



Land at Havant Road, Emsworth

Flood Risk Assessment

For: Barratt Homes

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Executive Summary

The proposed development is for the construction of 161 residential dwellings on greenfield land to the north of Havant Road and to the west of Selangor Avenue in Emsworth, Hampshire.

The site is shown on the Environment Agency flood risk maps as being within Flood Zone 1 (low risk of flooding from rivers and seas). The site is in excess of 1 hectare in area and therefore a Flood Risk Assessment is required to support the Planning Application in accordance with National Planning Policy Framework and Environment Agency guidance.

Havant Borough Council requires that Sustainable Drainage Systems [SuDS] be considered in all new developments and as a minimum there should be no nett increase in surface water runoff. This report covers both flood risk and sustainable drainage.

All sources of flood risk have been assessed including tidal, fluvial, artificial drainage, overland, infrastructure failure and groundwater. The conclusion of the assessment is that all risks are considered as low, providing that necessary mitigation measures for surface water drainage are undertaken. The pre-existing low risk of surface water flooding is mitigated through incorporation of a Sustainable Drainage System which will store the volume of a 100 year return period storm plus allowance for climatic change; the surface water drainage system will ensure no increase in flood risk to adjacent or downstream sites. Proposals include the raising of road levels and finished floor levels in areas of potential high groundwater which mitigates any pre-existing risk to the site.

The previous flooding problems experienced by the residential area to the east of the site are primarily due to the flow in the Nore Farm Stream exceeding the capacity of the piped section of the watercourse. This is not caused by the development site and has been addressed by the Environment Agency Nore Farm Flood Alleviation Scheme. The proposed development does not represent an increase in flood risk to neighbouring land and the storage provided within permeable pavements, soakaways and swales will reduce runoff.

Foul drainage from the development shall connect to an adoptable onsite foul water pumping station located at the southern boundary of the site which will connect via rising main to the nearby Public Foul Sewer located beneath Havant Road. The sustainable surface water drainage system stores large return period storms and mimics the existing drainage condition of infiltration to ground utilising a series of soakaways and permeable paving areas maintained by a Management Company which will drain surface water from the roofs and car parking areas. Infiltration swales are provided adjacent to impermeable sections of the access road.

Water quality of runoff is achieved through use of geotextile and the naturally high pollutant retention shallow subsoil layers to ensure adequate treatment of surface water before infiltration to ground.

This Flood Risk Assessment concludes that the proposed development is not at significant risk of flooding and will not increase the risk of flooding to others. It is in accordance with all local and national drainage and flood risk policy.

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1. Introduction

1.1 Reason for Report and Planning Context

The development site is located within an area of low flood risk and the site area exceeds one hectare. In accordance with the National Planning Policy Framework [NPPF] and Planning Practice Guidance a Flood Risk Assessment is required to support the Planning Application.

The development proposal is classified as C3 Residential Dwellings in terms of Planning Use Classes.

In lieu of setting out National Standards on SuDS and implementing SuDS Approval Bodies, on 18 December 2014 the Central Government Department for Food and Rural Affairs directed Planning Authorities to 'ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate.' This is to be applied to all major applications (10 dwellings or more or equivalent non-residential development) from 6 April 2015. No additional national planning guidance on sustainable drainage in amplification of the NPPF has yet been adopted at a National level.

The Havant Borough Core Strategy Policy CS15 'Flood and Coastal Erosion Risk' states that priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage.

The proposed development is a major planning application and as such a sustainable drainage system is required. This Flood Risk Assessment assesses flood risk and sets out the sustainable drainage strategy.

1.2 Scope of Report

This report has been written to meet the requirements of a site-specific flood risk assessment in accordance with the National Planning Policy Framework (NPPF) and includes the following:

- An appraisal of the availability and adequacy of existing information on flood risk.
- An appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere.
- An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels.
- The foul and surface water drainage strategy.

The report is a desk based study and considers all forms of flood risk.

1.3 Site Location

The site is located within the town of Emsworth in Hampshire. The postcode of the development is PO10 7LG and centred at National Grid reference SU734062.

The site is located north of Havant Road and is adjacent to the A27 which forms the northwest boundary of the site. Selangor Avenue borders the site to the east and a West Coastway rail line borders the site to the north.

The site is approximately 1.2km to the north of the Emsworth Channel which runs into the English Channel.

A map highlighting the location of the site is shown in Figure 1.

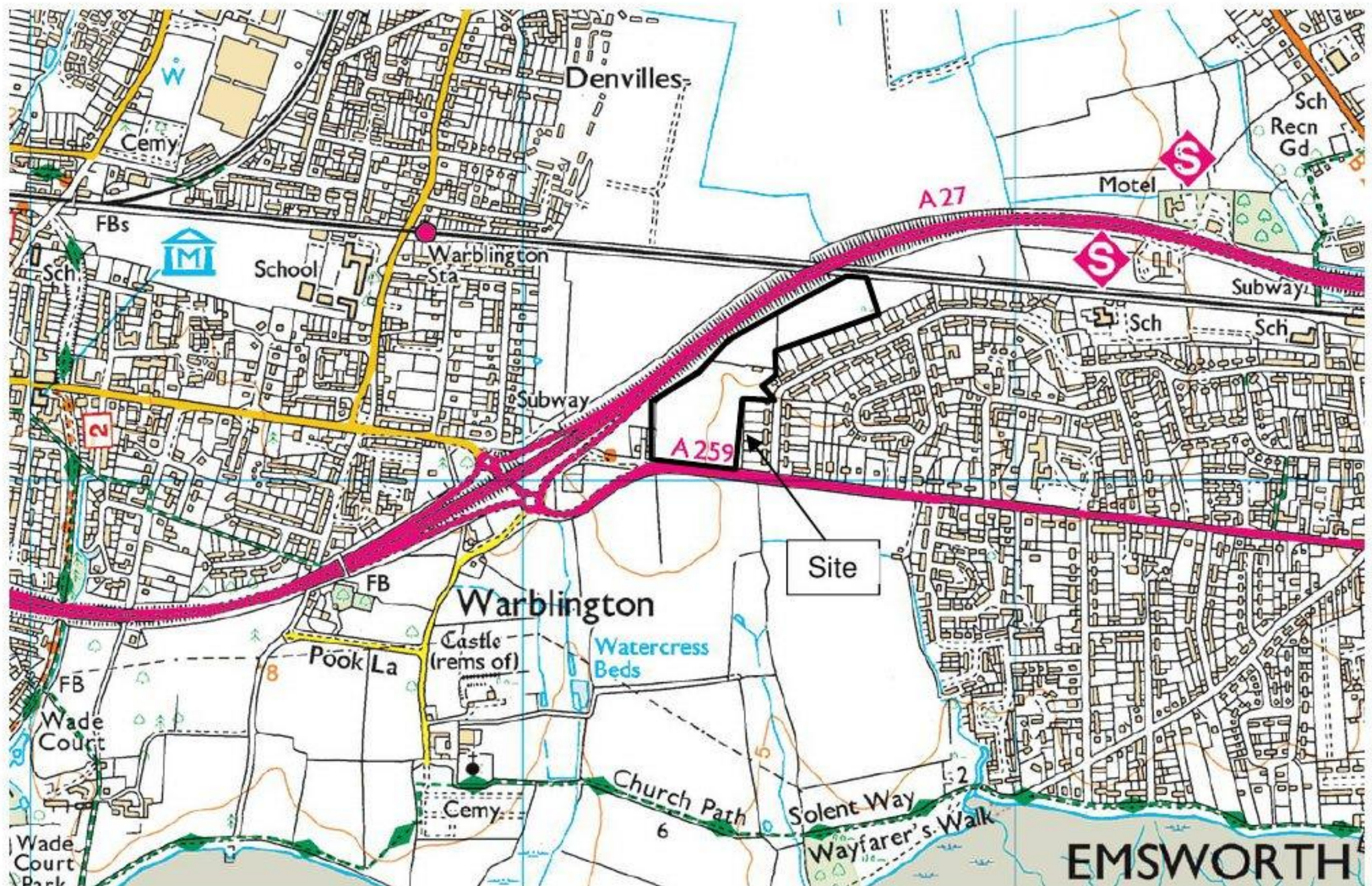


Figure 1 Site Location

1.4 Existing Site and Surrounding Area

The site is irregular in shape and consists of greenfield land approximately 62,300m² (6.23ha) in area. The site is currently undeveloped pasture land and there are no existing structures or paved areas. There are residential properties forming the eastern boundary of the site. There is a line of trees along the northwest boundary of the site shielding the neighbouring properties from the A27. Beyond the highways at the north and south boundaries of the site is open farmland.

Access to the site is through a gated entrance along Selangor Avenue. There is currently no access to the site from Havant Road to the south although a footway crossing indicates a previous point of access.

The northern half of the site is relatively level. The southern half of the site falls towards the east and south with a low point in the south-eastern corner. The northern and south-western parts of the site are located at approximately 11m AOD. The south-eastern part of the site is located at approximately 9.5m AOD. The gradient from west to east in the southern part of the site is approximately 1/120. The gradient from northwest to southeast in the northern part of the site is approximately 1/485. The gradient across the full length of the site from southwest to northeast is approximately 1/765. Gradient variation across the site is shown in Appendix 1.

The Nore Farm Stream watercourse passes to the east of the site as a piped watercourse and through surface water sewers. The catchment to the north of the A27 is conveyed via a series of drainage ditches and open watercourses across farmland and through culverts which runs beneath the A27 and West Coastway Railway Line adjacent to the north-eastern boundary of the proposed development site. The

watercourse then passes beneath Nore Farm Avenue southwards as a piped watercourse before outflowing to an open watercourse close to Barn Close to the southeast of the site.

The proposed development site does not currently discharge surface water into the Nore Farm Stream other than potentially via topsoil seepage from the very northern corner which is adjacent to the existing culvert beneath the railway line. This part of the site is outside the developable area.

The existing site is shown in the aerial photograph in Figure 2 below. Photographs of the site are shown in Appendix 2 of this report.



Figure 2 Existing Site

1.5 Hydrogeology and Existing Drainage

From the British Geological Survey website, the local superficial geology on the site consists primarily of River Terrace Deposits (alluvium of sand, silt and clay) with a small area of clayey gravel in the south-eastern corner of the site. The bedrock geology across the entirety of the site is London Clay formation (clay, silt and sand). Borehole records undertaken on site indicate that alluvium on site consists of a 200mm – 400mm layer of topsoil underlain by sandy clay. The southern half of the site is further underlain by sand; the northern half has layers of gravel interspersed by silt and sand strata.

Groundwater flows through the sand and gravel layers and is typically 1.9m (average recorded) below existing ground level. Groundwater monitoring has been undertaken over several years. The most shallow recorded groundwater level on the site is 0.48m below existing ground level; this was recorded in February 2013 (winter high groundwater level) in the southern area of the site. Groundwater levels vary across the site but in general the southern half of the site has recorded groundwater levels approximately 0.5m – 1m higher than the northern half of the site.

Soakage tests were undertaken across the site in July 2016. A series of shallow and deep percolation tests were taken across the site to gather results for both the shallow sand-clay strata and the deeper gravel-clay strata. The results of these tests indicate that soakage rates for the sand-clay strata range from 1.4e-6m/s to 9.2e-6m/s and rates for the gravel-clay strata range from 1.7e-4m/s to 2.5e-6m/s. An overview of the recorded soakage rates is shown in Appendix 3.

The existing site is undeveloped and has no positive foul or surface water drainage. Rainwater currently drains to ground through the shallow sandy clay layer and discharges through the groundwater in the sand and gravel layers with any remaining surface water run-off discharging overland following local topography.

