



Persimmon Homes Countryside

Proposed Residential and Commercial Development on Land at Maghull East

Flood Risk Assessment

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Flood Risk Assessment



Report Control

REPORT Flood Risk Assessment

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1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

Persimmon Homes and Countryside have commissioned WYG Engineering Ltd to undertake a Flood Risk Assessment (FRA) in respect of the proposed development on a 84 ha site at Maghull East, hereafter referred to as the Development Site.

This report has been prepared to support the Sefton Borough Council's allocation within the Local Plan.

1.2 PROPOSED DEVELOPMENT

The proposed development is to consist of up to 1400 dwellings, a 1.0 ha Local Centre, 20 ha of B1 (Business) development, 20 ha of open space together with the associated required infrastructure all as shown on the Indicative Masterplan contained within Appendix A.

The development site is to be located on land that is currently used as agricultural land and is therefore deemed a green field site in flood risk terms.

1.3 REQUIREMENT FOR FLOOD RISK ASSESSMENT

As part of the development site is in excess of 1 ha, partially within Flood Zones 2 and 3 and within a Critical Drainage Area, then this FRA has been prepared to identify the existing flood risks and how these will be mitigated within the proposed framework plan.

1.4 SCOPE OF THE FLOOD RISK ASSESMENT

The FRA will be undertaken in accordance with the guidelines of the Environment Agency Flood Risk Assessment (FRA) Guidance Note 3.

The FRA will assess the existing flood risk to the site and identify any necessary mitigation measures and also establish an outline management regime for surface water runoff from the site such that flood risk to adjoining areas is not exacerbated. If not managed properly, surface water runoff from the site could potentially lead to increases in flood risk to other areas or the development itself.

In line with the Planning Practice Guidelines (Flood Risk & Coastal Erosion), the FRA will also consider other potential sources of flood risk, such as sewers, overland flow routes, groundwater flooding, reservoir flooding, and minor watercourses not shown on EA flood map.



Flood Risk Assessment

It should be noted that as this FRA has only been prepared to provide an assessment of the existing flood risks and consider outline surface water management strategies. Therefore specific detailed drainage measures will not be discussed, but rather the report will seek to identify a feasible proposed surface water drainage strategy compliant with national guidelines that can be developed further during the future planning applications for the development.

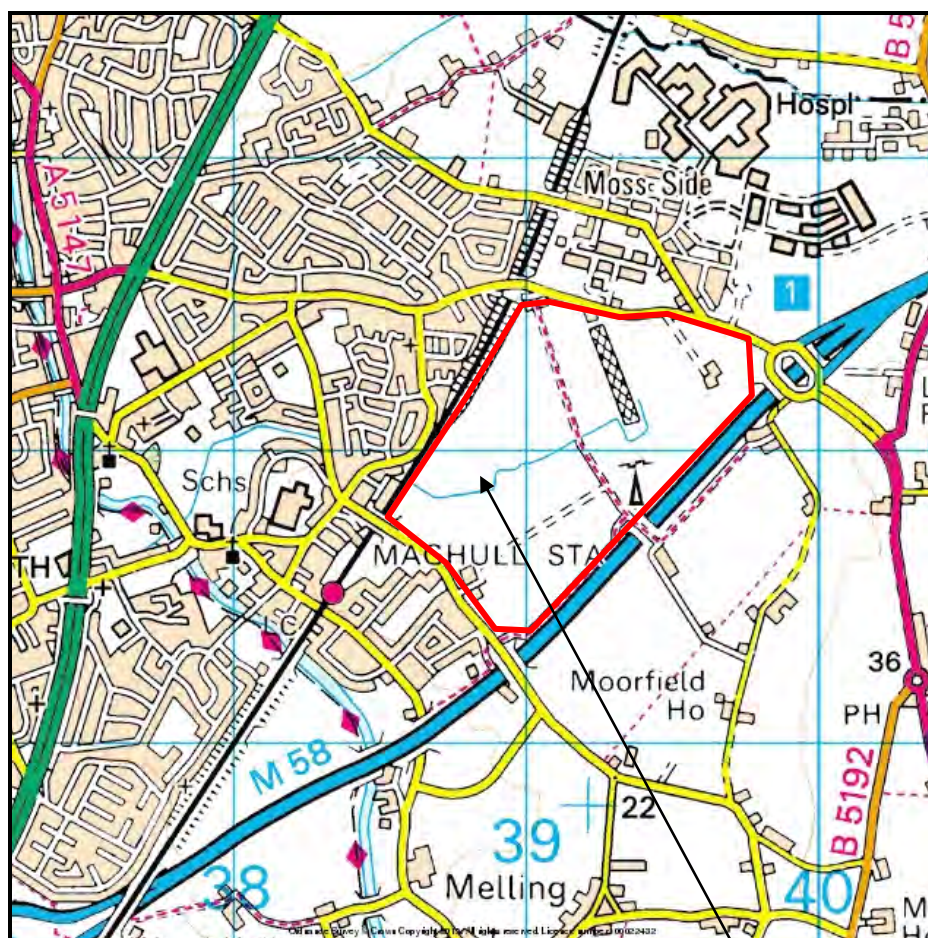
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2 SITE DESCRIPTION

2.1 EXISTING SITE

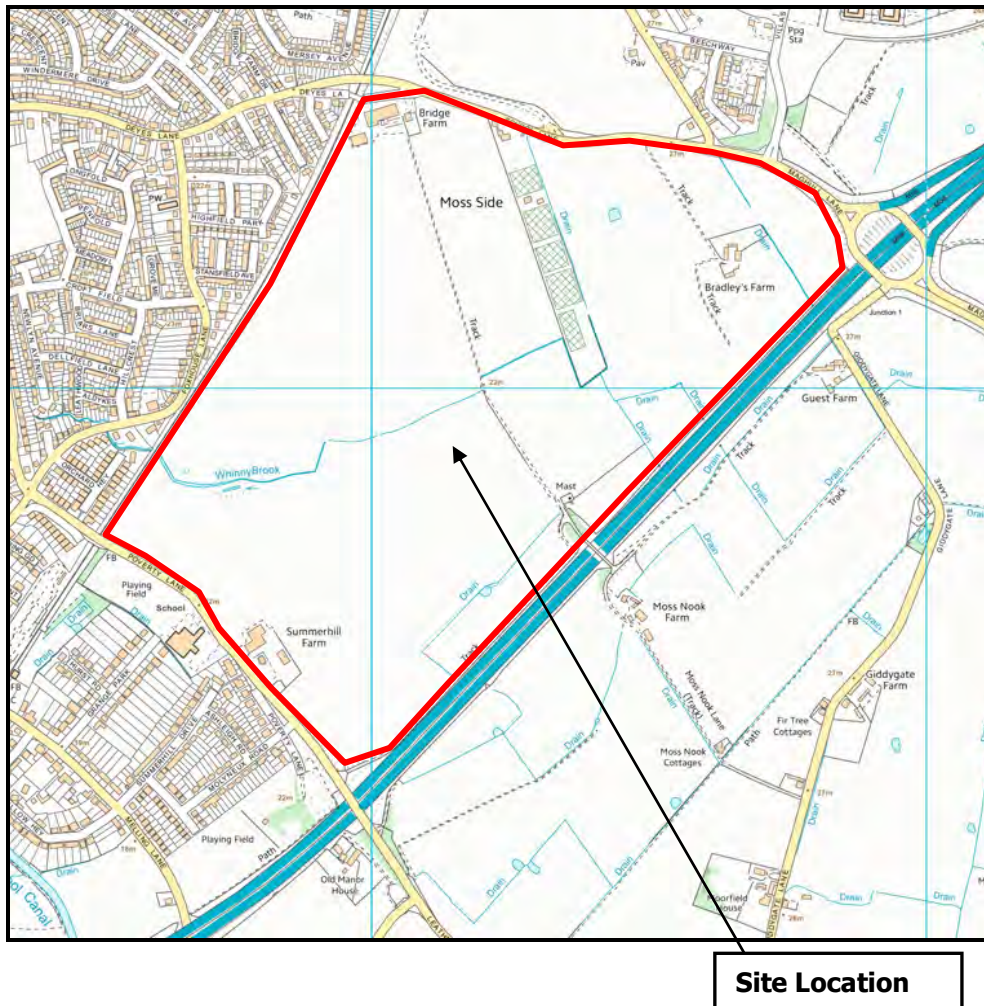
The development site covers an area of approximately 84 ha and is located to the north of Poverty Lane in Maghull, Liverpool as shown in Figure 1 and Figure 2 below.

Figure 1 – Site Location¹



Site Location

Figure 2 – Site Plan



The development site is currently used for agricultural purposes.

The development site is bounded by Poverty Lane to the south and by the Northern Line of the Mersey Rail network along the western boundary with the railway line mainly being in a cutting. Along the northern boundary the site is bounded by School Lane and along the eastern boundary by the M58 which is set on an embankment at a higher level than the development site.

Within the northern part of the development site there are several existing buildings, these being Bridge Farm which is located within the northern part of the development site, disused greenhouses within the northern central part of the development site and Bradleys Farm within the north eastern part of the development site. Summerhill Farm is located within the southern part of the development site.

No topographic survey data was available in preparing this report and therefore LIDAR data was obtained to assess the existing site levels.

