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FLOUR MILL, ASHFORD

Flood Risk Assessment and Drainage Strategy – Revision A – Vol. 1 of 8

FLOUR MILL, ASHFORD
Flood Risk Assessment and Drainage Strategy

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FLOUR MILL, ASHFORD
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Revision A

Contents

Figures

Appendices

Plans

001	Site Location Plan
002	Existing & Proposed Block Plan
003	Existing Site Layout Plan
004	Existing Ground Flood Plan
005	Existing First Floor Plan
006	Existing Floor Plans
007	Existing Elevation AA
008	Existing Elevation BB & DD
009	Existing Elevation CC
010	Existing Elevation EE
101	Proposed Site Layout Plan
103	Proposed Lower Floor Plans Block A & B
104	Proposed Upper Floor Plans Block A & B
105	Proposed Lower Floor Plans Block C, D & E
106	Proposed Upper Floor Plans Block C, D & E
120	Proposed Section A
121	Proposed Section B
123	Proposed Section C
130	Proposed Elevations AA, BB, CC & DD
131	Proposed Elevations EE, FF, GG & HH
132	Proposed Elevations II & JJ
133	Proposed Elevations KK && LL
B20061_Flour_01-Sheet_01	Topographic Survey – Sheet 1
B20061_Flour_01-Sheet_02	Topographic Survey – Sheet 2
2206/02/001	Surface Water Drainage Strategy

Registration of Amendments

Revision	Amendment Details	Revision Prepared By	Revision Approved By
Rev A 22.04.2022	Amended post submission to overcome EA 'Flood Risk' objection.	JJ	GS

1.0 INTRODUCTION

Brief

1.1 Create Consulting Engineers Ltd were instructed by Oliver Davis on behalf of Mulberry Tree Holdings Ltd to undertake a Flood Risk Assessment (FRA) and drainage strategy to inform a residential development (53 residential dwellings) at Flour Mill, Ashford, TN24 8PA.

Project Context

1.2 The Site comprises a 0.56ha parcel of brownfield land, as shown in Figure 1.1. The Client intends to submit a planning application for a redevelopment comprising the conversion of the existing Flour Mill, demolition of existing structures, and the erection of four ancillary blocks to provide a total of no. 53 apartments (Use Class C3), ancillary residential facilities (including residents' gym and 'superlounge'), 1 x office (Use Class E(g)(i)), retained access from East Hill, parking, and associated landscaping and infrastructure. Architect's Layouts showing the proposed scheme are included on Drawings 001-133.

Planning Policy Context

1.3 The potential consequences of inappropriate development in a flood risk area for occupiers, either of the development or elsewhere, pose significant risks in terms of personal safety and damage to property.

National Policy

1.4 The National Planning Policy Framework[1] (updated 2021) includes Government policy on development and flood risk stating that:

> *167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*
> *a) Within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
> *b) The development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
> *c) It incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*

[1] Ministry of Housing, Communities & Local Government., 2021. *National Planning Policy Framework (NPPF)*. [Online]. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed December, 2021].

d) Any residual risk can be safely managed; and

e) *Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

1.5 The Planning Practice Guidance to the NPPF[2] requires that at the planning stage, the developer should prepare and submit an appropriate FRA to demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed now and when taking climate change into account.

1.6 To comply with the NPPF a FRA must be submitted for planning applications for developments within flood zones 2 and 3 (medium or high risk of fluvial or tidal flooding) and for all developments located in Flood Zone 1 (low risk) which are 1 hectare or greater; which has been identified by the Environment Agency as having critical drainage problems; identified in a strategic flood risk assessment as being at increased flood risk in future; or that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

1.7 A FRA should be appropriate to the scale, nature and location of the development and should identify and assess the risk from all sources of flooding to and from the development and demonstrate how any flood risks will be managed over the lifetime of the development.

1.8 An assessment of surface water and drainage is also required as part of the FRA in order to demonstrate how flood risk to others will be managed following development and taking climate change into account.

1.9 The Planning Practice Guidance (substantially revised in March 2015 in relation to drainage) requires that sustainable drainage systems should be considered and included where practicable, in line with DEFRA Technical Standards[3].

1.10 The Technical Standards are therefore a key reference document and should be used in the formulation of the surface water drainage strategy for a scheme of this nature. The standards include the following requirements:

"Flood risk outside the development

S1 *Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control*

[2] Ministry of Housing, Communities & Local Government., 2014. *Planning Practice Guidance (PPG) - Flood Risk and Coastal Change*. [Online]. Available at: http://planningguidance.planningportal.gov.uk/ [Accessed December, 2021].

[3] Department for Environment and Rural Affairs (DEFRA)., 2015. *Sustainable drainage systems: non-statutory technical standards*. [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf [Accessed December, 2021].

*standards (**S2** and **S3** below) and volume control technical standards (**S4** and **S6** below) need not apply.*

Peak flow control

***S2** For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.*

***S3** For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.*

Volume control

***S4** Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.*

***S5** Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.*

***S6** Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

Flood risk within the development

***S7** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the Site for a 1 in 30 year rainfall event.*

***S8** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100*

year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

***S9** The design of the Site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.*

Structural Integrity

***S10** Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirements for reasonable levels of maintenance.*

***S11** The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.*

Designing for Maintenance Considerations

***S12** Pumping should only be used to facilitate drainage for those parts of the Site where it is not reasonably practicable to drain water by gravity.*

Construction

***S13** The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.*

***S14** Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed."*

County Council Policy

1.11 Kent County Council act as Lead Local Flood Authority (LLFA) for the area and are a statutory consultee for all major developments4, which includes the following:

- the provision of dwelling houses where:

[4] The Town and Country Planning (Development Management Procedure) (England) Order 2015 (Accessed December, 2021) http://www.legislation.gov.uk/uksi/2015/595/pdfs/uksi_20150595_en.pdf

- the number of dwelling houses to be provided is 10 or more; or
- the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);

- the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or
- development carried out on a site having an area of 1 hectare or more.

1.12 The LLFA have produced a number of Flood Risk to Communities reports which cover the main settlement areas within the county[5], a Drainage and Planning policy statement (2019) 6 and district level Surface Water Management Plans7 which together include construction standards and provide assistance to developers in creating sustainable drainage systems on their sites as well as the LLFA's consenting policy and various protocols. Kent County Council also provide guidance within their Preliminary Flood Risk Assessment (PFRA, 2011)[8] and Local Flood Risk Management Strategy (2017-2023)[9] on development and flood risk.

District Council Planning Policy

1.13 The Ashford Local Plan 2030 manages and directs growth up until 2030 in the district. The relevant policies from the Ashford Local Plan are:

- ENV6 Flood Risk

Proposals for new development should contribute to an overall flood risk reduction.

Development will only be permitted where it would not be at an unacceptable risk of flooding on the site itself, and there would be no increase to flood risk elsewhere.

The sequential test and exception tests established by the National Planning Policy Framework will be strictly adhered to across the Borough, with new development preferably being located in Flood Zone 1. Where it is demonstrated development is unable to take place in an area of lower flood risk, essential transport or utility

[5] Kent County Council Flood Risk to Communities (Accessed December, 2021) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/flood-risk-to-communities

[6] Drainage and Planning policy statement (Accessed December, 2021) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/drainage-and-planning-policy-statement

[7] Kent County Council Surface Water Management Plans (Accessed December, 2021) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/surface-water-management-plans

[8] Kent County Council Preliminargry Flood Risk Assessment (Accessed December, 2021) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/preliminary-flood-risk-assesment

[9] Kent County Council Local Flood Risk Management Strategy 2017- 2023 (Accessed December, 2021) https://www.kent.gov.uk/about-the-council/strategies-and-policies/environment-waste-and-planning-policies/flooding-and-drainage-policies/kent-flood-risk-management-plan

infrastructure, or other development may be allowed as per an exception test if the development is designed to be compatible with potential flood conditions, and:

a) *Suitable flood protection and mitigation measures are incorporated into the development appropriate to the nature and scale of risk;*
b) *Comprehensive management and maintenance plans are in place for its effective operation during the lifetime of the development (taking account of climate change allowances);*
c) *Adoption arrangements are secured (where applicable) with the relevant public authority or statutory undertaker;*
d) *The development would make a significant contribution to the overall sustainable development objectives of the Local Plan, such that the wider sustainability benefits of the development outweigh the flood risk; and,*
e) *It can be demonstrated to the satisfaction of the Council and the Environment Agency that adequate resistance and resilience measures have been put in place to avoid any increase in flooding either on site or elsewhere.*

A site-specific Flood Risk Assessment (FRA), endorsed by the Environment Agency, appropriate to the scale and nature of the development and the risks involved will be required in line with Planning Practice Guidance and in particular where the Strategic Flood Risk Assessment or Surface Water Management Plan, indicates there are records of historic flooding or other sources of flooding.

In all cases, development that would harm the effectiveness of existing flood defences or prejudice their maintenance or management will not be permitted.

- ENV9 Sustainable Drainage

All development should include appropriate sustainable drainage systems (SuDS) for the disposal of surface water, in order to avoid any increase in flood risk or adverse impact on water quality, and to mimic the drainage from the pre-developed site.

On greenfield sites, development should discharge at a maximum of 4l/s/ha, or 10% below current greenfield rates for the existing 1:100 storm event, whichever is lower. There must be no increase in discharge rate from less severe rainfall events, with evidence submitted to demonstrate this principle.

Any SuDS scheme must demonstrate regard to the adopted Sustainable Drainage SPD and any subsequent revisions.

SuDS features should always be the preferred option and provided onsite wherever practicable.

All development proposals will be required to:

a) Ensure all new developments are designed to reduce the risk of flooding, and maximise environmental gain, such as: water quality, water resources, biodiversity, landscape and recreational open space;
b) Ensure that all new developments are designed to mitigate and adapt to the effects of climate change;
c) Lower runoff flow rates, reducing the impact of urbanisation on flooding;
d) Protect or enhance water quality. Incorporating appropriate pollution control measures, to ensure there are no adverse impacts on the water quality of receiving waters, both during construction and in operation;
e) Be sympathetic to the environmental setting and the needs of the local community;
f) Incorporate a SuDS scheme that is coherent with the surrounding landscape and/or townscape;
g) Provide a habitat for wildlife in urban watercourses; and encourage natural groundwater recharge (where appropriate);
h) Demonstrate that opportunities have been taken to integrate sustainable drainage with biodiversity enhancements through appropriately designed surface water systems, as well as contribute to amenity and open spaces;
i) Demonstrate that the first 5mm of any rainfall event can be accommodated and disposed of on-site; and,
j) Demonstrate that clear arrangements have been established for the operation and maintenance of the SuDS component for the lifetime of the development.

1.14 These documents have been utilised as part of this assessment and are referenced where applicable throughout this report.

Climate Change

1.15 Climate change has important implications for the assessment and management of flood risk. The NPPF requires that climate change is considered when making an assessment of flood risk posed to future development.

1.16 Climate change has the potential to affect all identified sources of flooding at the Site. The likely impacts of climate change include increased severity of rainfall events as well as wetter winters leading to higher groundwater levels and increased frequency and severity of surface water flooding.

1.17 The influence of climate change on rainfall intensity has been taken into account by the surface water drainage strategy outlined in Chapter 6 as an inclusion of 40% has been made for climate change for all rainfall events up to and including the 1 in 100 year event in

accordance with NPPF requirements, and 'Flood Risk Assessments: Climate Change Allowances'[10].

1.18 Climate change has also been considered within the modelling exercise as detailed in Chapter 6 and Appendix F. The 1 in 100 event has been run with an inclusion of 45% climate change as the 'design flood event'. Whilst the revised July 2021 climate change allowances now requires the 'Central' allowance to be applied for 'More Vulnerable' developments which is 38% (Central) for the 2080's within this 'Stour Management Catchment', the 45% pre July 2021 (Higher Central) climate change allowance has been selected within the modelling exercise as a worst case.

Objectives

1.19 The following specific objectives were set by Create Consulting Engineers Ltd after a review of the available data:

- To assess the suitability of the scheme in relation to all sources of flooding for the life time of the development;
- To assess the flood risk posed by the scheme once it is complete and operational;
- To suggest mitigation measures in order to reduce any residual risks to acceptable levels.

Constraints and Limitations

1.20 The copyright of this report is vested in Create Consulting Engineers Ltd and the Client, Mulberry Tree Holdings Ltd . The Client, or their appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or the Client.

1.21 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

1.22 The Flood Risk Assessment addresses the flood risk posed to and from the proposed development, the extent of which is shown by the Site boundary, as indicated on the attached drawings.

1.23 This report has been undertaken with the assumption that the Site will be developed in accordance with the above proposals without significant change. The conclusions resulting

[10] Environment Agency., 2021. *Flood Risk Assessments: Climate Change Allowances*. [Online]. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed November, 2021].

from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the Site.

1.24 Create Consulting Engineers Ltd has endeavoured to assess all information provided to them during this appraisal. The report summarises information from a number of external sources and cannot offer any guarantees or warranties for the completeness or accuracy or information relied upon. Information from third parties has not been verified by Create Consulting Engineers Ltd unless otherwise stated in this report.

1.25 The revised Construction (Design and Management) Regulations 2015[11] (CDM Regulations) came into force in April 2015 to update certain duties on all parties involved in a construction project, including those promoting the development. One of the designer's responsibilities is to ensure that the client organisation, in this instance Mulberry Tree Holdings Ltd , is made aware of their duties under the CDM Regulations. Further information on the CDM Regulations is provided in the client guide and is available online. It has been assumed for the purposes of this assessment that the lead designer will be responsible for advising the Client.

1.26 The approach to this FRA follows the ethos of the CDM Regulation, in as much as during the assessment process the proposed development is considered and any foreseeable associated health and safety flood risks are identified. It is then considered how these flood risk can be eliminated, or mitigations identified to reduce or control them. The outcome of this assessment process is presented in this report. While preparing this FRA no other noteworthy or unique health and safety risk have been identified.

[11] Health and Safety Executive., 2015. *Construction (Design and Management) Regulations.* [Online]. Available at: http://www.hse.gov.uk/pubns/indg411.pdf [Accessed November, 2021].

2.0 SOURCES OF INFORMATION

2.1 The information contained in this report is based on a review of existing information and consultation with interested parties.

Records Review

2.2 Key reports and websites reviewed as part of this study are listed in Table 2.1 below.

Document/Website	Author/Publisher	Date
Fluvial/Tidal Flood Maps, Groundwater Mapping – https://flood-warning-information.service.gov.uk/long-term-flood-risk/map	Environment Agency (EA)	Accessed December 2021
Surface Water and Reservoir Flood Mapping – Data.gov.uk	GOV.UK	Accessed December 2021
Kent County Council Preliminary Flood Risk Assessment (PFRA)	Kent County Council	2011
Kent County Council Local Flood Risk Management Strategy	Kent County Council	Undated
Kent County Council Flood Risk to Communities	Kent County Council	2017
Drainage and Planning policy statement	Kent County Council	2017
Surface Water Management Plan	JBA Consulting	2013
Ashford Strategic flood risk assessment	JBA Consulting	July 2014
Site Location Plan (001)	Holloway	November 2021
002-006 Existing Floor Plans	Holloway	November 2021
007-010 Existing Elevations	Holloway	November 2021
101 Proposed Site Layout Plan	Holloway	November 2021
103-106 Proposed Floor Plans	Holloway	November 2021
120-123 Proposed Sections	Holloway	November 2021
130-133 Proposed Elevations	Holloway	November 2021
Existing Site Layout (Topographic Survey) Drawing: B20061_Flour_01-Sheet_01/02	RL Surveys	May, 2015
SW asset plans (included as Appendix A) and Pre-Planning Enquiry Report	Southern Water	November, 2021 Awaiting Response
Flood Investigation Reports	Kent County Council	Various

Table 2.1: Key Information Sources

Consultation

2.3 The agencies and individuals consulted as part of this exercise to obtain records or seek input to the proposals as part of this FRA are listed in Table 2.2 and key records are included in the appendices.

