2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The proposed development is located in Woolton, Liverpool and accessed directly off 'Speke Road' Woolton, via an existing access road to the former 'Watergate School'. The Ordnance Survey National Grid Reference (OS NGR) for the site is 342612 (Easting), 386575 (Northing) and the nearest postcode is L25 8QA. A site location plan has been included and is shown in Appendix A.

2.1.2 The proposed development site is approximately 0.921ha in size, and indicated in Figure 1 below by the red edge boundary, the area edged in green (Figure 1) is land in control of the developer which is proposed to be utilised as part of the drainage strategy and therefore is required to be included within the flood risk assessment, however no other development proposals are specified for this land at this time.

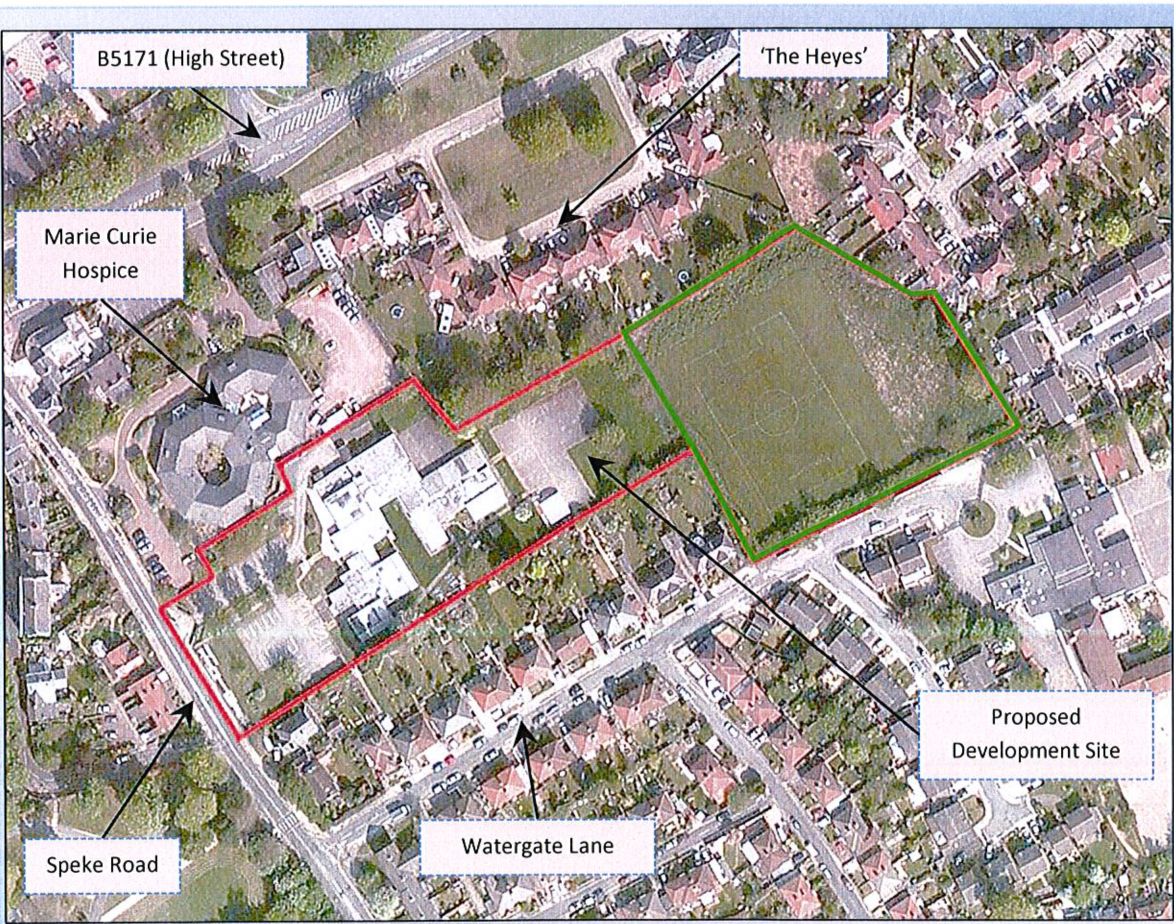

Figure 1: Aerial Photograph of site (Bing Maps 2014)
Aerial view of the proposed development parcels (edged in red).

2.1.3 The site is bounded; to the north the 'Marie Curie Hospice, Liverpool', 'Woolton Day Nursery' and rear gardens of residential dwellings off 'The Heyes'. To the east lies further residential dwellings and associated gardens off 'The Heyes' along with further undeveloped land in control of the developer. To the south lie residential dwellings off 'Watergate Lane' and 'Speke Road' and to the west lies 'Speke Road', 'St Julie's Catholic High School' and 'Woolton Street (see Figure 1 for details).

2.2 Existing and Historical Land Use

2.2.1 The preparation of this report has identified that the proposed development site currently houses the former 'Watergate School', the existing impermeable areas for the total development site is approximately 0.439ha (48%) as indicated in Appendix J. No other historical land-use has been identified during the preparation of this report.

2.3 Topography

2.3.1 A detailed topographical survey is provided in Appendix B, the topography is considered to vary through site based on review of this survey. The site topography is considered to fall from the western boundary to the eastern boundary, as indicated in Figure 2 (below).

