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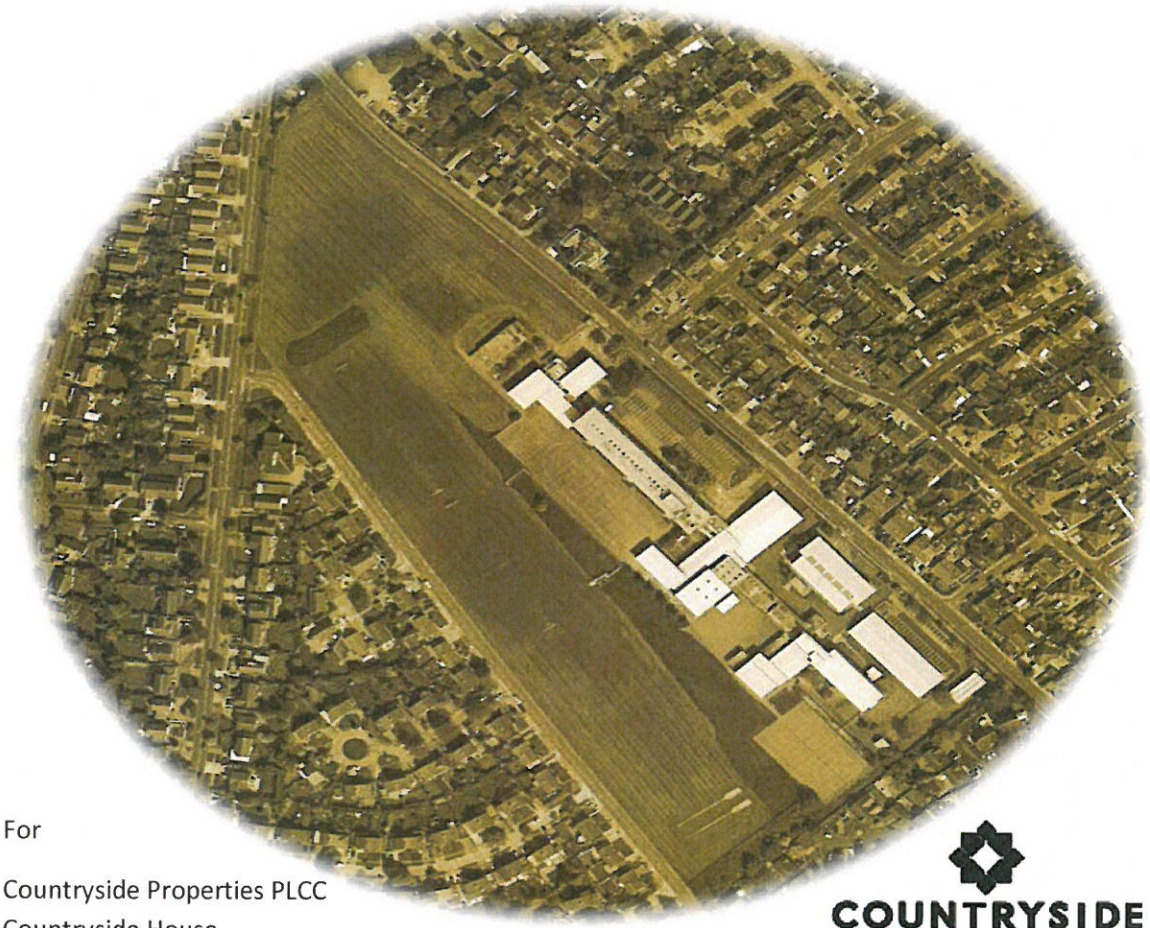
GATEACRE
LIVERPOOL

FLOOD RISK ASSESSMENT



For

Countryside Properties PLCC
Countryside House
Lakeside Drive
Centre Park
Warrington
WA1 1RW

COUNTRYSIDE
Places People Love

Countryside Properties (UK) Limited
Regeneration North, 600 Lakeside Drive
Centre Park, Warrington WA1 1RW
Tel: 01925 248900 Fax: 01925 248901
www.countryside-properties.com

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Prepared by:
Kirsty Williams BSc (Hons)
Graduate Flood Risk Analyst

Christopher Pickles
Engineering Technician

Checked by:
Mel Frimston BSc (Hons) CEng MIStructE
Managing Director

Authorised by:
Richard Nicholas BEng (Hons) MBA
Associate Director

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Old Marsh Farm Barns
Welsh Road, Sealand
Flintshire CH5 2LY
Telephone: 01244 288 178
Fax: 01244 288 516

www.betts-associates.co.uk

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EXECUTIVE SUMMARY

This Flood Risk Assessment was commissioned by Countryside Properties PLC, referred to hereafter as 'the client'. The Flood Risk Assessment has been prepared to support a detailed planning application for the construction of 202no. residential dwellings on the existing Gateacre School site to the south-west of 'Grange Lane' Gateacre. The development proposals are to include estate roads, private access roads, external works, footpaths, car parking, external lighting, landscaping, boundary walls, fencing, external services and drainage.