Flood Risk Assessment



A review of this data has identified that the site predominantly falls from the north east to the central part of the site into Whinny Brook. Similarly the development site falls from the south east to the central part of the site, again into Whinny Brook. Although at a lesser gradient, the site also falls from both the eastern and western boundaries into the central part of the development site, again falling towards Whinny Brook.

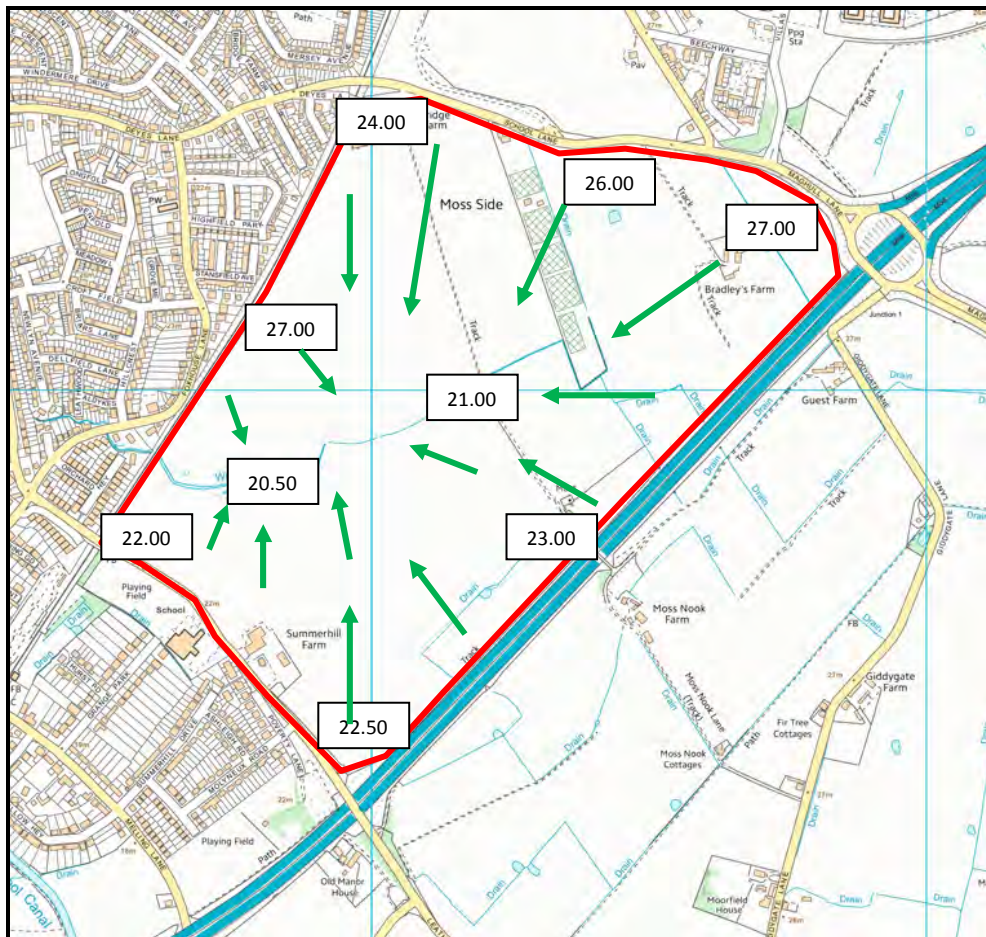


Figure 3 – Plan Showing Existing Principal Levels and Site Falls

A copy of the more detailed site levels based on the LIDAR data is contained within Appendix B

2.2 EXISTING RIVERS AND WATERCOURSES

2.2.1 Main Rivers

The nearest main river is Whinny Brook, which although it drains through the central part of the site, is only designated (according to the Environment Agency Flood Maps) as being a Main River on the western side of the railway line. To the west of the development site Whinny Brook drains to the west through an urban area where it is partially culverted before discharging into Dover's Brook and eventually into the River Alt.



Flood Risk Assessment

2.2.2 Ordinary and Manmade Watercourses

There are numerous ordinary watercourses within the development site with the key watercourse being Whinny Brook which drains from the central part of the development site to the south west and under the existing railway line. There are numerous other smaller watercourses which drain from outside of the development site into the site and these are described along with Whinny Brook in more detail below.

a) Whinny Brook

This watercourse drains from the central part of the development site towards the western boundary where it flows under the railway line via what is understood to be two 800mm diameter culverts which have an approximate bed level of 18.65m AOD.

From information supplied by the Environment Agency it is understood that there are restrictions within the two culverts under the railway line which restrict the flows and as part of any future drainage works it is recommended that a full survey is undertaken to identify these structures to assess their impact on the upstream flood risks.

The length of the watercourse within the development site is a total of 850m of which the first 350m consists of a 2m wide channel with approximate bank slopes of 1 in 1 with the sides of the channel being heavily vegetated. Over the remaining 500m the watercourse is narrower with a bed width of 0.75m at the downstream end reducing to 0.3m at the upstream end. At about Ch 700m the watercourse is culverted by a short section of 300mm pipe which is reflected within the model data as this presents a restriction to the flow and an increased flood risk due to backing up of the flows.

Within the lower part of the watercourse (Ch 150 to Ch 230m) there is an adjacent linear pond which was constructed by the farmer (around 2000) to overcome some localised water logging of this area during times of heavy rainfall. It is understood from the farmer that this additional storage area has resulted in no flooding having occurred since it was constructed over 15 years ago.

b) Watercourse A

Within the north eastern part of the development site, Watercourse A flows into the site and then out under the M58 before discharging into Watercourse B. Watercourse A is a shallow ditch system and drains some highway drainage from Park Lane and Maghull Lane.

Flood Risk Assessment



c) Watercourse B

This watercourse is a shallow ditch system and drains an area to the east of the M58 and receives the flow from Watercourse A before draining westwards under the M58 into the development site and discharging into Watercourse C.

d) Watercourse C

This watercourse is a shallow ditch system and drains a ditch system from the eastern side of the M58 and also receives the flow from Watercourse B. Watercourse C discharges into Watercourse D.

e) Watercourse D

This watercourse which is a shallow ditch system and receives an element of highway drainage from School Lane at its upstream section and then drains south east around the perimeter of the old greenhouses. The watercourse then drains to the west for a short distance receiving the flows from Watercourse C before draining to the north into the head of Whinny Brook.

Watercourse E

This watercourse which is generally a shallow ditch system where it drains from the east under the M58, but becomes deeper as it drains north east through the site. At a point adjacent to the existing access track into the development site the watercourse appears to become culverted via a 300mm diameter pipe and drains to the north east. A similar sized pipe was identified draining into Whinny Brook at the assumed point of discharge, although this will be required to be confirmed by a drainage survey at a future date.

It should be noted that during the walkover survey undertaken in September 2013 all the watercourses were dry and heavily vegetated and showed no signs of any maintenance. During this walkover some standing water was noted within the lower sections of Whinny Brook and this may be due to the restrictions under the railway section identified under Section 2.2.2 (a)

A plan showing the location of the various watercourses is shown in Figure 4 below.

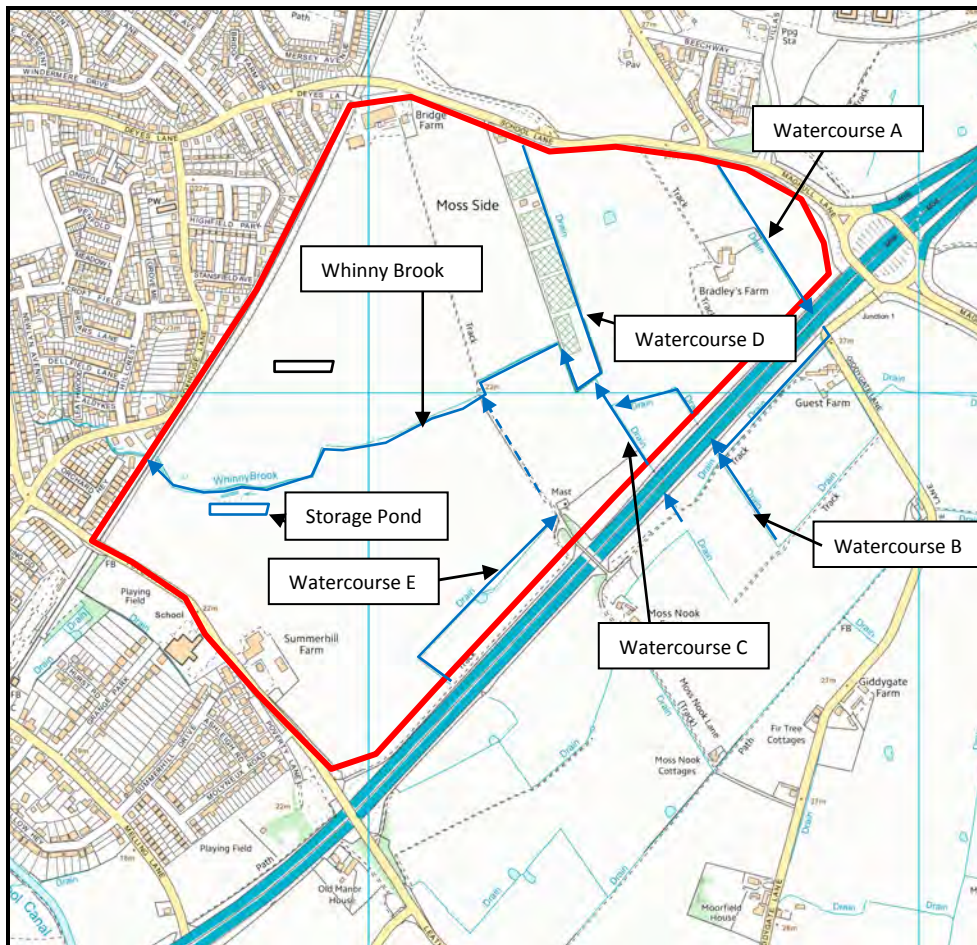


Figure 4: Plan showing Existing Watercourses within the Development Site

2.3 EXISTING SEWERS

United Utilities Sewers

There are no public or private sewers located within the development site, although elements of highway drainage discharge into the watercourses adjacent to School Lane and Maghull Lane.

