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Flood Risk and Drainage Strategy Assessment:

Ickleford Manor
Turnpike Lane
Ickleford
Hertfordshire

July 2016

451816 – PEP – 00 – XX – RP – D – 6200

Rev No – P02

ISO 9001 REGISTERED FIRM
CONTRACTORS HEALTH & SAFETY ASSESSMENT SCHEME
Constructionline Part of Capita plc

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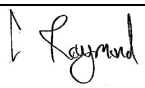
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1. INTRODUCTION

PEP Civil and Structures Limited have been commissioned by Jarvis Homes to provide a Flood Risk Assessment and Drainage Strategy for the redevelopment of part of the Ickleford Manor site, to provide residential accommodation.

Ickleford Manor is situated in Hertfordshire, on the southwest side of Ickleford at the junction of Turnpike Lane to the north and the A600 Bedford Road to the west (*See Figure 1 and 2).*

The development area is currently occupied by a series of industrial buildings that are situated immediately to the west of the Manor House itself. The Manor House does not form part of the development, but the Manor owners are the development site vendors.

Development proposals include the erection of 19 dwellings, together with associated hardstanding and supporting infrastructure. Primary vehicular access is proposed off a Turnpike Lane to the north of the site.

A desktop site investigation has been undertaken by WDE Consulting, which suggests the underlying local geology is likely to comprise up to1.25m of Made Ground overlaying Firm Clay. However, detailed liaison between Jarvis Homes and the Caretaker of the industrial site (who has been working there since the 1970's) has confirmed that a number of the industrial buildings are currently drained by soakaways, suggesting that more permeable soils are present. This would also explain the apparent lack of a public surface water drainage network serving the existing houses to the north of Turnpike Lane. It is understood that the remainder of the industrial units and the Manor House itself discharge surface water via a private combined sewer which eventually links to the Anglian Water sewer further along Turnpike Lane.

The EA Flood Map shows that the site falls within Flood Zone 1 (*See Figure 3).*

2. DEVELOPMENT DESCRIPTION AND LOCATION

2.1 Site Location and Description

The proposed site is located immediately to the South of Turnpike Lane and will be accessed by a new entrance road off this lane. The road will replace the current site access which serves a number of industrial and office buildings plus the Manor House itself. It should be noted that the access road works (and some additional parking provision for the Manor House and a number of retained office units) is to be undertaken by others outside of the Jarvis Homes development proposals described and assessed here.

The development area covers the land currently occupied by the industrial buildings, plus associated areas of hardstanding and soft landscaping. The existing Manor House lies immediately to the east and will remain unaffected by the proposals, with the exception of the replacement site access which it will share.

The current site area consists of 0.175ha of existing buildings plus associated hardstandings, giving a total impermeable area of 0.269ha pre-development (*See Figure 5).*

The proposed development area consists of 0.152ha of new buildings plus associated hardstandings, giving a total impermeable area of 0.274ha post-development. This represents a 2% increase on the pre-development impermeable area of the site (*See Figure 6).*

The development proposals suggest that the entire site be developed to form 19 dwellings together with their associated hardstanding and supporting infrastructure *(See Figure 6).*

2.2 Site Vulnerability Classification

As the development proposals include the erection of residential units, Table 2 in the NPPF technical guide classifies the development as *More Vulnerable*, see below.

More Vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

PPG Extract: Table 2: Flood Risk Vulnerability Classification

2.3 Evidence that the Sequential / Exception Test has been applied

The site is located within Flood Zone 1 *(See Figure 3)* and on this basis targets an area considered as having the lowest probability of flooding. In line with the guidance provided by Table 3 of the PPG extracted below, the development is therefore deemed suitable in this location.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓*

PPG Extract: Table 3: Flood Risk Vulnerability and Flood Zone Compatibility.

3. DEFINITION OF THE FLOOD HAZARD

3.1 Determination of the sources of flooding that may affect the site

In accordance with PPG, the potential sources of flooding facing the development may categorised as follows:

- River Flooding
- Overland Flooding
- Groundwater Flooding
- Sewer Flooding
- Lake & Reservoir Flooding

Each of the above sources is addressed below with regards to their effect and proposed method of mitigation for the proposed development.

3.1.1 River Flooding

The only potential source of River flooding in the vicinity of the development is the River Oughton 0.2km to the South. However, the river lies approximately 5m lower than the site level (based on Ordnance Survey data).

In accordance with the EA Flood map the site is located within Flood Zone 1 and is assessed as having an annual probability of exceedance of less than 0.1%. On this basis, we may consider the probability of flooding by this means as negligible *(See Figure 3).*

3.1.2 Overland Flooding

The proposed drainage regime for the site development area will be designed to adequately intercept the overland flows experienced during the 100 year storm event. This will include a 20% increase in peak rainfall intensities to combat the potential future effects of climatic change during the life of the buildings, plus a secondary review at 40%.

The on-site flows will be conveyed to the new surface drainage system, thus mitigating the effect of the redevelopment on the surrounding area. The pipework system will be designed in such a way as to ensure no surcharging during the 2 year return period, no flooding during the 30 year return period and controlled surface ponding for the 100 year plus climate change event. For additional protection to the proposed buildings, site levels will be designed in such a way as to form flood flow lines away from ground floor units, thus further minimising the risk associated with this form of flooding.

Turnpike Lane immediately to the north of the development site, and Bedford Road immediately to the west will act as effective cut-off channels for any potential overland flows from the existing residential development area to the north (in the event of a sewer network failure affecting the existing housing developments). Both of these roads have positive drainage systems and decent kerbing. They also sit lower than the general site levels, and fall relatively steeply (Turnpike Lane falling to the east and Bedford Road falling to the south) so any overland flows reaching the roads will be channel away along the carriageway to areas much lower-lying than the site.

In conclusion, the local topography and existing road layout, coupled with the proposed approach to the design of the on-site drainage systems, will ensure that the risk associated with this form of flooding may be regarded as negligible.

3.1.3 Groundwater Flooding

As this report is being provided for Outline Planning Permission only, a full intrusive site investigation report is not currently available to us.

A desk study report has however been undertaken by WDE Consulting, which includes some British Geological Survey borehole records. The boreholes were located approximately 0.5km from the site, and encountered no groundwater down to depths of between 7.25m and 10.0m below ground level.

Furthermore, the caretaker for the current industrial development on the site has confirmed that a number of the industrial buildings are presently drained by soakaways, suggesting that permeable soils are present (at least locally). Nor is he aware of any groundwater problems on site during his 45+ year tenure.

Groundwater flooding is not therefore considered to be a risk item for the site.

It is however proposed that a fully detailed intrusive geotechnical site investigation will be commissioned at the next stage of the development process, and this will include a check of groundwater levels.

3.1.4 Sewer Flooding

The current proposals for the site drainage system are based on using a combination of permeable pavements and cellular crate soakaways to dispose of the on-site flows by infiltration techniques, based on anecdotal feedback from the site caretaker in relation to the current drainage system utilised by a number of the industrial buildings. The validity of this approach will be confirmed as part of a fully detailed intrusive geotechnical site investigation to be commissioned at the next stage of the development process. This will include trial pit soakage testing to BRE Digest 365.

As such there will be no surface water discharge or increase in associated flows to the local public sewer network, so the development will have no adverse impact on this.

Should any flooding issues occur within the existing public sewer network then flood flows would be directed away from the development site as described under the third paragraph of section 3.1.2 above.

The on-site drainage network will be adequately designed to intercept and accommodate the high intensity rainfall experienced during the 1% annual probability event, which will include an increase of 20% to 100 year peak rainfall intensities to combat the potential future effects of climatic change, plus a secondary review at 40%. Furthermore, the pipe network will be designed to ensure that no surcharging is experienced during the 2 year return period and no surface flooding during the 30 year return period.

The above approach to the proposed on-site drainage network will therefore ensure there is no increased risk associated with sewer flooding for the immediate and downstream areas of the development. In fact, the development will remove some of the current combined discharge to the Anglian Water sewer (see the fifth paragraph of section 1 above) which will improve the future flow rates in the public sewer downstream.

3.1.5 Lake and Reservoir Flooding

There are no lakes or reservoirs within the vicinity of the development site. Consequently there is no the risk to the development associated with this form of flooding.

