedicated landscaped overland flow routes have been designed and are illustrated in Figure 15. These locally depressed paths will allow for conveyance of the intense storm runoff generated off-site to safely be conveyed through the valleys alongside the ponds as shown on the drainage plans included in Appendix I. The overland flow corridors will also provide safe conveyance of excess surface water generated in Catchment C's (EH South) smaller ponds to the base of the southern valley where it can be stored away from the Proposed Development.

The proposed overland flow corridors have been designed to be 15m wide with an average 1:150 longitudinal slope. They have been assessed to have sufficient capacity to accommodate the typical 1:100+cc overland flow. Current overland flow rates were estimated through open channel hydraulic principles from the existing flood maps. The calculation for the typical section is presented in Appendix P.

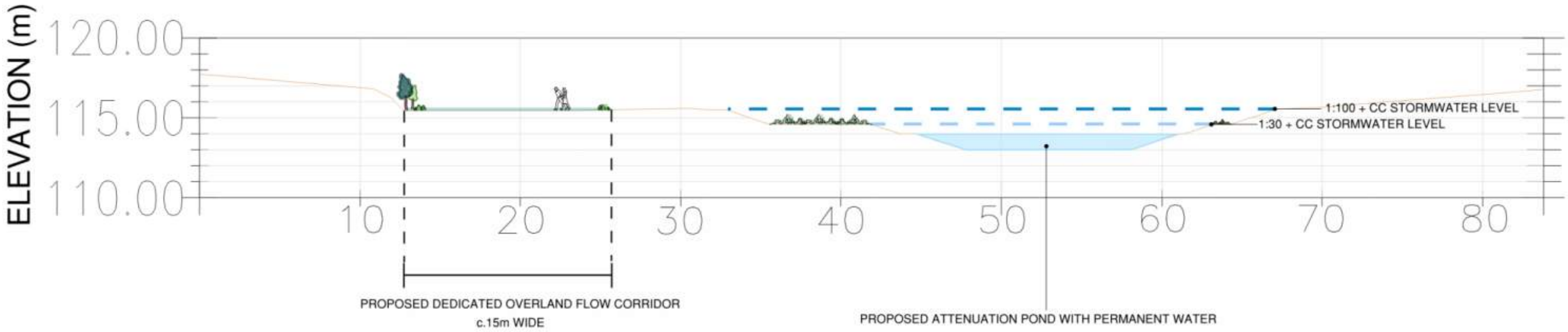


Figure 16: Typical section through pond and overland flow corridor

5.9 Pollution Control and Water Quality

Source control features have been proposed as part of the sustainable drainage strategy (see Section 5.4). Source controls on-plot, such as raingardens and permeable paving, and along street corridors, such as swales, will intercept diffuse urban pollutants before water is discharged into ponds. This, together with sediment forebays in ponds, will help manage water quality in the ponds.

The ponds will act as second stage of treatment in SuDS train before water is discharge to the sewer and River Ver.

An assessment of the water quality of the surface water runoff has been carried out following the 'Simple Index Approach' defined within the SUDS Manual (CIRIA C753) [5]. This sets out the water treatment requirements in relation to land use. To ensure sufficient treatment is achieved, the total pollution mitigation index of the proposed SuDS train must equal or exceed the pollution hazard index for the proposed land use. This assessment takes into account the car numbers proposed across the development.

This assessment is summarised in **Error! Reference source not found.**below, Appendix Q includes all supporting assessments with reference to the SUDS Manual.

The assessment demonstrates that the proposed strategy achieves more than adequate water treatment for discharge.

Table 11: Pollution Indices

<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">Pollution hazard level</th><th colspan="3">Pollution Indices</th><th colspan="3">Mitigation indices for ponds</th><th rowspan="2">Pollution mitigated?</th></tr>
<tr><th>TSS</th><th>Metals</th><th>Hydrocarbons</th><th>TSS</th><th>Metals</th><th>Hydrocarbons</th></tr>
<tr><td>Residential roofs</td><td>Very low</td><td>0.2</td><td>0.2</td><td>0.05</td><td rowspan="3">0.7</td><td rowspan="3">0.7</td><td rowspan="3">0.7</td><td>Yes</td></tr>
<tr><td>Commercial roofs</td><td>Low</td><td>0.3</td><td>0.2</td><td>0.05</td><td>Yes</td></tr>
<tr><td>Lightly trafficked residential streets</td><td>Low</td><td>0.5</td><td>0.4</td><td>0.4</td><td>Yes</td></tr>
</table>

5.10 Harvesting of rainwater and water circularity

The Site is within an area under serious stress on water resources, which will likely be exacerbated by climate change. Water demands across the site will be reduced at source with efficient water fittings, leakage control and metering. This will reduce demand from baseline by approximately 40% in non-residential buildings and at least 25% in residential buildings to achieve a demand of 95-100l/per person per day.