The proposed development site is approximately 8.249ha in size and is located exclusively within Flood Zone 1 according to the Environment Agency's Flood Mapping Data. The National Planning Policy Framework (NPPF) requires that all planning applications for development proposals that exceed 1 hectare be accompanied by a Flood Risk Assessment.

The proposals are 'residential' in nature and as such classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the NPPF. Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there no increase in flood risk elsewhere due to the proposals.

The development is accessible for emergency access and egress during times of extreme flooding as the 100 year floodplain does not extend into the proposed development area.

An Internet based search for flooding events did not recall any historical flooding to the immediate site area, review of the Liverpool City Preliminary FRA also failed to highlight any flooding issues within the immediate site area. Consultation with various interested parties furthermore failed to highlight any historical flooding in or adjacent to the proposed development area.

This Flood Risk Assessment has reviewed all sources of flood risk to both the proposed development and to the existing adjacent development as a result of the proposals, including; fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources. As a result of the relatively low flood risk from all of the sources reviewed, the principle focus of this report is on the effective management of surface water drainage.

Infiltration does not appear feasible based on the infiltration characteristics ascertained form the BGS and NSRI Mapping data. The nearest watercourse is not a practical option for the discharge of surface water from site due to its proximity. It is proposed that the surface water run-off generated by the development be discharged to the public sewer network to mimic the existing situation.

It is understood that multiple connections to the existing public sewer network will be required from site to accommodate the proposed layout and identified topographic constraints. The flows generated by the majority of site are proposed to discharge to the existing combined sewer within Grange Lane, utilising the existing connections where feasible. The flows generated by the proposals along the north-western and south-western boundaries are proposed to discharge into the existing surface water system along 'Cuckoo Lane' and 'Gateacre Park Drive' via new connections.

The discharge of surface water run-off generated by the proposals is proposed to be restricted to the pre-development rate with 30% betterment; the proposed rate is calculated to be 255.1l/s. A flow restriction will be most likely in the form of a Hydrobrake® or similar approved flow control device.

The proposed onsite surface water drainage system will need to be sized to prevent overland run-off offsite from storm events up to and including the 100 year return period storm event with a 30% allowance for climate change.

Detailed design will be required to confirm the feasibility of the proposed strategy following more detailed levels review. Consents will be required from United Utilities, along with approval of the proposed discharge rates; therefore early discussion is advised.

SuDS methods should be incorporated into the surface water management strategy wherever possible; the use of soft landscaping, permeable paving and swales (where appropriate) may offer a reduction in surface water run-off generated by the development site. Although the exact SuDS methods to be used within the proposals are to be confirmed during detailed design, the implementation of a pond system along the northern boundary is identified on the proposals.

The foul water flows generated by the proposals are proposed to discharge in part to the public sewer network within Grange Lane as they do currently, utilising the existing connection where appropriate. A detailed design will be required to confirm feasibility based on the topographic levels following more detailed investigation, further discussion with United Utilities will be required to confirm the strategy. Based on topographic constraints it is understood that multiple connections to the public sewer network will be required; however the flows generated by the majority of site are proposed to discharge to the public combined sewer within Grange Lane, with the flows generated by the dwellings along the north-western and south-western boundaries are proposed to discharge into the existing foul water sewer system along 'Cuckoo Lane' and 'Gateacre Park Drive' via new connections.

This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The Flood Risk Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

CONTENTS

Figures & Tables

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.

- MicroDrainage WinDES (v.14.1) – CaLCCulation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	mAOD	Metres Above Ordnance Datum
BGL	Below Ground Level	NGR	National Grid Reference
BGS	British Geological Survey	NPPF	National Planning Policy Framework
CC	Climate Change	NSRI	National Soil Resources Institute
EA	Environment Agency	OS	Ordnance Survey
FEH	Flood Estimation Handbook	PFRA	Preliminary Flood Risk Assessment
FRA	Flood Risk Assessment	PPS	Planning Policy Statement
FRMSR	Flood Risk Management Strategy Report	QSE	Quick Storage Estimate
FZ	Flood Zone	QBAR	Mean Annual Flood
Ha	Hectare	SFRA	Strategic Flood Risk Assessment
IDB	Internal Drainage Board	SuDS	Sustainable Urban Drainage Systems
LDP	Local Development Plan	TWL	Top Water Level
LCC	Liverpool City Council	UKCIP	United Kingdom Climate Impacts Programme
LLFA	Lead Local Flood Authority	UU	United Utilities
LPA	Local Planning Authority		

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1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change.