3.2 Existing Surface and Foul Water Drainage Arrangement

The following sources have been used to determine the current surface and foul water drainage arrangements on the site:

- Site topographical survey plan
- Anglian Water public sewer record plan
- Anecdotal feedback from the site caretaker who has been involved with the site since the 1970s

On the basis of the above it is understood that:

Surface water run-off from a number of the existing industrial buildings is directed to a pair of rubble filled trench soakaways located toward the southern boundary of the site.

The remaining surface water run-off from the other industrial buildings and the Manor House itself, plus all foul water flows, are discharged to an existing private combined sewer running through the adjacent Manor House grounds. This eventually connects to the Anglian Water public foul sewer network at their manhole ref 0301 located at the junction of Turnpike Lane and Greenfield Avenue.

4. PROBABILITY

4.1 Flood Zone Classification

The Environment Agency flood maps show that the site is situated within Flood Zone 1, with an annual risk of flooding from river or sea of less than 1:1000 (*See Figure 3).*

4.2 Existing Surface Water Discharge

It is understood that the site is currently part drained by on-site soakaways, with the remaining surface water discharged via a private combined sewer connected to the Anglian Water public sewer network further along Turnpike Lane.

5. EFFECT OF CLIMATE CHANGE

In accordance with PPG Technical Guidance and the design life of the re-development, storm water calculations will include a 20% increase in the 100year peak rainfall intensities to combat the potential future effects of climatic change, with additional checks at 40% climate change.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

EA Guidance Extract: Table 2: Recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height.

6. DETAILED DEVELOPMENT AND DRAINAGE PROPOSALS

6.1 Investigation into possible SUDS Techniques

Figure 7 illustrates the schematic drainage layout and location of the various SUDS techniques that form part of the proposed surface water solution.

Various methods of disposing of the surface water run-off generated by the development have been investigated in line with the guidance provided in *CIRIA C753*, before arriving at the proposed drainage solution discussed under item 6.2 below. A brief summary of the findings of this exercise is listed below.

- **Soakaways / Infiltration Basins:**

  Based on anecdotal evidence from the caretaker for the current industrial development on the site, it is understood that a number of the existing buildings are drained by soakaways, indicating that permeable soils are present (at least locally). The proposed surface water drainage strategy is consequently based on this approach, i.e. using infiltration techniques.

  The validity of this approach will be confirmed as part of a fully detailed intrusive geotechnical site investigation to be commissioned at the next stage of the development process. This will include trial pit soakage testing to BRE Digest 365.

- **Swales:**

  No communal soft-landscaped open space is proposed as part of the new development, and the only undeveloped area along Turnpike Lane is heavily populated with trees and shrubs. Consequently there are no practicable areas where swales could be utilised, and as a result this form of technique has not been included.

- **Porous Paving:**

  The main access road, parking bays and driveways within the development area boundary readily lend themselves to this approach, subject to infiltration testing at a later stage.

- **Geocellular / Modular Systems:**

  In order to minimise excavation volumes, cellular crates will be used for the on-site soakaways to maximise the available storage volume per unit area. Adequate maintenance access will be provided by rodding points and channels within the base units of each soakaway.

- **Basins and Ponds:**

  These techniques have been ruled out for the reasons described previously under the section on Swales above.

- **Stormwater Wetlands:**

  These techniques have been ruled out for the reasons described previously under the section on Swales above.

6.2 Proposed Surface Water Drainage System

The development proposals include the erection of 19 residential units with a footprint of 1520m^2, along with their associated hardstanding and supporting infrastructure *(See Figure 7)*. Primary access to the development is via a proposed new entrance road off Turnpike Lane, the construction of which does not form part of the main development covered by this report.

Based on our understanding that part of the current site discharges to soakaways, and subject to BRE Digest 365 testing to be undertaken at the next stage of the development process, it is proposed that the surface water run-off will be discharged using on-site infiltration techniques.

The main site road, parking bays and driveways will be constructed as permeable pavements, with the sub-base stone depth designed to provide the required attenuation storage during infiltration. As well as taking run-off from the road surface, the permeable pavement will also take discharge from paths and driveways fronting onto the road, together with the front roofs to the housing units.

The permeable stone sub-base will deal with any oil that may find its way off the road and driveway surfaces, with a secondary line of defence provided by a geotextile at formation level. In this way the system will provide a suitable number of treatments in line with the SUDS train to achieve a suitable quality of runoff prior to discharging into the ground.

The rear roofs to the housing units will be discharged into a traditional piped network linked to a number of individual soakaways in the rear gardens. Catchpit manholes will be provided immediately upstream of the soakaways to catch any silt and pollutants (although as the network will only be taking roof discharge, the run-off should be clean).

As site specific infiltration test results are not available to us at this stage, we have used a value (based on table 25.1 of the CIRIA SUDS Manual) for a very silty clayey sand of 5.0E-6 m/s in order to undertake some preliminary soakaway sizing.

TABLE 25.1 Typical infiltration coefficients based on soil texture (after Bettess, 1996)

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media		
• gravel	Sandy GRAVEL	$3 \times 10^{-4} - 3 \times 10^{-2}$
• sand	Slightly silty slightly clayey SAND	$1 \times 10^{-5} - 5 \times 10^{-5}$
• loamy sand	Silty slightly clayey SAND	$1 \times 10^{-4} - 3 \times 10^{-5}$
• sandy loam	Silty clayey SAND	$1 \times 10^{-7} - 1 \times 10^{-5}$
Poor infiltration media		
• loam	Very silty clayey SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$
• silt loam	Very sandy clayey SILT	$1 \times 10^{-7} - 1 \times 10^{-5}$
• chalk (structureless)	N/A	$3 \times 10^{-8} - 3 \times 10^{-6}$
• sandy clay loam	Very clayey silty SAND	$3 \times 10^{-10} - 3 \times 10^{-7}$
Very poor infiltration media	–	
• silty clay loam	–	$1 \times 10^{-8} - 1 \times 10^{-6}$
• clay	Can be any texture of soil	$< 3 \times 10^{-8}$
• till	described above	$3 \times 10^{-9} - 3 \times 10^{-6}$
Other		
• rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$

CIRIA C753:The SuDs manual, 2015

Preliminary microdrainage design calculations can be found under *Figure 10* at the end of this report, and the various storage structure sizes are indicated on *Figure 7*.

6.3 Proposed Foul Water Drainage System

It is proposed that foul water will be discharged to the Anglian Water public sewer network in Turnpike Lane, via their manhole ref 0301 located at the junction of Turnpike Lane and Greenfield Avenue. This mimics the current outfall arrangement as described by the site caretaker, and will require the construction of a new foul sewer across the Manor House grounds to reach the outfall location *(See Figure 8)*. This will be subject to financial and legal agreement between the developer and site vendor.

Using the SFA7 guidance of 4000l/day, the peak foul flow is estimated to be 0.88l/s for the 19 units.

6.4 Maintenance of SUDS Features

The maintenance guidance for the various SUDS features forming the proposed drainage network is based on guidance provided in CIRIA C753. All surface water drainage systems will be maintained by a reputable service company appointed by the developer.

6.4.1 Porous / Permeable Surfaces

Also refer to manufacturer's specific guidance.

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

CIRIA C753:The SuDs manual, 2015

6.4.2 Geocellular / Modular System Soakaways

Also refer to manufacturer's specific guidance.

TABLE 13.1 Operation and maintenance requirements for soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

CIRIA C753:The SuDs manual, 2015

6.4.3 Inlets and Outlets

It is suggested that six monthly inspections are carried out to ensure inlets and outlets are fit for purpose and clear of litter, debris and any other obstructions. Over and above the six monthly inspections, it is suggested that additional inspections be carried out after large storm events. These large events have a greater probability of mobilising litter and debris within the network which could negatively affect the performance of the network.

7. FLOOD RISK MANAGEMENT MEASURES

Floor levels will be raised above adjacent areas of hardstanding as far as practicably possible, and site levels will be designed to form flood flow lines away from units, thus ensuring that water ingress to ground floor units is not a risk.