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
Southern Water (SW) South East Water Developer Services Team	Request for Foul and Clean Water Asset Plans	Asset plans were requested in order to inform the foul and surface water drainage strategies. Clean water asset plans from Southeast Water (Appendix A) dated 25th November 2021 show that there is a 6 inch, 9 inch and 12 inch water main flowing on East Hill towards Mace Lane, which becomes a 12 inch ST distribution main. From the east of the site, along Mill Court, there is a 100 mm DI distribution main which connects to a 6-inch distribution main along Henwood road. The foul asset plans from Southern Water (Appendix B) dated 23rd, November, 2021 show foul water assets in the vicinity of the Site. There is a 900 mm combined gravity sewer runs underneath the carpark on site which attaches to a 300 mm combined gravity sewer to the west. There is a 225 mm foul gravity sewer flowing from the southeast of the site towards the northeast extent of the site. A rising main is also shown to be underneath the carpark in the south and then crosses the East Stour before flowing adjacent to the proposed development. The surface water gravity sewer is in the southern extent of the site boundary with an outfall to the East just overbank of the East Stour.
	Request for Pre-planning report	A Pre-Planning Enquiry has been submitted and at the time of writing a response is awaited.
Customers and Engagement Team, Environment Agency.	Email request for Products 4-7 (model report, outputs, and inputs).	A request for Products 4-7 was submitted on the 12th September 2020 and a response with the requested data was received via hard drive in October 2020.
	Email	A request for modelling scope approval was submitted on 7th May 2021 and was approved on the 3rd June 2021 and is located in Appendix A of the appended modelling report (Appendix G).

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
Environment Agency Jenny Wilson, East Kent Planning Specialist Mike Wilkinson and Dave Rich, PSO – Planning & Permitting	Pre Application Meeting	A meeting was held on 14th April 2021 to discuss the development proposals at the Site. A few key points from the meeting are summarised as follows: • The EA confirmed they were happy with the idea of lowering the East Stour River Path. • The key Finished Floor Level (FFL) requirements is to raise living accommodation 600 mm above the design flood event. • Due to the type of development proposals on Site a level-for-level basis would likely not be achievable and therefore over compensation at lower levels would be acceptable. • Safe access should be considered, but the EA confirmed if this could not be achieved, as there was no residential accommodation on the ground floor, it was unlikely to be a reason for objection. Meeting minutes have been included within Appendix B of the hydraulic modelling report (Appendix G).
Environment Agency Jenny Wilson, East Kent Planning Specialist Dave Rich and Linda Winberg, PSO – Planning & Permitting	Emails and Meeting	An objection notice (dated 12th January 2022) was received from the EA which objected in principle to the development due to the presence of Flood Zone 3b (1 in 20 year event) on Site. During a meeting held on 22nd February 2022 to discuss this further it was agreed that the objection would be removed if the 1 in 20 year extent could be moved away from the development areas on the Site by both raising the development above the 1 in 20 year event flood level and lowering the river corridor further to provide adequate flood compensation (including for the 1 in 100 year plus climate change event). It was agreed during the meeting and further correspondence that whilst Block A will still remain within the 1 in 20 year extent that this would be acceptable as it's being retained as existing. During additional correspondence with the EA an issue was raised that the 2D results for the 1 in 20

Consultee	Form of Consultation	Topics Discussed and Actions Agreed
		year event the model was showing unintuitive results. With this in mind the EA were asked on the 21st March 2022: "Providing we can demonstrate that the buildings will remain dry during the 1 in 20 year event, either because they are higher than the 1D flood level or because they are protected by defences/river walls, and that sufficient flood compensatory storage is available during the 1 in 100 year + climate change event, can you confirm that you are would be happy with this approach?" A response dated 22nd March confirmed that the EA were happy with this approach. See Appendix B for correspondence.

Table 2.2: List of Parties Consulted

Site Walkover

2.4 A site walkover was undertaken by Create Consulting Engineers Ltd on the 10th March 2021. A visual examination of the Site as well as an assessment its hydrological context within the surrounding area were carried out.

3.0 SITE SETTING

Site Location

3.1 The Site is located in central Ashford, Kent, approximately 0.5 km from Ashford International train station at ordnance Survey grid reference 601540E, 142783N. The Site lies within the administrative area of Ashford Borough Council (ABC) and comprises approximately 0.3 ha of brownfield land with the Great and East stour subdividing the site. The Site is bound by Mace Lane to the East and East Hill to the Northwest.

Description of Site and Surroundings

3.2 The Site is irregularly shaped and is covered mainly by disused buildings, car parking and associated infrastructure which is bound by East Hill to the east and Mill Court to the southeast. The Great Stour flows adjacent to the site boundary to the west and the East Stour flows adjacent to Mill Court. The site boundary currently encompasses shrubs and grassland to the east and southwest of the site and on the banks of the East Stour. There are also trees and smaller shrubs on the western boundary.

3.3 The Topographic Survey, included with this report on Drawing B20061/1 – 2, summarises elevations in the area of the Site. The Site generally falls to the South from 35.6 mAOD to 34.5 mAOD with a few slightly higher sections (38.2 mAOD) on the Eastern extent of the site.

Geological/Hydrological Setting

Underlying Geology

3.4 British Geological Survey (BGS) mapping (1:50,000 scale)[12] (Figure 3.2) identifies bedrock geology at the Site to comprise the Atherfield Clay formation (Mudstone, Sand). Superficial deposits across the majority of the Site (Figure 3.1) comprise the Alluvium (clay, silt, sand and gravel).

3.5 BGS borehole records[13] indicate that the closest published borehole log to the Site is TR04SW631, which is located approximately 10 m South of the Site. This borehole identifies the Atherfield Clay formation with superficial deposits of Alluvium (clay, silt, sand and gravel).

Surface Watercourses

[12] British Geological Survey (BGS) Onshore GeoIndex., 2021. *DiGMapGB-50 Bedrock Geology and Superficial Deposits*. [Online]. Available at: www.bgs.ac.uk/geoindex [Accessed November, 2021].

[13] British Geological Survey (BGS) Onshore GeoIndex., 2021. *Borehole records*. [Online]. Available at: www.bgs.ac.uk/geoindex [Accessed November, 2021].

3.6 The nearest watercourses to The Site are the East and Great Stour, subdividing the site, as shown on Figure 3.3

Groundwater

3.7 The site is underlain by a Secondary A bedrock aquifer[14] defined by the Environment Agency as:

'permeable strata capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers'.

3.8 The site is also underlain by a Secondary A superficial deposit aquifer[10].

3.9 The Site does not lie within any Groundwater Source Protection Zones[15], as identified by the Environment Agency (Figure 3.5).

3.10 Groundwater was not identified within any local boreholes provided by the BGS online mapping service[7].

Artificial Water Bodies

3.11 The nearest water body to the Site is a small lake located approximately 350 m Northeast of the site boundary.

Public Sewers and Water Supply Mains

3.12 Southern Water (SW) are the statutory sewerage undertaker for the area and responsible for the operation and maintenance of public sewers serving Ashford.

3.13 Clean water asset plans (South East Water) found in Appendix A and dated 25th November 2021 show that there is a 6 inch, 9 inch and 12 inch water main flowing on East Hill towards Mace Lane, which becomes a 12 inch ST distribution main. From the east of the site, along Mill Court, there is a 100 mm DI distribution main which connects to a 6-inch distribution main along Henwood road.

3.14 Foul sewers present in the immediate vicinity of the Site are shown within sewerage asset mapping provided by Southern Water (Appendix B) and comprise:

[14] Department for Environment and Rural Affairs (DEFRA) Magic Website., 2010. [Online]. *Environment Agency Aquifer Designation Data.* Available at: https://magic.defra.gov.uk/MagicMap.aspx [Accessed November, 2021].

[15] Department for Environment and Rural Affairs (DEFRA) Magic Website., 2019. [Online]. *Environment Agency Source Protection Zones (Merged.* Available at: https://magic.defra.gov.uk/MagicMap.aspx [Accessed November, 2021].

- A 225 mm diameter combined gravity foul sewer network serving development leading off East Hill. This flows to the south east of the site to a connection just east of the carpark in the southern extent of the site and then flows underneath the site and towards Henwood Road as a 900 mm sewer. There is also a 225 mm VC sewer which flows from the southeast of the site towards the northeast extent of the site.
- A rising main is also shown to be underneath the carpark in the south and then crosses the East Stour before flowing adjacent to the proposed development.

Existing Site Drainage

3.15 As the Site is currently brownfield in nature an existing foul water drainage network is present which will be re-used were condition and positioning allows and removed/replaced where necessary. There a two drainage channels that flow from the western extent of the site boundary adjacent to East Hill which both run south following the gradient of the site boundary (higher terrain in the northern extent). These are connected to rainwater pipes found on the external boundaries of the current buildings. There is also a drainage channel connected to several rainwater pipes in the northern extent the site, connected to the current disused mill building. Therefore, it is assumed that the SW flows will flow the course of the drainage channels and discharge into the adjacent river and the FW will flow into existing combined sewers as can be viewed in Appendix B.

4.0 SCHEME DESCRIPTION

The Scheme

4.1 The Client intends to apply for planning application for a redevelopment comprising the conversion of the existing Flour Mill, demolition of existing structures, and the erection of four ancillary blocks to provide a total of no. 53 apartments (Use Class C3), ancillary residential facilities (including residents' gym and 'superlounge'), 1 x office (Use Class E(g)(i)), retained access from East Hill, parking, and associated landscaping and infrastructure.

4.2 The proposed scheme is shown on Drawings 001 – 133 within the plans appended within this report.

Proposed Land Use Vulnerability Classification

4.3 The development is proposed to include residential dwellings which is defined as a 'more vulnerable' use according to the NPPF.

4.4 Given the proposed land use classification and the location of the Site within Flood Zone 3 (as noted in Chapter 5 below), the Sequential and Exception Tests will need to be undertaken for the purposes of the proposed development. These have been provided as separate submissions as part of the planning application.

Finished Floor Levels

4.5 The ground floor of the proposed buildings will be set at 35.80 mAOD which is generally close to the existing level of the Site (as shown on Drawing 120 Proposed Section A). The floor level of Block A and Block B will be retained as the existing Block A level (36.04 mAOD).

4.6 All accommodation will be provided on the first floor and above. The lowest first floor level on Site is set at 38.83 m AOD, which means that the first-floor level will be 2.51 m above the 1 in 100 plus 45% climate change event.

5.0 FLOOD RISK ASSESSMENT

Scope of Work

5.1 The scope of this FRA was refined to meet the brief outlined in Chapter 1 of this report and considers the following:

- Flood risk to the development from all sources for the life time of the development;
- Potential for the design, construction and operation of the Site to increase the risk of flooding to neighbouring properties;
- Any necessary mitigation measures to mitigate identified potential flood risks;

5.2 The approach is consistent with the NPPF[1] and its associated Technical Guidance[2] along with the requirements of local planning policy.

Flood Risk to the Proposed Development

Flood Risk from Fluvial Sources

5.3 EA flood mapping[16], indicates that a large part of the site boundary is at a lower risk of flooding. This is indicated by Figure 5.1 showing a substantial amount of the southern extent of the site (Flood Zone 2) should only experience between a 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of fluvial flooding in any one year. Parts of the northern extent of the site are within Flood Zone 3, which is assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

5.4 After conversations with the EA (Table 2.2) it was agreed that a hydraulic modelling exercise would be required to assess the impact of the new development proposals at the Site to ensure the occupiers are safe from flooding and that the development does not increase flood risk elsewhere.

5.5 The full modelling methodology and results from this exercise are detailed in Appendix G, with a brief summary of the main findings below.

Climate Change Allowances

5.6 The EA strategic fluvial model for the region is the 'Updated South Ashford 2D Modelling Study' undertaken by Mott Mcdonald in 2010. The model is a 1D/2D model (ISIS/TUFLOW). This was then updated in 2012 and then again updated in 2016/2017 to consider the latest

[16] Environment Agency., 2021. *Flood Map for Planning (Rivers and Sea) - Flood Zone 2 and Flood Zone 3. [Online]. Available at:* https://data.gov.uk/dataset/cf494c44-05cd-4060-a029-35937970c9c6/flood-map-for-planning-rivers-and-sea-flood-zone-2 [Accessed November, 2021]

climate change allowances (pre July 2021) which were 35% (Central), 45% (Higher Central), and 105% (Upper End) by JBA.

5.7 The revised July 2021 climate change allowances splits up each river basin district into smaller catchments and now requires the 'Central' allowance to be applied for 'More Vulnerable' developments instead. Given the revised climate change allowance within the 'Stour Management Catchment' for the 2080's is 38% (Central) the 45% pre July 2021 (Higher Central) climate change allowance has been used within the modelling exercise as a worst case.

Existing Case Scenario

5.8 There were no changes made to the model within the existing case runs with exception of updating the model to the latest versions of each software; TUFLOW 2020-10-AB and Flood Modeller 5.0.

Developed Case Scenario

5.9 The following changes were made to the developed case runs:

- The development scenario includes Block C and D and associated car parking area set at a level of 35.80 mAOD (using a zsh file), Blocks A and B retained as the same as existing.
- The Manning's n file (2d_mat_BUILDINGS4_TR0042) was adjusted to suit the new layout of the site.
- An area equating to 550.0 m^2 was lowered by on average 0.6 m along the East Stour (totalling to 330.0 m^3) to provide flood compensation.
- The western bank of the East Stour within the 1D nodes (AE_04 and AE_04d) were lowered by 1.3 m to tie into the lowered river corridor.

Summary of Results

5.10 The model was run for the following return periods;

- 1 in 20 Year
- 1 in 100 Year (plus an allowance for 45% climate change – Design Flood Event, used as a proxy for the 38% event as detailed above)

5.11 The 1D flood levels from the flood modelling exercise for each modelled return period are shown below in Table 4.1 for the existing scenario and in Table 5.2 for the developed case scenario. 1D Nodes AG_03 – AG_05 (East Stour) and AG_09 and AG_11 (Great Stour) were selected due to their close proximity to the Site, on both adjacent watercourses, and these in channel nodes are shown on Figure 4.1 of the modelling report.

1D Node	Flood Levels (m AOD)	
	1 in 20 Year	1 in 100 Year (+45%CC)
AG_03 (East Stour)	35.51	36.26
AG_04 (East Stour)	35.55	36.32
AG_05 (East Stour)	35.57	36.32
AG_09 (Great Stour)	35.42	36.03
AG_11 (Great Stour)	36.15	36.33

Table 5.1. 1D in Channel Flood Levels for the Existing Scenario for five nodes in proximity to the Site

1D Node	Flood Levels (m AOD)	
	1 in 20 Year	1 in 100 Year (+45%CC)
AG_03 (East Stour)	35.34	35.90
AG_04 (East Stour)	35.39	35.94
AG_05 (East Stour)	35.42	35.98
AG_09 (Great Stour)	35.42	36.03
AG_11 (Great Stour)	35.97	36.31

Table 5.2. 1D in Channel Flood Levels for the Developed Scenario for five nodes in proximity to the Site

5.12 When comparing the existing and proposed 1D in channel flood levels shown above the proposed results are equal or lower (0 – 180 mm) for the 1 in 20 year event and (0 – 380 mm) for the 1 in 100 year event plus 45% climate change event. It can therefore be concluded that the addition of the development proposals does not increase the risk of flooding at the Site and surrounding area.

5.13 When reviewing the 1 in 20 year flood extents it was apparent that for the western watercourse (the Great Stour) flooding occurred within the 2D even though when inspecting the 1D network and levels it is evident that flooding does not get out of bank. It was also evident that flooding in this part of the Site was not from the easternmost watercourse either (the East Stour) as flood levels are between 300 to 600 mm lower within this channel (Table 4.2).

5.14 This was tested by raising the buildings significantly higher than the 1D flood levels, however flooding was still being shown in the 2D.

5.15 As a result the 2D flood map for the 1 in 20 year event has been omitted from this report and the 1D levels used to assess the extent of the 1 in 20 year event as the 2D results are unrealistic. It is assumed that this is due to an instability within the modelling in this area potentially due to the two in connecting watercourses. This approach was agreed with the EA (see Appendix B of the modelling report).

5.16 When reviewing levels on the Site it is evident that the water does not get out of bank for both the East and Great Stour for the 1 in 20 year event with the flood mitigation measures

incorporated within the developed case scenario. As a result, it can be concluded that the Site post development remains dry within the 1 in 20 year event thus out of the Flood Zone 3b extent.

5.17 The 2D flood extents for the 1 in 100 year plus 45% climate change event of the modelled return periods are shown in Figures 4.2 to 4.5 in the modelling report.

5.18 When comparing the existing case and developed case extents for the 1 in 100 year event the results are very similar, with slight differences shown in the western part of the Site and to the south of the Site.

5.19 Flood levels from the 2D flood plain for a series of nodes (labelled in the same manner as the EA's Product 4) are detailed in Table's 5.3 below, for the 1 in 100 year plus 45% climate change event.

