



**PROPOSED RESIDENTIAL DEVELOPMENT
LAND OFF WESTWOOD CLOSE, EMSWORTH**

FLOOD RISK ASSESSMENT

JANUARY 2019

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	Name	Position	Signature	Date
Prepared by:	Terry Seymour	Director		22.06.2018
Approved by:	Terry Seymour	Director		22.06.2018

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1	04/01/2019	Updated with further EA consultation. Addition of Appendix J	TRS	TRS
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Flood Risk Assessment

Contents

1. Executive Summary	2
2. Introduction	3
3. Proposed Development Site	5
3.1 Site Location	5
3.2 Existing Topography	5
3.3 Development Proposal.....	6
3.4 Existing geological information	6
3.5 National Policy Context	7
3.6 Local Planning Policies	7
3.7 Existing Flood Defences	7
3.8 NPPF Flood Zone & Vulnerability	7
4. Flood Risk to the Site	9
4.1 Strategic Flood Risk Assessment	9
4.2 Existing information on Flooding	9
4.3 Climate Change	12
4.4 The Sequential Test	12
5. Surface Water Management	15
6. Foul Water Drainage Strategy.....	20
7. Conclusions	20

Appendices

Appendix A Site Location Plan
 Appendix B Topographical Survey
 Appendix C Feasibility Study – Site Layout Plan
 Appendix D Geotechnical Information
 Appendix E EA Correspondence
 Appendix F Existing Drainage Regime
 Appendix G Proposed Surface Water Strategy
 Appendix H MicroDrainage Calculations
 Appendix I Exceedance Flow Paths
 Appendix J Fluvial Flood Modelling

1.0 Executive Summary

Rogers Cory Partnership Limited has prepared this Flood Risk Assessment (FRA) in accordance with the guidance set out in the Department for Communities and Local Government National Planning Policy Framework (NPPF).

This report summarises the methodology and results of the FRA in relation to the planning application for the residential development of 36 dwellings at the land off Westwood Close in Emsworth, Hampshire.

According to data supplied by the Environment Agency (EA), the site lies partly within Flood Zone 1, 2 and 3 considered a low, medium and high risk of flooding from fluvial sources respectively. This report therefore focuses on the site specific flood risk assessment and surface water management in line with the requirements of the Environment Agency and Hampshire County Council.

The study will also examine the effects of the development on adjacent parcels of land.

A surface water drainage strategy has been developed and hydraulically modelled incorporating sustainable urban drainage systems (SuDS) in line with the NPPF and EA standing advice. The strategy is based on a reduction in the surface water run-off rates thus ensuring that the development does not increase the risk of flooding from the site during peak storm events.

This report has therefore been prepared in support of a planning application for the residential development of 36 dwellings with associated access roads, parking areas and landscaping.

The report also aims to assess potential flood risk sources to and from the site and detail the drainage strategy for implementation on the scheme.

Flood Risk Assessment

2.0 Introduction

Rogers Cory Partnership Limited have been instructed on behalf of Hampshire Homes Limited to prepare a Flood Risk Assessment (FRA) and surface water drainage strategy in support of a planning application for the proposed residential development in Emsworth.

The development site seeks planning permission from the Havant Borough Council for the residential development of 36 dwellings with associated access roads, driveways and open space.

The National Planning Policy Framework (NPPF) was published in March 2012 by the Ministry of Housing, Communities and Local Government and replaced all planning policy statements including Planning Policy Statement 25 (PPS 25): Development and Flood Risk. The NPPF set out the Government's planning policy for England and how these are expected to be applied. The Planning Practice Guidance (PPG), published in March 2014, provides additional guidance and retains key elements of the now superseded PPS 25. The revised NPPF was published on the 24th July 2018.

Initial searches into the Environment Agency's (EA) website has identified the development site to lie mainly within flood zone 1, considered to be at low risk of flooding from rivers or sea, whilst the southern and eastern parts lie within Flood zones 2 and 3 considered to have a medium to high risk of flooding from the rivers.

The EA Flood Risk Assessment Guidance Note 3 (April 2012) highlights that a FRA is required to ensure flood risk to the proposed development is considered as well as the impact the development will have elsewhere on people and property. In addition the FRA should consider the risk of flooding from other sources (groundwater, overland flow, sewers).

The PPG sets out the objectives of a site specific FRA as to establish the following:

- *"Whether the proposed development is likely to be affected by current or future flooding from any source;*
- *Whether it will increase flood risk elsewhere;*
- *Whether the measures proposed to deal with these effects and risks are appropriate;*
- *The evidence for the local planning authority to apply (if necessary) the Sequential Test, and;*
- *Whether the development will be safe and pass the Exception Test, if applicable."*

Flood Risk Assessment

As such this report has been prepared in accordance with the requirements of the NPPF, PPG and EA Guidance.

3.0 Proposed Development Site

3.1 Site Location

The site is located off Westwood Close, Emsworth with National Grid reference 475222 106949 (See **Appendix A**).

The application site consists of open fields with grasslands. The site is bounded by residential properties to the north and west, by open fields and the A27 and to the east by fields and the River Ems. (see **Figure 1** below).



Figure 1- Site Location and Extent

3.2 Existing Topography

A topographical survey was carried out by Global Surveys in May 2017 and is related to Ordnance Survey Datum.

The survey generally shows the site falls to the north east and south west with levels ranging from approximately 9.20m AOD on the western boundary falling to 5.8m AOD on the north east boundary and 5.8m AOD on south eastern. (See **Appendix B**).

3.3 Development Proposals

The proposed development comprises of the construction of 36 new dwellings with associated access roads, parking and open space.

3.4 Existing Geological Information

According to existing British Geological Survey (BGS) maps the site is located over the London Clay Formation with a superficial Head deposit comprising of Clayey Gravel.

Intrusive ground investigations carried out by WDE Consulting in October 2017 indicate the in-situ ground as comprising of Topsoil to 0.3mbgl over soft Gravelly, Sandy Clay between 0.3m to greater than 1.90m in thickness, over stiff Clay proven from 1.90m to 5.0mbgl. Groundwater was encountered during the investigations between 1.20m to 1.50mbgl. Further Winter groundwater monitoring was carried out and indicated that the levels varied from 0.383 to 1.56m in parts of the site. The shallowest groundwater readings were found to be in BH4, located in the south eastern part of the site and outside of the proposed new built area of the development. BH3 which is located more centrally within the proposed built area yielded results from 0.420 to 1.25mbgl. Infiltration testing carried out indicated low infiltration rates ranging from 4.29×10^{-5} to 8.69×10^{-6} m/s. Infiltration drainage has been deemed unsuitable on this site due to the depth of the shallow groundwater.

3.5 National Policy Context

National policy regarding flood risk is contained within the National Planning Policy Framework was issued by the Ministry of Housing, Communities and Local Government in March 2012 and updated in July 2018.

The Environment Agency's latest revision of their Flood Risk Standing Advised (FRSA) (version 3.1) was released in April 2012.

The Department for Environment, Food and Rural Affairs (DEFRA) released the Non-statutory technical standards for sustainable drainage systems in March 2015. The document sets out non-statutory technical standards for SuDS to be read in conjunction with the NPPF and PPG.

As of the 15th April 2015 the Lead Local Flood Authority (LLFA) has now become a statutory consultee on all major planning applications and as such will assess planning applications in respect of surface water drainage and sustainable drainage systems which was previously the responsibility of the Environment Agency. The LLFA's primary duties will be to ensure that flood risks from surface water run-off, groundwater and ordinary watercourses are identified and managed properly. The use of SuDS will be a material consideration in planning conditions and as such the proposed use of SuDS will need to be demonstrated on all major developments unless it can be demonstrated otherwise.

3.6 Local Planning Policies

As the site is located within Havant any future development would need to accord with the policies set out in the Havant Borough Council Core Strategy (adopted in 2011). The policies most relevant to flooding are CS15

“Policy CS15 Flood and Coastal Erosion Risk

Development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:

- 1. It meets the sequential and exception test (where required) in relation to PPS25.*
- 2. The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.*
- 3. A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*
- 4. The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.*
- 5. Appropriate flood warning and evacuation plans are in place.*
- 6. New site drainage systems are designed taking account of events which exceed the normal design standard.*

All development will be required to ensure that there is no net increase in surface water run off. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDS are provided arrangements must be put in place for their whole life management and maintenance.

The council will work with partners to implement the Coastal Policy Zones in the North Solent Shoreline Management Plan to ensure that development avoids areas at risk from coastal erosion and coastal flooding and that areas required to offset coastal squeeze and prevent habitat fragmentation, to allow species to adapt to climate change, are identified and protected from development.”

3.7 Existing Flood Defences

The site does not benefit from any existing flood defences.

3.8 NPPF Flood Zone and Vulnerability

Table 1 within the Planning Practice Guidance (Flood Risk and coastal change) confirms the flood zone Classification based upon the probability of flooding. The site is shown to lie within Flood Zone 1 (low risk of fluvial flooding) with the southern

Flood Risk Assessment

and eastern parts within Flood zones 2 and 3 considered to have a medium to high risk of flooding from the rivers.

Table 2 within the PPG confirms the 'Flood Risk Vulnerability Classification' of a site, depending on its proposed use. The classification is then applied to Table 3 to determine whether:

- The proposed development is suitable for the flood zone in which it is located
- An Exception Test is required for the proposed development.

The proposed development is classified as 'More Vulnerable' according to the NPPF and suited for the flood zone in which it is located.

4.0 Flood Risk to the Site

The degree of detail appropriate to an FRA depends upon the scale and potential impact of the proposed development to and from the surrounding boundaries. In this case, the applicant has the intention of re-developing an area of land which is located mainly within Flood Zone 1, considered the lowest risk of flooding from fluvial sources, with the southern and eastern parts of the development within Flood Zones 2 and 3.

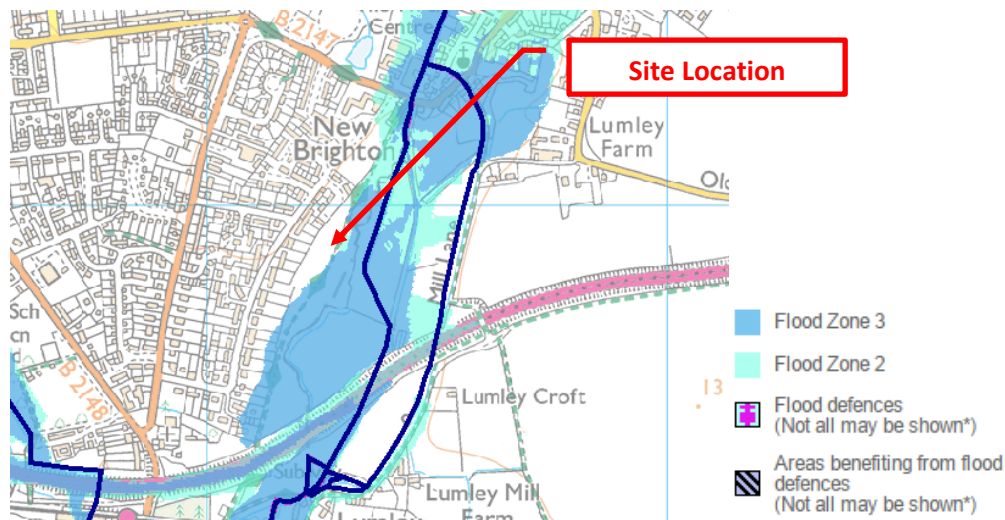


Figure 2- Extract from EA Website- Flood Map for Planning (Rivers and Sea)

4.1 Strategic Flood Risk Assessment

The National Planning Policy Framework confirms that Regional Planning Bodies (RPBs) or local planning authorities (LPAs) should prepare strategic Flood Risk Assessments (SFRAs) in consultation with the EA. The SFRA is then used to refine information on areas liable to flooding by taking into account other sources of flooding and the impacts associated with climate change in addition to the EA flood map data.

The document informs the Council's policies in the emerging Local Development framework and a strategic approach to the allocation of sites for development and the future management of flood risk, in line with the National Planning Policy Framework.

The Partnership for Urban South Hampshire (PUSH) is made up of 10 local planning authorities within Hampshire. Atkins were commissioned in 2006 to undertake a Strategic Flood Risk Assessment (SFRA), which was divided into two stages.

The first stage of the SFRA included for the collation of data and production of scoping appraisal. This stage also provided a high level analysis of flood risk within each sub-region. This stage was developed to assist in assessing the feasibility of the PUSH housing allocation.

Flood Risk Assessment

The second stage of the SFRA involved the production of detailed mapping outputs to assist the Planners and Flood Risk Managers.

4.2 Existing Information on Flooding

Fluvial Flood Risk

The site lies partly within Flood Zone 1, 2 and 3 respectively. The residential portion of the development is proposed to be located wholly within Flood zone 1 (considered low risk of flooding from rivers and sea) **figure 2**. In accordance with the NPPF, Flood Zone is compatible with residential land use which is classified as “more vulnerable” development.

In order to assess the area within the site which falls wholly within Flood Zone 1, the fluvial flood model data was obtained from the EA to determine the extent the Flood Zones within the site. Using the modelled flood level data, the extent of Flood Zone 2, which is the extent of area susceptible to fluvial flooding between the 1 in 100 year and 1 in 1000-year event, has been assessed in relation to the existing site levels using topographic survey information. By assessing the extent of the 1 in 1000-year fluvial flood event and ensuring that the proposed residential development lies outside of this zone, this ensures that the residential development proposals will be kept outside of the 1 in 100 year plus climate change fluvial flood event, to satisfy the new climate change requirements introduced by DEFRA in February 2016.

Drawing HAM/E4559/SK001 provides an overlay of the modelled fluvial flood levels in relation to the topographic level information. This information has been used to determine the extent of the 1 in 1000-year flood event (Flood Zone 2) and thus determine area of the site which would be designated as Flood Zone 1.

Consultation with the Environment Agency to agree the principles of using this approach has been carried out and copies of the correspondence is provided in **Appendix E**.

Development has undertaken a site based sequential test approach by locating the residential portion of development solely within Flood Zone 1 and thus compatible development in relation to the designated Flood Zone in accordance with the NPPF and Planning Practice Guidance.

Proposed finished floor levels for plots along eastern side of development will be set a minimum of 600mm above existing ground levels, elsewhere plots will be set a minimum 300mm above existing ground levels. This ensures that the finished floor levels of a min. of 600mm above the 1 in 1000-year fluvial flood level.

Update- 04/01/2019

Further to previous pre-application consultation carried out with the EA to agree the above flood mitigation measures, the EA changed their position on their requirements, outlining their new requirements per their consultation response dated 21st August 2018. A meeting was held with the EA on the 25th September 2018, to clarify their new position and requirements to address the items per their letter of objection.

Flood Risk Assessment

In response to the request by the EA, the existing EA fluvial model for the extent of the site was updated to consider the impacts of climate change for the 1 in 100 yr plus 35%, 45% and 105% event as well as the 1 in 1000-year event. The summary details of the output of the hydraulic model is provided within the Hydraulic Modelling Note by Ardent Consulting Engineers which can be found in **Appendix J**. The fluvial flood level for the 1 in 100 year plus 45% has been used to inform the flood mitigation proposals which is summarised on drawing **HAM-E4559-008** and presented in **Appendix E** along with the updated correspondence from the EA. This supersedes the previous proposals and assessment based on LiDAR information.

There is an existing unmade Public Footpath which runs through the site, as part of the development the Footpath is proposed to be diverted further eastwards within the grazing land. Whilst this relocates part of the path further into the area of Flood Zone 3, the footpath forms part of grazing land and considered as water-compatible development by the Table 2 of the PPG. Should users seek to traverse the site during a peak fluvial flood event, this opportunity is still maintained through the provision of the new footway within the residential part of the development.

Tidal Flood Risk

The site is not deemed to be at risk from Tidal flooding.

Sewer Flood Risk

There are no recorded incidences of sewer flooding within the vicinity of the site. Any potential future risk to the proposed development from sewer flooding events is considered low in the context that the finished levels on the site will be designed to ensure that any overland flow is directed away from the buildings and not pose a risk to people or property.

Surface Water Flood Risk

The Environment Agency's maps for the risk of potential surface water flooding (**figure 3**) indicates that the proposed area for the residential portion within the site is not at risk of flooding from surface water. The EA's maps for surface water flooding are based on a coarse level of modelling which does not account for the presence of existing drainage networks or features which may already accommodate surface water run-off.

Flood Risk Assessment

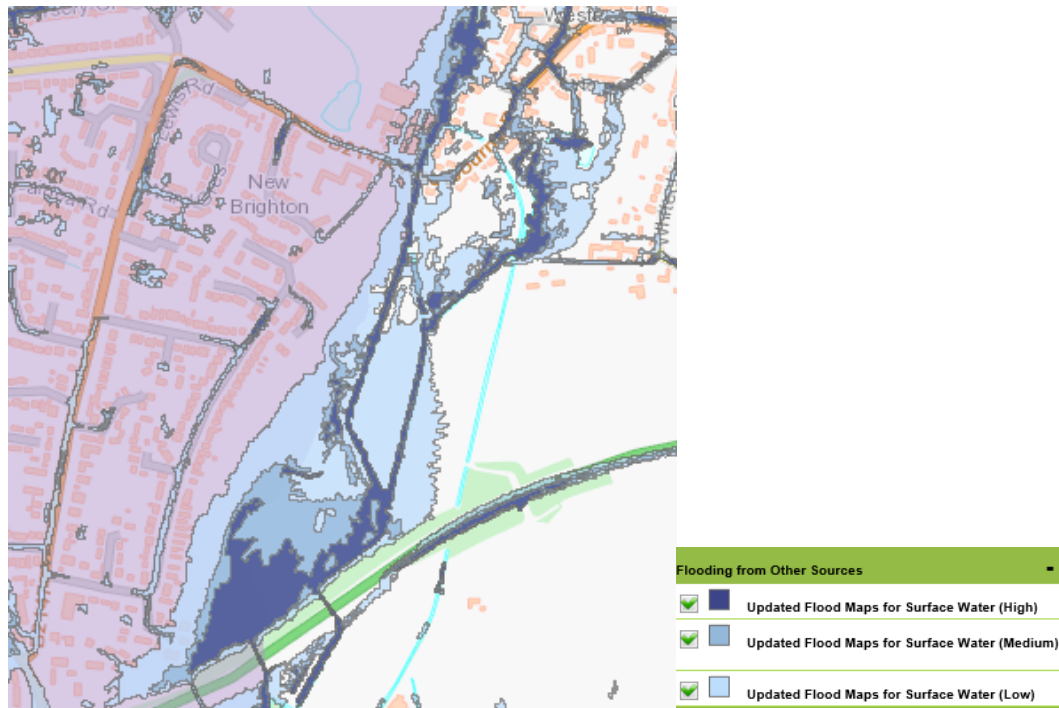


Figure 3- Extract from PUSH Maps of Surface Water Flooding Map

Groundwater Flood Risk

The PUSH maps indicate that whilst the site is located in an area with low bedrock permeability there are no recorded incidences of groundwater flooding. A review of the groundwater levels indicate that the site is subject to shallow groundwater.

Any potential residual risk to the new development will be mitigated through the detailed design of the finished ground levels which will seek to have building floor levels above the existing ground levels and ensure adequate falls away from the building to protect both building and people.

Flood Warning

The EA's Flood Warning service is aimed to mitigate the impact of flooding for people who live in areas subject to flooding and is available for the areas within the floodplain of the main rivers in England and Wales.

This site falls within the current extent of area where the EA issue flood warnings.

4.3 Climate Change

As of the 19th February 2016, the EA has updated guidance on the application of climate changes allowances for the following:

- peak river flow by river basin district
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height

Flood Risk Assessment

Peak river flow allowances are now to be based on River Basin areas thus making them more geographically relevant, based on the range of predicted allowances.

Rainfall – increases in peak rainfall over time is to be assessed on two scenarios to assess the sensitivity of the areas as per table 1 below

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 1: Extract from www.gov.uk website- Table 2 – peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

As a conservative approach, a lifetime of the development should be considered of up to 100 years (i.e. up to 2117) when assessing flood risk for residential developments. According to Table 1 above, an increase of 20% to 40% on the peak rainfall intensity should be expected. To mitigate any residual risk at the site as a result of climate change, an appropriate climate change allowance (i.e. 40% increase in rainfall intensity) will therefore be considered and accommodated within the design strategy for managing surface water run-off.

4.4 The Sequential Test

The sequential test approach is aimed to steer new development to areas of lowest probability of flooding. In this regard to determine the suitability and classification of the development, as a check of the proposed scheme, consultation has been made to tables 2 and 3 of the PPG.

Table 2 of the PPG determines that the proposed development is considered to be a 'more vulnerable' land class usage, in terms of flood risk, as illustrated in Figure 4.

Flood Risk Assessment

More vulnerable - Hospitals. - Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. - Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. - Non-residential uses for health services, nurseries and educational establishments. - Landfill and sites used for waste management facilities for hazardous waste⁶. - Sites used for holiday or short-let caravans and camping, <i>subject to a specific warning and evacuation plan.</i>⁷

Figure 4: Extract of Table 2: Flood Risk Vulnerability Classification

Table 3 of the NPPF considers sites providing a 'more vulnerable' land-class usage in a Flood Risk Zone 3 area to require the application of the Exception Test, (see Figure 4):

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	*	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	*	*	*

Key: ✓ Development is appropriate.
 * Development should not be permitted.

Figure 5: Table 3 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

As the development lies partly within Flood Zone 2 and 3 and based on the proposed development's vulnerability it will need to pass the Exception Test in order to satisfy the requirements of the PPG.

For the Exception Test to be passed a development proposal:

- Must demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA;
- The development should be on developable brownfield land or, if not, it must be demonstrated that there is no such alternative land available; and

Flood Risk Assessment

- A FRA must demonstrate that the development will be safe for its lifetime taking into account the vulnerability of its users, without increasing flood risk elsewhere, and where possible, reducing flood risk overall.

5.0 Surface Water Management

Hampshire County Council (HCC) are the Lead local flood Authority for Havant Borough Council and statutory consultee on surface water management on all planning applications within the County.

The surface water management section should ensure that there is no adverse impact on flood risk elsewhere as a result of a change in the surface water runoff regime from the re-development.

5.1 Existing Surface Water Drainage Regime

A base line hydrology plan has been produced to review the current surface water run-off from this Greenfield site and into the existing ordinary watercourses along its southern and eastern boundary. This plan is presented as **Appendix F**

5.2 Pre-Development Run Off

The historic Greenfield run-off rate is based on the IH Report 124 'Flood estimation for small catchments' (Marshall and Bayliss, 1994).