All roads and surface water drainage networks will be maintained by a reputable service company appointed by the developer.

8. OFF SITE IMPACTS

As the site is located within flood zone 1, and the proposed surface water runoff will be dealt with on site, the downstream risk is negligible. In fact, the proposal to deal with all surface water run-off on site means that the current partial combined discharge to the Anglian Water public sewer will be reduced, improving conditions in the public sewer network downstream.

9. RESIDUAL RISKS

As the proposed surface water drainage system will be designed to accommodate the high intensity rainfall experienced during the 100 year return event, and include allowance for a 20% increase in peak rainfall intensities to accommodate potential future climatic change (plus a further check at 40%) the residual risk of flooding only remains for those storm events greater than the 100 year return period. On this basis the residual risks may be regarded as negligible.

10. CONCLUSION

Subject to undertaking an intrusive geotechnical investigation at the next stage of the development process in order to affirm the validity of the infiltration techniques proposed, the re-development of this site will provide significant betterment over the current drainage system and will not be subject to adverse flood risk.

FIGURES



Site Location

Address: Ickleford Manor
Hitchin

National Grid Ref: TL1782931214

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DRAWN	FC
CHK'D	CR
APR'D	GR
SCALE	NTS
DATE	Jun '16

CONTRACT
ICKLEFORD MANOR
HITCHIN

TITLE
FIGURE 1
LOCALITY PLAN

JOB No 451816

DRG No F 01

REV -



Site Location

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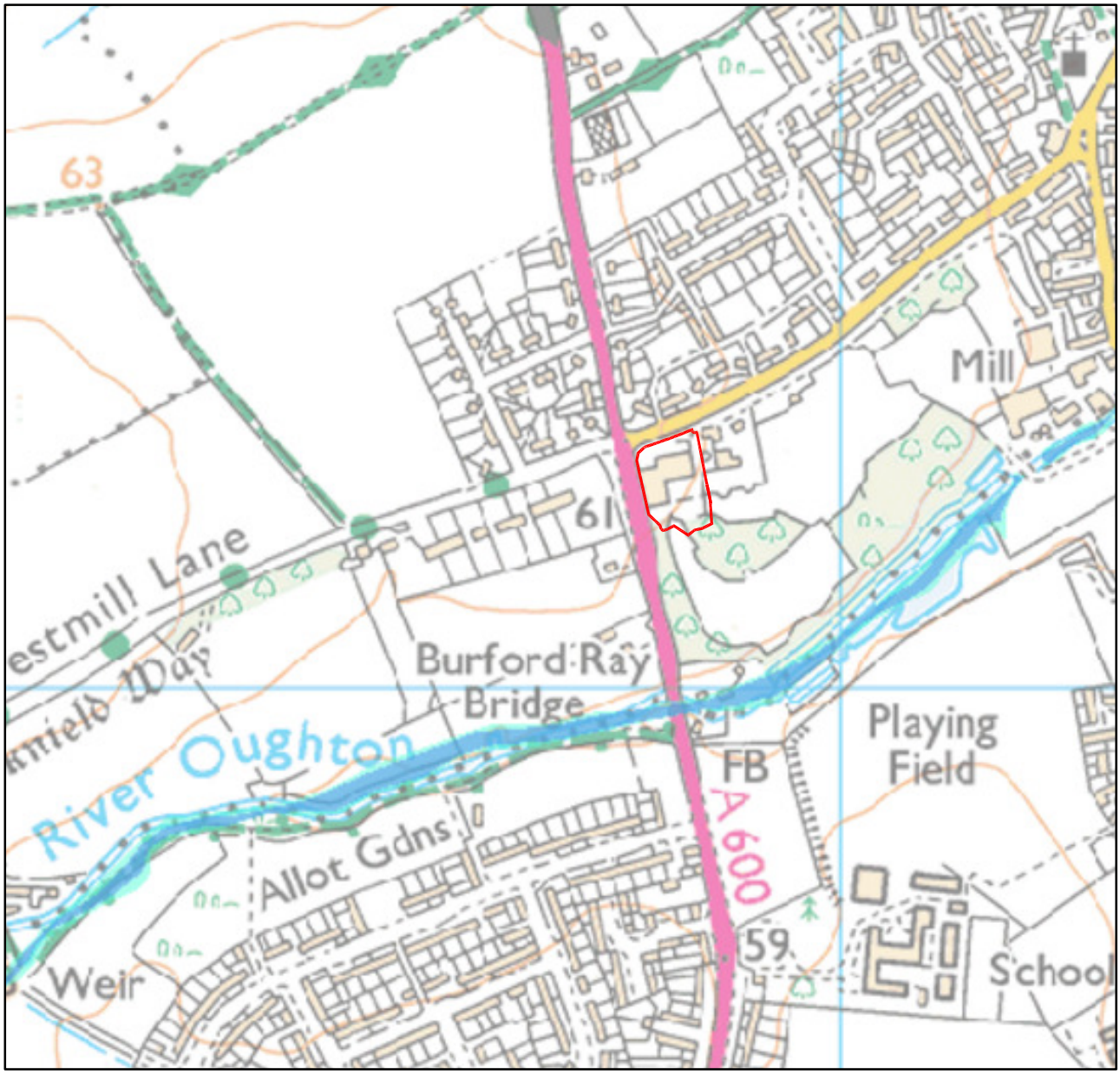
CONTRACT
ICKLEFORD MANOR
HITCHIN

TITLE
FIGURE 2
AERIAL PHOTOGRAPH

JOB No
451816

DRG No
F 02

REV
A



Site Location

Flood Zone 3
Flood Zone 2
Flood defences
(Not all may be shown*)
Areas benefiting from
flood defences
(Not all may be shown*)
Main rivers

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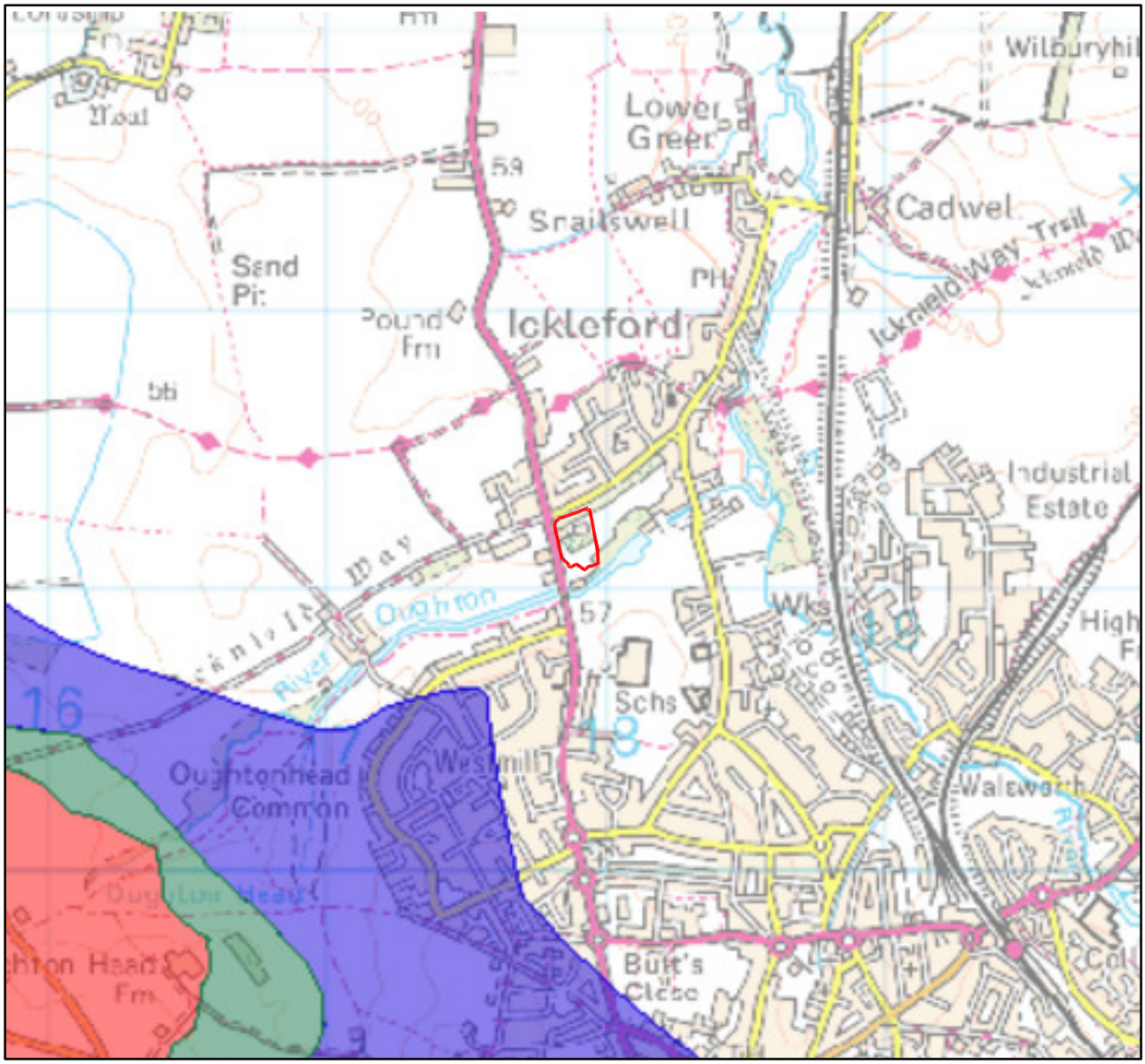
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TITLE
FIGURE 3
EA FLOOD MAP

