

**MOSS LANE  
SOUTHPORT**

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**FLOOD RISK ASSESSMENT AND  
DRAINAGE MANAGEMENT STRATEGY**

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For

Redrow Homes Limited  
St. David's Park  
Ewloe  
Flintshire  
CH5 3RX



**OCTOBER 2015**

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## EXECUTIVE SUMMARY

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This Flood Risk Assessment and Drainage Management Strategy was commissioned by Redrow Homes referred to hereafter as 'the client'. This report has been prepared to aid in discussions regarding the sites allocation in the local plan and support a potential residential planning application on land adjacent to Moss Lane, Southport. The site is located within Flood Zones 1, 2 and 3 and is approximately 18.926ha in size; the National Planning Policy Framework (NPPF) requires that the planning application be accompanied by a FRA.

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 in the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals. In order for residential development to be considered appropriate within Flood Zones 2 and 3 the sequential and exception test must be passed, with appropriate mitigation measures being implemented to secure the development for its design life.

The proposed development site is confirmed to have been sequentially tested and is understood to be allocated within the Local Development Plan (LDP) for residential development. Due to the presence of significant flood defences and the sites suitability for providing affordable housing, part 1 of the exception test is considered to be met; this FRA will form the final part of the exception test.

An Internet based search for flooding events did not recall any historical flooding to the development site, review of the available publications also failed to highlight any flooding issues onsite. Review of the Sefton Council Strategic Flood Risk Assessment identified that the wider Southport area is susceptible in areas to tidal, fluvial, surface water, sewer and groundwater flooding although no onsite flood risks were identified. Consultation with various interested parties including United Utilities and the Environment Agency, failed to highlight any historical flooding to the immediate site area.

The primary mitigation measure will be the incorporation of minimum finished floor levels; typically for this nature of development, finished floor levels should be set a minimum of 600mm above the predicted Top Water Level during the design event. Taking into account the significant flood defences, the design event is considered to be the Q100+CCA event, based on the modelled defended scenario; therefore minimum finished floor levels onsite would be 3.1mAOD. Any levels raising within Flood Zone 3 should be kept to a minimum and there is a requirement to provide compensatory floodplain storage (on a level for level basis) as a result of any levels raising within Flood Zone 3, this approach has been agreed in principle with the Environment Agency (see correspondence in appendices).

It would be advised that the primary access and egress route within site be located within Flood Zone 1 (and 2 where required) to minimise potential flood risk. The proposed access/egress route is required to be raised to a level that would result in no more than 300mm of flooding during the design event; and any levels raising within Flood Zone 3 would require compensatory flood storage.

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. The principle focus of this report is on the effective mitigation from the potential fluvial/tidal flood risk onsite and the effective management of surface water drainage.

Based on the ground conditions identified by the BGS and NSRI Soilscales Data, in terms of infiltration characteristics, it can be considered that infiltration is unlikely to be viable onsite; however further investigation is advised, with soakaway testing to BRE365 to be undertaken in specific locations where infiltration is considered most feasible. Should infiltration be proved not feasible, it is proposed that the surface water run-off generated by the development discharge to the watercourse adjacent to the eastern boundary.

The discharge of surface water run-off is proposed to be restricted to the pre-development rates, with some betterment in accordance with the LPA's guidance; calculated to be 59.8l/s for the annual event, 126.6l/s for the 1 in 30 year event and 163.5l/s during the 1 in 100 year event with an allowance for climate change. Detailed design will be required to confirm the feasibility of the proposed strategy following more detailed levels and layout review. Consents to outfall and agreement of discharge rate(s) will be required from the Environment Agency and some discussion may be required with the Lead Local Flood Authority (Sefton); therefore early discussion is advised.

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.

It is noted that typically there is a requirement to provide at least two stages of water treatment prior to discharge of surface water to the watercourse therefore it would be recommended SuDS techniques are considered as part of the proposals. Based on the nature and scale of the development there may be the opportunity to implement various SUDS options in private (non-adopted) areas such as permeable paving and bio-filtration units which would be recommended. Furthermore in accordance with Sefton's Surface Water Management Plan, green infrastructure should be sought; the potential to implement conveyance features such as swales, ditches and channels would improve water quality and biodiversity prior to discharge.

If sized appropriately a pond feature could cater for the attenuation requirements in the extreme events, although such should not be located within the extents of Flood Zone 3. It is understood that traditional drainage and POS areas would likely provide the remainder of required attenuation; although detailed design would be required to confirm such following a more detailed review of levels, capacity and attenuation requirements.

As with any drainage system blockages within either the foul or surface water sewer systems have the potential to cause flooding or disruption.

This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The Flood Risk Assessment and Drainage

Management Strategy is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

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## Specialist Software

-  Flood Estimation Handbook FEH CD-ROM (v.3.0) – Determination of Catchment Descriptors and depths of rainfall.
-  MicroDrainage WinDES (v.14.1) – Calculation 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         | NGR   | National Grid Reference                  |
| BGL  | Below Ground Level                    | NPPF  | National Planning Policy Framework       |
| BGS  | British Geological Survey             | NSRI  | National Soil Resources Institute        |
| CC   | Climate Change                        | OS    | Ordnance Survey                          |
| EA   | Environment Agency                    | PFRA  | Preliminary Flood Risk Assessment        |
| FEH  | Flood Estimation Handbook             | PPS   | Planning Policy Statement                |
| FRA  | Flood Risk Assessment                 | QSE   | Quick Storage Estimate                   |
| FRMS | Flood Risk Management Strategy Report | QBAR  | Mean Annual Flood                        |
| FZ   | Flood Zone                            | SFRA  | Strategic Flood Risk Assessment          |
| Ha   | Hectare                               | SuDS  | Sustainable Urban Drainage Systems       |
| IDB  | Internal Drainage Board               | SMBC  | Sefton Council                           |
| LDP  | Local Development Plan                | TWL   | Top Water Level                          |
| LLFA | Lead Local Flood Authority            | UKCIP | United Kingdom Climate Impacts Programme |
| LPA  | Local Planning Authority              | UU    | United Utilities                         |
| mAOD | Metres Above Ordnance Datum           |       |  |



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## 1.0 INTRODUCTION

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### 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 E).
- 1.1.3 The development proposals are over 1 hectare and located within Flood Zones 1, 2 and 3 therefore a Flood Risk Assessment is required to 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 proposals are understood to be residential in nature and therefore 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 is no increase in flood risk elsewhere due to the proposals.
- 1.1.5 In order for residential development to be considered appropriate within Flood Zones 2 and 3 the sequential and exception test must be passed, with appropriate mitigation measure being implemented to secure the development for its design life.
- 1.1.6 The proposed development site is confirmed to have been sequentially tested and is understood to be allocated within the Flood Risk Technical Paper (Sefton Local Plan) for residential development. The Flood Risk Technical Paper (Sept 2015) identified, that following the EA updated modelling information, the development site would still pass the criteria of the sequential test; however would now be required to meet the exception test.
- 1.1.7 Due to the presence of significant flood defences and the sites suitability to provide part of Southport's high affordable housing need, part 1 of the exception test is considered to be met in accordance to the Sefton Local Plan; this Flood Risk Assessment forms the final part of the exception test.

### 1.2 Site Context

- 1.2.1 This Flood Risk Assessment has been prepared to support an outline planning application for a residential development on land to the south of Moss Lane, Southport. Proposals are likely to be complete with access/estate roads, footpaths, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

- 1.2.2 The total site is approximately 18.926ha in size and although the site is considered to be brownfield the majority of site is currently undeveloped. The site comprises of two areas of development (Pool House Farm and Pitts House Farm), a portion of Pitts House Lane and the surrounding areas are considered to be undeveloped.
- 1.2.3 Multiple land drainage ditches (Ordinary Watercourses) are located within and adjacent to the development site, along with Three Pools Waterway (an EA classified Main River) flowing along the eastern boundary of site.

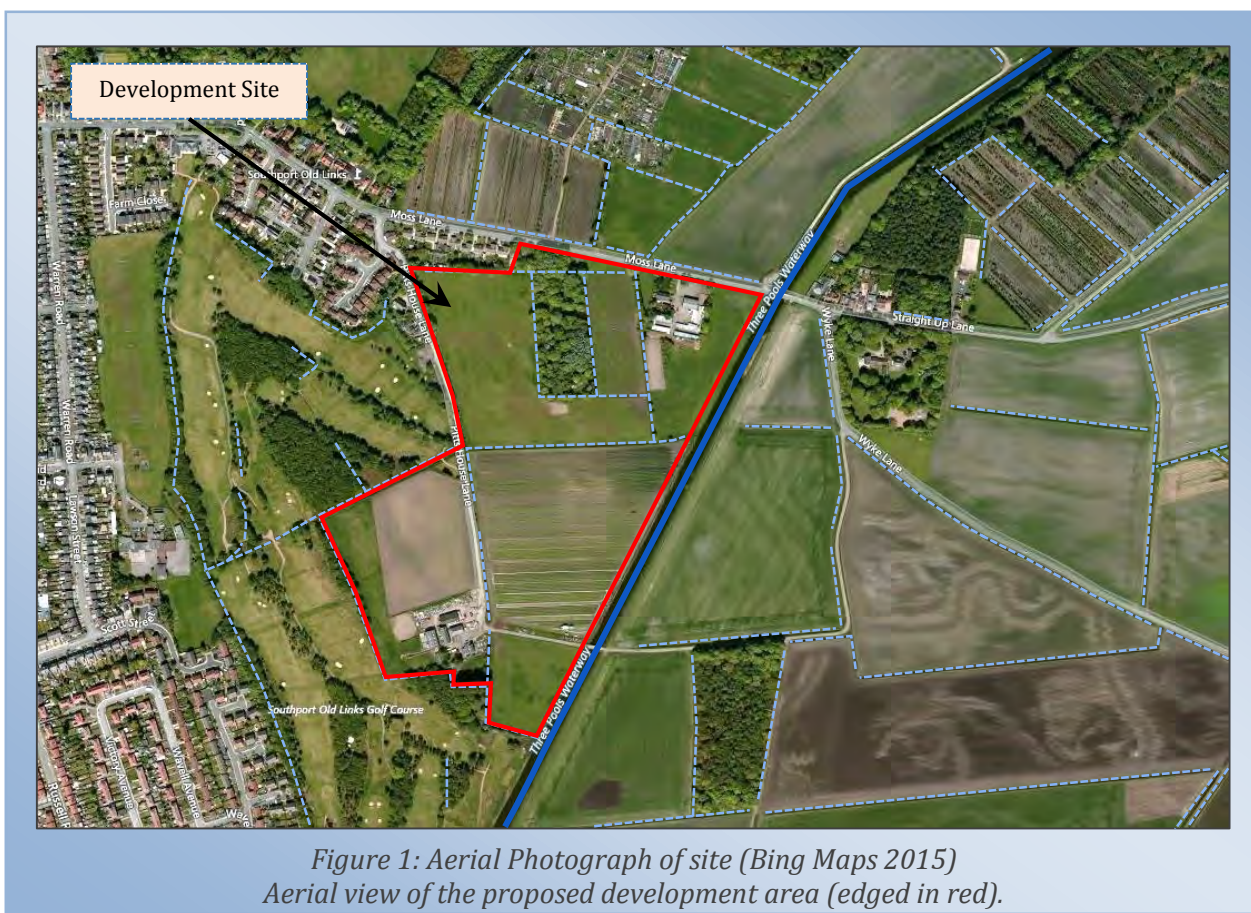
### **1.3 Consultation**

- 1.3.1 The preparation of this report has been undertaken in consultation with the following interested parties; Sefton Council (SMBC), the Environment Agency (EA) and United Utilities (UU).
- 1.3.2 The Local Planning Authority (LPA), Sefton Council (SMBC) has been consulted as part of the preparation of this report; Sefton also act 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 C).
- 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 F).
- 1.3.5 Sefton 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 G).