Using the Micro drainage source control suite ICP SuDS methodology the following baseline parameters were used to determine the sites historic Greenfield run off rates:

SAAR (mm): 808

Soil: 0.45

Region 7

Area: 0.708ha (impermeable area of proposed site)

Return Period: 100 Year

The historic Greenfield run-off rates have been summarised in Table 2 below:

QBar Urban (L/sec)	Q1 Year (L/Sec)	Q30 Year (L/Sec)	Q100 Year (L/Sec)	Greenfield Run-off Volume (m3)
3.7	3.1	8.3	11.7	183.413

Table 2: Summary of Greenfield runoff rates and volumes

5.3 Design Principles

Key design principles in the following guidance documents steer the approach to managing surface water runoff at sites:

- Building Regulations hierarchy of drainage (H3);
- Interim Code of Practice for SuDS; and
- CIRIA best practice guidance, including the use of the 'SUDS management train'

Building Regulations hierarchy of drainage outlines the preferred methods for the disposal of surface water with infiltration methods being the preferred option. If this is not possible the next favoured option is to drain to an existing watercourse. If neither of these options are feasible, the regulations state that rainwater discharge should be directed to a sewer.

The Interim Code of Practice for SUDS provides guidance about the hydraulic design criteria for Sustainable drainage systems. This in general refers to both peak rate of runoff and the volume of runoff, post development. Prior to mitigation measures such as the use of SuDS attenuation features, both the volume and peak rate of runoff may increase post development.

The design principles for surface water management extend beyond simple hydraulic criteria. CIRIA guidance promotes the use of the SUDS management train, a concept where SUDS techniques are used to treat, convey and store surface water runoff. This approach is considered as part of the SUDS selection methodology.

Sustainable Drainage Systems

To drain the development in a sustainable manner whilst complying with the requirements of the NPPF, the scheme should seek to adopt an appropriate form(s) of sustainable urban drainage systems (SUDS).

SUDS techniques comprise of implementation of infiltration drainage devices to discharge surface water to the underlying soil stratum (where ground conditions permit). These may be in the form of conventional soakaways, infiltration basins and ponds, filter strips, swales, permeable surfaces, green roofs, over-sized pipes/tanks geo-cellular attenuation units.

Infiltration Drainage

Intrusive ground investigations carried out indicate that the underlying strata consists of clay with low permeability and shallow groundwater. As such full infiltration drainage has not been deemed suitable for this site.

Existing Watercourses

Existing watercourses, have been identified along the southern boundary of the site.

In reviewing the hierarchy for a proposed outfall and constraints associated with the re-development we have determined the proposed discharge from the residential portion of the site would continue to the existing watercourses via a new bio-retention swale located in the south eastern part of the site

5.4 Post Development Run Off

Using the Micro drainage simulation suite, an assessment of the proposed peak discharge rates prior to mitigation measures has been made. A 360min storm duration was then applied to ascertain the discharge volume.

The following parameters were used for the initial assessment and findings tabled below.

M5-60 (mm): 19.60

Ratio: 0.324

Time of Entry: 4 minutes

Impermeable Development Area (Ha)	Q1 Year (L/sec)	Q30 Year (L/Sec)	Q100 Year Plus Climate (L/Sec)	Discharge Volume (m3) (360min Winter)
0.708	62	110.9	139.1	555.345

Table 3: Summary of Post Development Runoff prior to mitigation

5.5 Surface Water Drainage Strategy

In view of the requirements of the NPPF, PPG, HCC the design parameters and constraints associated with redeveloping this site, a surface water drainage strategy design has been devised and hydraulically modeled to demonstrate that the scheme can be suitably implemented without increasing the level of flood risk, when the surface water drainage system experiences a 1:100 year rainfall event (including climate change).

The surface water drainage scheme has been designed to ensure:

- A reduction in the pre development site discharge for peak storm events.
- Sustainable Urban Drainage systems are wholly incorporated within the scheme.
- Consideration is given for the improvement of water quality within the design.

Flood Risk Assessment

- The designed drainage scheme can satisfactorily retain a critical 1 in 100 Year storm event with climate change.

Having taken into consideration the above points, a scheme has been devised and hydraulically modelled based on attenuation techniques with a restricted discharge to the existing watercourse at the annual average Greenfield run-off rates. A copy of the proposed surface water strategy can be found in **Appendix G**.

5.5.1 Access Roads, Shared Surfaces, Private Drives and Roof Drainage

The proposed run-off from the access roads, drives and parking bays will be conveyed to the new below ground surface water network via trapped gullies and lined permeable paving where applicable. Rainfall run-off from the roofs of the new properties will discharge directly into the below ground surface water network

The surface water network will convey the flows, under gravity, southwards towards the new swale outfall, where the flows will be restricted upstream of this swale and attenuation provided within both the permeable paving and below ground cellular storage tanks.

5.5.3 Flow Control

A maximum overall development discharge is proposed to be limited to 3.7l/s which meets the pre-development annual average Greenfield run-off rate for the site.

The proposed discharge rate does however represent a betterment to the calculated 1 in 30 Year and 1 in 100 Year Greenfield run-off rates.

The hydraulic models of the proposed surface water networks, incorporating the SUDs attenuation basins and flow control devices can be found in **Appendix I**.

The hydraulic calculations have been simulated under various scenarios up to and included the critical 1 in 100 Year storm event with additional 40% allowance for climate change and an additional 10% to account for urban creep. The simulations confirm that the storm can be managed and maintained within the site without flooding.

Impermeable Development Area (Ha)	Q1 Year (L/sec)	Q30 Year (L/Sec)	Q100 Year Plus Climate (L/Sec)	Discharge Volume (m3) (360min Winter)
0.708	3.2	3.2	3.6	129.566

Table 4: Summary of Post Development Runoff with mitigation measures

5.5.4 Water Quality

It is important to address issues with regards to quality when considering surface water management. As the surface water is proposed to be discharge to the existing downstream watercourse, two stages of treatment is proposed as part of a SuDS Management Train in accordance with the recommendations of the SuDS Manual (Ciria 753) and as required by the LLFA.

This will be achieved though the permeable paving and swale outfall prior to discharging into the existing watercourse

5.5.5 Long Term Maintenance

Consideration has been given to the long term maintenance of the proposed drainage structures. SuDS attenuation basins, bio retention areas, granular filter drainage and all associated external pipework, chambers and manholes will be the responsibility of a management company.

A detailed maintenance schedule will be provided by the designers during the detailed design stage of the surface water proposals.

5.5.6 Exceedance

Whilst the drainage system has been designed to a very high standard (1 in 100 Year storm event including climate change), it is possible that a more extreme event will occur and that the design standard for the system will be exceeded. It is best practice to design the drainage system to shed water, primarily into landscaped and other areas, therefore reducing the risk of flooding areas of built development during extreme events.

A strategy for directing overland flows for the site will be confirmed using overland flow modeling as part of the detailed design once key ground levels or development levels across the site have been finalized. Based on the strategic finished floor levels and topographical survey it has however been possible to demonstrate the anticipated exceedance flow routes which can be found in **Appendix I**.

5.5.7 Safe means of access and egress.

A safe means of emergency dry access and egress is proposed from the development site through the proposed access road to Westwood Close.

6.0 Foul Water Drainage Strategy

Southern Water Services Limited are the Local Sewerage Authority in this area. The development proposals will seek to discharge to the existing Southern Water public sewer network.

The proposed connection to the existing foul public sewer will be undertaken under a Section 106 Agreement with Southern Water.

All domestic foul drainage should be designed in accordance with Part H of the Building Regulations.

7.0 Conclusion

This site specific flood risk assessment has demonstrated that the development proposals is appropriate in terms of flood risk and the provision of flood mitigation measures.

A preliminary design surface water drainage strategy has been prepared and hydraulically modelled which demonstrates that the redevelopment proposals can be successfully implemented and designed to withstand the impact of a 1:100 year rainfall event (including climate change), in accordance with the NPPF, PPG and HCC requirements

The development's surface water discharge is proposed to be attenuated to the pre-development annual average Greenfield run-off rate and thus represents a betterment to the site's existing 1 in 30 Year and 1 in 100 Year Greenfield run-off rates through the use of SuDS techniques and re-use of existing resources.

In view of this assessment, the report concludes that:

- i. That whilst the site is located partly within Flood Zones 2 and 3, the residential portion of the development is situated wholly within the Flood Risk Zone 1 area;
- ii. The Development and its occupants are not at an increased risk of flooding;
- iii. The Development does not increase the risk of flooding elsewhere;
- iv. The Development can be drained in a sustainable manner utilizing SuDS techniques;
- v. The Development will satisfactorily manage and maintain a 1 in 100 Year storm event with allowance for climate change

The findings of this report identify the opportunity to promote the sustainable re-use of existing resources and potential to implement an appropriate SUDS strategy.

Appendix (A)

Site Location Plan

Rev.	Date	Note	Author	Checked
A	21/06/18	Red Line updated to incorporate Swale/Bio-retention ditch area	RR	JP



	Project		NEW DWELLINGS EMS WALK EMSWORTH PO10 7QL		Drawing		LOCATION PLAN			
	Client		HAMPSHIRE HOMES		Job-Dwg Number		17017A-PL-2-01		Rev.	A
	Status		PLANNING				 www.jpa.design JPA - PORTSMOUTH Suite 1, Winter Works, Rear of 119 Winter Road Southsea, Portsmouth, PO4 8DS T: 44(0)2393 871 000			
	Scale		1:1250		Sheet Size				A1	
	Author		RH	Checked	JP	Date	09/04/18			

Appendix (B)

Topographical Survey

Appendix (C)

Feasibility Study – Site Layout Plan

SCHEDULE OF ACCOMMODATION

Affordable Housing 30%

1No. Evans	4Bed	99m ² (1066 ftsq)
1No. Lincoln	3Bed	94m ² (1011 ftsq)
2No. Wilson	3Bed	94m ² (1011 ftsq)
3No. Windom	2Bed	71m ² (767 ftsq)
4No. Flat	1Bed	52m ² (555 ftsq)
SUB TOTAL:		11 UNITS

4 Beds: 1	(9.1%)
3 Beds: 3	(27.3%)
2 Beds: 3	(27.3%)
1 Beds: 4	(36.3%)

Private Housing 70%

2No. Ingram	4Bed	130m ² (1400 ftsq)
3No. Evans	4Bed	99m ² (1066 ftsq)
3No. Lincoln	3Bed	94m ² (1011 ftsq)
1No. Wilson	3Bed	94m ² (1011 ftsq)
5No. Turner	3Bed	93m ² (1001 ftsq)
11No. Windom	2Bed	71m ² (767 ftsq)
SUB TOTAL:		25 UNITS

4 Beds: 5	(20%)
3 Beds: 9	(36%)
2 Beds: 11	(44%)

TOTAL UNITS: 36

ALLOCATED PARKING SPACES: 74

VISITORS PARKING SPACES: 15

TOTAL CAR PARKING SPACES: 89

KEY

■ ■ Current Trodden Footpath

■ 1 in 100 Year + 45% Flood Level Boundary

||| Proposed Footpath

■ Zone 1 Root protection zone (RPA)

■ Existing trees

■ Proposed trees

■ Proposed hedgerow

■ Existing hedgerow

■ Bio retention area

■ Connection point to proposed footpath/grazing land

● Existing boundary gates to be retained.

● Existing boundary gates to be relocated.

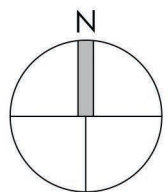
● Relocated boundary gate position.

■ Hampshire/ West Sussex County Boundary line

V Visitors parking spaces

G Garden gate location

SITE LAYOUT
1:500



Project	NEW DWELLINGS EMS WALK EMSWORTH PO10 7QL			Drawing	SITE LAYOUT - DRAFT		
				Job-Dwg Number	17017B-PL-2-02		Rev. A
Client	HAMPSHIRE HOMES						
Status	PLANNING						
Scale	1:500		Sheet Size		A1		
Author	JP	Checked	RR	Date	24/10/18		



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ASSOCIATES

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Southsea, Portsmouth PO4 8DS
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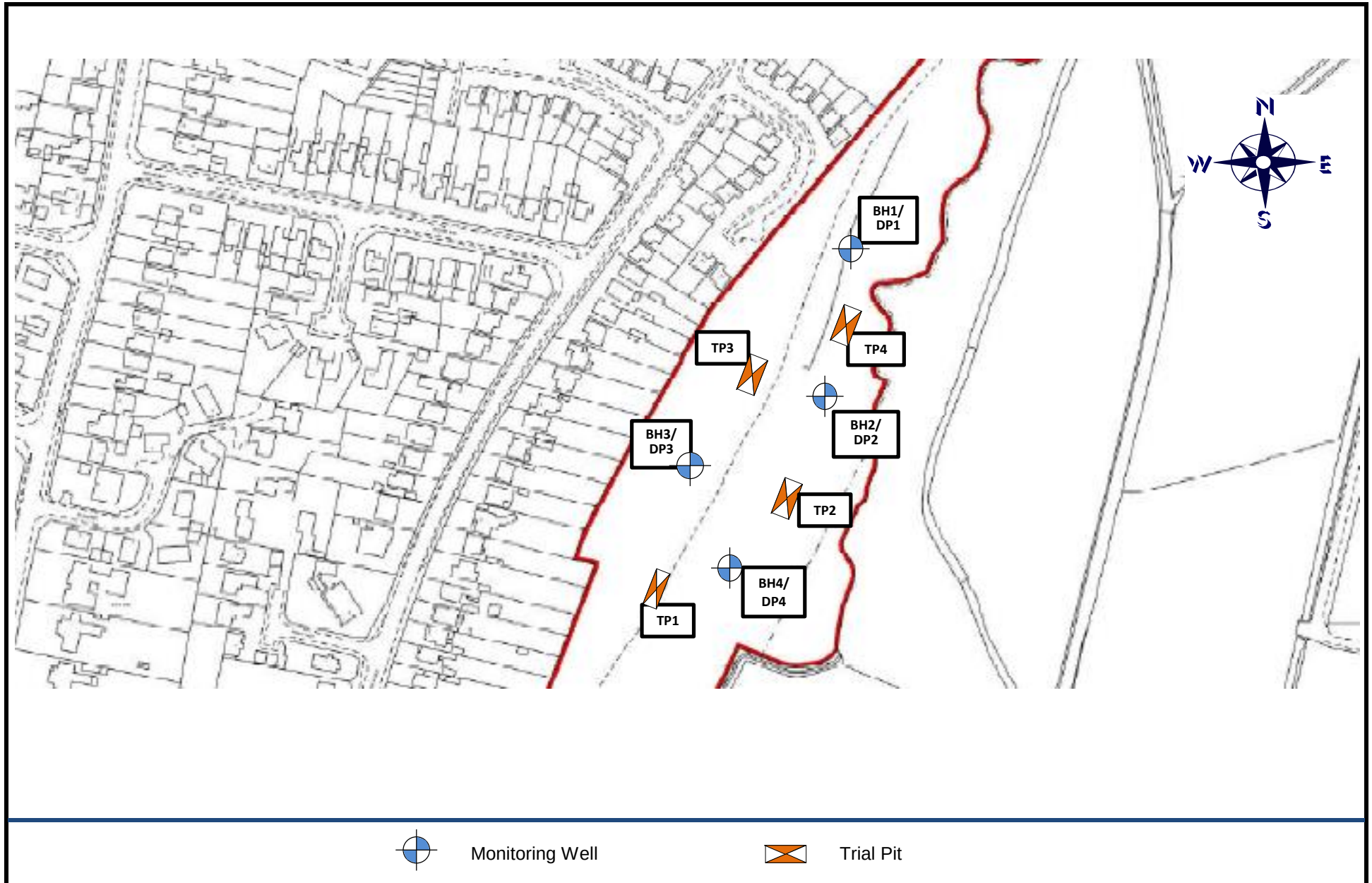


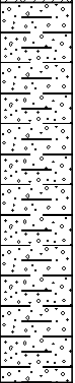
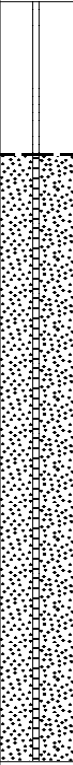
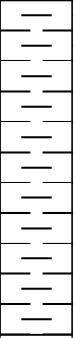
www.jpaa.design

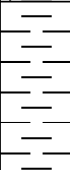
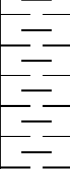
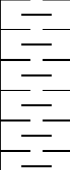
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T: +44(0)2393 871 000

Appendix (D)

Geotechnical Information

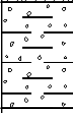


				62a Western Road Tring, Hertfordshire HP23 4BB Tel: 01442 825570 Fax: 01442 891410		Site Westwood Close, Emsworth		Number BH1	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client Hampshire Homes		Job Number 20768	
		Location		Dates 24/10/2017		Engineer JWF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.20	J1		0.0ppm		(0.30) 0.30	TOPSOIL: Dark brown sandy clay. Soft to very stiff brown very gravelly, slightly sandy CLAY. Gravels are fine to coarse subangular flints.	 		
1.00 1.00	J2 C1		1.0ppm Water strike(1) at 1.46m. 0.0ppm		(2.50) 2.80	Stiff grey CLAY			
3.90 4.00	B1 C2		0.0ppm 0.0ppm		(2.20) 5.00	Complete at 5.00m			
Remarks							Scale (approx) 1:50	Logged By JWF	
							Figure No. 20768.BH1		

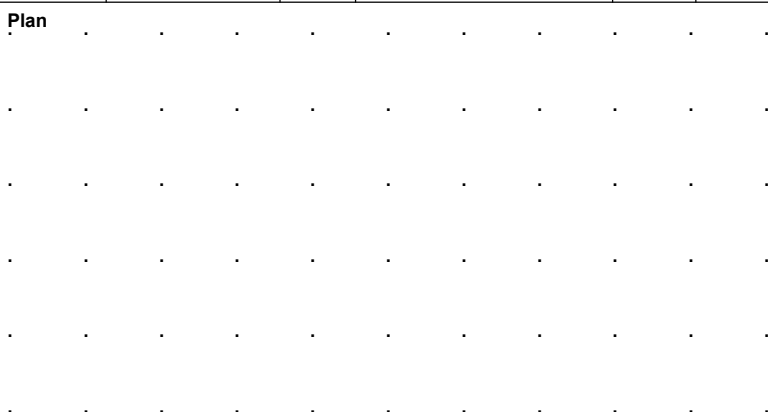
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Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client Hampshire Homes		Job Number 20768	
		Location		Dates 24/10/2017		Engineer JWF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.50	J1		0.0ppm		(0.30) 0.30	TOPSOIL: Dark brown sandy clay.			
1.00	C1				(1.10)	Soft to very stiff brown very gravelly CLAY. Gravels are fine to coarse subangular flints.			
2.00	J2		0.0ppm		1.40	Stiff brown grey mottled CLAY.			
3.00	C2		0.0ppm		(3.60)	... Becoming grey with depth.			
			0.0ppm						
			0.0ppm		5.00	Complete at 5.00m			
Remarks No groundwater encountered.							Scale (approx) 1:50		Logged By JWF
							Figure No. 20768.BH2		

				62a Western Road Tring, Hertfordshire HP23 4BB Tel: 01442 825570 Fax: 01442 891410		Site Westwood Close, Emsworth		Number BH3	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client Hampshire Homes		Job Number 20768	
		Location		Dates 24/10/2017		Engineer JWF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.20	J1		0.0ppm		(0.30) 0.30	TOPSOIL: Dark brown sandy clay.			
0.80	J2					Soft to very stiff brown very gravelly, sandy CLAY. Gravels are fine to coarse subangular flints.			
			0.0ppm		(1.30)				
					1.60	Stiff brownish grey CLAY.			
2.00	C1		0.0ppm			... Becoming grey with depth.			
			0.0ppm						
									
			0.0ppm		(3.40)				
									
4.00	C2		0.0ppm						
			0.0ppm						
									
			0.0ppm		5.00	Complete at 5.00m			
Remarks No groundwater encountered.							Scale (approx) 1:50		Logged By JWF
							Figure No. 20768.BH3		

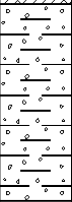
				62a Western Road Tring, Hertfordshire HP23 4BB Tel: 01442 825570 Fax: 01442 891410		Site Westwood Close, Emsworth		Number BH4	
Excavation Method Drive-in Window Sampler		Dimensions		Ground Level (mOD)		Client Hampshire Homes		Job Number 20768	
		Location		Dates 24/10/2017		Engineer JWF		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
1.00	J1		0.0ppm		(0.50)	TOPSOIL: Dark brown sandy clay.			
1.20	C1		0.0ppm		0.50	Soft to very stiff brown very gravelly sandy CLAY. Gravels are fine to coarse subangular			
			Water strike(1) at 1.20m.		(1.30)				
			0.0ppm		1.80	Stiff grey CLAY			
			0.0ppm						
			0.0ppm						
3.80	B1		0.0ppm		(3.20)				
			0.0ppm						
			0.0ppm						
4.50	C2		0.0ppm		5.00	Complete at 5.00m			
			0.0ppm						
									
									
									
									
									
									
									
									
									
									
									
									
Remarks							Scale (approx)	Logged By	
							1:50	JWF	
							Figure No.		
							20768.BH4		

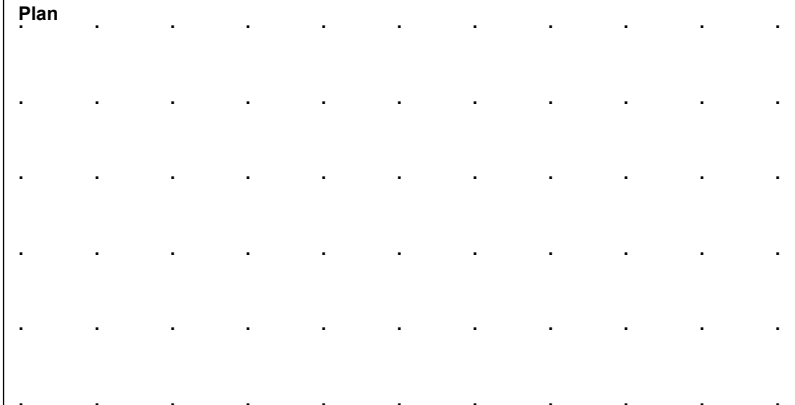
				62a Western Road Tring, Hertfordshire HP23 4BB Tel: 01442 825570 Fax: 01442 891410		Site Westwood Close, Emsworth		Trial Pit Number TP1			
Excavation Method Trial Pit		Dimensions		Ground Level (mOD)		Client Hampshire Homes		Job Number 20768			
		Location		Dates 25/10/2017		Engineer JWF		Sheet 1/1			
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water		
						TOPSOIL: Dark brown sandy clay.					
					(0.30) 0.30	Soft brown very gravelly CLAY. Gravels are fine to coarse subangular flints.					
					(0.70)						
					1.00	Stiff orange brown and grey CLAY					
					(0.50)						
					1.50	Complete at 1.50m					
Plan 						Remarks No groundwater encountered.					
										Scale (approx) 1:50	

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	TOPSOIL: Dark brown sandy clay.		
					(0.60)	Soft brown very gravelly CLAY. Gravels are fine to coarse subangular flints.		
					0.90 (0.50)	Stiff brown CLAY		
					1.40	Complete at 1.40m		

Plan 	Remarks		
	No groundwater encountered.		
	Scale (approx) 1:50	Logged By JWF	Figure No. 20768.TP2

Excavation Method Trial Pit	Dimensions		Ground Level (mOD)	Client Hampshire Homes	Job Number 20768
	Location		Dates 25/10/2017	Engineer JWF	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	TOPSOIL: Brown sandy clay.		
					(1.30) 1.60	Soft brown gravelly CLAY. Gravels are fine to coarse subangular flints.		
						Complete at 1.60m		