JOB No
451816

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F 03

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Site Location

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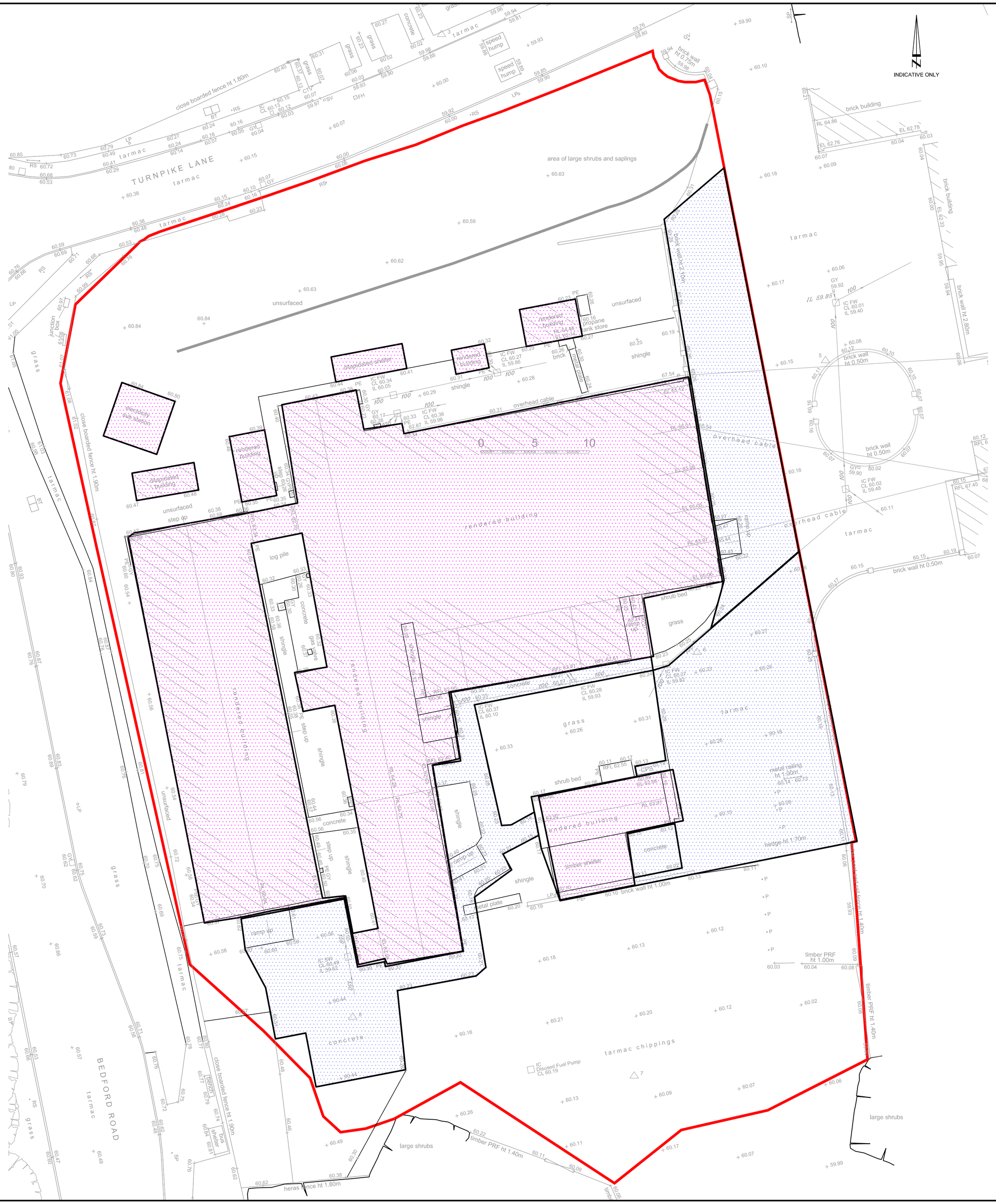
TITLE
FIGURE 4
EA SOURCE PROTECTION ZONE MAP

JOB No 451816

DRG No F 04

REV -

FIGURE 5



EXISTING IMPERMEABLE BUILDING AREA: 0.175 ha

EXISTING IMPERMEABLE HARDSTANDING AREA: 0.092 ha

DEVELOPMENT SITE BOUNDARY AREA: 0.59 ha

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT DETAILS, DRAWINGS, SPECIFICATIONS, REPORTS AND OTHER DOCUMENTS ISSUED BY THE ARCHITECT AND OTHER DESIGN TEAM MEMBERS.
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Jarvis

PROJECT
ICKLEFORD MANOR
TURNPIKE LANE
ICKLEFORD HERTFORDSHIRE

TITLE
EXISTING HARDSTANDING AREAS

DRAWN	CHECKED	APPROVED
FC	GR	GR

SCALE	ORIGINAL PAPER SIZE	FIRST ISSUE DATE
1:200	A1	26.07.2016

PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER
451816	PEP	00	GL	DR	D	1800

STATUS	SUITABILITY DESCRIPTION
S0	INITIAL / WORK IN PROGRESS

REVISION	REVISION DESCRIPTION	PEP PROJECT REF.
P01	PRELIMINARY	451816

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FIGURE 6

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INDICATIVE ONLY

CDM REGULATIONS 2015: DESIGNERS NOTES ON SIGNIFICANT RESIDUAL RISKS

1.

THESE NOTES RELATE SOLELY TO INFORMATION SHOWN ON THIS DRAWING. ONLY SIGNIFICANT RISKS WHICH ARE CONSIDERED TO BE UNUSUAL, OR UNLIKELY TO BE OBVIOUS TO A COMPETENT CONTRACTOR OR OTHER DESIGNER WILL BE HIGHLIGHTED. THIS INFORMATION MAY BE SUBJECT TO REVISION AS THE DESIGN DEVELOPS.