## 2.0 EXISTING SITE LOCATION

### 2.1 Location

- 2.1.1 The proposed development site is primarily accessed off Moss Lane, Southport; a secondary access is provided via Pitts House Lane, Southport. The Ordnance Survey National Grid Reference (OS NGR) for the site is 337053 (Easting), 417558 (Northing) and the nearest postcode is PR97QT. The site location plan is shown in Appendix A.
- 2.1.2 The total site area is approximately 18.926ha and edged in red in Figure 1 (below). The site is bounded; to the north by Moss Lane with undeveloped land beyond, to the east by Three Pools Waterway, to the south by undeveloped land with Three Pools Waterway beyond and to the west by Southport Old Links Golf Course with The Pool (watercourse) and Southport beyond (as illustrated in Figure 1; below).



- 2.1.3 Three Pools Waterway is located flowing alongside the eastern boundary of site as illustrated in Figure 1 above. This EA designated Main River discharges into Ribble Estuary to the north of site; multiple land drainage ditches (Ordinary Watercourses) are also identified to be located within and adjacent to the development site.

### 2.2 Existing and Historical Land Use

- 2.2.1 The preparation of this report has identified that the proposed development site consists of; two areas of development (Pool House Farm and Pitts House Farm), a portion of Pitts House Lane and the surrounding areas are considered to be



undeveloped. The development is considered to be 5% impermeable at present. Historically the undeveloped land was utilised for agricultural/grazing purposes and no other historical uses have been determined during the preparation of this report.

## 2.3 Topography

2.3.1 The general topographic fall within site is as illustrated in Figure 2 (below); a topographic survey has been provided as part of the proposals and is included in Appendix B.

2.3.2 The development site consist of predominantly undeveloped land with the exception of two existing areas of development, multiple land drainage ditches are located within the boundaries of site and are understood to ultimately discharge into the Main River (Three Pools Waterway) located on the eastern boundary of site. General fall is from the western boundary to the eastern boundary and the interior land drainage is understood to aid in the conveyance of pluvial flows generated on site.



## **3.0 DEVELOPMENT PROPOSALS**

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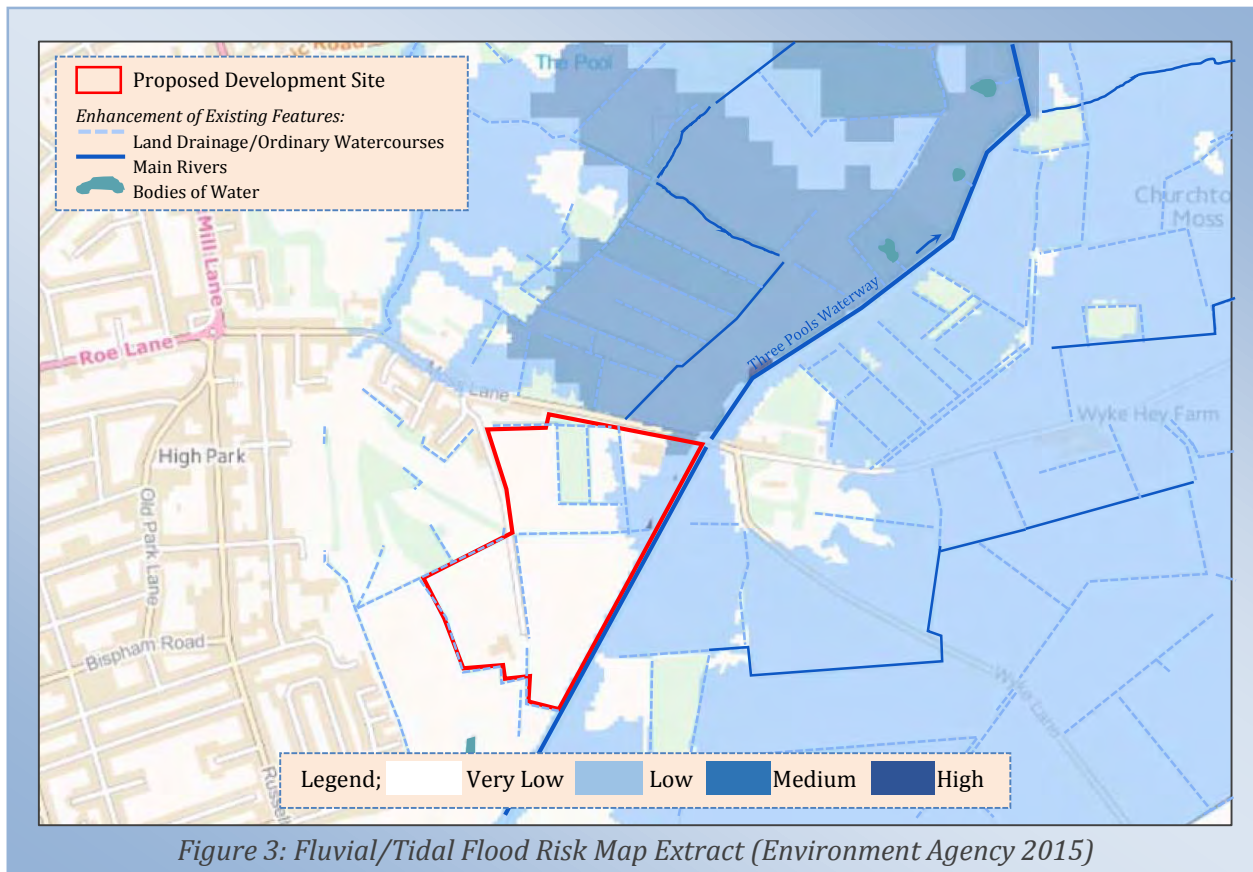
### **3.1 Nature of the development**

- 3.1.1 This planning application is for a residential development on land to the south of Moss Lane, Southport; although no indicative planning layout is available at this time for review, proposals are likely to include access/estate roads, footpaths, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.
- 3.1.2 It is understood that the development site has undergone the sequential test and been passed for residential development, this FRA will form part of the exception test in accordance with policy for more vulnerable development located within Flood Zone 3. An intra-sequential approach to flood risk management at the site should be adopted with the residential development taking place in those areas identified to be at least risk from flooding (Flood Zone 1 and where necessary Flood Zone 2).
- 3.1.3 The total site area is approximately 18.926ha and is considered to be 5% impermeable at present (see impermeable areas plan in Appendix I). Due to the residential nature of the proposals the impermeable areas of site are assumed to increase to approximately 40% (7.570ha).

## 4.0 SOURCES OF FLOOD RISK

### 4.1 Fluvial 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 3 (below).



4.1.2 Three Pools Waterway is located flowing along the eastern boundary of site as illustrated in Figure 1 above. This EA designated Main River discharges into Ribble Estuary to the north of site; multiple land drainage ditches (Ordinary Watercourses) are also identified to be located within and adjacent to the development site these existing features aid in the drainage of the surrounding area.

4.1.3 The online EA Flood Map indicates that the proposed development site is considered to be predominantly at 'Very Low' risk from fluvial flooding despite being adjacent to Three Pools Waterway, as illustrated in Figure 3 (above). The north-eastern corner of site is indicated to have between a 'low' and 'medium' risk of fluvial/tidal flooding.

4.1.4 Three Pools Waterway is classified as Main River by the EA and therefore they will require a maintenance easement (typically 8m from top of bank) which should provide clear and unimpeded access to the watercourse. This will require consideration within the design and should be considered at an early stage.

4.1.5 The development site falls within the Crossens Catchment which is a pumped catchment discharging flows from the watercourse network into the sea via the Crossens Pumping



Station located in Banks. Review of the Flood Estimation Handbook (FEH) CD-ROM identifies the catchment to be 49.4km (sq.). This figure includes the entire upper catchment to observe a more conservative approach to flood risk management however the overall risk to site is considered to be 'Low'.

