



JNP GROUP
CONSULTING ENGINEERS

Drainage Statement

Project: Neighbourhood Centre,
Hogwood Farm

Client: CALA Homes Thames Ltd

Reference: C86557-JNP-92-XX-RP-D-1200

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DOCUMENT CONTROL SHEET

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Contents

1 INTRODUCTION..... 2

1.1 Background 2

1.2 Scope of the Statement 3

2 DRAINAGE STRATEGY 4

2.1 Surface Water 4

2.2 Foul Water 6

2.3 Maintenance..... 7

2.4 BREEAM Credits 8

3 SUMMARY 10

APPENDIX A: OUTLINE SURFACE WATER DRAINAGE STRATEGY..... 11

APPENDIX B: OUTLINE FOUL DRAINAGE STRATEGY 12

APPENDIX C: DRAINAGE STRATEGY & SURFACE WATER HYDRAULIC CALCULATIONS 13

APPENDIX D: SURFACE WATER DRAINAGE AREA PLAN 14

APPENDIX E: FLOOD EXCEEDANCE FLOW PATHS..... 15

APPENDIX F: OUTLINE FLOOD RISK ASSESSMENT16

APPENDIX G: GREENFIELD RUNOFF RATE17

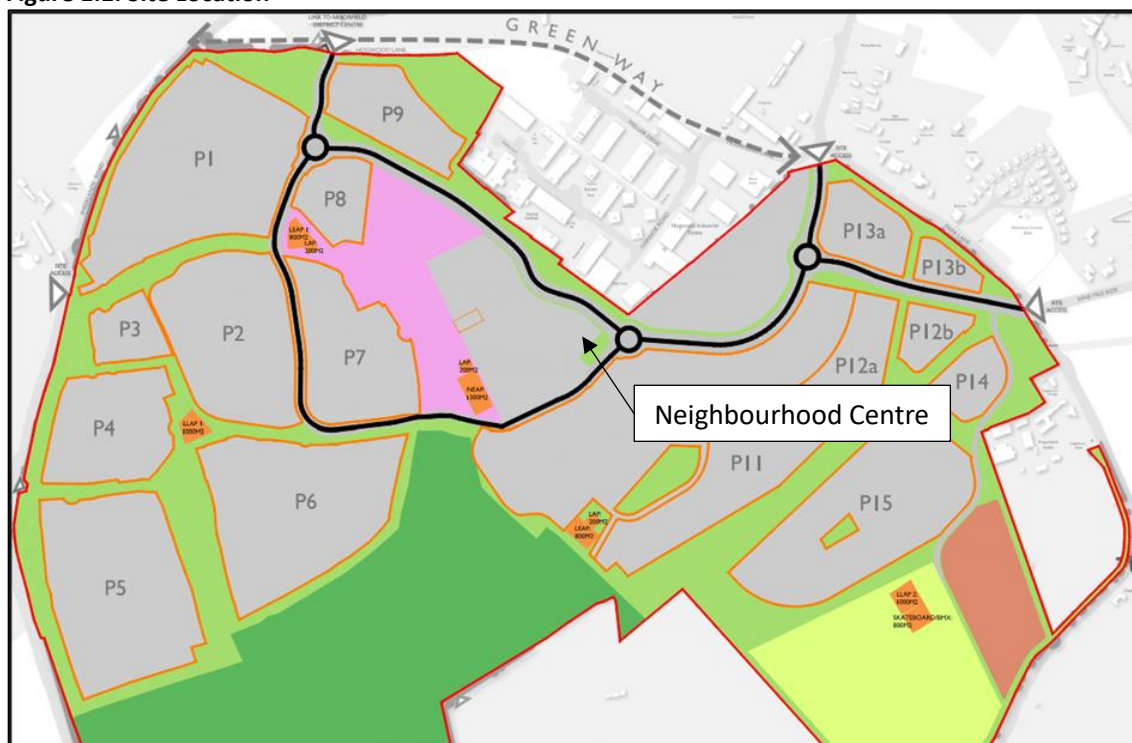
APPENDIX H: SUDS MANAGEMENT AND MAINTENANCE PLAN18

1 INTRODUCTION

1.1 Background

- 1.1.1 JNP Group have been commissioned by CALA Homes Thames Ltd to prepare a Drainage Statement to accompany a Reserved Matters planning application for the Neighbourhood Centre at Hogwood Farm, pursuant to the Hybrid Planning Consent O/2014/2179, as varied by application 181194.
- 1.1.2 The Reserved Matters application proposes the construction of two commercial units and 18 dwellings alongside the provision of associated parking, landscaping, footpaths and sustainable drainage systems (SuDS). Details of access, appearance, landscaping, layout and scale are to be considered.
- 1.1.3 The location of the neighbourhood centre within Hogwood Farm is shown on Figure 1.1 below.

Figure 1.1: Site Location



1.2 Scope of the Statement

- 1.2.1 This Drainage Statement is designed to build upon the content of the approved Outline Surface Water Drainage Assessment (C85672-SK203B-204B, available in Appendix A). The Outline Surface Water Drainage Assessment was prepared to support the hybrid planning application with a particular focus on detailing matters of the site-wide drainage system and associated attenuation and treatment.
- 1.2.2 It is important to note that the principles set out within this Reserved Matters submission are a part of the approved site-wide drainage strategy, which incorporates overland, high ecological and amenity value SuDS (such as attenuation basins and swales) along with areas of private permeable paving. The implementation of SuDS features across the site is not equal and therefore the use of SuDS should not be assessed on a 'parcel-by-parcel' basis.
- 1.2.3 The surface water drainage strategy for the neighbourhood centre includes 'Source Control' SuDS (permeable paving and rain gardens) wherever possible, and also incorporates an attenuation basin in the suitable alternative natural greenspace (SANG) area as approved under the outline planning consent.

2 DRAINAGE STRATEGY

2.1 Surface Water

- 2.1.1 Surface water run-off is assessed in detail in the Outline Drainage Assessment (Appendix A), in line with National Planning Policy and good practice documents, mimicking natural run-off directions and rates. The report also details discussions held with Wokingham Borough Council (WBC), which was instrumental in its development.
- 2.1.2 Soils across the neighbourhood centre are largely impermeable clay, and as such existing run-off mostly follows the site topography, running into local watercourses, which in turn run through the site in a southerly direction.
- 2.1.3 The main principle of the drainage strategy is to ensure that total discharge rates from the site are matched to greenfield rates, for all events up to and including the 1 in 100 year storm event plus 40% allowance for climate change, in accordance with the NPPF and good practice guide.
- 2.1.4 The neighbourhood centre is located in the centre of the wider site and forms part of the surface water catchment that drains towards SANG Basin 3. A sewer has already been constructed in the "Southern Bus Loop" (SBL), which bounds the neighbourhood centre to the south. The sewer in the SBL drains towards SANG Basin 3. It is understood that this sewer has been approved and constructed as part of the SANG area approvals and works.
- 2.1.5 The neighbourhood centre surface water drainage strategy has been developed using the following principles:
- Run-off will be collected from roofs and hardstanding areas using a combination of rainwater pipes, gullies, permeable paving and rain gardens, and drained via pipe networks into the main gravity sewer network.
 - Impermeable catchment areas have been measured from the planning site layout which total 0.52 ha. The SBL and associated pedestrian and cycle path have been excluded from the impermeable area as they will be drained by the highway drainage network, which has already been designed and constructed.
 - The impermeable catchment area considered in this strategy equates to approximately 60% of the total development area within the redline boundary.
 - No allowance for urban creep has been made to the impermeable area, as there are no private soft landscaped areas that could be made impermeable.
 - A detailed hydraulic model has been created and the results for this model are contained in Appendix C.
 - Discharge from the neighbourhood centre is restricted to 5 l/s into the surface water sewer in the SBL. This sewer discharges into SANG Basin 3.
 - Underground oversized pipes are proposed under civic space in front of the proposed building, to prevent flooding of the development for storm events up to and including the 1 in 100 year plus 40% allowance for Climate Change.

- SANG Basin 3 is already designed and constructed to accommodate runoff from the total catchment and discharge flows into the existing watercourse at a runoff rate of 17.7 l/s.
- 2.1.6 Water quality is assessed within the Outline Drainage Assessment, and it is demonstrated that, as all run-off from the neighbourhood centre is routed through at least one attenuation basin, the pollution risk indices are appropriately mitigated in-line with the CIRIA The SuDS Manual 2015. Refer to Table 6 in the Outline Surface Water Drainage Assessment (C85672-R003A in Appendix A).
- 2.1.7 The surface water drainage strategy can be viewed on drawings C86557-JNP-92-XX-DR-D-7210. The drawings and associated calculations are contained in Appendix C.
- 2.1.8 Catchment areas for the development can be viewed on drawing C86557-JNP-92-XX-DR-C-7212, contained in Appendix D.
- 2.1.9 Exceedance flood flow routes have been assessed throughout the proposed development to demonstrate the overland flow routes in the event of exceedance flooding and/or blockage of drainage components. Drawing C86557-JNP-92-XX-DR-C-7213 demonstrates that flows are primarily contained within the parking courts, with any overflows routed away from the accesses to the dwellings. Drawing C86557-JNP-92-XX-DR-C-7213 is included in Appendix E.
- 2.1.10 The proposed strategy follows the principles approved under the hybrid planning consent and is therefore considered to be acceptable in terms of flood risk.
- 2.1.11 The previously approved Outline Sitewide Drainage Strategy sets out the principles of the mains surface water drainage. The drainage strategy was updated following the initial approval to address changes required by the Local Highway Authority (removal of permeable paving from main roads) and has since been resubmitted to Wokingham Borough Council for re-approval. The updated version (ref: C85672-SK-203B and 204B) is available to view in Appendix A.