Plan 	Remarks No groundwater encountered.		
	Scale (approx) 1:50	Logged By JWF	Figure No. 20768.TP3

Excavation Method		Dimensions		Ground Level (mOD)		Client		Job Number		
Trial Pit						Hampshire Homes		20768		
		Location		Dates		Engineer		Sheet		
				25/10/2017		JWF		1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water	
			Water strike(1) at 1.40m.		(0.30)	TOPSOIL: Dark brown sandy clay.				
					0.30	Medium dense brown clayey fine to coarse subangular GRAVEL with occasional cobbles.				
					(1.10)					
					1.40	Complete at 1.40m				
Plan					Remarks					
.	.	.	.	.	.	Field interpretation of granular materials.				
.	.	.	.	.	.					
.	.	.	.	.	.					
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.	.	.	.	.	.					
					Scale (approx)		Logged By		Figure No.	
					1:50		JWF		20768.TP4	

Method Dynamic Probe	Cone Dimensions	Ground Level (mOD)	Client Hampshire Homes	Job Number 20768
	Location	Dates 24/10/2017	Engineer JWF	Sheet 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)	Blows for Depth Increment
0.00-0.10	1			0.00	
0.10-0.20	1				
0.20-0.30	1				
0.30-0.40	2				
0.40-0.50	3				
0.50-0.60	1			0.50	
0.60-0.70	1				
0.70-0.80	1				
0.80-0.90	1				
0.90-1.00	1				
1.00-1.10	3			1.00	
1.10-1.20	5				
1.20-1.30	6				
1.30-1.40	8				
1.40-1.50	8				
1.50-1.60	8			1.50	
1.60-1.70	9				
1.70-1.80	8				
1.80-1.90	8				
1.90-2.00	5				
2.00-2.10	1			2.00	
2.10-2.20	1				
2.20-2.30	1				
2.30-2.40	1				
2.40-2.50	1				
2.50-2.60	1			2.50	
2.60-2.70	1				
2.70-2.80	1				
2.80-2.90	2				
2.90-3.00	1				
3.00-3.10	1			3.00	
3.10-3.20	2				
3.20-3.30	2				
3.30-3.40	2				
3.40-3.50	2				
3.50-3.60	2			3.50	
3.60-3.70	2				
3.70-3.80	2				
3.80-3.90	2				
3.90-4.00	3				
4.00-4.10	2			4.00	
4.10-4.20	3				
4.20-4.30	2				
4.30-4.40	3				
4.40-4.50	3				
4.50-4.60	3			4.50	
4.60-4.70	3				
4.70-4.80	3				
4.80-4.90	3				
4.90-5.00	2			5.00	

Remarks

Scale (approx)	Logged By
1:25	JWF
Figure No.	
20768.DP1	

Method Dynamic Probe	Cone Dimensions	Ground Level (mOD)	Client Hampshire Homes	Job Number 20768
	Location	Dates 24/10/2017	Engineer JWF	Sheet 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)	Blows for Depth Increment
0.00-0.10	1			0.00	
0.10-0.20	1				
0.20-0.30	1				
0.30-0.40	1				
0.40-0.50	1			0.50	
0.50-0.60	6				
0.60-0.70	7				
0.70-0.80	7				
0.80-0.90	5				
0.90-1.00	5			1.00	
1.00-1.10	7				
1.10-1.20	6				
1.20-1.30	3				
1.30-1.40	1				
1.40-1.50	1			1.50	
1.50-1.60	1				
1.60-1.70	2				
1.70-1.80	2				
1.80-1.90	2				
1.90-2.00	2			2.00	
2.00-2.10	1				
2.10-2.20	1				
2.20-2.30	2				
2.30-2.40	2				
2.40-2.50	2			2.50	
2.50-2.60	2				
2.60-2.70	2				
2.70-2.80	2				
2.80-2.90	2				
2.90-3.00	2			3.00	
3.00-3.10	1				
3.10-3.20	2				
3.20-3.30	2				
3.30-3.40	2				
3.40-3.50	2			3.50	
3.50-3.60	2				
3.60-3.70	2				
3.70-3.80	2				
3.80-3.90	2				
3.90-4.00	2			4.00	
4.00-4.10	3				
4.10-4.20	2				
4.20-4.30	2				
4.30-4.40	3				
4.40-4.50	3			4.50	
4.50-4.60	3				
4.60-4.70	3				
4.70-4.80	3				
4.80-4.90	3				
4.90-5.00	3			5.00	

Remarks

Scale (approx)	Logged By
1:25	JWF
Figure No.	
20768.DP2	

Method Dynamic Probe	Cone Dimensions	Ground Level (mOD)	Client Hampshire Homes	Job Number 20768
	Location	Dates 24/10/2017	Engineer JWF	Sheet 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)	Blows for Depth Increment
0.00-0.10	1			0.00	0 2 4 6 8 10 12 14 16 18 20
0.10-0.20	1				
0.20-0.30	1				
0.30-0.40	1				
0.40-0.50	1			0.50	
0.50-0.60	1				
0.60-0.70	1				
0.70-0.80	1				
0.80-0.90	1				
0.90-1.00	3			1.00	
1.00-1.10	6				
1.10-1.20	9				
1.20-1.30	12				
1.30-1.40	10				
1.40-1.50	9			1.50	
1.50-1.60	8				
1.60-1.70	5				
1.70-1.80	2				
1.80-1.90	2				
1.90-2.00	1			2.00	
2.00-2.10	1				
2.10-2.20	2				
2.20-2.30	2				
2.30-2.40	2				
2.40-2.50	1			2.50	
2.50-2.60	2				
2.60-2.70	2				
2.70-2.80	2				
2.80-2.90	3				
2.90-3.00	3			3.00	
3.00-3.10	3				
3.10-3.20	3				
3.20-3.30	4				
3.30-3.40	4				
3.40-3.50	3			3.50	
3.50-3.60	3				
3.60-3.70	3				
3.70-3.80	3				
3.80-3.90	4				
3.90-4.00	4			4.00	
4.00-4.10	3				
4.10-4.20	3				
4.20-4.30	3				
4.30-4.40	3				
4.40-4.50	3			4.50	
4.50-4.60	3				
4.60-4.70	2				
4.70-4.80	3				
4.80-4.90	3				
4.90-5.00	3			5.00	

Remarks

Scale
(approx) 1:25

**Logged
By**
JWF

Figure No.
20768.DP3

Method Dynamic Probe	Cone Dimensions	Ground Level (mOD)	Client Hampshire Homes	Job Number 20768
	Location	Dates 24/10/2017	Engineer JWF	Sheet 1/1

Depth (m)	Blows for Depth Increment	Field Records	Level (mOD)	Depth (m)	Blows for Depth Increment
0.00-0.10	1			0.00	0 2 4 6 8 10 12 14 16 18 20
0.10-0.20	1				
0.20-0.30	1				
0.30-0.40	1				
0.40-0.50	1			0.50	
0.50-0.60	3				
0.60-0.70	5				
0.70-0.80	5				
0.80-0.90	5				
0.90-1.00	6			1.00	
1.00-1.10	9				
1.10-1.20	11				
1.20-1.30	9				
1.30-1.40	7				
1.40-1.50	3			1.50	
1.50-1.60	7				
1.60-1.70	6				
1.70-1.80	3				
1.80-1.90	2				
1.90-2.00	2			2.00	
2.00-2.10	1				
2.10-2.20	2				
2.20-2.30	2				
2.30-2.40	2				
2.40-2.50	2			2.50	
2.50-2.60	2				
2.60-2.70	2				
2.70-2.80	2				
2.80-2.90	2				
2.90-3.00	2			3.00	
3.00-3.10	2				
3.10-3.20	1				
3.20-3.30	2				
3.30-3.40	1				
3.40-3.50	2			3.50	
3.50-3.60	2				
3.60-3.70	2				
3.70-3.80	2				
3.80-3.90	2				
3.90-4.00	2			4.00	
4.00-4.10	2				
4.10-4.20	2				
4.20-4.30	2				
4.30-4.40	2				
4.40-4.50	2			4.50	
4.50-4.60	3				
4.60-4.70	2				
4.70-4.80	3				
4.80-4.90	3				
4.90-5.00	3			5.00	

Remarks

Scale
(approx) 1:25

**Logged
By**
JWF

Figure No.
20768.DP4

APPENDIX E

Ground Gas Sheets

Permeability Sheets

					Gas Monitoring			
Site Westwood Close, Emsworth Client Hampshire Homes					Job Number 20768			
					Sheet Number 1			
Date 25 th October 2017 Air Temperature °C °C Barometric Pressure 1021 mB 1021 mB Visit No								
Borehole No	BH1				BH2			
Condition of Standpipe	Good- Large Gas feed pipe				Good- Large Gas feed pipe			
Time	0 mins	5 mins	10 mins	15 mins	0 mins	5 mins	10 mins	15 mins
Combustible gas (CH4) % LEL	001	001	001	n/a	0	0	0	n/a
Combustible gas (CH4) % vol	00.1	00.1	00.1	n/a	0	0	0	n/a
Combustible Gas (CH4) Peak	00.1	00.1	00.1	n/a	0	0	0.1	n/a
Carbon Dioxide % vol	2.6	2.6	1.5	n/a	1.2	2.1	2.4	n/a
Oxygen % vol	17.7	17.4	19.0	n/a	19.4	17.5	17.1	n/a
Flow Rate (max) l/hr	-0			n/a	-0			n/a
Relative Downhole Pressure (mb)	+8.35			n/a	+2.2			n/a
Downhole Temperature (°C)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CO (ppm)	0000	0005	0002	n/a	0005	0008	0003	n/a
H2S (ppm)	0000	0000	0000	n/a	0000	0000	0000	n/a
Remarks								

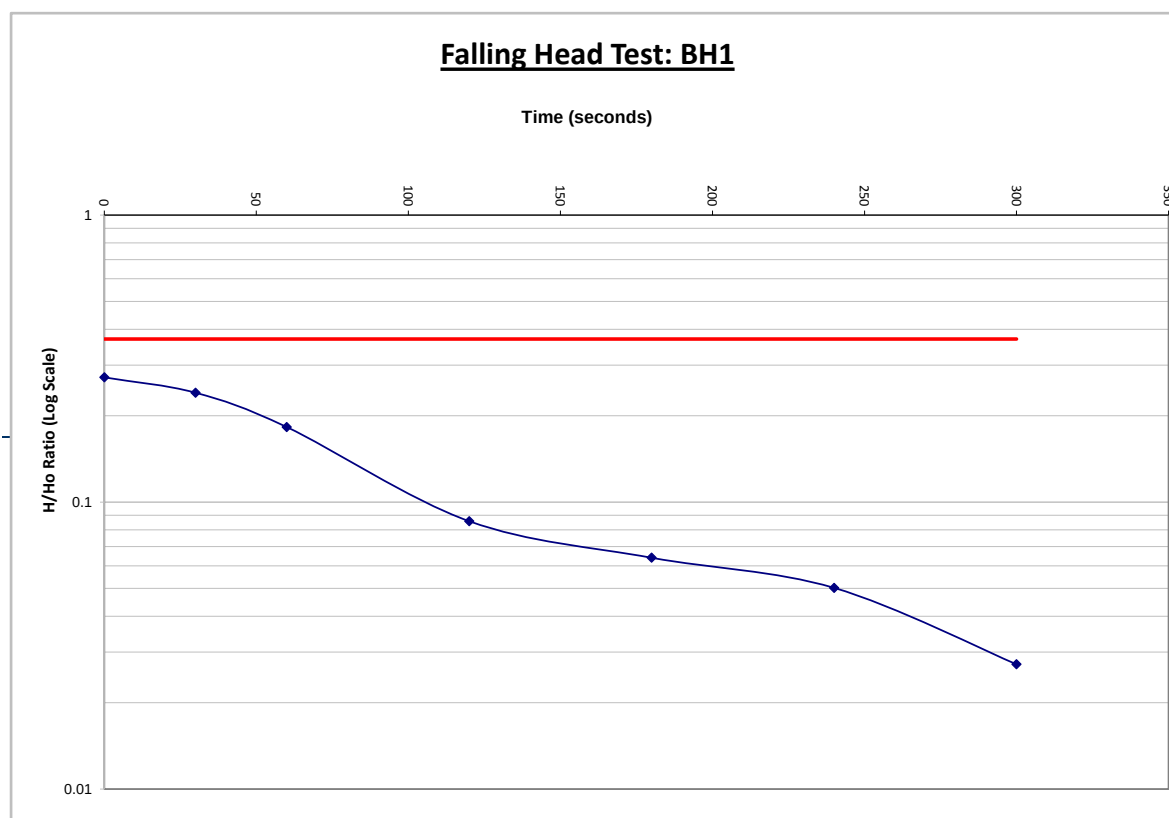
Date of Test	25/10/2017
Completed by	JWF
Site Name	WESTWOOD CLOSE, EMSWORTH
BH Location	BH1

Depth to Water-M (TOC)	4.08
Diameter of well (m)	0.05

		Units
Area (A)	0.00616225	m2
F	0.1375	
Head (H°)	4.08	m
Time (T)	300	sec
Permeability K	0.000149388	m/sec

Time (Secs)	DTW	H	H/Ho Ratio
0	2.970	1.11000	0.272058824
30	3.099	0.98100	0.240441176
60	3.335	0.74500	0.182598039
120	3.730	0.35000	0.085784314
180	3.819	0.26100	0.063970588
240	3.875	0.20500	0.050245098
300	3.969	0.11100	0.027205882

Comments:
>10^3



[illegible]

TP1

Time (seconds)

Depth (m) below ground level

V_{75}

V_{25}

Time (seconds)	Depth (m) below ground level
0	-0.45
1000	-0.46
2000	-0.46
3000	-0.46
4000	-0.46
5000	-0.47
6000	-0.47
7000	-0.48
8000	-0.49
9000	-0.49
10000	-0.50
11000	-0.51
12000	-0.52
13000	-0.53
14000	-0.54
15000	-0.55

Test concluded at 4 hours due to poor drainage. Failed to drain 25% of water added.

 $< 10^{-6}$

[illegible]

TP2

Time (seconds)

Depth (m) below ground level

V_{75}

V_{25}

Time (seconds)	Depth (m) below ground level
0	-0.38
1000	-0.41
2000	-0.53
3000	-0.58
4000	-0.64
5000	-0.65
6000	-0.65
7000	-0.65
8000	-0.65
9000	-0.65
10000	-0.65
11000	-0.65
12000	-0.65
13000	-0.65
14000	-0.65
15000	-0.65

Test concluded at 4 hours due to poor drainage. Failed to drain 75% of water added.

8.69E-06

[illegible]

TP3

Time (seconds)

Depth (m) below ground level

V_{75}

V_{25}

Time (seconds)	Depth (m) below ground level
0	-0.35
1000	-0.41
2000	-0.50
3000	-0.54
4000	-0.71
5000	-0.86
6000	-0.88
8000	-0.88
10000	-0.92
12000	-0.96
14000	-0.96
15000	-0.96

Test concluded at 4 hours due to poor drainage. Failed to drain 75% of water added.

9.64E-06

[illegible]

TP4

The graph displays the depth of a point over time. The x-axis represents time in seconds, ranging from 0 to 5000. The y-axis represents depth in meters below the ground level, ranging from 0.00 to -1.60. A blue line with diamond markers shows the depth increasing over time. Two horizontal red lines are drawn at -0.60m and -1.20m.

Time (seconds)	Depth (m) below ground level
0	-0.30
100	-0.35
200	-0.40
300	-0.40
400	-0.40
500	-0.45
700	-0.53
1000	-0.68
1300	-0.75
1700	-1.00
2200	-1.05
2800	-1.13
3500	-1.40

Vp	Amount of Water Lost	DTW bgl
75%	0.9	-0.593
25%	0.3	-1.193

4.29E-05

[illegible]

TP4 Fill 2

The graph displays the depth of TP4 Fill 2 over time. The x-axis represents Time in seconds, ranging from 0 to 6000. The y-axis represents Depth in meters below ground level, ranging from 0.00 to -1.60. A blue line with diamond markers shows the depth increasing over time. Two horizontal red lines are drawn at -0.50m and -1.10m.

Time (seconds)	Depth (m) below ground level
0	0.00
100	-0.20
200	-0.25
300	-0.30
400	-0.32
500	-0.35
600	-0.38
700	-0.40
800	-0.45
900	-0.50
1000	-0.55
1500	-0.65
2000	-0.75
2500	-0.85
3000	-1.05
3500	-1.15
4000	-1.20
4500	-1.25
5000	-1.30
5500	-1.35

Vp	Amount of Water Lost	DTW bgl
75%	0.9	-0.5
25%	0.3	-1.1

4.37E-05

Appendix (E)

EA Correspondence

From: [Brown, Sophie](#)
To: [Terry Seymour](#)
Subject: land off Westwood Close
Date: 07 November 2018 10:32:09

Hi Terry,

Sorry I missed your call yesterday. I have tried to call back but have missed you.

I just wanted to confirm that we have reviewed all the information you have submitted and are satisfied that if/when submitted to the council it is sufficient to remove our objection. I just wanted to clarify whether or not the information you have shared with us has yet been submitted to HBC?

When it is I can do a formal response. Happy to discuss around till 12pm today.

Sophie

Sophie Brown | Planning Advisor | Sustainable Places | Solent and South Downs Area | Environment Planning and Engagement
Environment Agency | Oving Road | Chichester | West Sussex | PO20 2AG
Tel: 020 3025 7250 Sophie.brown@environment-agency.gov.uk

Please be aware I work Part Time hours and will be available Monday, Tuesday, and Wednesday morning, only. If you have any urgent enquiries outside of those hours please email planningSSD@environment-agency.gov.uk

Information in this message may be confidential and may be legally privileged. If you have received this message by mistake, please notify the sender immediately, delete it and do not copy it to anyone else.

We have checked this email and its attachments for viruses. But you should still check any attachment before opening it.
We may have to make this message and any reply to it public if asked to under the Freedom of Information Act, Data Protection Act or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.
Click [here](#) to report this email as spam

From: [Terry Seymour](#)
To: [Brown, Sophie](#)
Cc: [Jan Wallace](#); daphney.haywood@havant.gov.uk
Subject: Re: land off Westwood Close
Date: 01 November 2018 14:34:06
Attachments: [HAM-E4559-008- Flood Mitigation.pdf](#)

Hi Sophie

Thank you for your email.

Just further to Ardent Consulting Engineers updated note, please find attached the flood mitigation drawing showing the extent of the existing 1 in 100 year plus 45% flood level overlaid to the revised site layout. In addition to this we have added minimum proposed FFL's set at 600mm above the flood level and indicated the proposed pedestrian dry access and egress route for ease of reference.

I hope this helps with Jon's review and look for to the EA's updated response.

Kind regards

Terry Seymour

Sent from my Samsung Galaxy smartphone.

Introduction

Ardent Consulting Engineers has been commissioned by Rogers Cory Partnership Ltd to undertake a Hydraulic Modelling exercise to support the planning application for the proposed residential development at the land off Westwood Close in Emsworth, Hampshire.

The need of a hydraulic model arose following the EA's review of the application in September 2018 (response ref. APP/18/00672). The EA requested that design event with climate change allowances – 1 in 100 year plus 35%, 45% and 105% Climate Change – were run in line with the latest Climate Change requirements. In addition, The EA confirmed that the outline of Flood Zone 2 in this area was not taken from detailed modelling and is smaller than the outline for Flood Zone 3 which was taken from a detailed ISIS model. The outline for Flood Zone 2 is based on generalised JFLOW modelling and therefore, far less certainty is given over its outputs than a detailed model. Therefore, it was requested that the existing hydraulic model was also run for the 1 in 1000 year event in order to determine whether the site falls within Flood Zone 2.

The purpose of this modelling study is to assess the latest Climate Change requirements and better determine the extent of Flood Zone 2 within close proximity to the Site of interest.

Site Location

The site is located off Westwood Close, Emsworth with National Grid reference 475222 106949. The application site consists of open fields with grasslands. The site is bounded by residential properties to the north and west, by open fields and the A27 and to the east by fields and the River Ems. The site location is shown in **Figure 1**.

Section 2: Hydraulic Modelling

The EA advised that the following climate change allowances need to be assessed as part of the FRA:

- 1 in 100yr plus 35% event
- 1 in 100yr plus 45% event which should be used as the design event
- 1 in 100yr plus 105% event which should be used for sensitivity testing
- 1 in 1000yr event should be used to accurately determine Flood Zone 2 within close proximity to the Site.

Background

The hydraulic model used to provide additional flood outlines was the existing ISIS River Ems model as requested by the EA. The model was developed by Peter Brett Associates in 2006 as part of The River Ems Flood Study.

Hydrology

The hydrological inputs of the model were revised to account for the new climate change allowances. All scaling factors were adjusted to account for the new Climate Change Scenarios.

The updated model uses boundaries which were scaled by appropriate factors based on the factors previously used in the model for the 20% climate change allowance.

Since the previous model only included hydrological inputs up to the 200 year event, a new hydrology study was undertaken in order to derive flows for the 1000 year event (Refer to Appendix A for the hydrology report). Design flows were updated as part of this study in order to utilise the additional data collected since the 2006 model was built. Therefore, the model outputs are slightly different compared to the old model. Another reason for that difference in the results is the newer version of the software.

Model Changes

The updated hydraulic model has been run using Flood Modeller version 4.4. The model has been run on the 64 bit version of this build to take advantage of the faster simulation times.

There were no other changes in the model .dat files apart from the inflow boundaries.

Section 3: Summary of Results

The EA's River Ems model was rerun to produce the 1000 year event, 100 + 35%, 100 + 45% and 100 + 105% Climate change flood outlines. The model results indicated that the maximum predicted flood levels for the 100 + 35% Climate Change is 7.7mAOD within close proximity to the channel. This level is reported in channel as the model provided is 1D only model.

The flood extents generated were taken from different in channel levels across the watercourse within close proximity to the site and interpolation was used between consecutive nodes. 1 m resolution LiDAR data were used to produce the outlines shown below.

Figure 2 below shows the predicted flood outlines for the events mentioned above.