1.1.2 Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Technical Guidance (refer to extracts in Appendix F).

1.1.3 The development proposals are over 1 hectare therefore require a Flood Risk Assessment be completed in accordance with NPPF to review all sources of flood risk both to and from the proposed development.

1.1.4 The development is considered to be solely 'residential' in nature and as such is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the National Planning Policy Framework. Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This Flood Risk Assessment has been prepared to support a detailed planning application for the construction of 202no. residential dwellings with private amenity areas; complete with access road, footpaths, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

1.2.2 The development site is predominantly undeveloped at present and therefore is considered to be 68% pervious. The proposed development site is located on the former Gateacre School site, to the south-west of Grange Lane, Gateacre.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultation with the following interested parties; Liverpool City Council (LCC), the Environment Agency (EA) and United Utilities (UU).

1.3.2 The Local Planning Authority (LPA), Liverpool City Council (LCC) has been consulted as part of the preparation of this report; Liverpool City Council acts as the Lead Local Flood Authority (LLFA). The NPPF advises that the LPA should consult with the Environment Agency who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

1.3.3 The Environment Agency was contacted to discuss the nature and extent of information to be provided in this Flood Risk Assessment and for any background knowledge of flood risk specific to the site (correspondence is included in Appendix D).

1.3.4 United Utilities Developer Services were contacted to discuss whether UU have any historical flooding issues in the area or any background knowledge on flood risk specific to the site (correspondence is included in Appendix G).

1.3.5 Liverpool City Council were contacted to discuss the nature and extent of information to be provided in this FRA and for any background knowledge of flood risk specific to the site (correspondence is included in Appendix H).

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The proposed development site is accessed directly off 'Grange Lane' Gateacre. The Ordnance Survey National Grid Reference (OS NGR) for the site is 342280 (Easting), 388178 (Northing) and the nearest postcode is L25 4SA. The site location plan is shown in Appendix A. The total development site is approximately 8.249ha and edged in red in Figure 1 (below).

2.1.2 The site is bounded; to the north by Grange Lane with residential developments beyond, to the east by further residential development, to the south by Cuckoo Lane with residential development beyond and to the west by the Cuckoo Lane and Gateacre Park Drive with residential development beyond (see Figure 1 below).

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

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 Gateacre Community comprehensive school, and associated recreational and landscaped areas, the total site is considered to be approximately 32% impermeable at present (see Appendix J for Pre-Development Impermeable Areas Plans).

2.2.2 No other historical uses have been determined during the preparation of this report.

2.3 Topography

2.3.1 The topography varies throughout site; a detail topographic survey is included in Appendix B. The general topographic fall is from the southern and western boundaries of site towards the existing school buildings as illustrated in Figure 2 below.

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

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This planning application is for the construction of approximately 202no. residential dwellings with private amenity areas, on the existing Gateacre School site to the south-west of Grange Lane, Gateacre. The proposals include construction of an access road, footpaths, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

3.1.2 The pertinent planning drawings are included in Appendix C; an extract of the development proposals is shown in Figure 3 (below).