Native drought resistant planting will not require irrigation. Drip irrigation and efficient scheduling will be promoted in allotment gardens.

It is also proposed to harvest rainwater for irrigation and non-potable uses within non-residential buildings with use of the latest smart weather-controlled technologies. This technology is based on real-time management of the stormwater storage to control the retention and release of water (Figure 16). Water will be retained for dry periods for non-potable uses and released in anticipation of a storm to free up the surface water storage capacity. This approach removes the need for a dedicated rainwater harvesting tank with its embodied carbon impacts. It has been successfully implemented in the US and mainland Europe for over 15 years and is being applied in the UK to a growing number of projects.

Harvesting storage has been sized using a bespoke water balance model using long climatic timeseries. Calculations of this are included in Appendix R representing the daily surface inflows and abstraction for irrigation and WC flushing.

The proposed approach of smart rainwater harvesting in addition to water efficiency measures result in the reduction of potable water demand by 55% against baseline in commercial buildings, schools and community buildings, achieving all 5 WAT 01 BREEAM Credits. This innovative approach will contribute to significantly reducing pressure on local water resources and help achieve the water efficiency targets.

The proposed harvesting storage is assumed to be dual-purpose below ground tanks to prevent contamination by wildlife. The volume of these tanks will be offset from the total attenuation storage as these are proposed to serve an integrated function.

Further supporting water circularity, it is proposed to use a smart harvesting system to retain water in the ponds to minimise topping up requirements of the proposed permanent water. Figure 17 illustrates the smart harvesting mechanism which can support this water circularity