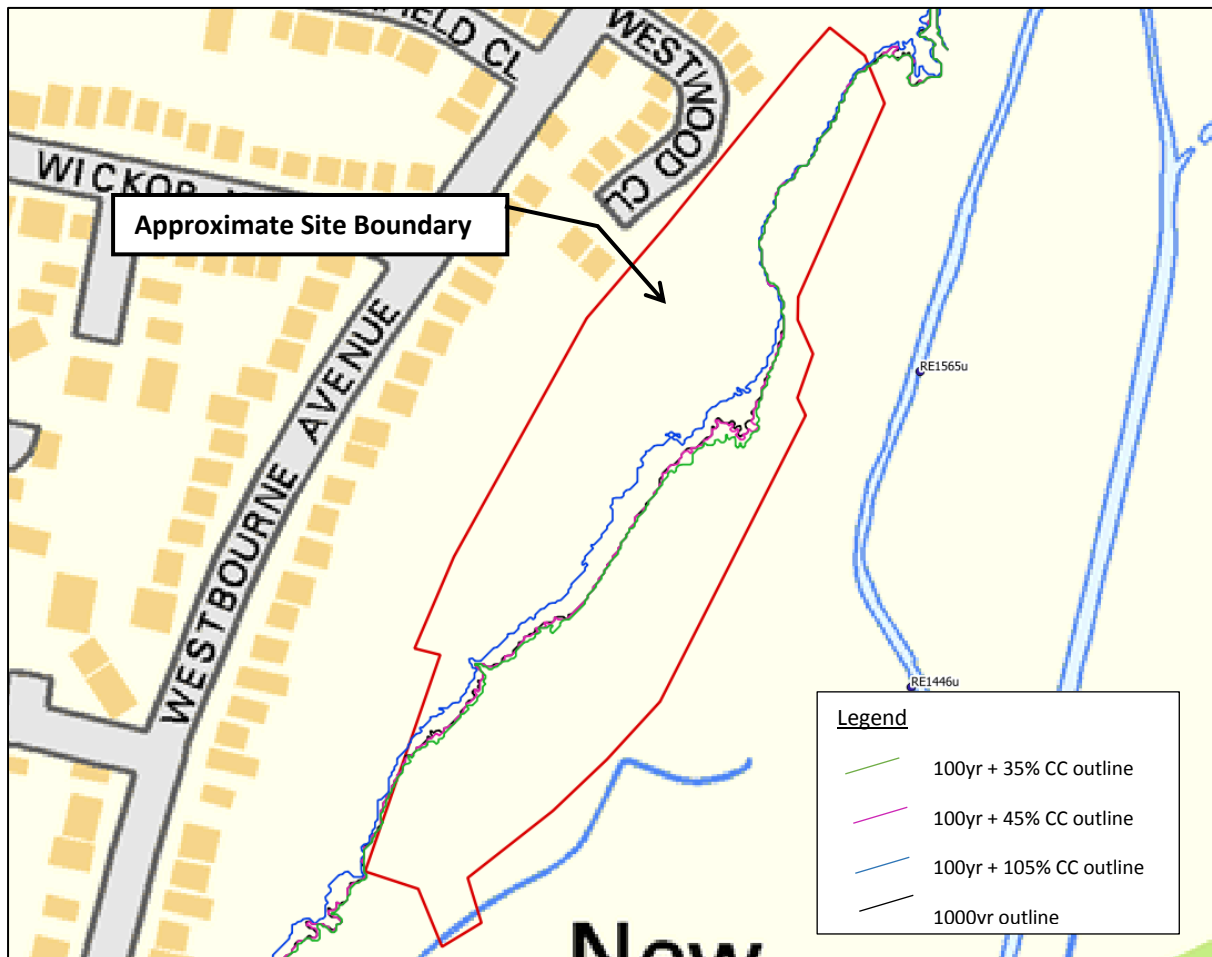


Figure 2: Predicted flood outline

Figure 3 and **Table 1** below show the predicted flood levels within close proximity to the Site.



Figure 3: Model Nodes

Table 1: Predicted flood levels

	Predicted flood level mAOD				
Node	100yr	100yr + 35% CC	100yr + 45% CC	100yr + 105% CC	1000yr
RE1743u	8.323	8.351	8.359	8.408	8.363
RE1726	8.204	8.23	8.237	8.283	8.241
RE1565u	7.679	7.703	7.709	7.749	7.712
RE1446u	7.316	7.391	7.416	7.558	7.496
RE1169	7.232	7.318	7.345	7.5	7.357
Res_2a	7.287	7.369	7.395	7.545	7.408

Section 5: Conclusions

Following consultation with the Environment Agency, an existing hydraulic model was re-ran in order to provide additional flood outlines for the required climate change events as well as the 1000 year event in order to determine Flood Zone 2 and the new climate change events.

The model results indicated that the maximum predicted flood level for the 100 + 35% is 7.7mAOD within close proximity to the Site.

DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	For EA	GA	GA	DRAFT ONLY	October 2018
A	For EA	GA	GA	DRAFT ONLY	October 2018

Appendix A
Hydrology Report

The River Ems at Westbourne Gauging Station

Revised Flood Flow Estimates

1 Objectives

The River Ems Flood Study Final Modelling Report (August 2005) provided flood flows estimates at the Westbourne gauging station on the Ems which were used to provide estimated flows at 5 tributaries on the Ems further upstream. The purpose of this short report s to reconsider these flood flows and provided updated flood estimates at the same location based on more recent data and techniques.

2 The Ems at Westbourne

The River Ems has one river flow measurement station at Westbourne (CEH ReF 41015) which is an asymmetrical compound Crump profile weir 190m upstream of Hampshire Bridge. This station has been operational since 1967 and is modular throughout the flow range. Most of the flows are contained within the structure and only the 2000 event exceeded the structure limit of 5.08m³/s.

The Chalk catchment provides a groundwater-dominated regime and flood events are typically small with a marked seasonal baseflow. The flow records are suitable for medium range flood flows, as it is gauged to within 10% of QMED and with a reasonable fit to the gaugings, but there are few high flow gaugings and the rating cannot be validated beyond QMED hence the records are not suitable for pooling.

Flow estimates in the 2005 Flood Study 2005 were based on 39 years of record to 2005 and there are now 49 years to 2016 and an update to these flood estimates is appropriate as QMED has changed (Table 1).

Table1 Available AMAX Data on the River Ems @ Westbourne

Water Year	2005	2018
Start Year	9 January 1968	9 January 1968
End Year	2 November 2005	2 January 2016
No Yrs Data	39	49
QMED	1.785	2.261

3 Estimated Flood Flows at Westbourne (2005)

The Flood Estimation Handbook (FEH) statistical analysis was used in 2005 based on a weighted pooling group of similar sites to generate the flood growth curve which with QMED gave the flood frequency curve and the flow flood estimates at different return periods for the subject site.

It was acknowledged in 2005 that FEH Stats method was not entirely suitable for permeable catchments and hence an adjustment was applied to both the pooling and single site analysis as SPRHOST was less than 20%. A permeable adjustment was applied only to the growth factors with QMED remaining the same. For the single site the approach all flows less than QMED/2 were removed, the L-moments adjusted and growth factors re-estimated. For the pooling group analysis this same approach was applied to all sites in the group which were classified as being permeable.

The results of the analysis (Figure 1) were provided for single site and pooled group, with and without the permeable adjustment (Table 2).

Figure 1 FEH Pooled Group and Single Site analysis at Westbourne (2005)

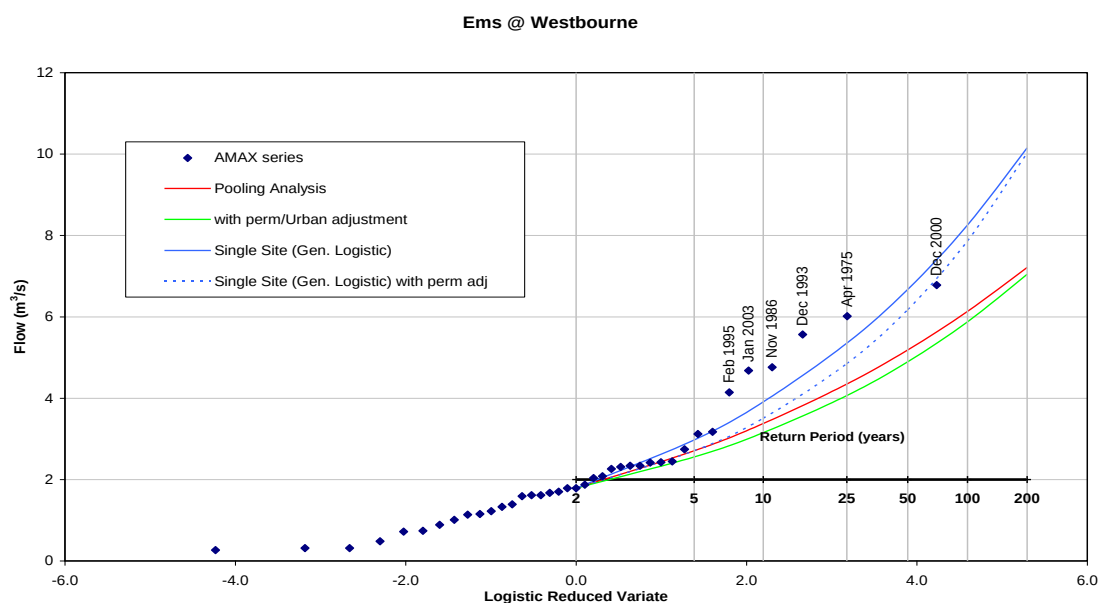


Table2 FEH Pooled and single site flow estimates for the Ems at Westbourne

Return Period	Peak Flow (m ³ /s)			
	FEH Pooling Group	PG with perm adj	Single Site GL	Single site GL with perm adj
2	1.79	1.79	1.79	1.79
5	2.71	2.56	2.97	2.71
10	3.38	3.15	3.91	3.51
25	4.35	4.07	5.35	4.85
50	5.18	4.89	6.67	6.17
100	6.13	5.88	8.25	7.86
200	7.21	7.04	10.15	10.03

This showed the FEH pooling group underestimate the AMAX flows as the pooling group will have contained stations far removed from Westbourne with fewer floods and hence flatter growth curves that the AMAX series. The FEH pooling group estimates suggest the December 2000 event was approximately the 200 year event whereas the single site analysis gave this flood a return period of 75 years which compares favourably with the results of a similar study on the adjacent River Lavant. The single site estimates were therefore preferred and the single site with the required permeable adjustment were adopted.

The 2005 analyses also separated the estimates into a baseflow and a quick response runoff which were analysed separately but were combined to provide the same single site permeable adjusted flows (Table 2).

4 Updated Flow Estimates for 2018

4.1 Single Site and Pooling Group

The updated flow estimates in 2018 are based on the longer flows series and available AMAX data and hence a revised slightly larger QMED (Table 1) and hence also a pooling group with fewer stations. The calculation of a flood frequency curve and peak flows for a range of return periods is also based on the construction of a pooling group and the fitting of an extreme value distribution to the annual maximum flow data from hydrologically similar sites (pooling group) using WINFAP4 and from a Single Site analyses. WINFAP4 uses a different range of parameters to provide the

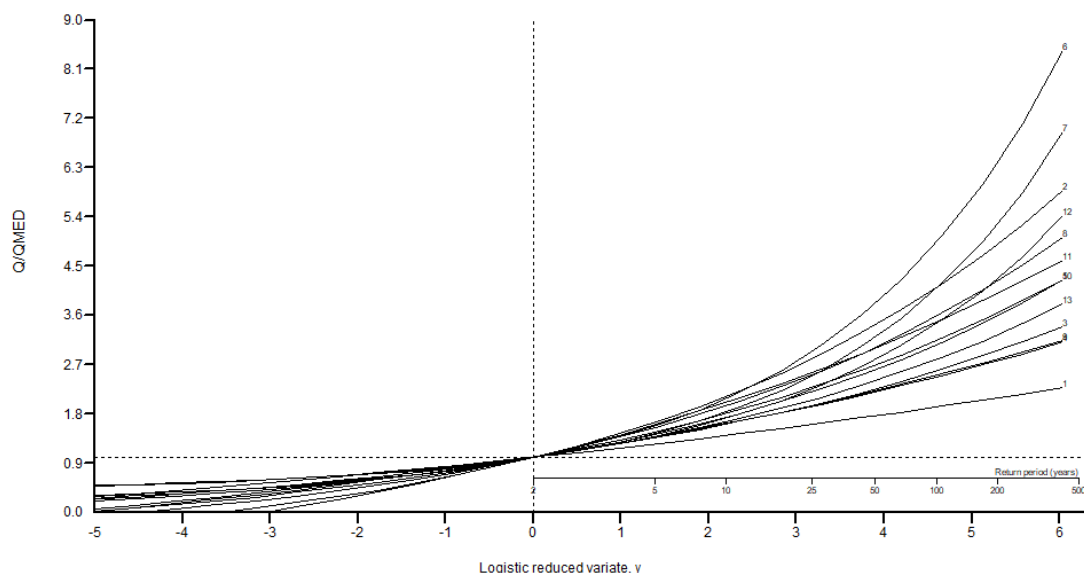
similar sites for the pooling group compared to WINFAP1 which would have been used in the 2005 analyses but this revised approach is now accepted practice under FEH.

The initial pooling group contains 13 stations with 515 station years of record and no stations were removed for having less than the required 8 years of data. Examination of the pooling group indicates it is possibly heterogeneous and a review considered optional ($H_2 = 1.766$) but a review of the pooling group suggests no obvious or valid reason to remove any of the component stations. This moderate discordancy arises as several of the component stations (Table 3) have relatively steep growth curves (Figure 2) and some very flat but there was no justification for removing any sites from the group.

Table 3 Component Stations of Pooling Group – Ems at Westbourne

Station	Dist	Yrs	QMED	L-CV	L-SKEW	Discord
42011 (Hamble @ Frogmill)	0.188	44	8.282	0.167	0.073	1.672
43806 (Wylfe @ Brixton Deverill)	0.291	25	2.080	0.376	0.211	1.056
44003 (Asker @ Bridport)	0.316	14	12.354	0.224	0.170	1.459
44011 (Asker @ East Bridge Bridport)	0.316	21	16.800	0.239	0.112	1.014
41022 (Lod @ Halfway Bridge)	0.341	46	16.260	0.288	0.181	0.426
51001 (Doniford Stream @ Swill Br)	0.357	50	11.980	0.325	0.385	1.355
42008 (Cheriton Stream @ Swards Br)	0.371	46	1.348	0.260	0.400	1.314
20007 (Gifford Water @ Lennoxlove)	0.383	43	16.190	0.325	0.204	0.275
53017 (Boyd @ Bitton)	0.393	43	13.820	0.247	0.106	0.388
42006 (Meon @ Mislingford)	0.395	57	3.003	0.257	0.217	0.465
20006 (Biel Water @ Belton House)	0.430	28	11.748	0.375	0.128	1.440
27059 (Laver @ Ripon Laver Weir)	0.433	39	21.878	0.234	0.342	1.608
49002 (Hayle @ st Erth)	0.442	59	4.649	0.234	0.202	0.528

Figure 2 WINFAP Component Stations – Ems at Westbourne



WINFAP4 is often found to provide discordant pooling groups and this arises because it uses the FEH parameters FARL and FPEXT to generate a pooling group, measures of flood storage and attenuation, whereas the original WINFAP was based on the soil or geology as reflected in BFIHOST. The shape of the growth curves of the component stations is more likely to be a function of the geology and WINFAP4 often provides a more discordant pooling group. However, the EA FEH Guidelines require the use of WINFAP4 and this method is therefore adopted in this report.

Two extreme value distributions are often used on the pooled group data (i) the Generalised Logistic (GL), and (ii) the General Extreme Value (GEV) distribution both fitted to the annual maximum data by the method of L-Moments. WINFAP indicates that in this case the GL distribution provides the best fit to extreme value flood series and this is used to provide the estimated flood flows (Table 4). There is no requirement to consider a permeable adjustment with WINFAP4. The updated Pooled Group provides a 100 year flood flow of 7.02 m³/s and the single site a 100 year of 8.38m³/s. The pooling group and single site flows are slightly higher than the 2005 analyses possibly due to the higher QMED.

Table 4 Previous and Revised Flood Estimates

Return Period	2005 PG	2005 PG + perm adj	2005 SS	2005 SS + perm adj		2018-PG	2018-SS
2	1.79	1.79	1.79	1.79		2.23	2.26
5	2.71	2.56	2.97	2.71		3.22	3.58
10	3.38	3.15	3.91	3.51		3.95	4.53
25	4.35	4.07	5.35	4.85		5.02	5.9
50	5.18	4.89	6.67	6.17		5.96	7.07
100	6.13	5.88	8.25	7.86		7.02	8.38

4.2 Extension to the 1000 year

The Statistical method was originally recommended for return periods up to 200 year event and ReFH is not calibrated beyond 150 years and technically these two methods are not suitable for extrapolating to the 1000 year event. The Environment Agency's Flood Estimation Guidelines² provide suggestions for calculating extreme floods up to the 1000 year event:

- Using a larger 200 year pooling group in the Statistical method as an intermediate between the more usual 100 year group and the potentially less homogeneous 1000 year although more recently a simple extension of the 100 year has been proposed.
- Use of ReFH although this relies on extending the method beyond the data set and as detailed above this method is not suitable in permeable catchments.
- Using the ReFH growth factors for the 200 and 1000 year events applied to the Stats method 100 year peak flow but the same issue of using ReFH for permeable catchments will apply.

The simple extension of the Stats method is often preferred and the SS gives a 1000 year peak flow of 14.22m³/s (Table 5)

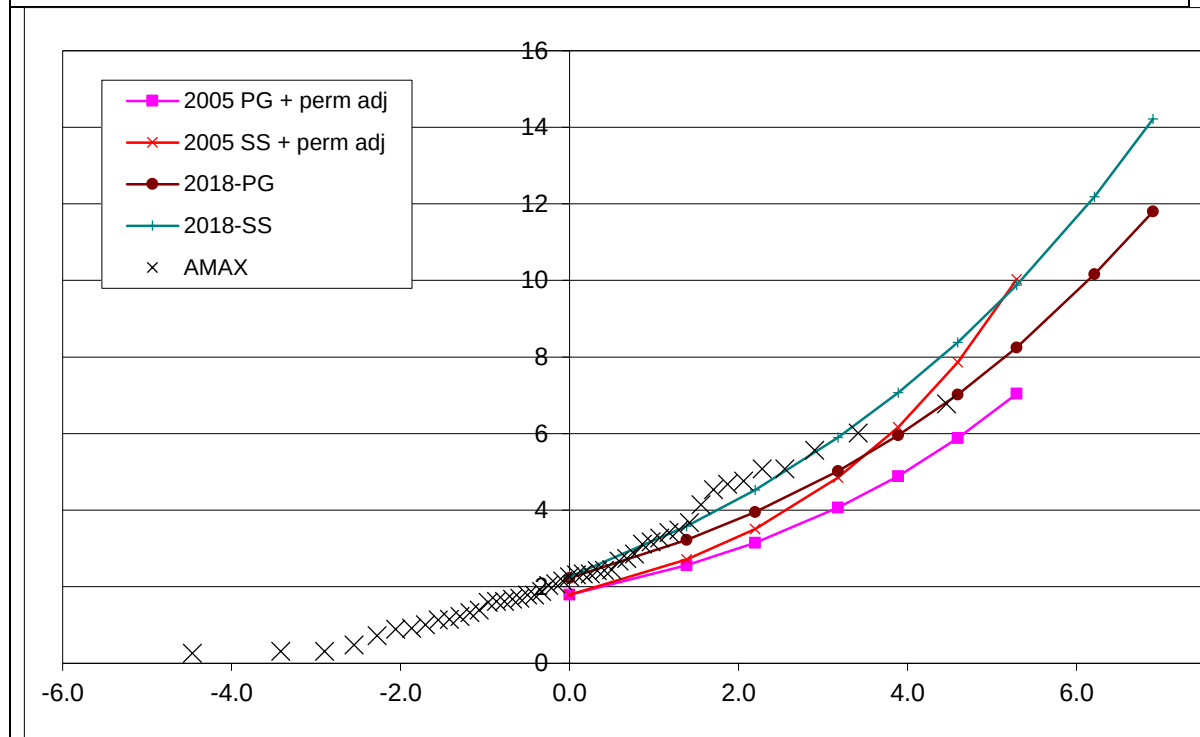
Table 5 Extension of Flood Flows – Ems at Westbourne

Return Period	2005 PG	2005 PG + perm adj	2005 SS	2005 SS + perm adj		2018-PG	2018-SS
2	1.79	1.79	1.79	1.79		2.23	2.26
5	2.71	2.56	2.97	2.71		3.22	3.58
10	3.38	3.15	3.91	3.51		3.95	4.53
25	4.35	4.07	5.35	4.85		5.02	5.9
50	5.18	4.89	6.67	6.17		5.96	7.07
100	6.13	5.88	8.25	7.86		7.02	8.38
200	7.21	7.04	10.15	10.03		8.25	9.88
500						10.16	12.19
1000						11.80	14.22

4.3 Adopted Flood Estimates

The 2005 SS and PG flood frequency curves do not fit the latest AMAX data, hence updates to the flow estimates are required, and the 2018 PG is discounted for the same reasons. The best fit to the AMAX data is provided by the SS 2018 curve (Figure 3).

Figure 3 SS and PG Flood Frequency Curves (2005 and 2018)



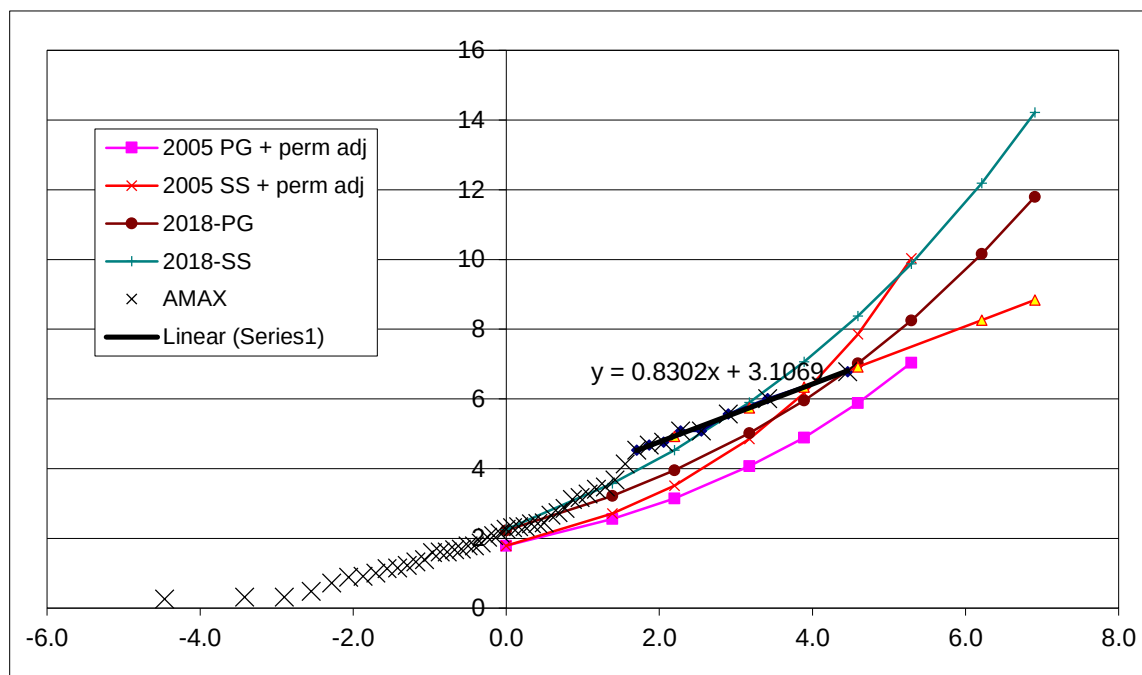
One issue with permeable catchments is that the AMAX data often provide a S shaped curve rather than a straight line or a curve and this occurs on the Westbourne as there are several floods of a similar magnitude (Figure 3). In such case the 3 parameter GL distribution may not provide a good fit to the more extreme value series and a 4 parameter distribution may be more suitable.