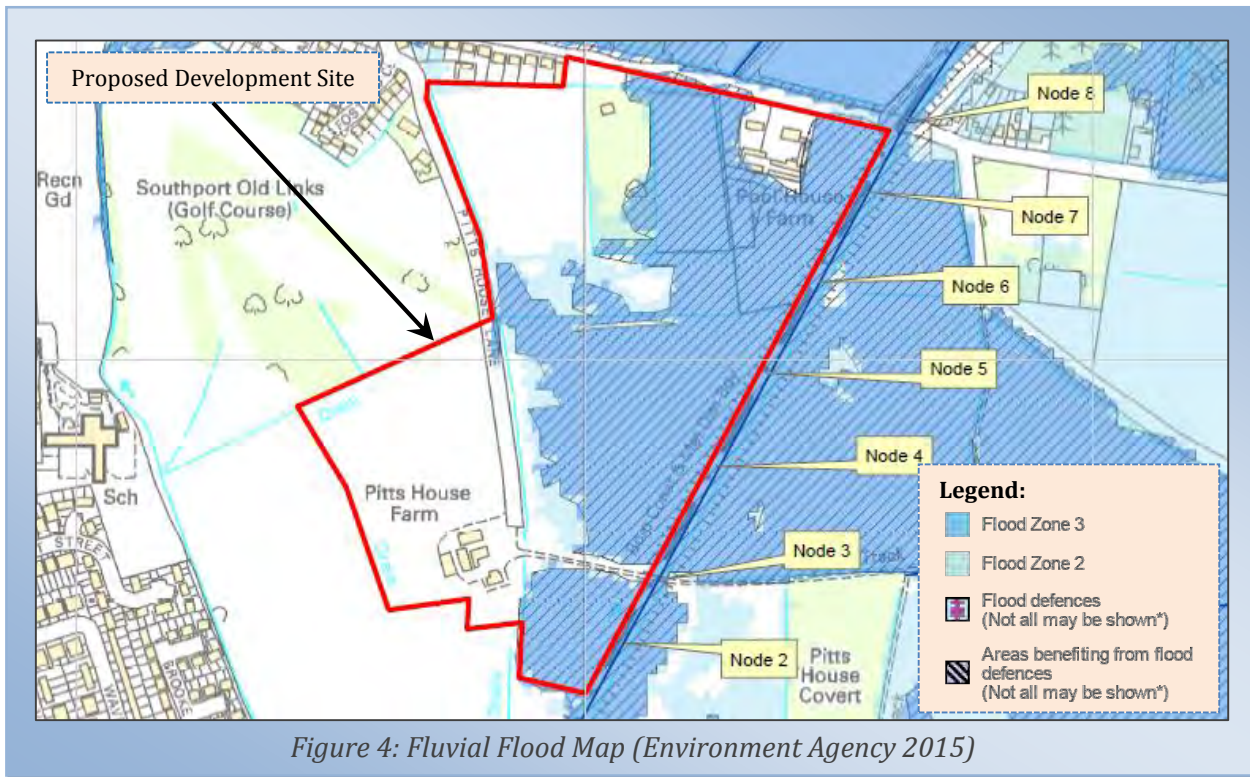


Figure 4: Fluvial Flood Map (Environment Agency 2015)

4.1.6 The Environment Agency’s Flood Map for Planning indicates the site is located within Flood Zones 1, 2 and 3a, as illustrated in Figure 4 (above). Consultation with the Environment Agency identified the predicted fluvial water levels at specific node locations along the adjacent watercourse during the fluvial defended and undefended modelled scenarios. Table 1 (below) indicates the predicted water levels as identified by the EA for use within this FRA.

| NODE | Q100     |            | Q100+CCA |            | Q1000    |            |
|------|----------|------------|----------|------------|----------|------------|
|      | DEFENDED | UNDEFENDED | DEFENDED | UNDEFENDED | DEFENDED | UNDEFENDED |
| 2    | 2.46     | 2.57       | 2.50     |            | 2.58     | 2.69       |
| 3    | 2.45     | 2.57       | 2.50     |            | 2.57     | 2.69       |
| 4    | 2.45     | 2.57       | 2.49     |            | 2.57     | 2.69       |
| 5    | 2.44     | 2.57       | 2.49     |            | 2.56     | 2.69       |
| 6    | 2.44     | 2.57       | 2.48     |            | 2.56     | 2.69       |
| 7    | 2.44     | 2.56       | 2.48     |            | 2.56     | 2.69       |

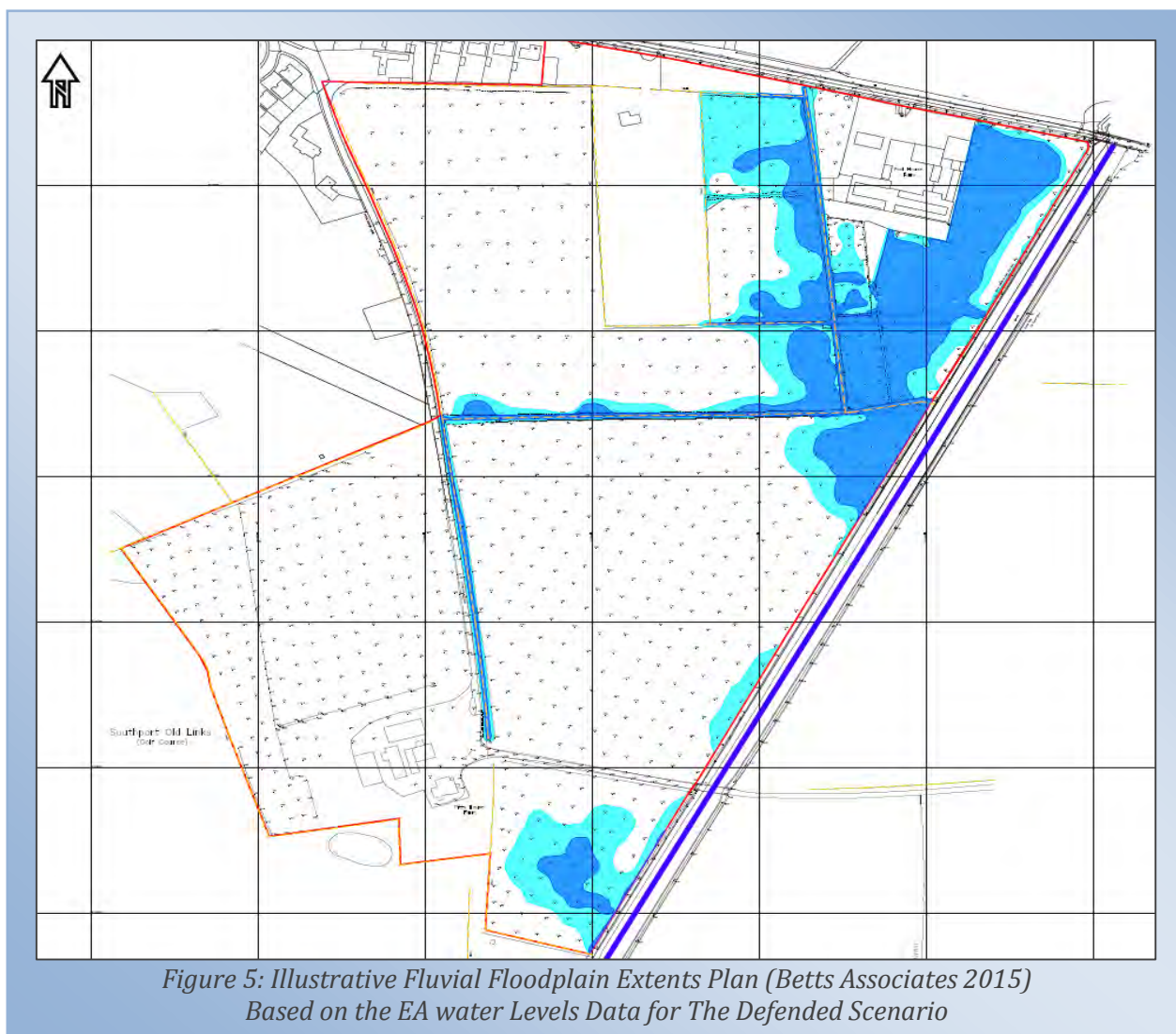
Table 1: Potential Fluvial Levels - Defended/Undefended Scenarios (EA 2015)

4.1.7 Review of the topographic survey, indicates that the existing ground levels onsite range generally from 2.00mAOD to 4.52mAOD; the existing drainage ditches onsite at the lowest are approximately 1mAOD. The development site is considered to benefit from the existing flood defences and when considering the influence of the existing defences the risk to the site is considered to be lower, which is justified in the Flood Risk Map



(Figure 3 previously) and the predicted fluvial water levels (Table 1 on the preceding page).

- 4.1.8 When comparing the EA water levels with the existing ground levels (topographical survey) the development site is considered to be at varying risk from potential fluvial flooding during both the defended and undefended scenarios. Illustrative floodplain extents plan (Appendix P) indicates the potential extents of Flood Zones 2 and 3 during the EA modelled undefended fluvial scenario. The extent of Flood Zones 2 and 3 is significantly lower than illustrated in the EA mapping data (Figure 4 on the preceding page); which also does not consider the influence of the existing defences.
- 4.1.9 In light of the existing flood defences, the water levels data for the fluvial defended scenario has been combined with the existing ground levels to produce an illustrative floodplain extents plan an extract of which is shown in Figure 5 below (Appendix Q). This plan shows the extents of potential flooding during the Q100 and Q1000 year return period events. The key areas indicated to be most susceptible to inundation during these extreme events even when considering the influence of existing defences, are the north-eastern corner of site where levels typically range from 2.1mAOD and 3.1mAOD and the southern corner (levels range from 2.38mAOD to 2.57mAOD).



- 4.1.10 It is proposed that an intra-sequential approach to flood risk be adopted at the site, with development being steered to those areas of least risk (Flood Zones 1 and where appropriate Flood Zone 2). Discussion is underway with the EA to establish the most appropriate mitigation measures for the site in light of its residential nature, the primary mitigation measure will be the incorporation of minimum finished floor levels.
- 4.1.11 Typically for this nature of development finished floor levels should be set a minimum of 600mm above the predicted TWL (Top Water Level) during the design event. Taking into account the significant flood defences, the design event is considered to be the Q100+CCA event based on the modelled defended scenario; therefore minimum finished floor levels onsite would be 3.1mAOD.
- 4.1.12 Although development should be steered away from Flood Zone 3, it is acknowledged that this may not be feasible for the whole of the site, any levels raising within Flood Zone 3 should be kept to a minimum and should any levels raising occur within Flood Zone 3 then there would be a requirement to provide compensatory floodplain storage, on a level for level basis to account for the potential loss of floodplain due to the proposals. Discussion is underway with the EA to establish, in light of the existing flood defence infrastructure, whether compensatory storage requirements would be accepted based on the defended scenario extents.