A drainage ditch runs along the outer edge of the site's north-western boundary at the base of the embankment to the A27 outside the site boundary which captures runoff from the highway and discharges to the east into the Nore Farm Stream. Surface water runoff from Highway land does not flow onto the site.

There is a 225mm diameter public foul water sewer flowing southwards beneath Selangor Avenue which discharges into the 350mm diameter public foul water sewer flowing eastwards beneath Havant Road, approximately 3.5m deep. There is an existing 150mm diameter surface water sewer flowing southwards beneath Selangor Avenue, which lies approximately 1m deep. This sewer discharges into the 450mm diameter public surface water sewer beneath Havant Road which lies approximately 1.5m deep, where it then discharges to an ordinary watercourse which flows southwards and outfalls to the Emsworth Channel.

The existing public sewer layout is shown in Figure 3 below.

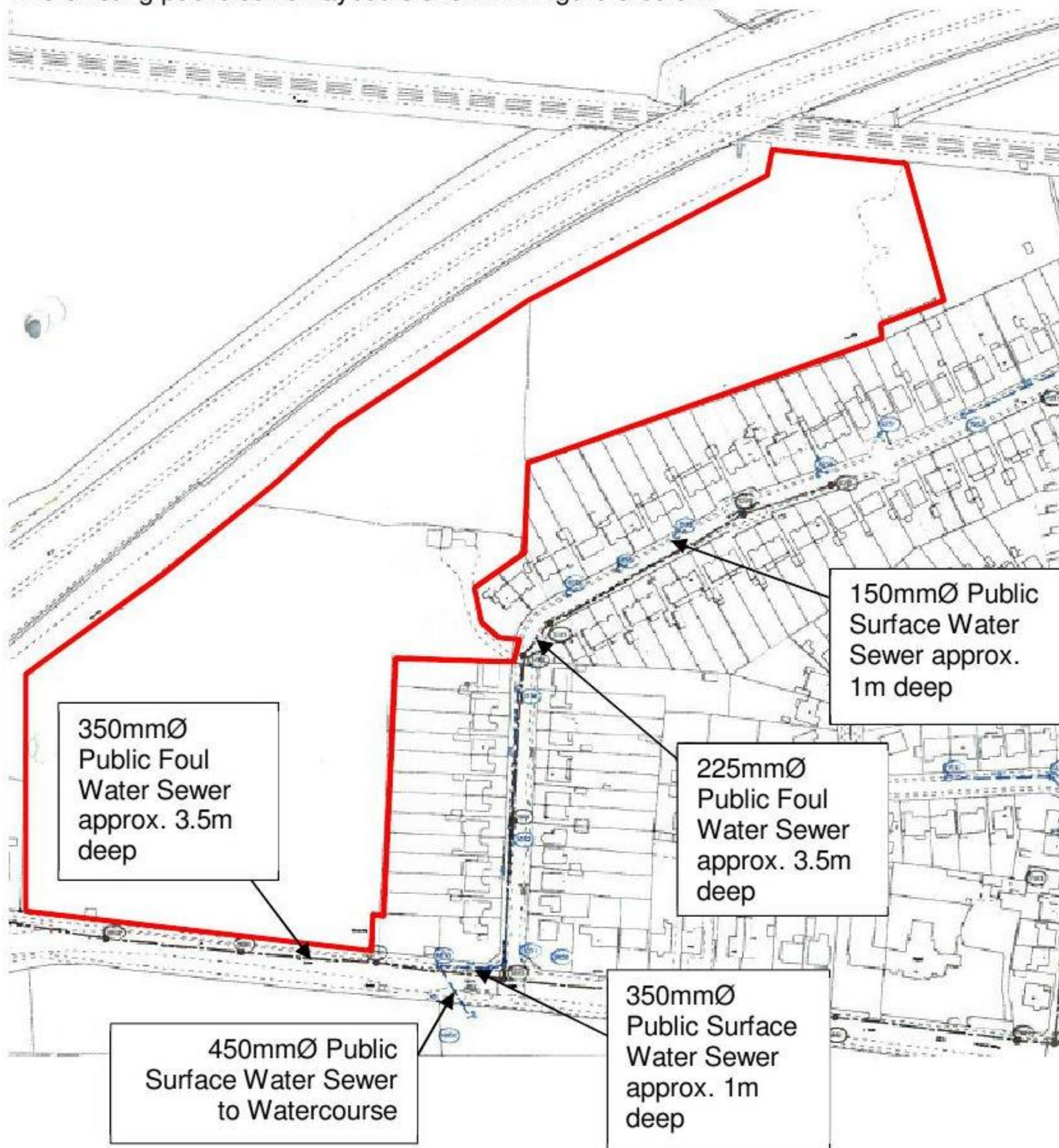


Figure 3 Extract of Public Sewer Records

1.6 Proposed Development

It is proposed to construct 161 residential dwellings on the site with associated parking, streets, driveways, gardens and landscaping.

The site will be accessed from a new highway access from Havant Road, with the existing access to the site via Selangor Avenue providing additional pedestrian access.

The impermeable positively drained areas of the site are the house roof areas, access roads and pavements, shared car parking areas and private driveways. The approximate impermeable areas are as follows:

Roof areas of the houses (including covered garages)	7,880m ²
Paved Surfaces - Parking areas and access roads and footpaths	16,730m ²
Total covered / paved area:	24,610m ²

The Architect's proposed site layout is shown in Figure 4 below.



Figure 4 Architect's Site Layout

1.7 Policy and Information Review

The following documents have been reviewed as part of this flood risk assessment:

- National Planning Policy Framework and Planning Practice Guidelines
- Central Government Written Statement to Parliament on Sustainable Drainage Systems, 18 December 2014
- Update from Environment Agency on Flood Risk Assessments: Climate Change Allowances, 19 February 2016
- Havant Borough Core Strategy, March 2011
- Havant Borough Local Plan (Allocations), July 2014
- Havant Borough Local Plan Housing Statement, December 2016
- Partnership for Urban South Hampshire [PUSH] Strategic Flood Risk Assessment, December 2007
- Emsworth Flood Risk Strategy Review, October 2015
- North Solent Shoreline Management Plan, December 2010
- HCC Surface Water and Sustainable Drainage Guidance for Developers

An overview of these policy documents in relation to the site is shown in Appendix 5.

2. Flood Risk Identification

2.1 Historical Instances

2.1.1 Reported instances of flooding in the press

From a search through various news sites on the internet, the following instances of flooding around the site and within the larger area of Emsworth have been identified in the past 10 years:

March 2008: Flooding in Emsworth. Emsworth Quay flooded at high water, A259 flooded.

November 2010: Flooding event affected 21 properties in Bridge Road and Selangor Avenue. The properties on Bridge Road were affected by water overflowing from the West Brook and the properties on Selangor Avenue were affected by overflow from the Nore Farm Stream.

June 2012: Properties in Selangor Avenue flooded.

December 2012: Properties in Selangor Avenue flooded.

December 2013: Flooding in Emsworth. Properties in Selangor Avenue flooded / close to flooding. Flooding along Havant Road.

January 2014: Flooding in Emsworth. Queen St flooded.

The Nore Farm Stream has had a large influence on instances of flooding in the surrounding area around the site, as the piped watercourse system has placed a restriction on the flow from the open watercourse upstream to the north of the A27 and Railway Line.

2.1.2 Instances of flooding identified by authorities

Several Hampshire local councils have produced a PUSH [Partnership for Urban South Hampshire] SFRA. The SFRA does not identify the site as in or bordering a flood zone. It does identify instances of surface water sewer flooding in Nore Crescent and hence if the surface water drainage system were to connect to this drainage system its capacity would have to be checked with Southern Water.

Previous Emsworth Flood Risk Strategy Reviews from Havant Borough Council identifies Selangor Avenue (adjacent to the site) as having previous reported flooding incidents, from a combination of fluvial and tidal influences. The latest Review identifies that the Environment Agency is leading the Nore Farm Stream Flood Alleviation Scheme (also referred to as the Emsworth Flood Alleviation Scheme), positioned to the north of the site and intended to help reduce flooding from the river. The Environment Agency were consulted in February 2016 and advised that this alleviation scheme has been completed.

Figure 5 below presents an excerpt from the Emsworth Flood Risk Strategy Review highlighting the locations of proposed alleviation schemes in the surrounding area.

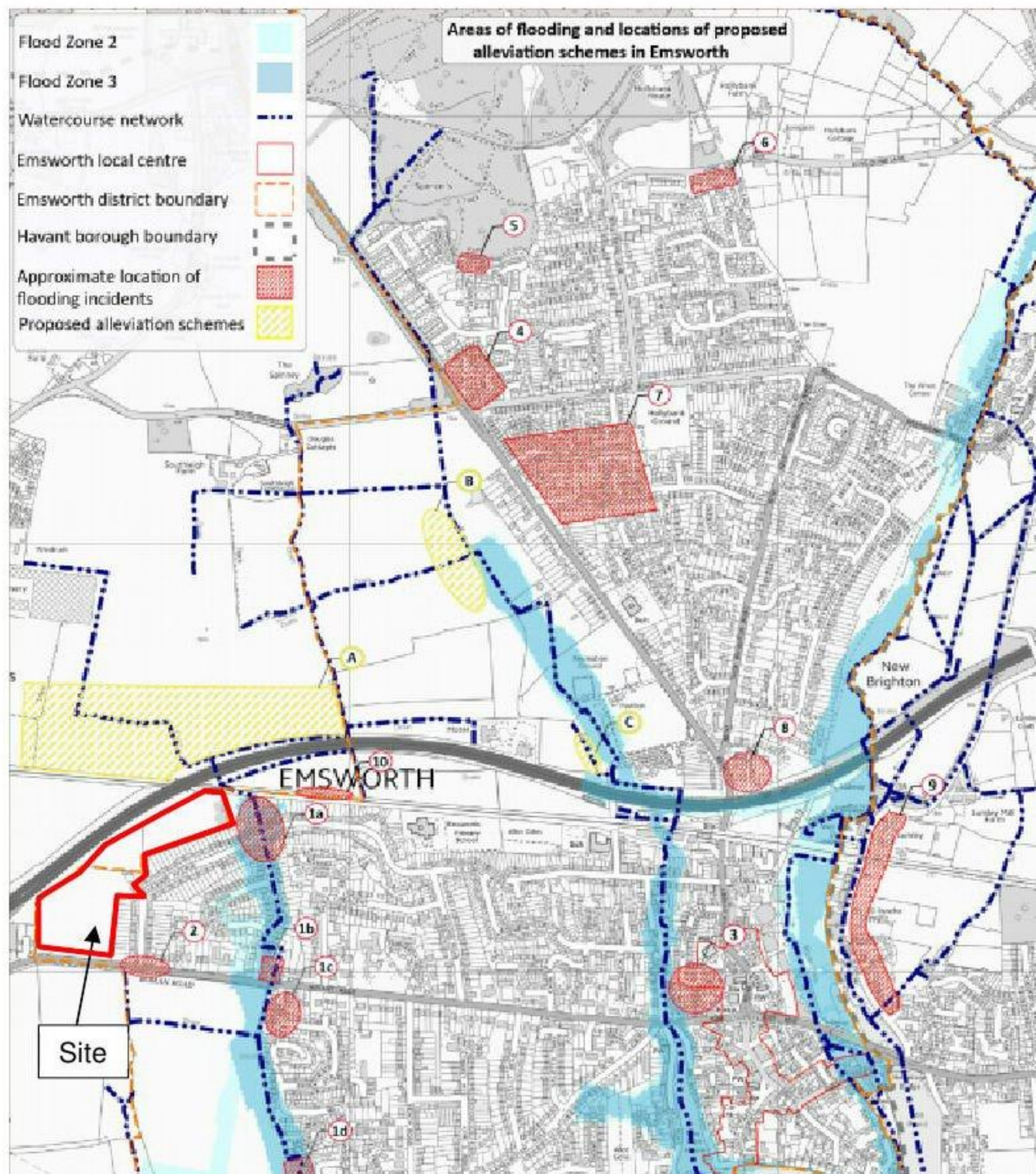


Figure 5 Location of proposed alleviation schemes

2.2 Flood Defences and Alleviation Works

The completion of the Nore Farm Stream Flood Alleviation Scheme in February 2016 has increased the standard of protection against flooding for the dwellings along Selangor Avenue, reducing the risk of flooding from 20% annual probability (1 in 5 year) to 1.4% annual probability (1 in 70 year) plus climate change.