One option is to provide a best fit line to more extreme values only (Figure 4) and whilst this may be technically correct the FEH approaches detailed above provide higher flood flows (Table 6) and are preferred as a worst case or conservative flood estimates.

Table 6 Extension of Flood Flows – Ems at Westbourne

Return Period	2005 PG	2005 PG + perm adj	2005 SS	2005 SS + perm adj	2018-PG	2018-SS	Linear Extension
2	1.79	1.79	1.79	1.79	2.23	2.26	
5	2.71	2.56	2.97	2.71	3.22	3.58	
10	3.38	3.15	3.91	3.51	3.95	4.53	4.93
25	4.35	4.07	5.35	4.85	5.02	5.9	5.74
50	5.18	4.89	6.67	6.17	5.96	7.07	6.34
100	6.13	5.88	8.25	7.86	7.02	8.38	6.92
200	7.21	7.04	10.15	10.03	8.25	9.88	7.50
500					10.16	12.19	8.26
1000					11.80	14.22	8.84

Figure 4 Best Fit curve to the Highest flows in the AMAX Series



Havant Borough Council
Development Control
Civic Offices
Civic Centre Road
Havant
Hampshire
PO9 2AX

Our ref: HA/2018/120592/01-L01
Your ref: APP/18/00672
Date: 21 August 2018

Dear Sir/Madam

ERECTION OF 46NO. DWELLINGS WITH ASSOCIATED PARKING, ACCESS FROM WESTWOOD CLOSE, DIVERSION OF HAVANT FOOTPATH 73, LANDSCAPING AND SURFACE WATER DRAINAGE. FELLING AND WORKS TO TREES WITHIN AREA A1, SUBJECT TO TPO 2071. LAND OFF WESTWOOD CLOSE, EMSWORTH

Thank you for the consultation on the above application, please quote our reference on all correspondence.

We have reviewed the information as submitted and have the following comments.

Environment Agency Position

In the absence of an acceptable Flood Risk Assessment (FRA) we object to the planning application as submitted. This is a holding objection and request for further information.

Reason

The FRA submitted with this application does not currently comply with the requirements set out in NPPF and the Planning Practice Guidance to the NPPF for Flood Risk and Coastal Change.

The submitted FRA does not therefore, provide a suitable basis for assessment to be made of the flood risks arising from the proposed development.

In particular, the submitted FRA fails to:

1. Accurately assess the level of flood risk to the site

Environment Agency
Guildbourne House Chatsworth Road, Worthing, West Sussex, BN11 1LD.
Customer services line: 03708 506 506
www.gov.uk/environment-agency

Cont/d..

2. Adequately take the impacts of climate change into account
3. Demonstrate that flood risk will not increase as a result of the proposed development

This objection is also in line with Policy CS15 Flood and Coastal Erosion Risk of the Havant Borough Core Strategy March 2011 and E12 Managing Flood Risk in New Development in Havant Borough Councils emerging Local Plan.

Overcoming our objection

The applicant can overcome our objection by submitting an FRA which covers the deficiencies highlighted above and demonstrates that the development will not increase risk elsewhere and where possible reduces flood risk overall. If this cannot be achieved we are likely to maintain our objection to the application. Production of an FRA will not in itself result in the removal of an objection.

We ask to be re-consulted with the results of the FRA. Our objection will be maintained until an adequate FRA has been submitted.

In accordance with the Planning Practice Guidance (Ref. ID: 20150415), please notify us by email within 2 weeks of a decision being made or application withdrawn. Please provide us with a URL of the decision notice, or an electronic copy of the decision notice or outcome.

If you are minded to approve the application contrary to our objection, we would be grateful if you could re-notify the Environment Agency to explain why material considerations outweigh our objection, and to give us the opportunity to make further representations. Should our objection detailed above be removed, it is likely we will recommend planning conditions to be included on any subsequent approval.

Advice to applicant/Local Planning Authority

Assessment of anticipated present day flood extents originating from the River Ems

The red line boundary includes land identified as being at medium probability (Flood Zone 2) and high probability (Flood Zone 3) of flooding at the present day, according to the Flood Map for Planning. The FRA incorrectly identifies the source of flood risk to the site as from tidal flood sources in Section 3.8. This should be corrected to fluvial risk with the correct corresponding annual probability bands.

It is noted that the residential portion of the development is proposed to be located within present day Flood Zone 1. The extent of Flood Zone 1 has been derived within the FRA by utilising data obtained by the Environment Agency. Specifically, the 0.1% annual probability level has been used in conjunction with a topographical survey to delineate the assumed boundary of Flood Zone 1, and therefore identify the land with a low probability of fluvial flooding.

The 0.1% annual probability level provided by the Environment Agency is derived from a national scale generalised model called JFLOW, which was developed with the

purpose of providing a broad indication of the extent of flood risk. A detailed assessment is subsequently triggered as part of a site specific FRA.

Outputs from JFLOW are only suitable to be used for decision making at a broad catchment scale and are not suitable for use in site specific FRAs and detailed decision making, as the decision that they influence could be the wrong ones. The 0.1% flood level used in the FRA has been estimated by comparing the JFLOW flood depth data we hold with current ground levels taken from LiDAR. We would not consider flood levels derived using this method to be reliable sources of data to use in detailed FRAs. Please find attached an information sheet relating to the use of JLOW data.

In relation to the proposed development site, the development layout has been precisely informed by the JFLOW data used. Residential properties are located immediately adjacent to the estimated Flood Zone 1 boundary. Any inaccuracy in the location of this boundary could result in properties being built within Flood Zones 2 and 3. Not only could these properties consequentially be at risk of fluvial flooding, but would additionally take up floodplain storage and potentially increase flood risk to adjacent land. Given the significance of the implications, we would suggest that the positioning of residential properties requires further justification, using data appropriate for a site specific assessment.

Connected to the issue above, we would request the applicant provide confirmation that the access road, which appears to lie within Flood Zone 2/3 will not require any raising of ground levels above existing. Any raising of levels within Flood Zone 3 will require floodplain compensation to be provided.

Assessment of climate change impacts

In addition to the risk of flooding at the present day, National Planning Policy requires FRAs to assess the potential impacts of climate change to and from the proposed development. The FRA submitted assumes that by locating development outside of Flood Zone 1, it will be consequentially outside of the 1% plus climate change extent. Notwithstanding the issues raised in relation to the assumed extent of Flood Zone 1 above, the 1% plus climate change level may exceed the present day 0.1% level and may therefore require additional mitigation to ensure development remains safe throughout its lifetime.

The Environment Agency has provided a 1% plus climate change level, derived from the River Ems Flood Study, 2006. The climate change allowance in this study was a 20% increase in peak river flow and therefore does not comply with the climate change allowances now required to be considered in FRAs. Sites that include more vulnerable development and Flood Zone 3a should assess the impact of a 45% and 105% increase in peak river flows.

An underestimation of the climate change impacts could result in the proposed mitigation being inadequate to keep people and property safe throughout the lifetime of the proposed development.

Catchment scale flood risk considerations

The Environment Agency is currently appraising existing flood risk issues within the River Ems catchment and considering various courses of action to reduce the probability and consequences of flooding to existing communities at risk. We are currently undertaking some flood modelling that will update and supersede the existing

River Ems model, which is now 12 years old. We anticipate that the updated modelling will be available by the end of the current financial year. We will use this modelling to develop a range of potential mitigation options to reduce the existing risk of flooding. Currently these options are conceptual, and include flood storage in areas of the catchment to attenuate flows downstream. One of the areas under consideration is land north of the A27. We cannot pre-empt the exact nature and impact of any option, or combination of options, until we have considered the model outputs, undertaken stakeholder engagement and further feasibility work.

However, it is possible that an unconstrained options appraisal would include flood storage and consequentially an increase in the frequency and depth of flooding to land adjacent to, and possibly within, the proposed development site.

We realise, despite the conceptual nature of the plans at present, it may be helpful to share this information to provide a full picture of the issues affecting the proposed development.

Local Plan

We are aware that the proposed development site is also being considered by Havant Borough Council through the Local Plan process. Our advice to date on flood risk issues relating to any proposed allocation site is that there should be an appropriate level of flood risk assessment available to inform decision making. We have asked Havant Borough Council to consider whether or not there is sufficient data available with respect to the impacts of climate change on Land adjacent to Westwood Close to enable robust decision making that complies with planning policy.

Surface water management

For the avoidance of doubt, we have not reviewed the information relating to surface water management on the site, as we are no longer a statutory consultee on these matters. Changes to the Town and Country Planning (Development Management Procedure) (England) Order 2015, came into force on 15 April 2015. The Order removed the Environment Agency as a statutory consultee in relation to surface water drainage.

Hampshire County Council, in their capacity as Lead Local Flood Authority, is now the statutory consultee on major planning applications with surface water drainage implications and have provided their views on the adequacy of the proposed surface water drainage strategy within the FRA.

Further points of clarification

The FRA states that proposed finished floor levels for plots along the eastern side of the development will be set a minimum of 600mm above existing ground levels, elsewhere plots will be set a minimum of 300mm above existing ground levels. Please could you equate this to a minimum level above Ordnance Datum, and confirm which plots will be subject to the 600mm raising.

Please note that this response relates solely to matters that are relevant to the Environment Agency's planning remit. This response does not represent endorsement or opposition to the proposed development as submitted. Ultimately it is for the Local Planning Authority to determine this planning

application.

Please do not hesitate to contact me on the number below should you have any queries on the above information.

Yours faithfully

Mrs Sophie Brown

Sustainable Places Planning Advisor

Direct e-mail planningSSD@environment-agency.gov.uk

From: [Maskell, Jon](#)
To: [Terry Seymour](#)
Cc: [Jan Wallace](#); [Bryan Jezeph \(bryan@jezeph.co.uk\)](mailto:bryan@jezeph.co.uk)
Subject: RE: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192
Date: 07 June 2018 15:54:06
Attachments: [image003.png](#)
[image004.png](#)
[image005.png](#)

Hi Terry

Thanks for your email, apologies for the delay in response. I hope that the following information answers your questions.

In terms of the timescales for the River Ems modelling, we are unlikely to have any outputs before the end of this year and the flood map is unlikely to be updated until after Christmas.

With regard to your question about the information that we would use to provide comment on an application, our position is that we would use the best available information at the time of consultation. We would be unable to delay making a response as once we are consulted we have a statutory duty to respond to the Local Authority within 21 days.

It should be noted however that we only provide comments on fluvial and coastal flooding, it will still be for the lead local flood authority and/or the local authority to consider other sources of flooding such as surface water and this should also take account of climate change.

I hope that this helps

Thanks
Jon

Jon Maskell

Team Leader | Sustainable Places

Solent & South Downs | Environment Agency

Email: PlanningSSD@environment-agency.gov.uk

Telephone: [020 8474 5888](tel:02084745888)

Environment Agency | Romsey Office

Canal Walk | Romsey | SO51 7LP



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From: Terry Seymour [mailto:Terry@rcpconsultants.co.uk]

Sent: 31 May 2018 19:36

To: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Cc: Ian Wallace <iewallace@hampshirehomesgroup.com>; Bryan Jezeph (bryan@jezeph.co.uk) <bryan@jezeph.co.uk>

Subject: RE: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192

Hi Jon

Thank you for your email and for the explanation.

Our Client is still looking to proceed with a planning application on this site, but due to their timescales cannot wait until elements of funding for the completion of the modelling exercise is resolved.

What we would like to understand is should the application be submitted now, will the EA, as statutory consultees, provide a response on the best available information (i.e. current flood maps with fluvial flood levels) at the time of consultation or will such consultation response be delayed until resolution of the updated modelling exercise?

Many Thanks

Terry Seymour CEng MICE
Engineering Director



Rogers Cory Partnership Ltd
Architectural & Civil Consultants

The Old School Old School Road

Hook Hampshire RG27 9NJ

T: 01256 769269

M: 07462134576

E: terry@rcpconsultants.co.uk

W: www.rcpconsultants.co.uk

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From: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Sent: 25 May 2018 15:25

To: Terry Seymour <Terry@rcpconsultants.co.uk>

Cc: Ian Wallace <iewallace@hampshirehomesgroup.com>; Bryan Jezeph (bryan@jezeph.co.uk) <bryan@jezeph.co.uk>

Subject: RE: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192 [Filed 11 May 2018 11:08]

Hi Terry

Thanks for the email. Apologies for the delay in response.

The River Ems model has been built and the hydrology is being reviewed. However, we have not yet got to the point where we have usable modelling outputs to update the flood maps.

The project team are having to get some further funding approval which means that work has stopped temporarily. My colleague from the project team has committed to giving me a further update in the next couple of weeks on the progress, she hopes that they will then have a better idea of when the information will be available.

Once this has been resolved and is fully completed we can inform & provide you with any updates so that you can use the data as you chose to. Just to confirm, we would not wait for the flood map to be updated on our external website before we would be in a position to share this information with yourselves and Havant Borough Council.

In terms of a meeting, currently we feel that we have explained our position regarding this issues and provided an update on the modelling to both yourselves and the council. As you will appreciate, we are all very busy at the moment and as we wouldn't have any additional information to discuss or updates to provide, a meeting would be more effective when we have something further to add. Please note that any meeting is likely to be chargeable. We will of course be in touch with you and Havant BC as soon we have more to add.

Kind Regards

Jon

Jon Maskell

Team Leader | Sustainable Places

Solent & South Downs | Environment Agency

From: Terry Seymour [<mailto:Terry@rcpconsultants.co.uk>]

Sent: 22 May 2018 07:36

To: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Cc: Ian Wallace <iewallace@hampshirehomesgroup.com>; Bryan Jezeph (bryan@jezeph.co.uk) <bryan@jezeph.co.uk>

Subject: Re: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192 [Filed 11 May 2018 11:08]

Morning Jon

Following our discussion last week can you please advise if you have managed to review with Laura?

We urgently need to arrange a meeting please to fully understand the current position.

Kind regards

Terry Seymour

Sent from my Samsung Galaxy smartphone.

----- Original message -----

From: Terry Seymour <Terry@rcpconsultants.co.uk>

Date: 11/05/2018 11:07 (GMT+00:00)

To: "Maskell, Jon" <jon.maskell@environment-agency.gov.uk>

Cc: Ian Wallace <iewallace@hampshirehomesgroup.com>, "Bryan Jezeph (bryan@jezeph.co.uk)" <bryan@jezeph.co.uk>

Subject: RE: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192
[Filed 11 May 2018 11:08]

Hi Jon

I hope you are well

I have left a voicemail to discuss,

Can you please give me a call when you get a chance as I would like to set up a meeting with yourself Laura Lax (who I believe works at the Romsey Office?) and John Denman regarding the current fluvial modelling study on the River Ems catchment.

I spoke with John Denman a few weeks ago regarding the updated modelling exercise and understand this was yet to be concluded and anticipated to be completed in the next few months and after that point the formal process of updating the Flood Maps would be undertaken and expected this to be completed by around January 2018.

Further to this I understand that Havant Borough Council have been in consultation with Laura who has raised concern over our site and advised they the EA feels that the area currently shown as Flood Zone 1 (which is where we are proposing to develop) will become Flood Zone 2 and 3 as a result of the updated modelling exercise. This is obviously very concerning for us as we have based all our work, design and development principles on the basis of developing within Flood Zone 1 and are now at a point of looking to submit the planning application, only to be advised that there is concerns over the flood mapping changing over the next few months.

I would clearly like to understand the current status of the modelling exercise and timescales for the updates for the EA maps which I feel we need to have a meeting with both John and Laura to ensure we have a consistent response from the EA please. If there is a speculative change then we need to be provided with the anticipated fluvial level information so we can review these against the actual site topographic survey and ensure we are not prejudiced by the LiDAR level assessment being used by the modelling exercise.

Can you please look to set up a meeting as early as possible (next week if possible?) and happy that the extra costs associated with this is attributed the pre-app charging services offer which

was set up last year.

I look forward to hearing from you

Kind Regards

Terry Seymour CEng MICE
Engineering Director



Rogers Cory Partnership Ltd
Architectural & Civil Consultants

The Old School Old School Road

Hook Hampshire RG27 9NJ

T: 01256 769269

M: 07462134576

E: terry@rcpconsultants.co.uk

W: www.rcpconsultants.co.uk

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From: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Sent: 03 April 2017 15:37

To: Terry Seymour <Terry@rcpconsultants.co.uk>

Subject: Programme of Works & Offer Letter Westwood Close PAC/SLTSDN/00192

Dear Mr Seymour,

Please find attached the Environment Agency's revised Offer Letter & Programme of Works for the Westwood Close site as discussed.

Please can you confirm, via email, that you are happy to accept this offer and the terms and conditions also attached to this email.

If you are happy with the offer please can you confirm the name and address of the relevant person/company to address the invoice to, by filling in the Payment Proforma attached.

Feel free to contact me should you have any questions.

Many Thanks

Jon

Jon Maskell | Sustainable Places Advisor | Solent and South Downs Area | Environment Planning and Engagement
Environment Agency | Romsey District Office | Canal Walk | Romsey | Hampshire | SO51 7LP

Tel: 020 8474 5888

jon.maskell@environment-agency.gov.uk

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Flood Risk Standing Advice was updated on 15 April 2015. For more information please follow the links below:

For developers: [FRSA developers page](#)

For councils: [FRSA council's page](#)



Our **climate change allowances** for planning were updated on 19 February 2016. The guidance is accessible here: [Flood risk assessment: Climate change allowances](#)

From: Terry Seymour [<mailto:Terry@rcpconsultants.co.uk>]

Sent: 30 March 2017 13:32

To: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Subject: RE: Westwood Close

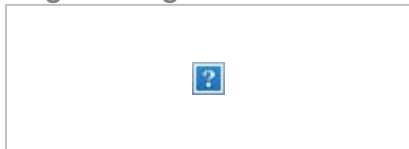
Hi Jon

Whilst we are going through the initial call for sites process with Havant it would be really great if we could get some form or written response from the EA in terms of the support/ agreement in principle of the proposals on how we are seeking to take forward the development outside of the Flood zones 2 and 3.

Is this something you could provide based on our drainage and flood risk pre-app note?

Kind Regards

Terry Seymour CEng MICE
Engineering Director



Rogers Cory Partnership Ltd
Architectural & Civil Consultants

The Old School Old School Road

Hook Hampshire RG27 9NJ

T: 01256 769269

M: 07462134576

E: terry@rcpconsultants.co.uk

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From: Maskell, Jon [<mailto:jon.maskell@environment-agency.gov.uk>]

Sent: 28 February 2017 14:25

To: Terry Seymour <Terry@rcpconsultants.co.uk>

Subject: RE: Westwood Close

Hi Terry,

Sorry no, not the 1 in 1000 levels, just JFLOW.

Thanks

Jon

From: Terry Seymour [<mailto:Terry@rcpconsultants.co.uk>]

Sent: 16 February 2017 16:41

To: Maskell, Jon <jon.maskell@environment-agency.gov.uk>

Subject: RE: Westwood Close

Hi Jon

Thank you for sending this through, do you by any chance have the 1 in 1000 year levels for these same sections?

Terry Seymour CEng MICE
Engineering Director



Rogers Cory Partnership Ltd
Architectural & Civil Consultants

The Old School Old School Road

Hook Hampshire RG27 9NJ

T: 01256 769269

M: 07462134576

E: terry@rcpconsultants.co.uk

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From: Maskell, Jon [<mailto:jon.maskell@environment-agency.gov.uk>]

Sent: 16 February 2017 16:38

To: Terry Seymour <Terry@rcpconsultants.co.uk>

Subject: Westwood Close

Hi Terry,

Good to catch up.

As discussed, please find attached a revised Levels map for the Westwood Close site in Havant.

Thought that this might give you a bit more info to go on.

Give me a shout if you need anything else.

Thanks

Jon

Jon Maskell | Sustainable Places Advisor | Solent and South Downs Area | Environment Planning and Engagement
Environment Agency | Romsey District Office | Canal Walk | Romsey | Hampshire | SO51 7LP

Tel: 020 8474 5888

jon.maskell@environment-agency.gov.uk

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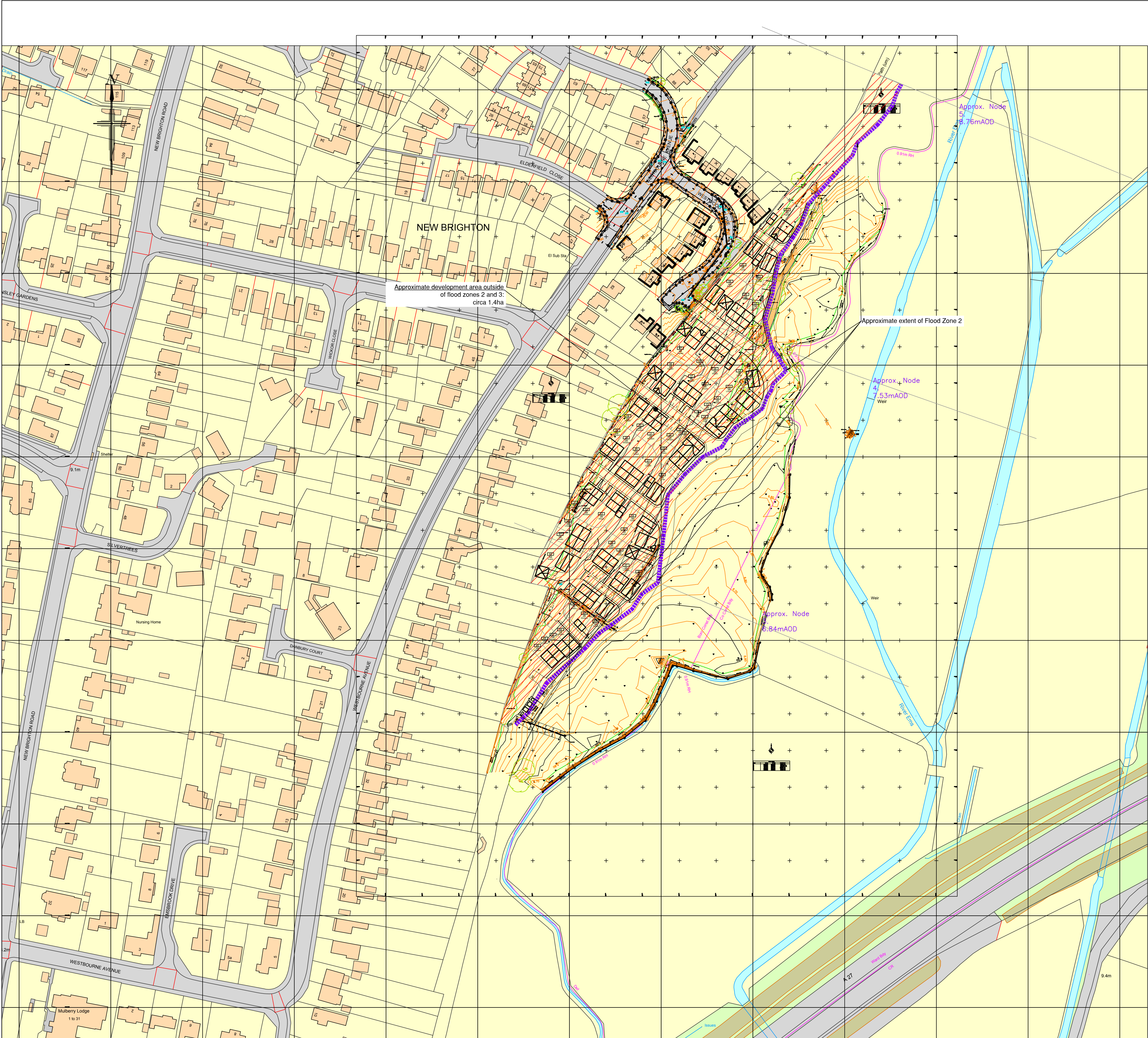
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NOTES

1. Background based on OS mapping.
2. Flood zone extents shown are based on EA product 4 flood level data .
3. Existing Levels based on Topographic Survey carried out by Global Surveys in May 2017 (17026-TOPO). Existing contours are at 0.1m level intervals.
4. The Flood Zones 2 extent is approximate only and subject to detailed hydrological information to confirm extents and verification with the Environment Agency

Rev.		Date	Details	By	Chkd	Appd
Client:-						
						
Site:- Hampshire Farm Emsworth				Drawing Title:- Outline Flood Zone Assessment		
Date:		January 2017		Scales:		1:1000 at A1
Drawn:		TS		Checked:		TS
Approved:		TS				
Drawing No. HAM/E4559/SK001B						
						
Rogers Cory Partnership Architectural and Civil Consultants The Old School Old School Road Hook Hampshire RG27 9NJ T: 01256 769269 E: mail@rcpconsultants.co.uk W: rcpconsultants.co.uk						

**Mr Terry Seymour
Rogers Cory Partnership Ltd
The Old School
Old School Road
Hook
Hampshire
RG27 9NJ**

**Our ref: HA/2017/119278/02
Your Ref: PAC/SLTSDN/00192
Date: 21 April 2017**

Dear Mr Seymour

DETAILED ADVICE - FLOOD RISK & SUDS STRATEGY NOTE

LAND AT WESTWOOD CLOSE EMSWORTH, HAMPSHIRE

Thank you for accepting our offer to provide detailed planning advice. We have reviewed the following documents:

- *Flood Risk & SuDs Strategy Note February 2017 – Doc Ref: TRS/HAM/E4559/16562*

We are providing this advice under Agreement **PAC/SLTSDN/00192**. Please note we have taken 3 hours to review and provide our advice on these documents which is in line with what we estimated in our Programme of Works. Please note that we have only reviewed this document in terms of flood risk.