## **4.2 Tidal Flood Risk**

- 4.2.1 The coastline is located approximately 4km to the north-west of site, however following discussion with the Environment Agency it has been identified that the watercourse adjacent to the eastern boundary of site is tidally influenced during the extreme events. Figure 6 (on the subsequent page) illustrates the potential depths of tidal flooding through site during the undefended Q200+CCA event.
- 4.2.2 The development site is considered to benefit from the existing flood defences (refer to Section 4.3 for flood defence information) and correspondence identified that there would be no on-site flooding during the modelled tidal scenario when considering the influence of the existing defences. The EA furthermore provided an estimated water level onsite for the undefended tidal scenario to allow the potential flood risks to be reviewed conservatively; Table 2 (below) indicates the EA predicted tidal flood water level onsite.
- 4.2.3 The water levels data for the undefended scenario (provided by the EA) has been compared with the existing ground levels onsite (as identified by the topographical survey undertaken in 2015) and an illustrative floodplain plan (Appendix R) has been produced to assist in the review of the potential risks at site.
- 4.2.4 Although the undefended tidal scenario predicts a potential higher inundation onsite compared to the previously discussed fluvial risks, as the site is not considered to be inundated during the tidal defended scenario, the potential tidal flood risk to site is considered to be residual.

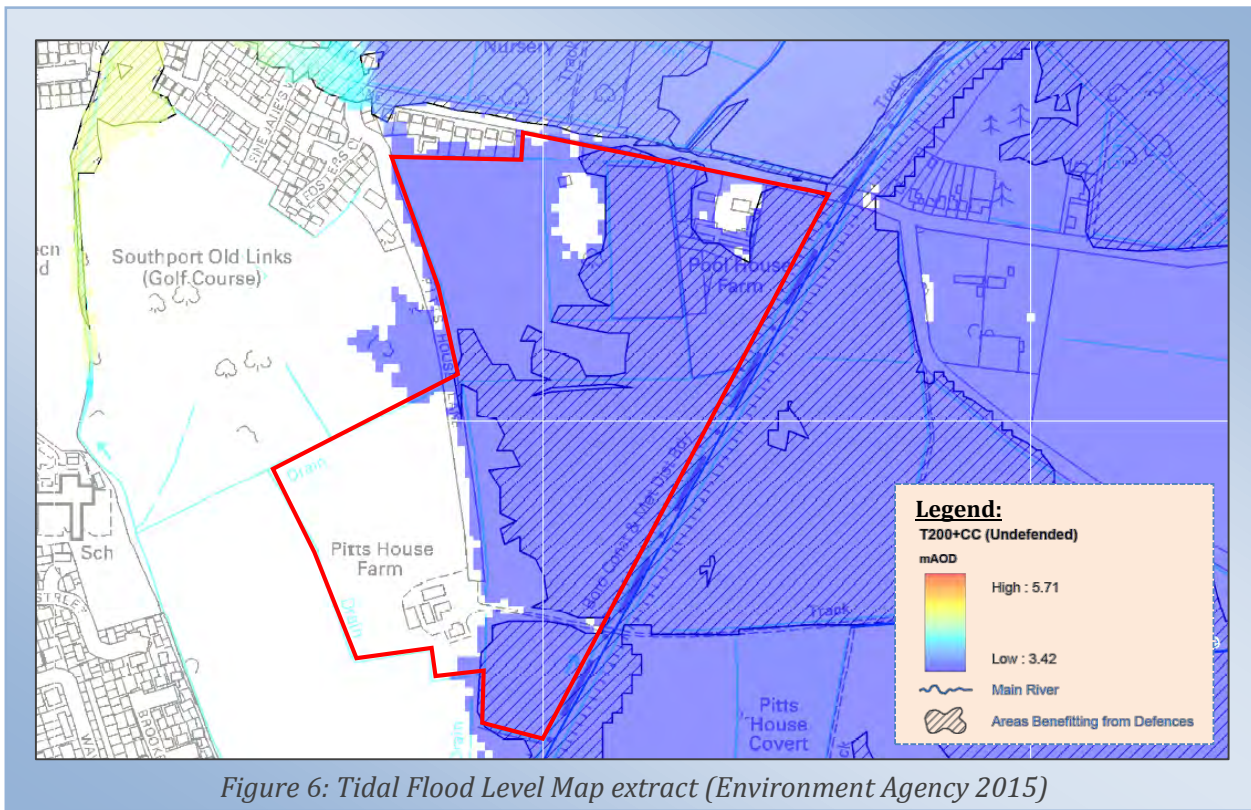


Figure 6: Tidal Flood Level Map extract (Environment Agency 2015)

| RETURN PERIOD EVENT | MODEL SCENARIO |            |
|---------------------|----------------|------------|
|                     | DEFENDED       | UNDEFENDED |
| Q100                | N/A            | 2.68mAOD   |
| Q200                | N/A            | 2.91mAOD   |
| Q200+CCA            | N/A            | 3.42mAOD   |
| Q1000               | N/A            | 3.02mAOD   |

Table 2: Potential Fluvial Levels - Defended/Undefended Scenarios (EA 2015)

4.2.5 The mitigation measures onsite (in the form of FFLs) are proposed to be based on the potential fluvial risks to site, minimum finished floor levels are proposed to be 3.1mAOD. Providing Min. FFLs were set as identified, then based on the Q200+CCA event, the residual risks due to failure in the existing defences, are considered to be acceptable; with potential internal flooding being at a depth of approximately 320mm.

### 4.3 Flood Defences

4.3.1 The development site is located in close proximity to both fluvial and tidal sources of flooding; however due to its location it is also thought to benefit from the protection of multiple flood defence infrastructure, including Three Pools Waterway (adjacent to the eastern boundary) which is identified to be an EA managed channel.

4.3.2 Sea defences are considered to be the principle line of defence for the Southport area; raised defences, sea walls, natural sand dunes, and natural, maintained, culverted channels are key in providing protection from the storm surges which commonly effect this section of Sefton' Coastline.



- 4.3.3 In total approximately 216km of defences are identified on the Environment Agency's National Flood and Coastal Defence Database (NFCDD); the EA is responsible for approximately 72% with Sefton MBC being responsible for 16%. Some mapping data has been included in Appendix K.
- 4.3.4 Maintenance is an integral part of ensuring the functionality of the defences into the future, the Strategic Flood Risk Assessment (SFRA) identifies that although the condition of the primary sea defences are generally good, more focus is required to the less significant watercourses within the catchment.
- 4.3.5 The Sefton Local Plan – Flood Risk Technical Paper (Sept 2015), considers the potential flood risks to the development site following the updated EA Flood Maps; it is acknowledged that the Flood Zones do not take into account the influences of existing defences. When considering the influence of the sea defences the Strategic Flood Risk Assessment (SFRA) and Technical Paper confirm that the northern areas of Southport would be considered to be at minimal risk.
- 4.3.6 Breach analysis of the sea defences reviewed within the SFRA (undertaken by the EA) furthermore confirmed that the development site would not be impacted during the breach modelled event. Although as the updated EA Flood Maps identify the site to be partly located within Flood Zones 2 and 3 the Exception test is now required to be passed in order for development to be considered appropriate.

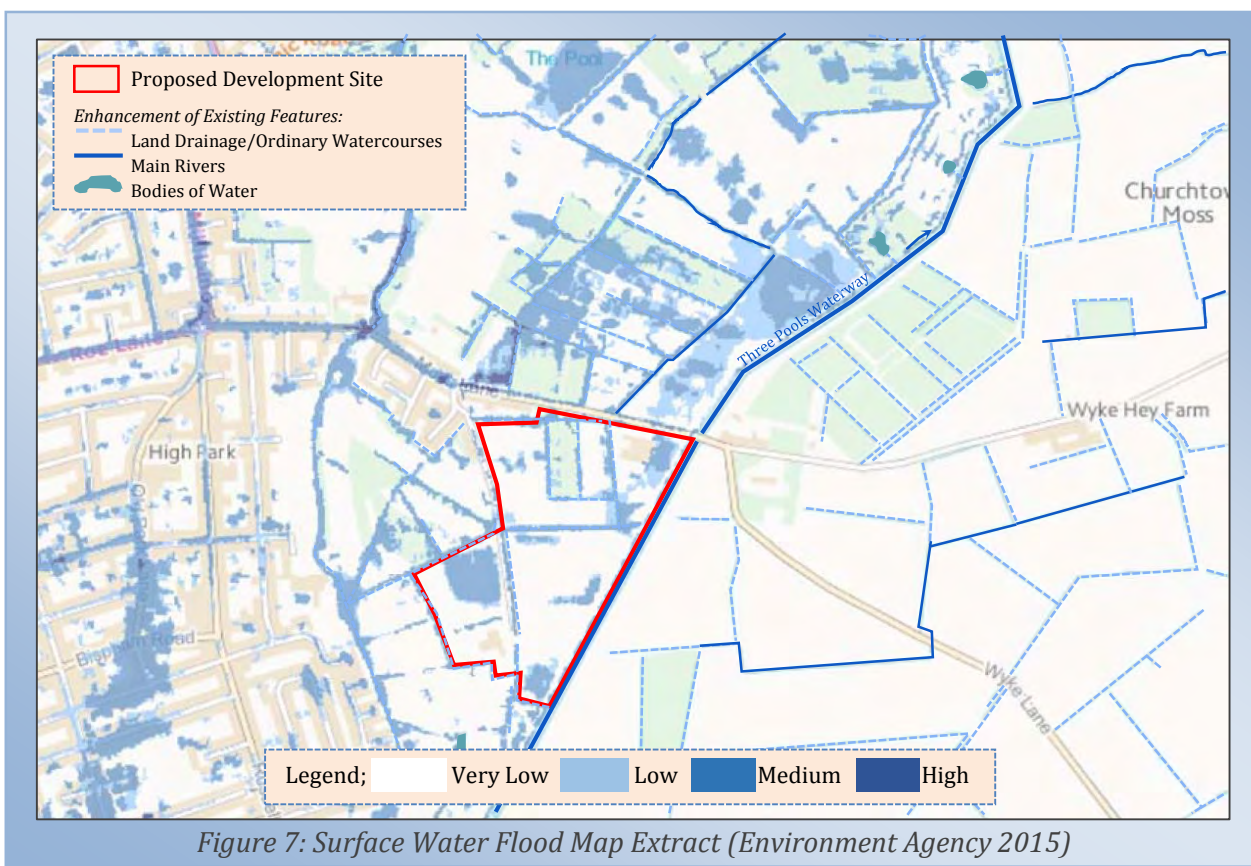
#### **4.4 Flood Risk Vulnerability Classification and Flood Zone Compatibility**

- 4.4.1 The development proposals are understood to be residential in nature and therefore 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 is no increase in flood risk elsewhere due to the proposals.
- 4.4.2 In order for residential development to be considered appropriate within Flood Zones 2 and 3 the sequential and exception test must be passed, with appropriate mitigation measure being implemented to secure the development for its design life. It is to our understanding that the site has been sequentially tested as part of the Strategic Flood Risk Assessment (2013) and passed for residential housing.
- 4.4.3 Subsequently the EA's Flood Zone classification of the site changed however confirmation of the site's suitability for residential development has been confirmed sequentially in the LPA's Flood Risk Technical Paper (2015); see Appendix K for extracts.
- 4.4.4 Part 1 of the exception test has been met, as identified in Sefton Council's Flood Risk Technical Paper (2015) due to the site's requirement to address Southport's High

Affordable Housing need, along with the presence of strong flood defences; this FRA will form the second part of the exception test in accordance with policy.