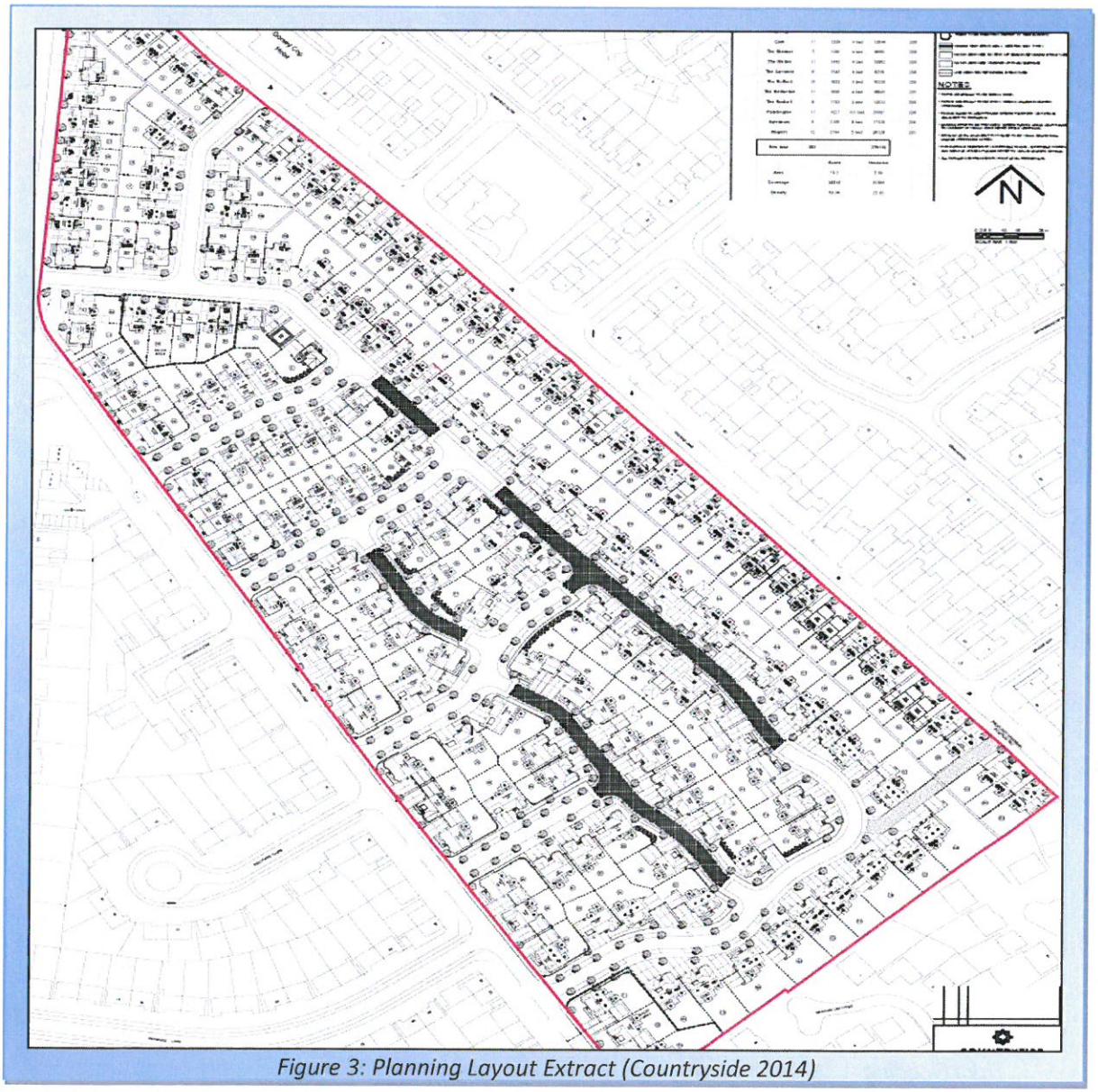

Figure 3: Planning Layout Extract (Countryside 2014)

3.1.3 The total site area total site area is approximately 8.249ha and is considered to be 32% impermeable at present. The proposed impermeable area of site is considered to increase to approximately 4.046ha (49%) based on the nature of the proposals.

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).