Environment Agency Advice

We have reviewed the submitted information in relation to the proposed development and have the following detailed comments:

As stated within the report the proposed site includes land designated as flood zones 1, 2 and 3, defined as having a low, medium and high probability of flooding. Flood zones 2 and 3 are generally confined to the south-eastern most corner of the plot. Paragraph 103, footnote 20 of the National Planning Policy Framework (NPPF) requires applicants for planning permission to submit an FRA when development is proposed in such locations.

We are pleased to see that the sequential approach has been proposed on this site. As set out within paragraph 101 of the NPPF, utilisation of the sequential approach within proposed sites ensures that new development is steered to areas with the lowest



probability of flooding. This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.

Application of the sequential approach in the plan-making process, in particular application of the Sequential Test, will help ensure that development can be safely and sustainably delivered and developers do not waste their time promoting proposals which are inappropriate on flood risk grounds.

Should a planning application for this site come forward where the sequential approach has been applied, as illustrated within this Strategy Note, the Environment Agency would not have any objections on flood risk grounds. However, should plans for this site change at any time prior to submission or during the planning process to include development within either flood zone 2 and/or 3 we would expect the local planning authority to apply the Sequential Test; that is, it must consider whether the applicant has demonstrated and sufficiently justified that no alternative sites are available in a lower flood risk zone.

In Section 2 of the Flood Risk & SuDs Strategy Note reference is made to the requirement of Flood Defence Consent from the Environment Agency should any works fall within 8 metres of a designated Main River. Please note that this process has recently changed and the permit/consent is now referred to as a Flood Risk Activity Permit under the Environmental Permitting (England and Wales) Regulations 2010.

The need for an environmental permit is separate to the need for planning permission. The granting of planning permission does not necessarily lead to the granting of an environmental permit.

Further details and guidance are available on the GOV.UK website:

www.gov.uk/guidance/flood-risk-activities-environmental-permits

As stated within the document, amendments to the Development Management Procedure Order (DMPO) came into effect on 15th April 2015. As a result the Environment Agency is no longer a statutory consultee on surface water drainage, in terms of flood risk. Hampshire County Council as the Lead Local Flood Authority are now statutory consultee for 'Major development with Surface Water Drainage'.

Next Steps

Should you proceed with a planning application for this site, in line with both national and local planning policy you will need to produce an adequate FRA. We would recommend that you clearly illustrate within the FRA that the sequential approach has been undertaken on site and that no development is to be located within flood zones 2 and/or 3.

I hope the above advice is helpful. If there is any further work you anticipate needing our detailed advice on in relation to this project please let me know so it can be incorporated into this charging agreement.

Yours sincerely

Jon Maskell

Sustainable Places
Environment Agency
PlanningSSD@environment-agency.gov.uk

Disclaimer

Our opinion is based on the information available to us at the time of the enquiry. When the formal planning application is submitted, our position may change if there have been changes to environmental risk or evidence, and/or planning policy.



**LAND AT WESTWOOD CLOSE
EMSWORTH, HAMPSHIRE**

FLOOD RISK & SUDS STRATEGY NOTE

FEBRUARY 2017

Rogers Cory Partnership
Architectural and Civil Consultants
The Old School, Old School Road
Hook, Hampshire, RG27 9NJ
E. mail@rcpconsultants.co.uk

T: 01256 769269

W. www.rcpconsultants.co.uk

Document Control Sheet

Project name: Westwood Close, Emsworth
Project ref: HAM/E4559
Report Title Flood Risk and SuDS Strategy Note
Doc. ref: TRS/HAM/E4559/16562
Date: 8th February 2017

	Name	Position	Signature	Date
Prepared by:	Terry Seymour	Director		08.02.2017
Approved by:	Terry Seymour	Director		08.02.2017

Revision	Date	Description	Prepared	Approved

Flood Risk and SuDS Strategy Note

Contents

1.	Introduction	2
2.	Existing Site	3
3.	Existing Flood Risk	4
4.	Sustainable Drainage Systems and Surface Water Management.....	8

Flood Risk and SuDS Strategy Note

1.0 Introduction

Rogers Cory Partnership Limited have been instructed on behalf of Hampshire Homes Group to prepare a preliminary flood risk and sustainable drainage systems appraisal to support the proposals for the residential development at Westwood Close in Emsworth, Hampshire.

The National Planning Policy Framework (NPPF) was published in March 2012 by the Department of Communities and Local Government and replaced all planning policy statements including Planning Policy Statement 25 (PPS 25): Development and Flood Risk. The NPPF set out the Government's planning policy for England and how these are expected to be applied. The Planning Practice Guidance (PPG), published in March 2014, provides additional guidance and retains key elements of the now superseded PPS 25.

Initial consultation carried out with the Environment Agency's (EA) has identified the development site to be located within Flood Zone 1, 2 and 3. The area proposed for the residential development within the site is to be kept outside of Flood Zones 2 and 3 and wholly within Flood Zone 1, considered to be at low risk of flooding from rivers respectively, in this respect requirements in the NPPF (foot note 20) states the following:

"site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding."

Flood Risk and SuDS Strategy Note

2.0 Existing Site

The site is located off Westwood Close and is bounded to the west and north by residential properties, to the south by open fields and the A27 and to the east by fields and the River Ems. The River Ems is designated as a Main River by the EA.



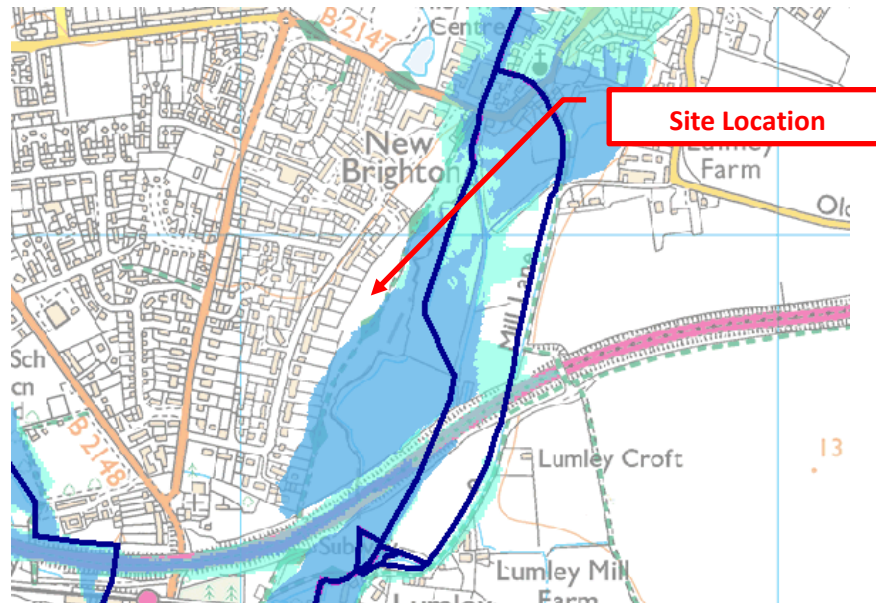
Figure 1: Site location

The existing site consists open fields with grasslands. The approximate centre of the site is at Ordnance Survey (OS) Grid Reference 475222; 106949.

Hydrology

The EA flood maps (see **figure 2** below) indicate the presence of existing watercourses in the vicinity of the site. There is an existing watercourse immediately east of the site as well as the designated Main River (River Ems). Any works within 8m of these Main Rivers will be subject to a Flood Defence Consent from the EA.

Flood Risk and SuDS Strategy Note

**Figure 2- Extract of EA's Flood Map****Ground Conditions**

According to existing British Geological Survey (BGS) maps the site is located over the London Clay Formation with a superficial Head deposit comprising of Clayey Gravel. Detailed ground investigations, including groundwater monitoring and infiltration testing to BRE365 will be carried out to support the site specific flood risk assessment and drainage strategy proposals.

3.0 Flood Risk

National policy regarding flood risk is contained within the National Planning Policy Framework and Technical guidance which was issued by the Communities and Local Government in March 2012.

The Environment Agency's latest revision of their Flood Risk Standing Advised (FRSA) (version 3.1) was released in April 2012.

The Department for Environment, Food and Rural Affairs (DEFRA) released the Non-statutory technical standards for sustainable drainage systems in March 2015. The document sets out non-statutory technical standards for SuDS to be read in conjunction with the NPPF and PPG.

As of the 15th April 2015 the Lead Local Flood Authority (LLFA) has now become a statutory consultee on all major planning applications and as such will assess planning applications in respect of surface water drainage and sustainable drainage systems which was previously the responsibility of the Environment Agency. The LLFA's primary duties will be to ensure that flood risks from surface water run-off, groundwater and ordinary watercourses are identified and managed properly. The use of SuDS will be a material consideration in planning conditions and as such the

Flood Risk and SuDS Strategy Note

proposed use of SuDS will need to be demonstrated on all major developments unless it can be demonstrated otherwise.

Local Planning Policies

Any future development would need to accord with the policies set out in the Havant Borough Council Core Strategy (adopted 2011)

The policy most relevant to this scheme in regards to flood risk and surface water drainage requirements from policy CS15. In this regard the policy states:

“Policy CS15 Flood and Coastal Erosion Risk

Development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:

- 1. It meets the sequential and exception test (where required) in relation to PPS25.*
- 2. The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.*
- 3. A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*
- 4. The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.*
- 5. Appropriate flood warning and evacuation plans are in place.*
- 6. New site drainage systems are designed taking account of events which exceed the normal design standard.*

All development will be required to ensure that there is no net increase in surface water run off. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDs are provided arrangements must be put in place for their whole life management and maintenance.

The council will work with partners to implement the Coastal Policy Zones in the North Solent Shoreline Management Plan to ensure that development avoids areas at risk from coastal erosion and coastal flooding and that areas required to offset coastal squeeze and prevent habitat fragmentation, to allow species to adapt to climate change, are identified and protected from development.”

Flood Risk and SuDS Strategy Note

Strategic Flood Risk Assessment

The National Planning Policy Framework confirms that Regional Planning Bodies (RPBs) or local planning authorities (LPAs) should prepare strategic Flood Risk Assessments (SFRAs) in consultation with the EA. The SFRA is then used to refine information on areas liable to flooding by taking into account other sources of flooding and the impacts associated with climate change in addition to the EA flood map data.

The document informs the Council's policies in the emerging Local Development framework and a strategic approach to the allocation of sites for development and the future management of flood risk, in line with the National Planning Policy Framework.

The Partnership for Urban South Hampshire (PUSH) is made up of 10 local planning authorities within Hampshire. Atkins were commissioned in 2006 to undertake a Strategic Flood Risk Assessment (SFRA), which was divided into two stages.

The first stage of the SFRA included for the collation of data and production of scoping appraisal. This stage also provided a high level analysis of flood risk within each sub-region. This stage was developed to assist in assessing the feasibility of the PUSH housing allocation.

The second stage of the SFRA involved the production of detailed mapping outputs to assist the Planners and Flood Risk Managers.

Fluvial Flood Risk

The site lies partly within Flood Zone 1, 2 and 3 respectively. The residential portion of the development is proposed to be located wholly within Flood zone 1 (considered low risk of flooding from rivers and sea) **figure 2**. In accordance with the NPPF, Flood Zone is compatible with residential land use which is classified as “more vulnerable” development.

In order to assess the area within the site which falls wholly within Flood Zone 1, the fluvial flood model data was obtained from the EA to determine the extent the Flood Zones within the site. Using the modelled flood level data the extent of Flood Zone 2, which is the extent of area susceptible to fluvial flooding between the 1 in 100 year and 1 in 1000 year event, has been assessed in relation to the existing site levels using 1m DTM LiDAR information. By assessing the extent of the 1 in 1000 year fluvial flood event and ensuring that the proposed residential development lies outside of this zone, this ensures that the residential development proposals will be kept outside of the 1 in 100 year plus climate change fluvial flood event, to satisfy the new climate change requirements introduced by DEFRA in February 2016.

Drawing HAM/E4559/SK010 provides an overlay of the modelled fluvial flood levels in relation to the LiDAR level information. This information has been used to

Flood Risk and SuDS Strategy Note

determine the extent of the 1 in 1000 year flood event (Flood Zone 2) and thus determine area of the site which would be designated as Flood Zone 1.

As part of the development of the site specific flood risk assessment, a detailed consultation process will also be undertaken with the EA to support the development.

Surface Water Flood Risk

The Environment Agency's maps for the risk of potential surface water flooding (**figure 3**) indicates that the proposed area for the residential portion within the site is not at risk of flooding from surface water. The EA's maps for surface water flooding is based on a coarse level of modelling which does not account for the presence of existing drainage networks or features which may already accommodate surface water run-off.

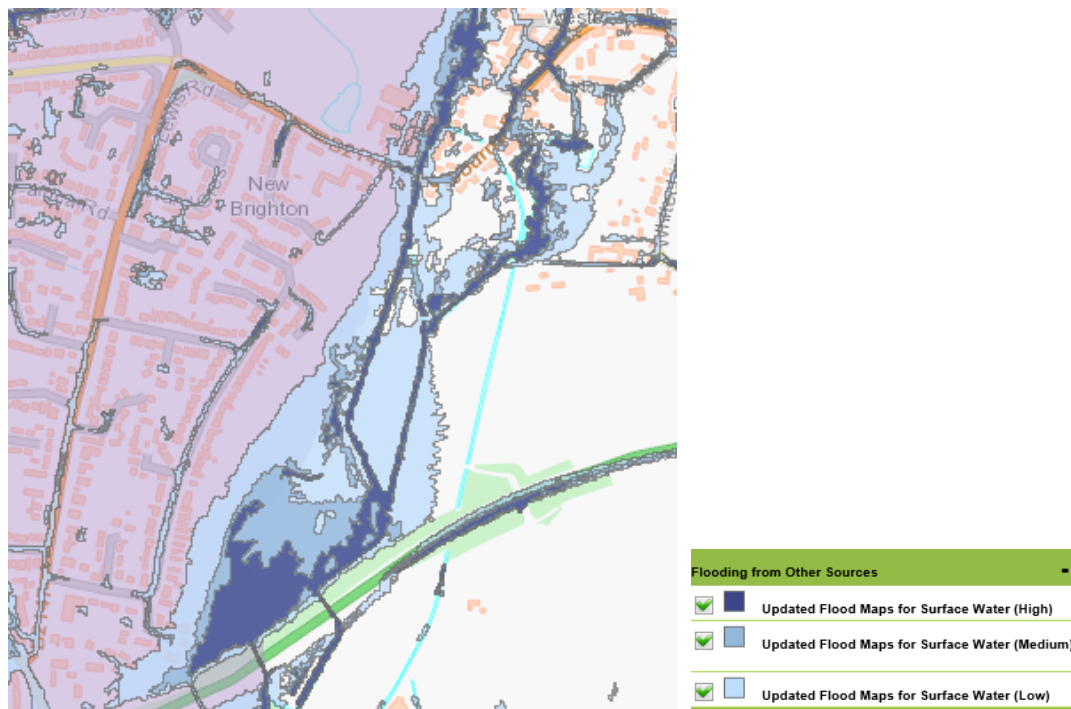


Figure 3- Extract from PUSH Maps of Surface Water Flooding Map

Groundwater Flood Risk

The PUSH maps indicate that whilst the site is located in an area with low bedrock permeability there are no recorded incidences of groundwater flooding.

Flood Risk and SuDS Strategy Note

4 Sustainable Drainage Systems and Surface Water Management

Hampshire County Council (HCC) are the Lead local flood Authority for Havant Council and statutory consultee on surface water management on all planning applications within the County.

The surface water management section should ensure that there is no adverse impact on flood risk elsewhere as a result of a change in the surface water runoff regime from the re-development.

Design Principles

Key design principles in the following guidance documents steer the approach to managing surface water runoff at sites:

- Building Regulations hierarchy of drainage (H3);
- Interim Code of Practice for SuDS; and
- CIRIA best practice guidance, including the use of the 'SUDS management train'

Building Regulations hierarchy of drainage outlines the preferred methods for the disposal of surface water with infiltration methods being the preferred option. If this is not possible the next favoured option is to drain to an existing watercourse. If neither of these options are feasible, the regulations state that rainwater discharge should be directed to a sewer.

The Interim Code of Practice for SUDS provides guidance about the hydraulic design criteria for Sustainable drainage systems. This in general refers to both peak rate of runoff and the volume of runoff, post development. Prior to mitigation measures such as the use of SuDS attenuation features, both the volume and peak rate of runoff may increase post development.

The design principles for surface water management extend beyond simple hydraulic criteria. CIRIA guidance promotes the use of the SUDS management train, a concept where SUDS techniques are used to treat, convey and store surface water runoff. This approach is considered as part of the SUDS selection methodology.

Sustainable Drainage Systems

To drain the development in a sustainable manner whilst complying with the requirements of the NPPF, the scheme should seek to adopt an appropriate form(s) of sustainable urban drainage systems (SUDS). SuDS techniques which should be considered for the development will investigate the opportunities to implement the following SuDS measures throughout the development:

Flood Risk and SuDS Strategy Note

- Swales;
- Ditches;
- SuDS Attenuation Basins;
- Cellular storage tanks

Surface Water Drainage Strategy

In view of the requirements of the NPPF, PPG, HCC the design parameters and constraints associated with redeveloping this site and the Code for sustainable homes, a surface water drainage strategy design has been devised and hydraulically modeled to demonstrate that the scheme can be suitably implemented without increasing the level of flood risk, when the surface water drainage system experiences a 1:100 year rainfall event (including climate change).

The surface water drainage scheme will be designed to ensure:

- A reduction in the pre development site discharge for peak storm events.
- Sustainable Urban Drainage systems are wholly incorporated within the scheme.
- Consideration is given for the improvement of water quality within the design.
- The designed drainage scheme can satisfactorily retain a critical 1 in 100 Year storm event with climate change.

Flow Control

The proposed discharge from the site is to be restricted to the Mean Annual Average Greenfield rate (Q_{bar}) which represents a betterment to the calculated 1 in 30 Year and 1 in 100 Year Greenfield run-off rates.

The hydraulic calculations will be simulated under various scenarios up to and included the critical 1 in 100 Year storm event with additional allowance for climate change to ensure that the storm can be managed and maintained within the site without flooding.

Water Quality

It is important to address issues with regards to quality when considering surface water management. The development proposals will implement a SuDS Management Train in accordance with the recommendations of the SuDS Manual (Ciria 753) and as required by the LLFA.

Flood Risk and SuDS Strategy Note

Long Term Maintenance

Consideration will be given to the long term maintenance of the proposed drainage structures and SuDS features.

Use of Environment Agency Information for Flood Risk Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

You should refer to the Environment Agency's Flood Risk Standing Advice, Planning Practice Guidance, and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

<https://www.gov.uk/flood-risk-assessment-standing-advice>

<http://planningguidance.planningportal.gov.uk/>

<http://www.planningportal.gov.uk/planning/planningpolicyandlegislation/previousenglishpolicy/ppgpps/pps25>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment (FRA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

The Old School Road
Hampshire
RG27 9NJ

Our ref: SSD/25878

Date: 18/11/2016

Dear Lorraine Green

Provision of Product 4 for address: Hampshire Farm, Emsworth, PO10 7QU

Thank you for your request of 13th October 2016 to use Environment Agency data, Product 4. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area partially located within Flood Zone 3 shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself.

Please find attached a copy of the Flood Map for Planning (Rivers and Sea) for the area relating to your address.

Further details about the Environment Agency information supplied can be found on the GOV.UK website:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments

<https://www.gov.uk/planning-applications-assessing-flood-risk>
<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Supporting Information

Flood Defences

Based on our records, there are no formal raised defences in this area.

Model Information

The levels, depths and flood outlines are taken from the River Ems Flood Study, completed in 2006 by Peter Brett Associates using ISIS (1D) software.

Flood History

We do not have any records of previous flood risk events affecting this location. However, for a more comprehensive flood history I would suggest also contacting the local Hampshire County Council.

Please note our records are not comprehensive and may not include all events, you can contact your Local Authority to check if they hold any relevant information regarding your application.

You are encouraged to use and re-use this information freely and flexibly, with only a few conditions. Details of which can be found here:

<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

If you have any queries or would like to discuss the content of this letter further please call us on 03708 506506.