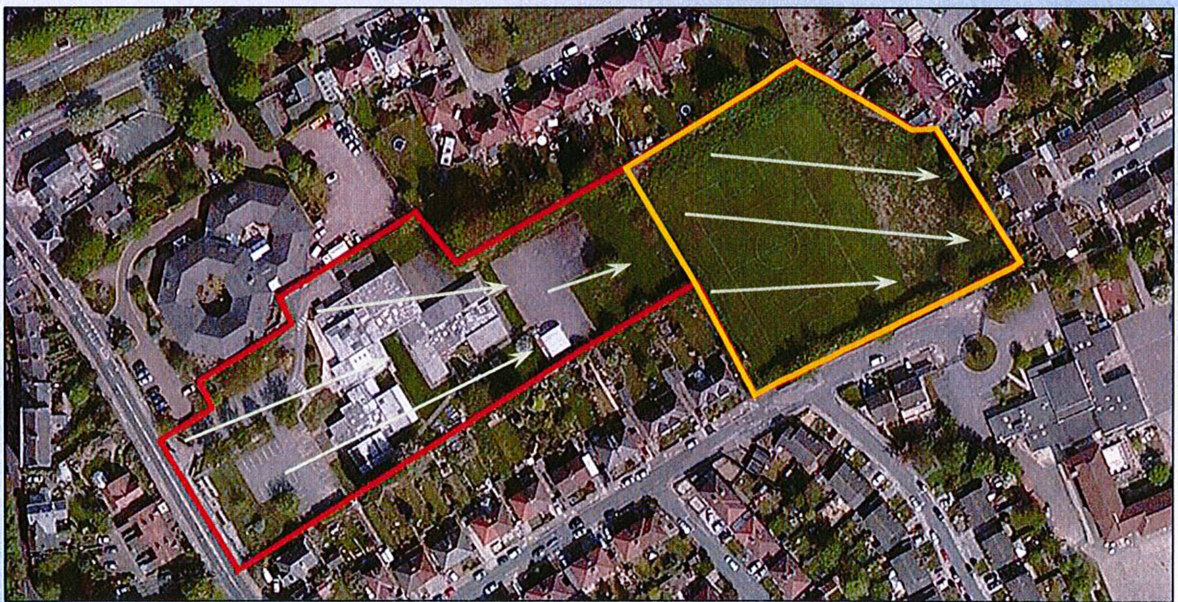

Figure 2: Aerial Photograph Indicating General Topography (Bing Maps 2014)

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This planning application is for 16no. residential units to be constructed, as aforementioned, on land surrounding and including the former 'Watergate School', Woolton, Liverpool (see Appendix C for planning layout).

3.1.2 The total site area is considered to be approximately 0.921ha in size; with approximately 0.439ha (48%) of existing impermeable areas, relating to its current land-use as the former 'Watergate School'.

3.1.3 The proposed impermeable area for the total site is to be approximately 0.385ha, 42% of the total site area (Appendix J).

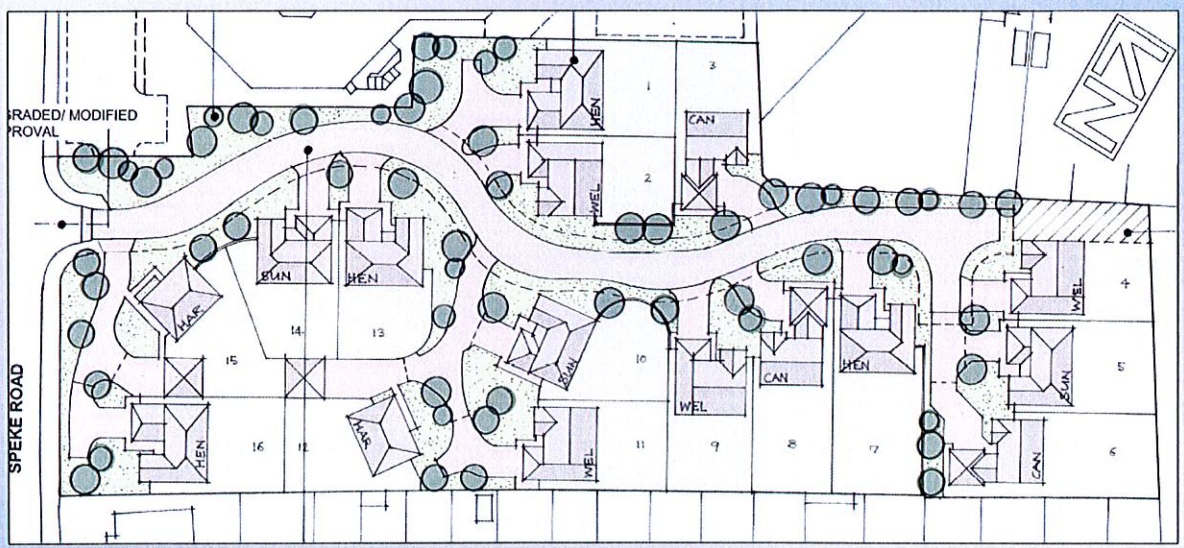

Figure 3: Planning Layout Extract (Redrow Homes. 2014)

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial & Tidal Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency's (EA) website and online Flood Map, an extract of which is shown in Figure 4 (below).