The nearest public sewers are a 225mm diameter combined public sewer located within School Lane to the north west of the development site and a 150mm diameter public combined sewer located within Poverty Lane to the south of the development site. Also within Poverty Lane is a 225mm diameter highway drain which drains to the east and discharges south east under the M58.

Within the urban area to the west of the railway line there are numerous public combined and surface water sewers which all drain to the north and west away from the development site.

Copies of the relevant sewer records are contained within Appendix C

Flood Risk Assessment

3 FLOOD RISK

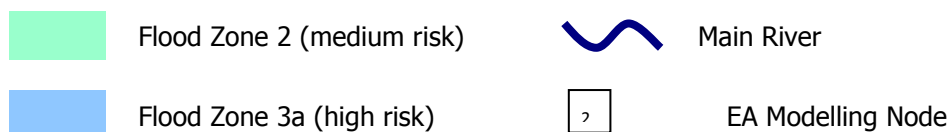
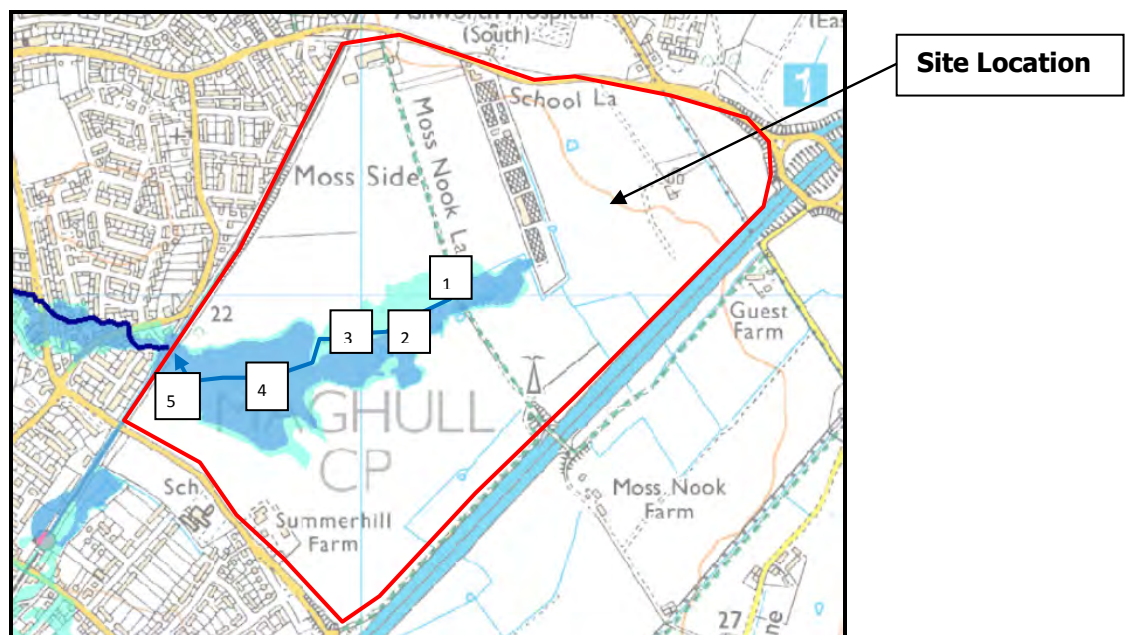
3.1 FLUVIAL FLOOD RISK

Fluvial flood risk is the risk arising from rivers and watercourses.

3.1.1 Environment Agency Data Review – Fluvial Flooding

According to Flood Risk Mapping for Planning provided by the EA, the site is predominantly located within Flood Zone 1 (i.e. land outside the extent of the 0.1% AEP (1 in 1000) risk of flooding from a major river in any one year). However, within the western and central part of the development site there is an area of both Flood Zone 2 (i.e. land assessed as having a between a 1 in 100 and 1 in 1,000 annual probability of river flooding) and Flood Zone 3 (i.e. land assessed as having a 1 in 100 or greater annual probability of river flooding). It should be noted that the extent of the Flood Zones 2 and 3 areas are directly attributed to Whinny Brook which drains through the development site to the west.

Figure 5 - Environment Agency Flood Map for Planning (downloaded 19th March 2015)





Flood Risk Assessment

3.2 DETAILED REVIEW OF FLOOD DATA

3.2.1 Flood Levels

In order to better understand the nature of the flood risk associated with Whiny Brook, Flood Product 4 was obtained from the Environment Agency and this provided flood model data from the Maghull Model Study undertaken in 2010.

Flood data was provided for 5 locations along the line of Whinny Brook and included flood levels for the 1 in 10 year, 1 in 50 year, 1 in 100 year, 1 in 100 +CC and 1 in 1,000 year storm return periods and these are shown in Figure 5 above.

Utilising the LIDAR data and the information obtained during the site walkover, these flood levels were combined and a revised more detailed flood outline derived. In general the revised outline was similar to that shown on the EA current flood mapping, however the extent of the Flood Zone 3 and 2 outlines were less between points 2 and 4 of the EA outline.

A copy of the Flood Product 4 data provided is contained within Appendix D and the plotted flood outlines (based on the LIDAR data) plotted against the framework plan is contained within Appendix F.

3.2.2 Impacts of Flooding

From a review of the flood data supplied and its transposition onto the LIDAR data, it can be seen that as the flood waters from the various watercourses upstream of the railway line converge to point 5, the flows are restricted where the waters flow through the existing culverts (and previously identified restrictions) resulting in backing up of the flood waters. As the flood waters increase the flood water not only backs up into the development site but also onto the lower lying land of the adjacent railway line resulting in flooding of the railway line which then drains to the south west.

Based on the flood data provided it can be shown that flooding starts to occur at relatively low level storm durations i.e. the 1 in 10 year storm event as the adjacent ground level at point 5 is only 20.00m AOD with more extensive flooding occurring during storm events greater than the 1 in 50 year storm event. Further upstream the impacts of the flooding only become relevant during storm events in excess of the 1 in 50 years.

A preliminary review of the 1 in 100 year storm event indicates that the volume of flood waters stored within the development site is approximately 19,000m³ excluding any additional flows which subsequently flow south west along the railway line.

Flood Risk Assessment



It should be noted that this assessment is only preliminary and will require to be reviewed following the detailed flood modelling that is proposed to be undertaken to support any future planning applications with such modelling incorporating the findings of the survey of the existing culverts under the railway line.

3.3 ENVIRONMENT AGENCY - CONSULTATION

As part of the request for the Flood Product 4 data a pre development consultation was also obtained from the Environment Agency.

The key issues identified within the consultation were as follows:

- a) Provision of a detailed flood map which confirmed the above flood zoning.
- b) Allocate green space to those areas identified as at flood risk.
- c) Housing should not "back onto" the watercourse, ensuring that an 8m easement is preserved.
- d) Finished Floor Levels should be at least 300mm above the 1 in 100 year plus climate change flood level.
- e) Surface water run-off generated from the site should be limited to Greenfield rates, using SUDs where possible, preferably infiltration methods.
- f) Take into consideration the potential blockage of culverts. The potential of the blockage of the culvert under the railway should also be considered as part of the Flood Risk Assessment.
- g) That the existing structures under the railway line provide a positive attenuating effect to the flood zoning downstream by providing a level of attenuation

The above issues will be dealt with in more detail under Section 4 Proposed Mitigation.

A full copy of the consultation received from the Environment Agency is contained within Appendix E.

3.4 SEFTON METROPOLITAN BOROUGH COUNCIL - CONSULTATION

A consultation was issued to Sefton MBC in respect to the proposed development and as part of their response they provided a summary of the Sefton MBC SFRA dated 2013 which confirmed the following

- a) That the extent of the flood zoning was as shown on the current Environment Agency Flood Maps
- b) That the watercourses identified within Section 2.2.2 reflect the SFRA.