Yours faithfully

Galeb Aqel
PSO West Sussex

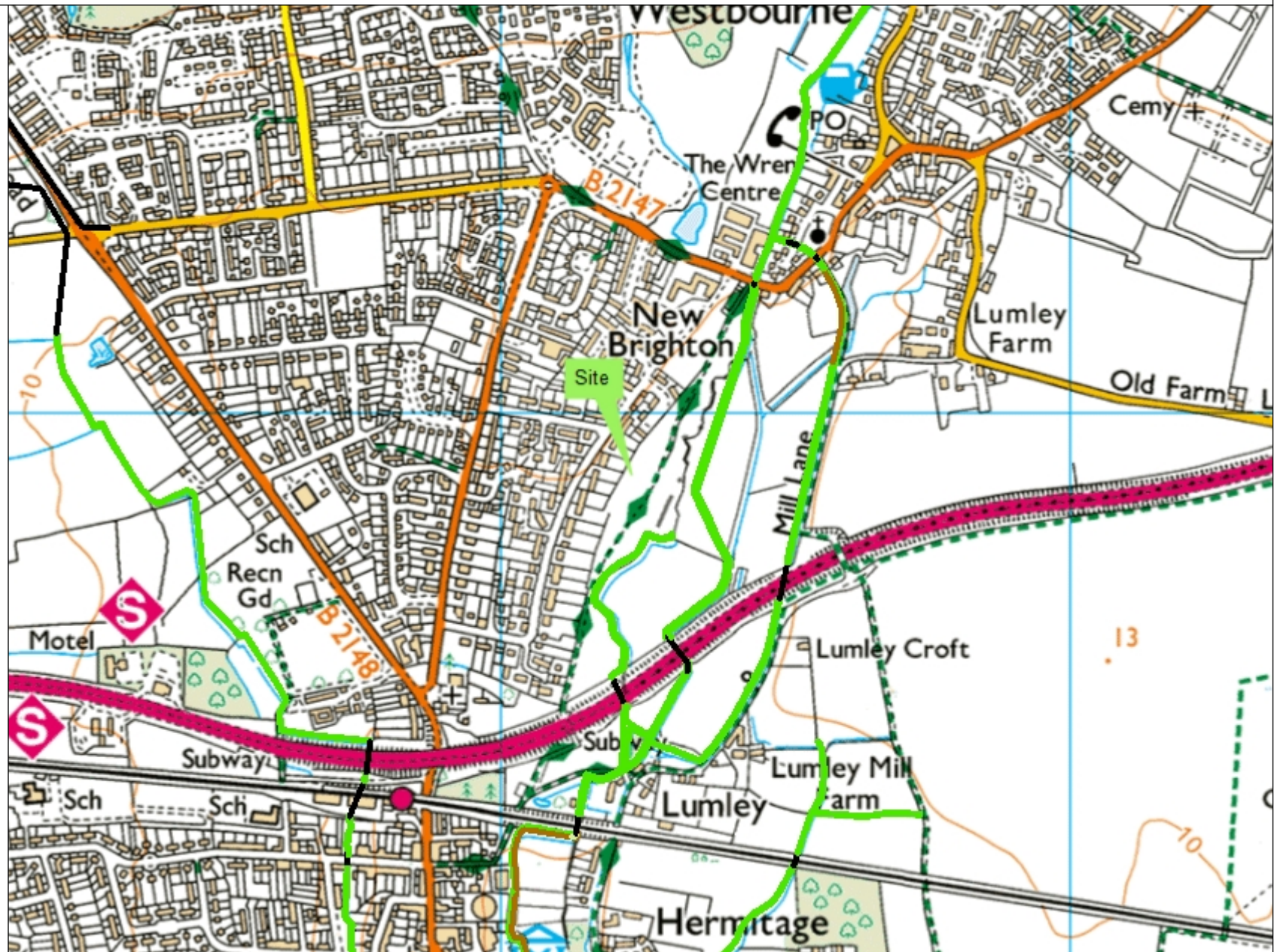
Enc. Flood Map (Rivers and Sea) / Node point locations / Flood levels/depths /
Modelled flood outlines / Flood Defence Locations

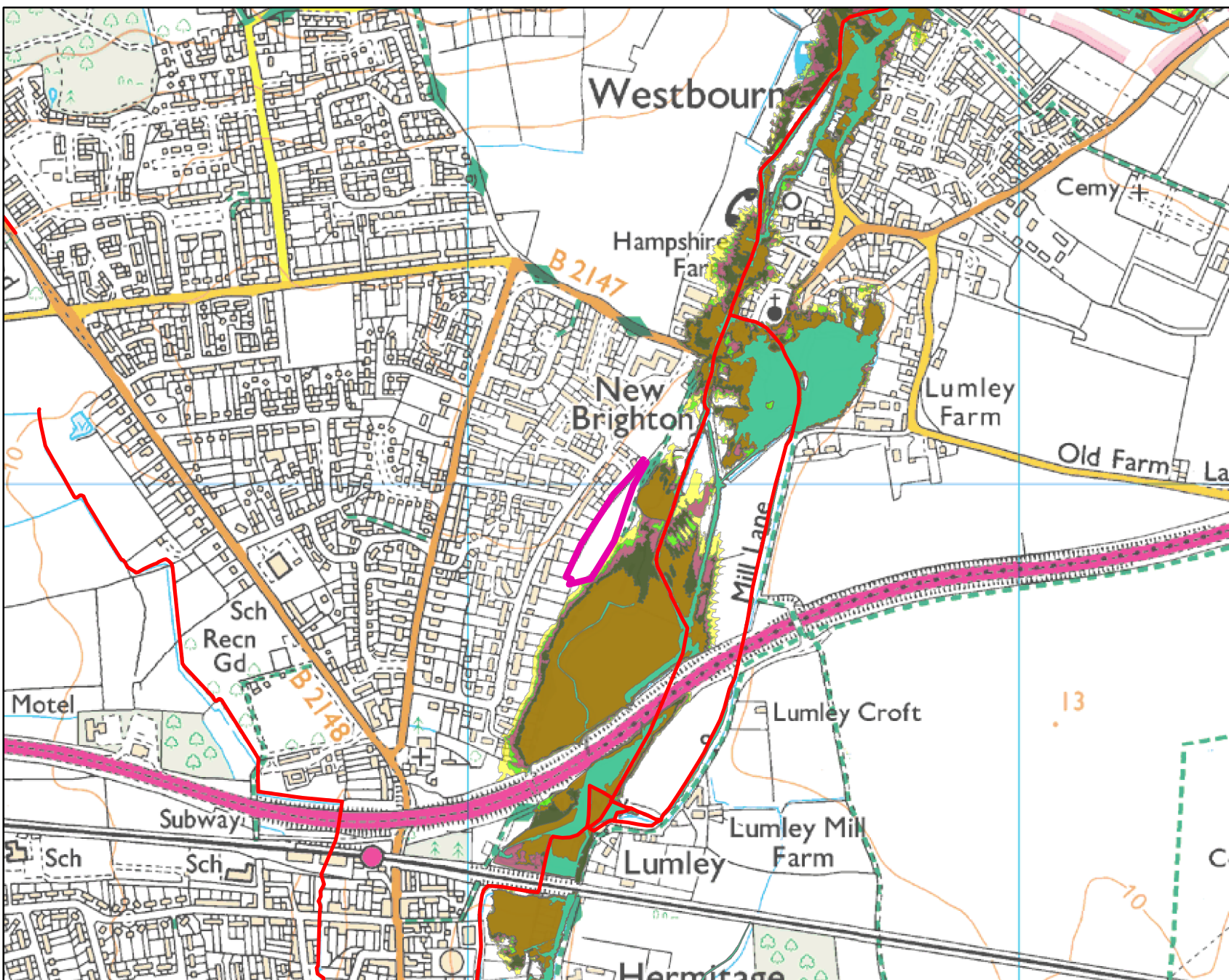
Flood defence location centred PO10 7QU. Created 17/11/16.

Legend

Defences

- Embankment
- Wall
- Flood Gate
- Demountable Defence
- Bridge Abutment
- High Ground
- Beach
- Barrier Beach
- Promenade
- Quay
- Cliff
- Dunes
- Culvert



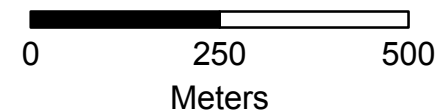


Legend

- Main River
- Boundary line
- 20% AEP (Undefended Fluvial)
- 4% AEP (Undefended Fluvial)
- 2% AEP (Undefended Fluvial)
- 1.3% AEP (Undefended Fluvial)
- 1% AEP (Undefended Fluvial)
- 1% AEP Plus Climate Change (Undefended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



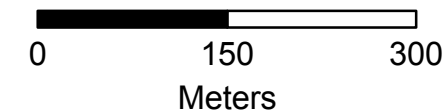
Modelled Site Node Points centred PO10 7QU. Created 17/11/2016 (Ref: SSD/25878)



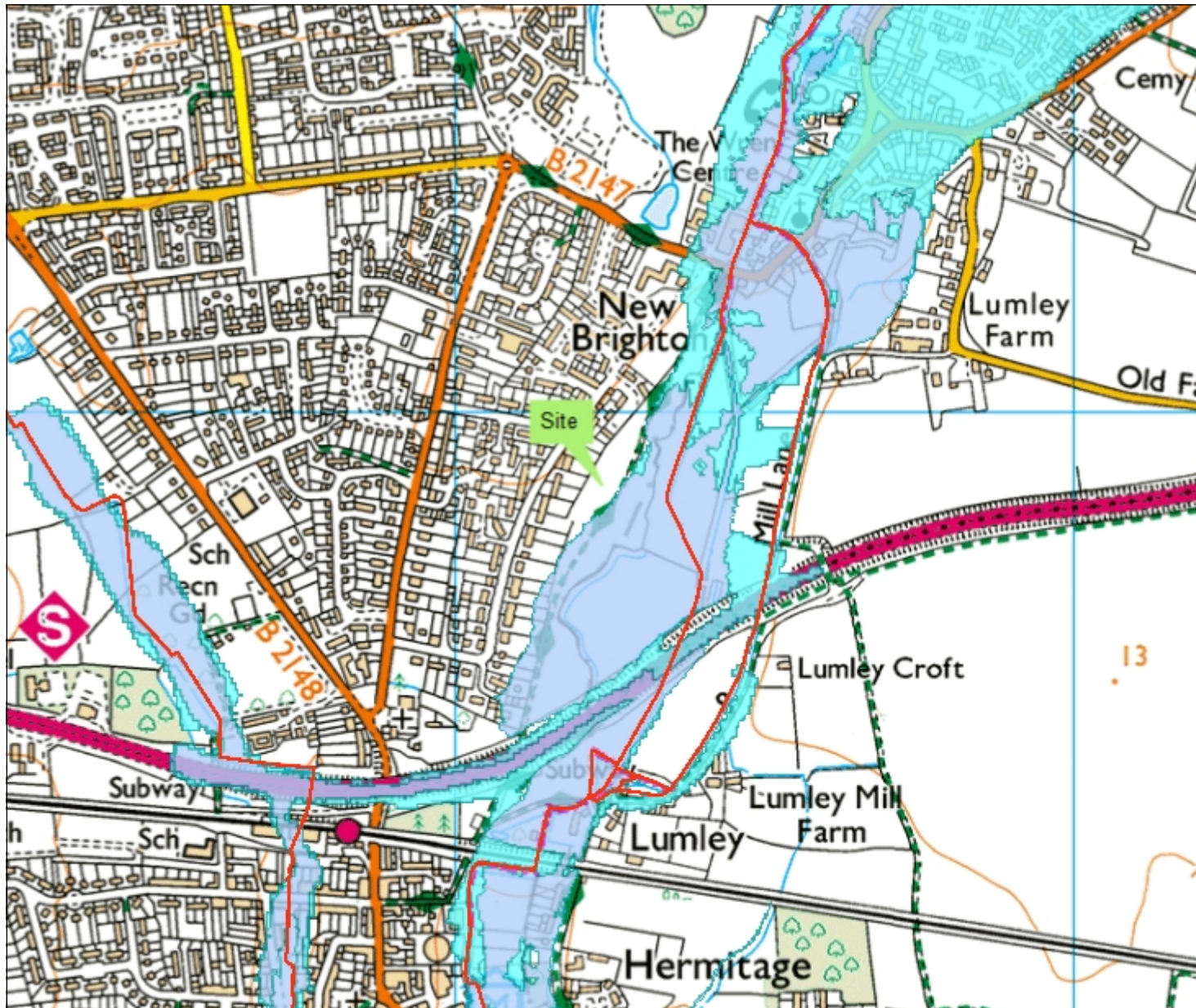
Legend

- Main River
- Boundary line
- Node

Scale: 1:6,000



Risk of Flooding (Rivers and Sea) centred PO10 7QU. Created 17/11/2016.



Scale 1: 10,000



Likelihood of Flooding from Rivers and the Sea

- Sealed Main Rivers
- - - Defences
- - - Flood Storage Areas
- ▨ Areas benefiting from flood defences
- Flood Zone 3
- Flood Zone 2

Likelihood of flooding from Rivers and the Sea (taking into account defences)

- High: Greater than or equal to 1 in 30 (3.3%) chance in any given year
- Medium: Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- Low: Less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
- Very Low: Less than 1 in 1,000 (0.1%) chance in any given year

This information is shown on the Risk of Flooding from Rivers and the Sea map on our website.

Product 4 Flood Risk Data Requested by: Terry Seymour

Site: Hampshire Farm, Emsworth, PO10 7QU

Table 1: Water Levels (mOD): Fluvial Undefended

	NGR		Modelled Flood Levels in Metres			
			Undefended Annual Exceedance Probability			
Node Reference	Eastings	Northings	20%	1%	1% Plus Climate Change	0.1%*
1	475168	106570	-	-	-	6.14
2	475201	106737	-	-	-	6.14
3	475276	106830	-	-	-	6.84
4	475304	106952	7.30	7.68	7.75	7.53
5	475379	107094	7.83	8.20	8.28	8.76
6	475436	107231	8.93	9.51	9.57	9.83

Table 2: Water Depth (m): Fluvial Undefended

	NGR		Modelled Flood Depth in Metres			
			Undefended Annual Exceedance Probability			
Node Reference	Eastings	Northings	20%	1%	1% Plus Climate Change	0.1%**
1	475168	106570	-	-	-	0.50
2	475201	106737	-	-	-	0.34
3	475276	106830	-	-	-	0.18

Table 3: Flow rate (m³/s): In channel flow (closest to node).

	NGR		Modelled Flood Flow Rate			
			Annual Exceedance Probability			
Node Reference	Eastings	Northings	20%	1%	1% Plus Climate Change	0.1%
4	-	-	2.36	6.89	8.23	-
5	-	-	2.36	6.89	8.23	-
6	-	-	2.40	-	8.43	-

All levels and flow rates are taken from River Ems Flood Study, completed in 2006 by Peter Brett Associates.

*The 0.1% levels are estimated by comparing 2009 JFLOW depths with current ground levels taken from LiDAR.

** The 0.1% depths are taken from JFLOW modelling 2009 by JBA.

Product 4 Flood Risk Data Requested by: Terry Seymour

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*The 0.1% levels are estimated by comparing 2009 JFLOW depths with current ground levels taken from LiDAR.

** The 0.1% depths are taken from JFLOW modelling 2009 by JBA.

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

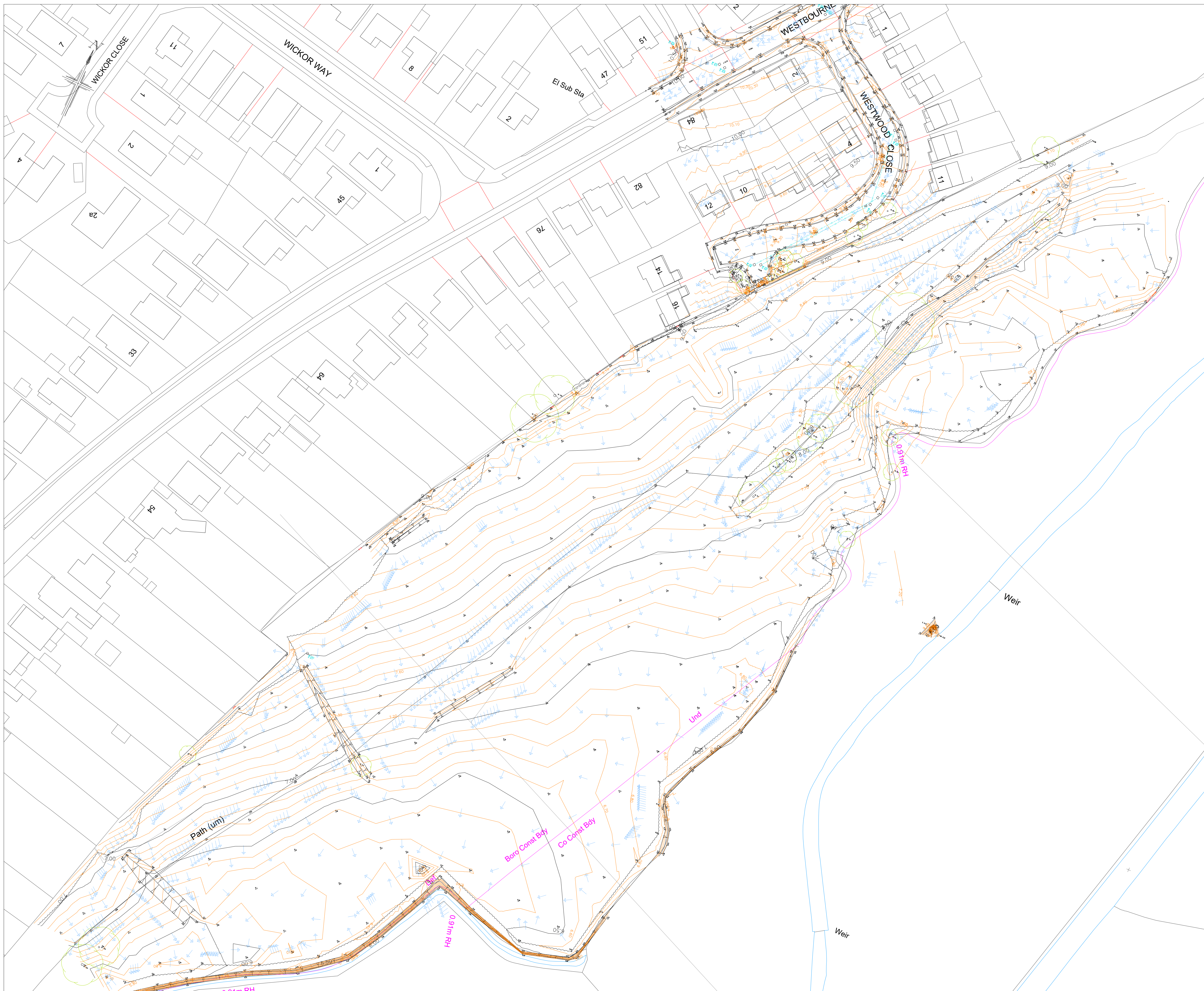
Produced on 05/01/2017

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

Produced on 05/01/2017

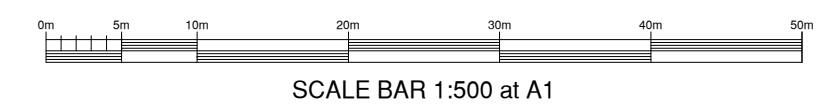
Appendix (F)

Existing Drainage Regime



NOTES

1. Existing Levels based on Topographic Survey carried out by Global Surveys in May 2017 (17026-TOPO).
2. All dimensions are in metres unless stated otherwise.
3. Background based on OS mapping.



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[illegible]

Rev.	Date	Details	By	Chkd	Appd
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Client:-



Site:-
Land at Westwood
Close
Emsworth

Drawing Title:-
**BASELINE
HYDROLOGY
PLAN**

Date: June 2018		Scales: 1:500 at A1	
Drawn: TRS	Checked: TRS	Approved: TRS	

Drawing No.