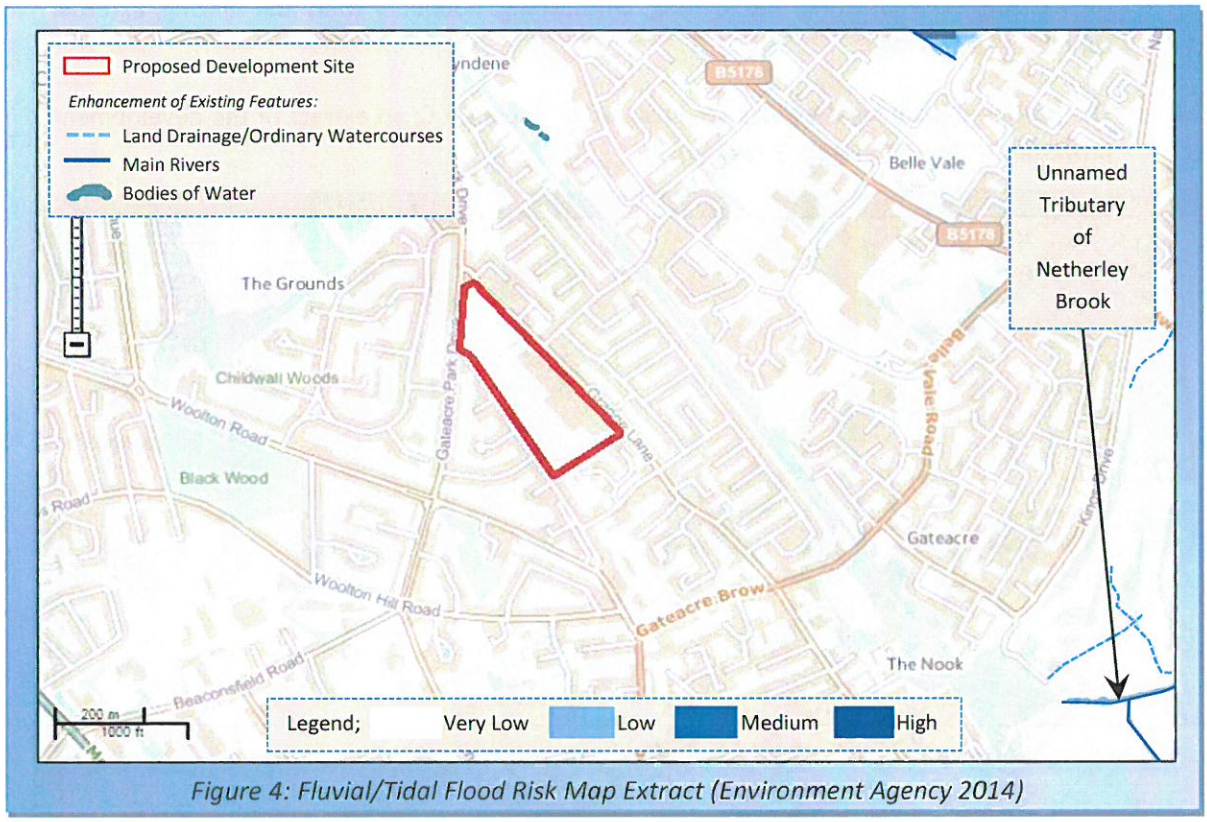

Figure 4: Fluvial/Tidal Flood Risk Map Extract (Environment Agency 2014)

Fluvial Flooding

4.1.2 The online EA Flood Map indicates that the proposed development area is considered to be at 'very low' risk from fluvial flooding, despite being located approximately 1.4km north-west of a tributary of Netherley Brook.

4.1.3 The Environment Agency's Flood Map for Planning indicates the proposed development site is located within Flood Zone 1 (land assessed as having a less than 1 in 1000 annual probability of flooding) and is therefore considered to be at little/no risk from fluvial/tidal flooding (see Figure 5 on the subsequent page).

4.1.4 Review of the Flood Estimation Handbook (FEH) CD-ROM identifies the catchment to be 0.56km (sq.). Given the relative elevation of site and the nature of the catchment the flood risk from this source is considered to be low.

Tidal Flooding

4.1.5 The coastline is located approximately 13.3km north-west of the proposed site, as such the associated risk is considered to be 'very low' as identified in the EA online Flood Map extract shown in Figure 4 (preceding page). The Mersey Estuary is located approximately 5.5km

south-west of site, therefore the associated risk from this source is also considered to be 'very low'.