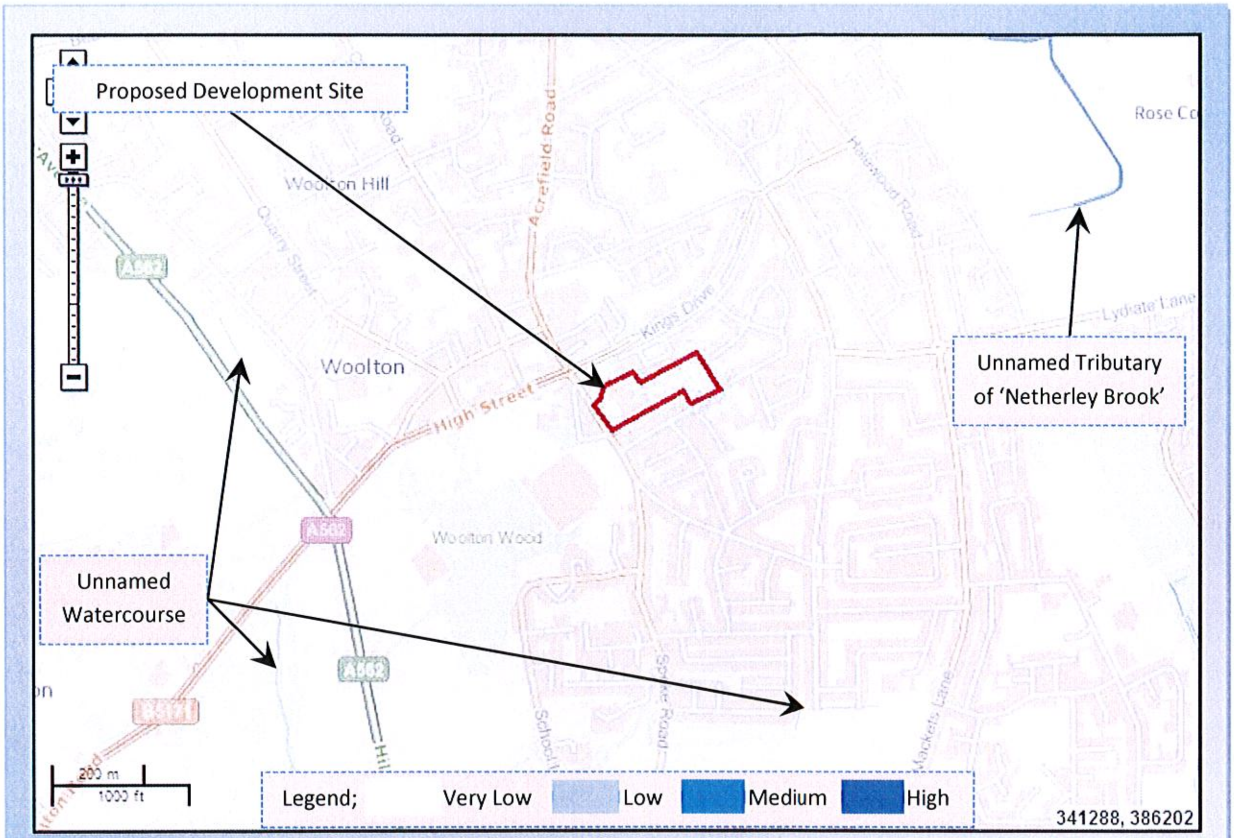

Figure 4: Flood Zone Map Extract (Environment Agency 2014)

Fluvial Flooding

4.1.2 As indicated in Figure 4 (above) all the proposed development site is considered to be at 'very low' risk from fluvial flooding (lack of blue shading near to or within the boundaries of the proposed development site). This identified low risk from fluvial flooding is understood to be due to the relative elevation of the site to the nearest identified sources of fluvial flooding.

4.1.3 From review of the available mapping data it can be stated an unnamed tributary of 'Netherley Brook' (EA designated Main River) is located approximately 1km, north-east of site, adjacent to the sewage treatment works located approximately 1.2km north-east of site. This unnamed tributary is also designated as Main River by the EA based on the online mapping data.

4.1.4 Multiple smaller watercourses (considered to be Ordinary Watercourses) are located within a kilometre of the proposed development site however the associated fluvial flood risk with these features is considered to be 'very low' due to their distance and elevation from site.

4.1.5 Review of the Flood Estimation Handbook (FEH) CD-ROM identifies the catchment to be 0.63km (sq.). Given the small nature of the catchment and the relative elevation of the proposed development area the flood risk from this source is considered to be low.

Tidal Flooding

4.1.6 The nearest coastline is considered to be approximately 18km north-west of the proposed development site and the Mersey Estuary is located approximately 4.5km south-west of the development site, as such the associated risk from these sources is considered to be 'very low' as identified in the EA online Flood Map extract shown in Figure 5 (preceding page).

4.1.7 Detailed Flood Mapping and Water Levels Data was requested from the Environment Agency as part of a more conservative approach to flood management of the proposed development site (details of which can be found in Appendix D).