HAM/E4559/007

PRELIMINARY



Rogers Cory Partnership
Architectural and Civil Consultants
The Old School Old School Road
Huddersfield Huddersfield HD3 7NH

T: 01256 769269 E: mail@rcpconsultants.co.uk W: rcpconsultants.co.uk

Rogers Cory Ptn Ltd		Page 1
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 17:09 File	Designed by Terry Checked by	
Micro Drainage Source Control 2017.1.2		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.450 Area (ha) 0.708 Urban 0.000 SAAR (mm) 808 Region Number Region 7 Results l/s QBAR Rural 3.7 QBAR Urban 3.7 Q100 years 11.7 Q1 year 3.1 Q30 years 8.3 Q100 years 11.7		
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The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 17:14 File	Designed by Terry Checked by	
Micro Drainage Source Control 2017.1.2		

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.600
Ratio R	0.324
Areal Reduction Factor	1.00
Area (ha)	0.708
SAAR (mm)	773
CWI	114.419
Urban	0.000
SPR	37.000

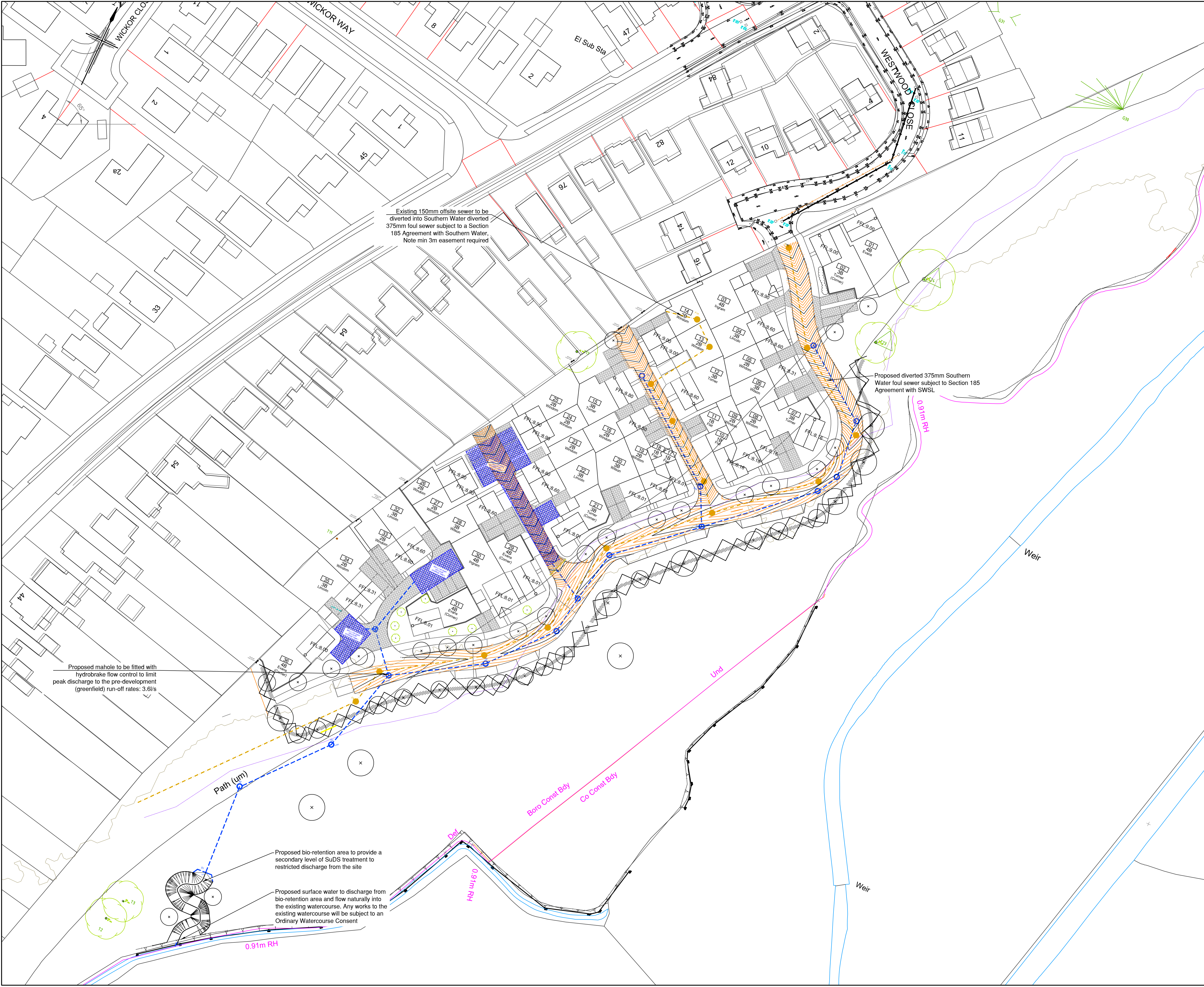
Results

Percentage Runoff (%)	38.84
Greenfield Runoff Volume (m³)	183.413

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Appendix (G)

Proposed Drainage Strategy



- NOTES**
- Background based on OS mapping.
 - Flood zone extents shown are based on EA product 4 flood level data.
 - Existing Levels based on Topographic Survey carried out by Global Surveys in May 2017 (17026-TOPO). Existing contours are at 0.1m level intervals.
 - The Flood Zones 2 extent is approximate only and subject to detailed hydrological information to confirm extents and verification with the Environment Agency
 - Access road to be lined permeable paving with nominal 600mm permeable sub-base to provide attenuation provision

KEY

- Lined Permeable Paving
- Below ground cellular storage
- Proposed Surface Water Drainage
- Proposed Foul Water Drainage & Diversion of existing sewer
- Surface Water Diversion

Rev.	Date	Details	By	Chkd	Appd
E	04.01.19	Invert levels for Surface Water updated		TS	TS
D	10.12.18	site layout updated		TS	TS
C	21.06.18	Sewer diversion proposals updated		TS	TS
B	20.06.18	Outfall arrangement and attenuation storage updated following receipt of groundwater monitoring results		TS	TS
A	20.03.18	Drainage Strategy updated to suit sewer survey		TS	TS

Client:

Site: Land at Westwood Close Emsworth

Drawing Title: Outline Surface Water Drainage Assessment

Date: February 2018 Scales: 1:500 at A1

Drawn: TS Checked: TS Approved: TS

Drawing No. HAM/E4559/002E

FOR INFORMATION ONLY

Rogers Cory Partnership
Architectural and Civil Consultants
The Old School Old School Road
Hook Hampshire RG27 9NJ
T: 01256 769269 E: mail@rcpconsultants.co.uk W: rcpconsultants.co.uk

Appendix (H)

MicroDrainage Calculations

Rogers Cory Ptn Ltd		Page 1
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage Network 2017.1.2		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.324	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	25.000	0.825	30.3	0.112	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	16.800	0.070	240.0	0.081	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	6.720	0.027	248.9	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	35.000	0.140	250.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	27.775	0.111	251.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	15.415	0.062	248.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	11.307	0.045	251.3	0.132	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	22.200	0.089	249.4	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	28.080	0.112	250.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	25.000	0.100	250.0	0.128	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.010	30.000	0.120	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.17	7.000	0.112	0.0	0.0	0.0	2.39	94.8	15.2
S1.001	50.00	5.45	6.110	0.193	0.0	0.0	0.0	1.01	71.4	26.1
S1.002	50.00	5.56	6.040	0.343	0.0	0.0	0.0	0.99	70.1	46.4
S1.003	50.00	6.15	6.010	0.391	0.0	0.0	0.0	0.99	70.0	52.9
S1.004	50.00	6.62	5.868	0.391	0.0	0.0	0.0	0.99	69.8	52.9
S1.005	50.00	6.88	5.698	0.391	0.0	0.0	0.0	0.99	70.2	52.9
S1.006	50.00	7.07	5.636	0.523	0.0	0.0	0.0	0.99	69.8«	70.8
S1.007	50.00	7.45	5.591	0.580	0.0	0.0	0.0	0.99	70.0«	78.5
S1.008	50.00	7.92	5.502	0.580	0.0	0.0	0.0	0.99	69.9«	78.5
S1.009	50.00	8.34	5.390	0.708	0.0	0.0	0.0	0.99	70.0«	95.9
S1.010	50.00	8.85	5.290	0.708	0.0	0.0	0.0	0.99	70.0«	95.9

Rogers Cory Ptn Ltd		Page 3
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage	Network 2017.1.2	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.112	0.112	0.112
1.001	-	-	100	0.081	0.081	0.081
1.002	-	-	100	0.150	0.150	0.150
1.003	-	-	100	0.048	0.048	0.048
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.132	0.132	0.132
1.007	-	-	100	0.057	0.057	0.057
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.128	0.128	0.128
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.708	0.708	0.708

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S1.011	S	6.700	5.039	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	15
Ratio R	0.324		

Rogers Cory Ptn Ltd		Page 4
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage	Network 2017.1.2	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.009, Volume (m³): 3.8

Unit Reference	MD-SHE-0083-3600-1500-3600
Design Head (m)	1.500
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	5.390
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	3.6
Flush-Flo™	0.362	3.2
Kick-Flo®	0.739	2.6
Mean Flow over Head Range	-	3.0

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	2.4	1.200	3.2	3.000	5.0	7.000	7.4
0.200	3.1	1.400	3.5	3.500	5.3	7.500	7.6
0.300	3.2	1.600	3.7	4.000	5.7	8.000	7.9
0.400	3.2	1.800	3.9	4.500	6.0	8.500	8.1
0.500	3.2	2.000	4.1	5.000	6.3	9.000	8.3
0.600	3.0	2.200	4.3	5.500	6.6	9.500	8.5
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.6	6.500	7.1		

Rogers Cory Ptn Ltd		Page 5
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage Network 2017.1.2		

Storage Structures for Storm

Porous Car Park Manhole: S12, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	16.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.110	Cap Volume Depth (m)	1.000

Porous Car Park Manhole: S10, DS/PN: S1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	16.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.010	Cap Volume Depth (m)	1.000

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m)	5.700	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	300.0	0.0	1.000	300.0	0.0
0.500	300.0	0.0	1.001	0.0	0.0

Complex Manhole: S4, DS/PN: S1.009

Tank or Pond

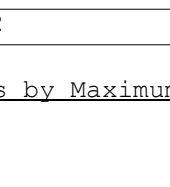
Invert Level (m) 5.450

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	170.0	1.000	170.0	1.001	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	60.0
Max Percolation (l/s)	133.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	6.450	Cap Volume Depth (m)	0.450

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Rogers Cory Ptn Ltd		Page 6
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX		
Designed by Terry Checked by		
Micro Drainage		Network 2017.1.2

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000	Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0	MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0	Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500	Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000	

Number of Input Hydrographs 0	Number of Storage Structures 4
Number of Online Controls 1	Number of Time/Area Diagrams 0
Number of Offline Controls 0	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R 0.324
Region England and Wales Cv (Summer)	0.750	
M5-60 (mm)	19.600 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep 2.5 Second Increment (Extended)	
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S13	15 Winter	1	+0%	100/15 Summer				7.061
S1.001	S12	15 Winter	1	+0%	30/15 Summer				6.254
S1.002	S11	15 Winter	1	+0%	30/15 Summer				6.226
S1.003	S10	15 Winter	1	+0%	30/15 Summer				6.176
S1.004	S9	15 Winter	1	+0%	30/15 Summer				6.034
S1.005	S8	15 Winter	1	+0%	30/15 Summer				5.871
S1.006	S7	360 Winter	1	+0%	30/60 Winter				5.782
S1.007	S6	360 Winter	1	+0%	30/60 Summer				5.780
S1.008	S5	360 Winter	1	+0%	30/30 Summer				5.777
S1.009	S4	360 Winter	1	+0%	1/60 Summer				5.774
S1.010	S3	360 Winter	1	+0%					5.333
S1.011	S2	360 Winter	1	+0%					5.187

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Rogers Cory Ptn Ltd		Page 7
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage		Network 2017.1.2

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Pipe Flow	Status	Level Exceeded
		Depth (m)	Volume (m³)	Cap.	(l/s)	(l/s)		
S1.000	S13	-0.164	0.000	0.16		14.2	OK	
S1.001	S12	-0.156	0.000	0.33		20.4	OK	
S1.002	S11	-0.114	0.000	0.70		35.0	OK	
S1.003	S10	-0.134	0.000	0.58		37.5	OK	
S1.004	S9	-0.134	0.000	0.59		37.0	OK	
S1.005	S8	-0.127	0.000	0.63		37.1	OK	
S1.006	S7	-0.154	0.000	0.17		9.3	OK	
S1.007	S6	-0.111	0.000	0.17		10.6	OK	
S1.008	S5	-0.025	0.000	0.16		10.2	OK	
S1.009	S4	0.084	0.000	0.05		3.2	SURCHARGED	
S1.010	S3	-0.257	0.000	0.05		3.2	OK	
S1.011	S2	-0.256	0.000	0.05		3.2	OK	

Rogers Cory Ptn Ltd		Page 8																																																																																																																																									
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Rogers Cory Ptn Ltd		Page 9
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage		Network 2017.1.2

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
S1.000	S13	-0.126	0.000	0.40		34.8		OK
S1.001	S12	0.161	0.000	0.68		41.4	SURCHARGED	
S1.002	S11	0.178	0.000	1.68		84.3	SURCHARGED	
S1.003	S10	0.114	0.000	1.24		79.8	SURCHARGED	
S1.004	S9	0.049	0.000	1.23		77.8	SURCHARGED	
S1.005	S8	0.134	0.000	0.23		13.4	SURCHARGED	
S1.006	S7	0.195	0.000	0.13		7.4	SURCHARGED	
S1.007	S6	0.238	0.000	0.14		8.6	SURCHARGED	
S1.008	S5	0.325	0.000	0.13		8.2	SURCHARGED	
S1.009	S4	0.434	0.000	0.05		3.2	SURCHARGED	
S1.010	S3	-0.257	0.000	0.05		3.2		OK
S1.011	S2	-0.256	0.000	0.05		3.2		OK

Rogers Cory Ptn Ltd		Page 10
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX		
Designed by Terry Checked by		
Micro Drainage		Network 2017.1.2

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.324
Region England and Wales	Cv (Summer)		0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S13	15 Winter	100	+40%	100/15 Summer				7.395
S1.001	S12	15 Winter	100	+40%	30/15 Summer				7.201
S1.002	S11	15 Winter	100	+40%	30/15 Summer				7.102
S1.003	S10	15 Winter	100	+40%	30/15 Summer				6.904
S1.004	S9	960 Winter	100	+40%	30/15 Summer				6.723
S1.005	S8	960 Winter	100	+40%	30/15 Summer				6.720
S1.006	S7	960 Winter	100	+40%	30/60 Winter				6.718
S1.007	S6	960 Winter	100	+40%	30/60 Summer				6.716
S1.008	S5	960 Winter	100	+40%	30/30 Summer				6.713
S1.009	S4	960 Winter	100	+40%	1/60 Summer				6.710
S1.010	S3	960 Winter	100	+40%					5.334
S1.011	S2	960 Winter	100	+40%					5.188

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Rogers Cory Ptn Ltd		Page 11
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by	
Micro Drainage		Network 2017.1.2

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)					
S1.000	S13	0.170	0.000	0.66		57.6	SURCHARGED	
S1.001	S12	0.791	0.000	1.13		68.7	FLOOD RISK	
S1.002	S11	0.762	0.000	2.42		121.8	FLOOD RISK	
S1.003	S10	0.594	0.000	1.73		111.3	SURCHARGED	
S1.004	S9	0.555	0.000	0.27		16.7	SURCHARGED	
S1.005	S8	0.722	0.000	0.28		16.5	SURCHARGED	
S1.006	S7	0.782	0.000	0.11		6.4	SURCHARGED	
S1.007	S6	0.825	0.000	0.13		7.9	SURCHARGED	
S1.008	S5	0.911	0.000	0.12		7.7	SURCHARGED	
S1.009	S4	1.020	0.000	0.05		3.4	SURCHARGED	
S1.010	S3	-0.256	0.000	0.05		3.4	OK	
S1.011	S2	-0.255	0.000	0.05		3.4	OK	

Rogers Cory Ptn Ltd		Page 12																														
The Old School Old School Road Hook RG27 9NJ																																
Date 04/01/2019 18:50 File proposed-rev2.MDX	Designed by Terry Checked by																															
Micro Drainage Network 2017.1.2																																
<u>User Report S:\Clients\HAMPSHIRE HOMES\4559 - HAMPSHIRE FARM, EMSWORTH\02 - ENGINEERS\01 - RCP DESIGN\03 - WINDES\SPREADHSHEET.SPDX for Storm</u>																																
<table border="1"> <thead> <tr> <th>PN</th> <th>Discharge Volume (m³)</th> </tr> </thead> <tbody> <tr><td>S1.000</td><td>87.851</td></tr> <tr><td>S1.001</td><td>144.033</td></tr> <tr><td>S1.002</td><td>258.947</td></tr> <tr><td>S1.003</td><td>287.221</td></tr> </tbody> </table>	PN	Discharge Volume (m³)	S1.000	87.851	S1.001	144.033	S1.002	258.947	S1.003	287.221	<table border="1"> <thead> <tr> <th>PN</th> <th>Discharge Volume (m³)</th> </tr> </thead> <tbody> <tr><td>S1.004</td><td>284.166</td></tr> <tr><td>S1.005</td><td>281.434</td></tr> <tr><td>S1.006</td><td>166.900</td></tr> <tr><td>S1.007</td><td>209.121</td></tr> </tbody> </table>	PN	Discharge Volume (m³)	S1.004	284.166	S1.005	281.434	S1.006	166.900	S1.007	209.121	<table border="1"> <thead> <tr> <th>PN</th> <th>Discharge Volume (m³)</th> </tr> </thead> <tbody> <tr><td>S1.008</td><td>206.510</td></tr> <tr><td>S1.009</td><td>129.946</td></tr> <tr><td>S1.010</td><td>129.732</td></tr> <tr><td>S1.011</td><td>129.566</td></tr> </tbody> </table>	PN	Discharge Volume (m³)	S1.008	206.510	S1.009	129.946	S1.010	129.732	S1.011	129.566
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Rogers Cory Ptn Ltd		Page 1
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...	Designed by Terry Checked by	
Micro Drainage Network 2017.1.2		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.600	Add Flow / Climate Change (%)	0
Ratio R	0.324	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	25.000	0.825	30.3	0.112	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	16.800	0.070	240.0	0.081	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	6.720	0.027	248.9	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	35.000	0.140	250.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	27.775	0.111	251.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	15.415	0.062	248.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	11.307	0.045	251.3	0.132	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	22.200	0.089	249.4	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	28.080	0.112	250.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.009	25.000	0.100	250.0	0.128	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.010	30.000	0.120	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.17	7.000	0.112	0.0	0.0	0.0	2.39	94.8	15.2
S1.001	50.00	5.45	6.110	0.193	0.0	0.0	0.0	1.01	71.4	26.1
S1.002	50.00	5.56	6.040	0.343	0.0	0.0	0.0	0.99	70.1	46.4
S1.003	50.00	6.15	6.010	0.391	0.0	0.0	0.0	0.99	70.0	52.9
S1.004	50.00	6.62	5.868	0.391	0.0	0.0	0.0	0.99	69.8	52.9
S1.005	50.00	6.88	5.698	0.391	0.0	0.0	0.0	0.99	70.2	52.9
S1.006	50.00	7.07	5.636	0.523	0.0	0.0	0.0	0.99	69.8«	70.8
S1.007	50.00	7.45	5.591	0.580	0.0	0.0	0.0	0.99	70.0«	78.5
S1.008	50.00	7.92	5.502	0.580	0.0	0.0	0.0	0.99	69.9«	78.5
S1.009	50.00	8.34	5.390	0.708	0.0	0.0	0.0	0.99	70.0«	95.9
S1.010	50.00	8.85	5.290	0.708	0.0	0.0	0.0	0.99	70.0«	95.9

Rogers Cory Ptn Ltd		Page 3
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...	Designed by Terry Checked by	
Micro Drainage	Network 2017.1.2	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.112	0.112	0.112
1.001	-	-	100	0.081	0.081	0.081
1.002	-	-	100	0.150	0.150	0.150
1.003	-	-	100	0.048	0.048	0.048
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.132	0.132	0.132
1.007	-	-	100	0.057	0.057	0.057
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.128	0.128	0.128
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.708	0.708	0.708

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S1.011	S	6.700	5.039	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	15
Ratio R	0.324		

Rogers Cory Ptn Ltd		Page 4
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...		
Designed by Terry Checked by		
Micro Drainage		Network 2017.1.2

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.324
Region England and Wales	Cv (Summer)		0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S13	15 Winter	1	+0%	30/15 Summer			
S1.001	S12	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.002	S11	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.003	S10	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.004	S9	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.005	S8	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.006	S7	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.007	S6	15 Winter	1	+0%	30/15 Summer			
S1.008	S5	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
S1.009	S4	15 Winter	1	+0%	30/15 Summer			
S1.010	S3	15 Winter	1	+0%	30/15 Summer			
S1.011	S2	15 Winter	1	+0%	30/15 Summer			

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Rogers Cory Ptn Ltd		Page 5
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...	Designed by Terry Checked by	
Micro Drainage Network 2017.1.2		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)			Flow (l/s)		
S1.000	S13	7.061	-0.164	0.000	0.16		14.2	OK	
S1.001	S12	6.266	-0.144	0.000	0.37		22.6	OK	4
S1.002	S11	6.238	-0.102	0.000	0.77		38.5	OK	9
S1.003	S10	6.191	-0.119	0.000	0.67		42.9	OK	7
S1.004	S9	6.049	-0.119	0.000	0.67		42.2	OK	6
S1.005	S8	5.905	-0.093	0.000	0.70		41.4	OK	7
S1.006	S7	5.866	-0.070	0.000	0.93		52.0	OK	5
S1.007	S6	5.818	-0.073	0.000	0.92		56.6	OK	
S1.008	S5	5.726	-0.076	0.000	0.88		55.4	OK	4
S1.009	S4	5.643	-0.047	0.000	1.00		62.5	OK	
S1.010	S3	5.527	-0.063	0.000	0.98		62.2	OK	
S1.011	S2	5.381	-0.062	0.000	0.99		62.0	OK	

Rogers Cory Ptn Ltd		Page 6
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...		
Designed by Terry Checked by		
Micro Drainage		Network 2017.1.2

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.324
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S13	15 Winter	30	+0%	30/15 Summer			
S1.001	S12	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.002	S11	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.003	S10	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.004	S9	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.005	S8	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.006	S7	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.007	S6	15 Winter	30	+0%	30/15 Summer			
S1.008	S5	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
S1.009	S4	15 Winter	30	+0%	30/15 Summer			
S1.010	S3	15 Winter	30	+0%	30/15 Summer			
S1.011	S2	15 Winter	30	+0%	30/15 Summer			

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Rogers Cory Ptn Ltd		Page 7
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...	Designed by Terry Checked by	
Micro Drainage Network 2017.1.2		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
S1.000	S13	7.451	0.226	0.000	0.39	34.3	SURCHARGED	
S1.001	S12	7.400	0.990	0.000	0.73	44.7	FLOOD RISK	4
S1.002	S11	7.319	0.979	0.000	1.58	79.2	FLOOD RISK	9
S1.003	S10	7.278	0.968	0.000	1.23	79.1	FLOOD RISK	7
S1.004	S9	7.133	0.965	0.000	1.12	70.5	FLOOD RISK	6
S1.005	S8	7.011	1.013	0.000	1.14	67.5	FLOOD RISK	7
S1.006	S7	6.934	0.998	0.000	1.58	88.4	FLOOD RISK	5
S1.007	S6	6.808	0.917	0.000	1.56	96.2	SURCHARGED	
S1.008	S5	6.601	0.799	0.000	1.50	94.9	SURCHARGED	4
S1.009	S4	6.349	0.659	0.000	1.80	112.6	SURCHARGED	
S1.010	S3	6.025	0.435	0.000	1.76	111.6	SURCHARGED	
S1.011	S2	5.653	0.210	0.000	1.77	110.9	SURCHARGED	

Rogers Cory Ptn Ltd		Page 8
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...		
Designed by Terry Checked by		
Micro Drainage		Network 2017.1.2

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.324
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S13	15 Winter	100	+40%	30/15 Summer			
S1.001	S12	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.002	S11	30 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.003	S10	30 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.004	S9	30 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.005	S8	30 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.006	S7	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.007	S6	15 Winter	100	+40%	30/15 Summer			
S1.008	S5	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
S1.009	S4	15 Winter	100	+40%	30/15 Summer			
S1.010	S3	30 Summer	100	+40%	30/15 Summer			
S1.011	S2	15 Winter	100	+40%	30/15 Summer			

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Rogers Cory Ptn Ltd		Page 9
The Old School Old School Road Hook RG27 9NJ		
Date 04/01/2019 19:21 File proposed-rev2-without m...	Designed by Terry Checked by	
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Flow (l/s)		
S1.000	S13	7.945	0.720	0.000	0.72	62.5	FLOOD RISK	
S1.001	S12	7.502	1.092	2.249	1.43	87.1	FLOOD	4
S1.002	S11	7.384	1.044	43.501	1.49	74.7	FLOOD	9
S1.003	S10	7.355	1.045	15.283	1.16	74.9	FLOOD	7
S1.004	S9	7.302	1.134	1.920	1.19	74.9	FLOOD	6
S1.005	S8	7.227	1.229	7.035	1.27	75.0	FLOOD	7
S1.006	S7	7.208	1.272	8.078	1.68	94.1	FLOOD	5
S1.007	S6	7.180	1.289	0.000	1.61	99.3	FLOOD RISK	
S1.008	S5	7.041	1.239	1.465	1.48	93.2	FLOOD	4
S1.009	S4	6.977	1.287	0.000	2.28	142.4	FLOOD RISK	
S1.010	S3	6.432	0.842	0.000	2.19	139.3	FLOOD RISK	
S1.011	S2	5.851	0.408	0.000	2.22	139.1	SURCHARGED	



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PN	Discharge Volume (m³)	PN	Discharge Volume (m³)	PN	Discharge Volume (m³)
S1.000	87.851	S1.004	306.693	S1.008	454.941
S1.001	151.386	S1.005	306.693	S1.009	555.345
S1.002	269.043	S1.006	410.232	S1.010	555.345
S1.003	306.693	S1.007	454.941	S1.011	555.345

Appendix (I)

Exceedance Flow Paths

Flood Risk Assessment