Flood Risk Assessment



- c) That the modelled flood depths in relation to the 1 in 100 plus CC event on Whinny Brook where it is within the development site were between 1m at the downstream section of Whinny Brook and less than 0.1m at the upstream section, with the corresponding velocities being 0.2m/s and less than 0.1m/s.
- d) That parts of the site were at risk of surface water flooding in particular the areas associated with the flooding of Whinny Brook and in addition an area within the south eastern part of the development site.
- e) That the development site is not susceptible to groundwater flooding.
- f) The development site is not at risk of reservoir flooding
- g) No historical flooding has been identified within the development site
- h) The development site is located within an area considered to have a "Very High" suitability to SUDS techniques(e.g. infiltration techniques)
- i) The development site is within a Critical Drainage Area (CDA) this mainly being CDA 04.
- j) Opportunities exist to increase ground levels and to provide compensatory storage to increase the potential area of development.
- k) Consideration will be required to consider overland flow paths as a result of any changes to the existing flood flow paths and flood levels should be set at least 150mm above future ground levels to facilitate this.
- l) Site permeability testing should be undertaken to fully assess the use of SUDs infiltration techniques

A copy of the consultation received from Sefton MBC together with the additional site specific SFRA details are contained within Appendix G.

3.5 CRITICAL DRAINAGE AREA

As stated above the development site is located with CDA 4 and a more detailed review was undertaken of this issue based on the study undertaken as part of the Sefton MBC Surface Water management Plan dated 2011.



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Within this report a CDA is defined as

"A discrete geographical area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones (LFRZ) during severe weather thereby affecting people, property and local infrastructure."

Furthermore a CDA is in effect *"land within a Critical Drainage Area either contributes to flooding within a LFRZ or acts as a pathway for the water that contributes to that flooding. At the outlet of the CDA, the land may be within a LFRZ and could therefore also be a receptor. Measures taken within a CDA to either increase infiltration or reduce surface water runoff would therefore contribute towards a reduction in flood risk within a LFRZ"*.

The assessment identified that there are flooding and drainage issues further to the west of the railway line although none specifically within the development site. However, it is understood that areas to the east of the M58 contribute to some potential LFRZ's within the development site due to insufficient information about any culverts under the M58 this could not be assessed in more detail and that further investigation is required to fully understand the existing flood risk arising from these culverts and flows from the upstream watercourses.

Recommendations within the SWMP in relation to CDA's identify that where possible the following should be incorporated into any development proposals:

- a) That future surface water runoff should be restricted to existing green field runoff rates and where possible existing volumes
- b) Surface water should in line with the Building Regulation hierarchy seek to discharge to soakaways, then watercourses and finally sewers
- c) All developments should seek to include at least one "at source" SUDs measure and where this is not possible provide sufficient information to demonstrate why this is not feasible.
- d) Review options to improve blockages of existing watercourses by the installation of trash screens
- e) Review options to provide additional attenuation upstream of LFRZ to reduce the existing flood risk.



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3.6 SEFTON MBC - STRATEGIC FLOOD RISK ASSESSMENT (SFRA)

A further review was undertaken of the Sefton MBC SFRA (updated in 2013) to identify any additional flood risks to the development site not outlined in the summary report provided by Sefton MBC and discussed in detail under Section 3.4 and this did not identify any additional flood risks nor that the development site has experienced any historical flooding.

3.7 SEFTON MBC – PRELIMINARY FLOOD RISK ASSESSMENT

A review was undertaken of the Sefton MBC Preliminary Flood Risk Assessment dated May 2011 and this did in general not identify any additional flood risk issues although there is reference in the EA historical map to a historic flooding incident occurring adjacent to Whinny Brook on the western side of the railway line.

3.8 SEWER FLOODING

No information has been provided by United Utilities in respect to any DG5 flooding incidents within or adjacent to the development site although the Sefton MBC does identify some sewer flooding incidents in the urban areas to the west and south of the development site.

3.9 SURFACE WATER FLOODING

Surface water flooding occurs where high rainfall events exceed the drainage capacity in an area (i.e. sewer system and/or watercourse), leading to flooding.

The Sefton MBC SFRA and SWMP both have identified that the areas adjacent to Whinny Brook and an area to the south east of the developments site are within areas of risk of surface water flooding as a result of the 1 in 100 year plus CC storm event.

A review as also undertaken of the latest Environment Agency Risk of Flooding from Surface Water Map which confirmed the development site is primarily at risk of surface water flooding from storm events between the 1 in 30 and 1 in 100 year storm event with flood depths up to 900mm within the areas adjacent to Whinny Brook.

This is in contradiction to the data set provided within the SFRA reports and further investigation is required to verify the true extents.

It should be noted that the Sefton and Environment Agency maps are based on different time sets and associated datasets and this may explain the variance.

An extract of the Environment Agency's Risk of Surface Water Flooding map is shown below in Figure 6 below

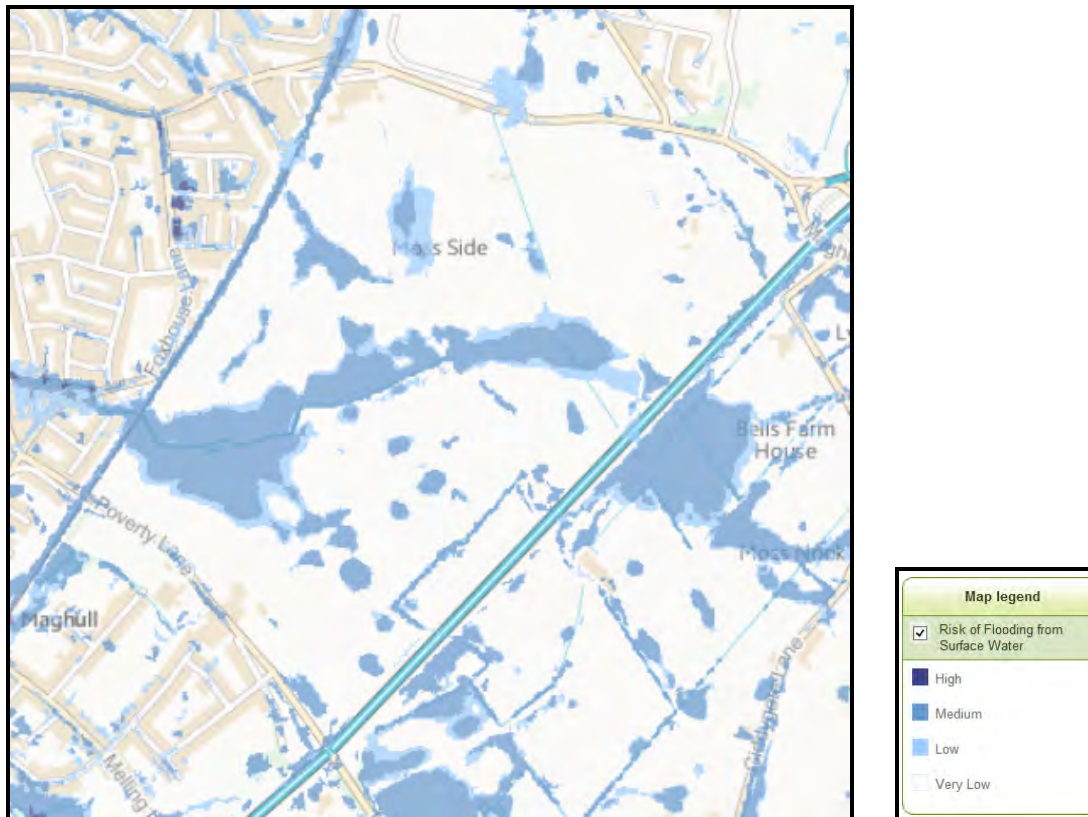


Figure 6 - Extract from the Environment Agency's Risk of Flooding Surface Water Map

3.10 RUNOFF FROM OVERLAND SOURCES

3.10.1 Assessment of Existing Overland Flows into the Site

Examination of the topography of the area surrounding the site shows that land to the east is intercepted by the raised section of the M58 which restricts any overland flows entering the development site other than by any existing culverts which drain under it and these have been taken into consideration within the fluvial flow assessment. The area to the north is although being slightly higher but drains to the north into Downholland Brook. The area to the east is intercepted by the existing railway line which is at a lower level and results in overland flows draining to the south west whilst the area to the south falls to the south away from the development site. Therefore the risk of overland flows to the development site is considered low.

3.11 GROUND WATER

A review of the EA's Ground Water Source Protection Zone (GWSPZ) map for the development site location shows that the site is located within GWMPZ 3.



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These zones show the risk of contamination from any activities that might cause pollution in the area. It is considered that the closer the activity is to a GWSP zone, then the greater the risk. This is of significance for any future development where the surface water drainage will be reliant on the use of infiltration based methods. As such the use of infiltration based methods would not be restricted from a GWSPZ perspective.

3.11.1 Groundwater

No site specific data was available in preparing this assessment and therefore a review has been undertaken of the BGS database and this identified that the development site is underlain by the Shirdley Hill Sand formation and that there is no indication of a high groundwater table. This is in line with the information contained within the Sefton MBC SFRA.

3.12 RESERVOIR FLOODING

Although the probability of a catastrophic dam failure is considered to be extremely low, the consequence of such an event would be severe. A review of the EA online 'Risk of Flooding from Reservoirs' identified that the site is not at risk of flooding as a result of reservoir failure.

3.13 OTHER SOURCES OF FLOOD RISK

From a review of the topographic survey, a walkover of the development site and all other publically available sources no other sources of flood risk were identified.

3.14 SUMMARY OF FLOOD RISK

3.14.1 Overview of Flood Risk

Based on the above it can be seen that the site is considered within the central part of the development site adjacent to Whinney Brook to be at medium risk of fluvial and surface water flooding and at low risk of flooding from all other sources.