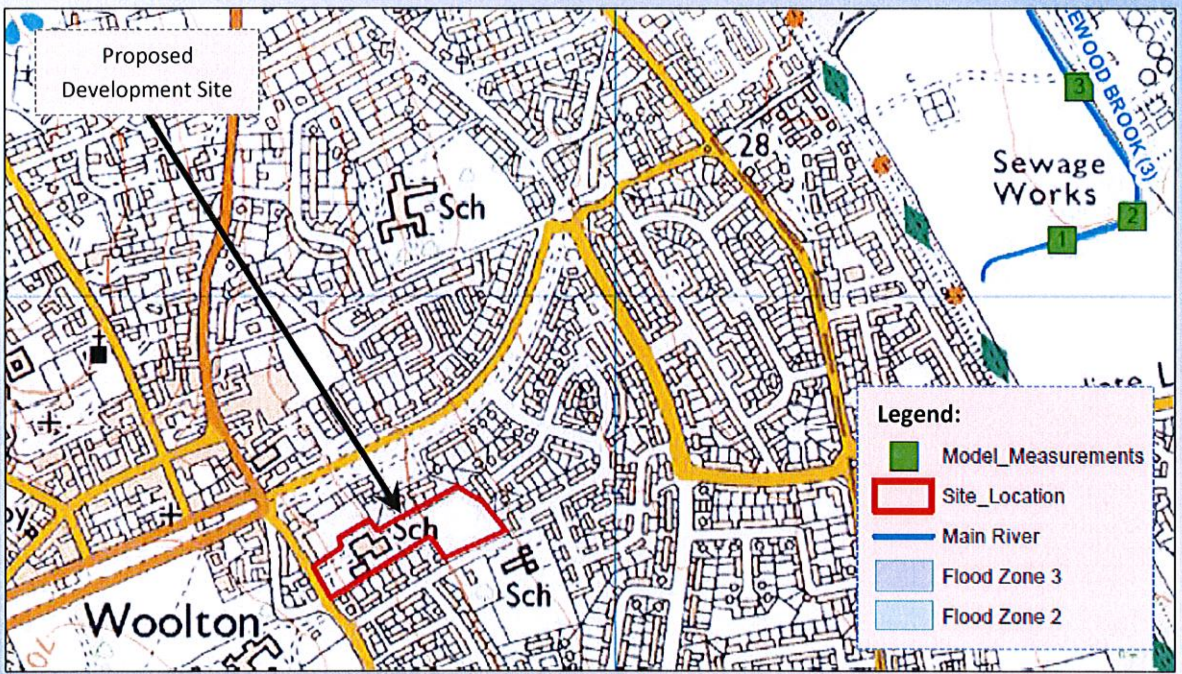

Figure 5: Flood Zone Map Extract (Environment Agency 2014)

4.1.8 As shown in Figure 5 (above) the proposed development site is confirmed to be located within Flood Zone 1 (land assessed as having a less than 1 in 1000 annual probability of river or sea flooding); the water levels data is shown in Table 1 (below) which indicates the proposed development site is not considered to be located within the floodplain and therefore is at 'low' risk of fluvial and/or tidal flooding.

Map Reference	Model Measurements (mAOD)		
	1% AEP (1 in 100 year.)	1% AEP + CCA (1 in 100 yr. + CCA)	0.1% AEP (1 in 1000 year.)
1	19.41	19.48	19.64
2	18.37	18.43	18.60
3	17.13	17.20	17.39

(Model data taken from Netherley and Halewood 2012 Study)

Table 1: EA Flood Water Levels Data (Environment Agency 2014)

Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.1.9 The proposed development site is solely 'residential' in nature (16 units) based on the detailed planning proposals (Appendix C); as such it is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the NPPF. The NPPF (Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility') confirms that this type of land-use is appropriate for development within Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.2 Surface Water Flood Risk

4.2.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

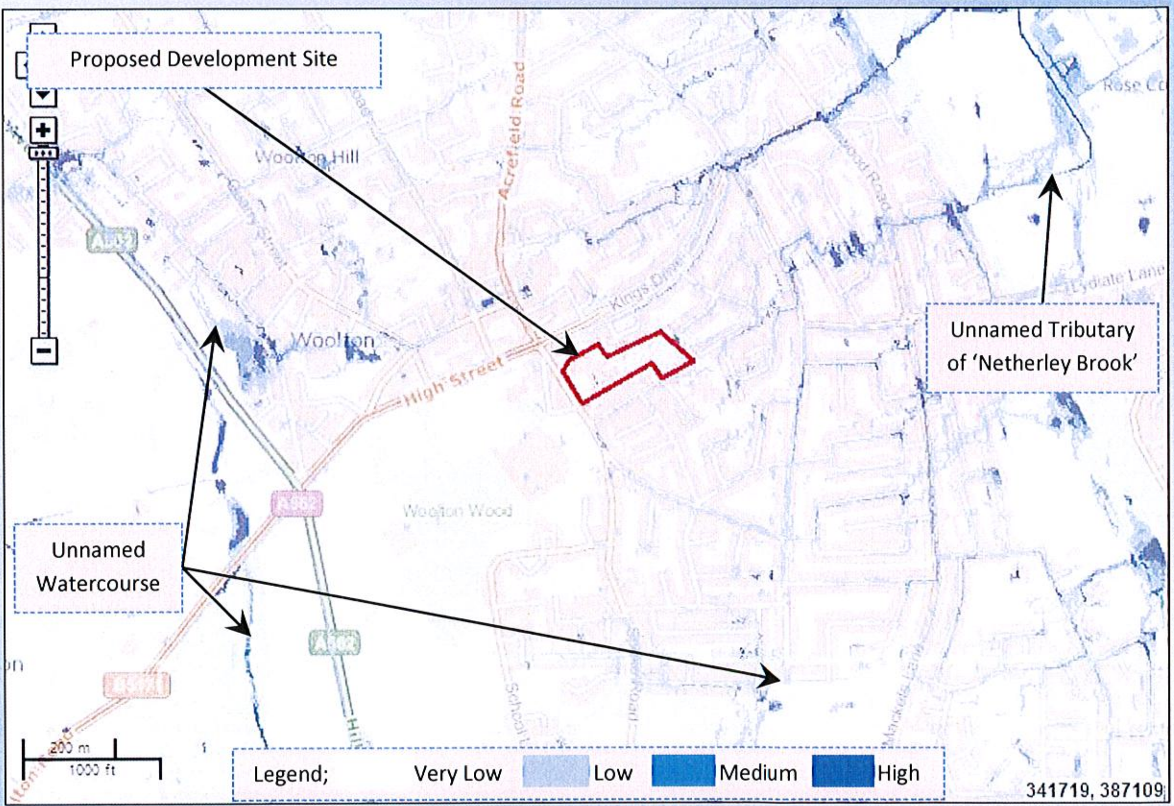

Figure 6: Surface Water Flood Map Extract (Environment Agency 2014)

4.2.2 The risk associated with surface water run-off is indicated by the EA online mapping data (see Appendix D) as shown in Figure 6 (above); it illustrates that the majority of the proposed development site is at 'very low' risk from surface water flooding. There is a small isolated area (existing school building) where the identified risk is 'medium' based on surface water flooding, this area is understood to be the existing school building/car park area meaning the large areas of hardstanding could account for the identified risk in these areas (Figure 6).