## 4.5 Surface Water Flood Risk

- 4.5.1 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.
- 4.5.2 The risk associated with surface water run-off is indicated by the EA mapping data as shown in Figure 7 (below); it illustrates that the site is considered to be at varying risk from surface water flooding. The risk through site varies from 'very low' to 'medium' risk, which is dependent on multiple contributing factors including topography, existing land-use and proximity to watercourses (Ordinary and Main River).



- 4.5.3 The Sefton Council Strategic Flood Risk Assessment provides surface water mapping outputs for review (Appendix K). The identified levels of risk follows a similar pattern to that indicated on the EA mapping, illustrating that the site is at varying risk from surface water flood potential. The site is understood to have the potential for surface water flooding in part during the 100yr rainfall and 100yr+CC rainfall events (see Appendix K). The site is in part less susceptible to surface water flooding with some areas shown to be intermediately susceptible; the areas considered to be a most risk coincide with the natural topographic lows and existing watercourse features within site.

- 4.5.4 Development of the site would provide the opportunity to improve the existing situation and reduce the level of surface water flood risk within site. The design would implement formal drainage infrastructure which would offer a reduction in the potential risk. The implementation of interception ditches along particular boundaries where oncoming flows are a possibility based on topography and land-use may offer a further reduction in the potential flood risks.
- 4.5.5 In order to mitigate any potential flood risk from surface water it is advised that (following any re-grade) 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***

- 4.5.6 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.
- 4.5.7 The topography of the surrounding area is generally flat and low lying, the site is identified to be lower than the neighbouring urban sprawl to the west and any overland flow not catered for within the drainage networks would potential encroach onto the adjacent Golf Course and ultimately the western boundary of site. The catchment falls from site north towards Crossens Marsh and any surface water/pluvial flows utilise the existing surface water infrastructure (including watercourses and culverted channels) to convey flows safely away from the proposed and existing development before out-falling to the sea at Crossens Pumping Station.
- 4.5.8 Any overland flows generated by the proposed development (Appendix L) must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwellings are advised.

#### ***Sewer Flood Risk***

- 4.5.9 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.
- 4.5.10 United Utilities (UU) records identify multiple public foul water, surface water and combined sewers within the vicinity of site; as illustrated in the sewer records (Appendix F). An existing public foul water sewer runs within Moss Lane to the north of site, this system is part gravity and part rising main and flows into a foul water pumping station located adjacent to the junction between Fosters Close and Moss Lane (to the north-west of site).

- 4.5.11 UU sewer records identify a public surface water sewer system to run within the adjacent residential developments to the north-west of site (Fosters Close and Fine Janes Way). This surface water system discharges into the Ordinary Watercourse adjacent to Moss Lane (to the north of site). A separate surface water system is understood to discharge into the Ordinary Watercourse to the north-west of site (at Moss Lane Bridge).
- 4.5.12 Furthermore the sewer records identify a public combined system to run within the residential development to the south-west of site, along with a surface water rising main sewer to cross the golf course to the south of site before out falling into Three Pools Waterway (upstream of site).
- 4.5.13 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 F for correspondence.

## **4.6 Groundwater Flood Risk**

- 4.6.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.
- 4.6.2 In general terms groundwater flooding can occur from three main sources: - raised water tables, seepage and percolation and groundwater recovery or rebound.
- 4.6.3 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.
- 4.6.4 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.
- 4.6.5 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.
- 4.6.6 The EA mapping data for groundwater shows that the site is underlain by a 'Secondary B' bedrock aquifer with 'Secondary A' superficial deposits on part of the site (Appendix C). The site is considered to be located partly within a high vulnerability zone to a Minor Aquifer.



- 4.6.7 Sefton Council's SFRA identifies that a portion of site is considered to be located within an area susceptible to ground water emergence (see Appendix K for mapping data). Groundwater emergence is where exceptional wet winters can result in groundwater levels rising close to or at ground surface; however the SFRA states there to be no direct evidence of groundwater contributing to flood risk at the development site.
- 4.6.8 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.

#### 4.7 Artificial Sources of Flood Risk

- 4.7.1 Figure 8 (below) shows an extract of the EA's online Reservoir flood map; Appendix C shows the EA's reservoir flood map in full.

##### Reservoirs

- 4.7.2 The EA recognises reservoirs as bodies of water over 25,000 cu.m, the nearest EA identified reservoirs are approximately 25km east of site and approximately 52km north-east of site. As illustrated in Figure 8 (below) the extent of flooding associated with a potential failure in one of the nearest reservoirs does not encroach onto site.

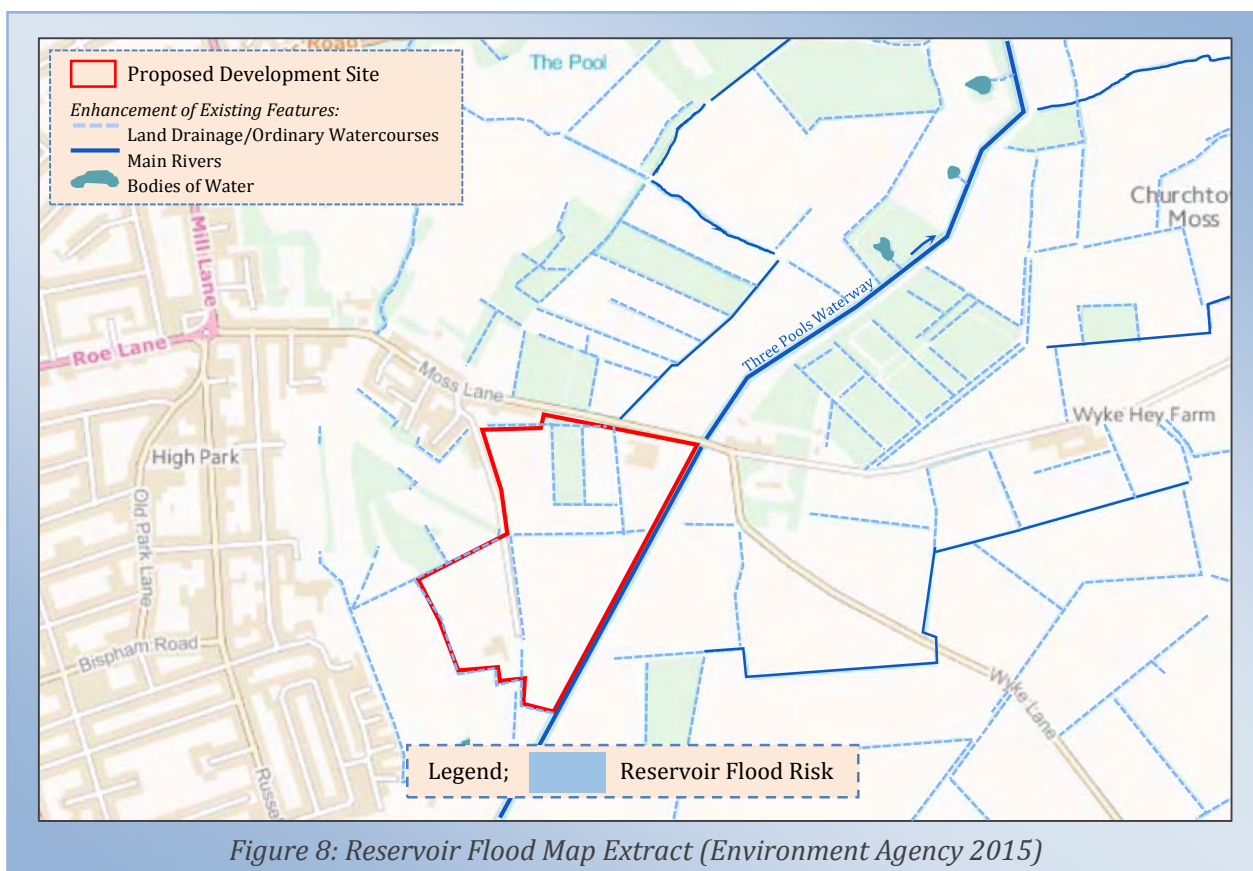


Figure 8: Reservoir Flood Map Extract (Environment Agency 2015)

- 4.7.3 As indicated in Figure 8, there are a few small bodies of water (less than 25,000cu.m) located within 1km of the site; however due to the natural topography the risk to site is considered to be 'Low'.



### **Canals**

- 4.7.4 The nearest identified canal system to the proposed development site is the 'Leeds and Liverpool Canal' located approximately 6km to the south-east of site. Due to the proximity from site and the catchment characteristics the associated flood risk to site is considered to be 'Low'.
- 4.7.5 Review of the Sefton Council Strategic Flood Risk Assessment (SFRA) did not indicate any historical flooding within the vicinity of site, due to artificial sources. No previous flooding due to such has been recorded at or surrounding the property. The potential risk of flooding to the development site from the nearby canal is considered to be low, significant management of the canal is undertaken and therefore any risk is understood to be residual.
- 4.7.6 Irrespective, by keeping the Finished Floor Levels elevated relative to the externals, an overland flood flow route in the event of a breach or any other source of flooding that could lead to overland flow will be created.