2.2 Foul Water

- 2.2.1 Foul drainage for the entire development is to discharge to the Thames Water public sewer network at manhole ref SU77645904, located in Park Lane to the north-east of the site.
- 2.2.2 Due to the site topography, two adoptable pumping stations will be required to serve the entire site, one located within the western area in Parcel 5, one located in the eastern area in Parcel 15. The location of the pumping stations has been approved as part of separate Reserved Matters and condition discharge applications.
- 2.2.3 Foul water flows from the neighbourhood centre will connect the Eastern Foul Water Pump Station, in Parcel 15 via a new gravity sewer network. The foul water rising main from the Eastern Foul Water Pump Station has already been laid from the pump station to the connection point at the sewers within the Nine Mile Ride Extension, by others.
- 2.2.4 The previous Sitewide Foul Drainage Strategy (ref: C85672-SK-220 Development Foul Drainage Phasing Plan, available to view in Appendix B) sets out the principles of the mains foul water drainage.
- 2.2.5 Thames Water (TW) are the sewerage authority for the area and confirmed that upgrade works are required to serve the total development. Cala have an ongoing relationship with TW to ensure that these upgrade works are planned in-line with the proposed build programme for the development. Cala discharged Condition 66 of the site-wide planning permission to Wokingham Borough Council (ref. 210569) on 22nd September 2021.

2.3 Maintenance

- 2.3.1 The SuDS management and maintenance plan, included in Appendix H, sets out the management and maintenance requirements for the proposed drainage.
- 2.3.2 The report outlines the periodic and reactive maintenance activities that must be carried out for each of the proposed drainage elements.

2.4 BREEAM Credits

- 2.4.1 A bespoke flood risk assessment was undertaken to support the hybrid planning application for the wider scheme, included in Appendix F. This report demonstrates that the proposed development is at low flood risk from all sources.
- 2.4.2 Climate change has been taken into account in this assessment, which has established that flood risk from all sources will remain low for the development's design life.
- 2.4.3 The development is therefore eligible for two Flood Resilience credits under Pol 03.
- 2.4.4 The drainage strategy in Section 2.1 describes a bespoke solution to manage surface water runoff from the development, taking into account the site-specific requirements.
- 2.4.5 Pre-development runoff rates for the neighbourhood centre site were calculated using the HR Wallingford greenfield runoff tool. Refer to Appendix G.
- 2.4.6 The discharge rate from SANG Basin 3 is 17.7 l/s for all storm events up to and including the 1 in 100 event + 40% climate change (in accordance with local requirements). As shown in Table 2-1, the peak rate for the entire SANG Basin 3 catchment is no greater than the pre-development rate for the same area, for the 1 in 1 and 1 in 100 year events.

Table 2-1: Pre-development discharge rates

Event	Pre-development runoff rate (l/s/ha)	Pre-development runoff rate applied to 9.7 ha impermeable area draining to SANG Basin 3 (l/s)
1 in 1 year	2.4	23.7
1 in 100 year	9.2	89.2

- 2.4.7 The maintenance requirements for all proposed SuDS elements are detailed in the SuDS management and maintenance plan, in Appendix H.
- 2.4.8 This demonstrates the development is eligible for one BREEAM credit under Pol 03, for surface water runoff – rate.
- 2.4.9 The exceedance routing plan in Appendix E shows that, in the event of local drainage system failure, exceedance flows would be directed away from the building and the property would not be flooded.
- 2.4.10 Given the proposed development's impermeable area is greater than the pre-development impermeable area, the total volume of surface water runoff is also greater.
- 2.4.11 It is not possible to prevent this additional volume from leaving the site using infiltration, as described in the site wide drainage strategy to support the outline planning application, in Appendix A.
- 2.4.12 The limiting discharge is defined as the highest flow rate of the three in Table 2-2, applied to the catchment area of SANG Basin 3.

Table 2-2: Limiting discharge

Pre-development one-year peak flow rate	23.7 l/s
Mean annual flow rate (Greenfield Q_{BAR})	28 l/s
2L/s/Ha	19.5 l/s

- 2.4.13 Therefore, the limiting discharge is 19.5 l/s. The discharge rate for SANG Basin 3 is 17.7 l/s for all events up to and including the 1 in 100 year + 40% climate change. Therefore, the peak rate has been reduced to a rate lower than the limiting discharge.
- 2.4.14 All calculations include a 40% allowance for climate change, in accordance with best practice and local requirements.
- 2.4.15 The maintenance requirements for all proposed SuDS elements are detailed in the SuDS management and maintenance plan, in Appendix H.
- 2.4.16 This demonstrates the development is eligible for one BREEAM credit under Pol 03, for surface water runoff – volume.

3 SUMMARY

- 3.1.1 Overall, this Drainage Statement demonstrates that the proposals for the neighbourhood centre meet the design standards and principles set out within local and national guidance and the approved outline foul and surface water drainage strategies.
- 3.1.2 The neighbourhood centre is eligible for four BREEAM credits under category Pol 03.

APPENDIX A: OUTLINE SURFACE WATER DRAINAGE STRATEGY



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Report

Drainage Assessment

Project: Hogwood Farm, Finchampstead

Client: Legal & General Homes

Reference: C85672-R003A

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Executive Summary

jnp group was commissioned by Legal & General Homes to undertake an assessment of the existing drainage arrangement at the application site and proposes a surface water and foul drainage strategy in line with Wokingham Borough Council guidance.

The existing site is mainly large open fields separated by hedgerows and fences. Sections of mature woodland, ditches, and various buildings are present across the site. The site is bounded by Reading Road (A327) to the west, Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west.

The site is 109.824ha and the development proposed consists of the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments, 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG).

A topographic survey of the site shows multiple valleys which fall from the north, west and east towards the central and south-western areas of the site. The lowest area onsite is located in south-west, this area is also the flattest with a more gradual fall which continues south-westwards (towards Long River approximately 880m away). In the far north-western corner of the site the land also falls north towards Barkham Brook, approximately 1.2km to the north. The topographic survey shows that on more localised scales the land falls towards the onsite ditch network which drains the site.

It will not be possible to infiltrate into the ground due to the impermeable clay geology of the area. Surface water run-off naturally drains into the onsite ditch network. This ditch network in turn drains into one of two onsite watercourses which flow towards the south-western corner of the site where flows are conveyed offsite via a culvert under Reading Road.

The proposed surface water drainage strategy aims to mimic the existing drainage regime by following the local topography and discharging attenuated run-off from the site into the ditch and watercourse network. All post-development run-off from the site will be limited to greenfield flow rates (QBAR which is the mean annual maximum flow rate) during all storm events up to and including the 1in100 year plus a 40% allowance for climate change storm event. Where feasible, Sustainable Drainage Systems (SuDS) shall be utilised, including attenuation in the form of basins and tanked permeable paving, as well as swales.

An additional 10% allowance for soft landscaped runoff and a further 10% allowance for urban creep has been included in the sizing of all surface water attenuation.

The geology of the site is mainly comprised of impermeable clay and groundwater was rarely encountered during the intrusive works. Also, when groundwater was encountered it was described as a slow trickle or seepage at depths between 1.2 and 2.4m bgl. Further groundwater monitoring will be carried out to support detailed design and temporary works design. All drainage features will be lined to prevent any groundwater ingress.

In a storm event exceeding the design capacity of the surface water drainage system, surface water from the drainage network will be routed away from residential properties and into low risk areas.

Surface water run-off generated from the site will be treated in accordance with guidance contained within the 2015 SuDS Manual (C753) to ensure that there is no negative impact on the water quality of onsite or downstream watercourses.

During the construction stage and subsequent phased works, appropriate measures will be put in place to ensure that the implemented drainage infrastructure will be protected from damage, ensuring their future effectiveness. Run-off during construction will be managed to ensure that the risk of on and offsite flooding, pollution and sediment build-up is minimised.

Maintenance and management of all onsite drainage infrastructure, culverts and downstream watercourses has been considered within a SuDS maintenance plan appended to this report. This will be updated through the development process.

The proposed surface water drainage strategy is entirely onsite and therefore, there will be no requirements for offsite sewer works or diversions. However, a Thames Water surface water sewer serving Hogwood Industrial Estate will need to be diverted into a new attenuation basin.

In terms of foul drainage Thames Water carried out a Sewer Impact Study to assess if the existing sewer system has capacity for the additional volume the development would add. The development proposes to connect into the existing foul sewer network which runs beneath Park Lane which is the road adjacent to the sites eastern boundary. The manhole which the site will connect at is located past the sites north-eastern corner and is named SU77645601. The result of the Sewer Impact Study was that the existing foul sewer system does not have capacity to accept the increase in foul sewage from the development and the proposed connection would lead to surcharging and flooding. However, Thames Water outline the following strategy for upgrading the foul sewer system:

-  Development flows to be connected to manhole SU77645601.
-  A new manhole must be provided 20m downstream of the existing manhole, SU77645601.
-  The addition of 83m³ of online storage must be provided by increasing the size of the existing gravity sewer off Park Lane. This will be done by changing the sewer from a 300mm diameter sewer to a rectangular sewer which will be 1500mm x 1000mm (width x length) between the required new manhole and existing manhole (SU77645601). The total length of the upsized sewer will be approximately 58m.
-  Discharge from the site into the public sewer network will be limited to 48l/s at manhole SU77645904.

By carrying out this strategy the development will be able to connect into the existing foul sewer at manhole SU77645601, without any detrimental effects further downstream.

Following the changes to infrastructure charges for new connection services, introduced April 2018, the responsibility to provide off-site foul water capacity is the responsibility of Thames Water.