The remainder of the development site outside of the above areas are considered to be at low risk of flooding from fluvial, pluvial, sewer, groundwater, and overland flows sources and from reservoir failure.

However, it will be essential to ensure that no increase in flooding occurs downstream of the site as a result of the development and this matter is discussed in more detail within Section 4.



4 DEVELOPMENT PROPOSALS

4.1 PROPOSED DEVELOPMENT

The proposed development is to consist of up to 1400 dwellings, a 1.0 ha Local Centre, 20 ha of B1 (Business) development, 20 ha of open space together with the associated required infrastructure all as shown on the Indicative Masterplan contained within Appendix A.

4.2 SEQUENTIAL TEST

One of the aims of NPPF is to steer development away from zones of high flood risk towards Flood Zone 1. The development is classified as 'More Vulnerable' in accordance with Table 2 of the PPG (Flood Risk & Coastal Change) and as identified within Section 3.1 is partially located at present within Flood Zones 2 and 3 with the remainder of the development site being located Flood Zone 1.

As part of the proposed mitigation measures it is proposed, by undertaking earthworks to reconfigure the existing flood zones and align these parallel to Whinny Brook, to remove the flood zones outside of the developed areas and this is discussed in more detail within Section 4.2.

By adopting a new sequential layout this will enable the development to comply with the requirements of both the PPG and Sefton MBC planning policies and remove the requirement for both the Sequential and Exception tests.

4.3 MITIGATION MEASURES

4.3.1 Flood Risk

As identified within Section 3.14.1, the area where development is proposed adjacent to Whinny Brook is currently located within Flood Zones 2 and 3 and will in its current state not permit development to be located within this zone and a preliminary assessment has identified that the extent of the Flood Zone 3 flood waters is approximately 19,000m³.

The framework plan has identified a nominal 80m wide greens pace along the Whinny Brook corridor which provides the opportunity to incorporate some flood compensatory works and the creation of a blue corridor within this area either side of Whinny Brook.

Therefore it is proposed to undertake flood compensatory works along this section which will consist of lowering the land either side of Whinny Brook to provide not only sufficient compensatory flood storage to retain the existing flood volumes but also to provide an element of betterment to remove the existing flooding of the railway line.



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The flood storage can be provided by creating a series of stepped shallow terraces each with a height between 300 and 500mm within an overall zone of 40m. Such a design will allow the area to be fully accessible and to be utilised as an open space and also to allow access to Whinny Brook and retain the 8m access zone each side as required by the Environment Agency. In addition the lower sections of the terraced area could be enhanced with suitable planting and water features to significantly improve the ecological habitat along this section thus creating a blue corridor through the development site.

As part of the flood compensatory works it will be necessary in two locations to modify the alignment of Whinny Brook to remove the sections which bend closer to the proposed development. Also as part of the improvements the short section of existing culvert will be removed improving the flows from within the upstream section.

An indicative plan showing the outline extent of the proposed flood compensation works is contained within Appendix H.

It should be noted that as part of any future planning applications it will be necessary to undertake a detailed hydraulic assessment of the section of Whinny Brook to identify in more detail the extent of the existing flood zones and also the exact flood volumes. This assessment will be in two parts, firstly to update the current Environment Agency Whinny Brook hydraulic model based on the results of the detailed survey of the existing culverts under the railway line and based on a detailed topographic survey of the site and the Whinny Brook profile. The second model will be to test the proposed flood compensatory works to ensure that the flood volumes can be retained within the new profile and also to identify the extent of any improvement to reducing the existing flooding of the railway line.

Also as part of the future assessment work in relation to the Flood Compensatory works and their impact on Whinny Brook it may be required to undertake a Water Framework Assessment on the implications on the proposed works to assess any impacts within the section of Whinny Brook which is main river downstream of the development site and further consultation with both the Environment Agency and Sefton MBC (LLFA) is required to clarify this requirement.

4.3.2 Surface Water

The other identified flood risk is that due to surface water flooding and it is proposed to mitigate this via three elements.

Any flood risk arising from Whinny Brook will be mitigated by the flood compensatory measures and secondly the flood risk arising from the existing watercourses will be mitigated by diverting and improving the flow characteristics of the retained watercourses. Finally by restricting the surface water runoff to the



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greenfield Q_{bar} discharge rate there will be a significant reduction in runoff rates to a level lower than exists at present (i.e. runoff in excess of the 1 in 2.33 year storm events and above).

4.4 FLOOD RISK ARISING FROM THE DEVELOPMENT

The new development will result in the development of a greenfield site in flood risk terms, therefore in accordance with the requirements of Planning Policy EP8 (Flood Risk) it will be required to not increase the risk of flood risk to adjacent areas and to ensure that flood risk with the development site is managed for all storm events up to and including the 1 in 100 year plus climate change storm events.

Policy DQ5 (Sustainable Drainage Systems) also requires the use of Sustainable Drainage Systems where viable.

4.5 PROPOSED SURFACE WATER DRAINAGE STRATEGY

4.5.1 General Strategy

As stated previously, this FRA will not be providing any detailed surface water drainage proposals and these will be provided at a later date to support the future planning applications.

This report will therefore only consider and discuss the outline surface water design principles which are to be developed and agreed with the LLLFA (Sefton MBC) as part of the later planning application process.

As the gestation period of the planning application leading up to resolution of a detailed approval for the site will in reality extend to mid 2016, it is proposed to adopt the design principles within the possible new SUDS legislation which will require any new surface water designs to comply with the National Standards and Guidance Notes as will be contained within Schedule 3 of the Flood & Water Management Act 2010.

At present the new standards are only available in draft format and are anticipated to be adopted in late 2015 with no details or guidance notes being available currently to establish how the National Standards will be implemented by the LLFA. The following surface water strategy has therefore been based on the draft SUDS National Standards and design principles to ensure that the future detailed design can comply with the new design standards when implemented.

The surface water strategy is based on providing a SUDS design where feasible based on the above and the guidance as set out within The SUDS Manual (CIRIA 697). Further discussion on the SUDS design elements is contained within Section 5.



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4.5.2 Site Specific Strategy

The BGS database identifies the underlying ground to consist of sands (Shirdley Hill Sands) and this would indicate that the use of infiltration techniques can be adopted as the primary means of surface water disposal and therefore localised use of soakaways could be adopted to serve the residential units. Larger impermeable areas such as parking areas, highways and the industrial areas could be drained utilising permeable paving and traditional drainage systems linked to a series of infiltration swales located within the main green space areas (outside of the Flood Zone 3 areas) all of which could drain into Whinny Brook.

In the event that future site investigation and permeability testing identifies that the use of infiltration techniques is not viable, then a similar strategy could be adopted with the swales being enlarged to accept the larger attenuation volumes required, although it is likely that the final strategy will incorporate a combination of the two elements.

4.6 ASSESSMENT OF PRE & POST SURFACE WATER DISCHARGE RATES

4.6.1 Existing Discharge Rates

The site is currently a green field site and drains to Whinny Brook and therefore an assessment of the existing greenfield runoff rates has been undertaken using the ICP SUDs program and Table 2 below sets out the identified green field discharge rates:

Area	1 in 1 year Greenfield Discharge Rate (l/s)	1 in 30 year Greenfield Discharge Rate (l/s)	1 in 100 year Greenfield Discharge Rate (l/s)	Q _{BAR} Greenfield Discharge Rate (l/s)
Residential North	50.4	98.2	120.5	57.9
Commercial Area	43.8	85.4	104.8	50.4
Residential South	37.3	72.6	89.1	42.8

Table 2 – Assessment of Greenfield Runoff Rates

A copy of the associated ICP SUDs Greenfield Calculation is contained within Appendix I.

4.6.2 Proposed Discharge Rates

As discussed previously within Section 4.4.2 it is proposed for the purposes of this assessment to adopt Q_{bar} as the limiting green field discharge rate in order to provide a robust assessment. Future designs and



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assessment may also consider utilising the varying green field discharge rates should a complex flow control device be adopted allowing the various green field rates to be catered for.

4.7 PROPOSED MITIGATION

4.7.1 Flood Risk due to Surface Water Runoff from the Site

In order to ensure that surface water runoff from the site does not cause an increase in flood risk the management of runoff has been considered via a sequential approach, in line with Building Regulations. The following options for the disposal of surface water runoff were considered, in order of preference¹:

- i) A soakaway or some other infiltration system,
- ii) A watercourse
- iii) A sewer

4.6.1.1 Discharge to soakaway

As has been noted in Section 4.6.2 no site specific ground investigation study has been undertaken to provide details of the underlying ground conditions, therefore a review was undertaken of the BGS database which has identified that the underlying ground consists of sands (Shirdley Hill Sands) which would allow the use of infiltration techniques to be utilised as the primary means of surface water runoff discharge.

Site specific infiltration testing will be required to be undertaken in order to confirm that this method is viable and based on the results a site wide surface water strategy developed.

4.6.1.2 Discharge to Watercourse

In the event that the development areas cannot be drained via infiltration techniques, then it is proposed to drain the surface water runoff to Whinny Brook and the adjacent watercourses which in turn drain into Whinny Brook.

With this option it will be necessary to attenuate the runoff restricting the discharge to the relevant Q_{bar} green field discharge rate as identified within Section 4.7.1 and further information regarding the required attenuation is set out in the following sections.

4.6.1.3 Discharge to Sewer

As it is assumed that the surface water runoff will be discharged via either an infiltration based system or to a watercourse, then this option has not been discussed further.