## **4.8 Historical and Anecdotal Flooding Information**

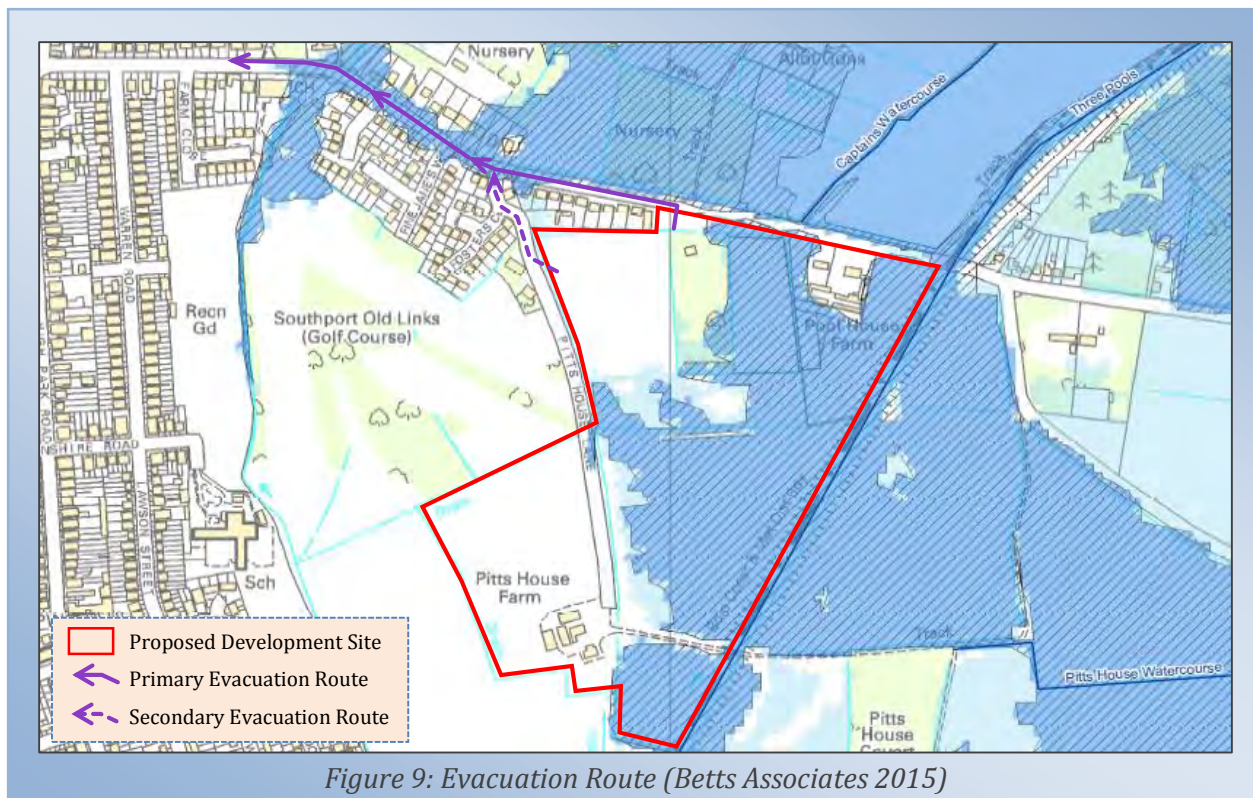
- 4.8.1 An internet based search for flooding events did not recall any historical flooding to the immediate development site area, including review of the Chronology of British Hydrological Events.
- 4.8.2 Review of the Sefton Council's Strategic Flood Risk Assessment (SFRA) did not highlight any historic flooding at the development site; some mapping data is included in Appendix K. The SFRA did identify some recorded historical incidences of flooding, within the wider Southport area due to damages to the Southport Sea Wall in 1839, 1852 and 1959.
- 4.8.3 The SFRA identifies that the existing surface water infrastructure is in places significantly under capacity, during periods of intense rainfall the existing systems can be susceptible surcharging. The Southport area is considered to be relatively low lying and therefore due to the topographical characteristics particularly susceptible to water collection/ponding. However no historical flooding of the site was identified within the SFRA.
- 4.8.4 The SFRA mapping data identifies those areas within the borough where historical flooding has occurred due to multiple sources, including surface water and sewer; mapping extracts included in Appendix K. The nearest identified historical flood incidents are understood to be sewer related, based on the mapping data such occurred 200m to the north-west of site.
- 4.8.5 Consultation with various interested parties including United Utilities and the Environment Agency failed to highlight any historical flooding to the immediate site area or the neighbouring area (see correspondence in Appendices). A response from Sefton Council is still outstanding.

## 4.9 Flood Warning and Evacuation

- 4.9.1 The proposed development site is located within an EA Flood Alert Area (see mapping data in Appendix D). The EA provide a free Flood Warning Direct service, where flood alerts and warnings are issued to home and business owners when flooding is possible in a particular area. It would be recommended that all future residents sign up to this free service to improve community preparedness; more information can be found on the Environment Agency's Website ([www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)) or by calling Floodline on 0845 988 1188.
- 4.9.2 The development site is located adjacent to the Merseyside Tidal Breach At Southport (Area B) Flood Warning Area and although not directly associated with the risk it would be advised that residents are aware of the potential for flooding along Moss Lane and within the surrounding areas to the north and west of site (see Appendix K for mapping data).

### *Flood Evacuation*

- 4.9.3 In severe conditions, the authorities may decide to evacuate, Sefton Council may activate a Helpline in severe events to provide information, advice and guidance to the public in relation to evacuation arrangements, welfare, temporary accommodation etc. Residents would be strongly advised to evacuate, however if evacuation is deemed not possible or too dangerous it is recommended that occupants retreat to the first floor.
- 4.9.4 It is possible that roads in the area may be flooded by surface water/groundwater flooding before fluvial flooding occurs. Such flooding may impact the road network in the area and not all routes may be accessible. In such an event the protection of evacuation routes will become a critical priority; once flooded only adequately equipped vehicles may be able to negotiate these roads



- 4.9.5 The proposed evacuation route is indicated in Figure 9 (preceding page) by the purple arrow; the extents of the floodplain are identified on the EA mapping to encroach onto the proposed evacuation route. However in light of these areas benefiting from the existing defences the flood risk along the route is considered to be low. Due to the areas being located within EA Flood Alert and Warning areas it is considered that adequate warning of potential flooding during the extreme events would be provided and therefore residents would be provided with adequate time for safe evacuation.
- 4.9.6 Residents would be advised to refer to Southport's Emergency Planning information for specific details on evacuation procedures. There may be a requirement for a site flood evacuation plan to be prepared to be provided to future residents to improve community preparedness; although such should be confirmed following further discussions.

#### ***Emergency Access and Egress***

- 4.9.7 As part of the development site is confirmed to be located within Flood Zones 2 and 3 and the nature of the proposals are residential; there is a requirement to consider safe emergency access and egress from the site. No indicative planning layout is available for review, however it would be advised that the primary access and egress route within site be steered to Flood Zone 1 where possible, to minimise potential flood risk, the primary access and egress route should refrain from being located within Flood Zone 3.
- 4.9.8 The proposed access/egress route is required to be raised to a level that would result any potential flooding being below the EA identified threshold, typically up to 300mm flooding along the access and egress route is considered acceptable by the EA although such should be confirmed with them during detailed design. Any levels raising within Flood Zone 3 will require consideration for the resultant compensatory floodplain storage (to be confirmed during detailed design).

### **4.10 Flood Risk Mitigation Measures & Residual Risks**

- 4.10.1 The development site is located within Flood Zones 1, 2 and 3; in accordance with the NPPF mitigation measures are required to ensure the development is safe for its design life. Discussion has been undertaken with the EA to establish the most appropriate mitigation measures for the site in light of its potential residential nature; this has indicated that they are in agreement with the proposal mitigation approach discussed below (correspondence including in Appendix C).

#### ***Mitigation Measures***

- 4.10.2 The primary mitigation measure will be the incorporation of minimum finished floor levels within site; typically for this nature of development, finished floor levels should be set a minimum of 600mm above the predicted TWL (Top Water Level) during the design event. Taking into account the significant flood defences the design event is considered to be the Q100+CCA event based on the modelled defended scenario; therefore minimum finished floor levels onsite would be 3.1mAOD.

- 4.10.3 Although development should be steered away from Flood Zone 3, it is acknowledged that this may not be entirely feasible, however any levels raising within Flood Zone 3 should be kept to a minimum. Should any levels raising occur within Flood Zone 3 then there is a requirement to consider the compensatory floodplain storage (on a level for level basis) as a result of any levels raising within Flood Zone 3.
- 4.10.4 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.
- 4.10.5 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. Any Overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from any existing and proposed buildings are advised.
- 4.10.6 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.
- 4.10.7 It is proposed that this be achieved using a Hydrobrake® flow control device with stormwater storage being provided to prevent overland run-off from leaving site for events up to and including the 100yr event with a 30% allowance for climate change.
- 4.10.8 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.
- 4.10.9 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***

- 4.10.10 Although the undefended tidal scenario predicts a potential higher inundation level onsite, the potential tidal flood risk to site is considered to be residual as the site is not considered to be inundated during the tidal defended scenario. Providing Min. FFLs are set to 3.1mAOD, then the residual risks due to failure in the existing defences (based on the Q200+CCA event) is considered to be acceptable; the potential flood depth, during the undefended tidal scenario, would be approximately 320mm above the proposed Min. FFL.
- 4.10.11 The development would be considered accessible for emergency access and egress during times of extreme flooding, providing minimum finished floor levels are set 600mm above the TWL during the design criteria event. The site and proposed

evacuation route benefit from the protection of the existing flood defences, furthermore development is proposed to be steered to areas of least risk (Flood Zone 1 and where required Flood Zone 2).

4.10.12 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 L) 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 At present, it is understood that any surface water/pluvial run-off generated onsite discharges to the watercourse utilising the existing overland flow routes and drainage networks. The existing areas of hardstanding associated with the farm developments are understood to ultimately discharge to the watercourse on the eastern boundary. The total site is approximately 18.926ha in size and is considered to be predominantly undeveloped at present, approximately 5% impermeable.