DESIGN ASSUMPTIONS

PROPOSED IMPERMEABLE BUILDING
AREA: 0.152 ha

PROPOSED IMPERMEABLE HARDSTANDING
AREA: 0.122 ha

DEVELOPMENT SITE BOUNDARY
AREA: 0.59 ha

REV	BY	CHK	AMENDMENTS	DATE

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PROJECT
ICKLEFORD MANOR
TURNPIKE LANE
ICKLEFORD HERTFORDSHIRE

TITLE
PROPOSED HARDSTANDING LAYOUT

DRAWN	CHECKED	APPROVED
FC	CR	BB

SCALE	ORIGINAL PAPER SIZE	FIRST ISSUE DATE
1:200	A1	01.07.2016

PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER
451816	PEP	00	B1	DR	D	1202

STATUS	SUITABILITY DESCRIPTION
S0	INITIAL / WORK IN PROGRESS

REVISION	REVISION DESCRIPTION	PEP PROJECT REF.
P02	PRELIMINARY	451816

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FIGURE 7

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INDICATIVE ONLY

CELLULAR CRATE SOAKAWAY SA1:
DRAINED IMPERMEABLE AREA: 260m²
8m x 5m x 0.8m DP
V_{TOT} = 30.4m³
WAVIN AQUACELL OR SIMILAR APPROVED. STRICTLY INSTALLED TO THE MANUFACTURERS SPECIFICATION

CELLULAR CRATE SOAKAWAY SA2:
DRAINED IMPERMEABLE AREA: 270m²
8m x 5m x 0.8m DP
V_{TOT} = 30.4m³
WAVIN AQUACELLOR SIMILAR APPROVED. STRICTLY INSTALLED TO THE MANUFACTURERS SPECIFICATION

PERMEABLE PAVED ROAD AND PARKING BAYS:
DRAINED IMPERMEABLE AREA: 1960m²
DESIGN STORAGE VOLUME V_{TOT} = 260.5m³

CELLULAR CRATE SOAKAWAY SA3:
DRAINED IMPERMEABLE AREA: 245m²
8m x 5m x 0.8m DP
V_{TOT} = 30.4m³
WAVIN AQUACELL OR SIMILAR APPROVED. STRICTLY INSTALLED TO THE MANUFACTURERS SPECIFICATION

INDICATIVE FFL SUBJECT TO DETAILED DESIGN

SUBSTATION

F1 IL:58.931
F2 IL:58.751
F3 IL:
F4 IL:58.502
F5 IL:58.312
F6 IL:58.261
F7 IL: 58.075
IC1 IL:59.550
IC2 IL:59.084
IC3 IL:59.015
IL 59.250

KEY:

- PERMEABLE BLOCK PAVING WITH 30% VOID RATIO

PERMEABLE PAVING BUILD UP:

80mm BLOCK
50mm SAND
80mm TARMAC
790mm STONE
(1000mm TOTAL)

CDM REGULATIONS 2015: DESIGNERS NOTES ON SIGNIFICANT RESIDUAL RISKS

1. POSSIBLE CONTAMINATION, SUBJECT TO TESTING.

THESE NOTES RELATE SOLELY TO INFORMATION SHOWN ON THIS DRAWING. ONLY SIGNIFICANT RISKS WHICH ARE CONSIDERED TO BE UNUSUAL, OR UNLIKELY TO BE OBVIOUS TO A COMPETENT CONTRACTOR OR OTHER DESIGNER WILL BE HIGHLIGHTED. THIS INFORMATION MAY BE SUBJECT TO REVISION AS THE DESIGN DEVELOPS.

DESIGN ASSUMPTIONS

1. INDICATIVE ATTENUATION SIZES AND VOLUMES ARE BASED ON AN ASSUMED INFILTRATION RATE OF $5.0x\ 10^{-6}$ m/s FROM CIRIA GUIDANCE FOR A VERY SILTY CLAYEY SAND. ALL SUBJECT TO BRE 365 INFILTRATION TESTING AT NEXT STAGE.
2. LAYOUT SCHEMATIC AND FFLs ARE SUBJECT TO DETAILED DESIGN.

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Jarvis

PROJECT
ICKLEFORD MANOR
TURNPIKE LANE
ICKLEFORD HERTFORDSHIRE

TITLE
PROPOSED SCHEMATIC DRAINAGE LAYOUT

SHEET 1 OF 2

DRAWN	CHECKED	APPROVED
FC	CR	BB
SCALE	ORIGINAL PAPER SIZE	FIRST ISSUE DATE
1:200	A1	01.07.2016

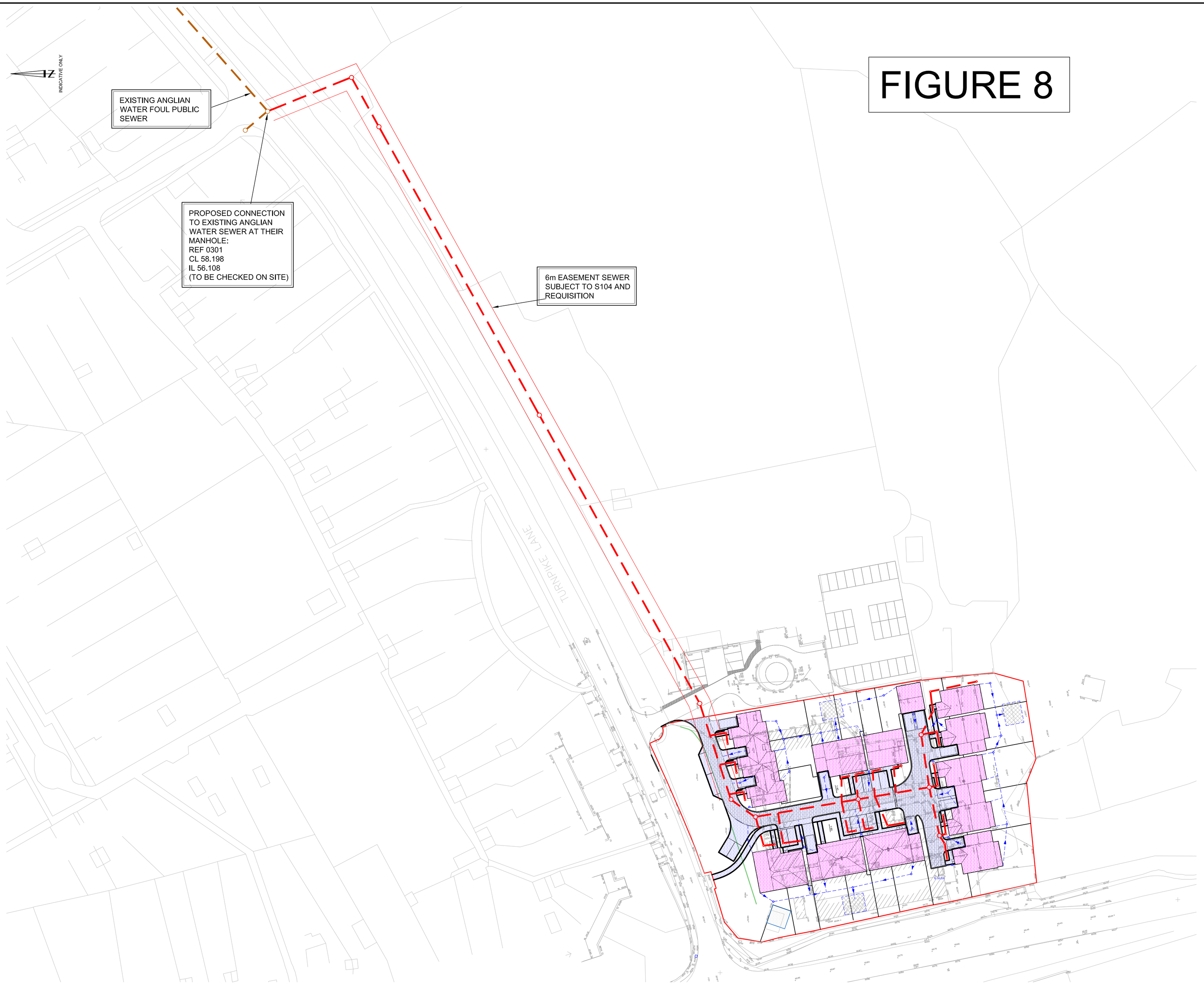
PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER
451816	PEP	00	B1	DR	D	1200