Contents Page

1	INTROUDCTION	6
1.1	TERMS OF REFERENCE	6
1.2	SITE DESCRIPTION.....	6
1.3	TOPOGRAPHY	8
1.4	HYDROLOGY.....	9
1.5	EXISTING GEOLOGY AND GROUND CONDITIONS.....	10
2	SURFACE WATER DRAINAGE STRATEGY	13
2.1	EXISTING SITE SURFACE WATER RUN-OFF.....	13
2.2	EXISTING GREENFIELD RUN-OFF RATES	13
2.3	EXISTING GREENFIELD RUN-OFF VOLUMES	14
2.4	GENERAL PRINCIPLES FOR PROPOSED SITE RUN-OFF	14
2.5	SUSTAINABLE DRAINAGE SYSTEMS (SuDS).....	14
2.6	PROPOSED SURFACE WATER DRAINAGE STRATEGY	16
2.7	POST DEVELOPMENT RUN-OFF VOLUMES.....	18
2.8	EXCEEDANCE FLOODING.....	18
2.9	CONSENTS, OFFSITE WORKS AND DIVERSIONS.....	19
2.10	MAINTENANCE	19
2.11	POST-DEVELOPMENT WATER QUALITY TREATMENT.....	19
3	FOUL WATER DRAINAGE STRATEGY	24
3.1	FOUL WATER DRAINAGE	24
4	DRAINAGE DURING CONSTRUCTION	25
4.1	CONSTRUCTION RUN-OFF MANAGEMENT.....	25
4.2	MANAGEMENT OF REPAIRS (INCLUDING DRAINAGE)	25
4.3	TEMPORARY DRAINAGE DURING CONSTRUCTION.....	25
4.4	PROTECTION OF DRAINAGE INFRASTRUCTURE DURING CONSTRUCTION.....	26
5	CONCLUSIONS	27

List of Figures

Figure 1: Site Location Plan	7
Figure 2: 1m Resolution Environment Agency LiDAR Data for the Wider Area Around the Site.....	8
Figure 3: EA Blackwater River (Hawley to Whitewater confluence at Bramshill) Catchment	10
Figure 4: Trial Pit locations	11

List of Tables

Table 1: Greenfield Run-Off Calculation Parameters	13
Table 2: Existing Greenfield Run-Off Rates.....	13
Table 3: SuDS Selection Based on the SuDS Hierarchy.....	15
Table 4: Pollution Hazard Indices as per the 2015 SuDS Manual (C753)	20
Table 5: Indicative SuDS Mitigation Indices from the 2015 SuDS Manual (C753)	21
Table 6: Site Roof/Land Use Types Water Quality Mitigation Summary	21

List of Appendices

APPENDIX A – PROPOSED DEVELOPMENT PLAN	29
APPENDIX B – SITE PLAN.....	30
APPENDIX C – TOPOGRAPHIC SURVEY	31
APPENDIX D – EXISTING DITCH NETWORK PLAN.....	32
APPENDIX E – GREEN FIELD RUNOFF RATES	33
APPENDIX F – THAMES WATER ASSET LOCATION SEARCH PLANS.....	34
APPENDIX G – DRAINAGE SCHEMATIC.....	35
APPENDIX H – MICRODRAINAGE CALCULATIONS	36
APPENDIX I – ANCIENT WOODLAND DRAINAGE CROSSING	37
APPENDIX J – CHL CORRESPONDENCE AND PLANS.....	38
APPENDIX K – SSE CORRESPONDENCE AND PLAN	39
APPENDIX L – SUDS MAINTENANCE PLAN.....	40
APPENDIX M – THAMES WATER FOUL SEWER IMPACT STUDY	41
APPENDIX N – FOUL SEWER SCHEMATIC.....	42

1 INTRODUCTION

1.1 Terms of Reference

- 1.1.1 **jnp group** was commissioned by Legal & General Homes to undertake a Drainage Assessment for the proposed development of Hogwood Farm, Finchampstead.
- 1.1.2 This Drainage Assessment has been produced in support of the development proposals which include the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments, 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG). A copy of the Proposed Development Plan is provided in Appendix A.
- 1.1.3 **jnp group** has assessed the requirements for the full planning application laid out in the Wokingham Borough Council (WBC) Developer Pack and has produced this drainage assessment in line with these guidelines.
- 1.1.4 We have also reviewed WBC's guidelines information in their 'Wokingham SuDS Strategy: Guidance on the use of sustainable drainage systems' and 'Borough Design Guide: Supplementary Planning Document' and have determined the below information is required for a full planning application.
-  To manage known surface water drainage issues in the Borough.
 -  To manage water quality issues in the Borough.
 -  To manage water quantity issues in the Borough.
 -  To ensure well designed SuDS are used appropriately in all new and re-development;
 -  To ensure high quality new development and redevelopment that manages surface water quantity and quality effectively.
 -  To ensure amenity and biodiversity benefits are provided through the use of SuDS where possible.
- 1.1.5 Liaison has also been carried out with WBC's Lead Local Flood team and Amenity, Greenspaces and Ecology teams.
- 1.1.6 The assessment should be read in conjunction with the Flood Risk Assessment **jnp group** Report Ref: C85672-R001.

1.2 Site Description

- 1.2.1 The site is approximately 109.93ha in size and is bounded to the west by Reading Road (A327), Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west. Hogwood Lane is present at the site's northern boundary which provides access to pedestrians between Sheerlands Road and Hogwood Industrial Estate. All the site's boundaries are marked by woodland and hedgerows. Adjacent to the site's northern boundary is Hogwood Industrial Estate, located within this area there is a brewery, multiple garages and offices. Just south of Hogwood Industrial Estate there is another smaller industrial estate located onsite. This onsite industrial estate is mainly comprised of garages for car repairs, there is also an irrigation systems supplier based in this area. Both of these areas will be a source of pollutants for the site due to the activities being carried out in these areas using chemicals and oil. Cutting through the site's south-western end is West Court, this road connects directly between Reading Road to the west and West Court house, a Grade two listed 17th Century former manor house. This road is also known as the Devil's Highway and is part of a former Roman Road network which still

exists as a footpath through the area. As well as cutting through the site, this road is built over the onsite watercourse, which passes beneath the road via a culvert.

- 1.2.2 The site location is shown below in Figure 1. A larger plan of the site is provided in Appendix B.

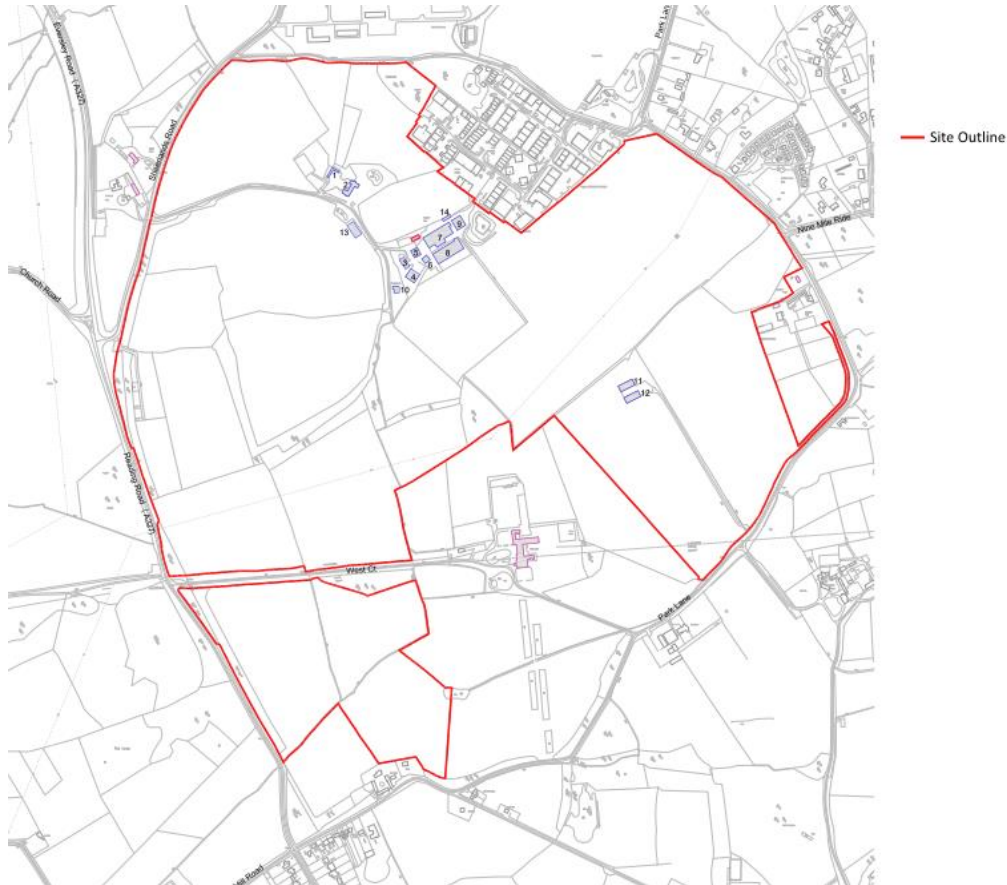


Figure 1: Site Location Plan

- 1.2.3 The site is comprised mainly of large open fields which are used for agricultural purposes and separated by hedgerows and fences. Sections of mature woodland are also present at the site, included in this is the Hogwood Shaw (which is a Wildlife Heritage Site). Various buildings are present across the site, the majority of these buildings are either agricultural (stables etc) or small buildings (garages etc). There are also two houses present; Hogwood Farmhouse and The Lodge. These lie to the north and south of a small private road that leads directly to Hogwood Farm respectively. Hogwood Farmhouse which is a Grade II Listed Building, is located within the onsite Industrial Estate.

- 1.2.4 The site co-ordinates are:

 N477056
 E164329
 RG404QY

1.3 Topography

Wider Topography

- 1.3.1 1m resolution Digital Surface Model (DSM) LiDAR data has been provided by the Environment Agency (EA); enabling a review of the wider topography around the proposed development site. A map created from this data is provided in Figure 2 below.