4.2.3 The EA online mapping data indicates the potential 'high' risk of surface water flooding adjacent to the north-eastern boundary (with residential dwelling off 'Heyscroft Road'), this identified risk could be due to the topographical fall of the area. Depending on the development proposals layout there may be potential to alleviate some of the associated risk to dwellings proposed along this boundary following a re-grade of site by raising finished floor levels. Although this would require confirmation following further investigation during the detailed design stage.

4.2.4 The EA also provides estimates for potential surface water flood depths and velocities under key probability events; low, medium and high (chance of occurrence). The worst case scenario (low chance of occurrence) shows the potential depth of surface water flooding to be predominantly between 300mm and 900mm in the isolated areas discussed as being at risk (see Appendix D for mapping data).

4.2.5 The isolated areas discussed as being at most risk within the boundaries of site are understood to have potential surface water flood depths predominantly 'over 0.25m/s' (although the mapping resolutions are poor); mapping data is included in Appendix D.

4.2.6 Surface water flood flows are understood to encroach into the proposed development site along the south-eastern boundary before flowing east, there may be the potential to intercept any oncoming flows from the neighbouring land, providing the planning layout accounts for such action; although this would require confirmation during the detailed design stage.

4.2.7 In order to mitigate potential flood risk from a variety of sources it is advised that following a re-grade of the site, finished floor levels are raised above the external levels to allow overland flood routes for excess surface water run-off.

Pluvial (Overland run-off) Flood Risk

4.2.8 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow.

4.2.9 Large catchment areas are particularly prone to this type of flooding. The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area.

4.2.10 The current understanding of the topography of the development and surrounding area means there is the potential for significant flows to impact on the proposed development. The area is generally falls away from site providing safe routes (along the main highways) for flows.

4.2.11 Any overland flows generated by the proposed development (Appendix O) must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwellings are advised.

Sewer Flood Risk

4.2.12 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.

4.2.13 Review of the United Utilities sewer records have identified multiple public sewer systems within the vicinity of site (see Appendix G for correspondence). Review of the UU sewer records a surface water sewer (225mm dia.) system is understood to be located on the south-eastern boundary running north-east along 'Watergate Lane'. Furthermore a foul water (300mm dia.) sewer is located parallel to the surface water system discussed above and a combined (225mm dia.) sewer is located running north-west along the western boundary of site ('Speke Road').

4.2.14 Correspondence with United Utilities (UU) has not identified any existing sewer flood risk issues or historical flooding of the immediate site area (see Appendix G for correspondence).

4.3 Groundwater Flood Risk

4.3.1 In general terms groundwater flooding can occur from three main sources: - raised water tables, seepage and percolation and groundwater recovery or rebound.

4.3.2 If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified during consultation with the various interested parties.

4.3.3 Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.

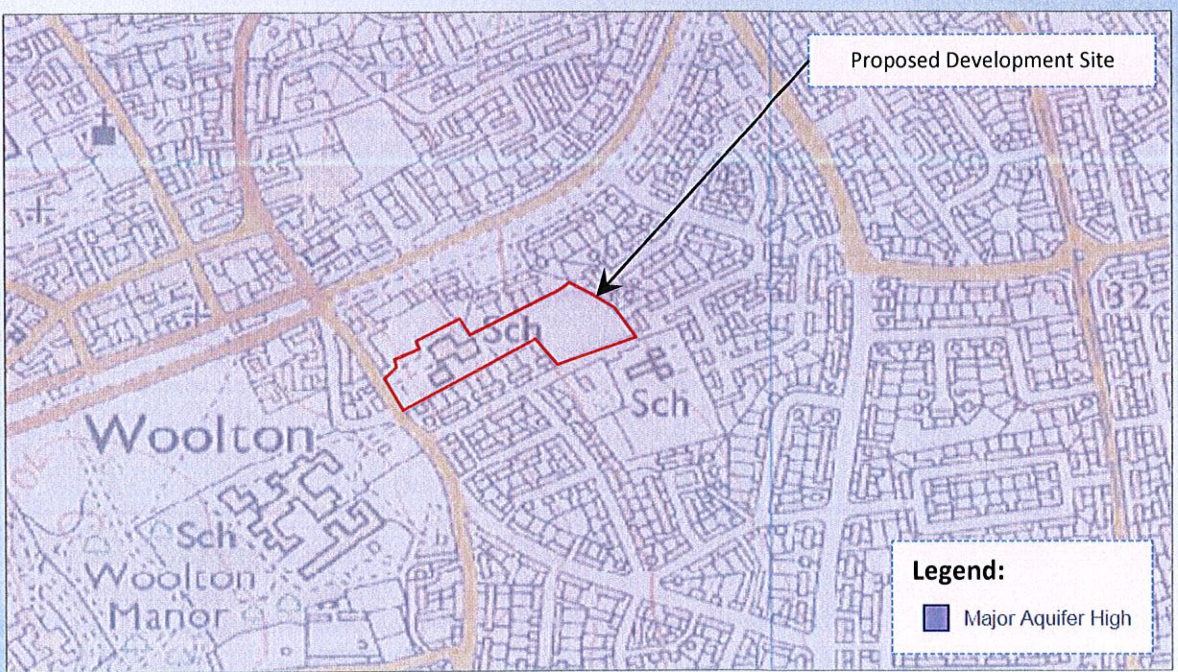

Figure 7: Groundwater Vulnerability Map Extract (Environment Agency 2014).