Flood Node	X	Y	Existing Case Flood Level (mAOD)	Developed Case Flood Level (mAOD)	Difference (m)
1	601533	142818	No Flood	No Flood	n/a
6	601548	142807	36.13	36.13	0.00
8	601535	142766	36.28	36.28	0.00
10	601547	142749	36.27	36.27	0.00
11	601524	142740	36.30	36.30	0.00
14	601528	142705	36.31	36.32	0.01
18	601569	142795	36.19	36.19	0.00

Table 5.3. 2D Floodplain Flood Levels for the Developed Scenario across the Site for the 1 in 100 year plus 45% climate change flood event

5.20 When comparing the existing and proposed 2D floodplain flood levels shown above the results again are very similar, with any difference within 1 mm. It can therefore be concluded that the addition of the development proposals does not increase the risk of flooding at the Site across the floodplain, as a result of added floodplain compensatory storage (as detailed below).

5.21 Based on the ground floor Finished Floor Level (FFL) of blocks C and D (35.80 mAOD) and Node 11, as the worst case flood level for this event within the central development area, flood depths for the 1 in 100 year plus 45% climate change event could be up to 520 mm. For Blocks A and B the ground floor FFL's are 36.04 mAOD flood depths for the 1 in 100 year plus 45% climate change event could be up to 280 mm.

Downstream Impact

5.22 The existing and proposed water level 2D outputs were compared for the 1 in 100 year plus 45% climate change event to assess the impact of the development proposals upstream and downstream. The results are shown in Figure 4.6 of the modelling report.

5.23 The results show that there is no impact downstream as a result of the development.

Fluvial Flood Risk Summary

5.24 The Site is therefore considered to be at a low/medium risk of fluvial flooding, as there is a medium likelihood of flooding on the site but due to all accommodation being above ground floor level and with appropriate flood mitigation in place, there is a low likelihood after mitigation measures, which are included in Table 7.1.

5.25 Additionally, it is evident that the water does not get out of bank for both the East and Great Stour for the 1 in 20 year event with the flood mitigation measures incorporated within the developed case scenario. As a result, it can be concluded that the Site post development remains dry within the 1 in 20 year event thus out of the Flood Zone 3b extent.

Flood Risk from Surface Water

5.26 The EA Surface Water Flood Mapping[17], as shown on Figure 5.2, suggests that the majority of the Site is primarily at a 'low' to 'medium' risk of surface water flooding, which is defined as having between a 1 in 100 (1%) and 1 in 1000 (0.1%) probability of flooding. A small area of the Site towards the North has a 'High' risk of flooding, which has a 1 in 30 (3.3%) or greater probability of flooding. These areas of higher risk are directly correlated to the two watercourses subdividing the site. However, this section does not directly affect the proposed development area.

5.27 Flood depths across the majority of the Site remain below 300 mm for the High (Figure 5.3) risk events, around 600 mm for the medium risk events (Figure 5.4). The only area of 900 mm flood depths suggesting 'High risk' (Figure 5.5) are outside of the site boundary of just within it, not encroaching on any purposed buildings. However, as this figure (5.5) depicts the lowest risk event, this is therefore only a low risk.

5.28 Given the nature of the proposed development with all residential accommodation on the first floor and above as well as the dwelling units being placed away from primary flow routes, it is considered that the risk from surface water flooding is generally low.

5.29 Flooding from surface water remains a residual risk due to the potential for rainfall to exceed the design standard of the proposed drainage system and the effects of climate change on the

[17] Environment Agency., 2021. *Risk of Flooding from Surface Water Extent: 3.3 percent annual chance, 1 percent annual chance and 0.1 percent annual chance.* [Online]. *Available at:* https://data.gov.uk/dataset/95ea1c96-f3dd-4f92-b41f-ef21603a2802/risk-of-flooding-from-surface-water-extent-3-3-percent-annual-chance [Accessed November, 2021].

frequency and severity of rainfall events, appropriate mitigation measures are therefore included in Table 7.1 of this report.

Flood Risk from Groundwater

5.30 After consulting the Strategic scale Flood Risk Assessments prepared by Ashford District Council (SFRA[11]) and Kent County Council (PFRA[8]), there are no direct incidences of previous groundwater floods. The site is also underlain by clay which has a low intergranular permeability which will reduce the risk to ground water flooding.

5.31 Therefore, the risk of groundwater flooding in this location is considered to be low, particularly given the adjacent watercourses will provide a control to this, therefore this source is not considered further in this report.

Flood Risk from Artificial Water bodies

5.32 The nearest artificial waterbody to the site is a small lake located approximately 300 m to the northeast.

5.33 The Site is also not in an area at risk from flooding during a reservoir breach event, therefore flooding from this source is not considered a significant risk and will not be considered further in this report.

Flood Risk from Public Sewers

5.34 The SFRA shows no record of sewer flooding affecting the site or the immediate area and the risk of sewer flooding is therefore considered to be low.

5.35 Sewer flooding from blockage of private site and building drainage as well as the Southern Water network is, however, a residual risk managed by the design of the site drainage and regular inspection and maintenance of the public and private sewer network. The flood risk associated with this source may also increase over time due to the effects of climate change. Appropriate mitigation measures are therefore included in Table 7.1 of this report.

Flood Risk from Water Mains

5.36 Flood risk from this source is considered to be a residual risk with no existing mains shown within the supplied South East Water asset plans (Appendix A) crossing the site or within the immediate area. The main threat therefore will be from damage to newly constructed internal pipe work during the construction phase or as a result of any future individual property building works. Appropriate mitigation measures are discussed in Table 7.1 below.

Flood History

5.37 A review of the SFRA and PFRA confirms these documents hold no records of flooding affecting the site itself.

5.38 Review of available flood investigation records provided by Kent County Council[18] has identified that there have been years subject to regular flooding- notable events include 1947, 1967, 1968, 1972, 1973, 1979, 1985, 1986, 1988, 1998, 2000, 2001 and the recent winter 2013-14 period. However, there is no evidence in any of the flood reports or council policies that evidences that the site has been flooded during any of these historical events.

5.39 Review of available flood investigation records provided by Kent County Council has identified no record of flooding from this source affecting the Site.

5.40 Flood investigation records provided by Kent County Council do not identify separate incidences of surface water flooding affecting the wider area of Ashford.

Flood Risk Summary

5.41 In summary, the risk of flooding from all sources is generally considered to be low to moderate. A number of mitigation measures are recommended in Table 7.1 to address and manage the flood risks posed by fluvial flooding as well as residual risks from other identified forms of flooding.

[18] Kent County Council., Various. *Flood Investigation Reports*. [Online]. Available at: https://www.Kent.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/flood-investigations [Accessed November, 2021].

6.0 FOUL AND SURFACE WATER DRAINAGE AND FLOOD RISK FROM THE DEVELOPMENT

Existing Foul Water Drainage

6.1 As the site is currently brownfield in nature an existing foul water drainage network is present (Appendix B), it is therefore assumed that the site drains to the combined sewer network. This may need to be re-used were condition and positioning allows and removed / replaced where necessary.

Proposed Foul Water Drainage Strategy

6.2 Foul water from the Site will be designed to drain to a connection to the 900mm combined sewer crossing the site. The connection point will be confirmed with Southern Water as part of ongoing discussions relating to the build over agreement concerning this sewer, as part of the detailed design.

Existing Surface Water Drainage

6.3 The table below shows the current impermeable (brownfield) and permeable (greenfield) areas for the existing Site:

Rainfall Event	Brownfield Runoff Rate for Existing Impermeable Areas (0.363ha, l/s)	Greenfield Equivalent Runoff Rate for Whole Site (0.509ha, l/s)	Greenfield Equivalent Runoff Rate for Permeable Paving Area 1 (0.195ha, l/s)	Greenfield Equivalent Runoff Rate for Permeable Paving Area 2 (0.052 ha, l/s)
Q 1 year	42.3	0.8	0.3	0.1
Q 30 year	103.69	2.2	0.8	0.2
Q 100 year	133.71	3.1	1.2	0.3

Table 6.1: Brownfield / Greenfield Runoff Rates from the Site for Various Rainfall Events.

6.4 As noted in Chapter 3 the Site currently benefits from a conventional piped drainage network which either drains to the combined sewer or discharges directly into the watercourses surrounding the site.

Proposed Surface Water Drainage Strategy

6.5 The following provides a summary of the proposed method of management and disposal of surface water runoff from the Site:

- Surface water flows will be attenuated using SUDS such that flows from the Site are restricted (with an allowance for an increase in rainfall intensity of 40% due to climate

change) prior to a discharge into the East Stour River to the eastern boundary and to the existing mill leat within the site to the west.

- Two surface water outfalls are proposed, both using a gravity connection to the river/leat.
- As part of the initial design process sustainable drainage methods have been included where practicable, to provide the required attenuation in accordance with the SUDS hierarchy (see Table 6.4).
- There is little potential for Infiltration forms of SUDS (i.e., soakaways) to be viable due to the generally clay based nature of the soils beneath the Site, which would result in very poor infiltration rates. On the basis that infiltration systems are not viable the following forms of SUDS are proposed, as shown on Drawing 2206/02/001:
  - An area of tanked permeable paving to the south of the site, covering the proposed re-used car park. This will drain itself along with all flows from the proposed new roof areas (an impermeable area of 0.195ha). This is referred to as Permeable Paving Area 1.
  - A secondary area of tanked permeable paving will cover the existing carparking and accessways to the west of the site, draining itself only (an impermeable area of 0.052ha). This is referred to as Permeable Paving Area 2.
  - A flow control restricting runoff to the lowest operable rate of 1.0 l/s for each area of tanked permeable paving will be included prior to the discharge into the adjacent river (east) and mill leat (west). This will restrict flows to this level for all events up to and including the 1 in 100 year plus 40% climate change event.
- Micro Drainage calculations included in Appendix F indicate that for Area 1, 188 m^3 of storage is required and for Area 2, 22 m^3 of storage is required. The calculations assume a maximum sub-base depth of 1.1 m for Area 1 and 0.5 m for Area 2.
- The 1.0 l/s restricting flow rate used is the minimum operable flow rate required by the flow control devices specified. This is required to provide a flushing flow to prevent blockage of the device and provide a level of self-cleaning, reducing overall maintenance requirements. Whilst this is acknowledged to be above the calculated greenfield run-off rate equivalent, it is significantly less than the current flow rates achieved by the site (see Table 6.1 above) and therefore is considered as providing a betterment.
- The above tanked permeable paving has been designed on the basis that all flows from the 1 in 30 year plus 20% climate change will be stored within the sub-base, discharging to half this volume within the standard half drain time of 24 hours. Capacity also exists within the sub-bases of both areas to store flows from the 1 in 100 year plus 40% climate change event discharging to half within 29 hours 54 minutes for Area 1 and 2 hours 38 minutes for Area 2.
- The first 5mm of rainfall will be managed by the permeable paving allowing evaporation and saturation of sub-base substrates.

- Allowances for urban creep have not been made as the proposed development consists of flats and apartments which are exempt, as stated within Kent County Council Drainage and Planning Policy.
- As part of the SUDS management train suitable pollution measures must be included to ensure infiltrating water quality meets acceptable standards as set out within Chapter 26 of the SUDS Manual.
- Pollution control requirements are determined by the using the Simple Index Approach as detailed in the CIRIA SuDS Manual.
- Suitable pollution hazard indices are allocated for the proposed land uses. The indices range from 0 (no pollution hazard for this contaminant type) to 1 (high pollution hazard for this contaminant type).
- From the designated mitigation indices a total SuDS mitigation index is calculated for each of suspended solids, metals and hydrocarbons using:

  Total SuDS mitigation index = mitigation index $_1$ + 0.5(mitigation index $_2$)

  Where:

  Mitigation index $_n$ = mitigation index for component n

- 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).

  Total SuDS mitigation index ≥ pollution hazard index

- In this case the SuDS mitigation indexes are detailed in Table 6.2.

Land Use	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads, and non-residential car parking with infrequent change	0.5	0.4	0.4

Table 6.2: Pollution Hazard Indices for the Site

- All impermeable areas will drain through the tanked permeable paving. Permeable paving provides mitigation indices that equal or exceed those required for the Site in all cases (Table 6.3) and therefore is considered an appropriate method to deliver adequate pollution mitigation treatment.

SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7

Table 6.3: Indicative SuDS mitigation indices

- It should be noted that SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the CIRIA SuDS Manual.

6.6 A summary of the potential SUDS options which led to the above drainage strategy is included in Table 6.2. This drainage strategy however is in compliance with both local and national policy as outlined in Section 1 of this report.

SUDS Option	Suitability/Included in the Scheme?	Comments
Soakaways and porous paving	x	Based on our understanding of the ground conditions it is assumed that the underlying geology beneath the developed part of the Site is not suitable for infiltration systems such as this.
Porous paving (storage)	✓	Two areas of tanked permeable paving are proposed with Area 1 draining flows from the proposed new roof areas.
Rainwater Harvesting	*	Not included in the client and architect design proposal at present.
Swales	x	Not suitable for use due to space constraints within the site.
Attenuation Ponds (above ground storage)	x	Not suitable for use due to space constraints within the site.
Below ground storage in cellular systems	*	Not included in the client and architect design proposal at present.
Flow control devices	✓	The peak flow rates will be managed by a simple flow control (as shown in Appendix F). This will restrict flows to 1.0 l/s for each outfall. This flow control also takes into account the 40% inclusion for climate change.
Green Roofs/Brown Roofs/Blue Roofs	*	Not included in the client and architect design proposal at present.

Table 6.4: SUDS Options

Key:

✓ *Suitable for use and included in the scheme*

* *Possibly suitable for use – not included in the client and architect design proposal at present – should be considered further as part of the detailed design*

X *Unlikely to be suitable for use*

Exceedance Flow Routes

6.7 Exceedance flow routes are shown on Figure 6.1, these may be adapted to suit any proposed changes to the Site layout as the design progresses in line with the following principles:

- Surcharged flows from highways, driveways and roof areas will be retained within kerb lines and channelled towards the tanked permeable paving;
- External ground levels will be profiled such that no ponding occurs against buildings, with flows directed as above;
- All flows in excess of the drainage network design standard (1 in 30 year) will be channelled to the tanked permeable paving which has been sized to accommodate the 1 in 100 year plus climate change event whilst also allowing a suitable freeboard for inflows above this.

Management and Maintenance of Drainage Assets

6.8 Given the nature of the development all site drainage will be managed by site management company given nature of development .

6.9 Further detail regarding the exact management and maintenance procedures required will be provided as part of any reserved matters submission once a management company has been instructed and a scope agreed. This will however, follow the principles set out in Table 6.5 below:

Maintenance Schedule	Required Actions	Typical Frequency
Permeable paving		
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 communal 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

Maintenance Schedule	Required Actions	Typical Frequency
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm 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	
	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, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	

Table 6.5: SuDS Management and Maintenance Requirements

Flood Risk from the Development

6.10 As this is the development of a brownfield site the Site it is unlikely the runoff characteristics will be significantly altered, and if in particular runoff rates form the site during extreme rainfall will be significantly improved.

6.11 The following sections provide a drainage assessment of the scheme and appropriate mitigation measures are presented in Table 7.1

Effects on the Public Foul Sewer Network

6.12 As the Site will now produce foul water flows SW have been consulted to confirm there will be no detriment to the surrounding foul water network as a result of the scheme. Consultation will remain ongoing as part of a build over agreement process and a connection point will be agreed as part of the detailed design.

6.13 SW are however, obligated to accept the foul flows from developments with the benefit of planning consent and would therefore take the necessary steps to ensure that there is sufficient treatment capacity should the planning authority grant planning permission, therefore the impacts to the local area are considered to be negligible.

Effects on Nearby Watercourses

6.14 As the majority of the Site is impermeably paved, it is assumed that under current conditions, any surface water will currently runoff to adjacent watercourses during extreme rainfall events. Following development, the surface water drainage strategy set out above ensures that sufficient sustainable drainage systems will be included to make sure that there is a significant betterment as a reduction in surface water runoff rates from the Site compared to the existing situation (for all rainfall events up to the 1 in 100-year rainfall event including an allowance for climate change). Calculations in Appendix E confirm this.

6.15 For all events beyond the 1 in 100 year plus climate change rainfall event, the situation will be no worse than existing, as long as a consideration of exceedance flows is made as part of the detailed drainage design to ensure that any excess surface water runoff would continue to overflow away from the proposed residential properties.

Nutrient Neutrality

6.16 As this development is within the Stour catchment it will be required to demonstrate nutrient neutrality in relation to both foul and surface water discharged from the Site. At detail design stage nutrient calculations will be undertaken in accordance with the methodology set out in the related Natural England Advice. Then as required, measures will be designed to mitigate the impact of any additional nutrients generated.

6.17 Natural England's (NE) position regarding Total Phosphorus and Total Nitrogen is set out in 'Advice on Nutrient Neutrality for New Development in the Stour Catchment in Relation to Stodmarsh Designated Sites – For Local Planning Authorities' (Natural England, July 2020) which was subsequently updated in November 2020[19] as well as there is now also being a further update from NE in June 202120.