The scheme has created a Flood Water Storage Area within nearby arable land to the north of the A27. The size of the culvert that runs beneath the A27 has been reduced to prevent large volumes of fast-flowing water passing through.

The Nore Farm flood alleviation scheme will significantly reduce the flood risk to the affected area to the east of the site.

2.3 Tidal and Fluvial

The northernmost and southwestern parts of the site are located approximately 11m AOD. The south-eastern part of the site is allocated at approximately 9.5m AOD. There is a slight dip in the centre of the site to approximately 10m AOD.

The Environment Agency were contacted in February 2016 to provide flood risk information for the site and this information (covering flooding risks from tidal and fluvial sources and surface water) is included in Appendix 4. Where relevant excerpts of maps provided by the EA are included in the subsequent sections of this report.

The site is not within a flood warning zone.

In accordance with the Environment Agency's detailed flood map for planning the site lies within Flood Zone 1 and therefore has a low probability of flooding from tidal or fluvial sources. The north-eastern part of the site borders an area lying in Flood Zone 3 (indicating a 0.1% annual probability of flooding) and a main river line. As mentioned in Section 2.2 above the flood alleviation scheme to the north of the proposed site will reduce flood risk to this area. The EA have advised that the Nore Farm Stream alleviation project has been completed and that the standard of protection for properties south of the A27 is 1 in 70 years plus climate change; the Flood Maps have not yet been updated following the completion of this scheme.

The extent of tidal and fluvial flooding risk is shown in Figure 6 below.



Figure 6 Environment Agency - Flood Map (Rivers and Sea) (contains Environment Agency information © Environment Agency and database right)

The site is outside of the flood risk zones and the risk from rivers and seas is low.

Assessment of Impact: LOW

Assessment of Probability: LOW

2.4 Surface Water Flooding and Overland Flow

The Environment Agency have mapped the areas that could flood from surface water and overland flow. The map is based on hydraulic modelling following topography and natural flow path ignoring manmade obstructions. The extent of the flood risk around the site is shown in Figure 7 below.

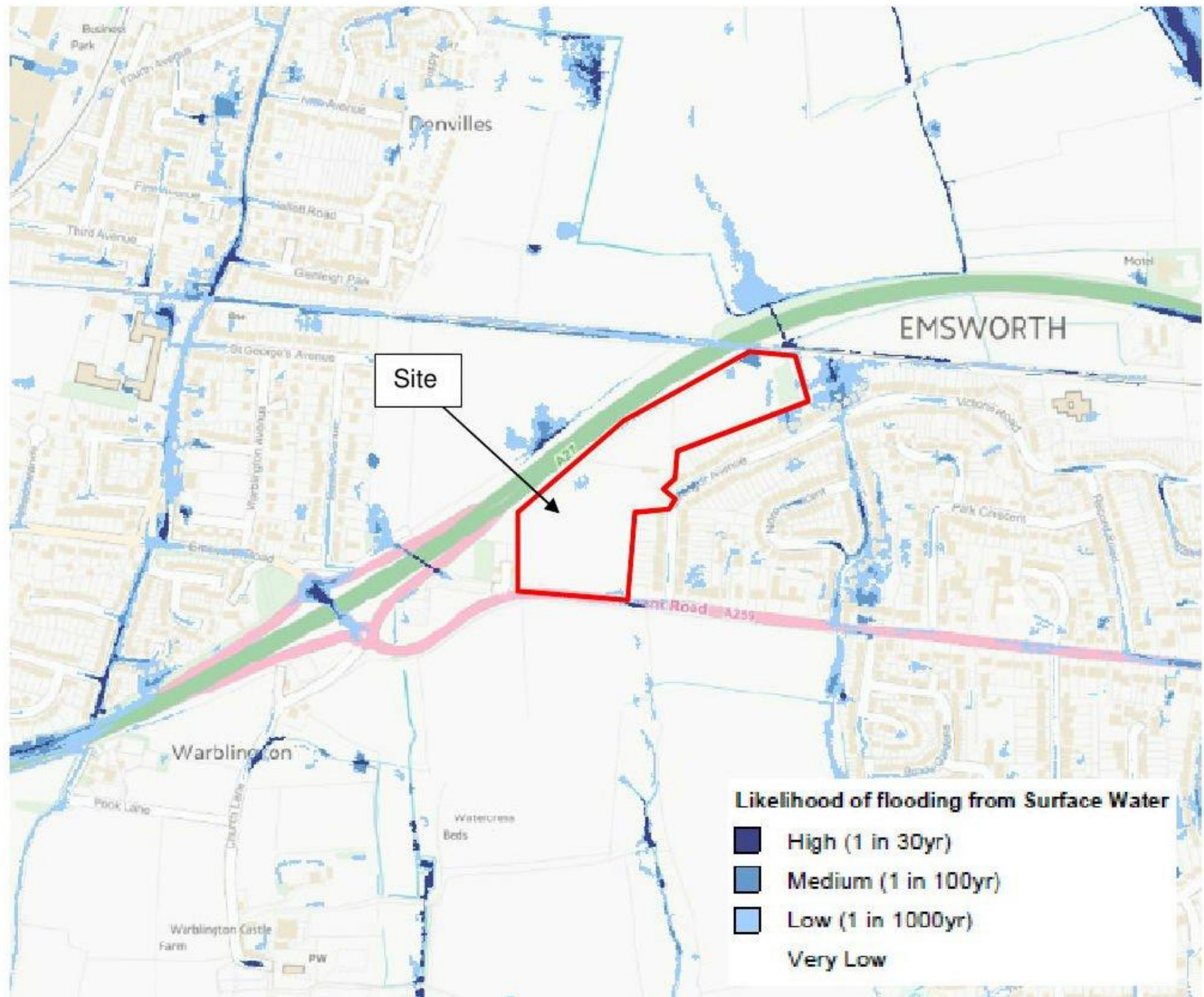


Figure 7 Environment Agency Surface Water Extent map (contains Environment Agency information © Environment Agency and database right)

These maps do not take flood defences and alleviation schemes into account, so the Nore Farm Flood Alleviation Scheme is not taken into account in this flood mapping. Areas of flood risk to the northeast of the site in the area of the Nore Farm Stream are alleviated by the completed flood alleviation scheme.

Detailed surface water maps received from the Environment Agency indicate that very little of the site is highlighted as at risk of flooding from surface water. The north-eastern boundary lies adjacent to a watercourse (i.e. the Nore Farm Stream) – most risk areas correspond to a low flood risk of below 0.1% annual chance (1 in 1000 year return period) of surface water flooding.

There is a small area of medium flood risk of 1% (1 in 100 year return period) chance of flooding. Within the context of the proposed development the risk areas located in the north-east of the site will be situated in land which is to remain undeveloped open space and hence will not affect the proposed properties. Areas of risk away from the north-eastern boundary will be addressed within the proposed site surface water strategy.

Based on the modelling prediction the Environment Agency have estimated the potential depth and rate of flow for the areas at risk from surface water and overland flow.

The depth and velocity are shown in Figures 8 and 9 below.

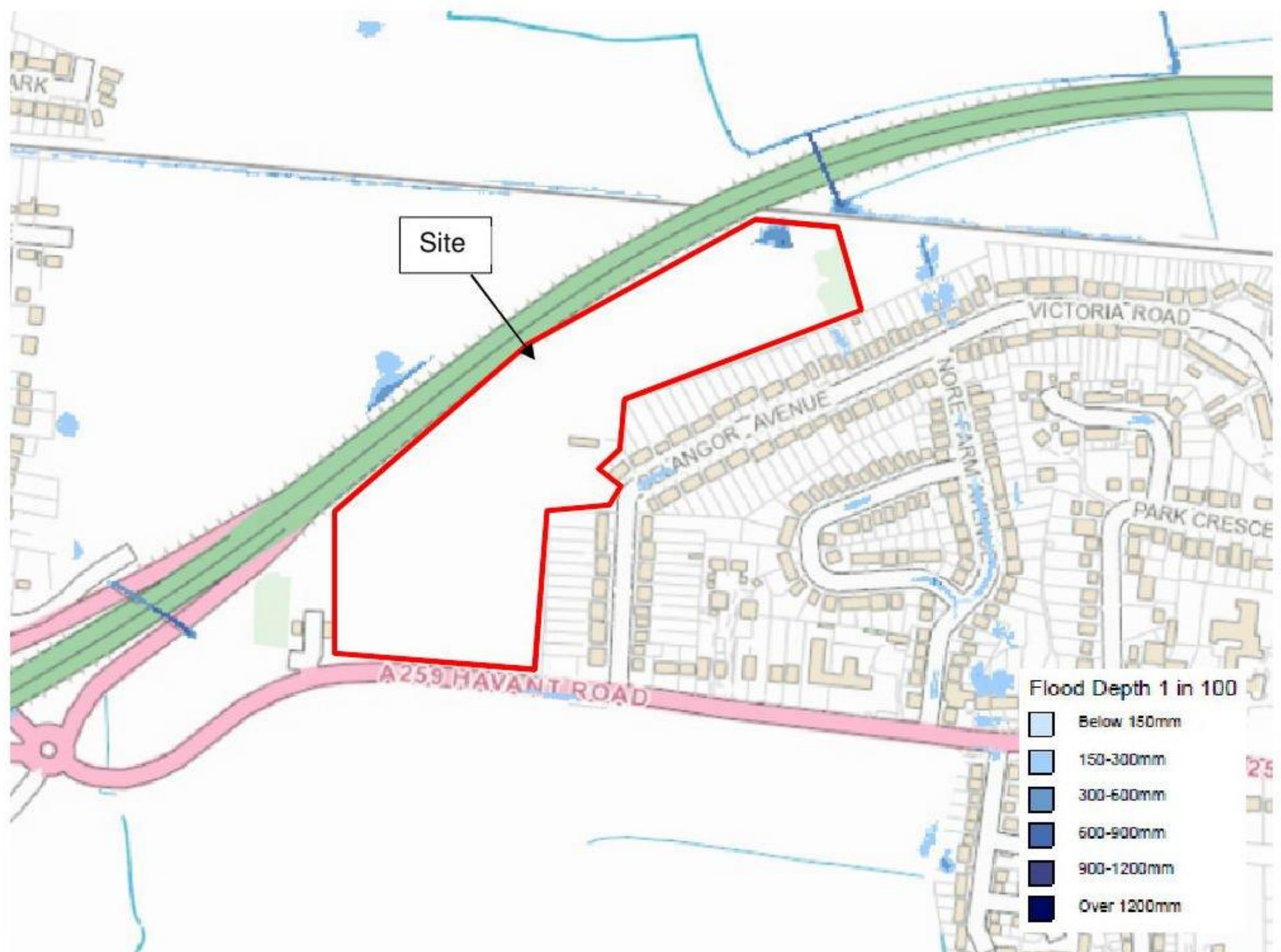


Figure 8 Environment Agency Surface Water Depth map for 1 in 100 year flood event (contains Environment Agency information © Environment Agency and database right)