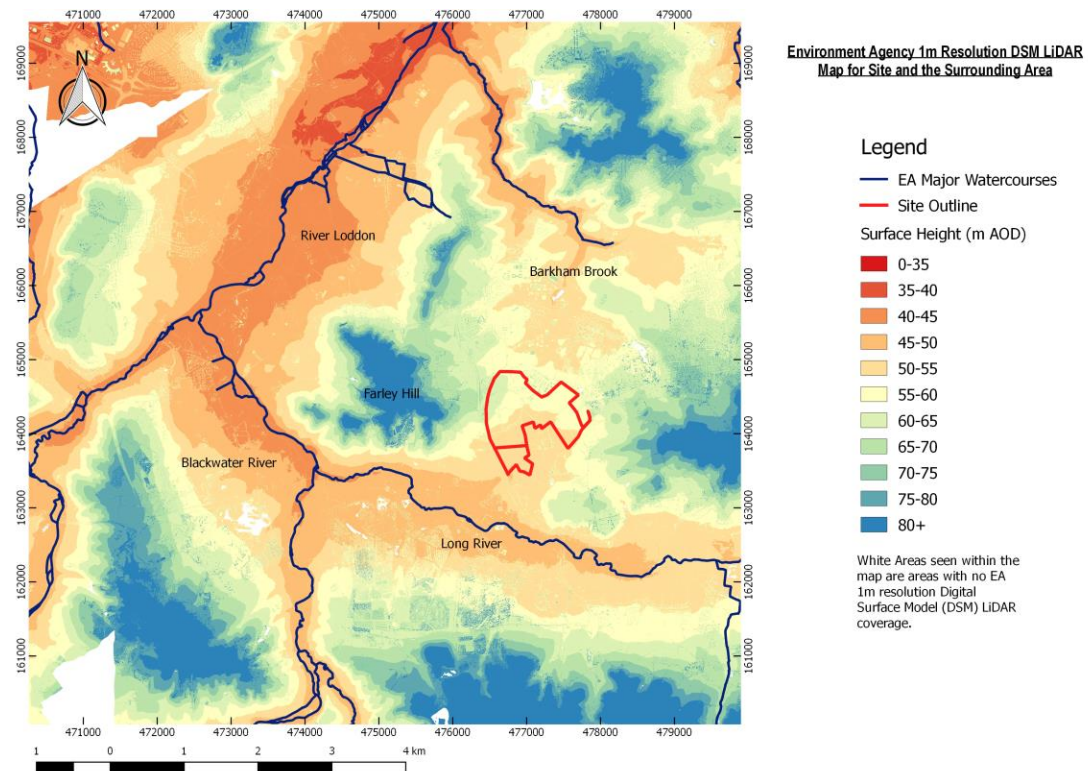


Figure 2: 1m Resolution Environment Agency LiDAR Data for the Wider Area Around the Site

- 1.3.2 The wider area around the site is defined by the River Loddon valley which lies to the west of the site. This in turn is fed by the catchment of Blackwater River to the south-east and Barkham Brook's catchment to the north-west. The majority of the site falls towards the Long River, which flows westwards into the Blackwater River to the south of the site. A tributary of the Long River leaves the site at its south-western corner, forming a valley leading into the wider Long River valley which falls from east to west approximately 0.75km to the south of the site. For ease of reference, this tributary is hereafter called Hogwood Ditch. The wider Barkham Brook valley is located approximately 1.2km north of the site boundary. Part of the sites northern area forms part of the Barkham Brook catchment.
- 1.3.3 Approximately 2km west of the site is Farley Hill, which Figure 2 shows in the LiDAR band of 80+m Above Ordnance Datum (AOD). Approximately 1km east of the site there is another area of high topography in the form of a ridge.
- 1.3.4 The EA's LiDAR information is a useful guide in indicating topographic trends but at a 1m resolution, can be prone to accuracy issues, particularly in areas with extensive waterbodies and trees. Across the site specifically various inaccuracies have been found, especially along the ditch network. This is due to the ditches commonly being surrounded by large hedgerows or woodland. However, the overall general trends for the wider area around the site are considered accurate.

Site Topography

- 1.3.5 This section should be read in conjunction with the site specific topographic survey carried out by Brunel Surveys Ltd in November 2017. A copy of this survey is provided in Appendix C.
- 1.3.6 Generally, the site falls from north to south and from the east and west towards the centre of the site, where Hogwood Ditch flows south, before falling towards the south-western corner. However, the onsite topography is undulating, with hills, secondary ditches and smaller valleys all present.
- 1.3.7 63.53m AOD is the peak height found on the site; located adjacent to where the private access road in the north-west joins Sheerlands Road. However, this was observed as a mound of earth during a site visit in November 2017, giving this area an exaggerated height on the survey. Nevertheless, even without the mound, the land surrounding this point does still fall away from this high point, although the fall is not as pronounced as that suggested by the site specific topographic survey.
- 1.3.8 The land falls from the base of the mound to the east at approximately 1:150. This fall continues to the Hogwood Ditch valley in the centre of the site before rising towards the north-eastern boundary with Hogwood Industrial Estate. The land at the boundary with Hogwood Industrial Estate has a peak height of 58.71m AOD and a fall towards the south-west of 1:70.
- 1.3.9 In addition to the general fall towards the central valley, the land also generally falls from north to south. This fall is approximately 1:194 and continues across the site from the north in general to the south-western boundary with Lea Farm. Past this boundary, the land continues to fall towards Long River.
- 1.3.10 The land also drops from the mound towards the northern site boundary of Hogwood Lane with an average 1:100 fall. Levels at this boundary are a minimum of 59.08m AOD.
- 1.3.11 On the eastern side of the site, the land falls from the boundaries of Shepperlands Farm and Park Lane from north towards the south and west at approximately 1:130 before reaching a valley with a tributary of Hogwood Ditch flowing westwards from the north-east site boundary. This tributary is hereafter referred to as Robinson Crusoe Ditch. On the adjacent side of the valley, land rises at approximately 1:50.
- 1.3.12 As identified in the general site trends, levels fall towards the south and west. However, the site is flatter in the south, with a much gentler fall of approximately 1:318 towards Hogwood Ditch, which leaves via a culvert in the south-western corner and flows away into Long River. Levels in the south-eastern corner are approximately 49.80m AOD.

1.4 Hydrology

- 1.4.1 To aid understanding, this section should be read in conjunction with the plan showing the existing ditches and onsite hydrological features created by **jnp group** (reference: C85672-SK-011) provided in Appendix D.
- 1.4.2 The closest major watercourse to the site according to the EA's Rivers and Major Watercourses Map is Long River which is located approximately 880m away to the south-west. Long River flows into Blackwater River approximately 3.5km south-west of the site before merging with the River Hart and flowing into the River Loddon which flows away to the north-west and eventually into the River Thames. Figure 3 below shows the Blackwater River catchment which the site and Long River to the south form a part of.

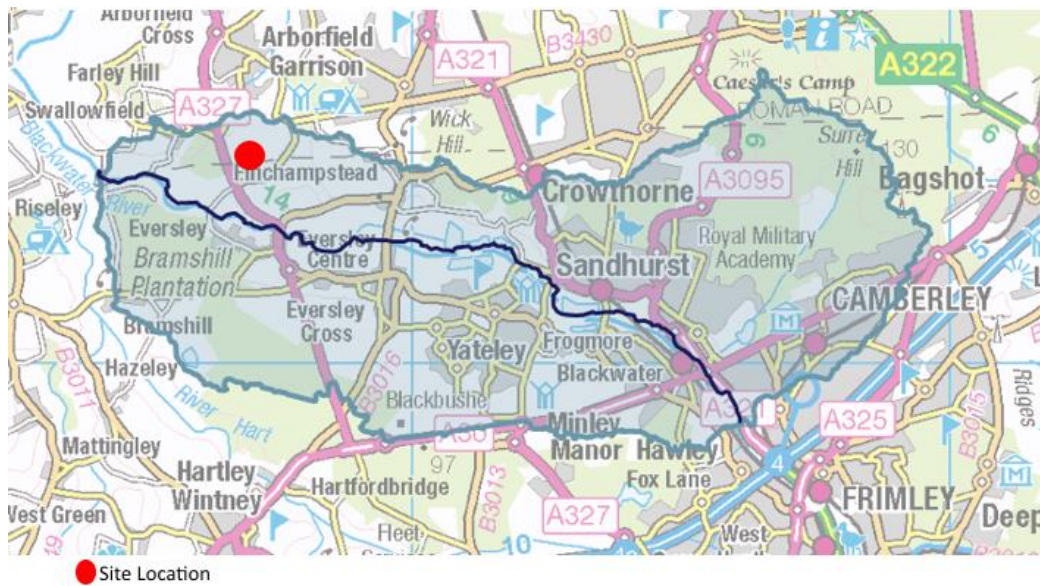


Figure 3: EA Blackwater River (Hawley to Whitewater confluence at Bramshill) Catchment

- 1.4.3 Whilst the mapping provided by the EA does show the major watercourses in the area, it does not show the two watercourses present onsite; Hogwood Ditch and its tributary Robinson Crusoe Ditch which joins Hogwood Ditch in the central area of the site. Hogwood Ditch flows across the site towards the south-western corner where it leaves via a culvert. Past the site boundary the watercourse continues to flow towards the south-west where it feeds into Long River.
- 1.4.4 As well as Hogwood Ditch and Robinson Crusoe Ditch, other ditches are present throughout the site. These ditches are key to the sites drainage due to the low permeability of the areas geology, which is outlined in Section 1.5 below. The majority of these ditches form on-site, and it should be noted that a number are not hydrologically effective i.e. they have variable falls, or they have no outfall. The ones that do have outfalls all drain into Hogwood Ditch or Robinson Crusoe Ditch.
- 1.4.5 Ditches have also been identified running along the sites boundary parallel to the roads adjacent to the site. The most prominent of which is the ditch which runs along the sites eastern boundary with Park Lane (hereafter referred to as Park Lane Ditch). These ditches formally drain the roads and convey offsite flows to either the onsite watercourses or away from the site.
- 1.4.6 In addition to the onsite ditch network, a number of ponds are also present on site, these are all hydraulically linked by the local ditch network into either Hogwood Ditch or Robinson Crusoe Ditch. In the north-eastern area of the site there is a large pond which attenuates run-off from the Hogwood Industrial Estate via a surface water sewer (shown on the Asset Location Plan for the site). The controlled outflow to this pond drains directly into Hogwood Ditch.