[19] NE - Advice on Nutrient Neutrality for New Development in the Stour Catchment in Relation to Stodmarsh Designated Sites - For Local Planning Authorities November 2020 ttps://www.ashford.gov.uk/media/l3dgnfyu/stodmarsh-nutrient-neutral-methodology-november-2020.pdf

20 Letter from NE to Heads of Planning - June-2021- re the Nutrient Neutrality Methodology including advice on mitigation https://www.dover.gov.uk/Planning/Letter-from-Natural-England-to-Heads-of-Planning-June-2021-re-the-Nutrient-Neutrality-Methodology-including-advice-on-mitigation.pdf

7.0 MITIGATION MEASURES

7.1 Flood Risk Mitigation measures are proposed in Table 7.1 in order to both mitigate flood risk posed to the development and to ensure the development poses no risk to the surrounding area.

Type of Flooding (Source)	Issue	Mitigation Measures	Justification	Residual Risk *
Flooding from fluvial sources – overtopping of Great Stour and East Stour	High flows within the surrounding river network.	• Where possible areas should be surrounded by suitable fencing to prevent mobilisation of on-site non-fixed objects such as cars and cycles. • Appropriate flood warning information signs to be placed in marked areas to inform site users of potential risk. • Site management to provide updates to site users, in the form of additional notices, in the event flooding from rivers is expected. • External areas will be profiled so as any runoff will be directed away from any buildings. • Existing surface water flow paths will be maintained and external levels will be profiled such that water can be directed around the building and away from entrance points. • Appropriate flood resilience/resistance measures will be included on the ground floor in agreement with the relevant authorities. These could include, but are not limited to: ○ Electrical wiring feeding low level points and switches should drop from the ceiling rather than be fed from floor level. Switches and points should be raised as high as reasonably practicable and within Building Regulations standards. ○ Use of dry-proofing and wet-proofing building materials; ○ Water resistant coatings for external walls; ○ Raise plant as high as practically possible; ○ Non-return valves will be considered for foul/surface water sewers to prevent backflow; ○ Use of concrete or hard surfaced floors rather than timber or soft coverings. Or use of waterproof floor coverings with appropriate sealing such as Aquastep; ○ Location of boilers as high as possible; ○ PVC windows and external finishes should be used; ○ Use of plastic or metal alternatives to chipboard or MDF; ○ Use of concrete ground bearing slab as opposed to a suspended floor to avoid water entry beneath the floor structure; ○ Partition walls should be constructed such that replacement is not required following a flood event; ○ Underfloor services using ferrous metals will be avoided where practicable; ○ Use of self-closing airbricks or air brick covers; ○ Waterproof pointing to any brickwork; ○ The use of flood channels internally with sump pump system to remove water (these are run round the edge of the ground floor/individual rooms and collect any incoming water below floor level); ○ Inclusion of liquid DPMs over floor screeds; and, ○ Use of full cell insulation in all walls and floors instead of fibre.	Will ensure flood risk from this source is managed and mitigated appropriately and no persons are exposed to risk.	Low
Flooding from failure of water mains associated with existing assets (external water supply system)	A residual risk of flooding associated with burst water mains may result in flooding of open areas, access roads and dwellings.	• Appropriate easements, where applicable, will be maintained around all identified water mains as part of the detailed design of the scheme and carry out diversion of assets as required and with the agreement of SW. • All water mains within development areas will be suitably located and marked prior to the commencement of construction to minimise the risk of strikes during excavation works.	Will ensure the residual risk is minimised for the lifetime of the development.	Low
Flooding from proposed water mains (proposed internal water supply system).	A residual risk of flooding associated with internal water supply and distribution systems may result in flooding of dwellings.	• Routine inspection of the Site and public water supply and distribution system by the Site owner and SW.	Will ensure the residual risk is minimised for the lifetime of the development.	Low

Type of Flooding (Source)	Issue	Mitigation Measures	Justification	Residual Risk *
Sewer flooding from existing public and private drainage (foul and surface water).	Blockages or surcharges in the Site drainage or the public sewer network crossing the Site or in the Site vicinity may result in flooding of the Site.	• Engage in discussions with SW to agree appropriate management as part of any future build-over agreement. • Confirm capacity is still available in the public sewer network at the detailed design stage; • Where connections are proposed to the existing foul sewer network, any required upgrades will carried out prior to the occupation of the relevant development areas, to ensure suitable capacity is available. • All sewers within development areas will be suitably located and marked prior to the commencement of construction to minimise the risk of strikes during excavation works. • At the detailed design stage consideration will be given to flood flow routes in the event of a system surcharge/blockage, these will ensure any surcharged water is kept within kerb line and away from properties and all access points. • Consider opportunities for flood resilient design, as above. • Ensure routine inspection and maintenance of both the on-site and offsite drainage systems by the Site management and SW; • A management plan for the maintenance of drainage assets should be prepared and agreed with appropriate authorities as part of the detailed design. This should ensure routine inspection and maintenance of both the foul and surface water drainage systems by the Site management and/or any adopting body and SW;	In the event of foul and surface water flooding occurring, these measures will ensure the effects of flooding to external areas and dwellings will be minimised.	Low
Flooding from surface water runoff – overland flow/ponding	Risk of flooding from rainfall events in exceedance of the site drainage design and by run-off from surrounding areas, may result in on-site property flooding.	• All dwellings will be placed at first floor level or above; • The detailed design of the development will make an allowance for flow routing from rainfall events in exceedance of the drainage design capacity (i.e. the 100 year plus 40% climate change) in accordance with best practice guidance; • External areas will also be profiled so as any runoff will be directed away from dwellings and into the roads and designated open space areas; • Appropriate maintenance of downstream riparian watercourses, culverts and main rivers by the respective riparian owners and EA. • Ensure mitigation measures, as detailed in Appendix G and on Drawings 2206/02/001, relating to alterations to ground levels and finished floor levels are included in the detailed design such that the surface water flood risks posed are minimised and not increased elsewhere, in line with the NPPF.	Will ensure flood risk from this source is minimised for the lifetime of the development and as updated modelling becomes available, whilst also ensuring no downstream impacts arise from new structures within the flood zone.	Low
Increased flood risk to surrounding and downstream properties and land as a result of the increased impermeable area associated with the scheme.	The scheme will change surface water run-off rates and patterns which may increase risk of flooding to neighbouring land or property, most notably due to the increase in runoff volume.	• Sustainable drainage systems and surface water attenuation will be included to ensure the risk of flooding to the surrounding area is minimised whilst no flooding of properties occurs during the design 1 in 100-year surface water flood plus 40% climate change event. Associated with this is the restriction of flows to the equivalent 1 in 1-year greenfield runoff rate for all impermeable areas, as outlined in Chapter 6. • The detailed design of the development will make an allowance for flow routing from rainfall events in exceedance of the drainage design capacity (i.e., the 100 year plus 40% climate change) in accordance with best practice guidance to ensure surcharged flows are directed, above ground and within roadways or open space, towards the tanked permeable paving. • At the detailed design stage consideration will also be given to flood flow routes in the event of a system surcharge/blockage, these will ensure any surcharged water is kept within kerb line and away from properties. • External areas will also be profiled so as any runoff will be directed away from dwellings, into roadways/open space and towards the tanked permeable paving. • Maintenance plans and schedules will be compiled for all sustainable drainage systems in the scheme at the detailed design stage. These should ensure routine inspection and maintenance of both the foul and surface water drainage systems and will be targeted	These measures will ensure the risk of flooding posed by the development will be reduced in line with the design standard, whilst events in excess of this are suitably managed where possible, in line with local and	Low

Type of Flooding (Source)	Issue	Mitigation Measures	Justification	Residual Risk *
		towards all responsible parties including homeowners, adopting authorities and private management companies. These measures will ensure the effective operation of all drainage assets for the lifetime of the development. • Appropriate maintenance of downstream sewers by SW and of any downstream culverts by the respective riparian owners.	national policy requirements.	
	The development of the Site will increase foul water flows in the local network.	• SW will be consulted further at the detailed design stage to confirm network capacity. • The existing site network, where connections are proposed, will be upgraded, where necessary, in liaison with SW. • Routine inspection and maintenance of both the foul water drainage systems private owners, management companies and the adopting authority.		

Table 7.1. Mitigation Measures

*Following adoption of the mitigation measures

Outline Flood Response Strategy

7.2 This section summarises an outline of the proposed flood response procedures recommended for the site. These should be reviewed by the local planning authority, formalized into a standalone document and made available to all future residents.

Information for Site Management

7.3 The Site is located in an area which is at risk of fluvial flooding from the Great Stour and East Stour, located adjacent to the Site.

7.4 Also it should be noted that flood depths may increase overtime as a result of climate change and the EA should be contacted periodically to check whether the flood levels and/or degree of protection has changed as this may affect the risk to your property of safety in a flood.

Summary of Flood Warning Procedures

7.5 The following summarises the flood warning system and sets out the recommended procedures for responding to flood warnings and for evacuation in the event of a flood:

- Site management should have a pre-prepared Flood Kit as outlined below and should be prepared for refuge at the site in the event evacuation cannot be carried out due to rapid onset of flood waters.
- Site management should monitor the online EA flood warnings both online and through signing up to the EA flood warning service whereby telephone messages are provided by the EA to warn occupants of any impending floods. The EA flood warning system is shown in Table 5.3 and its interpretation for this site is as follows:
  - When the flood warnings reach 'Flood Alert' all occupants of the site should be notified of the potential for flooding by the EA and told to prepare for evacuation of the site.
  - When the warning level changes to 'Flood Warning' site management should, if safe to do so, isolate all gas, electricity and water supplies to the site before they evacuate to the nearest evacuation shelter at a location to be advised by the Local Emergency Planning Officer or Environment Agency via the EA floodline or local radio and television broadcasts. Evacuation should be made towards to the west of the Site along East Hill.
- If flood waters have progressed to the site and the water is fast moving all occupants should not progress through the potentially dangerous flood waters away from the site. Instead they should take refuge within the building on the upper floors.
- On receipt of a severe warning, occupants are advised to remain at the site as above.
- If taking refuge all occupants should remain in contact with the emergency services by phone and cooperate with any instructions issued by the police or other emergency

services. As long as occupants make themselves known to the emergency services they will be rescued.

- Site management should not turn services such as gas supply back on again until the service provider confirms it is safe to do so.

Flood Alert Category	What it Means	When it is Used
 Flood Alert	Flooding is possible, be prepared	Two hours to two days in advance of flooding
 Flood Warning	Flooding is expected, immediate action required	Half an hour to one day in advance of flooding
 Severe Flood Warning	Danger to life	When flooding poses significant threat to life
Warnings No Longer in Force	No further flooding expected in your area	When river conditions begin to return to normal

Table 7.2: Environment Agency flood warning system. (Images courtesy of the Environment Agency website)

8.0 RESIDUAL FLOOD RISKS AND IMPACTS TO SURROUNDING AREAS

Residual Risks

8.1 A number of residual risks have been identified, associated with public sewers, site drainage and water supply pipes and intense rainfall.

8.2 As long as the mitigation measures outlined in Table 7.1 are adhered to then the residual risks will be minimised.

Impact on Flood Risk of Surrounding Areas

8.3 Given the drainage strategy proposed and significant reduction in surface water runoff rates, it is considered that the development of the Site will not increase the risk of flooding in other areas, surrounding the Site, assuming the measures proposed in Table 7.1 are implemented.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Based on our understanding of the Site setting and the development proposals, it is considered that the risk of flooding from all sources is generally low, and the development can be operated safely and without significantly increasing flood risk elsewhere. However, a risk of fluvial flooding, as well as a number of residual risks have been identified, associated with public sewers, site drainage and water supply pipes and intense rainfall. Appropriate mitigation measures have been provided in Table 7.1 to address and manage the risks and residual risks from these forms of flooding.

9.2 We recommend that the assessment of residual risks should be reviewed by site owners as new flood risk information becomes available, and the flood risk associated with adjacent sewers may also increase over time in the area due to climate change.

10.0 REFERENCES

i. Kent County Council (2011) Preliminary Flood Risk Assessment.

ii. Kent County Council (Undated) Local Flood Risk Management Strategy.

iii. Kent County Council (2017) Flood Risk to Local Communities.

iv. Kent County Council (2017). Drainage and Planning policy statement.

v. Kent County Council (2013). Surface Water Management Plan. JBA Consulting.

vi. British Geological Survey Geoindex. Available at: www.bgs.ac.uk/geoindex (accessed December, 2021).

vii. Department for Environment and Rural Affairs (2015). Sustainable drainage systems: non-statutory technical standards.

viii. Environment Agency Groundwater Maps Available at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=514500.0&y=188500.0&topic=floodmap&ep=map&scale=8&location=Harrow,%20Harrow&lang=_e&layerGroups=default&textonly=off (accessed December, 2021).

ix. Environment Agency Flood Maps for Planning. Available at: https://flood-map-for-planning.service.gov.uk/ (accessed December, 2021).

x. Environment Agency Surface Water Flood Maps and Reservoir Flood Maps Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/ (accessed December, 2021).

xi. Environment Agency (2021). Flood Risk Assessments: Climate Change Allowances. [Online]. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances (accessed December, 2021).

xii. Health and Safety Executive (2015). *Construction (Design and Management) Regulations* (accessed December, 2021).

xiii. Ministry of Housing, Communities & Local Government (2021). *National Planning Policy Framework (NPPF).*

xiv. Ministry of Housing, Communities & Local Government (2014). *Planning Practice Guidance (PPG) – Flood Risk and Coastal Change.*

xv. Office of the Deputy Prime Minister. *The Building Regulations 2000. Drainage and Waste Disposal Approved Document H, 2002 Edition*.

FIGURES

Figure 1.1: Site Location

Source: Google Earth Mapping (2021)

Figure 3.1: BGS 1:50,000 Superficial Deposit Geology

Source: https://mapapps2.bgs.ac.uk/geoindex/home.html (2021)

Figure 3.2: BGS 1:50,000 Bedrock Geology

Source: https://mapapps2.bgs.ac.uk/geoindex/home.html (2021)

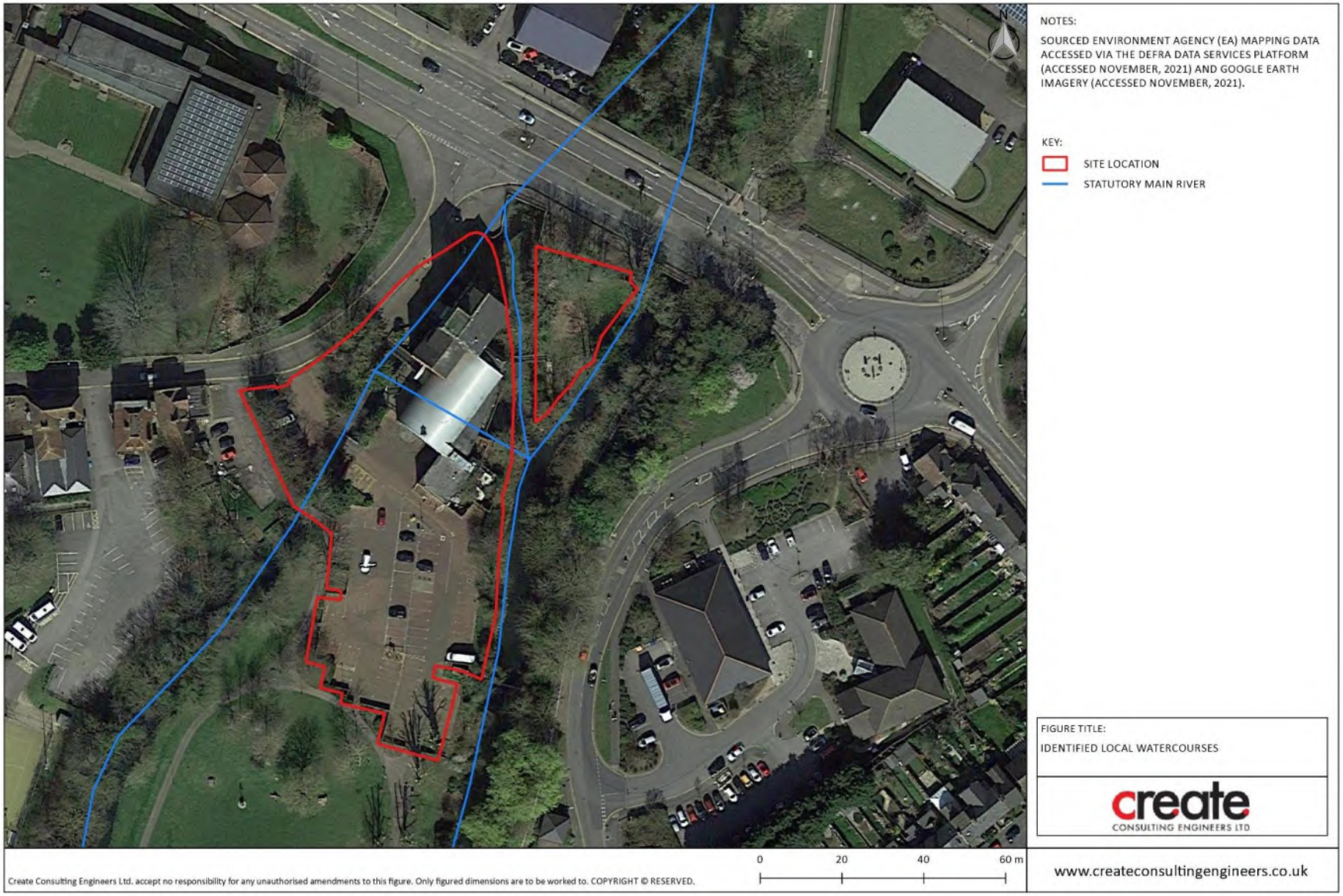


Figure 3.3: EA local identified watercourses

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

Figure 3.4: Source Protection Zones Map

Source: Defra Data Services Platform (https://environment.data.gov.uk/)