5.1.2 The surface water run-off rates have been calculated using the IH124 Greenfield run-off method, utilising rainfall catchment characteristics from the Flood Estimation Handbook (FEH), details of which are included Appendix D. The peak rate of run-off and volumes generated by the site have been calculated for the peak events and are shown in Table 3 below.

| Development Area          | RATES                   |                          |                           | VOLUMES                 |                           |
|---------------------------|-------------------------|--------------------------|---------------------------|-------------------------|---------------------------|
|                           | 1 In 1 Year Storm Event | 1 In 30 Year Storm Event | 1 In 100 Year Storm Event | 1 In 1 Year Storm Event | 1 In 100 Year Storm Event |
| Greenfield<br>17.968ha    | 36.4l/s                 | 71.0l/s                  | 87.1l/s                   | 828.1cu.m               | 3056.6cu.m                |
| Brownfield<br>0.985ha     | 38.3l/s                 | 87.2l/s                  | 117.3l/s                  | 121.7cu.m               | 617.0cu.m                 |
| <b>Total<br/>18.926ha</b> | 74.7l/s                 | 158.2l/s                 | 204.4l/s                  | 949.7cu.m               | 3673.6cu.m                |

Table 3: Pre-Development Surface Water Run-Off Rates

### 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 assumed impermeable area post-development will be approximately 7.570ha; 40% of the total development (refer to Appendix I). The post-development rates and volumes have been calculated and summarised in Table 4 (below); full details can be found in Appendix H.

| Development Area      | RATES                   |                          |                               | VOLUMES                 |                                |
|-----------------------|-------------------------|--------------------------|-------------------------------|-------------------------|--------------------------------|
|                       | 1 In 1 Year Storm Event | 1 In 30 Year Storm Event | 1 In 100 Year Storm Event+CCA | 1 In 1 Year Storm Event | 1 In 100 Year Storm Event +CCA |
| Brownfield<br>7.570ha | 302.7l/s                | 689.4l/s                 | 1204.6l/s                     | 961.4cu.m               | 6337.6cu.m                     |




Table 4: Post-Development Unrestricted Surface Water Run-Off Rates

### **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 the watercourse.
- 5.3.5 It is noted that there is a requirement to provide at least two phases of water treatment prior to discharge of surface water from site therefore it would be recommended SuDS techniques as discussed above are considered as part of the proposals. 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.

### **5.4 Methods of Surface Water Management**

- 5.4.1 At present the site is considered to be undeveloped, the total site covers approximately 18.926ha; the impermeable area will increase to approximately 40% (7.570ha).
- 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 subsequently.

-  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:**

**Sidmouth Mudstone Formation - Mudstone.** Sedimentary Bedrock formed approximately 217 to 250 million years ago in the Triassic Period. Local environment previously dominated by hot deserts.

**1:50 000 scale superficial deposits description:**

**Blown Sand - Sand.** Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by windblown deposits.

**Peat - Peat.** Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by organic accumulations.

- 5.5.3 The Cranfield Soil and Agrifood Institute Soilscape soil type viewer identifies the soils as; naturally wet very acid sandy and loamy soils. The area is understood to drain to local groundwater sources.
- 5.5.4 Based on the ground conditions identified by the BGS and NSRI Soilscape Data, it can be considered that infiltration would be unlikely to provide a full viable drainage solution the surface water run-off generated by the proposals, in terms of infiltration characteristics. However if infiltration is to be perused in part of full then further investigation is advised; with soakaway testing to BRE365 to be undertaken.

## **5.6 Discharge to Watercourse**

- 5.6.1 The Environment Agency's mapping data is supported by various other publications in identifying the presence multiple land drainage ditches (Ordinary Watercourses) within the vicinity of and bisecting site. Furthermore an EA designated Main River (Three Pools Waterway) is confirmed to flow along the eastern boundary of the development site. The existing drainage infrastructure is required to be considered within the proposed surface water management strategy for the development site.
- 5.6.2 The development site is predominantly undeveloped at present; with the exception of the existing farm buildings (Pitts House and Pool House Farms). The existing development is understood to ultimately drain to the watercourse network at present and the undeveloped areas are also considered to naturally drain to the watercourse via infiltration overtime and overland run-off (refer to Appendix M for the Existing Drainage Situation Plan).
- 5.6.3 In order to comply with the guidance set out in the NPPF the proposed surface water management strategy should incorporate the existing drainage features where at all feasible. Therefore should infiltration be deemed not feasible following soakaway testing to BRE365, then the next sought outfall in the hierarchical approach, for the management of surface water run-off should be to mimic the existing regime and discharge to watercourse.
- 5.6.4 The surface water run-off generated by the development area is therefore proposed to discharge to the watercourse (Three Pools Waterway) adjacent to the eastern boundary (as illustrated in Figure 10 on the subsequent page; Appendix N). Three Pools Waterway



is an EA designated Main River and therefore a future maintenance easement is required to be incorporated into the design; this easement is typically 8m for top of bank and should provide clear and unimpeded access to engineers.

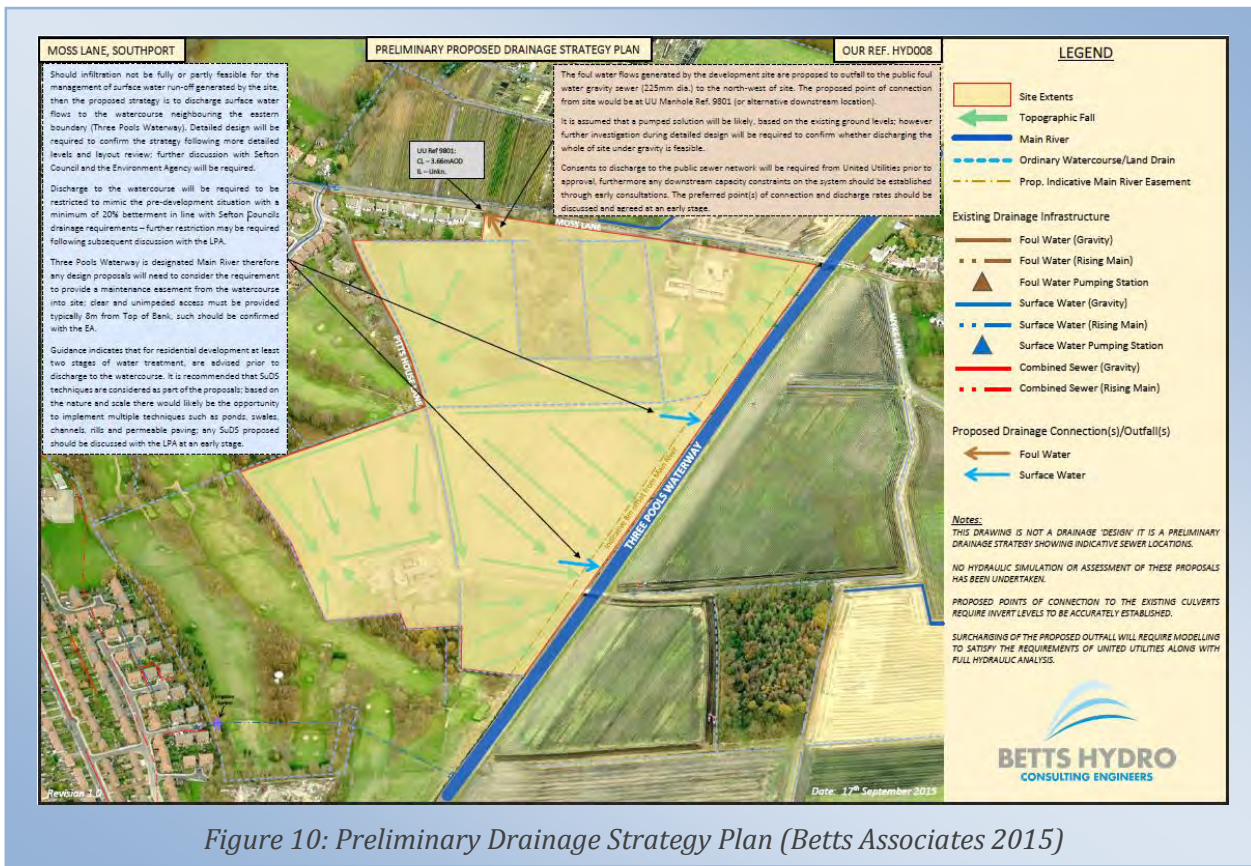


Figure 10: Preliminary Drainage Strategy Plan (Betts Associates 2015)

- 5.6.5 Detailed design will be required to confirm feasibility of the strategy following more detailed levels and layout review. Consents to outfall and agreement of the discharge rate(s) will be required from the Environment Agency and some discussion may be required with the Lead Local Flood Authority (SC); therefore early discussion is advised. Appropriate easements must be considered, incorporated into the design and discussed with the EA at an early stage.
- 5.6.6 In order to minimise the flood risk to the proposed dwellings and neighbouring property, the discharge of surface water run-off generated by the development is proposed to be restricted to the pre-development rates. In light of the identified flood risks surrounding the site it is proposed that 20% betterment be applied to the pre-development rates, to minimise the potential flood risks. A flow restriction will be most likely in the form of a Hydrobrake® or similar approved flow control device.
- 5.6.7 The proposed restricted discharge rate for the development area is calculated to be 59.8l/s for the annual event, 126.6l/s for the 1 in 30 year event and 163.5l/s during the 1 in 100 year event with an allowance for climate change; see Appendix H for full details of the surface water calculations.
- 5.6.8 The restricted flow generates a storage requirement during periods of intense rainfall. The stormwater storage figures quoted in Table 5 (on the subsequent page) are

estimates only based on the assumed restricted rates. The detailed drainage design will determine with accuracy the stormwater storage requirements (Appendix J).

| Impermeable Area (7.570ha)                 | 1 In 1 Year Storm Event | 1 In 30 Year Storm Event | 1 In 100 Year Storm Event |
|--|-------------------------|--------------------------|---------------------------|
| <b>Restricted Run-Off Rate</b>             | 59.8l/s                 | 126.6l/s                 | 163.5l/s                  |
| <b>Estimated Stormwater Storage Volume</b> | 559cu.m-1055cu.m        | 1534cu.m-2387cu.m        | 3178cu.m-4561cu.m         |

*Table 5: Estimated Stormwater Storage Requirements*

5.6.9 Guidance indicates that for residential development at least two stages of water treatment, are advised prior to discharge to the watercourse. It is recommended that SuDS techniques are considered as part of the proposals; based on the nature and scale there would likely be the opportunity to implement multiple techniques such as ponds, swales, channels, rills and permeable paving; any SuDS proposed should be discussed with the LPA at an early stage. Detailed design would be required to confirm the attenuation requirements following a more detailed review of levels, capacity and attenuation requirements.

## 5.7 Discharge to Public Sewer Network

5.7.1 Should infiltration be proved infeasible for the management of surface water generated by all or part of site the next method for surface water management should be discharge to watercourse. In light of such and the location of the existing drainage features on site there are no proposals, to discharge surface water to the sewer network.

## 5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall.

5.8.2 The NPPF Technical Guidance Table 5 states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. It is widely believed that the impact of climate change means there is likely to be a long term increase in the average sea levels, with an expectation that sea levels will rise gradually.