4.3.4 Groundwater recovery / rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is 'low'.

4.3.5 The groundwater vulnerability extract as shown in Figure 7 (preceding page), indicates that development site lie within a 'High Vulnerability Zone' to a Major Aquifer (purple shading).

BEDROCK & SUPERFICIAL AQUIFER DESIGNATION

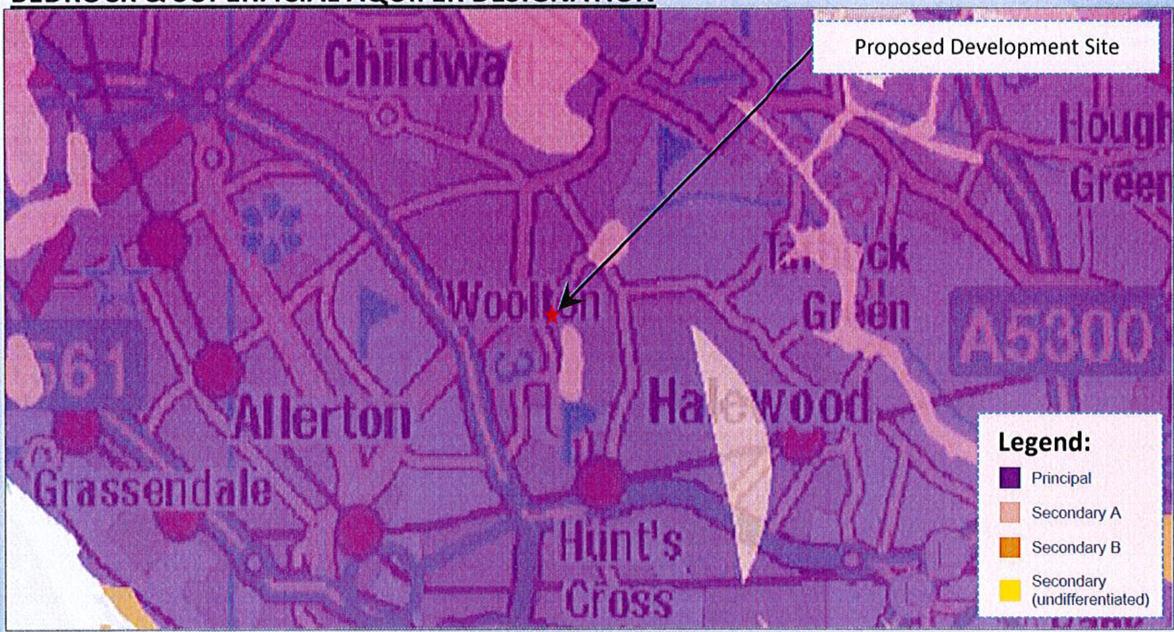

Figure 8: Bedrock and Superficial Aquifer Designation Extracts (Environment Agency 2014)

4.3.6 The bedrock aquifer designation for the site is shown in Figure 8 (above) which indicates the site is underlain by a 'Principal Aquifer' (purple shading) and is not underlain by a superficial aquifer based on the Environment Agency Data (Figure 8; Appendix D).

4.3.7 No historical groundwater flooding of the site has been identified during consultation with the various interested parties.

4.4 Artificial Sources of Flood Risk

4.4.1 Figure 9 (subsequent page) shows an extract of the EA's online Reservoir flood map; Appendix D shows the EA's reservoir flood map in full.

Reservoirs

4.4.2 The nearest EA identified reservoir (>25,000cu.m) known as 'Sefton Park Lake' (owned by Liverpool City Council) is located approximately 4.9km north-west of the proposed development site. Due to the site location and elevation relative to any reservoirs the risk of flooding from this source is considered to be 'very low'; as indicated in Figure 9 (subsequent page).

Canals

4.4.3 The closest canal to the proposed development site is the 'St Helens Canal' (also known as the 'Sankey Canal') approximately 8.9km south-east of site, it runs into the River Mersey approximately 9.1km to the south-east. The Manchester Ship Canal and the Weaver Navigation are the next close proximity canals located approximately 5km south-east of site. Due to the natural topography and distance from site, flood risk associated with these identified canal systems is considered to be 'very low'.