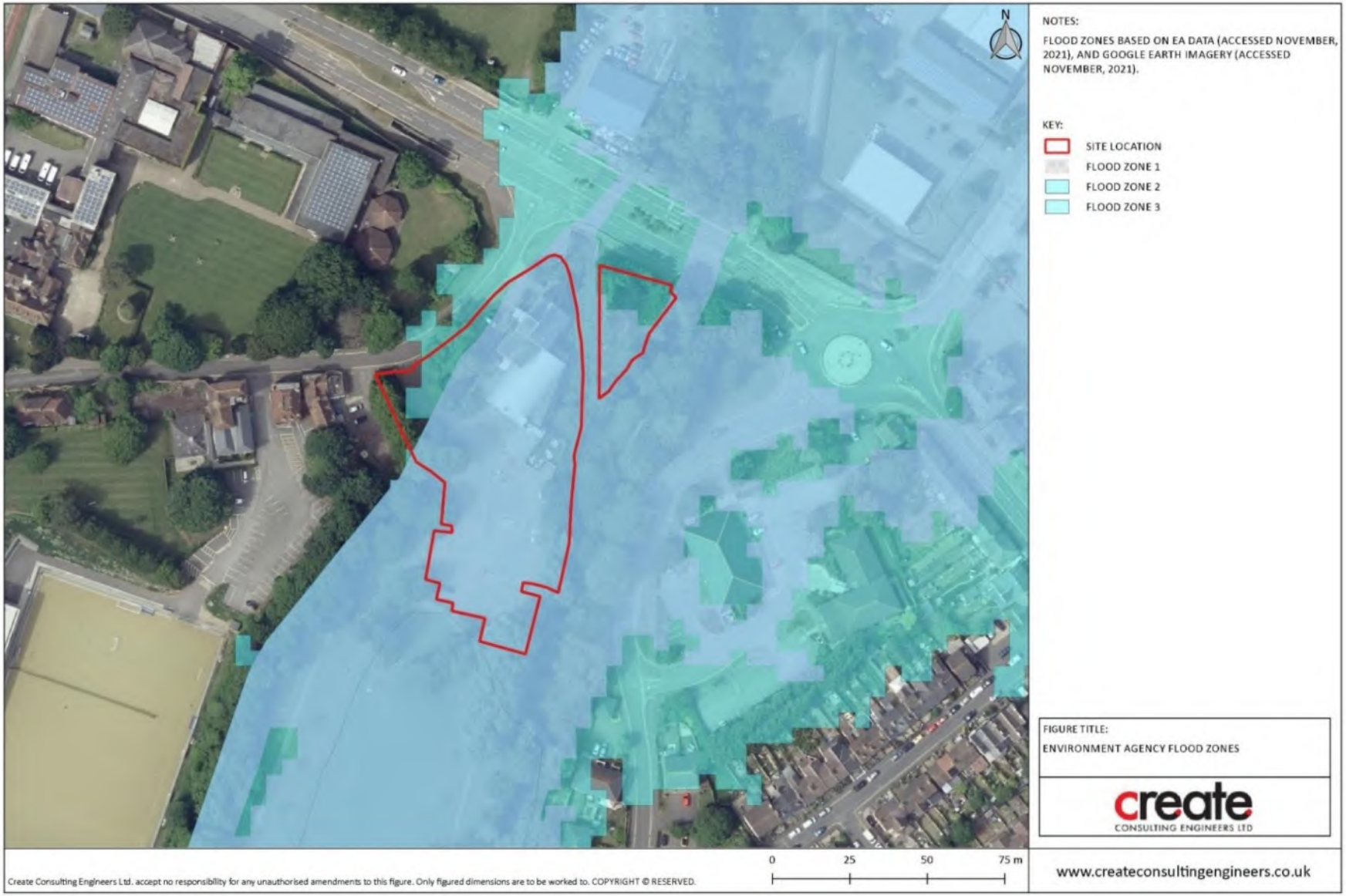


Figure 5.1: Environment Agency's Fluvial/Tidal Flood Map

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

Figure 5.2: Environment Agency's Surface Water Flood Extent Map

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

Figure 5.3: Environment Agency's Surface Water Flood Depths Map 1 in 30 Year Event (3.3%)

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

Figure 5.4: Environment Agency's Surface Water Flood Depths Map 1 in 100 Year Event (1%)

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

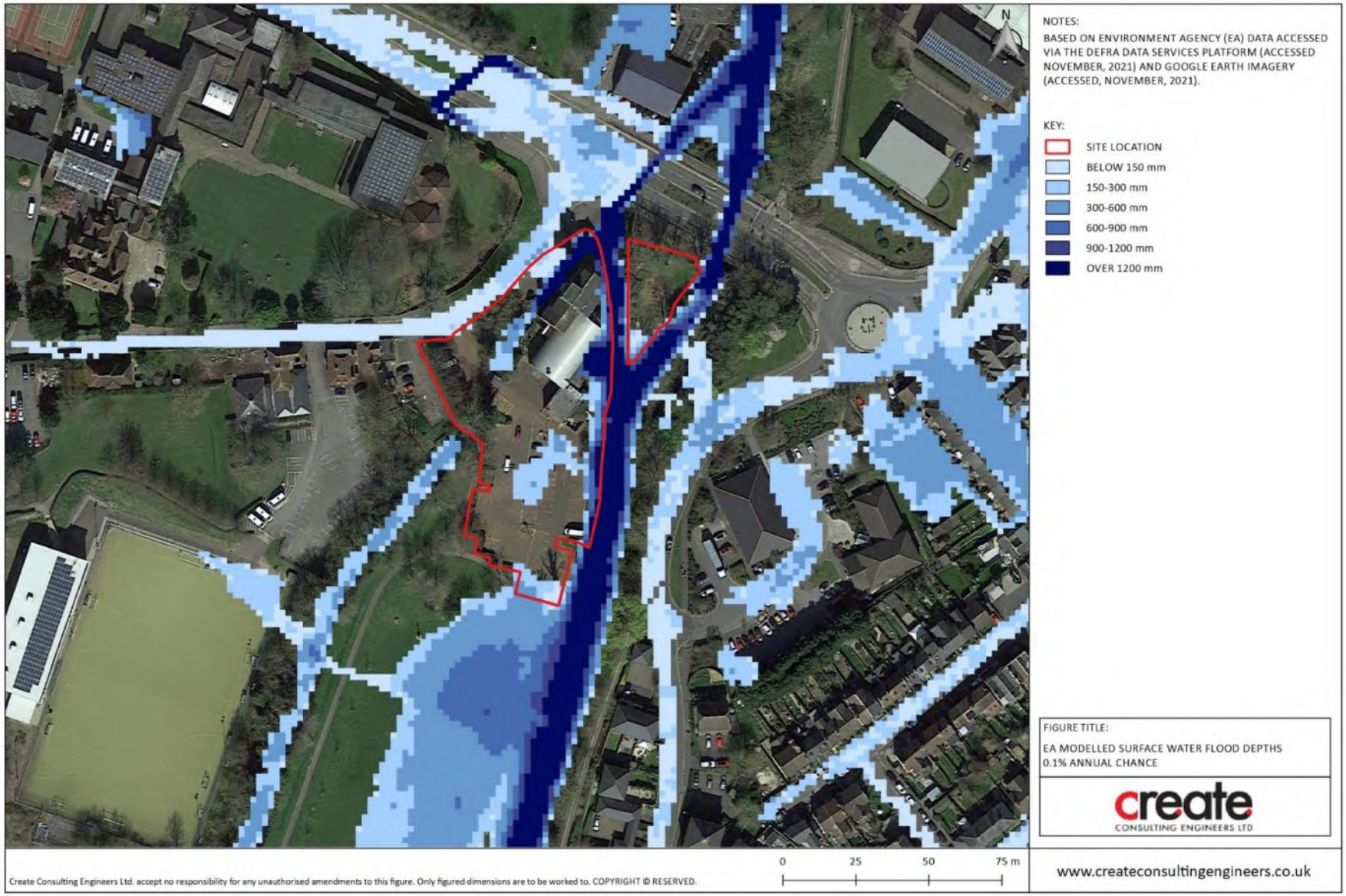


Figure 5.5 Environment Agency's Surface Water Flood Depths Map 1 in 1000 Year Event (0.1%)

Source: Defra Data Services Platform (https://environment.data.gov.uk/).

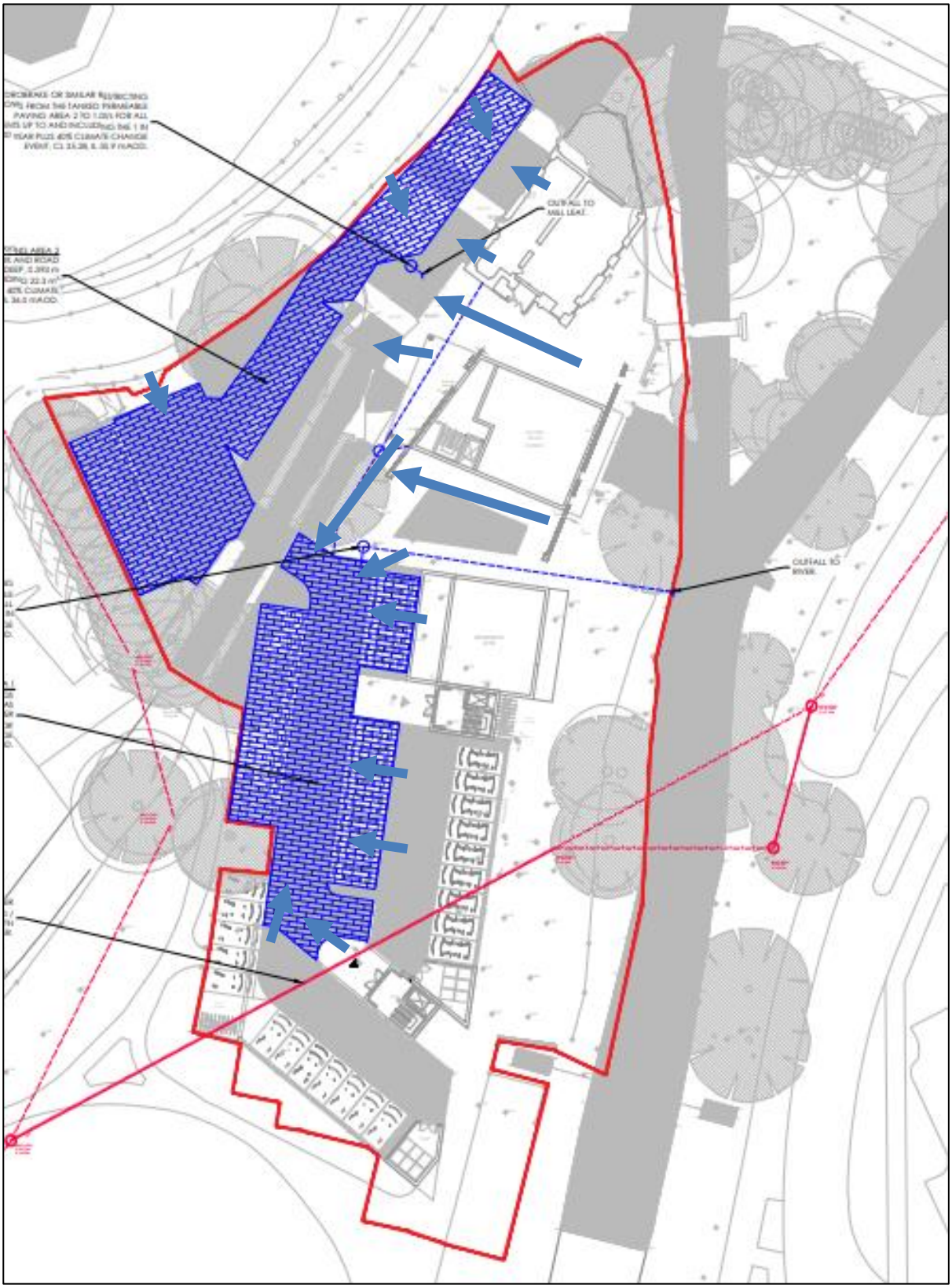


Figure 6.1: Exceedance Flow Routes

Source: Defra Data Services Platform (https://environment.data.gov.uk/)

APPENDICES

APPENDIX A

Drawing Title: Flour Mills 24 East Hill Ashford TN24 8PA

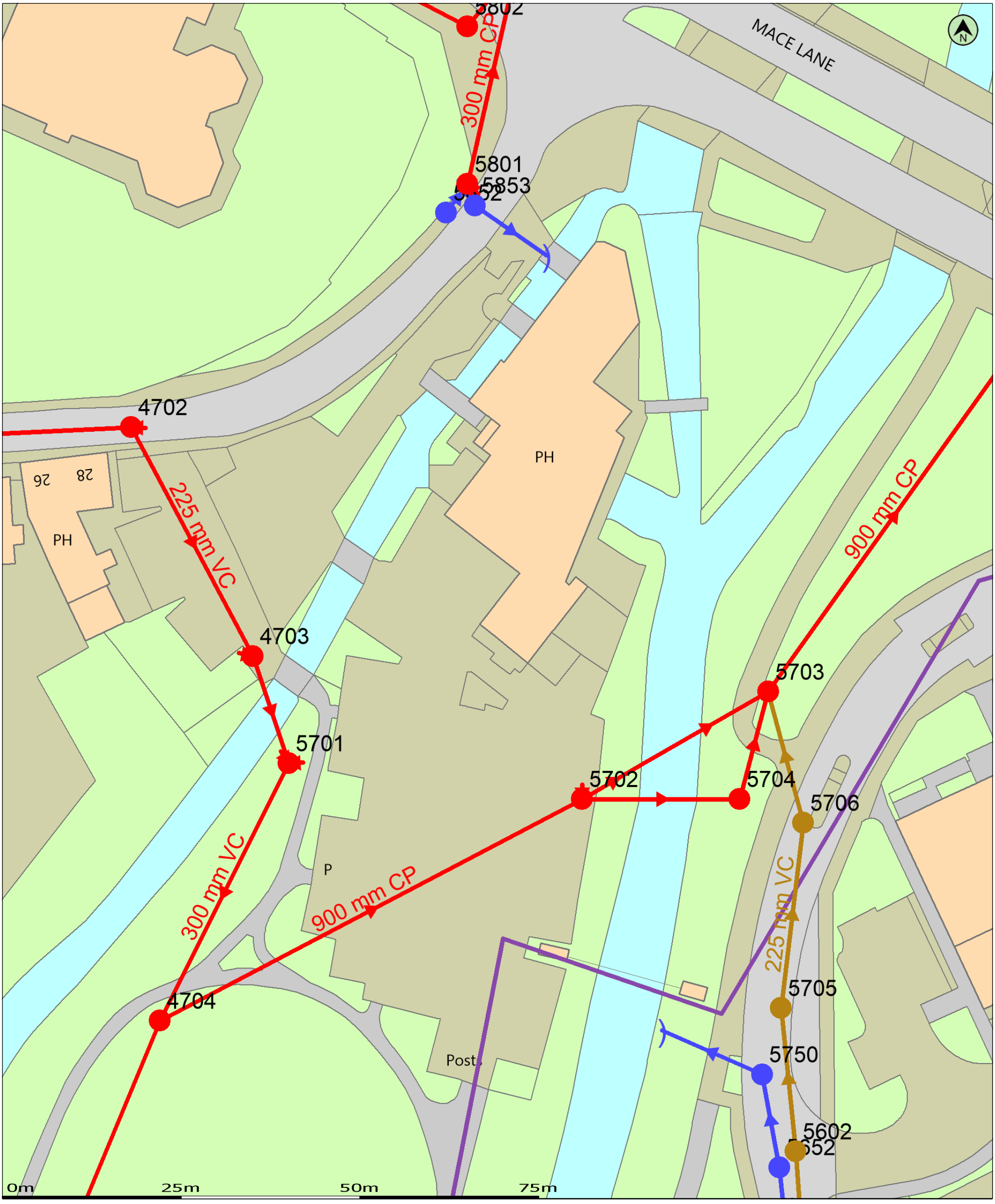
South East Water Mains and Fittings

Valve	Meter	Distribution Main	
Washout	Pressure Valve	Abandoned Main	
Fire Hydrant	Air Valve	Company Boundary	

Reference:	
Plot Date:	25/11/2021
Grid Reference:	601,540.0000 142,773.0000
Scale:	1:1,250

south east water
(Water Maps)
PO Box 105
Snodland, Kent
ME6 9DW
Telephone: 0333 000 0058
Email: water.maps@southeastwater.co.uk
Website: www.southeastwater.co.uk

APPENDIX B



Data updated: 20/10/21

Scale: 1:500

Map Centre: 601530,142768

Date: 23/11/21

Our Ref: 710219 - 1

Wastewater Plan A3

Powered by digdat

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

claire.seymour@createconsultingengineers.co.uk

P20-2206 Flour Mill

from Southern Water

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4702	C	37.99	36.11	
4703	C	37.16	34.71	
4704	C	36.32	31.58	
5701	C	36.42	34.68	
5702	C	36.22	31.47	
5703	C	36.25	31.42	
5704	C	36.35	0.00	
5801	C	36.55	35.20	
5802	C	36.90	35.22	
5602	F	36.70	34.92	
5705	F	36.55	34.75	
5706	F	36.30	34.52	
5652	S	36.72	34.40	
5750	S	36.57	34.18	
5852	S	36.45	0.00	
5853	S	36.39	34.91	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX C

Wastewater pre-planning enquiry

A pre-planning enquiry can assist developers in understanding the impact of development proposals on our sewerage networks prior to land acquisition or the submission of a planning application.