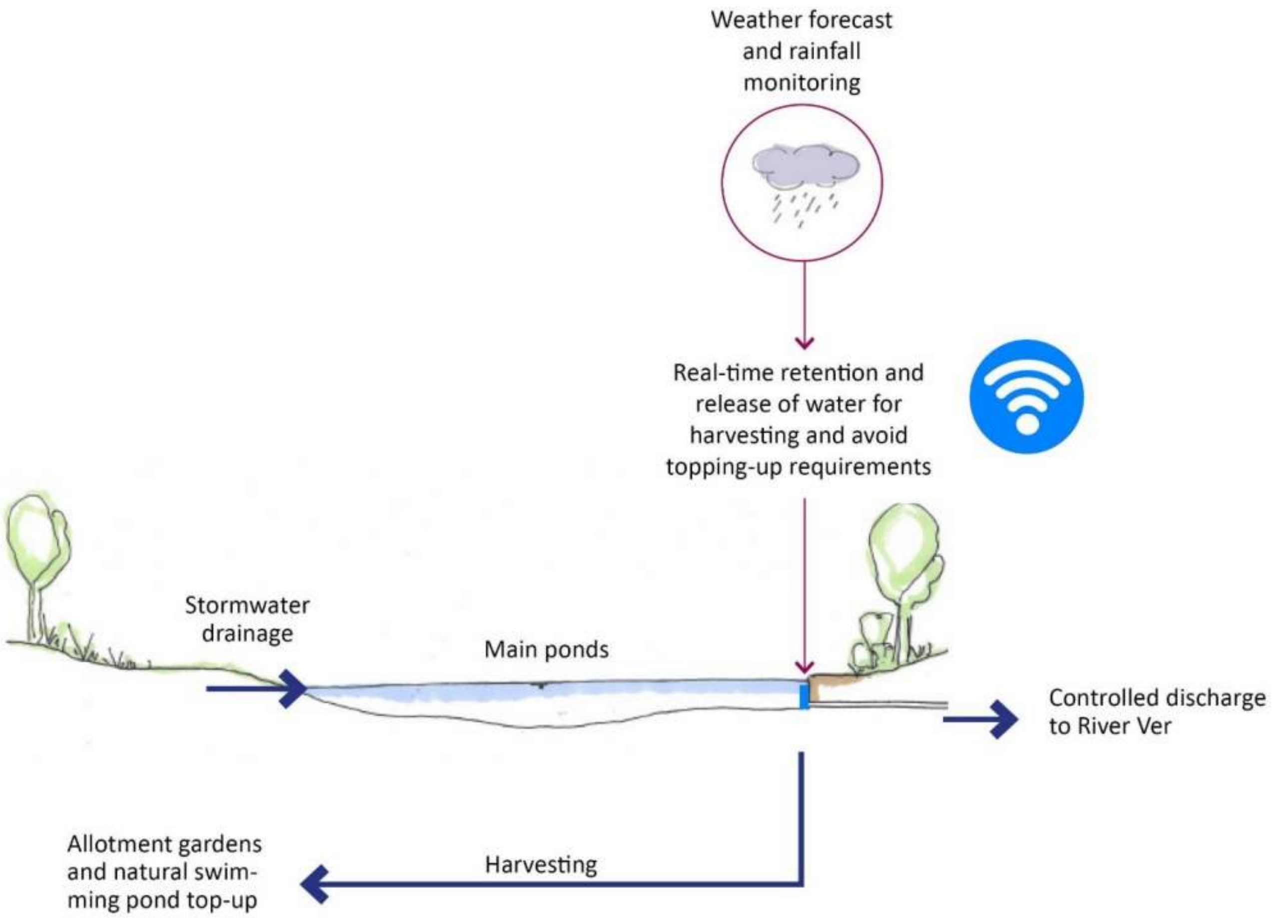


Figure 17: Illustrative smart rainwater harvesting arrangement

Beyond reducing topping up requirements, the ponds are able to provide additional non-potable water which can be used for irrigation of allotments and the topping up of the proposed wild swimming pond in the Country Park in EH North.

6 Foul Water Strategy

At present there is no foul drainage networks or assets within the Site. The existing Thames Water foul network services the residential and commercial properties adjacent to the west of the Site boundary, as defined in Section 3.

Proposed foul flows will be directed via gravity sewer to local low points before being pumped to the surrounding Thames Water network. This arrangement is illustrated in Figure 18and Appendix S.

The proposed foul drainage system has been designed for the three large catchments defined in Firgure 18. An estimated 6no. foul water pumping stations and associated infrastructure will be required for the Proposed Development. The north foul network will be served by 1no. pump station (PS01), and the central commercial foul network by 2no. pump stations (PS02-PS03). The south foul network will be served by 3no. pump stations (PS04-PS06).

The proposed peak flows for the three catchments were established in accordance with the Sewage Sector Guidance (SSG) [11] with the Population Method for determining approximate peak flows for the sub-catchments' proposed accommodation schedule. It was assumed that the proposed homes will incorporate efficient water fittings to reduce the consumptive demand to 105lpd. This is included in Appendix T.

Table 12: Peak foul flows (l/s) presents the summary number of homes (or commercial properties in the central area) serviced and associated peak flows for each sub-catchment.

Table 12: Peak foul flows (l/s)

Catchment	No. homes serviced	Gross floor area serviced (m^2)	Dry Weather Flow (DWF) (l/s)	Peak Flow (l/s)
A – Northern Residential	1,608	-	9.2	32.9
B.1 – Central Commercial	-	26,942	1.2	2.6
B.2 – Central Commercial	-	108,218	2.0	4.4
C.1 – Southern Residential	1,545	-	5.6	24.4
C.2 – Southern Residential	425	-	1.2	7.9
C.3 – Southern Residential	485	-	1.3	8.4

A pre-development enquiry has been submitted to Thames Water based on this strategy. TW have responded (Appendix D), explaining that the discharge peak flows are likely in excess of the available network capacity. Thames Water will therefore undertake strategic reinforcing across the existing foul sewer network. This will be undertaken following determination of the Outline Planning application and aligned with the phasing strategy for the development.

Figure 18: Propose foul water sewer network where (1) identifies pumping locations and (2) identifies possible points of connection

7 Maintenance

Maintenance of the drainage system including SUDS components, will be carried out by the following organisations summarised in Table 13: Proposed management organisations.