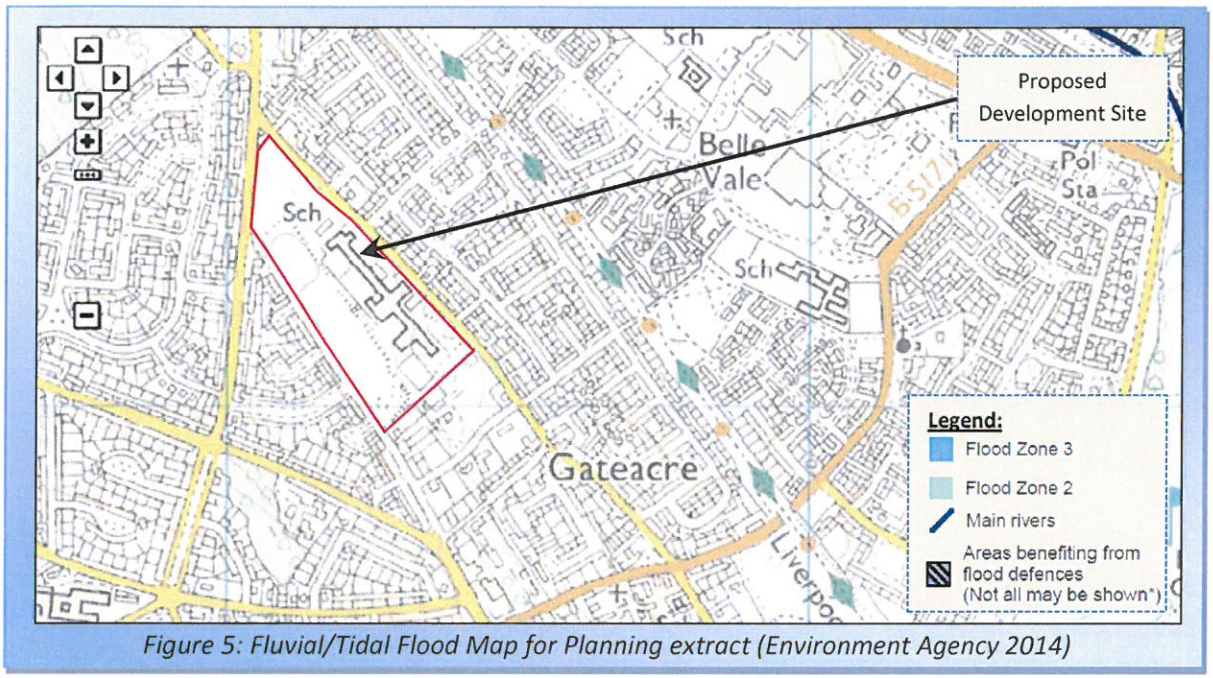

Figure 5: Fluvial/Tidal Flood Map for Planning extract (Environment Agency 2014)

Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.1.6 The development is considered to be solely 'residential' in nature (202no. units) and as such is classified as 'more vulnerable' in Table 1: Flood Risk Vulnerability Classification within the Technical Guidance to the NPPF. Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' within the NPPF confirms that this type of land-use is appropriate for development within Flood Zone 1, providing there is no increase 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.

4.2.2 The risk associated with surface water run-off is indicated by the EA mapping data as shown in Figure 6 (on the subsequent page); it illustrates that the proposed development site is predominantly at 'very low' risk from surface water flooding.

4.2.3 The areas indicated on the EA map (blue shading) as being at 'low' and 'medium' risk from surface water flooding are located along the north-western boundary and the eastern portion of site (Figure 6). These areas have associated surface water risks primarily due to the topography and existing land-use within site and as such correspond with the natural topographic depressions, areas of hard standing and existing small pond feature.

4.2.4 The identified level of surface water flood risk would be significantly reduced providing any overland run-off onto site was catered for within the design through the implementation of interception ditches or similar features.