¹ Building Regulations H3(3), Rainwater drainage

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4.8 ASSESSMENT OF PRE AND POST DEVELOPMENT AREAS

In order to consider the impact the development will have on the proposed surface water discharge an assessment has been undertaken on the pre and post development areas.

Due to the magnitude of the development the areas have been split into three primary areas as follows:

- 1 The residential area within the northern part of the development site (including Local Centre)
- 2 The commercial area to the east
- 3 The residential area to the south.

No assessment has been undertaken in relation to the new green space as there will be no impact in relation to surface water runoff in this area.

Based on the current framework plan an assessment of the permeable and impermeable areas is shown within Table 1 below.

Area	Pre Development Permeable (Ha)	Pre Development Impermeable (Ha)	Post Development Permeable (Ha)	Post Development Impermeable (Ha)
Residential North	23	0	9.2	13.8
Commercial Area	20	0	2.0	18
Residential South	17	0	6.8	10.2

Table 1 Assessment of Pre & Post Developed Areas

In undertaking the above assessment no assessment has been undertaken of the existing farm buildings or greenhouses as no details have been made available as to how they drain and they have therefore been ignored in order to provide a robust assessment.

In assessing the post development impermeable areas a figure of 60% has been utilised for the residential development areas and 90% for the commercial areas. These figures will need to be reviewed during any future detailed drainage assessments.

4.9 ASSESSMENT OF POST DEVELOPMENT ATTENUATION VOLUMES

In order to provide an estimation of the future attenuation volumes required, a preliminary assessment using the MicroDrainage modelling programme has been undertaken. It should be noted that the following figures do not allow for any reduction by infiltration and therefore provide a robust assessment.

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Table 1 below provides a summary of the estimated attenuation volumes based on the impermeable areas stated within Section 4.8 and the proposed discharge rates assessed within Section 4.6.

Option	Impermeable area (ha)	Allowable discharge rate (l/s)	1 in 30 year storage (m ³)	Additional storage required to satisfy 1 in 100 (plus 20% CC) exceedance flows (m ³)	Total storage to satisfy 1 in 100 (plus 30% CC) exceedance flows (m ³)
Residential North	13.8	57.9	5,478	4,908	10,386
Commercial Area	18	50.4	8,068	6,955	15,023
Residential South	10.2	42.8	4,049	3,627	7,676

Table 1: Summary of WinDes Quick Storage Calculations

A copy of the preliminary WinDes Quick Storage calculations is contained within Appendix J.

It is envisaged that the 1 in 30 year volume will be retained within a series of swales located within the main development areas linked to a more regional swales system which would in turn discharge either to an adjacent watercourse or direct to Whinny Brook (outside of the remodelled Flood Zone 3 areas). Depending on the final layout and the ground conditions there may be areas where the attenuation may need to be provided by utilising over sized pipe work or below ground storage tanks although the final site layout should seek to minimise these requirements wherever possible.

As discussed previously where infiltration techniques are proven viable then the attenuation swales could incorporate a basal infiltration system to reduce the overall direct discharge to the watercourse.

In respect to the exceedance volumes in excess of the 1 in 30 year storm event as the development site is relatively flat then this should be able to be provided by setting the ground levels such that the area around the detention ponds or within the development areas (i.e. car parking areas and highways) can retain the additional volume without creating any flood risk to either the surrounding properties or outside of the site boundary.

It should be noted that the volumes indicated are preliminary and should be verified as part of the detailed scheme design once the detailed site layout has been established and the exact extent of the developed impermeable areas has been confirmed.



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The outfalls from the relevant attenuation swales or below ground structures will be controlled via a flow restrictor device rated at the relevant Q_{bar} green filed discharge rate or any other future agreed discharge rate.

More specific design details in respect of the proposed attenuation features and details of any alternative storage systems to be adopted are to be submitted as part of any future planning application for the site.

4.9.1 Off Site Improvements

No offsite improvements are anticipated to be required at present although this should be reviewed following the results of the future surveys previously identified.

4.9.2 Minimum Finished Floor Levels & Overland Flood Route

The Environment Agency have requested that the Finished Flood Levels (FFL) of any new buildings within the development site are set at a minimum of 300mm above the adjacent 1 in 100 year plus CC flood level of Whinny Brook.

Although the existing flood levels of Whinny Brook have been provided by the Environment Agency, these will be subject to change following the proposed flood compensatory works and the revised agreed flood levels will be adopted in setting the future FFL's for the development site.

In setting the final external levels for the development it is important to ensure that if flows in exceedance of the 1 in 100 years plus climate change storm event occur, then a suitable overland flood route is provided towards Whinney Brook or the watercourses to ensure no localised flooding of properties occurs within the development.

It should be noted that the finished floor levels of the new buildings are to be set at 150mm above the average ground level and this will ensure that in the event of extensive overland flows then no flooding of the properties will occur.

4.10 DIVERSION AND RATIONALISATION OF EXISTING WATERCOURSES

As part of the proposed framework plan it will be necessary to divert and rationalise the existing watercourses and the proposed works are described in more detail below.

Watercourse A

Where this passes through the north eastern part of the development site it is proposed to divert this around the northern sector of the commercial area with the new watercourse draining along the eastern boundary and discharging into the realigned discharge point of Watercourse E.

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Watercourse B

Where this watercourse drains under the M58 the section within the commercial area will be abandoned and the flows discharged into the realigned Watercourse A.

Watercourse C

As with Watercourse B, where this watercourse drains under the M58 the section within the commercial area will be abandoned and the flows discharged into the realigned Watercourse A.

Watercourse D

The main upstream section of this watercourse will be retained with the downstream section where it drains around the southern section of the disused greenhouses being locally diverted into the head of Whinny Brook

Watercourse E

Where the existing section drains under the proposed commercial development area then this section is to be abandoned and the flows immediately downstream of the section where it drains under the M58 diverted to drain along the eastern boundary and then through the commercial area. At this point the new watercourse will receive the flows from the diverted section of Watercourse A.

Existing Culvert

Where the flows from Watercourse E are currently drained via a 300mm diameter culvert into the upper reached of Whinny Brook, then this section of culvert is to be removed and opened up to provide an additional section of open watercourse.

In order to allow the detailed design of the above watercourse diversions it will be necessary to undertake a detailed survey of the existing watercourses and prior to this survey it is recommended that the watercourses are cleared of any vegetation to enable accurate survey data to be obtained.

Following the survey works, then a detailed hydraulic assessment shall be undertaken of each watercourse taking into account both the existing upstream flows and the proposed flows from the development as identified within the surface water design. The assessment shall ensure that an adequate profile and gradient is provided to ensure that no flooding from these realigned watercourses impacts onto the development.

A plan showing the extent of the retained and diverted watercourses is contained within Appendix K.



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4.11 RESIDUAL FLOOD RISK

If the above mitigation measures are provided as part of the development, it is considered that the primary residual failure would be as a result of some type of failure of the site drainage system during the life of the development. Regular, ongoing maintenance will be required by the final site owner to ensure that the capacity of the system is maintained as it has been designed.

In addition, as discussed above there remains a residual risk of a storm event that exceeds the capacity of the drainage system, as events beyond the 1 in 100 year storm event will not be catered for explicitly.

4.12 FUTURE MAINTENANCE RESPONSIBILITIES

Responsibility for the maintenance of the new and existing surface water drainage systems including any attenuation features will undertaken utilising the options identified within the recent government response to the consultation "Implementing SUDs" (October 2014).

It is anticipated that the future maintenance will be by a management company or alternatively United Utilities and this is to be agreed at a later date and incorporated into the future planning applications under which the impending planning guidance will require details of the maintenance to be defined.

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5 SUDS

5.1 SUDS AND DESIGN PRINCIPLES

As stated above, where it is possible, it is proposed to incorporate a fully compliant SUDS strategy where economically viable in relation to the discharge of surface water drainage from the proposed development.

This section will also seek to identify some of the SUDS systems and techniques which are to be considered and reviewed as part of the proposed detailed surface water drainage design and subsequent planning application for the development site.

Details of the SUDS that will be adoptable will require review on publication of the National SUDS Standards.

5.2 THE SUDS MANAGEMENT TRAIN

The overarching principles of a SUDS system are to minimise the impacts arising from the development on the quantity and quality of the development surface water run-off, whilst at the same time replicating the natural drainage from the site before development.

SUDS key objectives are to minimise the impacts from the development on the quantity and quality of run-off and to maximise amenity and biodiversity opportunities.

The accepted SUDS management train consists of three elements:

Source Control

- Water butts, green roofs, filter drains, pervious surfaces, swales, rain water harvesting

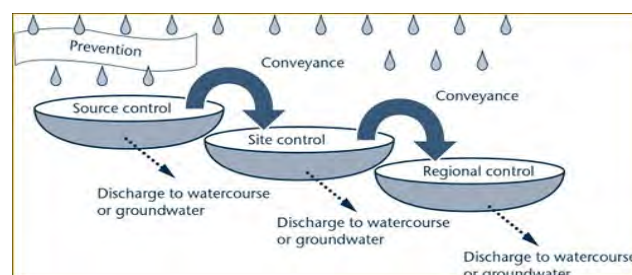
Site Control

- Swales, ponds, wetlands, infiltration devices

Regional Control

- Basins, ponds and wetlands
- Reservoirs

The following is an illustration of these principles and how they may be applied to a development via a SUDS Management Train.