Please complete this form and save a copy and email it to **developerservices@southernwater.co.uk** or alternatively post it to: Developer Services, Southern House, Yeoman Road, Worthing, West Sussex BN13 3NX.

All fields are required unless otherwise stated. Please note incomplete information may cause delays to your application. When answering the yes/no questions please tick in the appropriate box. Please keep a copy of the completed application for your records.

If you need any help completing the form please call us on **0330 303 0119** and we'll be happy to help.

Section 1: About you

Are you? (please tick)

	Developer	✔	Consultant		Landowner		Other (please state)

Name:	**Tracey Tooke**	Address:	
Company name (if applicable):	**Create Consuiting Engineers Ltd**		**15 Princes Street**
			Norwich
Phone:	**01603 877010**		**Norfolk**
Email:	**Tracey.Tooke@createconsultingen**	Postcode:	**NR3 1AF**

Section 2: Development details:

Do you intend to offer any of the sewers for adoption by Southern Water under S104? Y ✔ N

Please provide as much of the site address that is available. This address must include a road name, town/city.

Site name:	**Flour Mill**	Address (including nearest postcode):	
National Grid Reference (NGR) for site. The NGR is a 12 digit grid reference split into two 6 digit numbers (X and Y). This will help us identify a point of connection for the development:			**The Flourmills, East Hill**
			Willesborough, Ashford
			Kent
Grid reference number:	**601529, 142746**	Postcode:	**TN24 8PA**

Development type (please tick all that apply)

	Commercial	✔	Residential		Industrial		Other (please state) eg.schools, care homes

Please click here to read our privacy statement: **developerservices.southernwater.co.uk/Home/PrivacyPolicy**

Residential: number of domestic dwellings to be connected	**53**
Commercial: Estimated population to be connected	**1**
Industrial: Estimated maximum trade flow l/s (litres per second)	

Applications for trade effluent discharges should be progressed through your retailer. Information is available here: **open-water.org.uk**

For general information on trade effluent please visit: **southernwater.co.uk/retail/trade-effluent-retailer**

Datum at lowest point on site (mAOD) metres	33.1	Calculated foul sewer design flow l/s*	
Total site area (hectares)	0.51	(* Our calculation spreadsheet is available on request)	

H3 Building Regulations Guidance should be followed, see link:
gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h

Estimate of impermeable area to contribute to surface water flows (m^2)	2470
Estimate of peak surface water run-off in two-year event (l/s)	2.0

Is the site identified in the local plan?	Y		N	✔	If yes, please provide reference number		
Does this site have planning permission?	Y		N	✔	Planning reference number		
Have you approached us about this site previously?	Y		N	✔	If yes, please provide reference number		

Council area: **Ashford**

Please provide a brief description of the development proposal (e.g. new build, conversion, number of properties)

it is intended to re-develop the site incorporating parts of the existing building to provide 53 flats (29 2 bed, 21 1bed & 3 studio), 1 new office unit (192 m2) and a small gym (192m2) for residents use only.

Is the development part of a larger site that will be developed in phases?	Y		N	✔

Section 3: Existing and previous land use

Does the site drain to an existing foul sewer?	Y	✔	N		What is the present impermeable area? (m^2)	3630
Does the site drain to an existing surface water sewer?	Y		N	✔		

Please confirm what the land was previously used for or the existing land use and provide the following information:
Description of previous/current land use e.g. new build, conversion, brownfield redevelopment

the site contains a disused mill (801m2) most recently used as a nightclub venue and carpark (2829m2) and is classified as brownfield.

The site borders a river to the east and has mill leat running through it to the west. It is assumed that surface water from the existing building and carpark areas discharge to these via a small scale private drainage network, the proposed surface water drainage scheme shall mimic this with the inclusion for suds and

Greenfield	Y		N	✔	**Brownfield** (site must have drained to the sewer network and incurred charges within last 12 months)	Y	✔	N	

If Brownfield site please fill in Table 1 below:

Table 1	Foul water flows before development (l/s if known, enter 'n/a' if not known)	Surface water flows before development (l/s if known, enter 'n/a' if not known)
Number of domestic dwellings		
Commercial area m^2	**801 m2**	
Industrial area m^2		
Schools		
Care Homes		
Other uses		

Section 4: Drainage strategy

Foul connection: How are you proposing to drain foul flows from the site?

Via an existing connection to the public sewer?	Y		N		Via a new connection to the public sewer?	Y	✔	N	
Do your drainage proposals involve pumping to the public sewer network?						Y		N	✔

Surface water connection: You should follow the surface water hierarchy with water reuse/harvesting to be considered as the first option. Please indicate below and provide evidence to support your strategy as an attachment to this enquiry. H3 Building Regulations Guidance is available here: **gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h**

	Infiltration	✔	Surface water body		Surface water sewer/Highway Drain		Combined sewer

SuDS: Have SuDS features been considered in the surface water drainage strategy? Y ✔ N

Section 5: Supporting Information checklist

Please confirm that the following list of information has been provided to support with your enquiry:

• Layout drawing with site boundary clearly shown	Y	✔	N	
• Roads clearly shown	Y	✔	N	
• Adjacent buildings clearly shown	Y	✔	N	
• Preferred drainage outfall route(s) and point(s) of access etc.	Y		N	
• Private pipe run to Southern Water network clearly shown	Y		N	
• Topographical survey	Y	✔	N	
• Ground investigation report to show infiltration could be utilised on the site – or use of BGS data where permeability results not available	Y		N	
• Area map inc NGR	Y		N	
• Detailed site layout inc NGR	Y		N	
• Flood Risk Assessment (where required under NPPF guidelines) or statement for site and associated risk	Y		N	
• Evidence of existing drainage connections and estimated rates of discharge (for Brownfield sites)	Y		N	
• Full calculations to show pre-development surface water rates for Greenfield sites	Y		N	
• Proposed principles of ownership	Y		N	

• Exceedance routes on and offsite – please give details on route of flood flows that might occur due to exceedance of design criteria or failure of any part of the system (including blockage), or other infrastructure:
(For assistance, please read our pdf: **Guidance notes: Wastewater pre-planning enquiry**)

surface water flows will be directed to car parking areas to be laid to tanked permeable paving.

• Proposed accessibility arrangements	Y		N	
• Operational requirements of components e.g. pumping stations	Y		N	

Section 6: Notes

Maximum file limit is 50mb. Allowed file types are DOCX, DOC, PDF, XLS, XLSX, JPG, JPEG, BMP, PNG, DWG (AutoCAD), DXF (AutoCAD), DGN (microstation), PRP (microstation), PRW (microstation).

Section 7: Payments and charges

Wastewater flow capacity check Note: Under conditions where it is deemed necessary to carry out a full pumping station survey it is advised that discussions be held with Southern Water prior to submission of the form.			**Surface water flow capacity check** Note: For flows in excess of 500l/s it is advised that discussions be held with Southern Water prior to submission of this form.		
Number of units	**Cost £**	Please tick	**Number of units**	**Cost £**	Please tick
0 to 50	169.00		0 to 50	341.00	
51 to 250	510.00	✔	51 to 250	1019.00	
251 to 500	680.00		251 to 500	1360.00	
>500	680.00		>500	1360.00	

Section 8: Declaration and terms and conditions

I confirm that to the best of my knowledge the information I have supplied is complete and correct. Failure to include any of the requested information will be deemed as an incomplete application and may result in this application being delayed/returned. This application **does not** mean approval has been granted. No work should commence until written approval has been given by Southern Water. In some cases the pre-design strategic assessment cannot be completed due to incomplete or insufficient records. In this instance, we may ask the applicant to provide surveys of drainage in the area. These would be conducted at the applicant's expense. The contents of the report are for direct use only by the applicant and are to be kept private and confidential. They may only be disclosed to third parties with the written approval of Southern Water. Such third parties to have no subsequent implied or other right to disclose the contents and information to any other parties.

Amount to pay:	**Cost £**
Wastewater	**510**
Surface water	**0**
VAT @ 20%	**102**
Total	**612**

Do you require a VAT receipt?

Y	✔	N	

Section 9: Preferred payment method

BACS:	**Please ensure to include the application number as the payment reference.**
Application number:	
Payments can be made directly via BACS transfer to:	Sort code: 40-02-50 Account no: 81426834 SWS Ltd, Miscellaneous Income account, HSBC Bank PLC, PO Box 125, 2nd Floor, 62-76 Park Street, London SE1 9DZ.

Cheque:	**Cheque number:**	
Application number:		
Site details/address:		
Send cheque to:	Miscellaneous Income, Southern Water, PO Box 4056, Worthing, West Sussex. BN13 3NX	

Signature:	**Tracey Tooke**	Position:	**Water and Flood Consultant**
Print name:	**Tracey Tooke**	Date:	**29.11.21**

Service levels: We plan to acknowledge receipt of your application within 7 calendar days of receipt and provide a full response to your query within 28 calendar days unless an extension is agreed.
About us: Southern Water supplies water to 2.5 million customers residing in 1.1 million properties and provides wastewater services to 4.6 million living at 2 million properties. See what is happening in your area at: **southernwater.co.uk/your-area**
Registered number 2366670

APPENDIX D

MEETING NOTES

Meeting Title:	EA – Pre-App Advice – Initial Meeting	
Attendees:	Jenny Wilson (JW) Mike Wilkinson (MK) David Rich (DR) Chris Downs (CD)	EA – East Kent Planning Specialist EA – PSO – Planning & Permitting EA – PSO – Planning & Permitting Create – Technical Director for Water
Date of Meeting:	5th March 21	Apologies: none
Project Ref:	CD/ P20-2206/EA-M1-Rev1	cc: Ben Ludlow
Date of Notes:	14th April 21	Revision: Rev 1 (Final)

Notes: Actions:

1.0 Introduction

1.1 CD provided an introduction to the proposed scheme as shown in the pre meeting issued proposed development plan (20.068_Flour Mill_Revised Option (Overlay)) and he confirmed the following:

i. It is a flat based residential development, with Blocks A&B being the existing building and Block C&D are new build.

ii. Residential accommodation will start on the first floor, with commercial on ground floor, e.g. café.

iii. It is being proposed to lower the eastern side of the Site to provide a naturalized river path close to the water. This will also reduce the amount of flooding of the Site and compensate for the building.

1.2 MW advised the EA's view of the Site based on discussions with the catchment engineer Barrie Neaves:

i. The Site is bordered by both the Great Stour (GS) and East Stour (ES).

ii. The GS water level is at a higher level by up to 2m depending on flooding than the ES as it was the leat for the old mill.

iii. The characteristics of the water courses are not easy to simplify. Model reports are available for the Mott McDonald 2010 South Ashford 2D Modelling Study and the JBA Consulting 2012 Model Update. The former can provide details of the construction of the model and analysis of the results.

iv. There is an outlet from the GS mill leat to ES via an old mill channel, which is controlled by sluices and these are open. This therefore help level out the water between the two watercourses. This channel needed to be

maintained and kept in a good condition by the site owner as the riparian owner.

v. Some 8 years ago the weir was lowered and a fish pass was added as well as gabion baskets. At the same time the channel below the mill building was also refurbished. The EA led on the refurbishment of the channel and the School on the mill leat.

vi. There is also a sewer across the GS U/S (upstream) end of the Site which causes the river to weir of it and make flood locally worse. As part of the scheme this was to be lowered, but it was not. The EA would be keen for the developer to do this. This was previously costed at £30k.

2.0 Site Flood Risk

2.1 From discussion it was agreed generally that the west side of the Site was defended, probably due to the U/S storage areas. The rest of the Site was mainly in Flood Zone (FZ) 3a, while there was a small area of FZ3b on the east side.

2.2 MW said he was happy with the idea of lowering the ES river path to move FZ3b off the site to be developed.

2.3 It was agreed that that climate change increase for the design flood was 45%, but a resilience check was also required for the 105% to show that it had been considered and taken account of.

2.4 MW stated that for commercial development the free board was 300mm to be added on top of the climate change increase and for living accommodation this was 600mm.

2.5 He said the aim should be to have commercial floor levels above the 1 in 20 years flood level. (NB: BN had commented that that the existing building had not flooded during events up to 1 in 50 years.)

2.6 Safe access should be considered, but MW said if this could not be achieved, as there was no residential accommodation on the ground floor, unlikely to be a reason for objection. They would need to consult with the Council's Emergency Planner about this. CD said that this might be in part provided via elevated paths to the building entrances from the defended areas of the Site. MW said his initial concern with this was that they would need to be compensated for and not block flood conveyance from the GS to ES.

3.0 Sequential and Exceptions Tests

3.1 JW advised that the Sequential Test was a matter for the Council and not the EA. MW confirmed that if they saw a site that was inappropriate for a development they would only then make a comment. He said this was not such a case as the Site is already developed, therefore, it would mean this and other evidence could be referenced in the Flood Risk Assessment (FRA) to satisfy this test.

3.2 MW advised that for the Exception Test the FRA would need to show that those occupying the development were safe and flood risk did not increase elsewhere. MW clarified after the meeting that the EA would need to see the exception test, but the Local Planning Authority might also require evidence that the

sustainability benefits of the development to the community outweigh the flood risk.

4.0 Modelling

4.1 CD said Create had already run the model and there had been some issues, but these should be resolved with the completion of the initial model review. This would consider how the Site was handled in the model and if there was a need to modify it to better represent the Site.

4.2 CD asked if there were any notified issues with the model that Create would need to take account of when modelling. MW said none had been flagged and it had been reported internally that the Ashford model was a reasonable model.

4.3 DR said that U/S near the railway station there was another link between the GS and ES, which was controlled by a weir. CD said this will be checked to see if it is in the model, but it was not proposed to do any off-site alterations to the model.

4.4 MW advised that ideally there needed to be level-for-level compensation of flood storage lost by the development, e.g. 100% lost need to 100% compensated. However, he realised that it would not be possible to cover for the loss of flood storage due to the columns on a level-for-level basis so over compensation at lower levels would be acceptable. As well as modelling the loss of compensation and showing this had been address by the river path ground lowering, a compensation table also needed to be provided.

4.5 CD said as he understood it the material excavated to form the lower river path would be removed from site. JW advised that this would need a registered waste carrier to remove this material to a suitably authorised site.

4.6 CD said Create would produce a modelling brief to be commented on by the EA modelling team as they start the modelling process. Once the modelling work had been completed, that a modelling report and outputs would be submitted for review and acceptance by the EA.