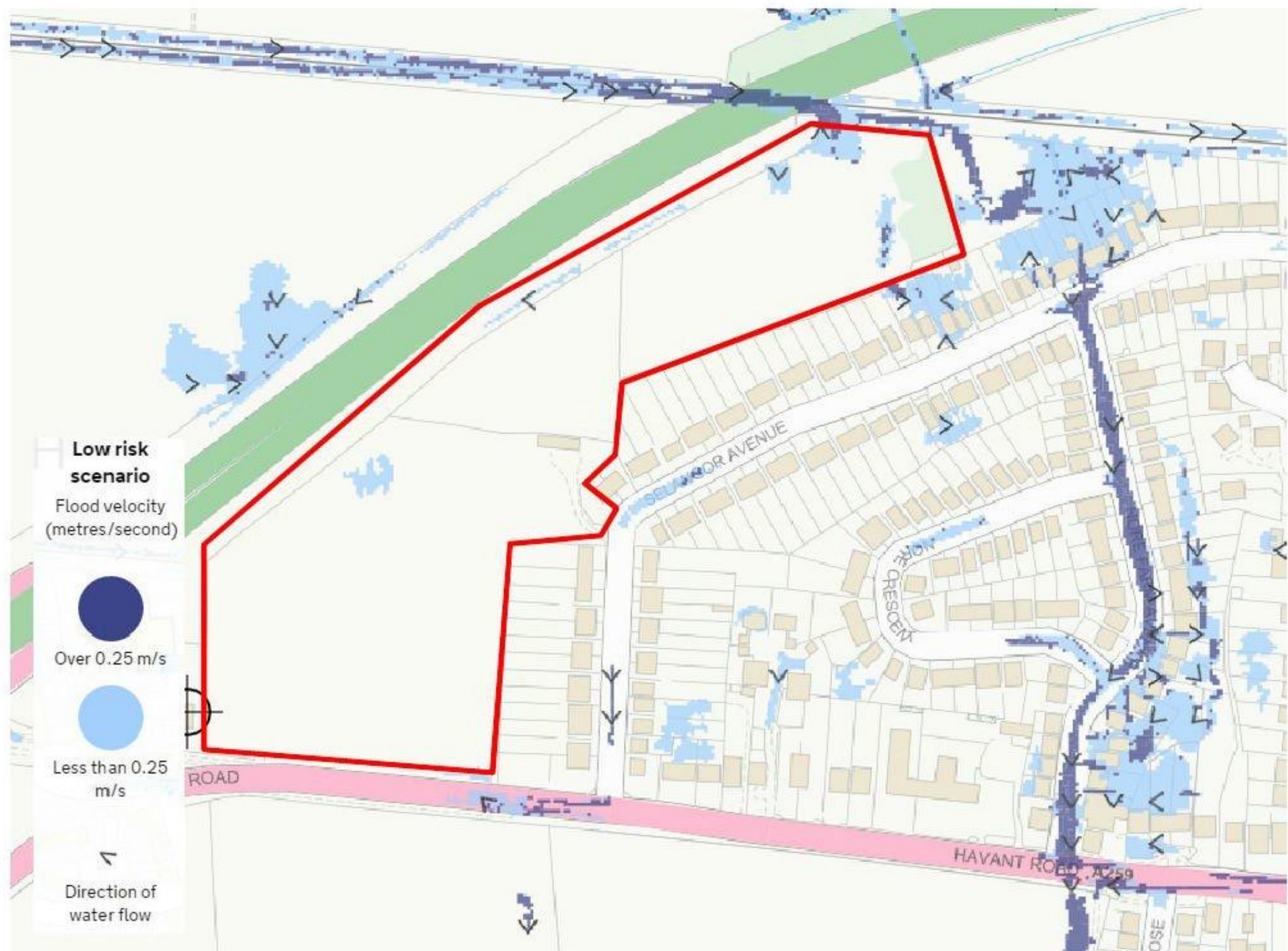


Figure 9 Environment Agency Surface Water Velocity Estimate

Without the effects of any flood alleviation works the potential depth of surface water for the low risk classification (1 in 100 year flood event) is less than 600mm and the velocity is less than 0.25m/s (i.e. ponding, not flowing). If flooding should occur by this mechanism it could result in damage to property if the flow entered homes but would not represent a danger to safety. Once the site is developed the drainage system and setting of floor levels above street or garden level would remove the risk of surface water flooding. The small area to the north of the site which is subject to ponding is to be left as greenfield land on the proposed site plan and will not affect any of the proposed developments.

Taking into consideration the proposed development of the site and the existing flood alleviation scheme against the flood risk plans the risk of flooding from surface water or overland flows is low.

Assessment of Impact: LOW

Assessment of Probability: LOW

2.5 Infrastructure Failure

The Environment Agency have mapped the areas that could flood in the event of a failure of large reservoirs (greater than 25,000m³ in volume). There are no smaller reservoirs or other above ground bodies of water which could affect the site.

The risk of flooding from infrastructure failure is low.

Assessment of Impact: LOW

Assessment of Probability: LOW

2.6 Groundwater

The Hampshire Groundwater Management Plan does not attribute flooding in the Havant area as attributable to groundwater.

The PUSH SFRA identifies the site as in an area of low bedrock permeability and does not highlight any historic instances of groundwater flooding.

Groundwater flooding does not occur historically at this site. Extensive ground water monitoring has been undertaken onsite which shows a worst case of approximately 0.5m below ground level in the lower southern part of the site.

There is a risk that prolonged winter storms could potentially raise groundwater levels close to the existing ground level; there is no groundwater modelling available which would aid to predict the potential movements of groundwater in large storm events. In the event of such a storm occurring the watercourse located to the south of the site would release groundwater pressure and provide an outlet for groundwater flow. Should groundwater levels rise significantly to cause flooding the flow would be directed in the first instance to this watercourse, rather than occur via spring action through the clay strata on site; it is likely that should the site be affected by groundwater flooding the flood depths on the site would be shallow.

The PUSH SFRA shows the site lying within an area of low bedrock permeability. Any rise in groundwater could lead to greater overland flows should the water level reach the surface, which could in turn lead to flooding of nearby drainage systems where the surface water flow is directed. This situation is particularly applicable to the Nore Farm Stream culvert, which carries a large overland flow from the field to the north of the site.

The alleviation works on the Nore Farm Stream together with a proposed levels strategy which raises floor levels in the lower south-eastern part of the site and where ground water monitoring has shown potential for shallow ground water will address the potential for ground water flood risk.

In consideration of the above there is a low risk of impact to the proposed development from groundwater flooding however there is a medium risk of probability that groundwater flooding may occur within the site. Subsequently the overall risk of groundwater flooding to the is medium following the precautionary principle.

Assessment of Impact: LOW

Assessment of Probability: MEDIUM

2.7 Drainage

2.7.1 Existing Drainage

The PUSH SFRA has identified instances of previous surface water sewer flooding caused by incapacity of drainage infrastructure, shown in Figure 10.

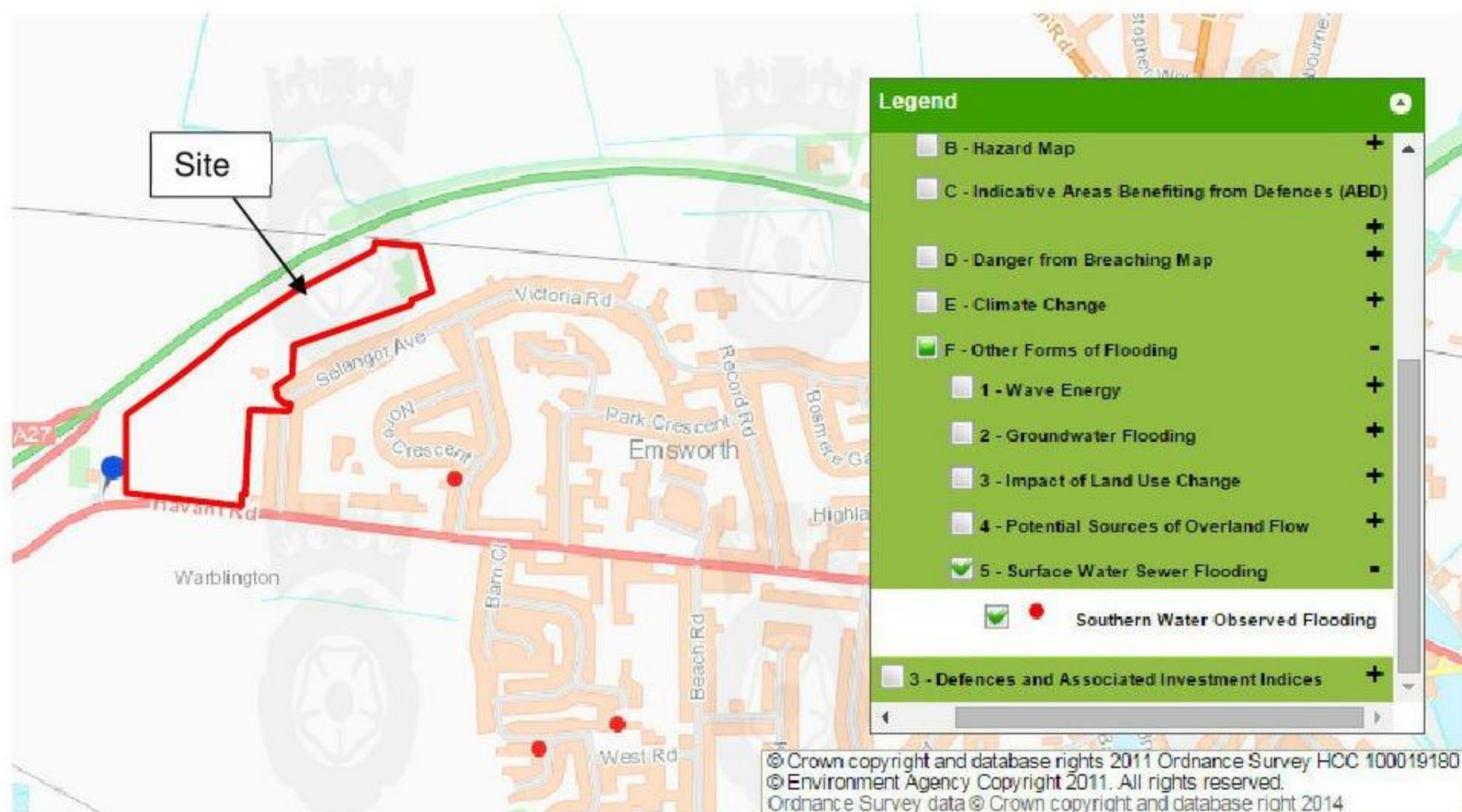


Figure 10 Extract from PUSH SFRA for Surface Water Sewer Flooding

There are no previously recorded instances within the immediate vicinity of the site. Flooding from existing sewers to the south and east of the site would not affect the development due to levels and flow paths. There are no existing sewers which, if flooding occurred, would flow into the site.

We are aware from Local Residents previous issues with foul water flooding have affected the local area and is it therefore important that the capacity of the existing foul sewerage network is satisfactorily established and an appropriate point of discharge for the new foul drainage from the development be established. Discussions have been held with Southern Water and flow monitoring of their network is being undertaken to better assess the capacity of the existing drainage system and identify any specific problems which could potentially be solved by the Applicant.

The risk of flooding to the site from existing drainage infrastructure is low.