1.5 Existing Geology and Ground Conditions

- 1.5.1 British Geological Survey (BGS) 1:50,000 map shows that the bedrock geology of the site is comprised of London Clay, there is no record of the areas superficial geology on the BGS map. BGS borehole data in the area of Hogwood Industrial Estate shows a layer of top soils that ranges between 0.15 to 0.3 meters in thickness. The BGS boreholes show that this layer is underlain by the London Clay (bedrock layer).

- 1.5.2 A Site Investigation was carried out by Eastwood & Partners Consulting Engineers between 25-27th July 2017 (report reference 41623-002). During the Ground Investigation 45 trial pits were dug across the site, to depths of between 1.2 to 3.2m below ground level (m bgl). The location of each trial pit is displayed on Figure 4 below.

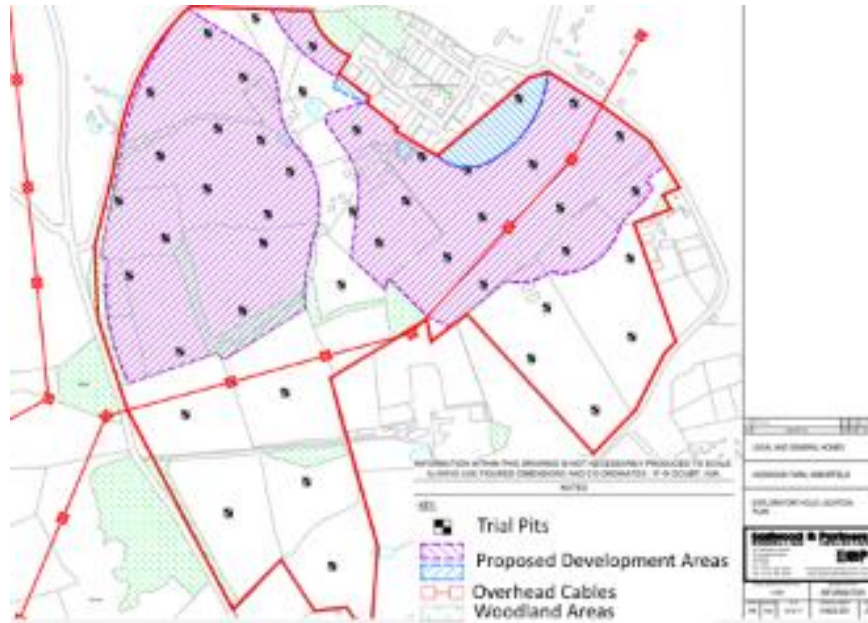


Figure 4: Trial Pit locations

- 1.5.3 Figure 4 above shows, at least one trial pit was dug in every field across the site.
- 1.5.4 A summary of the findings from the Site Investigation are provided below:
-  Topsoil was found at thicknesses of between 0.2 to 0.4m. This layer was mainly composed of silty clay and occasional pockets of gravel with flints.
 -  At the eastern side of the site Bagshot formation was found between the topsoil and London Clay layers. This formation was found between 0.3 to 0.5m bgl. This layer was described as being orange/brown in colour, medium to fine in grain size and medium density. Varying amounts of medium to coarse grained gravel and silt were also found within the Bagshot formation.
 -  The site is underlain by London Clay at between 0.25 to 0.6m bgl. The depth of the London Clay was not proven during the Site Investigation. This layer was described as orange, brown and grey/blue in colour. The clay is commonly described in the logs as stiff with varying amounts of sand and gravel present across the site.
- 1.5.5 Due to the impermeable clay present across the site, groundwater was rarely encountered during the Site Investigation. Only 13% of the trial pits encountered any groundwater, it was recorded as ingress and described as a slow trickle or seepage at depths between 1.2 and 2.4m bgl. No groundwater monitoring was carried out and the Site Investigation intrusive works were carried out in July which is a dry period where ground water levels and concentrations are less. Further groundwater monitoring is recommended to support detailed design and temporary works design.
- 1.5.6 The EA's aquifer classification system designates London Clay as an unproductive strata, meaning that it has low permeability and little effect on the areas water supply. However, the eastern end of the site has deposits of Bagshot Formation which the EA classifies as a Secondary A aquifer. This means that

the aquifer is not highly permeable or has a high level of storage potential and is only capable of supporting water supplies at a localized scale.

- 1.5.7 The site is not within a groundwater Source Protection Zone as defined by the EA.

2 SURFACE WATER DRAINAGE STRATEGY

2.1 Existing Site Surface Water Run-Off

2.1.1 The site currently consists mainly of open fields and woodland with a small number of buildings (mainly farm houses or structures related to agriculture) and a small industrial estate in the central northern area.

2.1.2 Due to the impermeable geology and existing infrastructure, currently all rainfall drains to the previously described onsite ditch network which in turn drains into one of the onsite watercourses. The watercourses leave the site via a culvert located in the south-west corner of the site. There are also a number of ponds located onsite, with the largest being located in between the onsite industrial estate and the offsite industrial estate just north of the sites boundary. This pond is currently an outfall for the offsite industrial estate and is connected to the pond via a surface water sewer, this pond drains into Hogwood Ditch.

2.2 Existing Greenfield Run-Off Rates

2.2.1 To confirm that there is no increase in surface water run-off from the site, the existing run-off rates for a variety of return periods have been calculated per ha using the Flood Estimation Handbook (FEH) Statistical method within the industry standard MicroDrainage 'Source Control' module.

2.2.2 The greenfield run-off rates are based on the parameters provided below in Table 1.

Table 1: Greenfield Run-Off Calculation Parameters

Parameter	Value
Area (ha)	3.36
SAAR (mm)	659
Soil	0.439

2.2.3 The soil value has been determined by comparing the identified geological characteristics of the site with the MicroDrainage Soil Index. MicroDrainage automatically selected a value of 0.439, meaning a mainly impermeable catchment. Which is accurate as the site is underlain by London Clay with a few areas of Bagshot formation.

2.2.4 The calculated greenfield run-off rates are provided below in Table 2.

Table 2: Existing Greenfield Run-Off Rates

Event	Run-Off (l/s/Ha)
QBAR	2.04
Q1	1.74
Q30	4.7
Q100	6.52

2.3 Existing Greenfield Run-off Volumes

- 2.3.1 Existing greenfield volumes have been calculated using the FEH Rainfall model within the industry standard MicroDrainage 'Source Control' module. This model shows 203.84m³ greenfield run-off volume per ha during a 360-minute duration 1in100 year storm event. Details on the factors used and the results are provided in Appendix E.

2.4 General Principles for Proposed Site Run-Off

- 2.4.1 The National Standards for Sustainable Drainage Systems (Defra,2011) state that the following options must be considered for disposal of surface water run-off in order of preference:

-  *Discharge to Ground*
-  *Discharge to Surface Water Body*
-  *Discharge to Surface Water Sewer*
-  *Discharge to Combined Sewer*

Discharge to Ground

- 2.4.2 The area of the proposed development consists almost exclusively of impermeable ground and therefore discharging to ground is not feasible.

Discharge to Surface Water Body

- 2.4.3 The onsite watercourses and ditch network are feasible to discharge surface water run-off to, as this is the natural drainage regime. In doing this surface water run-off would be conveyed away from the site and to Long River in the south. However, discharge rates post development must not be greater than greenfield rates or there would be an increased risk of flooding further downstream. Achieving greenfield discharge rates post development will be done through the use of attenuation and SuDS.

Discharge to Surface Water Sewer/Combined Sewer

- 2.4.4 Discharge to the public sewer network should only be considered once all other options for draining surface water from the site have been exhausted.
- 2.4.5 The existing drainage regime discharges to the onsite watercourses and therefore, the proposed development will do the same. Also, there is only one surface water sewer located onsite according to a Thames Water Asset Location Search Plan (See Appendix F) and it is an outfall into the site from the industrial estate adjacent to the sites northern boundary.

2.5 Sustainable Drainage Systems (SuDS)

- 2.5.1 To maximise the potential use of SuDS at the site, a review of each SuDS component has been undertaken and is shown below in Table 3 in accordance with the SuDS Hierarchy (refer to SuDS: A Practical Guide prepared by the Environment Agency). This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be

incorporated into the development. All recommendations are indicative only at this stage and will be assessed in further detail.