5.8.3 An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact. Any increase in the level of flood risk to the proposed development from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.4 Climate Change should be accounted for within the design and it is recommended that an increase in peak rainfall intensity of 30% is allowed for.

## 6.0 FOUL WATER MANAGEMENT

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- 6.1 Consultation with United Utilities has identified the presence of multiple public foul water and combined sewers within the vicinity of site; as illustrated in the sewer records (Appendix F). An existing public foul water sewer runs within Moss Lane to the north of site, this system is part gravity and part rising main and flows into a foul water pumping station located adjacent to the junction between Fosters Close and Moss Lane (to the north-west of site). Furthermore the sewer records identify a public combined system to run within the residential development to the south-west of site.
- 6.2 Any foul water flows generated by the existing development are understood to be dealt with onsite at present, no confirmed connections from site to the adjacent sewer network have been identified and no sewer infrastructure is understood to run within the boundaries of site.
- 6.3 At this time no planning layout is available for review, however from review of the topographic survey and UU sewer records it is understood that the primary means for foul water drainage will be to the foul water sewer located to the north of site.
- 6.4 It is proposed that the foul water flows generated by the development site outfall to the public foul water gravity sewer (225mm dia.) located within Moss Lane to the north-west of site. The proposed point of connection from site would be at UU Manhole Ref. 9801 (or alternative downstream location). It is assumed that a pumped solution will be likely, based on the existing ground levels; however further investigation during detailed design will be required to confirm whether discharging the whole of site under gravity is feasible.
- 6.5 Initial discussion with United Utilities would indicate they are in agreement in principle with the preliminary proposed drainage strategy however detailed design will confirm the strategy following detailed levels and layout review and further discussions will be required. Consents to discharge to the public sewer network will be required from United Utilities prior to approval, furthermore any downstream capacity constraints on the system should be established through early consultations. The preferred point(s) of connection and discharge rates should be discussed and agreed at an early stage.

## 7.0 SUMMARY AND CONCLUSIONS

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- 7.1 This Flood Risk Assessment and Drainage Management Strategy has been prepared to aid in discussions regarding the sites allocation in the local plan and support a potential residential planning application on land adjacent to Moss Lane, Southport. The site is located within Flood Zones 1, 2 and 3 and is approximately 18.926ha in size; the National Planning Policy Framework (NPPF) requires that the planning application be accompanied by a Flood Risk Assessment.
- 7.2 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 in the NPPF confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.
- 7.3 In order for residential development to be considered appropriate within Flood Zones 2 and 3 the sequential and exception test must be passed, with appropriate mitigation measures being implemented to secure the development for its design life. The proposed development site is confirmed to have been sequentially tested and is understood to be allocated within the Local Development Plan (LDP) for residential development. Due to the presence of significant flood defences and the sites suitability for providing affordable housing, part 1 of the exception test is considered to be met; this FRA forms the final part of the exception test.
- 7.4 An Internet based search for flooding events did not recall any historical flooding to the development site, review of the available publications also failed to highlight any flooding issues onsite. Review of the Sefton Council Strategic Flood Risk Assessment identified that the wider Southport area is susceptible in areas to tidal, fluvial, surface water, sewer and groundwater flooding although no onsite flood risks were identified. Consultation with various interested parties including Sefton Council, United Utilities and the Environment Agency, failed to highlight any historical flooding to the immediate site area.
- 7.5 It would be advised that the primary access and egress route within site be located within Flood Zone 1 (and 2 where required) to minimise potential flood risk. The proposed access/egress route is required to be raised to a level that would result in no more than 300mm of flooding during the design criteria event; and it is acknowledged that any levels raising within Flood Zone 3 would require compensatory flood storage.
- 7.6 The primary mitigation measure will be the incorporation of minimum finished floor levels; typically for this nature of development, finished floor levels should be set a minimum of 600mm above the predicted Top Water Level during the design event. Taking into account the significant flood defences, the design event is considered to be the Q100+CCA event, based on the modelled defended scenario; therefore minimum finished floor levels onsite would be 3.1mAOD.
- 7.7 Although development should be steered away from Flood Zone 3, it is acknowledged that this may not be entirely feasible, however any levels raising within Flood Zone 3



should be kept to a minimum. Should any levels raising occur within Flood Zone 3 then there is a requirement to consider the compensatory floodplain storage (on a level for level basis) as a result of any levels raising within Flood Zone 3.

- 7.8 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. The principle focus of this report is on the effective mitigation from the potential fluvial/tidal flood risk onsite and the effective management of surface water drainage.
- 7.9 Based on the ground conditions identified by the BGS and NSRI Soilscales Data, in terms of infiltration characteristics, it can be considered that infiltration is unlikely to be viable for surface water management at the proposed development site. However further investigation is advised; with soakaway testing to BRE365 to be undertaken in specific locations where infiltration is considered most feasible.
- 7.10 Should infiltration be proved not feasible, it is proposed that the surface water run-off generated by the development discharge to the watercourse adjacent to the eastern boundary. The discharge of surface water run-off is proposed to be restricted to the pre-development rates; calculated to be 59.8l/s for the annual event, 126.6l/s for the 1 in 30 year event and 163.5l/s during the 1 in 100 year event with an allowance for climate change.
- 7.11 Appropriate easements must be considered and incorporated into the design; typically an easement of 8m is required from Top of Bank (TOB) on Main River/Ordinary Watercourse(s) for future maintenance requirements. Detailed design will be required to confirm the feasibility of the proposed strategy following more detailed levels and layout review. Consents to outfall and agreement of discharge rate(s) will be required from the Environment Agency and some discussion may be required with the Lead Local Flood Authority (Sefton); therefore early discussion is advised.
- 7.12 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.
- 7.13 It is noted that typically there is a requirement to provide at least two stages of water treatment prior to discharge of surface water to the watercourse therefore it would be recommended SuDS techniques are considered as part of the proposals. Based on the nature and scale of the development there may be the opportunity to implement various SUDS options in private (non-adopted) areas such as permeable paving and bio-filtration units which would be recommended. Furthermore in accordance with Sefton's Surface Water Management Plan, green infrastructure should be sought within the Surface Water Management Strategy; the potential to implement conveyance features such as swales, ditches and channels within the development would improve water quality and biodiversity prior to discharge.

- 7.14 The attenuation pond feature, if sized appropriately, could cater for the attenuation requirements in the extreme events; such should not be located within the predicted extents of Flood Zone 3 in accordance with the EA's requirements. It is understood that the below ground pipe network and the proposed POS areas within site would likely provide adequate stormwater storage for the extreme events; although detailed design would be required to confirm such following a more detailed review of levels, capacity and attenuation requirements.
- 7.15 The foul water flows generated by the development are proposed to discharge to the sewer network; detailed design will be required to confirm the strategy following detailed levels and layout review. Further investigation is required to determine whether discharging the whole site via gravity is feasible and whether a pumped solution in part or in full is required. Early discussions with United Utilities and any Third Party Land Owners should be undertaken; initial discussions with UU have indicated they are in agreement with the proposed drainage strategy although consent to discharge will be required during detailed design.
- 7.16 As with any drainage system blockages within either the foul or surface water sewer systems have the potential to cause flooding or disruption.
- 7.17 This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The Flood Risk Assessment and Drainage Management Strategy is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

## 8.0 RECOMMENDATIONS

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- 8.1 The primary mitigation measure will be the incorporation of minimum finished floor levels; typically for this nature of development, finished floor levels should be set a minimum of 600mm above the predicted Top Water Level during the design event. Taking into account the significant flood defences, the design event is considered to be the Q100+CCA event, based on the modelled defended scenario; therefore minimum finished floor levels onsite would be 3.1mAOD.
- 8.2 Although development should be steered away from Flood Zone 3, it is acknowledged that this may not be entirely feasible, however any levels raising within Flood Zone 3 (base on the 1% AEP defended scenario event) should be kept to a minimum. Should any levels raising occur within Flood Zone 3 then there is a requirement to consider the compensatory floodplain storage (on a level for level basis) as a result of any levels raising within Flood Zone 3. Discussions with the Environment Agency have indicated they would be in agreement with the mitigation approach outline above.
- 8.3 Any overland flows generated by the proposed development must be directed away from existing and proposed buildings; safe avenues of overland flow away from any existing and proposed buildings are advised. 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.
- 8.4 Appropriate easements must be considered and incorporated into the design in accordance with the EA (Main River) and LLFA (Ordinary Watercourse) guidance; typically an easement of 8m is required from Top of Bank (TOB) for future maintenance requirements.
- 8.5 It would be advised that the primary access and egress route within site be located within Flood Zone 1 (and 2 where required) to minimise potential flood risk. The proposed access/egress route is required to be raised to a level that would result in no more than 300mm of flooding during the design criteria event; and it is acknowledged that any levels raising within Flood Zone 3 would require compensatory flood storage.
- 8.6 Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. Added benefits include biodiversity and visual enhancements. The use of permeable paving and swales may be appropriate in some areas to reduce the surface water run-off generated by the proposals.
- 8.7 It is noted that typically there is a requirement to provide at least two phases of water treatment prior to discharge of surface water to the watercourse therefore it would be recommended SuDS techniques (as discussed) are considered as part of the proposals. It would be recommended that a POS area be incorporated into the design, furthermore a series of swales, ditches and channels could be utilised as conveyance features within the development to improve water quality and biodiversity prior to discharge into the watercourse.

- 8.8 An attenuation pond feature, if sized appropriately, could cater for the attenuation requirements in the extreme events; such should not be located within the predicted extents of Flood Zone 3. It is understood that the below ground pipe network and the proposed POS areas within site would likely provide adequate stormwater storage for the extreme events; although detailed design would be required to confirm such following a more detailed review of levels, capacity and attenuation requirements.
- 8.9 The development and its drainage systems should be designed to cope with intense storm events up to and including the 100 year return period rainfall event with an allowance for Climate Change (CC), based on the design life of the proposed development this allowance for CC is in the form of a 30% increase in rainfall intensity.
- 8.10 Detailed design will confirm the foul water strategy following detailed levels and layout review. Further investigation is required during detailed design to determine whether discharging the whole site via gravity is feasible and whether a pumped solution in part or in full is required. Offsite works would be present and any Third Party Land Constraints require consideration; early discussions should be undertaken to secure foul water outfall.



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