5.0 Nutrient Neutral Development

5.1 JW introduced the issue of this development in its location needing to be nutrient neutral due to the concerns about the Stodmarsh Nature Reserve the other side of Canterbury.

5.2 CD advised that he had raised this issue with the architect – Hollaways who were currently leading on the development. They had confirmed this was known about and was being addressed. However, CD confirmed he would flag this again now the EA had mentioned it.

6.0 Flood Risk Activity Permit (FRAP)

6.1 DR said yes this would be required and he would be the contact for this. It was confirmed that a FRAP would be required for the lower river path as this was work within 8m of the watercourse.

6.2 DR also advised any modification to the bridges over the watercourse would also likely to need a FRAP.

6.3 DR advised early involvement with him about this was useful. CD said it might be worthwhile starting this during the design process so where possible modification that did not impact the development could be made to aid or even remove the need for some of the FRAPs.

7.0 Riparian Responsibilities

7.1 MW said that the site owner is the riparian owner and is responsible for the maintenance of both watercourses running along the boundary of the Site, the fish pass, gabions and the channel beneath the mill.

7.2 CD asked if the EA was aware of any issue with the maintenance of the existing river related assets which the site owner needed to be aware of and address. MW said he was not, but he recommended that they had them surveyed to confirm their condition and to make sure that there were no issues.

8.0 Ecology

8.1 CD said he assumed a Water Framework Directive Assessment was not required for the FRAPs. JW said this would need further consideration before an answer could be given. WFD Assessment may be required but depends on the proposal(s).

8.2 JW said that the works could not have a negative impact on the water course (water quality/ecology) and therefore, a base line survey was needed. This should then be used to inform an early consultation process with the EA's Biodiversity Team, to stop issues being raised at a later stage. It was confirmed that the GS was a wildlife site.

8.3 The idea of notifying the East Kent Catchment Improvement Partnership was mentioned by CD to see if they had advice on how the ecological improvements along the river path corridor could be made to best enhance its ecological value.

9.0 EA Advice Agreement

9.1 JW advised that the current agreement only covered this initial meeting. That the Model Brief and Report Review by the EA modelling team would need an addendum to the current agreement. It was discussed that as the EA budget figure for a report review was £5k the developer should be approached for their agreement to an increase in the budget by this amount to cover the modelling stage.

9.2 JW advised while this seemed a large figure it was only a estimate and they would only be charged for the actual time taken.

9.3 CD confirmed he would recommend to the developer that he approved this increase in the budget and would then let JW know so an agreement addendum could be prepared, so that that there was no interruption in their inputs.

APPENDIX E

Location : **Flour Mill, Ashford, Kent**
M5-60 : 20 mm
r : 0.45

Wallingford Method - maps

For different durations,

From Table 1

Duration, D	Z1			
15 min	0.65	**M5-15:**	Z1 x M5-60	13.00 mm
30 min	0.82	**M5-30:**	Z1 x M5-60	16.40 mm
60 min	1	**M5-60:**	Z1 x M5-60	20.00 mm
6hr	1.51	**M5-360:**	Z1 x M5-60	30.20 mm

For different return intervals,

From Table 2*

		Z2	
Duration, D	M1	M30	M100
15 min	0.62	1.52	1.96
30 min	0.62	1.53	2.00
60 min	0.64	1.54	2.03
6 hr	0.68	1.51	1.97

Average point intensity, API = I/(D/60)

	D min	Calculation	I mm	API mm/hr
M 1-15	15	M5-15*Z2(M1)	8.06	32.24
M 1-30	30	M5-30*Z2(M1)	10.17	20.34
M 1-60	30	M5-360*Z2(M1)	12.80	25.60
M1-360	360	M5-360*Z2(M1)	20.54	3.42
M 30-15	15	M5-15*Z2(M30)	19.76	79.04
M 30-30	30	M5-30*Z2(M30)	25.09	50.18
M 30-60	60	M5-60*Z2(M30)	30.80	30.80
M30-360	360	M5-360*Z2(M30)	45.60	7.60
M 100-15	15	M5-15*Z2(M100)	25.48	101.92
M 100-30	30	M5-30*Z2(M100)	32.80	65.60
M100-60	60	M5-60*Z2(M100)	40.60	40.60
M100-360	360	M5-360*Z2(M100)	59.49	9.92

Peak Runoff

Q=2.78CiA Rational Method, SUDS Manual Section 4.3.3

where: (1) C = Cv Cr

Cv = 1 **

Cr = 1.3 constant value for design purposes

therefore , C = 1.3

(2) i = API, defined above Q=2.78CiA

(3) A = areas measured for subcatchments

Table 1

	Rainfall Duration D									
Minutes					Hours					
r	5	10	15	30	1	2	4	6	10	24
0.12	0.22	0.34	0.45	0.67	1.00	1.48	2.17	2.75	3.70	6.00
0.15	0.25	0.38	0.48	0.69	1.00	1.42	2.02	2.46	3.32	4.90
0.18	0.27	0.41	0.51	0.71	1.00	1.36	1.86	2.25	2.86	4.30
0.21	0.29	0.43	0.54	0.73	1.00	1.33	1.77	2.12	2.62	3.60
0.24	0.31	0.46	0.56	0.75	1.00	1.30	1.71	2.00	2.40	3.35
0.27	0.33	0.48	0.58	0.76	1.00	1.27	1.64	1.88	2.24	3.10
0.30	0.34	0.49	0.59	0.77	1.00	1.25	1.57	1.78	2.12	2.84
0.33	0.35	0.50	0.61	0.78	1.00	1.23	1.53	1.73	2.04	2.60
0.36	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
0.39	0.37	0.52	0.63	0.80	1.00	1.21	1.46	1.62	1.82	2.28
0.42	0.38	0.53	0.64	0.81	1.00	1.20	1.42	1.57	1.74	2.16
0.45	0.39	0.54	0.65	0.82	1.00	1.19	1.38	1.51	1.68	2.03

Table 2 - England and Wales

	Growth Factor Z2									
M5 rainfall	M1	M2	M3	M4	M5	M10	M20	M50	M100	M30 interpolated
5.00	0.62	0.79	0.89	0.97	1.02	1.19	1.36	1.56	1.79	1.25
10.00	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.65	1.91	1.49
15.00	0.62	0.80	0.90	0.97	1.03	1.24	1.44	1.70	1.99	1.53
20.00	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.73	2.03	1.54
25.00	0.66	0.82	0.91	0.97	1.03	1.24	1.44	1.72	2.01	1.53
30.00	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.70	1.97	1.51
40.00	0.70	0.84	0.92	0.97	1.02	1.19	1.38	1.64	1.89	1.47
50.00	0.72	0.85	0.93	0.98	1.02	1.17	1.34	1.58	1.81	1.42
75.00	0.76	0.87	0.93	0.98	1.02	1.14	1.28	1.47	1.64	1.34
100.00	0.78	0.88	0.94	0.98	1.02	1.13	1.25	1.40	1.54	1.30
150.00	0.78	0.88	0.94	0.98	1.01	1.12	1.21	1.33	1.45	1.25
200.00	0.78	0.88	0.94	0.98	1.01	1.11	1.19	1.30	1.40	1.23

* The rainfall depths from cells E8-E11 are compared with the depths given in cells J29-J40 and Z2 interpolated accordingly for each return period

** Cv varies between 0.6 (rapidly draining soils) and 0.9 (heavy clay) with an average of 0.75 taken if ground conditions not known.

2.78*C= **3.614**

		Contributing Impermeable Area Ha	
	i mm/hr	Site 0.363	Per hectare 1
M 1-15	32.24	42.30	116.52
M 1-30	20.34	26.68	73.49
M 1-60	25.60	33.58	73.49
M1-360	3.42	4.49	12.37
M 30-15	79.04	**103.69**	285.65
M 30-30	50.18	65.84	181.36

		Contributing Impermeable Area Ha	
	i mm/hr	Site 0.363	Per hectare 1
M 30-60	30.80	40.41	181.36
M30-360	7.60	9.97	27.47
M 100-15	101.92	**133.71**	368.34
M 100-30	65.60	86.06	237.08
M 100-60	40.60	53.26	237.08
M100-360	9.92	13.01	35.84

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IoH 124 Calculation of Greenfield Runoff Rate

Project:	P20-2206 Flour Mill			
OS Location	601514	E	142716	N
Date:	22.11.21			
Written By:	TT	**Checked By:**	JJ	

SAAR	726	mm
Pro Rata Site Area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$Qbar_{rural}$ = 0.00108 x (AREA)0.89 X (SAAR)1.17 X (SOIL)2.17

Qbar-50ha = 0.095 m^3/s

From Regional Growth Curve Factor

Region: 7

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.88	1.28	1.62	2.14	2.24	2.62	3.19	4.49

Q_1 50ha =	0.081	m^3/s	=	80.83	l/s	=	1.617	l/s/ha
Q_2 50ha =	0.084	m^3/s	=	83.68	l/s	=	1.674	l/s/ha
Q_5 50ha =	0.122	m^3/s	=	121.72	l/s	=	2.434	l/s/ha
Q_{10} 50ha =	0.154	m^3/s	=	154.05	l/s	=	3.081	l/s/ha
Q_{25} 50ha =	0.204	m^3/s	=	203.50	l/s	=	4.070	l/s/ha
Q_{30} 50ha =	0.213	m^3/s	=	213.01	l/s	=	4.260	l/s/ha
Q_{50} 50ha =	0.249	m^3/s	=	249.15	l/s	=	4.983	l/s/ha
Q_{100} 50ha =	0.303	m^3/s	=	303.35	l/s	=	6.067	l/s/ha
Q_{500} 50ha =	0.427	m^3/s	=	426.97	l/s	=	8.539	l/s/ha

Factored for Development Impermeable Area

Site Area = 0.509

Q_{bar} site =	0.001	m^3/s	=	1.0	l/s	=	1.9	l/s/ha
Q_1 site =	0.001	m^3/s	=	0.8	l/s	=	1.6	l/s/ha
Q_2site =	0.001	m^3/s	=	0.9	l/s	=	1.7	l/s/ha
Q_5site =	0.001	m^3/s	=	1.2	l/s	=	2.4	l/s/ha
Q_{10} site =	0.002	m^3/s	=	1.6	l/s	=	3.1	l/s/ha
Q_{25} site =	0.002	m^3/s	=	2.1	l/s	=	4.1	l/s/ha
Q_{30} site =	0.002	m^3/s	=	2.2	l/s	=	4.3	l/s/ha
Q_{50} site =	0.003	m^3/s	=	2.5	l/s	=	5.0	l/s/ha
Q_{100} site =	0.003	m^3/s	=	3.1	l/s	=	6.1	l/s/ha
Q_{500} site =	0.004	m^3/s	=	4.3	l/s	=	8.5	l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IoH124 does not require consideration of storm duration.

IoH 124 Calculation of Greenfield Runoff Rate

Project:	P20-2206 Flour Mill			
OS Location	601514	E	142716	N
Date:	22.11.21			
Written By:	TT	**Checked By:**	JJ	

SAAR	726	mm
Pro Rata Site Area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$Qbar_{rural}$ = 0.00108 x (AREA)0.89 X (SAAR)1.17 X (SOIL)2.17

Qbar-50ha = 0.095 m^3/s

From Regional Growth Curve Factor

Region: 7

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.88	1.28	1.62	2.14	2.24	2.62	3.19	4.49

Q_1 50ha =	0.081	m^3/s	=	80.83	l/s	=	1.617	l/s/ha
Q_2 50ha =	0.084	m^3/s	=	83.68	l/s	=	1.674	l/s/ha
Q_5 50ha =	0.122	m^3/s	=	121.72	l/s	=	2.434	l/s/ha
Q_{10} 50ha =	0.154	m^3/s	=	154.05	l/s	=	3.081	l/s/ha
Q_{25} 50ha =	0.204	m^3/s	=	203.50	l/s	=	4.070	l/s/ha
Q_{30} 50ha =	0.213	m^3/s	=	213.01	l/s	=	4.260	l/s/ha
Q_{50} 50ha =	0.249	m^3/s	=	249.15	l/s	=	4.983	l/s/ha
Q_{100} 50ha =	0.303	m^3/s	=	303.35	l/s	=	6.067	l/s/ha
Q_{500} 50ha =	0.427	m^3/s	=	426.97	l/s	=	8.539	l/s/ha

Factored for Development Impermeable Area

Site Area = 0.195

Q_{bar} site =	0.000	m^3/s	=	0.4	l/s	=	1.9	l/s/ha
Q_1 site =	0.000	m^3/s	=	0.3	l/s	=	1.6	l/s/ha
Q_2site =	0.000	m^3/s	=	0.3	l/s	=	1.7	l/s/ha
Q_5site =	0.000	m^3/s	=	0.5	l/s	=	2.4	l/s/ha
Q_{10} site =	0.001	m^3/s	=	0.6	l/s	=	3.1	l/s/ha
Q_{25} site =	0.001	m^3/s	=	0.8	l/s	=	4.1	l/s/ha
Q_{30} site =	0.001	m^3/s	=	0.8	l/s	=	4.3	l/s/ha
Q_{50} site =	0.001	m^3/s	=	1.0	l/s	=	5.0	l/s/ha
Q_{100} site =	0.001	m^3/s	=	1.2	l/s	=	6.1	l/s/ha
Q_{500} site =	0.002	m^3/s	=	1.7	l/s	=	8.5	l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IoH124 does not require consideration of storm duration.

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IoH 124 Calculation of Greenfield Runoff Rate

Project:	P20-2206 Flour Mill			
	Area 2			
OS Location	601514	E	142716	N
Date:	22.11.21			
Written By:	TT	**Checked By:**	JJ	

SAAR	726	mm
Pro Rata Site Area =	50	ha
	0.5	km^2
Soil WRA Class	2	
Soil Type SPR Value	0.3	

$Qbar_{rural}$ = 0.00108 x (AREA)0.89 X (SAAR)1.17 X (SOIL)2.17

Qbar-50ha = 0.095 m^3/s

From Regional Growth Curve Factor

Region: 7

Return period	1	2	5	10	25	30	50	100	500
Growth Factor	0.85	0.88	1.28	1.62	2.14	2.24	2.62	3.19	4.49

Q_1 50ha =	0.081	m^3/s	=	80.83	l/s	=	1.617	l/s/ha
Q_2 50ha =	0.084	m^3/s	=	83.68	l/s	=	1.674	l/s/ha
Q_5 50ha =	0.122	m^3/s	=	121.72	l/s	=	2.434	l/s/ha
Q_{10} 50ha =	0.154	m^3/s	=	154.05	l/s	=	3.081	l/s/ha
Q_{25} 50ha =	0.204	m^3/s	=	203.50	l/s	=	4.070	l/s/ha
Q_{30} 50ha =	0.213	m^3/s	=	213.01	l/s	=	4.260	l/s/ha
Q_{50} 50ha =	0.249	m^3/s	=	249.15	l/s	=	4.983	l/s/ha
Q_{100} 50ha =	0.303	m^3/s	=	303.35	l/s	=	6.067	l/s/ha
Q_{500} 50ha =	0.427	m^3/s	=	426.97	l/s	=	8.539	l/s/ha

Factored for Development Impermeable Area

Site Area = 0.052

Q_{bar} site =	0.000	m^3/s	=	0.1	l/s	=	1.9	l/s/ha
Q_1 site =	0.000	m^3/s	=	0.1	l/s	=	1.6	l/s/ha
Q_2site =	0.000	m^3/s	=	0.1	l/s	=	1.7	l/s/ha
Q_5site =	0.000	m^3/s	=	0.1	l/s	=	2.4	l/s/ha
Q_{10} site =	0.000	m^3/s	=	0.2	l/s	=	3.1	l/s/ha
Q_{25} site =	0.000	m^3/s	=	0.2	l/s	=	4.1	l/s/ha
Q_{30} site =	0.000	m^3/s	=	0.2	l/s	=	4.3	l/s/ha
Q_{50} site =	0.000	m^3/s	=	0.3	l/s	=	5.0	l/s/ha
Q_{100} site =	0.000	m^3/s	=	0.3	l/s	=	6.1	l/s/ha
Q_{500} site =	0.000	m^3/s	=	0.4	l/s	=	8.5	l/s/ha

Note: For greenfield site, the critical duration is generally not relevant and the prediction of the peak rate of runoff using IoH124 does not require consideration of storm duration.