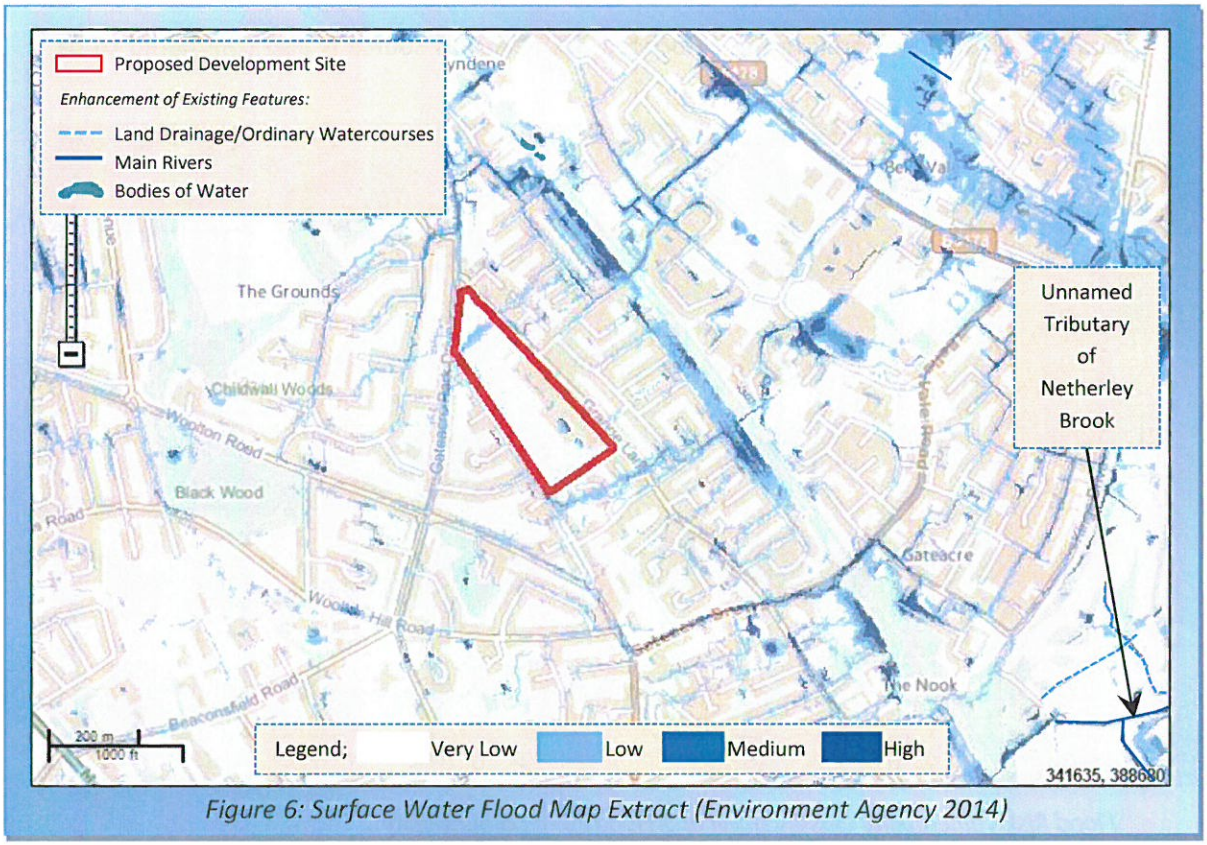

Figure 6: Surface Water Flood Map Extract (Environment Agency 2014)

4.2.5 In order to mitigate any potential flood risk from surface water it is advised that (following any 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

4.2.6 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. 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.

4.2.7 The topography of the development and surrounding area means there is little potential for overland flows to impact on the proposed development site from adjacent fields, however any overland flows generated by the proposed development (Appendix M) must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwellings are advised.

Sewer Flood Risk

4.2.8 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.

4.2.9 United Utilities (UU) records identify multiple public surface water, foul water and combined systems within the vicinity of site. Two existing public sewers are understood to run south-east along 'Grange Lane' to the north/east of site, with a surface and foul water system running north-west along Cuckoo Lane to the south and west of site. A combined sewer system is understood to be located within the residential developments to the south-east of site (see online sewer records in Appendix G).

4.2.10 Consultation with United Utilities, has not identified any existing sewer flood risk issues or historical flooding of the immediate site area as a result of over-loaded sewers, 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.

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 mapping data for groundwater shows that the site is underlain by a 'Principal' bedrock aquifer with no recorded superficial deposits. The proposed development site is located within a high vulnerability zone to a major aquifer according to the online EA groundwater vulnerability mapping data.

4.3.6 No historical groundwater flooding of the site has been identified during consultation with the various interested parties; however setting Finished Floor Levels a minimum of 150mm above the external levels (following any re-grade) should mitigate any risk of flooding from this source.

4.4 Artificial Sources of Flood Risk

4.4.1 Figure 7 (subsequent page) shows an extract of the EA's online Reservoir flood map; Appendix D shows the EA's reservoir flood map in full.