Assessment of Impact: LOW

Assessment of Probability: LOW

2.7.2 Proposed Drainage

In accordance with Havant Borough Council's requirements for sustainable drainage systems for all new developments, priority should be given to incorporating a sustainable drainage system to manage surface water drainage. This will ensure the drainage system will accommodate any rainfall events up to and including a 1 in 100 year return period storm with 40% increase in storm intensity to allow for the predicted effects of climate change over the design life of the development in accordance with current guidance. The detailed design will allow for exceedance without flooding property.

Foul water drainage will be designed to meet Adoptable and British Standards where appropriate and will be subject to Building Regulations Approval. There is low risk of flooding within the site from proposed foul water drainage.

Foul water discharge from the development will discharge to the public foul sewer network at a point of discharge which is confirmed by the Statutory Sewerage Undertaker (Southern Water) as being acceptable be accommodated within their network. The existing network is over capacity under storm conditions and a local improvement can be undertaken to offset the new foul flows as a developer contribution. In this way, the development can be accommodated on the existing network at nil detriment or nett improvement in terms of risk of downstream foul flooding.

The sustainable drainage strategy, details of the design of the sustainable drainage system and water quality control measures are set out in Section 5 of this report.

Once the sustainable drainage system is installed the risk of flooding from surface water and rainfall both at the development and to adjacent and downstream land is low.

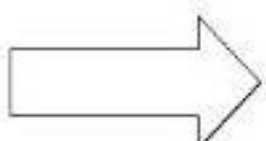
Assessment of Impact: LOW

Assessment of Probability: LOW

3. Flood Risk Summary

3.1 Analysis

A summary of the flood risks identified in Section 2 prior to mitigation are shown in the table below.

RISK ASSESSMENT MATRIX				
	Impact			
Probability of Event		Low	Medium	High
	Low	A, B, C, E		
	Medium	D		
	High			

Key:

A: Tidal & Fluvial – (Section 2.3)

B: Surface Water / Overland Flow – (Section 2.4)

C: Infrastructure Failure – (Section 2.5)

D: Groundwater – (Section 2.6)

E: Artificial Drainage – (Section 2.7)

3.2 Mitigation

3.2.1 Groundwater

Groundwater monitoring indicates that groundwater across the site has in recent years risen as high as to be within 500mm of the existing ground levels in the southern half of the site. Although the risk of groundwater flooding is considered low in terms of impact to the proposed development, as a precaution road levels and finished floor levels of the proposed developments situated in areas with high groundwater levels (less than 1m below ground level during winter months) shall be raised to mitigate against any potential rise in groundwater. Following this mitigation measure the risk of groundwater flooding to buildings is removed.

3.2.2 Surface Water

The risk of flooding from that shown by previous modelling is greatly reduced following completion of the Emsworth / Nore Farm Flood Alleviation Scheme. Any remaining flood risk to the site will be removed by the alteration in proposed levels and the proposed surface water drainage system will also ensure no increase in flood risk from surface water run-off to adjacent sites.

4. Sequential and Exception Tests

4.1 Sequential Test

The development of the site introduces residential dwelling (C3) land use. In accordance with Table 2 of the National Planning Policy Framework the development's vulnerability classification is 'more vulnerable' for residential use.

The development is located within 'Flood Risk Zone 1'.

In accordance with the NPPF Technical Guidance Tables 2 and 3 shown in Appendix 6 the development is appropriate in this location and the Sequential Test is passed.

4.2 Exception Test

The Sequential Test is passed and the development is acceptable in this location in flood risk planning terms, therefore the Exception Test is not required.

5. Drainage Strategy

5.1 Foul Water Drainage

There is no existing foul water discharge or drainage infrastructure on site.

The peak domestic foul flow from the site is calculated as 7.45 litres per second in accordance with the approximation of 4,000 litres per household per day within Sewers for Adoption which incorporates a six times peaking factor.

Foul water drainage from the proposed development will be drained to an adoptable foul water pumping station situated at the southern border of the site adjacent to the highway access. The pumping station will connect into the existing foul drainage network in Havant Road via a rising main.

Southern Water have confirmed that additional infrastructure is required in order for the existing sewer system to accommodate the proposed foul flows. This is due to the inadequacy of the existing system which is already at (or over) capacity will not be rectified in time to allow for the additional flows.

A Section 98 sewer requisition is being progressed by the Applicant to implement a proposed sewer improvement to the local area involving providing storage for foul flows in excess of a flow which the existing infrastructure cannot cope with hydraulically and would otherwise have the potential to cause downstream flooding. This will be achieved by installing offline foul water attenuation within the proposed development site land adjacent to Havant Road for flows in the existing Havant Road sewer.

The design and installation of the Section 98 works will be carried out by Southern Water but paid for by the Applicant. This improvement will benefit the local area providing a level of protection far exceeding the pre-existing or 'nil detriment' / without development scenario. This therefore represents considerable Planning Gain provided by the Applicant in terms of mitigating the existing inadequacy of the public sewerage system.

5.2 Surface Water Drainage

There is no positive drainage on the pastureland which currently drains partially to ground and partially via run off to surrounding land to the south and east. At times of heavy rain where the natural attenuation within the top soil is exceeded the resulting runoff is a concern to neighbouring properties in Selangor Road.

The proposed development will add areas of roof and paved hard-standing to the site thus increasing the impermeable area which will require positive drainage. This will be achieved by storing rainwater within soakaways and permeable paving where it lands and allowing it to soak into shallow subsoil. This will reduce the existing runoff to surrounding land providing a benefit to local area in terms of sustainable drainage.

There is a surface water sewer in Havant Road and watercourse to the south which could accept the flows from the site if drained by impermeable surface via piped drainage and underground storage tanks but this would increase the flow to the offsite sewers and downstream watercourses where the site currently does not drain directly and would require surface water pumping due to the shallow depths of the downstream outfalls which is inherently inefficient and not in accordance with current policy and guidance on sustainable drainage.

5.2.1 Greenfield Run-Off Rate

The existing greenfield run off rates are calculated for the existing site area and compared with the post development remaining green field area not captured by the drainage system.

The existing and proposed greenfield runoff rates are calculated for a 50ha site using the IH 124 Method and factored down to suit the site area. The runoff rates from this method are shown in Table 1 below.

Table 1 Existing and Post Development Greenfield Runoff Rates to IH 124

Storm Return Period	Existing Flow Rate (Litres per second)	Post-Dev Flow Rate (Litres per second)
QBAR	21.4	2.2
1 Year	18.2	1.9
2 Years	18.9	1.9
5 Years	27.4	2.8
10 Years	34.7	3.5
20 Years	42.9	4.4
50 Years	56.2	5.7
100 Years	68.4	6.9

The full site area of 6.3ha has been used in the existing greenfield runoff calculations. The QBAR Flow Rate for the site is 21.4 litres per second. The full greenfield calculation output can be found in Appendix 7.

Post-development the area of greenfield land remaining on site is approximately 6,400m² (0.64ha). This area of greenfield is situated in the undeveloped north-eastern corner of the site; the remainder of the site will be developed into hardstanding area. Factoring down the QBAR Flow Rate for the lessened greenfield area of site gives a value of 2.2 litres per second. This represents a reduced flow of rainwater which will run off of the site to the surrounding area than the undeveloped greenfield rate.

5.2.2 Runoff Control and Storage Volume

The site consists of relatively shallow gradients across the full area and surface water dissipates primarily by infiltration into the ground. The remaining soft standing in the proposed development layout shall also drain in this way as the existing situation.

To replicate as close as possible the existing drainage for the undeveloped site whilst reducing runoff a series of infiltration methods are proposed. The drainage system will be designed to accommodate the surface water runoff from the impermeable areas being introduced to the site and ensure that this runoff is contained within the site boundary.

Onsite drainage systems will be designed to accommodate storm events up to and including the 1 in 100 year return period storm (1% annual probability) with an increase of intensity of 40% (the Design Storm) to allow for future climate change in accordance with sustainable drainage principles and the latest Environment Agency guidance.

Permeable paving will be provided in private car parking areas which will be sized to allow sufficient storage to accommodate the roof water drainage from adjacent buildings. Surface water from roofs remote from parking areas are to drain by trench soakaways provided within private gardens which will discharge into the deeper more permeable subsoil.

Streets and driveways will be designed as permeable surfaces with storage accommodated within the pavement construction which will drain into the shallow subsoil. Infiltration swales will be provided along the lengths of impermeable access road in order to capture surface water runoff from carriageways and footways which do not drain via permeable surfaces.

Infiltration calculations to the Flood Studies Report (FSR) Rainfall Profile for a 1 in 100 year return period have been undertaken for individual porous paving and trench soakaways. These calculations are included in Appendix 7 at the rear of this report.

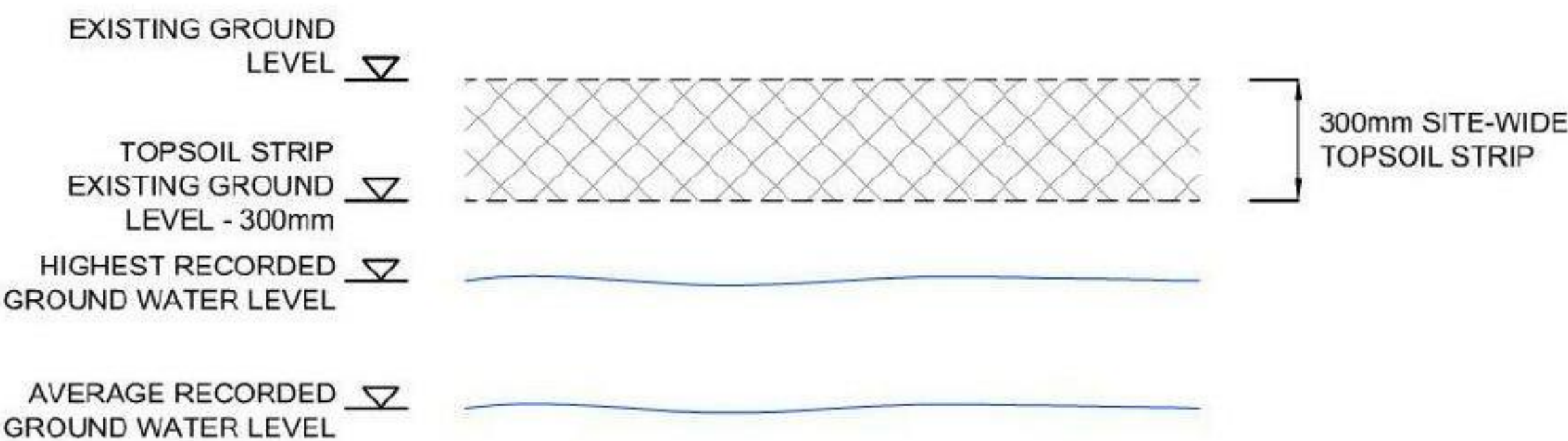
In the event of exceedance flows occurring during a storm greater than the design storm, the raised water levels in road areas will be contained between kerb upstands along the edges of the private roads. Where impermeable areas are draining to trench soakaways the exceedance flow will be contained within the additional volume provided by the pipework and chambers upstream of the soakaway. All building floor levels are set above surrounding ground and drainage cover levels.

Land drainage trenches will be installed where necessary in areas of open space where the detailed levels design indicates areas which could suffer surface water ponding in winter. This simply provides a pathway through the low permeability soils to the more porous layers beneath.