STATUS	SUITABILITY DESCRIPTION
S0	INITIAL / WORK IN PROGRESS

REVISION	REVISION DESCRIPTION	PEP PROJECT REF.
P02	PRELIMINARY	451816

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FIGURE 8



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Jarvis

PROJECT
ICKLEFORD MANOR
TURNPIKE LANE
ICKLEFORD, HERTFORDSHIRE

TITLE
DRAINAGE LAYOUT PROPOSED SCHEMATIC

SHEET 2 OF 2

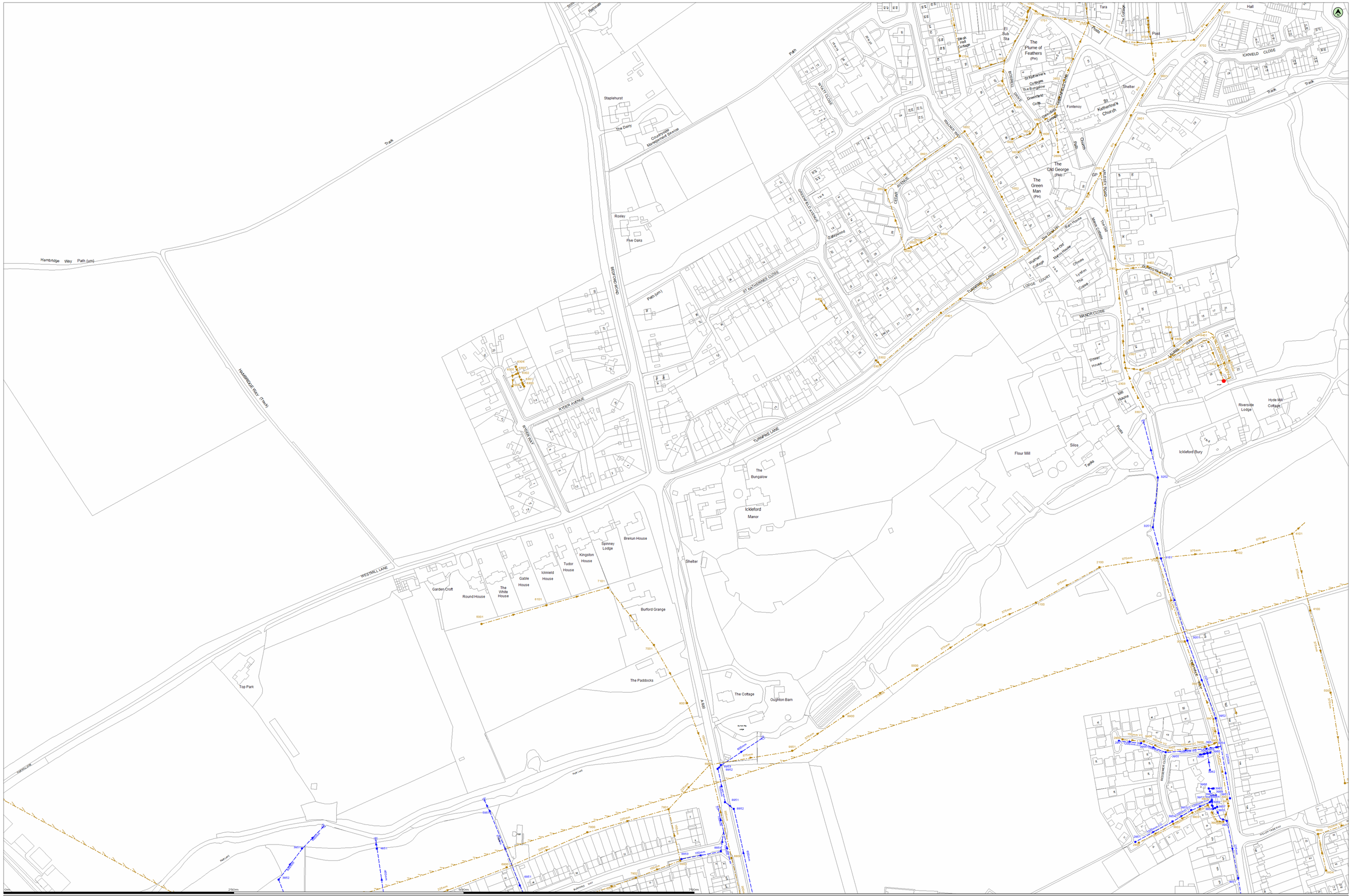
DRAWN	CHECKED	APPROVED
FC	CR	BB
SCALE	ORIGINAL PAPER SIZE	FIRST ISSUE DATE
1:500	A1	25.07.2016

PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER
451816	PEP	00	XX	DR	D	1201

STATUS	SUITABILITY DESCRIPTION
S0	INITIAL / WORK IN PROGRESS

REVISION	REVISION DESCRIPTION	PEP PROJECT REF.
P02	PRELIMINARY	451816

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Track
Hambridge Way Path (um)
HAMBRIDGE WAY (Track)
WESTMILL LANE
Path (um)
Staplehurst
The Dairy
Countryside Management Service
Roxley
Five Oaks
BECKFORD ROAD
Path
WATTS CLOSE
GREEN FIELD AVENUE
ST KATHERINES CLOSE
RYDER AVENUE
RYDER WAY
TURNPIKE LANE
Path (um)
Garden Croft
Round House
The White House
Gable House
Icknield House
Tudor House
Kingston House
Spinney Lodge
Brekun House
Burford Grange
Top Park
The Paddocks
A 600
Shelter
The Bungalow
Ickleford Manor
The Cottage
Oughton Barn
Path (um)
Path (um)
BURFORD WAY
Path
Path
Path