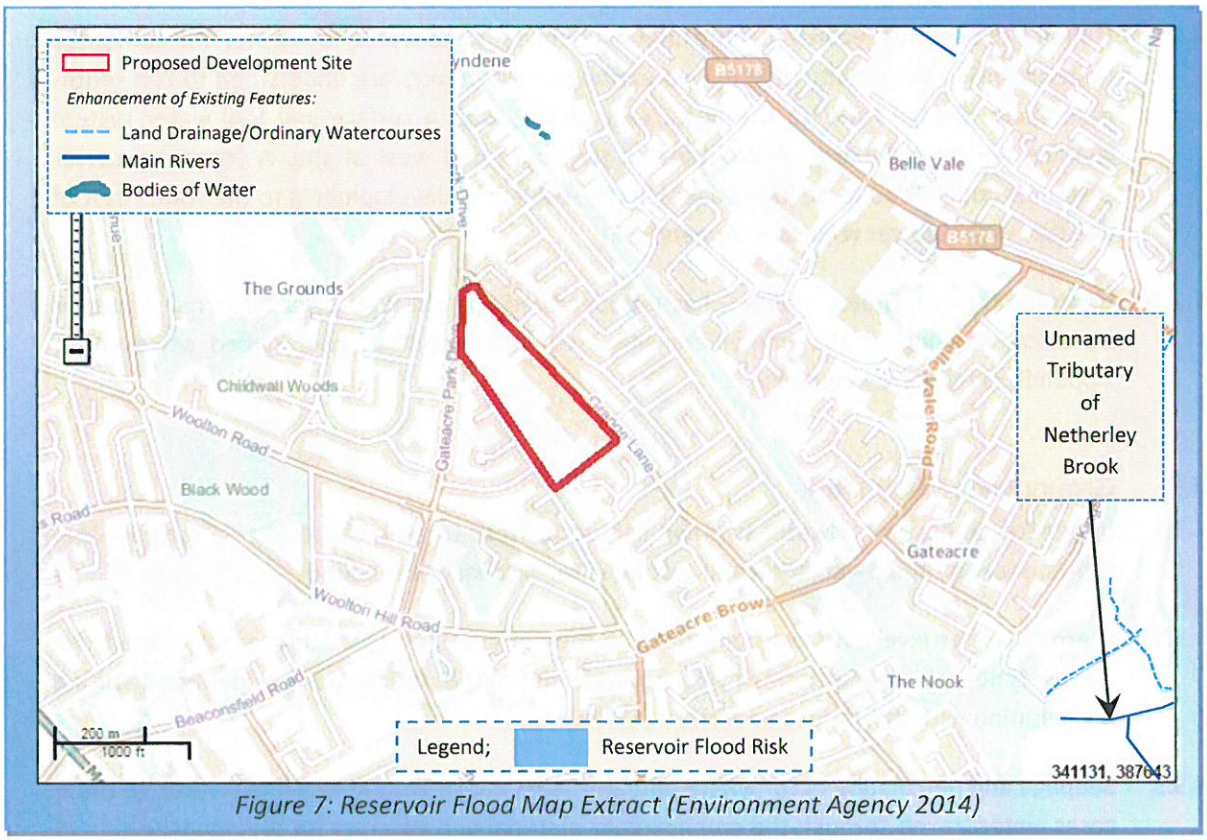

Figure 7: Reservoir Flood Map Extract (Environment Agency 2014)

Reservoirs

4.4.2 The EA recognises reservoirs as bodies of water over 25,000 cu.m, there are no EA identified reservoirs within the vicinity of the proposed development site; therefore the risk of flooding is considered to be 'very low' (as indicated in Figure 7).

4.4.3 As indicated in Figure 7, there are a few smaller bodies of water (less than 25,000cu.m) located within 2km of site, furthermore a small pond feature is understood to be located within the boundaries of site, however due to the scale and nature of these identified sources the associated risk is considered to be very low.

Canals

4.4.4 The nearest identified canal systems to the proposed development site is the 'Leeds and Liverpool Canal' approximately 9km to the north-west of site, due to the distance between this source of artificial flooding and the proposed site, combined with the understanding of the catchment characteristics, the associated flood risk to site is considered to be 'low'.

4.4.5 Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the Finished Floor Levels elevated relative to the externals, this should help create an overland flood flow route in the event of a breach or any other source of flooding that could lead to overland flow

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's Preliminary Flood Risk Assessment (PFRA), did not highlight any historic flooding pertinent to this FRA (some mapping data is included in Appendix L).

4.5.3 Consultation with various interested parties including Liverpool City Council, United Utilities and the Environment Agency, failed to highlight any historical flooding to the immediate site area or the neighbouring area (see correspondence in Appendices).

4.6 Flood Risk Mitigation Measures & Residual Risks

4.6.1 The proposed development site is located solely within Flood Zone 1 and in accordance with the NPPF no specific mitigation measures are required. A more conservative approach to flood risk management has been adopted as part of this FRA and mitigation measures have been considered below, to secure the development for its design life, taking into account the impacts of that mitigation on flood risk elsewhere within the catchment.

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

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

4.6.6 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.

4.6.7 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.

4.6.8 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.

Residual Risks

4.6.9 The development is accessible for emergency access and egress during times of extreme flooding, as the 100 year floodplain does not extend into the proposed development area.

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 M) in the event that the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The surface water run-off generated by the existing development onsite discharges to the public sewer network located within Grange Lane to the east of site. The total site area is approximately 8.249ha and is considered to be 32% impermeable at present.

5.1.2 The peak rate of run-off generated by the existing development during the annual return period event is calculated to be approximately 100.6l/s. The peak rate generated by the development during the 1 in 100 year return period event is calculated to be approximately 313.4l/s.

5.1.3 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.

5.1.4 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 3187.5cu.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 an increase in the impermeable areas of the site, resulting in an increase in both the volume and the peak rate of surface water run-off if flows are unrestricted.

5.2.2 The proposed impermeable area will be approximately 4.046ha; approximately 49% of the total development area (refer to Appendix J).

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 3387.3cu.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.

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 Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Opportunities should be taken to provide soft landscaping

where at all possible on site to assist in minimising surface water run-off; added benefits would include improved bio-diversity and visual enhancement.

5.3.4 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.

5.3.5 The exact SuDS features to be incorporated into the proposals are to be determined during the detailed design stage however the use multiple of the methods discussed above would significantly reduce the surface water run-off due to the proposals.

5.4 Methods of Surface Water Management

5.4.1 At present the site is considered to be predominantly undeveloped, the total site area covers approximately 8.249ha. The proposed impermeable area of the development is will increase from approximately 2.624ha (32%) to approximately 4.046ha, which accounts for approximately 49% of the total site 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) mapping data indicates that ground conditions are as follows:-

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

5.5.3 The Cranfield Soil and Agrifood Institute Soilscapes soil type viewer identifies the soils as; Naturally wet very acid sandy and loamy soils. The area is understood to drain to local groundwater although drainage is described as being naturally wet.