APPENDIX F

Summary of Results for 30 year Return Period (+20%)

Half Drain Time : 1171 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.826	0.176	0.0	0.7	0.7	30.3	O K
30 min Summer	34.884	0.234	0.0	0.7	0.7	40.2	O K
60 min Summer	34.944	0.294	0.0	0.7	0.7	50.5	O K
120 min Summer	35.011	0.361	0.0	0.7	0.7	61.9	O K
180 min Summer	35.051	0.401	0.0	0.7	0.7	68.7	O K
240 min Summer	35.077	0.427	0.0	0.7	0.7	73.3	O K
360 min Summer	35.109	0.459	0.0	0.7	0.7	78.8	O K
480 min Summer	35.127	0.477	0.0	0.7	0.7	81.8	O K
600 min Summer	35.136	0.486	0.0	0.7	0.7	83.3	O K
720 min Summer	35.139	0.489	0.0	0.7	0.7	83.9	O K
960 min Summer	35.134	0.484	0.0	0.7	0.7	83.1	O K
1440 min Summer	35.118	0.468	0.0	0.7	0.7	80.3	O K
2160 min Summer	35.092	0.442	0.0	0.7	0.7	75.9	O K
2880 min Summer	35.068	0.418	0.0	0.7	0.7	71.7	O K
4320 min Summer	35.018	0.368	0.0	0.7	0.7	63.1	O K
5760 min Summer	34.970	0.320	0.0	0.7	0.7	55.0	O K
7200 min Summer	34.921	0.271	0.0	0.7	0.7	46.6	O K
8640 min Summer	34.880	0.230	0.0	0.7	0.7	39.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	92.442	0.0	30.9	19
30 min Summer	60.499	0.0	41.3	34
60 min Summer	38.105	0.0	52.7	64
120 min Summer	23.713	0.0	66.3	124
180 min Summer	17.903	0.0	75.4	182
240 min Summer	14.628	0.0	82.3	242
360 min Summer	10.942	0.0	92.6	362
480 min Summer	8.891	0.0	100.5	482
600 min Summer	7.559	0.0	106.9	600
720 min Summer	6.616	0.0	112.3	720
960 min Summer	5.350	0.0	118.4	914
1440 min Summer	3.952	0.0	115.4	1152
2160 min Summer	2.897	0.0	147.0	1540
2880 min Summer	2.320	0.0	156.5	1960
4320 min Summer	1.694	0.0	170.3	2808
5760 min Summer	1.361	0.0	181.4	3632
7200 min Summer	1.158	0.0	191.8	4392
8640 min Summer	1.020	0.0	201.7	5104

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	34.846	0.196	0.0	0.7	0.7	33.6	O K
15 min Winter	34.850	0.200	0.0	0.7	0.7	34.3	O K
30 min Winter	34.915	0.265	0.0	0.7	0.7	45.5	O K
60 min Winter	34.984	0.334	0.0	0.7	0.7	57.2	O K
120 min Winter	35.059	0.409	0.0	0.7	0.7	70.2	O K
180 min Winter	35.105	0.455	0.0	0.7	0.7	78.1	O K
240 min Winter	35.137	0.487	0.0	0.7	0.7	83.5	O K
360 min Winter	35.176	0.526	0.0	0.7	0.7	90.3	O K
480 min Winter	35.200	0.550	0.0	0.8	0.8	94.3	O K
600 min Winter	35.213	0.563	0.0	0.8	0.8	96.7	O K
720 min Winter	35.221	0.571	0.0	0.8	0.8	98.0	O K
960 min Winter	35.223	0.573	0.0	0.8	0.8	98.4	O K
1440 min Winter	35.203	0.553	0.0	0.8	0.8	94.9	O K
2160 min Winter	35.167	0.517	0.0	0.7	0.7	88.8	O K
2880 min Winter	35.131	0.481	0.0	0.7	0.7	82.6	O K
4320 min Winter	35.056	0.406	0.0	0.7	0.7	69.6	O K
5760 min Winter	34.981	0.331	0.0	0.7	0.7	56.9	O K
7200 min Winter	34.900	0.250	0.0	0.7	0.7	42.9	O K
8640 min Winter	34.836	0.186	0.0	0.7	0.7	31.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.920	0.0	211.1	5848
15 min Winter	92.442	0.0	34.9	19
30 min Winter	60.499	0.0	46.6	33
60 min Winter	38.105	0.0	59.4	62
120 min Winter	23.713	0.0	74.6	122
180 min Winter	17.903	0.0	84.8	180
240 min Winter	14.628	0.0	92.6	238
360 min Winter	10.942	0.0	104.2	356
480 min Winter	8.891	0.0	113.0	470
600 min Winter	7.559	0.0	120.1	584
720 min Winter	6.616	0.0	120.1	698
960 min Winter	5.350	0.0	119.3	916
1440 min Winter	3.952	0.0	117.2	1312
2160 min Winter	2.897	0.0	165.3	1644
2880 min Winter	2.320	0.0	176.0	2108
4320 min Winter	1.694	0.0	191.8	3028
5760 min Winter	1.361	0.0	204.3	3920
7200 min Winter	1.158	0.0	216.1	4680
8640 min Winter	1.020	0.0	227.4	5368

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	34.786	0.136	0.0	0.7	0.7	23.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.920	0.0	238.3	6056

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 601550 142750 TR 01550 42750
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.195

Time (mins) From:	To:	Area (ha)
0	4	0.195

Model Details

Storage is Online Cover Level (m) 35.750

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	11.0
Membrane Percolation (mm/hr)	1000	Length (m)	52.0
Max Percolation (l/s)	158.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	34.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	34.550
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

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

Half Drain Time : 1794 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	34.922	0.272	0.0	0.7	0.7	46.6	O K
30 min Summer	35.014	0.364	0.0	0.7	0.7	62.5	O K
60 min Summer	35.109	0.459	0.0	0.7	0.7	78.8	O K
120 min Summer	35.208	0.558	0.0	0.8	0.8	95.7	O K
180 min Summer	35.273	0.623	0.0	0.8	0.8	107.0	O K
240 min Summer	35.324	0.674	0.0	0.8	0.8	115.6	O K
360 min Summer	35.402	0.752	0.0	0.9	0.9	129.0	O K
480 min Summer	35.460	0.810	0.0	0.9	0.9	139.0	O K
600 min Summer	35.503	0.853	0.0	0.9	0.9	146.4	O K
720 min Summer	35.535	0.885	0.0	0.9	0.9	151.8	O K
960 min Summer	35.572	0.922	0.0	0.9	0.9	158.2	O K
1440 min Summer	35.583	0.933	0.0	0.9	0.9	160.1	O K
2160 min Summer	35.549	0.899	0.0	0.9	0.9	154.3	O K
2880 min Summer	35.511	0.861	0.0	0.9	0.9	147.8	O K
4320 min Summer	35.438	0.788	0.0	0.9	0.9	135.1	O K
5760 min Summer	35.373	0.723	0.0	0.8	0.8	124.0	O K
7200 min Summer	35.315	0.665	0.0	0.8	0.8	114.1	O K
8640 min Summer	35.263	0.613	0.0	0.8	0.8	105.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	47.2	19
30 min Summer	91.000	0.0	60.1	34
60 min Summer	57.540	0.0	81.2	64
120 min Summer	35.420	0.0	100.5	124
180 min Summer	26.791	0.0	114.4	184
240 min Summer	22.050	0.0	123.9	242
360 min Summer	16.870	0.0	125.8	362
480 min Summer	14.007	0.0	127.7	482
600 min Summer	12.115	0.0	130.0	602
720 min Summer	10.745	0.0	132.7	722
960 min Summer	8.840	0.0	136.9	960
1440 min Summer	6.609	0.0	140.0	1340
2160 min Summer	4.846	0.0	249.6	1704
2880 min Summer	3.859	0.0	256.5	2076
4320 min Summer	2.771	0.0	238.8	2900
5760 min Summer	2.189	0.0	297.5	3744
7200 min Summer	1.826	0.0	308.7	4544
8640 min Summer	1.577	0.0	318.7	5360

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	35.215	0.565	0.0	0.8	0.8	97.0	O K
15 min Winter	34.957	0.307	0.0	0.7	0.7	52.7	O K
30 min Winter	35.061	0.411	0.0	0.7	0.7	70.4	O K
60 min Winter	35.168	0.518	0.0	0.7	0.7	88.9	O K
120 min Winter	35.280	0.630	0.0	0.8	0.8	108.1	O K
180 min Winter	35.355	0.705	0.0	0.8	0.8	121.0	O K
240 min Winter	35.414	0.764	0.0	0.9	0.9	131.1	O K
360 min Winter	35.506	0.856	0.0	0.9	0.9	146.8	O K
480 min Winter	35.575	0.925	0.0	0.9	0.9	158.7	O K
600 min Winter	35.628	0.978	0.0	1.0	1.0	167.8	O K
720 min Winter	35.668	1.018	0.0	1.0	1.0	174.6	O K
960 min Winter	35.718	1.068	0.0	1.0	1.0	183.3	O K
1440 min Winter	35.747	1.097	0.0	1.0	1.0	188.3	O K
2160 min Winter	35.711	1.061	0.0	1.0	1.0	182.1	O K
2880 min Winter	35.661	1.011	0.0	1.0	1.0	173.5	O K
4320 min Winter	35.558	0.908	0.0	0.9	0.9	155.8	O K
5760 min Winter	35.465	0.815	0.0	0.9	0.9	139.8	O K
7200 min Winter	35.380	0.730	0.0	0.8	0.8	125.2	O K
8640 min Winter	35.303	0.653	0.0	0.8	0.8	112.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.396	0.0	328.2	6160
15 min Winter	137.200	0.0	53.2	19
30 min Winter	91.000	0.0	59.4	34
60 min Winter	57.540	0.0	91.3	64
120 min Winter	35.420	0.0	113.0	122
180 min Winter	26.791	0.0	124.6	180
240 min Winter	22.050	0.0	126.0	240
360 min Winter	16.870	0.0	128.8	356
480 min Winter	14.007	0.0	132.5	474
600 min Winter	12.115	0.0	136.7	590
720 min Winter	10.745	0.0	140.0	706
960 min Winter	8.840	0.0	144.1	932
1440 min Winter	6.609	0.0	146.5	1370
2160 min Winter	4.846	0.0	270.4	1772
2880 min Winter	3.859	0.0	267.1	2216
4320 min Winter	2.771	0.0	255.4	3152
5760 min Winter	2.189	0.0	334.4	4040
7200 min Winter	1.826	0.0	347.3	4904
8640 min Winter	1.577	0.0	358.8	5792

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	35.233	0.583	0.0	0.8	0.8	100.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.396	0.0	369.1	6656

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 601550 142750 TR 01550 42750
Data Type	Catchment
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) 0.195

Time (mins) From:	To:	Area (ha)
0	4	0.195

Model Details

Storage is Online Cover Level (m) 35.750

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	11.0
Membrane Percolation (mm/hr)	1000	Length (m)	52.0
Max Percolation (l/s)	158.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	34.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	34.550
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

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

Half Drain Time : 158 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	36.262	0.262	0.0	1.2	1.2	9.9	O K
30 min Summer	36.306	0.306	0.0	1.2	1.2	13.5	O K
60 min Summer	36.339	0.339	0.0	1.2	1.2	16.6	O K
120 min Summer	36.356	0.356	0.0	1.2	1.2	18.3	O K
180 min Summer	36.361	0.361	0.0	1.2	1.2	18.8	O K
240 min Summer	36.362	0.362	0.0	1.2	1.2	18.9	O K
360 min Summer	36.362	0.362	0.0	1.2	1.2	18.9	O K
480 min Summer	36.361	0.361	0.0	1.2	1.2	18.7	O K
600 min Summer	36.357	0.357	0.0	1.2	1.2	18.3	O K
720 min Summer	36.352	0.352	0.0	1.2	1.2	17.8	O K
960 min Summer	36.337	0.337	0.0	1.2	1.2	16.3	O K
1440 min Summer	36.298	0.298	0.0	1.2	1.2	12.8	O K
2160 min Summer	36.230	0.230	0.0	1.2	1.2	7.6	O K
2880 min Summer	36.164	0.164	0.0	1.2	1.2	3.9	O K
4320 min Summer	36.040	0.040	0.0	1.1	1.1	0.2	O K
5760 min Summer	36.000	0.000	0.0	0.9	0.9	0.0	O K
7200 min Summer	36.000	0.000	0.0	0.8	0.8	0.0	O K
8640 min Summer	36.000	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.200	0.0	10.7	18
30 min Summer	91.000	0.0	15.1	32
60 min Summer	57.540	0.0	19.7	62
120 min Summer	35.420	0.0	24.8	120
180 min Summer	26.791	0.0	28.4	150
240 min Summer	22.050	0.0	31.4	182
360 min Summer	16.870	0.0	36.4	252
480 min Summer	14.007	0.0	40.5	322
600 min Summer	12.115	0.0	44.0	392
720 min Summer	10.745	0.0	46.8	462
960 min Summer	8.840	0.0	51.4	598
1440 min Summer	6.609	0.0	57.7	854
2160 min Summer	4.846	0.0	63.0	1216
2880 min Summer	3.859	0.0	66.5	1560
4320 min Summer	2.771	0.0	70.4	2204
5760 min Summer	2.189	0.0	73.0	0
7200 min Summer	1.826	0.0	74.9	0
8640 min Summer	1.577	0.0	76.4	0

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	36.000	0.000	0.0	0.6	0.6	0.0	O K
15 min Winter	36.282	0.282	0.0	1.2	1.2	11.5	O K
30 min Winter	36.329	0.329	0.0	1.2	1.2	15.6	O K
60 min Winter	36.365	0.365	0.0	1.2	1.2	19.2	O K
120 min Winter	36.387	0.387	0.0	1.2	1.2	21.5	O K
180 min Winter	36.392	0.392	0.0	1.2	1.2	22.2	O K
240 min Winter	36.393	0.393	0.0	1.2	1.2	22.3	O K
360 min Winter	36.392	0.392	0.0	1.2	1.2	22.1	O K
480 min Winter	36.387	0.387	0.0	1.2	1.2	21.6	O K
600 min Winter	36.380	0.380	0.0	1.2	1.2	20.7	O K
720 min Winter	36.370	0.370	0.0	1.2	1.2	19.7	O K
960 min Winter	36.345	0.345	0.0	1.2	1.2	17.1	O K
1440 min Winter	36.282	0.282	0.0	1.2	1.2	11.5	O K
2160 min Winter	36.173	0.173	0.0	1.2	1.2	4.3	O K
2880 min Winter	36.048	0.048	0.0	1.1	1.1	0.3	O K
4320 min Winter	36.000	0.000	0.0	0.8	0.8	0.0	O K
5760 min Winter	36.000	0.000	0.0	0.7	0.7	0.0	O K
7200 min Winter	36.000	0.000	0.0	0.5	0.5	0.0	O K
8640 min Winter	36.000	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.396	0.0	77.7	0
15 min Winter	137.200	0.0	12.3	18
30 min Winter	91.000	0.0	17.2	32
60 min Winter	57.540	0.0	22.5	60
120 min Winter	35.420	0.0	28.1	118
180 min Winter	26.791	0.0	32.2	170
240 min Winter	22.050	0.0	35.6	196
360 min Winter	16.870	0.0	41.2	272
480 min Winter	14.007	0.0	45.8	350
600 min Winter	12.115	0.0	49.7	428
720 min Winter	10.745	0.0	52.9	500
960 min Winter	8.840	0.0	58.0	644
1440 min Winter	6.609	0.0	65.1	910
2160 min Winter	4.846	0.0	71.2	1256
2880 min Winter	3.859	0.0	75.1	1528
4320 min Winter	2.771	0.0	79.8	0
5760 min Winter	2.189	0.0	82.9	0
7200 min Winter	1.826	0.0	85.2	0
8640 min Winter	1.577	0.0	87.2	0

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	36.000	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.396	0.0	88.9	0

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 601550 142750 TR 01550 42750
Data Type	Catchment
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) 0.052

Time (mins) From:	To:	Area (ha)
0	4	0.052

Model Details

Storage is Online Cover Level (m) 36.500

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	11.0
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	146.7	Slope (1:X)	87.3
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	36.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	34.750
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0	Kick-Flo®	0.415	0.7
Flush-Flo™	0.205	0.8	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.6	7.000	2.4
0.200	0.8	1.400	1.2	3.500	1.8	7.500	2.5
0.300	0.8	1.600	1.2	4.000	1.9	8.000	2.6
0.400	0.7	1.800	1.3	4.500	2.0	8.500	2.7
0.500	0.7	2.000	1.4	5.000	2.1	9.000	2.7
0.600	0.8	2.200	1.4	5.500	2.2	9.500	2.8
0.800	0.9	2.400	1.5	6.000	2.3		
1.000	1.0	2.600	1.5	6.500	2.3		