Table 3: SuDS Selection Based on the SuDS Hierarchy

Component	Recommendation
Green (living) roofs	Whilst the use of green roofs provides additional environmental benefits such as enhanced aesthetics and ecology, its exposure to wind and orientation must be considered. Access to undertake the construction and maintenance easily and safely is also a high priority. The proposed residential units will feature traditional pitched roofs, which are unsuitable for installation of a green roof.
Basins and Ponds	Ponds and attenuation basins can provide overland storage of surface water whilst also providing additional biodiversity and aesthetic/amenity value. The use of attenuation ponds and basins to help drain the sites run-off and these will be used where possible. Basins and ponds will also provide the necessary storage for surface water to be discharged at the existing greenfield rate. Any existing ponds that are proposed to be removed will be compensated for in terms of the surface water storage lost.
Filter Strips and Swales	Swales are linear vegetated drainage features, which provide overland conveyance and storage of surface water whilst trapping sediments and hydrocarbons within run-off. They also create biodiverse areas for planting and habitat. Where possible, swales will be used to formalise existing overland flow paths and provide effective conveyance across the site. Where swales are not feasible (due to site gradients), a traditional pipe network will be used.
Infiltration Devices	Infiltration devices, such as soakaways, are not feasible for this site due to the poor ground permeability of the underlying soils and potentially shallow depth of groundwater.
Permeable Paving	Tanked permeable paving will be used where possible to provide storage beneath private roads and parking areas, it is also considered as an option on adopted highways. This will provide additional attenuation of surface water run-off across the site. Permeable paving also provides treatment through filtration of silt (and attached pollutants), settlement and retention of solids, adsorption of pollutants and biodegradation of organic pollutants, including petrol and diesel.
Tanked Systems	This is the least sustainable option in terms of the SuDS Hierarchy. However, the use of tanked systems would still be of benefit compared to traditional drainage systems as it does allow run-off to be slowed down to an acceptable discharge rate. Tanked systems are currently proposed in areas of the site where other forms of attenuation/storage are not possible.

2.6 Proposed Surface Water Drainage Strategy

- 2.6.1 The following chapter should be read in conjunction with the surface drainage schematic plan which has been prepared to provide a detailed overview of the proposed site drainage strategy, see Appendix G, and Microdrainage calculations in Appendix H.
- 2.6.2 The total increase in impermeable area currently amounts to 28.12ha, however, consideration has also been given to the following:
-  The 2013 Environment Agency 'Rainfall Run-off Management for Developments' Reports (SC030219) states that urban creep, the process of gradually increasing impermeable area within an urban area (through paving soft landscaped surfaces and the construction of outbuildings etc.), is an acknowledged issue. To include an allowance for urban creep, the impermeable area of 28.12ha used in the drainage calculations has been increased by 10% in accordance with the recommendations made in SC030219.
 -  To include an allowance for the soft landscaping (public open space, verges and private gardens) within the development. The 28.12ha impermeable area used in the drainage calculations has been increased by a further 10%.
 -  This means that an additional 20% in impermeable area is incorporated in the attenuation shown on the drainage schematic provided in Appendix G.
- 2.6.3 Run-off from the development areas and roads (including the three proposed site accesses) will be captured at source and conveyed via a network of permeable paving, swales and/or pipes to a series of attenuation ponds, basins or underground tanks. Outflow controls will be set to ensure that the total discharge rate from the site is at the pre-development QBAR rate for all storm events up to and including the Q100 storm event plus a 40% climate change allowance. The climate change allowance used in the Drainage Strategy is in line with updated EA guidance values published in February 2016 for increased rainfall intensities by 2115.
- 2.6.4 Calculations to size the attenuation basins are based on the FEH rainfall method. This follows the 2015 EA Flood Estimation Guidelines Report (197_08); which states that flood estimates should be derived from Flood Estimation Handbook (FEH) methods in preference to other existing methods.
-  The size, location and profile of the basins have been indicatively proposed with consideration of detailed design constraints, including ground conditions in relation to earthworks and bank gradients. The land around the proposed attenuation basins will be locally levelled to a maximum depth of 1.25m above the existing ground levels, to minimise the earthworks required to construct the basins and achieve gravity outfalls into the existing ditch network.
- 2.6.5 The drainage schematic and calculations have been built around the following principles: -
-  A schematic network with the main pipe network shown and 3 pipes within each sub-catchment, set at a length to represent the average road length. This schematic network gives a more accurate representation of the drainage performance than the simplistic Source Control approach.
 -  Each of the 3 pipes within each sub-catchment are set as follows: -
 - 1 pipe represents uncontrolled flow from the permeable paved area, with the Time of Concentration manually adjusted within the drainage model to represent the slowing of run off through the sub-base. This is assumed as all roads within the model. However, this is an option only at this stage and will be reviewed on a parcel by parcel basis within the Reserved Matters applications.

- 1 pipe represents controlled flow from tanks located in private areas, these have been estimated based on the masterplan, and the storage volume noted on the drawing.
 - 1 pipe represents uncontrolled runoff from the sub-catchment, taking flows from areas not captured by tanks or private areas.
 -  Attenuation basins are proposed within the SANG and open space area, the SANG ponds are well detailed, given the need to provide detailed information for this area within the planning conditions. The remainder of the basins in the open space will be detailed in due course.
 -  The SANG basins have been designed to be naturalistic in shape and form, with varying bank profiles and shape. These were developed in close liaison with the landscape architect and WBC and are enhanced further by the landscaping scheme submitted to WBC under separate cover.
- 2.6.6 The existing Ancient Woodland running across the north of the western SANG area is a significant constraint as surface water drainage needs to cross from the development area to the north, into the SANG and onwards into the existing watercourses to the south, as shown on the drainage strategy. This has been reviewed in detail with the design team and in particular the arboriculturalist. An open swale was considered, however the depth of the drainage at this location and the size and heavily reinforced nature of swale required to carry the significant flows, lead to this option being discounted.
- 2.6.7 Initial liaison has been undertaken with a trenchless installation specialist and with Thames Water to confirm that a trenchless installation would be feasible. This approach has the advantage that sewers can be installed under the Ancient Woodland, whilst maintaining the existing land form and soil structure. Retention of the trees is a matter for discussion with WBC as some soil settlement is expected from the trenchless installation which may be detrimental to trees. Correspondence and a preliminary section for the Ancient Woodland is included in Appendix I.
- 2.6.8 The presence of the existing oil pipeline has been a major factor in the design of the site layout and has been agreed with CHL. Drainage crossings of the oil pipeline have also been a major constraint and the principles of these crossings agreed with CHL, correspondence and typical section included in Appendix J. The line and level of the oil pipeline is to be determined through on-site trenching shortly.
- 2.6.9 Drainage also crosses the existing overhead High Voltage cabling in the SANG, where SSE have agreed to the location and form of the SuDS basins as shown on the drainage schematic in Appendix G. Surface water outfalls also cross the grounded section of HV cabling in the eastern phase of the development, where the cabling is to run in parallel with Robinson Crusoe Ditch. SSE have agreed in principle that the HV cabling will locally dip under the surface water pipework, as per the typical sections in Appendix K.
- 2.6.10 The proposed impermeable area will be formally drained as part of the drainage strategy. This will reduce the open space available for potential infiltration to ground (although the sites underlying geology is mostly impermeable), which in turn will reduce the groundwater level below the site. Therefore, the post-development groundwater level is likely to be lower than the existing. Despite this, a low risk of groundwater ingress into the attenuation areas (especially in the south-western area of the site) remains. This is because the Site Investigation contains no groundwater monitoring and the levels recorded were taken during the seasonal low in terms of groundwater levels. Ground water monitoring at the site during a seasonal peak is recommended to support detailed design.
- 2.6.11 There is potential for the installation of underground utilities to create a groundwater flow pathway (i.e. the sewers and their associated granular surround). The potential for groundwater ingress into the attenuation basins via granular surround of the incoming pipes will be mitigated through the provision of interception trenches to divert any groundwater flows around the pond preventing ingress.

- 2.6.12 In the north-eastern corner of the site a drainage ditch which runs along Park Lane will be re-aligned to join into Robinson Crusoe ditch, allowing the construction of the eastern connection of the Nine Mile Ride Extension. The proposed re-alignment of the ditch will also improve the drainage of the highways in the area. This is covered in more detail in Section 3.3 of the Flood Risk Assessment and will be subject to further review at detailed design stage.

2.7 Post Development Run-off Volumes

- 2.7.1 The post development surface water run-off volume during a 360-minute duration Q100 storm event will increase due to the inclusion of new impermeable areas.
- 2.7.2 Given the unsuitability of infiltration across the site, reducing post development run-off volumes to pre-development rates is not possible. If controlling run-off volume to greenfield volumes is unachievable, the 2015 SuDS Manual notes that *“any additional volume should be stored and released at a low rate that will not increase downstream flood risk (normally 2 l/s/ha) is considered an appropriate rate, using either of the following approaches:*
-  *The additional run-off volume (i.e. the difference between the predicted development run-off volumes and the estimated greenfield run-off volume for the Q100 event, often called Long Term Storage) should be discharged from the site at a rate of 2 l/s/ha or less, while still allowing greenfield run-off peak flow rates to be applied for the greenfield run-off volume.*
 -  *All the run-off from the site for the Q100 year event should be discharged at either a rate of 2 l/s/ha or the average annual peak flow rate (i.e. the mean annual flood, QBAR). Whichever is the greater.”*
- 2.7.3 By controlling run-off rates to QBAR for all storm events up to and including a Q100 plus climate change allowance event, the additional run-off volume will not increase downstream flood risk.
- 2.7.4 The onsite pond which is an outfall for the adopted network from Hogwood Industrial Estate will be relocated. No details are available for this pond or flow control, other than the topographical survey. This pond has a water level of 56.5m and an estimated volume of approximately 1650m³, and a discharge rate of 5 l/s. The discharge rate was calculated by modelling the Industrial Estate's existing surface water sewer network from the information provided in the Thames Water Asset Records. Impermeable areas were measured from the Ordnance Survey Map of the area and applied to the modelled network. The network was simulated at the 1in30 year storm event as the existing basin was designed to this parameter. The discharge rate was determined by restricting the outflow until the storage volume available in the basin, was fully utilised.
- 2.7.5 The outfall for the industrial estate will be re-located to an onsite SuDS basin and attenuation area. The outfall will be set at the existing rate of 5 l/s, so there is no increased risk of flooding downstream or on the industrial estate.

2.8 Exceedance Flooding

- 2.8.1 The designs of the development land should consider the layout of buildings and roads to follow the principle of routing exceedance flows away from buildings and into areas of SuDS, drainage or watercourses. This will be considered at detailed design stage.