Table 13: Proposed management organisations

Feature	Adopted and maintained by
Primary attenuation ponds	Private – TBC
Local ponds (commercial area)	Private – TBC
Permeable paving (largely residential area)	Private – TBC
Primary surface water sewers (trunk mains and requisition)	Thames Water
Secondary surface water sewers	Thames Water
Tertiary surface water sewers	Private- TBC
Roadside SuDS including raingardens and swales	HCC
Foul rising main	Thames Water
Foul sewers	Thames Water
Foul pumping stations	Thames Water

This will be confirmed as Key Phases (Tier 2) and Reserved Matters Applications (Tier 3) come forward. A maintenance and management schedule has been developed to ensure that the performance of the drainage system is achieved over its entire design life. This has been based on best practice guidance from the SUDS Manual (CIRIA C753) [5]. It covers all elements of the system including: drainage pipework, swales, ponds and permeable paving. It will be supplemented at the next design stage by manufacturer's specifications. The maintenance schedule is included in Appendix U.

8 References

[1] Hertfordshire County Council, “Local Flood Risk Management Strategy 2 2019-2029,” Hertfordshire County Council, 2018.

[2] Environment Agency, “Risk of Surface Water Flooding,” UK Government, March 2025. [Online]. Available: https://www.gov.uk/government/publications/flood-risk-maps-for-surface-water-how-to-use-the-map/risk-of-flooding-from-surface-water-understanding-and-using-the-map#the-rofsw-map-and-what-it-shows. [Accessed March 2025].

[3] British Geological Society, “BGS Geology Viewer,” British Geological Society, 2024. [Online]. Available: https://geologyviewer.bgs.ac.uk/?_ga=2.173204963.1501476481.1753884843-282465904.1753884843. [Accessed August 2024].

[4] UK Centre for Ecology & Hydrology, “Flood Estimation Handbook Web Service,” UK Centre for Ecology & Hydrology, 2025. [Online]. Available: https://fehweb.ceh.ac.uk/. [Accessed April 2025].

[5] CIRIA, “CIRIA SuDS Manual C753,” CIRIA, 2015.

[6] Ministy of Housing, Communities & Local Government, “National Planning Policy Guidance, Flood risk and coastal change,” 2014.

[7] DEFRA, “National standards for sustainable drainage systems (SuDS),” UK Government, 30 July 2025. [Online]. Available: https://www.gov.uk/government/publications/national-standards-for-sustainable-drainage-systems/national-standards-for-sustainable-drainage-systems-suds. [Accessed 31 July 2025].

[8] Water UK, “Sewerage Sector Guidance - approved documents,” Water UK, 2023.

[9] Ministry of Housing, Communities & Local Government, “National Planning Policy Framework,” 2019.

[10] Environment Agency, “Groundwater Source Protection Zones,” 1 August 2024. [Online]. Available: https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs. [Accessed August 2024].

[11] British Standards , *BS EN 752 - Drain and sewer systems outside buildings,* BSI, 2017.

[12] Environment Agency, “Peak River Flow and Rainfall Allowances,” UK Government, 27 May 2022. [Online]. Available: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall. [Accessed August 2024].

[13] Hertfordshire County Council, “LLFA Summary Guidance for Developers - Management of Surface Water Drainage,” Hertfordshire County Council, 2021.

Appendix A: Topographic Survey

Appendix B: Ground Conditions

Appendix C: Environment Agency Engagement

Appendix D: Thames Water Engagement

Appendix E: Existing Drainage and Thames Water asset records

Appendix F: LandIS Report

Appendix G: LLFA Engagement

Appendix H: Greenfield Runoff Calculations

Appendix I: Proposed Sustainable Drainage Arrangement and Sections

Appendix J: Infiltration Testing

Appendix K: National Highways Engagement

Appendix L: Initial Sizing Calculations

Appendix M: Catchment Characteristic Study

Appendix N: Additional Southern Valley Capacity

Appendix O: Cascading Modelling

Appendix P: Overland Flow Capacity Calculations

Appendix Q: Pollution Control Indices

Appendix R: Water Circularity Study

Appendix S: Proposed Foul Water Strategy

Appendix T: Foul Water Calculations

Appendix U: Maintenance and Management

Temple Chambers

3-7 Temple Avenue

London EC4Y 0DA

+44 (0)20 7307 1000

www.expedition.uk.com

info@expedition.uk.com

expedition