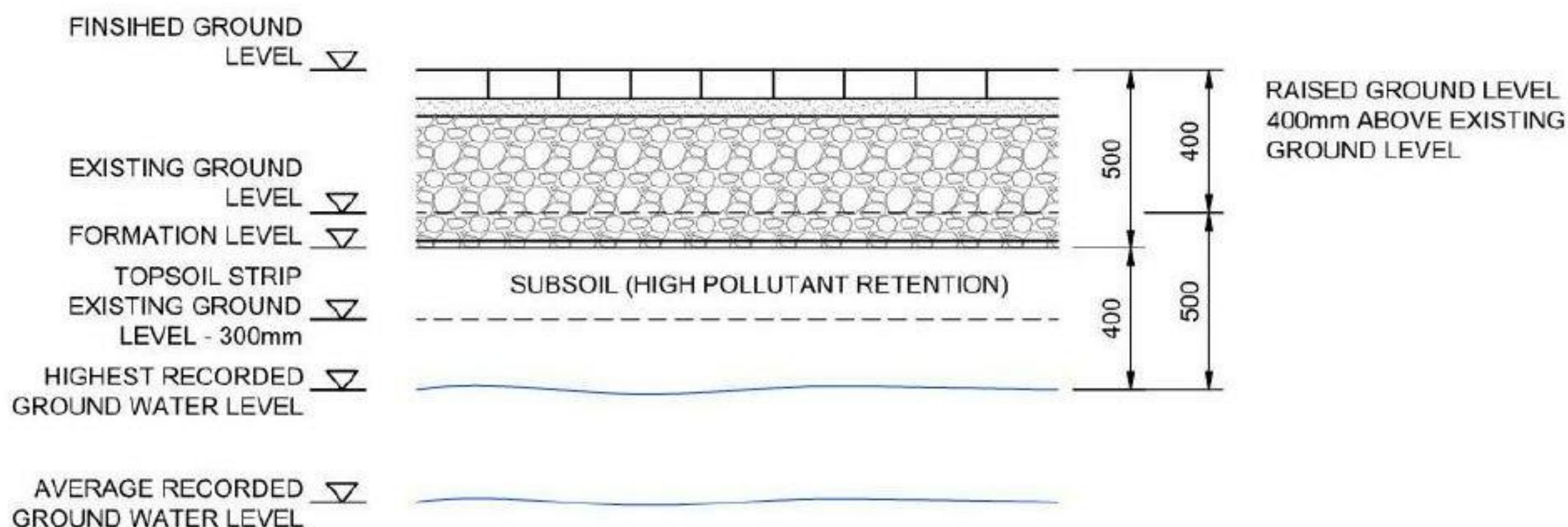
5.2.3 Mitigation for Potential High Groundwater

In order to remove the risk of ground water flooding (either from the water table or drainage unable to enter soakaways) and to mitigate the risk of pollution to groundwater from surface water runoff, permeable surfaces are raised above existing ground level in the southern area of the site prone to winter high ground water. The construction process is as follows:

- 1. A 300mm layer of topsoil (approximate / average depth of topsoil recorded on site) containing organic material will be removed ahead of construction.

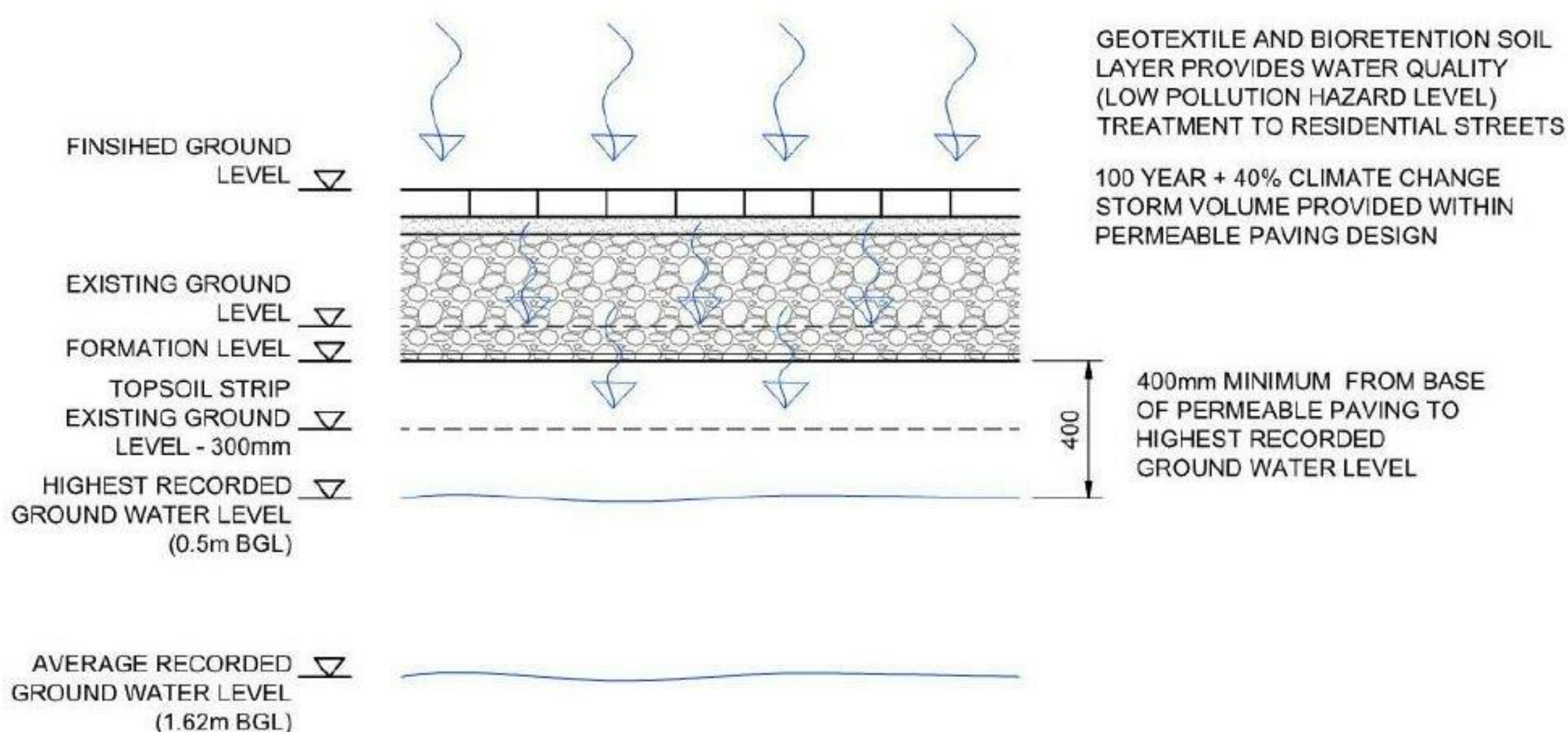


- The proposed levels will be built up by approximately 400mm from existing levels using a voided stone layer (imported material) which can contain rainwater while it drains to ground. Where a fill material is necessary beneath the formation of the permeable pavement, shallow subsoil won from the site will be used or other suitable high pollutant retention (low permeability) soil.



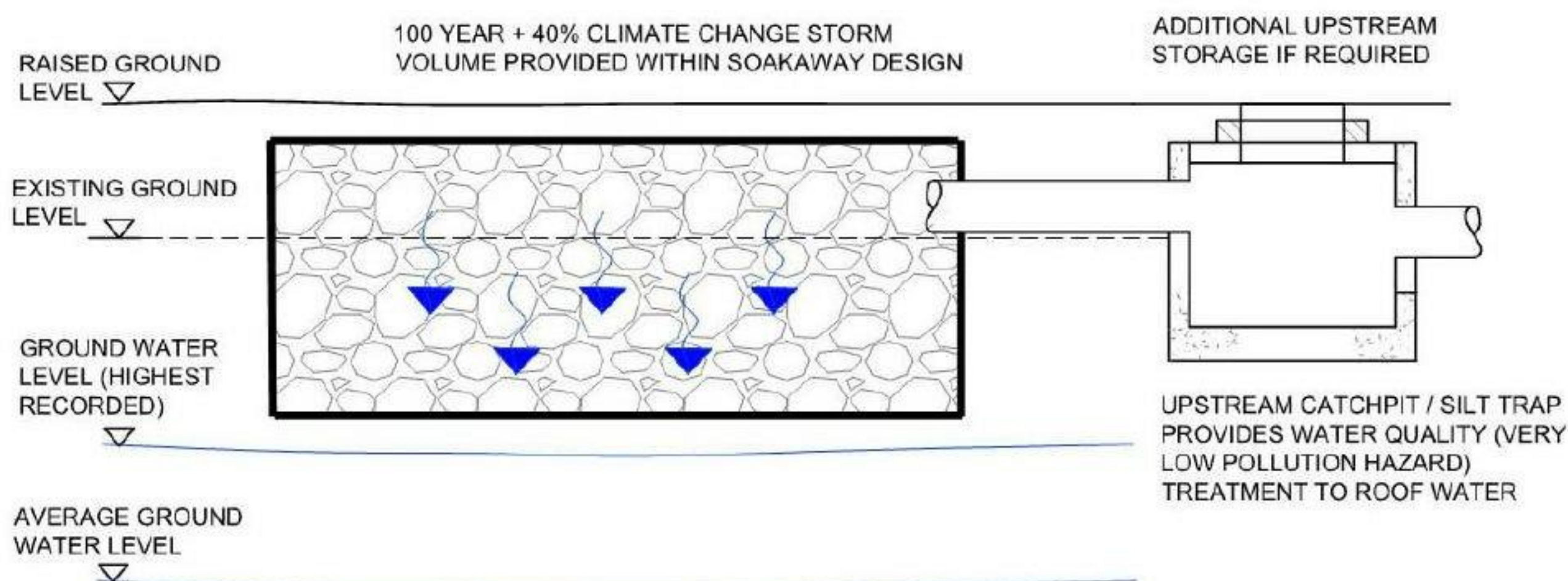
Highest groundwater levels in the northern section of the site are recorded to be approximately 0.5m-1m lower than the southern section of the site and so the base of soakaways and permeable paving layers will remain above the highest recorded groundwater level without a need to build up the surfaces above existing levels.

- By raising levels in the southern section of the site, this allows the infiltration layers of the installed permeable roads and car parks to be higher than the highest recorded level of groundwater on the site and allow water quality treatment in the soil layer between.