2.9 Consents, Offsite Works and Diversions

- 2.9.1 The proposed surface water drainage strategy is accommodated entirely onsite and therefore there will be no requirements for offsite sewer works or diversions.

2.10 Maintenance

- 2.10.1 A maintenance plan has been prepared to outline the management of the potential permeable paving, swales, pipe network and attenuation basins. This maintenance plan also includes details on the maintenance requirements for each type of SuDS used onsite and is provided in Appendix L. This plan will be updated through the development process.

2.11 Post-Development Water Quality Treatment

- 2.11.1 In line with the 2015 SuDS Manual (C753), certain criteria should be applied to manage the quality of run-off to support and protect the natural environment effectively. Treatment design, wherever practicable, should be based on good practice, comprising of the following principles:

-  Manage surface water run-off close to source
-  Treat surface water run-off on the surface
-  Treat surface water run-off to remove a range of contaminants
-  Minimise risk of sediment remobilisation
-  Minimise impacts for accidental spills

- 2.11.2 Managing pollution close to the source can help keep pollutant levels and accumulation rates low, essentially allowing natural treatment processes to be effective. This in turn can help maximise the amenity and biodiversity value of downstream surface SuDS components and keep maintenance activities straightforward and cost-effective.

- 2.11.3 The proposed development comprises of four types of land use; residential roofs, other roofs (commercial/industrial), individual property driveways/infrequent change carparks/low traffic roads and non-residential car parking with frequent changes/all other roads/delivery area. These land uses are classified as having from very low to medium hazard pollution levels.

- 2.11.4 As per Table 4.3 of the 2015 SuDS Manual (C753), the minimum water quality management requirement for discharges to surface water requires the Simplified Index Approach to be applied, which has replaced the previous requirement to provide 'treatment stages'. The Simplified Index Approach uses the following steps:

-  **Step 1** - Allocate suitable pollution indices for the proposed land use
-  **Step 2** - Select SuDS with a total pollution mitigation index that equals or exceed the pollution hazard index
-  **Step 3** - Where the discharge is to protected groundwater, consider the need for a more precautionary approach.

Step 1

2.11.5 Table 26.2 of the 2015 SuDS Manual (C753) sets out the required pollution hazard indices for various land uses. The pollution hazard indices for the site is as follows:

-  Total suspended solids (hereon referred to as TSS) is 0.2 to 0.7
-  Metals is 0.2 to 0.6 (with potential to reach 0.8 depending on metal leeching from roofs)
-  Hydro-carbons is 0.05 to 0.7. This table is provided below in Table 4.

Table 4: Pollution Hazard Indices as per the 2015 SuDS Manual (C753)

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Step 2

2.11.6 The proposed drainage strategy utilises the following SuDS features (to be confirmed at a later date):

-  Swales to convey surface water run-off from the development areas into attenuation.
-  Basins and ponds to attenuate surface water run-off before discharge into the local watercourse network.
-  Permeable pavement to attenuate and convey surface water run-off across the site into an attenuation basin or pond.

2.11.7 The indicative SuDS mitigation indices, provided in Table 26.3 of the 2015 SuDS Manual (C753) have been reviewed for the swales, permeable paving, detention basins and ponds. The table is provided below in Table 5.

Table 5: Indicative SuDS Mitigation Indices from the 2015 SuDS Manual (C753)

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

- 2.11.8 To deliver adequate treatment, the selected SUDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type), as follows:

$$\begin{array}{ccc} \text{Total SuDS mitigation} & \geq & \text{pollution hazard index} \\ \text{(for each contamination type)} & & \text{(for each contaminant type)} \end{array}$$

- 2.11.9 For each type of land use, the pollution hazard indices, mitigation indices and concluding hazard have been summarised in Table 6 below.

Table 6: Site Roof/Land Use Types Water Quality Mitigation Summary

Residential Roofs				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.2	0.2	0.05	Table 26.2
Mitigation Index (Basin)	0.5	0.5	0.6	Table 26.3
Mitigation Index (Swale)	0.5	0.6	0.6	Table 26.3
Mitigation Index (Permeable paving)	0.7	0.6	0.7	Table 26.2
Mitigation Index (Ponds)	0.7	0.7	0.5	Table 26.2
Total Mitigation index	2.4	2.4	2.4	
Result	Total SuDS mitigation index ≥ pollution hazard index and therefore hazard is exceeded			
Commercial/Industrial Roofs				SuDS Manual Reference

	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.3	0.2-0.8	0.05	Table 26.2
Mitigation Index (Basin)	0.5	0.5	0.6	Table 26.3
Mitigation Index (Swale)	0.5	0.6	0.6	Table 26.3
Mitigation Index (Permeable paving)	0.7	0.6	0.7	Table 26.2
Mitigation Index (Ponds)	0.7	0.7	0.5	Table 26.2
Total Mitigation index	2.4	2.4	2.4	
Result	Total SuDS mitigation index $\geq$ pollution hazard index and therefore hazard is exceeded			
Individual Driveways/Infrequent Change Carparks/Low Traffic Roads				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.5	0.4	0.4	Table 26.2
Mitigation Index (Basin)	0.5	0.5	0.6	Table 26.3
Mitigation Index (Swale)	0.5	0.6	0.6	Table 26.3
Mitigation Index (Permeable paving)	0.7	0.6	0.7	Table 26.2
Mitigation Index (Ponds)	0.7	0.7	0.5	Table 26.2
Total Mitigation index	2.4	2.4	2.4	
Result	Total SuDS mitigation index $\geq$ pollution hazard index and therefore hazard is exceeded			
All Other Roads/Non-Residential Carparks with Frequent Change				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.7	0.6	0.7	Table 26.2
Mitigation Index (Basin)	0.5	0.5	0.6	Table 26.3
Mitigation Index (Swale)	0.5	0.6	0.6	Table 26.3
Mitigation Index	0.7	0.6	0.7	Table 26.2

(Permeable paving)				
Mitigation Index (Ponds)	0.7	0.7	0.5	Table 26.2
Total Mitigation index	2.4	2.4	2.4	
Result	Total SuDS mitigation index $\geq$ pollution hazard index and therefore hazard is exceeded			

- 2.11.10 Therefore, it can be concluded that the provision of basins and swales exceed the required pollution mitigation indices and provides sufficient treatment as part of the surface water management train, in accordance with the 2015 SuDS manual (C753). Any additional SuDS measures that may be implemented would only further better this.

Step 3

- 2.11.11 The drainage strategy does not discharge to ground and therefore a more precautionary approach is not required.

3 FOUL WATER DRAINAGE STRATEGY

3.1 Foul Water Drainage

- 3.1.1 A Sewer Impact Study was carried out for the site by Thames Water in 2017, this report is provided in Appendix M.
- 3.1.2 The existing buildings on the development area are pumped towards a Thames Water manhole (SU77645601) adjacent to the sites north-eastern corner. There is a public gravity foul sewer located along Park Lane which runs along the sites eastern boundary, the sewer pipe is 300mm diameter. From there the foul water is transported 3.7km north-westwards to the Arborfield Sewage Treatment Centre.
- 3.1.3 Thames Water carried out hydraulic modelling to indicate if the existing foul sewer has capacity to take the increased flow from the proposed development. The findings of the hydraulic modelling were that a direct connection into the existing manhole (SU77645601) and 300mm diameter sewer would lead to surcharging and flooding of the sewer system.
- 3.1.4 Thames Water outline one indicative option to mitigate the impacts of the proposed development on the existing foul sewer network. The indicative option is comprised of the following key points:
-  Development flows to be connected to manhole SU77645601.
 -  A new manhole must be provided 20m downstream of the existing manhole, SU77645601.
 -  The addition of 83m³ of online storage must be provided by increasing the size of the existing gravity sewer off Park Lane. This will be done by changing the sewer from a 300mm diameter sewer to a rectangular sewer which will be 1500mm x 1000mm (width x length) between the required new manhole and existing manhole (SU77645601). The total length of the upsized sewer will be approximately 58m.
 -  Discharge from the site into the public sewer network will be limited to 48l/s at manhole SU77645904.
- 3.1.5 Thames Water have also stated that due to the development size it will be a requirement that two permanent depth loggers are installed to monitor the flows at the downstream point of the development and at the proposed connection point with the existing sewer network.
- 3.1.6 Following the changes to infrastructure charges for new connection services, introduced in April 2018, the responsibility to provide off-site foul water capacity is the responsibility of Thames Water. Given the site topography which falls south, away from the outfall manhole, 2 pump stations are proposed, as shown on drawing C85672-SK-207 in Appendix N, located within at the southern extent of the development area.

4 DRAINAGE DURING CONSTRUCTION

4.1 Construction Run-off Management

- 4.1.1 Installing the surface water and foul drainage system, whilst managing temporary run-off, are key aspects of the construction works involved in any development. The information provided below is in accordance with the 'C698 Site Handbook for the Construction of SuDS' (CIRIA, 2007).

4.2 Management of Repairs (Including Drainage)

- 4.2.1 The development will require the diversion of one surface water sewer and any other pipe work which is privately owned onsite. The proposed drainage strategy for the site will require excavation of material across the site and the laying of a new pipe network. It is important that any repairs/changes are managed to ensure no sediment or pollutants enter the network and cause blockages or compromise water quality downstream.
- 4.2.2 A plan for the management of repairs (including phasing works, details of any offsite works etc.) cannot be provided at this early stage, as construction work plans are not yet known. However, the following key points are common construction issues associated with installing SuDS, which will need to be addressed when plans are complete:

-  Silt, dust and construction material laden water from works may pollute the watercourses
-  Any polluted waters cannot enter the drainage system as it can cause clogging and pollute receiving outfalls in this case the onsite watercourses of Hogwood Ditch and Robinson Crusoe Ditch.
-  Any gulley's and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to the attenuation SuDS devices.