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0000	518059	231048	F	54.371	52.421	1.95
0301	518019	231379	F	58.198	56.108	2.09
0302	518014	231384	F	-	-	-
0401	518085	231436	F	56.442	54.532	1.91
0501	518025	231569	F	-	-	-
0502	518046	231505	F	-	-	-
0503	518052	231507	F	-	-	-
0504	518063	231513	F	-	-	-
0505	518079	231521	F	-	-	-
0601	518067	231603	F	-	-	-
1000	518132	231097	F	54.437	52.132	2.305
1100	518188	231121	F	54.735	51.925	2.81
1401	518128	231468	F	55.143	53.663	1.48
1501	518181	231503	F	53.902	52.362	1.54
1502	518151	231562	F	-	-	-
1601	518128	231605	F	-	-	-
1602	518110	231633	F	-	-	-
1603	518190	231641	F	-	-	-
1604	518181	231631	F	-	-	-
1605	518162	231625	F	-	-	-
1606	518195	231625	F	-	-	-
1607	518169	231610	F	-	-	-
1608	518151	231688	F	-	-	-
1609	518165	231661	F	-	-	-
1701	518195	231759	F	52.739	50.749	1.99
1702	518182	231767	F	-	-	-
1704	518105	231715	F	54.617	53.377	1.24
1705	518179	231763	F	-	-	-
1706	518178	231753	F	-	-	-
1707	518154	231710	F	-	-	-
1708	518127	231702	F	-	-	-
2100	518257	231160	F	54.352	51.712	2.64
2301	518283	231389	F	51.663	49.813	1.85
2302	518285	231376	F	-	-	-
2303	518293	231355	F	51.436	50.036	1.4
2401	518282	231422	F	51.774	49.634	2.14
2402	518275	231483	F	52.05	49.322	2.728
2501	518258	231588	F	51.97	48.46	3.51
2502	518273	231508	F	52.159	49.079	3.08
2503	518232	231545	F	52.89	51.2	1.69
2601	518291	231651	F	51.041	48.241	2.8
2602	518218	231689	F	53.194	51.694	1.5
2603	518208	231653	F	53.259	51.999	1.26
2604	518212	231611	F	54.295	53.035	1.26
2701	518284	231731	F	50.863	48.603	2.26
2702	518245	231751	F	51.526	48.936	2.59
2704	518228	231712	F	52.52	50.63	1.89
2800	518300	230860	F	58.45	55.24	3.21
2900	518282	230972	F	57.28	54.1	3.18
3000	518350	231079	F	54.607	52.417	2.19
3001	518366	231032	F	55.208	52.833	2.375
3100	518320	231170	F	53.252	51.537	1.715
3301	518304	231334	F	51.441	50.201	1.24
3302	518301	231374	F	-	-	-
3303	518334	231388	F	-	-	-
3304	518386	231378	F	-	-	-
3305	518398	231383	F	-	-	-
3306	518338	231400	F	-	-	-
3401	518375	231404	F	-	-	-
3402	518309	231486	F	52	49.517	2.483
3403	518335	231474	F	51.5	49.7	1.8
3404	518334	231415	F	-	-	-
3601	518317	231696	F	51.011	48.021	2.99
3701	518387	231765	F	-	-	-
3702	518360	231733	F	49.762	47.762	2
3703	518314	231729	F	50.396	47.896	2.5
3801	518391	230883	F	56.27	54.44	1.83
3802	518337	230881	F	56.89	54.91	1.98
3803	518358	230893	F	56.79	54.76	2.03
3804	518385	230883	F	56.52	54.5	2.02
3901	518380	230995	F	55.595	53.18	2.415
3902	518396	230907	F	55.81	53.78	2.03
3903	518397	230900	F	-	-	-
3904	518375	230901	F	56.62	54.64	1.98
3905	518382	230968	F	55.63	53.48	2.15
3906	518372	230964	F	55.93	53.56	2.37
3907	518331	230960	F	56.67	53.72	2.95
3908	518305	230970	F	57.07	53.9	3.17
4001	518404	231007	F	-	-	-
4100	518486	231112	F	52.683	50.828	1.855
4101	518467	231196	F	52.713	51.078	1.635
4102	518404	231178	F	53.047	51.317	1.73
4800	518494	230869	F	54	52.19	1.81
5000	518508	231023	F	53.288	50.563	2.725
5001	517586	231098	F	60.021	59.131	0.89
5804	518503	230830	F	53.78	52.5	1.28
5902	518524	230925	F	53.404	50.344	3.06
6101	517656	231118	F	-	58.336	-
6300	517632	231356	F	-	-	-
6301	517631	231358	F	-	-	-
6302	517629	231363	F	-	-	-
6303	517625	231370	F	-	-	-
6304	517623	231377	F	-	-	-
6305	517619	231368	F	-	-	-
6306	517619	231356	F	-	-	-
6800	517613	230833	F	57.488	54.888	2.6
7001	517773	231075	F	59.162	56.812	2.35
7101	517723	231137	F	60.444	57.574	2.87
7800	517701	230871	F	57.287	54.287	3
7801	517789	230896	F	56.752	53.592	3.16
7802	517753	230822	F	58.051	56.151	1.9
8001	517809	231012	F	55.902	55.452	0.45
8800	517857	230843	F	57.489	55.309	2.18
8801	517801	230841	F	58.177	55.677	2.5
8900	517833	230945	F	55.763	53.163	2.6
9400	517957	231445	F	-	-	-
9401	517959	231441	F	-	-	-
9900	517979	230998	F	54.149	52.664	1.485
9901	517923	230960	F	54.449	52.839	1.61
2851	518296	230861	S	58.39	55.56	2.83
2951	518278	230971	S	57.28	54.46	2.82
3051	518352	231080	S	54.607	-	-
3151	518324	231169	S	53.252	-	-
3251	518315	231203	S	-	-	-
3252	518321	231257	S	-	-	-
3851	517391	230854	S	56.893	55.513	1.38
3851	518395	230884	S	56.14	54.8	1.34
3852	517365	230820	S	57.339	55.749	1.59
3853	518357	230895	S	56.74	55.09	1.65
3854	518336	230883	S	56.86	55.28	1.58
3855	518383	230898	S	-	-	-
3856	518380	230897	S	-	-	-
3857	518385	230899	S	-	-	-
3951	518399	230908	S	55.81	-	-
3952	518383	230995	S	55.595	53.795	1.8
3953	518377	230904	S	56.51	54.91	1.6
3954	518384	230964	S	55.63	54	1.63
3955	518329	230958	S	56.65	54.3	2.35
3956	518302	230968	S	57.11	54.33	2.78
3957	518373	230962	S	55.87	53.69	2.18
3958	518366	230955	S	-	-	-
3959	518370	230956	S	-	-	-
3960	518378	230958	S	-	-	-
3961	518374	230957	S	-	-	-
3962	518377	230939	S	-	-	-
3963	518379	230906	S	-	-	-
3964	518381	230911	S	-	-	-
3965	518378	230911	S	-	-	-
3966	518376	230919	S	-	-	-
3967	518381	230919	S	-	-	-
3968	518384	230912	S	-	-	-
3969	518379	230901	S	-	-	-
4851	517472	230854	S	56.697	55.117	1.58
4851	518408	230821	S	56.324	54.424	1.9
5851	517594	230894	S	55.973	54.863	1.11
6851	517627	230814	S	57.84	55.68	2.16
8852	517860	230897	S	56.663	55.053	1.61
8853	517803	230842	S	57.934	56.404	1.53
8854	517846	230851	S	-	-	-
8951	517850	230904	S	56.355	55.085	1.27

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
8952	517842	230940	S	55.703	54.503	1.2
8953	517846	230944	S	55.773	54.173	1.6

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

FIGURE 10

MICRO DRAINAGE CELLULAR SOAKAWAYS

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1366 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	59.085	0.285	0.1	0.0	0.1	10.8	O K
30 min Summer	59.122	0.322	0.1	0.0	0.1	12.2	O K
60 min Summer	59.161	0.361	0.1	0.0	0.1	13.7	O K
120 min Summer	59.202	0.402	0.1	0.0	0.1	15.3	O K
180 min Summer	59.225	0.425	0.1	0.0	0.1	16.2	O K
240 min Summer	59.240	0.440	0.1	0.0	0.1	16.7	O K
360 min Summer	59.257	0.457	0.1	0.0	0.1	17.4	O K
480 min Summer	59.266	0.466	0.1	0.0	0.1	17.7	O K
600 min Summer	59.269	0.469	0.1	0.0	0.1	17.8	O K
720 min Summer	59.268	0.468	0.1	0.0	0.1	17.8	O K
960 min Summer	59.259	0.459	0.1	0.0	0.1	17.4	O K
1440 min Summer	59.237	0.437	0.1	0.0	0.1	16.6	O K
2160 min Summer	59.207	0.407	0.1	0.0	0.1	15.5	O K
2880 min Summer	59.181	0.381	0.1	0.0	0.1	14.5	O K
4320 min Summer	59.142	0.342	0.1	0.0	0.1	13.0	O K
5760 min Summer	59.105	0.305	0.1	0.0	0.1	11.6	O K
7200 min Summer	59.072	0.272	0.1	0.0	0.1	10.3	O K
8640 min Summer	59.042	0.242	0.1	0.0	0.1	9.2	O K
10080 min Summer	59.014	0.214	0.1	0.0	0.1	8.1	O K
15 min Winter	59.120	0.320	0.1	0.0	0.1	12.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	215.908	0.0	0.0	19
30 min Summer	122.570	0.0	0.0	34
60 min Summer	69.583	0.0	0.0	64
120 min Summer	39.502	0.0	0.0	124
180 min Summer	28.365	0.0	0.0	184
240 min Summer	22.425	0.0	0.0	242
360 min Summer	16.103	0.0	0.0	362
480 min Summer	12.731	0.0	0.0	482
600 min Summer	10.610	0.0	0.0	602
720 min Summer	9.142	0.0	0.0	720
960 min Summer	7.192	0.0	0.0	954
1440 min Summer	5.129	0.0	0.0	1168
2160 min Summer	3.658	0.0	0.0	1540
2880 min Summer	2.878	0.0	0.0	1956
4320 min Summer	2.086	0.0	0.0	2768
5760 min Summer	1.660	0.0	0.0	3576
7200 min Summer	1.390	0.0	0.0	4392
8640 min Summer	1.203	0.0	0.0	5112
10080 min Summer	1.064	0.0	0.0	5856
15 min Winter	215.908	0.0	0.0	19