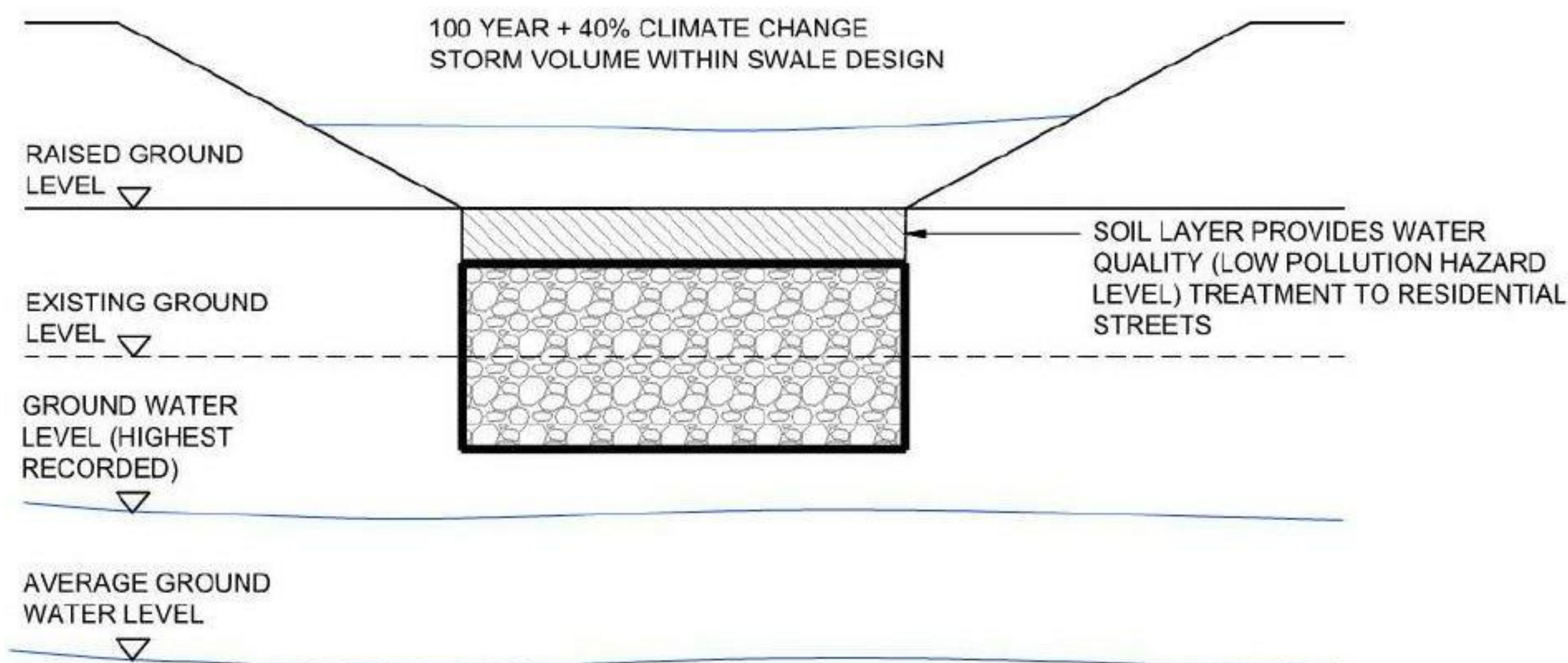


Under normal groundwater conditions, groundwater levels are far further below the infiltration layers typically over 1 metre lower than the highest recorded levels.

- The base of the proposed roof drainage soakaways will typically be above the highest recorded groundwater level to allow for high intensity storm events occurring during a period of high groundwater. Any exceedance will be stored within chambers and pipes upstream of the soakaway.



- As with the proposed soakaways, the base of the proposed infiltration swales will remain above the highest groundwater level. Additional storage for excess rainwater during high intensity rainfall events can be accommodated within the banks of the swale.



Calculations for capacity are attached in Appendix 7. Drawings showing the proposed drainage strategy including details of the proposed infiltration systems are attached in Appendix 8 at the rear of this report.

5.2.4 Pollution Control

As a Sustainable Drainage System pollution control in addition to flow control is an important aspect and has been considered in accordance with recommendations and guidance with the CIRIA SUDS Manual.

The Simple Index Approach has been used to determine whether the proposed water quality measures are sufficient for the site. This approach uses indices to indicate the level of pollution from particular land uses, ranging from 0 (no pollution hazard for contaminant type) to 1 (high pollution hazard for contaminant type).

In accordance with the SUDS Manual C753 the pollution hazard indices relevant to the site are as follows:

Land Use	Pollution Hazard Level	Pollution Hazard Indices ^a
Individual property driveways, residential car parks and low traffic roads	Low	TSS = 0.5, Metals = 0.4, HCs = 0.4
Notes: a TSS = Total Suspended Solids, HCs = Hydrocarbons		

In accordance with Table 4.3 of the SUDS Manual the application of the Simple Index Approach is not required for residential roofs as the pollution hazard level is very low and the runoff is considered to be clean water suitable for discharge directly to the environment without treatment. An upstream catch pit will be provided for private garden soakaways to trap silt.

The SUDS provided on site must have a total pollution mitigation index that equals or exceeds the pollution hazard index. All SUDS are to be designed to present a low pollution hazard. Geotextile and bioretention soil layers will be provided within the build-up for the permeable paving and a layer of bioretention soil at the base of the swale will provide water quality treatment.

All SUDS are to drain to groundwater rather than surface water, hence the indicative SUDS mitigation indices for the proposed SUDS solutions are as follows:

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	Indicative SUDS Mitigation Indices ^a (discharging to groundwater)
Permeable paving provided in private car parking areas: Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300 mm in depth.	TSS = 0.7, Metals = 0.6, HCs = 0.7 [Pollution Hazard Indices TSS = 0.5, Metals = 0.4, HCs = 0.4]
Swale provided next to low traffic roads: A layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300 mm in depth.	TSS = 0.6, Metals = 0.5, HCs = 0.6 [Pollution Hazard Indices TSS = 0.5, Metals = 0.4, HCs = 0.4]
Notes: a TSS = Total Suspended Solids, HCs = Hydrocarbons	

The above SUDS solutions provide higher values than the pollution hazard indices therefore they are acceptable solutions for water quality treatment on site.

5.3 Ownership and Maintenance of the Drainage System

The construction and maintenance of the drainage system, swale and access roads will remain private (not be offered for adoption by Hampshire County Council Highway Authority) and will be the responsibility of the freehold owners of the residential properties through a Management Company financed by a maintenance charge.

Foul Drainage will be offered for adoption by the Statutory Sewerage Undertaker (Southern Water) where appropriate and will be designed and specified to adoptable standard. Private drainage will be maintained by the Management Company.

A permanent record of the inspections will be kept by the management company recording previous issues and work carried out to help inform of future potential issues.

Table 2 below sets out the proposed schedule of maintenance for non-adopted infrastructure for the below ground drainage system which should be adhered to in order to ensure the system is kept free flowing and therefore reduce the risk of localised flooding due to blockages.

Table 2 – Drainage System Maintenance Requirements

Drainage Item	Maintenance Required	Frequency	Owner / Responsibility
Soakaways	Inspect and clean/remove silt. Inspect silt traps.	Annually	Maintenance Company
Gullies and Linear Drains	Inspect and clean/remove silt. Inspect silt traps.	Annually	Maintenance Company
Manholes (foul and surface)	Inspection and cleaning	Inspect bi-annually and after major storm event (excess of 50 year storm). Clean annually. Inspect integrity of manholes every 5 years and after major storm event.	Maintenance Company
Permeable Paving	Inspection and cleaning of silt	Every 5 years	Maintenance Company
Drain Runs	Cleaning/Jetting CCTV Survey	Every 5 years Every 10 years	Maintenance Company
Swale	Inspection of inlets and removal of any debris. Mowing of grass surface.	Bi-annually Monthly / As required by Landscaping strategy.	Maintenance Company

5.4 Risks Associated with Below Ground Drainage System

A risk assessment should be produced by the designer at detailed design stage and provided to the Principle Designer and Main Contractor in accordance with the requirements of the Construction Design and Management Regulations 2015.

The risks associated with the design of the proposed drainage solution identified at preliminary design stage are set out in Table 3 below.

Table 3 Preliminary Drainage Design Risk Assessment

Risk	Persons at Risk	Consideration of Risk and Mitigation Method	Residual Risk
Deep excavations in ground water	Construction personnel	Surface water system deep manholes avoided by strategy. Foul water system to be designed to be as shallow as possible.	Manholes and drain runs close to the pumping station may exceed 4m deep and involve deep excavation in groundwater. Contractor to produce Risk and Method Statements.
Confined spaces within drainage system (manholes)	Maintenance personnel	Maintenance to be carried out from the surface by way of jetting and rodding.	Required entry to system – must only be carried out by personnel who are confined spaces trained. Gas monitoring equipment to be used with appropriate breathing apparatus.

6. Conclusion

The site is within Flood Zone 1 at low risk of flooding from tidal or fluvial sources. The development is in accordance with the Sequential Approach to flood risk as set out within the National Planning Policy Framework and is acceptable in this location in flood risk planning terms.

The Nore Farm Flood Relief Scheme has mitigated the surface water / land drainage flood risk from the Nore Farm Stream which drains land to the north of the A27.

The proposed development is at low risk of flooding from tidal/fluvial sources, overland flow, infrastructure or drainage failure.

Although there is a potential risk of groundwater flooding due to the shallow winter ground water levels this will be fully mitigated by raising road levels and finished floor levels within the southern part of the site.

Foul water from the new properties will be discharged via pumping station and connection to the existing public sewer beneath the A259 Havant Road. As part of a sewer requisition process an offline attenuation tank will be designed and installed within the site by Southern Water. This will mitigate existing capacity problems in the existing network. Due to this there is nett benefit from the Development in terms of flood risk from infrastructure.

Surface water runoff will be controlled as part of a sustainable drainage system. Surface water from the impermeable areas will drain to ground via soakaways, permeable paving and swale. The drainage system will incorporate storage designed to accommodate large return period storm events up to and including the 1 in 100 year return period storm including allowance for 40% climate change. These sustainable drainage (SUDS) systems shall be designed to meet water quality requirements for draining to ground in accordance with guidance within the CIRIA SUDS Manual. Run-off from landscaped areas will be drained to ground via land drained trenches where the detailed levels design indicates surface water ponding could occur.

The proposed drainage solution mimics the existing surface water drainage method for the undeveloped site but provides storage layers for rainwater runoff from impermeable areas will be contained on site thereby reducing overall offsite surface water run-off.

Once these measures are installed the development represents a decrease in flood risk to the surrounding area and is in accordance with flood risk and sustainable drainage policy.