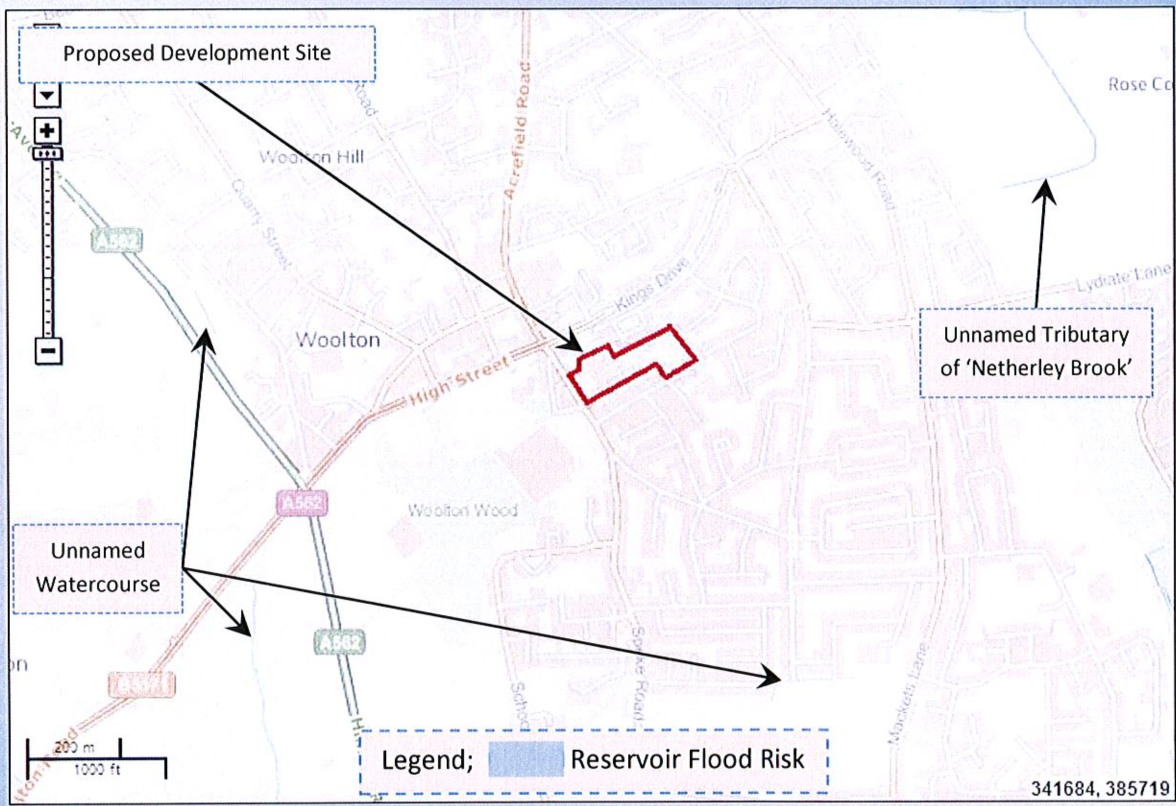

Figure 9: Reservoir Flood Map Extract (Environment Agency 2014)

4.5 Historical and Anecdotal Flooding Information

4.5.1 An internet based search for flooding events did not recall any historical flooding to the immediate development site area, including review of the Chronology of British Hydrological Events.

4.5.2 Review of the Liverpool City Council (2011) Preliminary Flood Risk Assessment (PFRA) and Strategic Flood Risk Assessment (SFRA) failed to highlight any historic flooding pertinent to this site specific Flood Risk Assessment (see Appendix L for mapping data). The SFRA did however indicate the importance of effective surface water management as the Liverpool wider area has lost efficiency in surface water drainage over the past decade due to development.

4.5.3 The Mersey Estuary Catchment Flood Management Plan (CFMP) 2009 furthermore failed to highlight any historic or flood related issues pertinent to this FRA.

4.5.4 Consultation with various interested parties including United Utilities and the Environment Agency, failed to highlight any historical flooding to the immediate site area or the neighbouring area from a variety of sources.

4.6 Flood Risk Mitigation Measures & Residual Risks

4.6.1 No specific flood risk mitigation measures are required in accordance with the NPPF as the development is located within Flood Zone 1. Irrespective:

Mitigation Measures

4.6.2 Setting Finished Floor Levels a minimum of 150mm above the external levels following any re-grade should mitigate any risk of flooding from a variety of sources, including groundwater and surface water run-off risks at the proposed development.

4.6.3 As with any development it is also advised that external levels fall away from property to minimise the flood risk from a variety of sources.

4.6.4 It is advised that external levels fall away from the proposed properties to minimise the flood risk from a variety of sources; elevating Finished Floor Levels relative to the carriageway should help create a safe overland flood flow route in the event of any source of flooding that could lead to overland flow.

4.6.5 Overland flows generated by the proposed development must be carefully controlled (Appendix O); safe avenues of overland flow away from any existing and proposed buildings are advised.

4.6.6 To minimise the flood risk to the proposed dwellings and neighbouring property it is proposed that surface water run-off generated by the proposed development be managed effectively and ideally with the peak rates of run-off being restricted to the equivalent of the pre-development situation.

4.6.7 It is proposed that this be achieved using a Hydrobrake® flow control device with stormwater storage being provided to prevent overland run-off from leaving site for events up to and including the 100yr event with a 30% allowance for climate change.

Residual Risks

4.6.8 The development is accessible for emergency access and egress during times of extreme flooding as the floodplain does not extend into the proposed development.

4.6.9 The development and its drainage systems should be designed to cope with intense storm events up to and including the 100 year return period rainfall event with an allowance for Climate Change (CC), based on the design life of the proposed development this allowance for CC is in the form of a 30% increase in rainfall intensity.

4.6.10 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the proposed planning layout (Appendix N) in the event that the capacity of the drainage system is exceeded.

4.6.11 Any overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwelling are advised.

4.6.12 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with an appropriate management company for these private drainage systems.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 For the purposes of determining the existing rate of surface water run-off the site is considered to be approximately 48% impermeable at present. A positive outfall for surface water run-off generated by the existing development is yet to be determined however due to the topographic constraints for discharging to watercourse and the lack of feasible infiltration characteristics it is assumed that surface water discharges to the existing public sewer network.