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Various methods are currently available for source, site and regional control. A review has been undertaken of how best the various systems and sub techniques could be incorporated into the proposed surface water management design and these are set out below:

Table 2 - Source Control Methods

Type of SUDS	Description	Applicability to the Site
Water butts	Small storage tanks on each individual housing plot	This is considered to be appropriate for this site.
Grey water recycling	Water collected from residential and commercial use and reused.	This is considered not to be appropriate for the residential areas but could be incorporated into the Commercial areas of the development site.
Rain water harvesting	Recycling of water from roofs and impermeable areas.	This may be appropriate for this site.
Green roofs	Vegetated roofs that reduce runoff and remove pollutants	This is considered not to be appropriate for the residential areas but could be incorporated into the Commercial areas of the development site.
Filter drains	Linear drains or trenches filled with granular material that allow infiltration to the surrounding ground	Subject to a more detailed assessment of the site permeability this may be appropriate for the site.
Pervious surfaces	Surfaces that allow surface water inflow into underlying surfaces	Subject to a more detailed assessment of the site permeability this may be appropriate for the site.
Swales	Vegetated channels to convey store and treat runoff.	The existing levels across the site should allow for swales to be considered to carry flows from the developed area to the proposed detention ponds.
Local Shallow basins/ponds	Shallow areas of open space that temporarily hold water and collect silt	The proposed Indicative Framework Plan has identified suitable locations and subject to further permeability testing these could incorporate infiltration systems. Detention ponds can still be considered to provide on site attenuation. Within the application site compliance to be with proposed SUDS National Standards.

Table 3 - Site Control Methods

Type of SUDS	Description	Applicability to the Site
Swales	Vegetated channels to convey, store and treat runoff.	The use of swales could be appropriate to convey water on the site as part of a site control system.
Shallow basins/ponds/wetlands	Shallow areas of public open space that temporarily hold water and collect silt	Subject to site specific permeability testing, the use of detention basins acting not only to attenuate the surface water runoff but also to allow infiltration may be appropriate.
Infiltration devices	Generally granular trenches or soakaways that store water and allow infiltration to the surrounding ground	Subject to a more detailed assessment of the site permeability this may be appropriate for the site.



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As the proposed SUDS strategy will only be seeking to utilise source and site wide methods, regional methods have not been considered.

5.3 PROPOSED SURFACE WATER DRAINAGE PRINCIPLES

The proposed surface water runoff is being restricted to the existing greenfield runoff rates with above ground attenuation provided via the proposed attenuation features or alternative acceptable SUDS techniques and will therefore meet some of the current SUDS management design guidelines.

Within this site a variety of SUDS techniques can be adopted as it is anticipated that they will be required to comply with the SUDS National Standards which will probably be in force when the subsequent reserved matters planning application is submitted.

In terms of utilising SUDS infiltration systems, a review of the underlying ground conditions has identified that these consist of sands which indicate that use of SUDs infiltration systems may be viable although further permeability testing within the site along with groundwater monitoring is required to fully assess the feasibility of using such techniques within the whole site.

The individual elements of the site wide surface water drainage system are discussed in more detail below:

Residential Areas

Parking areas could utilise permeable paving, which will act as infiltration devices and provide a level of water treatment to the potentially contaminated runoff from the vehicle parking areas.

The use of rain water butts and rainwater recycling could also be promoted in order to reduce runoff and to minimise water consumption.

Commercial Area

As with the residential area parking areas could utilise permeable paving, which will act as infiltration devices and provide a level of water treatment to the potentially contaminated runoff from the vehicle parking areas.

Grey water recycling could be utilised to recycle rainwater for use within the individual buildings. Opportunities exist to incorporate a site wide facility from within the commercial area to recycle rain water within the individual buildings.

The use of green roofs could also be considered within the commercial area in order to reduce the runoff volumes to the off site drainage systems

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Local Swales

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration (where ground conditions permit) and create low flow velocities so much of the suspended particulate load in the surface water run-off settles out, thus providing effective pollutant removal.

The swales would be shallow (i.e. 1m deep) depressions with a grass finish and where ground conditions permit an element of infiltration incorporated within the base filter trench. The route of the swale could follow the edge of the development footprint and discharge into the on site attenuation feature.

Detention Ponds and Attenuation Swales

Detention ponds (also known as detention basins) are dry basins that attenuate storm water run-off by providing temporary storage and controlled release of detained runoff. They are normally vegetated depressions (i.e. grass) that remain mainly dry, except during and immediately after storm events. The detention pond may also incorporate a small permanent pool of water at the outlet to prevent re-suspension of sediment particles by high intensity storms and to provide enhanced water quality treatment for frequent storm events.

The detention ponds may consist of shallow depressions located within the proposed green space between the two development areas and will be approximately 1.5m deep. The sides of the ponds will be approximately 1 in 3 and subject to the final design may incorporate shallow ledges.

The ponds will be designed to incorporate a shallow dish section within the central part to allow low flows to drain to the outfall which will incorporate a below ground flow control device rated to the required green field Q_{bar} runoff rate. At times of high rainfall the pond will fill up to provide the required attenuation and then drain down to maintain a grassed area for general amenity use. Where ground conditions permit, an element of infiltration will be allowed through the base of the pond by utilising a series of below ground filter trenches or drains.

Within the proposed development area, it is assumed that the upstream system may incorporate swales or piped systems or a combination of both to convey the surface water flows and to initially remove pollutants and therefore it is not considered necessary to incorporate a separate sediment fore bay. If however, no swales are to be provided upstream then it may be necessary to incorporate a sediment fore bay.



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Attenuation swales are similar in nature to the detention ponds but are major linear structures and can be incorporated into either the main highway network or within the main green space to be located within the central part of the development adjacent to Whinny Brook. As with the detention ponds where ground conditions permit, an element of infiltration will be allowed through the base of the pond by utilising a series of below ground filter trenches or drains.

In order to provide access for maintenance to the ponds/swales inlet and outlet structures vehicular access will be provided around the structure utilising a grass grid or similar pavement system.

Hydraulic Considerations

The detention ponds and attenuation swales will be designed to provide adequate storage for storm events up to and including the 1 in 30 year event. The exceedance volumes above this storm event up to and including the 1 in 100 year plus 30% allowance for climate change will be provided by setting the ground levels such that the area around the attenuation feature can retain the additional volume without creating any flood risk to either the surrounding properties or outside of the site boundary. Alternatively, the exceedance flows could be provided by allowing the external parking and access roads to flood in accordance with the guidelines set out within CIRIA 635 Designing for Exceedance Good Practice Guide.

House Drainage

Initially, if the ground conditions permit, then conventional infiltration techniques (i.e. soakaways) should be adopted to drain the roof and external hard standing areas.

House drainage (i.e. runoff from roofs and parking areas) could be drained to edge of carriageway swales discharging into collector swales located within the green spaces, which would then discharge into the local detention ponds or below ground storage systems. Alternatively, conventional below ground drainage systems could be utilised to discharge into the collector swales.

Where ground conditions provide adequate permeability, parking areas could utilise permeable paving. Should infiltration not be viable under the permeable paving then it could still be considered to provide a level of water treatment to the potentially contaminated runoff from the vehicle parking areas.

The use of water butts to store runoff from roof areas will also be promoted in order to reduce runoff and to minimise water consumption.

Rainwater recycling should also be considered in order to not only reduce surface water runoff but also to reduce water demand in line with the requirements of the Code for Sustainable Homes.

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Highways

Highways and footways could be designed by eliminating edge kerbing to allow surface water runoff to discharge direct to an edge swale and as this will be a departure from current highway adoption standards further negotiations should be held with the Highway Authority (Sefton MBC). Alternatively, edge filter strips could be utilised to receive the runoff.

In the event that such a design was not acceptable to the Highway Authority, then conventional gulleys could be utilised which would discharge into the edge swale, however this option would result in the swales becoming deeper and their appearance more like a ditch which would create possible maintenance and safety issues. Alternatively, a conventional below ground piped highway drainage system could be considered discharging to either swales or a downstream surface water sewer system.

5.4 EXAMPLES OF SUDS SYSTEMS

Typical details showing how the proposed SUDS techniques can be incorporated into the surface water design for the development are contained within Appendix L.

Subject to the publication of the approved National Standards these details may be subject to review and will need to be incorporated into the final detailed design proposals.

5.5 WATER QUALITY

The SUDS design should seek to provide an appropriate management train of SUDS components to effectively mitigate the pollution risks associated with the different site users.

Within this development, there are two key drivers in respect of pollutant risks to the off site watercourses, these being pollution from vehicle parking areas and pollution from highways.

In accordance with Table 3.3 of The SUDS Manual, the required number of treatment train components required for the development is two.

Reviewing the SUDS options, set out within Section 5.4, it can be demonstrated that up to four levels of treatment may be possible with these being provided by the following systems:

- a) Permeable Paving
- b) Filter Strips
- c) Swales
- d) Detention Ponds



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It can therefore be demonstrated that if during the detailed surface water drainage design, two of the components are not utilised, then an adequate number of treatment components will be provided.