7. Appendices

Appendix 1

Existing Gradient Variation across Site

Appendix 2

Current site photographs

Appendix 3

Results of Soakage Tests undertaken July 2016

Appendix 4

Environment Agency Product 4 Flood Risk Information

Appendix 5

Flood Risk Planning Policy Review

Appendix 6

NPPF Technical Guidance Tables 2 & 3

Appendix 7

Greenfield Runoff and SuDS Storage Calculations

Appendix 8

Drainage Strategy Plans

Appendix 1 - Existing Gradient Variation across Site



Appendix 2 - Current Site Photographs

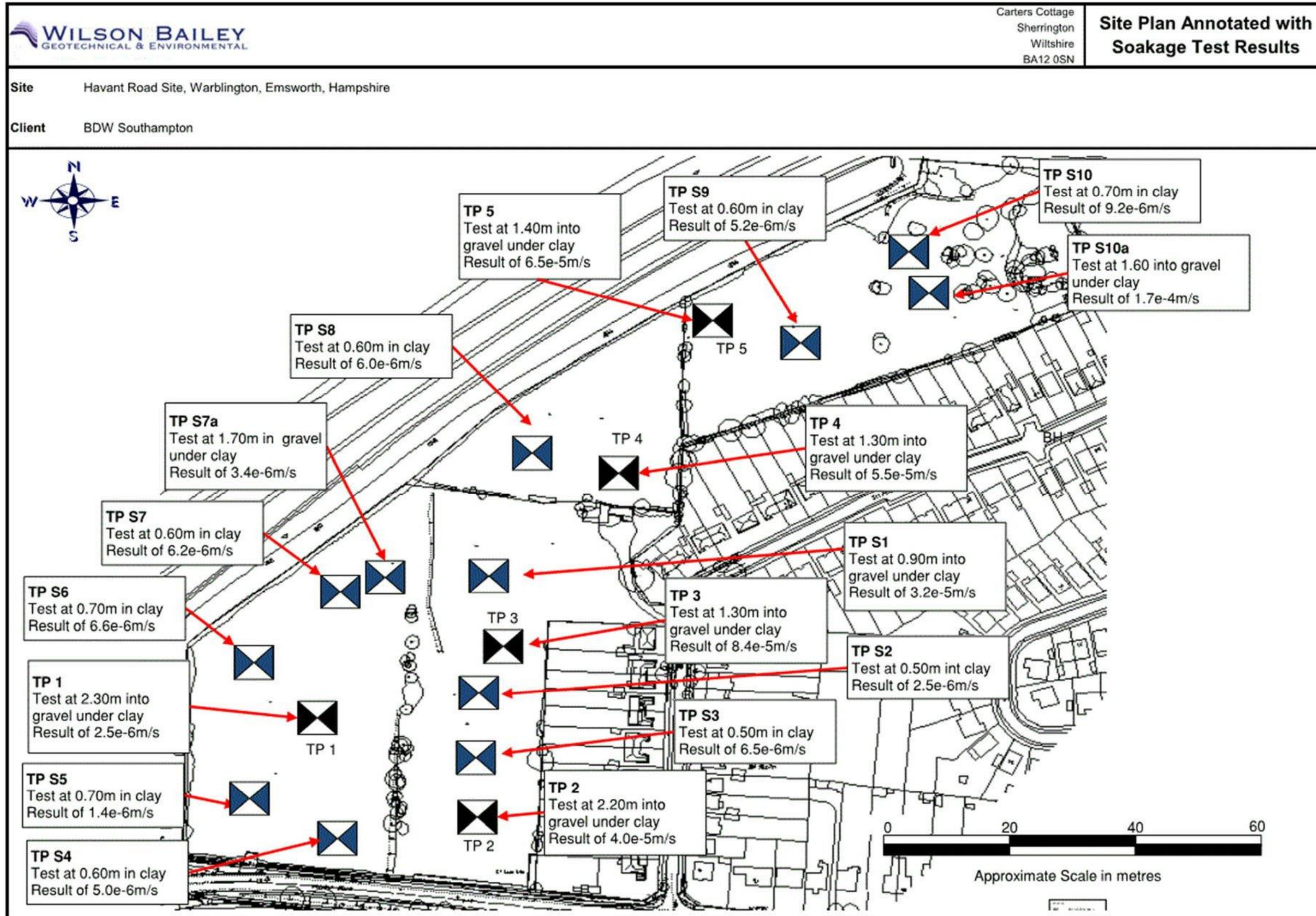
Current entrance to the site (looking towards Selangor Road):



Full site view looking northwest from current site entrance:



Appendix 3 - Results of Soakage Tests undertaken July 2016

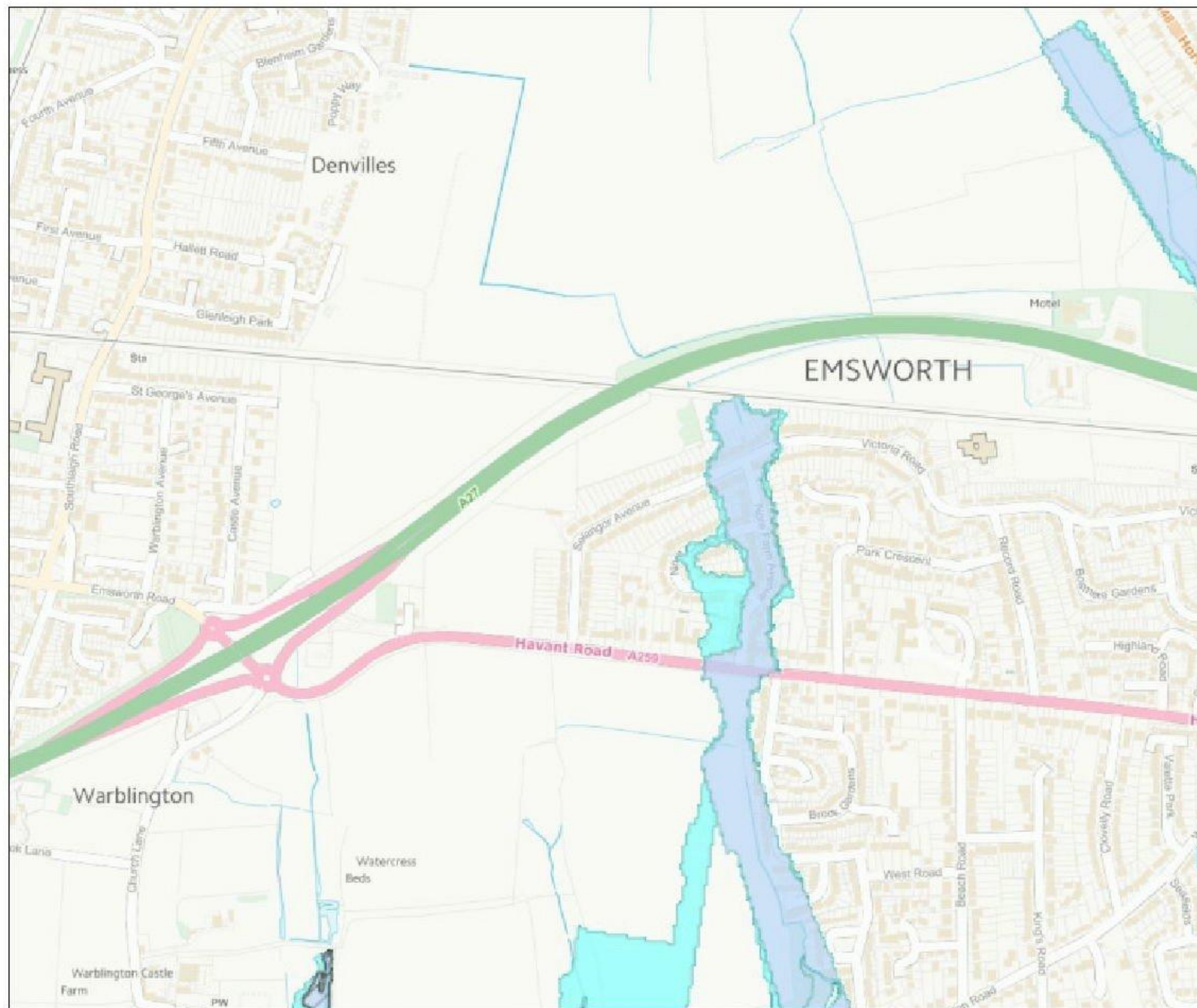


J11145 Site Plan (2)

Appendix 4 – Environment Agency Product 4 Flood Risk Information

- Flood Map for Planning (Rivers and Seas)
- Risk of Flooding from Surface Water
- Surface Water Depths - 1 in 30
- Surface Water Depths - 1 in 100
- Surface Water Depths - 1 in 1000

Flood Map for Planning (Rivers and Sea) Centered on Havant Road - Created 03 February 2016



Scale 1: 10,001



Flood Map for Planning (Rivers & Sea)

- Flood Map - Defences
- Area Benefitting from Flood Defences
- Flood Map - Flood Storage Area
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Risk of flooding from Surface Water



Scale 1:10,001



Likelihood of flooding from Surface Water

- High (1 in 30yr)
- Medium (1 in 100yr)
- Low (1 in 1000yr)
- Very Low

Likelihood of flooding from Surface Water

- | | |
|-----------|---|
| 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 |

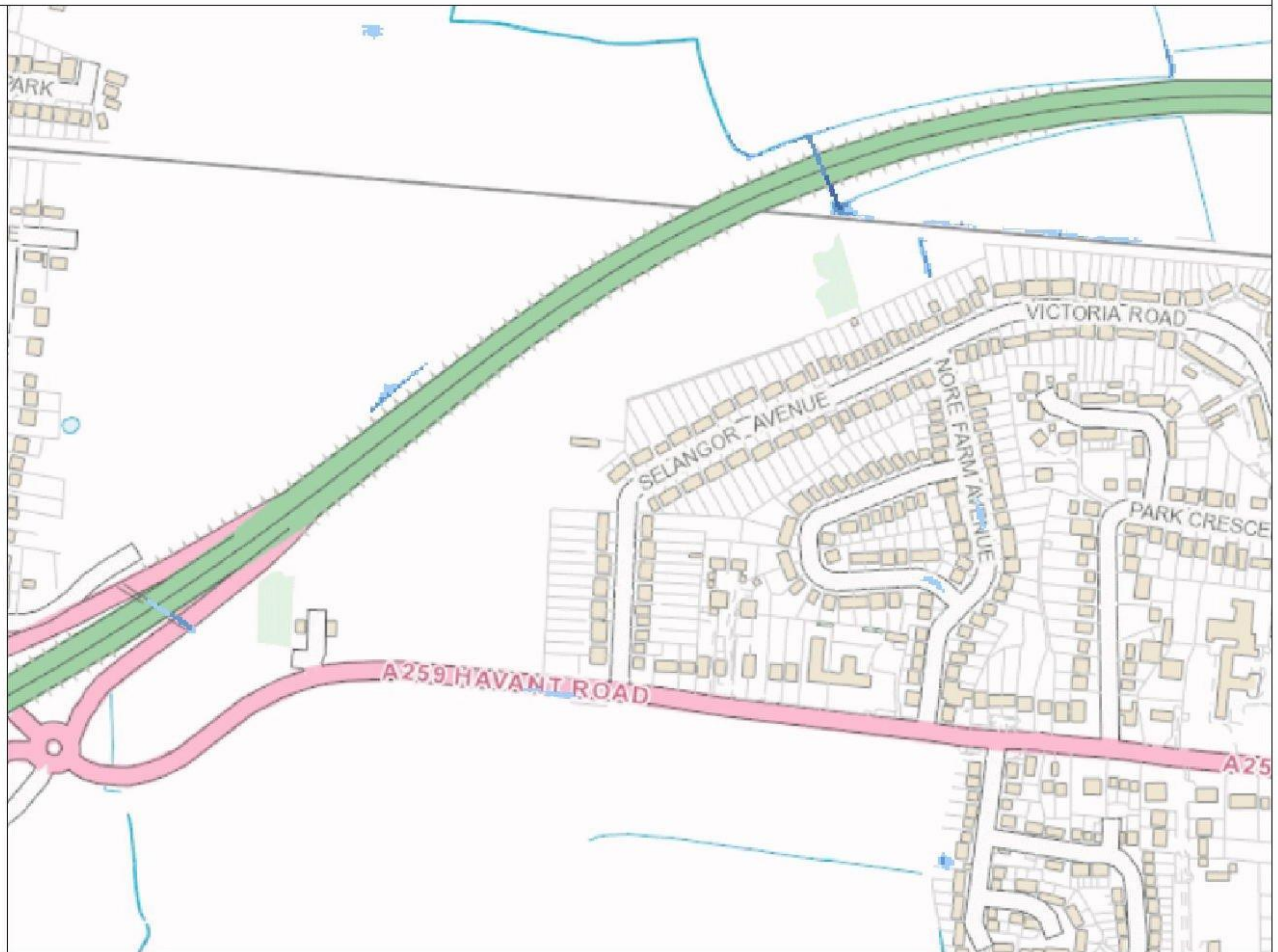
This information is shown on the Risk of Flooding from Surface Water map on our website.

Surface Water Depths Centered on Havant Road - Created 03 February 2016

Legend

Flood Depth 1 in 30

- Below 150mm
- 150-300mm
- 300-600mm
- 600-900mm
- 900-1200mm
- Over 1200mm



0 50 100 150
Metres



Surface Water Depths Centered on Havant Road - Created 03 February 2016

Legend

Flood Depth 1 in 100

- Below 150mm
- 150-300mm
- 300-600mm
- 600-900mm
- 900-1200mm
- Over 1200mm



0 50 100 150
Metres



Surface Water Depths Centered on Havant Road - Created 03 February 2016

Legend

Flood Depth 1 in 1000

- Below 150mm
- 150-300mm
- 300-600mm
- 600-900mm
- 900-1200mm
- Over 1200mm



0 50 100 150
Metres