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	59.161	0.361	0.1	0.0	0.1	13.7	O K
60 min Winter	59.206	0.406	0.1	0.0	0.1	15.4	O K
120 min Winter	59.253	0.453	0.1	0.0	0.1	17.2	O K
180 min Winter	59.279	0.479	0.1	0.0	0.1	18.2	O K
240 min Winter	59.297	0.497	0.1	0.0	0.1	18.9	O K
360 min Winter	59.318	0.518	0.1	0.0	0.1	19.7	O K
480 min Winter	59.330	0.530	0.1	0.0	0.1	20.1	O K
600 min Winter	59.335	0.535	0.1	0.0	0.1	20.3	O K
720 min Winter	59.337	0.537	0.1	0.0	0.1	20.4	O K
960 min Winter	59.331	0.531	0.1	0.0	0.1	20.2	O K
1440 min Winter	59.307	0.507	0.1	0.0	0.1	19.2	O K
2160 min Winter	59.270	0.470	0.1	0.0	0.1	17.8	O K
2880 min Winter	59.234	0.434	0.1	0.0	0.1	16.5	O K
4320 min Winter	59.177	0.377	0.1	0.0	0.1	14.3	O K
5760 min Winter	59.122	0.322	0.1	0.0	0.1	12.3	O K
7200 min Winter	59.073	0.273	0.1	0.0	0.1	10.4	O K
8640 min Winter	59.028	0.228	0.1	0.0	0.1	8.7	O K
10080 min Winter	58.988	0.188	0.1	0.0	0.1	7.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	122.570	0.0	0.0	34
60 min Winter	69.583	0.0	0.0	64
120 min Winter	39.502	0.0	0.0	122
180 min Winter	28.365	0.0	0.0	180
240 min Winter	22.425	0.0	0.0	240
360 min Winter	16.103	0.0	0.0	356
480 min Winter	12.731	0.0	0.0	472
600 min Winter	10.610	0.0	0.0	588
720 min Winter	9.142	0.0	0.0	700
960 min Winter	7.192	0.0	0.0	924
1440 min Winter	5.129	0.0	0.0	1340
2160 min Winter	3.658	0.0	0.0	1660
2880 min Winter	2.878	0.0	0.0	2108
4320 min Winter	2.086	0.0	0.0	3024
5760 min Winter	1.660	0.0	0.0	3864
7200 min Winter	1.390	0.0	0.0	4680
8640 min Winter	1.203	0.0	0.0	5448
10080 min Winter	1.064	0.0	0.0	6248

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 517850 231000 TL 17850 31000
C (1km)	-0.028
D1 (1km)	0.312
D2 (1km)	0.295
D3 (1km)	0.335
E (1km)	0.320
F (1km)	2.434
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.027

Time (mins) From:	To:	Area (ha)
0	4	0.027

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Model Details

Storage is Online Cover Level (m) 60.350

Cellular Storage Structure

Invert Level (m) 58.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.01800 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	40.0	0.801	0.0	60.8
0.800	40.0	60.8			

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 60.300

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MICRO DRAINAGE
PERMEABLE ROAD

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 486 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	59.835	0.635	1.9	0.0	1.9	72.7	O K
30 min Summer	59.876	0.676	2.0	0.0	2.0	82.3	O K
60 min Summer	59.915	0.715	2.1	0.0	2.1	92.0	Flood Risk
120 min Summer	59.948	0.748	2.2	0.0	2.2	100.8	Flood Risk
180 min Summer	59.962	0.762	2.3	0.0	2.3	104.4	Flood Risk
240 min Summer	59.967	0.767	2.3	0.0	2.3	105.9	Flood Risk
360 min Summer	59.966	0.766	2.3	0.0	2.3	105.5	Flood Risk
480 min Summer	59.962	0.762	2.3	0.0	2.3	104.4	Flood Risk
600 min Summer	59.957	0.757	2.3	0.0	2.3	103.2	Flood Risk
720 min Summer	59.952	0.752	2.3	0.0	2.3	101.8	Flood Risk
960 min Summer	59.939	0.739	2.2	0.0	2.2	98.2	Flood Risk
1440 min Summer	59.910	0.710	2.1	0.0	2.1	90.7	Flood Risk
2160 min Summer	59.867	0.667	2.0	0.0	2.0	80.2	O K
2880 min Summer	59.829	0.629	1.9	0.0	1.9	71.3	O K
4320 min Summer	59.771	0.571	1.7	0.0	1.7	58.7	O K
5760 min Summer	59.723	0.523	1.6	0.0	1.6	49.3	O K
7200 min Summer	59.683	0.483	1.4	0.0	1.4	42.0	O K
8640 min Summer	59.649	0.449	1.3	0.0	1.3	36.2	O K
10080 min Summer	59.619	0.419	1.3	0.0	1.3	31.5	O K
15 min Winter	59.875	0.675	2.0	0.0	2.0	82.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	215.908	0.0	0.0	22
30 min Summer	122.570	0.0	0.0	37
60 min Summer	69.583	0.0	0.0	66
120 min Summer	39.502	0.0	0.0	124
180 min Summer	28.365	0.0	0.0	184
240 min Summer	22.425	0.0	0.0	242
360 min Summer	16.103	0.0	0.0	338
480 min Summer	12.731	0.0	0.0	392
600 min Summer	10.610	0.0	0.0	452
720 min Summer	9.142	0.0	0.0	518
960 min Summer	7.192	0.0	0.0	654
1440 min Summer	5.129	0.0	0.0	926
2160 min Summer	3.658	0.0	0.0	1328
2880 min Summer	2.878	0.0	0.0	1732
4320 min Summer	2.086	0.0	0.0	2504
5760 min Summer	1.660	0.0	0.0	3232
7200 min Summer	1.390	0.0	0.0	3968
8640 min Summer	1.203	0.0	0.0	4672
10080 min Summer	1.064	0.0	0.0	5440
15 min Winter	215.908	0.0	0.0	22

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	59.919	0.719	2.2	0.0	2.2	92.9	Flood Risk
60 min Winter	59.960	0.760	2.3	0.0	2.3	104.0	Flood Risk
120 min Winter	59.997	0.797	2.4	0.0	2.4	114.2	Flood Risk
180 min Winter	60.012	0.812	2.4	0.0	2.4	118.7	Flood Risk
240 min Winter	60.019	0.819	2.5	0.0	2.5	120.8	Flood Risk
360 min Winter	60.020	0.820	2.5	0.0	2.5	121.2	Flood Risk
480 min Winter	60.014	0.814	2.4	0.0	2.4	119.3	Flood Risk
600 min Winter	60.008	0.808	2.4	0.0	2.4	117.4	Flood Risk
720 min Winter	60.001	0.801	2.4	0.0	2.4	115.5	Flood Risk
960 min Winter	59.983	0.783	2.3	0.0	2.3	110.4	Flood Risk
1440 min Winter	59.944	0.744	2.2	0.0	2.2	99.6	Flood Risk
2160 min Winter	59.887	0.687	2.1	0.0	2.1	84.9	O K
2880 min Winter	59.835	0.635	1.9	0.0	1.9	72.6	O K
4320 min Winter	59.756	0.556	1.7	0.0	1.7	55.6	O K
5760 min Winter	59.692	0.492	1.5	0.0	1.5	43.6	O K
7200 min Winter	59.640	0.440	1.3	0.0	1.3	34.9	O K
8640 min Winter	59.598	0.398	1.2	0.0	1.2	28.4	O K
10080 min Winter	59.562	0.362	1.1	0.0	1.1	23.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
30 min Winter	122.570	0.0	0.0	36
60 min Winter	69.583	0.0	0.0	66
120 min Winter	39.502	0.0	0.0	122
180 min Winter	28.365	0.0	0.0	180
240 min Winter	22.425	0.0	0.0	236
360 min Winter	16.103	0.0	0.0	346
480 min Winter	12.731	0.0	0.0	444
600 min Winter	10.610	0.0	0.0	476
720 min Winter	9.142	0.0	0.0	552
960 min Winter	7.192	0.0	0.0	704
1440 min Winter	5.129	0.0	0.0	1000
2160 min Winter	3.658	0.0	0.0	1428
2880 min Winter	2.878	0.0	0.0	1844
4320 min Winter	2.086	0.0	0.0	2600
5760 min Winter	1.660	0.0	0.0	3352
7200 min Winter	1.390	0.0	0.0	4104
8640 min Winter	1.203	0.0	0.0	4832
10080 min Winter	1.064	0.0	0.0	5544

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 517850 231000 TL 17850 31000
C (1km)	-0.028
D1 (1km)	0.312
D2 (1km)	0.295
D3 (1km)	0.335
E (1km)	0.320
F (1km)	2.434
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.196

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.098	4	8	0.098

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Model Details

Storage is Online Cover Level (m) 60.200

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01800	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	172.2
Max Percolation (l/s)	287.0	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	59.200	Cap Volume Depth (m)	0.000

Weir Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 60.200

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