4.3 Temporary Drainage During Construction

- 4.3.1 The three principal aspects of drainage control during construction are trapping sediment, conveying run-off, and controlling run-off.
- 4.3.2 Sediment traps and barriers can include basin traps and sediment fences (with any necessary boundary controls). The principal basins should be installed after the construction site is accessed. Sediment fences and barriers should then be installed as needed during grading.
- 4.3.3 Conveyance of run-off can be achieved through small ditches/stream, storm drains, channels and slope drain with sufficient inlet/outlet protection. Slope stability needs to be considered when using any channels to convey run-off across the site into any basins etc. Run-off control measures should be implemented to ensure that run-off does not overwhelm the temporary system and cause flooding issues. Run-off rates from the site should be managed so they are no greater than pre-development. Any additional conveyance measures should be installed as needed during grading.
- 4.3.4 Run-off control should include provision of perimeter ditches or appropriate levels grading to ensure that any water from the construction site stays onsite.
- 4.3.5 Any necessary surface stabilisation measures should be applied immediately on all disturbed areas where construction work is either delayed or incomplete.

4.3.6 Maintenance inspections should be performed weekly, and maintenance repairs should be made immediately after periods of rainfall.

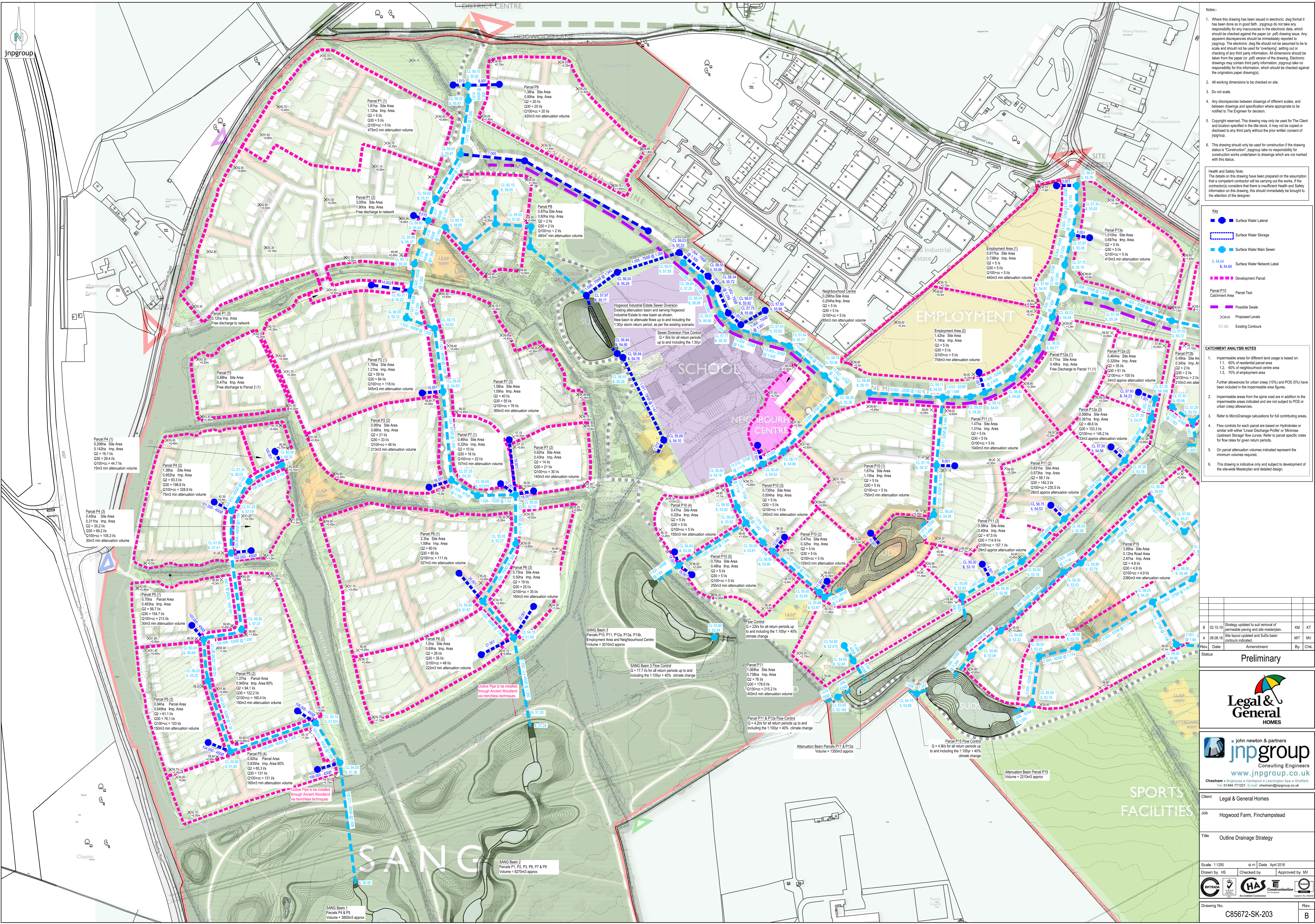
4.4 Protection of Drainage Infrastructure during Construction

4.4.1 All drainage infrastructure will be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers and storing construction materials away from the drainage infrastructure.

5 CONCLUSIONS

- 5.1.1 This drainage strategy has been prepared in accordance with Wokingham Borough Councils Guidance.
- 5.1.2 The existing site is mainly large open fields which are used for agricultural purposes and separated by hedgerows and fences. Sections of ancient woodland, ditches, and various buildings are present across the site. The site is bounded by Reading Road (A327) to the west, Park Lane to the east, south-east and north-east and Sheerlands Road to the north-west.
- 5.1.3 The site is 109.824ha and the development proposed consists of the construction of 1,500 dwellings, 6.529ha of general industrial and employment land, a 0.296ha neighbourhood centre, 2.506ha for the construction of a primary school, 1.866ha for use as community allotments. 5.970ha of outdoor sports facilities, 21.539ha of open space (parks etc.) and 29.942ha of Suitable Alternative Natural Greenspace (SANG).
- 5.1.4 The Site Investigation data for the site revealed that the soils underlying the site have poor infiltration potential due to its high clay content and seemingly low concentration's of groundwater. However, further groundwater monitoring is proposed to confirm groundwater levels across the site.
- 5.1.5 The existing site drains via a network of ditches and onsite watercourses to the south-western corner of the site where it leaves via a large concrete culvert. It is proposed to formalise and retain this arrangement post development.
- 5.1.6 To ensure that the rate of post development surface water run-off is no greater than existing it is proposed to attenuate run-off from all hardstanding using local attenuation basin, storage tanks, ponds and tanked permeable paving collectively designed to store surface water run-off from storm events up to and including the Q100 plus a 40% allowance for climate change storm event. Swales and permeable paving will be used to treat and convey surface water run-off across the site where feasible. Where swales and permeable paving cannot be utilised, piped systems will be used in order to convey surface water run-off to a form of attenuation.
- 5.1.7 The sites surface water run-off will be treated in accordance with guidance contained within the 2015 SuDS Manual (C753) to ensure that there is no negative impact on the water quality of the onsite watercourses.
- 5.1.8 Discharge from the development will be limited to QBAR rates. This discharge will be directed into the onsite ditch network and watercourses as per the existing flow paths. This will ensure that there is no greater risk of flooding post development, both on and offsite. The attenuation will have additional storage to attenuate the run-off from the main road infrastructure (including from the additional hardstanding that will results from the construction of the vehicular connections with the surrounding road network) to QBAR.
- 5.1.9 An additional 10% allowance for soft landscaping areas and another 10% for urban creep has been included in the sizing of attenuation.
- 5.1.10 A maintenance plan has also been developed to confirm the management of the proposed SuDS components.
- 5.1.11 During the construction stage and subsequent phased works, temporary drainage control and run-off management measures will be implemented to ensure flood and pollution risks are managed. Any constructed drainage infrastructure will be protected during the overall construction works to ensure their future effectiveness.
- 5.1.12 In conclusion, the proposed developments surface water run-off will be managed safely onsite and discharged at no greater than QBAR for all storm events up to and including the Q100 plus an allowance for climate change storm event without posing a risk of flooding.

- 5.1.13 The comments stated above are based on information received from other consultees. This report is intended for the use of the developer of the site in support of their planning application for the site only.



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The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

Key

- Surface Water Lateral
- Surface Water Storage
- Surface Water Main Sewer
- Surface Water Network Label
- Development Parcel
- Parcel P10 Catchment Area
- Possible Sewer
- Proposed Levels
- Existing Contours

CATCHMENT ANALYSIS NOTES

- Impervious areas for different land use is based on:
 - 1.1. 60% of residential parcel area
 - 1.2. 60% of neighbourhood centre area
 - 1.3. 70% of employment areaFurther allowances for urban creep (10%) and POS (5%) have been included in the impervious area figures.
- Impervious areas from the spine road are in addition to the impervious areas indicated and are not subject to POS or urban creep allowances.
- Refer to MicroDrainage calculations for full contributing areas.
- Flow controls for each parcel are based on Hydrobrake or similar with either 'Linear Discharge Profile' or 'Minimise Upstream Storage' flow curves. Refer to parcel specific notes for flow rates for given return periods.
- On parcel attenuation volumes indicated represent the minimum volumes required.
- This drawing is indicative only and subject to development of the site-wide Masterplan and detailed design.

Rev.	Date	Amendment	By	CHK.
B	02.10.19	Strategy updated to suit removal of permeable paving and site masterplan.	KM	KT
A	08.08.18	Site layout updated and SUDs basin contours indicated.	MIT	MV

Status: Preliminary

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Job: Hogwood Farm, Finchampstead

Title: Outline Drainage Strategy

Scale: 1:250 @ A0 Date: April 2018

Drawn by: HS Checked by: Approved by: MV

Drawing No. C85672-SK-203 Rev. B