It is recommended that the future detailed surface water drainage design for the development site should provide at least two levels of treatment in respect of water quality where possible. Although possible options have been stated above, alternative SUDS options may also be considered during the detailed design stage which achieves the same water quality objective.

Provided that the above two levels of treatment are provided then there should be no reduction in the overall water quality within the existing watercourses, however consideration should also be made as to the overall water quality objectives of the existing watercourses in particular any downstream ecologically sensitive areas (e.g. SSSI) that may be affected by a change in the water quality regime of the existing downstream watercourses.

5.6 TECHNICAL APPROVAL AND ADOPTION OF SUDS

When the new National Standards have been formally enacted under the Flood & Water Management Act 2010 and if the detailed planning application is submitted after the date of the enactment, it is understood that the SUDS surface water drainage design will have to comply with the published National Standards.

Maintenance will be able to be undertaken by either a management company, the LLFA or alternatively United Utilities and this is to be agreed at a later date and incorporated into the future planning applications under which the impending planning guidance will require details of the maintenance to be defined.



6 CONSENTS REQUIRED

6.1 LAND DRAINAGE CONSENTS

As the proposed development will require modifications to the existing ordinary watercourses and Whinny Brook then it will be necessary to obtain consent under Section 23 of the Land Drainage Act 1991 from Sefton MBC who acts as the LLFA.

6.2 ENVIRONMENT AGENCY

Although none of the watercourses within the development site come under the direct jurisdiction of the Environment Agency as the flood compensatory works will have an impact on Whinny Brook immediately downstream of the site (where it is a Main River) it is anticipated that the proposed works within the development site will require to be agreed with the Agency in order to demonstrate that there is no increase in flood risk within the downstream section of Whinny Brook.



7 CONCLUSIONS & RECOMMENDATIONS

This report has identified the following:

- The development site is shown on the EA statutory Flood Maps for Planning as being predominantly within Flood Zone 1 however, there is a section adjacent Whinny Brook which is within Flood Zones 2 and 3
- The Flood Zones 2 and 3 within the development site have been previously identified as being as a result of the downstream flows being restricted where Whinny Brook drains under the railway line along the western boundary
- The development site is located within Critical Drainage Area 04 as identified within the Sefton MBC Surface Water Management Plan
- The proposed development consists of 1400 new residential units which are identified as being a "More Vulnerable " development and 20 ha of Commercial development which is defined as being a "Less Vulnerable" development in accordance with Table 2 of the PPG (Flood Risk & Coastal Change)
- The development site is currently predominantly used for agricultural purposes
- The nearest Main River is Whinny Brook which is located immediately to the west of the existing railway line that runs along the western boundary
- Within the development site Whinny Brook is the main ordinary watercourse which receives the flows from numerous upstream watercourses and then drains under the existing railway line and to the west.
- Within the development site there are numerous ordinary watercourses some of which receive flows from the north and east and which drain through the development site and into Whinny Brook.
- Flood data obtained from the Environment Agency was obtained and plotted against LIDAR data and information obtained during a site walkover and this identified that the extent of Flood Zones 2 and 3 varied slightly from that shown on the EA data maps although the revised flood zones still impacted on the proposed residential development areas
- Information provided by Sefton MBC identified the development site is located within an area at risk of surface water flooding with this being as a result of flows in Whinny Brook and from the numerous watercourses which drain into Whinny Brook
- The nearest public sewers are located within School Lane to the north and Poverty Lane to the south
- From a review of the information assessed within this report the central part of the development site adjacent to Whinney Brook is considered to be at medium risk of fluvial and surface water flooding and at low risk of flooding from all other sources. The remainder of the development site is considered to be



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at low risk of flooding from fluvial flooding and at low risk of flooding from pluvial, groundwater sources, overland flows and from reservoir failure.

- The Environment Agency and Sefton MBC require that the allowable discharge rates from the development site are restricted to the respective greenfield discharge rates and in order to provide a robust assessment the Q_{bar} discharge rate has been adopted in assessing the required on site attenuation volumes
- The Environment Agency also recommended that the flood zones should be located with open green spaces and that a minimum FFL should be set 300mm above the 1 in 100 year plus CC flood level of Whinny Brook. The EA also requested that SUDs infiltration techniques should be adopted where viable and that further investigation as to the existing restrictions of Whinny Brook where it drains under the railway line is investigated further
- As part of the mitigation measures it is proposed to undertake some flood compensation works to re align the flood zones to ensure that they are retained within the central green space area and thus allow all of the development to be located outside of Flood Zone 2 and 3
- By undertaking the above flood compensation works it will be possible to enhance Whinny Brook incorporating additional ecological and biodiversity elements and create a blue corridor within the development
- One of the key issues to be addressed in undertaking any modifications to the flood zones within the development site is to ensure that there is no risk of increase to flood risk downstream and where possible an element of betterment should be provided by increase the storage (attenuation) volumes within the development site
- A review of the BGS database identified that the underlying ground conditions consist of sands (Shirdley Hill Sands) which indicate that the use of infiltration SUDs techniques would be a viable means of draining the surface water runoff from the development although this will be subject to a detailed site investigation study to confirm infiltration rates
- The initial surface water strategy will be to drain the surface water runoff from the development utilising infiltration techniques as the primary means of disposal and this will be based on utilising soakaways, permeable paving , local infiltration swales and a series of regional infiltration swales
- In the event that it is not viable to fully utilise infiltration techniques then an alternative means of surface water disposal will be by providing on site attenuation with the controlled discharge draining to a series of attenuation swales which would in turn either drain to the diverted watercourses or direct into Whinny Brook.



Flood Risk Assessment

- In relation to the required attenuation volumes a preliminary assessment has identified the following attenuation volumes

	Impermeable area (ha)	Allowable discharge rate (l/s)	1 in 30 year storage (m ³)	Additional storage required to satisfy 1 in 100 (plus 20% CC) exceedance flows (m ³)	Total storage to satisfy 1 in 100 (plus 30% CC) exceedance flows (m ³)
Residential North	13.8	57.9	5,478	4,908	10,386
Commercial Area	18	50.4	8,068	6,955	15,023
Residential South	10.2	42.8	4,049	3,627	7,676

- In respect to the exceedance volumes in excess of the 1 in 30 year storm event as the development site is relatively flat then this should be able to be provided by setting the ground levels such that the area around the attenuation swales or within the development areas (i.e. car parking areas and highways) can retain the additional volume without creating any flood risk to either the surrounding properties or outside of the site boundary.
- It should be noted that the above flood storage volumes are only preliminary and should be fully assessed during the detailed design stage once a full assessment of the underlying permeability has been undertaken which will potentially reduce the volume of attenuation required
- The detailed surface water drainage design should seek to maximise the use of SUDs techniques where economically viable in order to comply with the impending National SUDs Standards and typical details of such systems are set out within Appendix L of this report
- The preliminary assessment of the options available has demonstrated that it should be viable to provide a fully compliant SUDs based scheme to drain the surface water runoff from the proposed development whilst also being able to ensure that there is no increase in the risk of flooding downstream and that an element of betterment in relation to the potential flooding of the railway line may be able to be achieved
- As part of the proposed framework plan it will be necessary to divert and rationalise the existing watercourses. As part of the watercourse rationalisation it is also proposed to open up a section of culverted watercourse within the Commercial Area



Flood Risk Assessment

- In order to allow the detailed design of the above watercourse diversions it will be necessary to undertake a detailed survey of the existing watercourses and prior to this survey it is recommended that the watercourses are cleared of any vegetation to enable accurate survey data to be obtained.
- Following the survey works, then a detailed hydraulic assessment shall be undertaken of each watercourse taking into account both the existing upstream flows and the proposed flows from the development as identified within the surface water design. The assessment shall ensure that an adequate profile and gradient is provided to ensure that no flooding from these realigned watercourses impacts onto the development.
- It is anticipated that based on the current level of information available that the development site can be drained by a gravity surface water drainage system and separate drainage systems will be installed to serve the development

Based on the above, the following recommendations are made:

- That a full topographic survey of the development site is undertaken which will also include details of the existing culverts where they pass under the railway line.
- A detailed survey of the existing culverts under the railway line is undertaken to identify any restrictions or build up of debris which should be taken into consideration of the future hydraulic modelling of Whinny Brook
- That detailed hydraulic modelling of Whinny Brook is undertaken (based on a detailed topographic survey of the development site) firstly to assess the existing flood risk and secondly (based on the proposed flood compensatory works and detailed masterplan), to assess that the proposed flood compensatory works do not increase the flood risk downstream and identify any betterment that the works will have in possibly reducing the flood risk downstream
- That within the site permeability testing is undertaken including longer term monitoring of the water table to fully identify where SUDs infiltration techniques can be utilised
- As part of the topographic survey, a full survey of the existing watercourses is undertaken to allow the feasibility of diverting the watercourses to be undertaken
- Further liaison with both the Environment Agency and Sefton MBC (LLFA) is undertaken to review the proposed flood compensatory works and surface water drainage proposals
- Based on the preliminary hydraulic modelling that the flood compensatory works are developed in more detail and integrated into the developing masterplan



Flood Risk Assessment

- Further consideration considered in conjunction with the above to identify opportunities to develop a blue corridor within the development site
- Based on the existing ground conditions, options developed in relation to the proposed surface water drainage strategy to identify in more detail the volumes and location of the attenuation swales or other features
- Review and prepare an overall site wide SUDs strategy for the development site