5.1.2 The surface water run-off rates have been calculated using the Modified Rational Method and the IH124 Greenfield run-off method, utilising rainfall catchment characteristics from the Flood Estimation Handbook (FEH), details of which are included Appendix E.

5.1.3 The total site area is approximately 0.921ha and is considered to be approximately 48% impermeable at present (0.439ha). The peak rate of run-off generated by the impermeable area during the annual return period event is calculated to be approximately 16.6l/s. The peak rate generated by the impermeable area during the 1 in 100 year return period event is calculated to be approximately 57.l/s.

5.1.4 The approximate surface water run-off volume generated by the total site area based on the 1 in 100 year return period storm event is 404.1cu.m (Appendix I); estimated using the FEH rainfall catchment characteristics (6hr duration event).

5.2 Post-Development Surface Water Run-off

5.2.1 The residential nature of the development proposals means that there will be a decrease in the impermeable areas of the site. The proposed impermeable area of site will decrease to approximately 0.385ha, 42% of the total site area (refer to Appendix I for details).

5.2.2 The approximate surface water run-off rate generated by the post-development impermeable area, if unrestricted, based on the annual return period event is 14.5l/s and based on the 1 in 100 year return period storm event with a 30% allowance for climate change is 58.9l/s.

5.2.3 The approximate surface water run-off volume generated by the impermeable site area based on the 1 in 100 year return period storm event with a 30% allowance for climate change is 326.8cu.m (Appendix I); estimated using the FEH rainfall catchment characteristics (6hr duration event).

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 In accordance with the NPPF, Sustainable Drainage Systems (SuDS) should be specified wherever possible to manage surface water. This in turn reduces the burden downstream on both watercourses and sewerage systems. Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical.

5.3.2 SuDS have the ability to address three core objectives; water quantity, water quality and amenity value. With the appropriate system specified, all three core objectives can be satisfied. Where possible, peak surface water discharge rates to watercourses and sewers should be reduced.

5.3.3 Runoff from car parking areas and roads could be conveyed through swales, permeable pavements and petrol interceptors to provide a degree of treatment before flows are carried to public sewers.

5.3.4 Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. Added benefits include biodiversity and visual enhancements.

5.4 Methods of Surface Water Management

5.4.1 The total site area covers approximately 0.921ha, with approximately 48% of impermeable areas existing. The proposed impermeable area of the development will decrease, due to the nature of the proposals, to approximately 0.385ha, which accounts for approximately 42% of the total development area.

5.4.2 There are three methods that have been reviewed for the management and discharge of surface water detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority listed below.

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

5.5 Discharge via Infiltration

5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

5.5.2 The British Geology Survey (BGS) online mapping data indicates both the bedrock and superficial geology (at varying scales) within Britain; the BGS 'Geology of Britain' viewer indicates that ground conditions vary within site and are as follows:-

Western Portion of Site:

1:50 000 Scale Bedrock Geology Description: Chester Pebble Beds Formation - Sandstone, Pebbly (gravelly). *Sedimentary Bedrock formed approximately 246 to 251 million years ago in the Triassic Period.*

Setting: Rivers. *These rocks were formed from rivers depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from overbank floods* *forming floodplain alluvium, and some bogs depositing peat; includes estuarine and coastal plain deposits mapped as alluvium.*

1:50 000 Scale Superficial Deposits Description: *None Recorded*

Eastern Portion of Site:

1:50 000 Scale Bedrock Geology Description: Wilmslow Sandstone Formation - Sandstone. *Sedimentary Bedrock formed approximately 246 to 251 million years ago in the Triassic Period.*

Setting: Hot Deserts. *These rocks were formed in mainly hot dry environments where potential evaporation was greater than precipitation; often characterised by dunes, loess and evaporites.*

1:50 000 Scale Superficial Deposits Description: Till, Devensian - Diamicton. *Superficial Deposits formed up to 2 million years ago in the Quaternary Period.*

Setting: Ice Age Conditions. *These rocks were formed in cold periods with Ice Age glaciers scouring the landscape and depositing moraines of till with outwash sand and gravel deposits from seasonal and post glacial meltwaters.*

5.5.3 The Cranfield Soil and Agrifood Institute Soilscapes soil type viewer identifies the soil within site to vary, the western portion is understood to have predominantly 'naturally wet, very acid sandy and loamy soils'; drainage to considered to be to local groundwater sources. The eastern portion of site is understood to have 'slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils', drainage is considered impeded to the stream network.

5.5.4 In terms of infiltration characteristics, the majority of site is considered to have predominantly 'sand' based geology, which would suggest the potential for infiltration, however further investigation into the soils characteristics (Soilscapes) would suggest that infiltration is not likely to provide a viable solution to surface water management at the site as the soils are not considered to have feasibly infiltration characteristics.

5.5.5 If infiltration is perused as a possible method for the management of surface water run-off generated by the development proposals then further investigation is advised. Soakaway testing to BRE365 is to be undertaken in specific locations where infiltration is considered to be most feasible (eastern portion based on infiltration characteristics).

5.6 Discharge to a Watercourse

5.6.1 The Environment Agency's online mapping data is supported by various other publications in identifying the presence of a principal watercourse (a tributary of Netherley Brook) located approximately 1km to the north-east of the proposed development site.

5.6.2 However due to the surrounding elevation and existing land-use (urbanised) it is not considered feasible for discharge of the surface water run-off generated by the development to discharge to this watercourse via a new connection; as no existing connection for discharge to this watercourse has been identified an alternative surface water solution is required.